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THE MOTHS OF NORTH AMERICA
GEOMETROIDEA: GEOMETRIDAE (PART) FERGUSON

FASCICLE
17
Pt. 2

The Moths of North America

FASCICLE 17.2

GEOMETROIDEA Geometridae (Part)

Douglas C. Ferguson

2008

THE WEDGE ENTOMOLOGICAL RESEARCH FOUNDATION

THE MOTHS OF NORTH AMERICA

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28 April 1972
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- Fascicle 13.1B **Pyraloidea**, Pyralidae (part)
11 December 1972
- Fascicle 20.1 **Mimallonoidea**, Mimallonidae
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- Fascicle 13.1C **Pyraloidea**, Pyralidae (conclusion of part 1)
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16 September 1976
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- Fascicle 22.2 **Noctuoidea**, Lymantriidae
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- Fascicle 6.1 **Gelechioidea**, Cosmopterigidae
29 December 1978
- Fascicle 18.1 **Geometroidea**, Geometridae (part)
25 May 1985
- Fascicle 15.2 **Pyraloidea**, Pyralidae (part)
20 February 1986
- Fascicle 7.1 **Gelechioidea**, Gelechiidae (part)
26 November 1986
- Fascicle 27.2 **Noctuoidea**, Noctuidae (part)
22 October 1987
- Fascicle 5.1 **Sesioidea**, Sesiidae
18 January 1989
- Fascicle 15.3 **Pyraloidea**, Pyralidae (part)
27 June 1990
- Fascicle 25.1 **Noctuoidea**, Noctuidae (part)
23 August 1991
- Fascicle 26.1 **Noctuoidea**, Noctuidae (part)
30 March 1995
- Fascicle 15.4 **Pyraloidea**, Pyralidae (part)
27 March 1997
- Fascicle 27.3 **Noctuoidea**, Noctuidae (part)
24 September 1998
- Fascicle 7.6 **Gelechioidea**, Gelechiidae (part)
29 December 1999
- Fascicle 15.5 **Pyraloidea**, Pyralidae (part)
16 December 2003
- Fascicle 27.1 **Noctuoidea**, Noctuidae (part)
22 December 2004

Check List of the Lepidoptera of America North of Mexico
30 May 1983

The Moths of North America

INCLUDING GREENLAND

FASCICLE 17.2

GEOMETROIDEA
GEOMETRIDAE (PART)
ENNOMINAE (PART—ABRAXINI,
CASSYMINI, MACARIINI)

DOUGLAS C. FERGUSON

SYSTEMATIC ENTOMOLOGY LABORATORY
UNITED STATES DEPARTMENT OF AGRICULTURE

COLOR PHOTOGRAPHS AND PLATES OF ADULT MOTHS BY

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2008

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To my wife Charlotte H. Ferguson

THE MOTHS OF NORTH AMERICA

PATRONS

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IN MEMORY OF ELAINE R. S. HODGES

OLIVER and DEEDE DOMINICK and the estate of the late TATIANA DOMINICK
contributed significantly toward publication of this fascicle
in memory of Douglas C. Ferguson.

ABSTRACT

The Geometridae of the tribes Abraxini (one species), Cassymini (10 species), and Macariini (158 species) are revised. All species are resident in the United States and/or Canada except one each from Mexico and Bermuda, but many of those treated also occur in Mexico. The 169 species are assigned to 17 genera, 10 of which now bear names that differ from previous American usage. One new genus, *Letispe* (Type species: *Semiothisa metanemaria* Hulst, 1887), 22 new species, and three new subspecies are described. Eight distinctive subspecies are recognized. Previous treatment of two American genera, *Protitame* and *Heliomata*, as Abraxini is considered incorrect, and they are here reassigned to the Cassymini and Macariini respectively. However, a new indigenous species of the otherwise Palearctic genus *Ligdia* was discovered in 2001, and it is thought to be a true abraxine. The tribe Cassymini is newly recognized for the Western Hemisphere by transfer of genera from two other tribes. Twenty-two new species are described: *Ligdia wagneri* Ferguson and Adams (Tennessee); *Heliomata scintillata* Ferguson (Mississippi and Louisiana); *Speranza exonerata* Ferguson (eastern U.S.); *Speranza hesperata* Ferguson (western U.S.); *Speranza prunosata* Ferguson (Rocky Mountain states); *Speranza austrinaria* Ferguson (southern California); *Speranza saphenata* Ferguson (West Texas and New Mexico); *Macaria juglandata* Ferguson (southern California); *Macaria solisata* Ferguson (Tamaulipas, Mexico); *Macaria masquerata* Ferguson (southern Canada, northern U.S.); *Macaria ponderosata* Ferguson (Rocky Mountain region of U.S.); *Digrammia ubiquitata* Ferguson (Arizona to Alaska and Manitoba); *Digrammia terramalata* Ferguson (central Great Plains); *Digrammia palodurata* Ferguson (northwestern Texas); *Digrammia imparilata* Ferguson (southern California, Arizona); *Digrammia pallorata* Ferguson (southwestern U.S.); *Digrammia modocata* Ferguson (Oregon, northern California); *Digrammia extenuata* Ferguson (California and Nevada to British Columbia); *Digrammia equivocata* Ferguson (eastern and midwestern U.S., southern Manitoba); *Digrammia plemmelata* Ferguson (central California, Oregon); *Rindgea disparcata* Ferguson (Texas); and *Rindgea proliferata* Ferguson (Texas to southern California). Adults of all species and larvae of 81 species are illustrated in color; genitalia of most species are illustrated by drawings. Larvae of about 90 species are described, 45 of them for the first time, including reports of a like number of previously unrecorded host plants. When deemed practicable and useful, keys are provided for tribes, genera, and species, based on adults, larvae, and/or pupae.

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PREFACE

This is the second fascicle of *The Moths of America North of Mexico* to treat a group of Geometridae. The first part, issued in 1985, dealt with the subfamily Geometrinae, the greens or emeralds, but my interest in the Macariini goes back to 1953 or before. It was J. H. McDunnough who originally suggested that I work on them. The approximately 170 species covered in this monograph comprise a widespread and intricate assemblage that were badly in need of revision.

At the outset it appeared that all species to be considered would be in one tribe, the Macariini (then known as the Semiothisini). I had concluded even before the appearance of the 1983 Check List that the few species listed as Abraxini were incorrectly classified and belong elsewhere, presumably in the Macariini because of the characteristic bilobed valve in the male genitalia. Although I subsequently returned *Heliomata* to the Macariini, it seemed advisable to transfer *Protitame* McDunnough (with *Sperrya* Rindge as a junior synonym), *Taeniogramma* Dognin (incorrectly included by me in *Xenoecista* Warren in the 1983 Check List), together with *Nematocampa* Guenée (from the Ourapterygini [now the Ennomini]), to the tribe Cassymini proposed by Jeremy Holloway (1993: 117). Then in May 2001, a new species of *Ligdia*, which is otherwise a Palearctic genus currently placed in the Abraxini, fortuitously turned up in Great Smoky Mountains National Park, in time to be included in the present work and enabling me to reinstate that tribe as part of the North American fauna.

The tribe Cassymini was not previously recognized from the Western Hemisphere, although it includes taxa that have long been known and variously referred to other tribes, but whose true affiliations have long been in doubt. Holloway, who established the tribe Cassymini in *The Moths of Borneo* (1993), worked out a classification into which I was able to fit the three anomalous American genera, which embrace only 10 species in the United States, although there are more in the American Tropics. The largest complex in the Cassymini is comprised of the African and Tropical Asian species of *Zamarada* Moore and its relatives (about 200 species), revised by Fletcher (1974). Holloway identified 41 species of 12 rather diverse genera of Cassymini in the fauna of Borneo, probably more than in the entire New World fauna.

The higher classification of the Macariini and of the Geometridae in general has changed substantially over the past two decades as taxonomists on other continents actively pursued revisionary studies of the same groups while the present work was in progress. Jeremy Holloway of the Commonwealth Institute of Entomology, London (1995), Linda Pitkin, Roy Mora, and Malcolm Scoble (1996), Malcolm Scoble and others at the Natural History Museum, London (1999), Martin Krüger, Transvaal Museum, South Africa (2001), and Malcolm Scoble and Martin Krüger (2002) made major contributions that have largely complemented my work on the Nearctic fauna. Minet and Scoble (1999: 310—320) reviewed the classification of Geometridae generally in the *Handbuch der Zoologie*. Although I had been interested in these moths earlier (Ferguson, 1953, 1972, 1973, 1974a, 1974b), it was not until the 1980's that I seriously began the research that led to the present fascicle. It took a long time because I worked on other projects concurrently, and also set out to rear and photograph the larvae of as many species as possible. I reared 52 species, and was fortunate in enlisting the help of other lepidopterists who kindly assisted by providing

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additional host information and photographs, bringing the total of larval illustrations to about 85 species.

Identification keys are provided wherever it seemed that they could be used advantageously; but keys are often omitted because they would just not be useful, especially for groups of many similar species distinguished by shades of color not readily explained in few words, subtle differences in morphology, or by details of habitat or biology. The reader might save time by referring directly to the illustrations and relevant text.

In the legends for the color plates of adults and larvae, credit is given to the collector (adults) or photographer or contributor (larvae). When no credit is given, it means that the author was the collector or photographer. All photographs of adults were made by Jocelyn D. Gill.

In general I have refrained here and elsewhere from giving unnecessary explanations of the meaning, derivation, or gender of newly proposed names, because I think that this would make the work seem even more pedantic than it is already. Most words employed as scientific names may be found in any good Latin (or sometimes Greek) dictionary, except those that are arbitrary combinations of letters, patronyms, or self-evident words that refer to geographic, habitat, or host associations. Some of the species names are English words of mostly Latin derivation for which I have used my imagination to relatinize (e.g., *intransigata*, *promiscuata*, *ubiquitata*). I have found the book, *The Composition of Scientific Words* (Brown, 1956, 1978), to be an almost indispensable reference.

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I am indebted to the many individuals whose generous assistance over a long period has made this work possible. For lending specimens or providing information about material in their charge, or for granting access to their collections or facilities, I thank the following: J. K. Adams, (Dalton State College, Calhoun, GA); P. H. Arnaud (CAS); G. J. Balogh, Portage, MI; R. A. Belmont, Naples, FL.; H. D. Baggett, Palatka, FL; A. Blanchard, Houston, TX (deceased); V. A. Brou, Jr., Abita Springs, LA; V. O. Becker, Brasilia, D.F., Brazil; R. L. Brown, MSIC; R. A. Cannings (RBCM); S. G. Cannings (UBC); C. V. Covell, Jr., (McGuire Center, Gainesville, FL); L. Crabtree, Bieber, CA; T. S. Dickel, Anthony, FL; R. B. Dominick, McClellanville, SC (deceased); J. P. Donahue (LACM); M. Furniss, Moscow, ID; D. G. Furth (MCZ, formerly); J. G. Franclemont (CU) (deceased); J. D. Glaser, Baltimore, MD; P. C. Hammond (OSU); L. Handfield, Mt. St. Hilaire, PQ; J. R. Heitzman, Independence, MO; R. Hoebeke (CU); C. P. Kimball, Barnstable, MA (deceased); E. C. Knudson, Houston, TX; J. D. Lafontaine (CNC); J. Lattin (OSU); R. H. Leuschner, Manhattan Beach, CA; J. Liebherr (CU); N. McFarland, Hereford, AZ; J. C. Miller (OSU); S. E. Miller (MCZ, formerly); J. Minet (Muséum National d'Histoire Naturelle, Paris); R. B. Nagle, Tucson, AZ; L. M. Pitkin (BMNH); P. A. Opler, (CSUC); J. A. Powell (UCB); E. Quinter (AMNH, retired); J. E. Rawlins (CM); F. H. Rindge (AMNH, retired); M. A. Roberts, Steuben, ME; M. J. Scoble (BMNH); M. Sommerer (ZSBS); J. B. Sullivan, Beaufort, NC; D. L. Wagner, University of Connecticut, Storrs; R. Weich, Tucson, AZ; and B. Wright (NSM, retired).

Many managers of preserves, refuges, and parks, as well as local residents, made it possible to extend my field investigations into some wonderful places. The following deserve special acknowledgement: Malcolm Furniss, formerly with the USDA Forest Service, Moscow, Idaho, made local arrangements for a three-week field trip to the Priest River Experimental Forest in northern Idaho. Jack Lattin and Jeffrey C. Miller provided assistance for two trips to Oregon. Noel McFarland has always made available to me for moth collecting his property in Ash Canyon, Huachuca Mountains, Arizona, where his permanently installed collecting lights are almost legendary. Special thanks go to Rosemary and Ralph Snapp, Hereford, Arizona, whose kind hospitality provided easy access to one of the most interesting moth sampling sites that I have visited. Their location in Carr Canyon also happens to have been the homesite of Carl Biederman, an early Arizona collector whose material became widely distributed in museums. For similar reasons I thank Ray and Nancy Nagle of Tucson, Arizona for the use of their cabin high in the Santa Catalina Mountains. Valuable assistance was provided at Fort Niobrara and Valentine National Wildlife Refuges, Nebraska (R. M. Ellis and L. McDaniel); the Great Basin and Range Experiment Station, Manti Lasal National Forest, Ephraim, Utah (A. R. Tiedemann); Great Sand Dunes National Monument, Colorado (R. Reynolds and R. Schultz); the Sierra Diablo Wildlife Management Area, Van Horn, Texas; Big Bend National Park, Texas; Patuxent Wildlife Research Center, Laurel, Maryland (H. H. Obrecht); and Great Smoky Mountains National Park, Tennessee/North Carolina, where Jean Hilton's dedicated support in connec-

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tion with the *All Taxa Biodiversity Inventory* of the park led to the discovery of *Ligdia wagneri*, described as new in this work.

For myself and on behalf of The Wedge Entomological Foundation, I thank Jocelyn D. Gill (Canadian National Collection of Insects and Arachnids) for taking the photographs and making the color plates of the adults. I took most of the larval photographs, but for filling some important gaps in both images and host data I am indebted to Jeffrey C. Miller and David L. Wagner. Additional color slides came from the Canadian National Collection (J. D. Lafontaine) and the Northern Forestry Centre, Edmonton, Alberta (Greg Pohl). Many larval photographs, voucher specimens, and host data were obtained from Brian Scaccia, whose deep involvement in rearing western Geometridae made him a prime source of information. His contributions are acknowledged in the text and plate legends. Sally Brady, who worked mainly for Ron Hodges, also made hundreds of dissections and slides for me, contributing greatly to the study material available.

The line drawings are by Systematic Entomology Laboratory staff illustrator Linda H. Lawrence, and by contract artists David N. Adamski, Susan Escher, Taina Litwak, and Deborah L. Roney. I filled in by doing many of the genital drawings of *Digrammia* and *Rindgea* and the photographs of the eighth sterna of males.

Charlotte Hawthorn Ferguson, my wife, whose forbearance and support were of inestimable value to my unconventional pursuits, is happier than anyone to see this project completed.

EDITOR'S COMMENTS

Dr. Douglas C. Ferguson (hereafter Doug, 1926–2002) was a long-time friend and colleague. We first met in 1959 when we were graduate students at Cornell University. At the time he was the chief curator in the science division of the Nova Scotia Museum. Subsequently, he held positions at the Peabody Museum of Natural History (Yale University), the Systematic Entomology Laboratory (U. S. Department of Agriculture, Agriculture Research Service) at the National Museum of Natural History, and was a Collaborator of the U. S. Department of Agriculture and Research Associate of the Smithsonian Institution after retirement in 1996.

During his entire career he was singularly interested in the diversity of macrolepidoptera, their geographic variation, and their life histories. He collected adults throughout the United States and Canada and reared approximately 600 species. He documented many of the rearings with photographs and preserved specimens. Usually, he had more than one research project in varying stages of completion; however, he would focus narrowly on one as it reached the top of his self-imposed schedule to "... get things done."

The work that comprises the basis of the current fascicle occurred over many years. Doug published papers on species, species-complexes, and genera within the broad group commencing in 1953. He was particularly interested in associating species with their larval host plants and successfully reared many species, documenting many of them with 35 mm slides and brief written notes.

At the time of his death in 2002 he had a nearly completed manuscript, line drawings of 99% of the genitalia and other characters that he intended to illustrate, 35 mm images of most of the larvae that intended to illustrate, and most of the literature section. He had laid out the material studied in the collection of the National Museum of Natural History, but he had not labeled many of the holotypes nor any of the specimens. His manuscript was in multiple versions.

Undone was selection of adults for illustration, selection of the last images of larvae, comprehensive integration of his nomenclatural conclusions throughout the text and on the line drawings, integrating the line drawings into text figures, developing text for the images, dispersing the plate and figure numbers and text figure numbers throughout the text, completing the literature section, developing text for the check list and indexes, developing text for the all the named and implied species-groups, and producing a ready-for-review manuscript.

Many individuals have contributed much time and effort to bring this fascicle to fruition. Individual responsibilities are the following: J. Donald Lafontaine [oversight of developing the plates and legends of adults, developing text for some of the species-groups, and careful reading and interpretation of the entire text]; Paul Opler [selecting specimens of adults to photograph]; David Wagner [oversight of developing the plates and legends of larvae]; James Adams, George Balogh, Martin Kruger, and Paul Opler [careful review of the text]; Jocelyn Gill [photography of adults, layout of these plates, and development of the legends for them]; and editor [producing a cohesive manuscript for review, integrating the reviewers' comments and suggestions, and making the manuscript ready for Allen Press]. With lesser involvement, but always highly and quickly cooperative were David Adam-ski, John Brown, Barbara Gleason, and Rene Twarkins.

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Doug's conclusions have not been changed; the text is his. Instances where a contrary conclusion or addition to the text are noted in square brackets followed by "ed." [..., ed.]. Recognition of genera and their assignment to tribes proved difficult, and his conclusions are at variance with those of other contemporary workers. Additional study of the group using formal phylogenetic analysis and molecular data is encouraged.

Since fascicle 27.1 appeared in 2004, four of the group that started this project have died. They are Tatiana Dominick, 2005 [photographer, board member], John G. Franclemont, 2005 [editorial board, author], Elaine R. S. Hodges, 2006 [artist, illustrator], and Eugene G. Munroe, 2008 [board member, editorial board, author]. Each is deeply missed.

Ronald W. Hodges

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SUPERFAMILY

GEOMETROIDEA (continued)

FAMILY

GEOMETRIDAE (continued)

SUBFAMILY

Ennominae (continued)KEY TO TRIBES ABRAXINI, CASSYMINI,
AND MACARIINI FOR NORTH AMERICA

1. Male with costal lobe of valve long, slender, curved; saccular lobe also with a long, tapered dorsal process; remainder of lobe triangular, distally bifid; strong setae on juxta. Female genitalia not known. Forewing of our one species brown in basal and distal thirds, white in median space (known only from Great Smoky Mountains National Park) Abraxini
p. 18
- Not as described above 2
2. Male with costal lobe or process of valve long, slender, angled, sickle shaped, or recurved; female genitalia with signum present, transversely elongate, shaped like a pair of horns or, if stellate, not radially symmetrical. Larvae diverse, thickest in thoracic area, or with dorsal filaments, or, if simple and cylindrical, without longitudinal pale stripes Cassymini
p. 26
- Male with costal lobe of valve usually a flat, elongate lobe with the sides subparallel and the tip rounded, not prominently angled, cylindrical or sickle shaped as described above; if curved, angled, or bearing one or more processes, (*Digrammia*, in part), then female has no signum. Female with signum present or absent; when present, radially symmetrical with but one exception (*Heliomata*). Chaetosemata bridged or

nearly so by transverse row of setae behind head in all except first five genera. Larvae simple, cylindrical, green, brown, or purplish, usually with longitudinal pale stripes, which may be broken into series of oblique bars or spots in some species Macariini
p. 46

KEY TO NEARCTIC GENERA OF
CASSYMINI AND MACARIINI
(Based on pupal characters)

NOTE—This key has various shortcomings. For example, some features may be hard to see, such as the distinctive sculpturing (prespiracular furrows) on the fifth abdominal segment of *Digrammia* and many *Speranza* species. These furrows may be concealed beneath the intersegmental integument if the abdomen is too contracted, with the segments closely fitted together. Also, the relative lengths of the maxillae and antennae are subject to some variation, and exceptions may occur; and the delicate hooks of the cremaster are often found to be damaged or missing. Such characters are nonetheless important, however, and the key is more a summary of pupal differences than an aid to identification. (*Nematocampa* is omitted because nothing was found to distinguish its pupa from those of many Ennomini).

1. Deep dorsal groove present between abdominal segments 9 and 10; or, if uncertain, foretibia not or hardly showing, and/or large part of eye vertically rugose; callosities present or absent; cremaster nearly always regularly conical, with terminal process bifurcate at tip 2
- Deep dorsal groove absent; foretibia always exposed; callosities always present although sometimes small or obsolescent; cremaster variable, with 2–6 hooks 7
2. Callosities present 3
- Callosities absent 5

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3. Callosity low, flat, not visibly setose; pupal length 12–13 mm; cremaster long, tapered, with as many as 6 minute hooks at tip (often broken off) *Isturgia*
p. 56
- Callosity decidedly elevated, finely, densely setose on top; pupal length 11 mm or less; cremaster not as described above 4
4. Cremaster with short process terminating in a confused cluster of long, sharp hooks, probably 6, but each may be bifurcate; eyes mostly smooth *Mellilla*
p. 63
- Cremaster short, conical, with short process ending in bifurcate tip, foretibia may show as narrow slit in some specimens; eye in large part vertically rugose *Eumacaria*
p. 61
5. Prothoracic tibia exposed as a narrow slit between maxilla and mesothoracic leg; cremaster long, tapered, acuminate, slender, with two minute, widely divergent hooks at tip *Heliomata*
p. 50
- Prothoracic tibia not exposed; cremaster various, but not as described above 6
6. Pupa small, less than 10 mm; cremastral process long and slender, minutely bifurcate at tip *Protitame*
p. 39
- Pupa larger, more than 10 mm; cremaster relatively small, with a stout, medium length process having a prominently bifurcate tip *Trigrammia*
p. 66
7. Tips of maxillae concealed so that antennae and mesothoracic legs appear much longer; callosity unusually elevated and prominent, almost round, with base constricted; fine sclerotic ridge less than one mm long near and parallel to anterior margin of A5, extending above and below level of spiracle, its tips curved anterad, and with apparent cavity beneath on anterior side .. *Fernaldella*
p. 344
- Tips of maxillae exposed and as long as antennae or more nearly so; callosities less prominent or obsolescent and transversely elongate, their bases unconstricted; A5 without the structure described above, but with or without prespiracular furrows 8
8. Maxillae extending as far as tips of antennae *Epelis*
p. 161
- Maxillae slightly longer than antennae 9
9. Segment A5 with prespiracular furrows; i.e., distinctive sculpturing in the form of 2–5 distinctive, dorsolateral, elongate, closely parallel

grooves and ridges on anterior beveled surface close and parallel to edge of intersegmental membrane *Digrammia* and many species of *Speranza*
pp. 234, 69

- Segment A5 without prespiracular furrows ...
..... *Macaria*, *Psamatodes*, and some species of *Speranza*
pp. 179, 164, 69

NOTE—The pupa of *Speranza* is unique among the above genera in not having a winter diapause; i.e., the pupal stage occurs in late spring or early summer because it is the egg stage that overwinters. In other genera the pupa overwinters.

TRIBE

Abraxini Warren, 1893

Type genus: *Abraxas* Leach, 1830 [1815], in Brewster, *Edinburgh Encycl.* 9: 134.

Type species of *Abraxas*: *Phalaena grossulariata* Linnaeus, 1758, *Syst. Nat.* (Edition 10), 1: 525; designated by Curtis, 1834, *British Entomology*, 11: 515. (Europe)

Two American genera, *Heliomata* Grote and Robinson and *Protitame* McDunnough, were identified as members of the Abraxini by Forbes (1948: 35, 36) and were subsequently referred to this tribe by McGuffin (1972: 8–11) and by me (1983: 88). Early in the preparation of the present volume, however, I concluded that *Heliomata* is a modified macariine, and that *Protitame*, with *Taeniogramma* Dognin and possibly some Neotropical relatives, and subsequently also *Nematocampa* Guenée, belong to the Cassymini of Holloway (1993:117). That seemingly eliminated the Abraxini from further consideration as part of the American fauna.

Then in the spring of 2001, I participated in a field trip with colleagues as part of the *All Taxa Biodiversity Inventory* [ATBI] of Great Smoky Mountains National Park, where we were astonished to collect about 12 examples of a real abraxine in the cove forest habitat on the Tennessee side. It was first discovered and recognized as something new by James Adams in a trap at the type locality on 16 May 2001. Following his directions, D. L. Wagner and I found the site and collected more specimens. It is a new species of *Ligdia*, quite similar in appearance to the Palearctic type species, *L. adustata* [Denis and Schiffermüller] but smaller and with good structural differences, and it is the sole represen-

GEOMETROIDEA

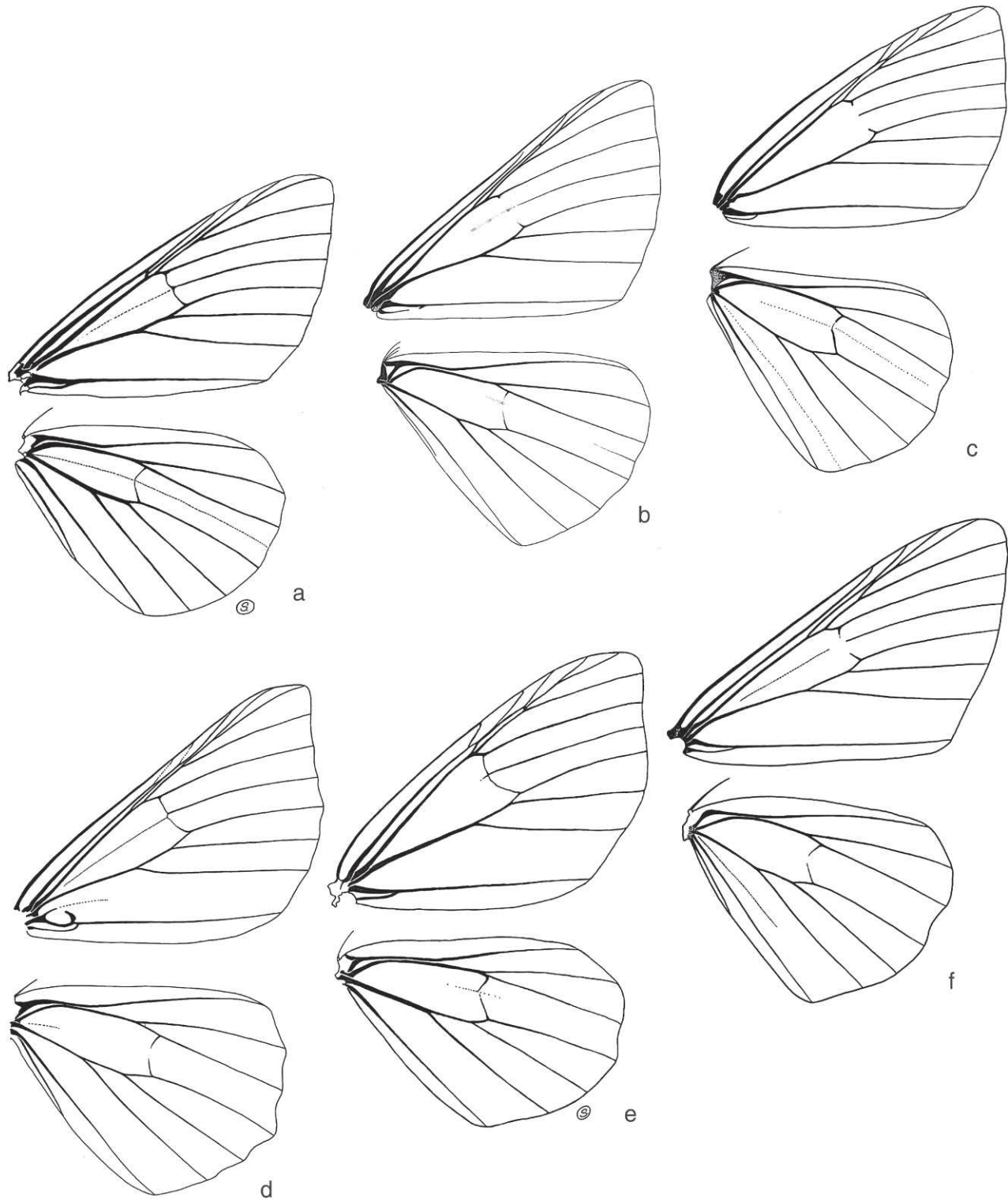


FIGURE 1: VENATION OF REPRESENTATIVES OF GENERA

a. *Taeniogramma octolineata*. b. *Taeniogramma tenebrosata* (USNM 56547). c. *Protitame virginalis*. d. *Eumacaria madopata*. e. *Mellilla xanthometata*. f. *Heliomata cycladata*.

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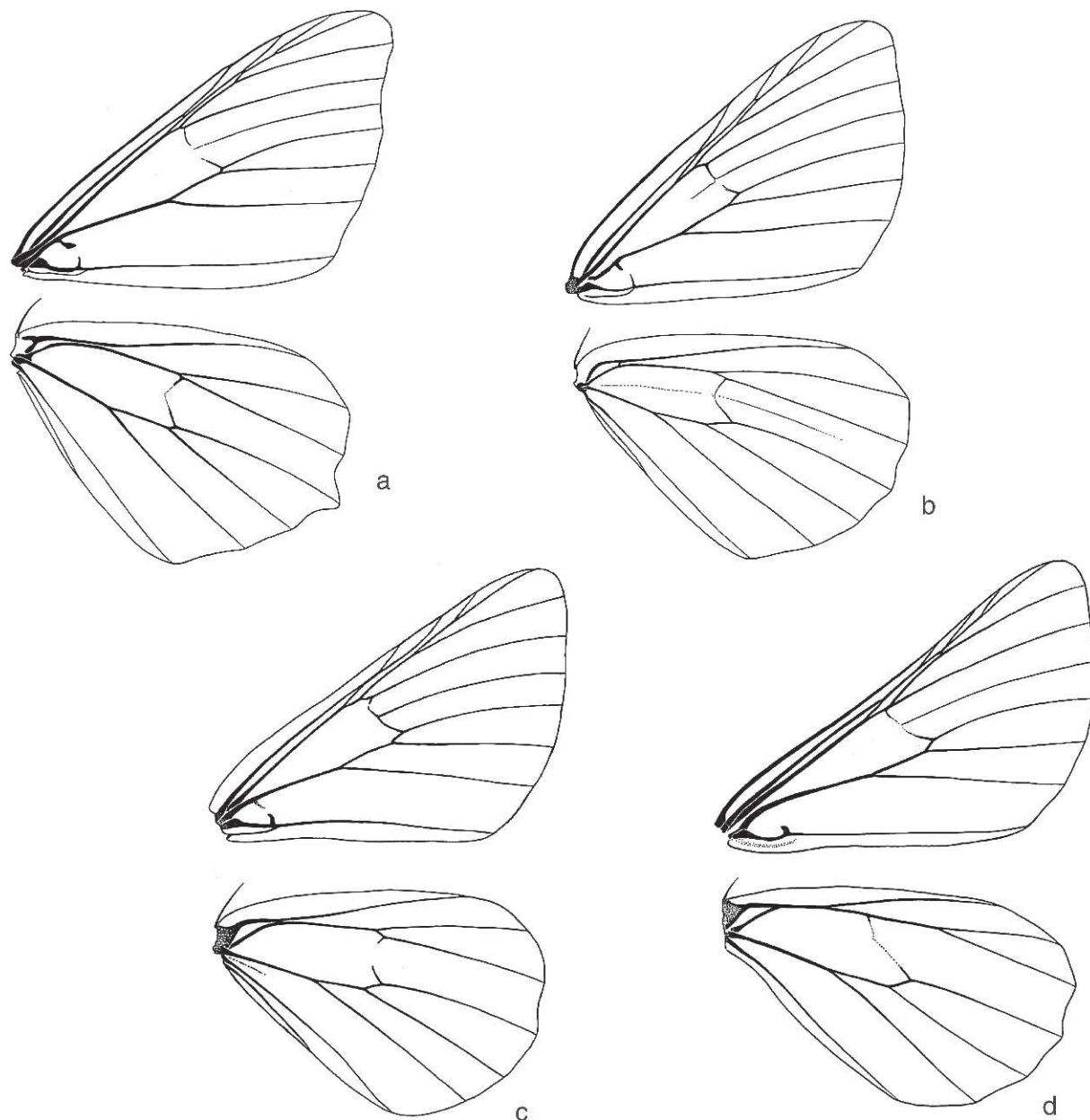


FIGURE 2: VENATION OF REPRESENTATIVES OF GENERA
a. *Macaria signaria*. b. *Speranza brunneata*. c. *Epilis truncataria*. d. *Fernaldella fimetaria* (USNM 56545).

tative of the Abraxini known from the Western Hemisphere.

The tribe is characterized mainly by the valve structure, which can be distinctive. As in the Cassymini and Macariini, the valve is divided into costal and saccular (ventral) lobes, and the latter may be large and rounded or triangular, or further subdivided into two lobes or processes. The male genitalia may be adorned with stout setae or thornlike processes, although these are minimal

in the genus *Ligdia*. The aedeagus sometimes bears a short, thornlike, dorsal process near the distal end. The gnathos varies from a weak, simple ring to strongly developed, and socii are absent as in the Cassymini and Macariini. The male antenna may be simple and merely ciliate, as in *Ligdia*, or bipectinate. The female genitalia are of a normal ennominine type, having a rounded stellate signum with numerous points. Coremata arising from the valve bases, although present in

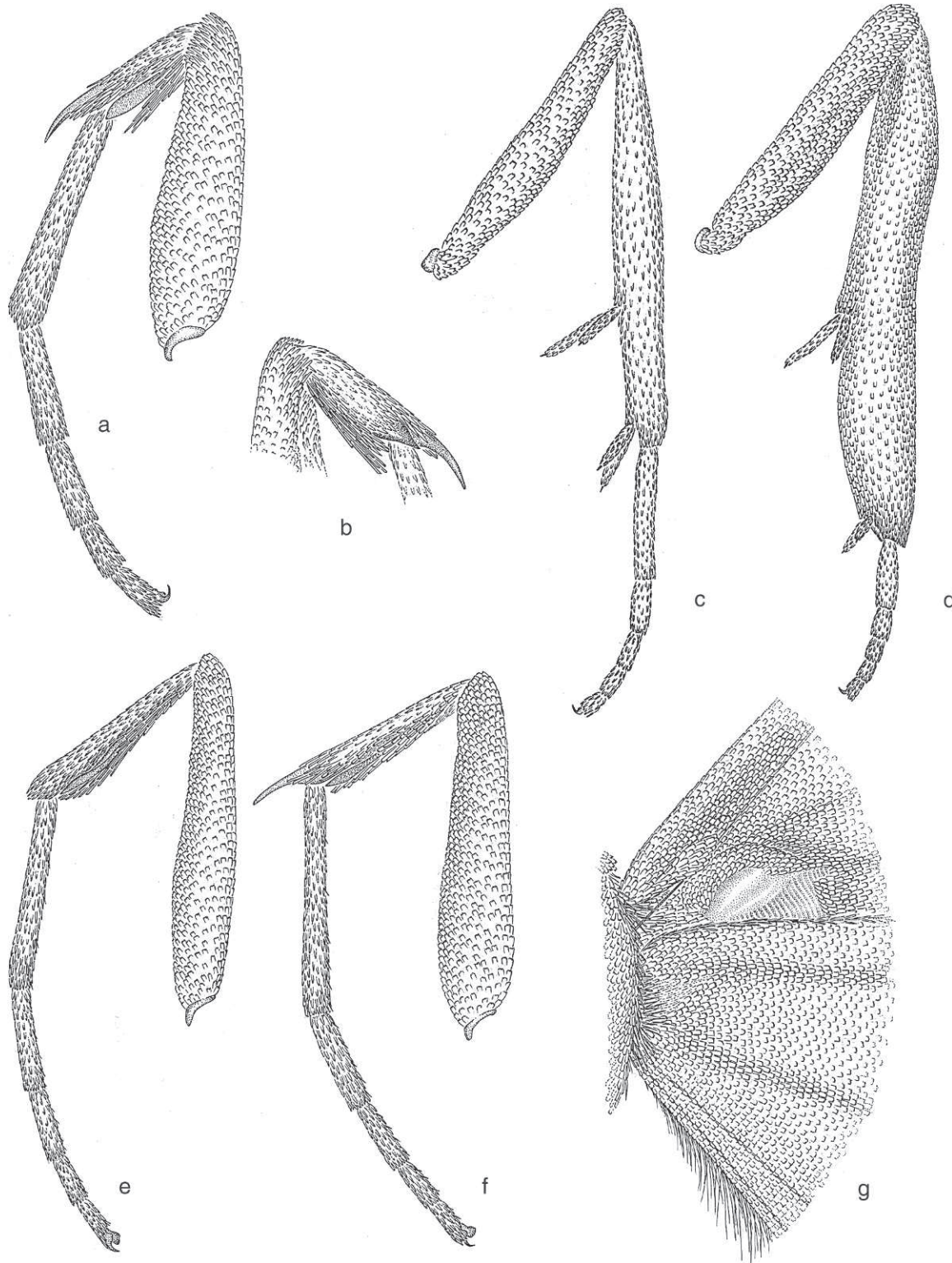


FIGURE 3: LEGS AND WINGS

a. *Isturgia dislocaria*, left foreleg; b. right foretibia. c. *Macaria aemulataria*, hindleg. d. *Macaria promiscuata*, hindleg. e. *Digrammia subminiata*, foreleg. f. *Digrammia indeterminata*, right foreleg [Valentine National Wildlife Refuge, Cherry County, Nebraska]. g. *Macaria aequiferaria*, ventral view of bases of left wings.

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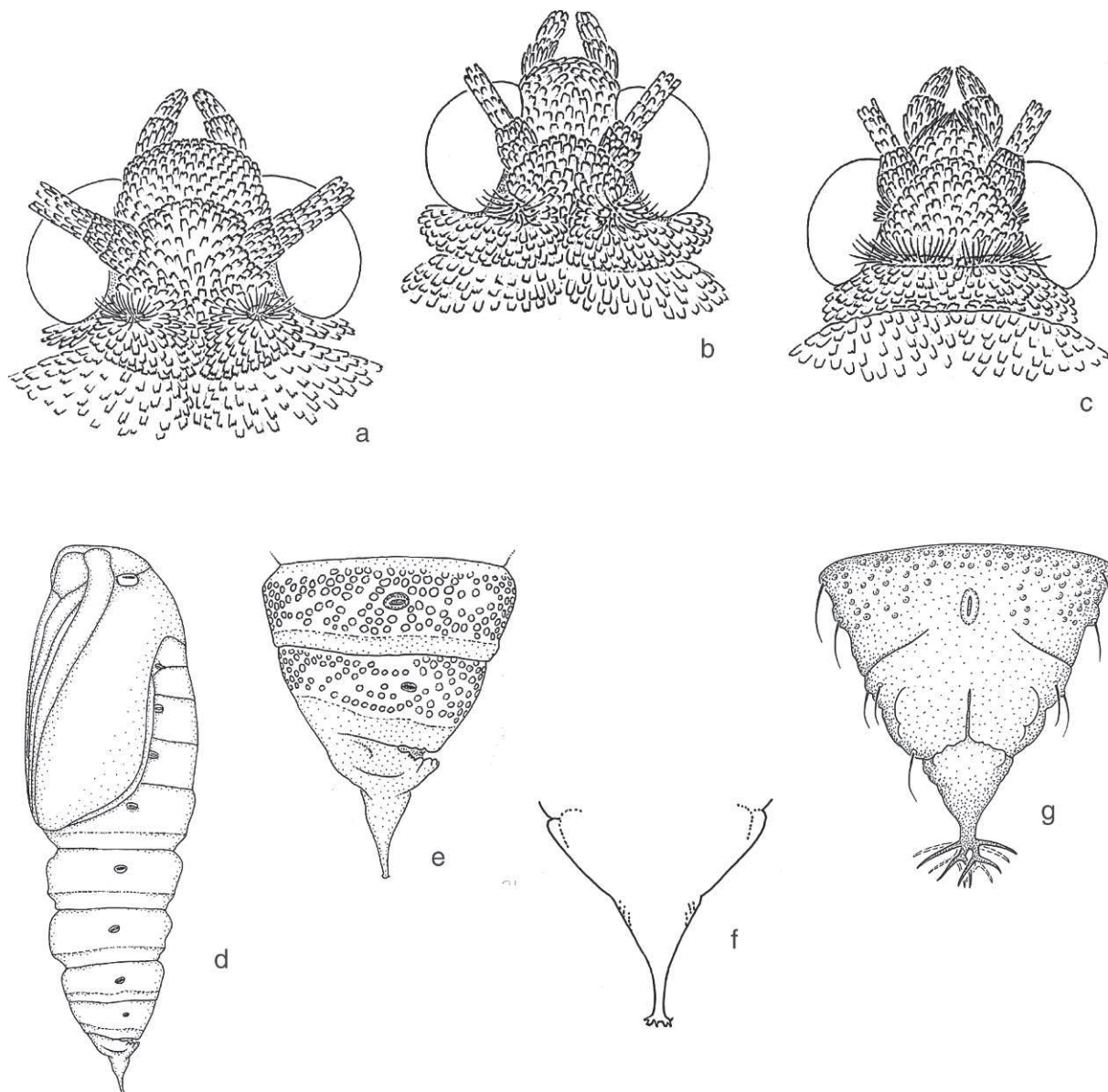


FIGURE 4: HEADS OF ADULTS AND VIEWS OF PUPAE

a. *Isturgia dislocaria*, dorsal view of head. b. *Trigrammia quadrinotaria*, dorsal view of head. c. *Digrammia neptaria*, dorsal view of head. d. *Isturgia dislocaria*, lateral view of pupa; e. lateral view of apex of pupal abdomen; f. ventral view of apex of abdomen. g. *Mellilla xanthometata*, ventral view of apex of pupal abdomen.

some Cassymini, are absent in the Abraxini and Macariini.

The forewing lacks a fovea, which is commonly present in related tribes; the chaetosemata are of the usual ennemine type; and a pecten is often present on the third abdominal sternum as in related groups. The tympanic cavi are abnormally small in some genera (e.g., *Abraxas*) but not in *Ligdia*. The pupa of *Abraxas* has three pairs of hooked setae on the cremaster.

Adult Abraxini have the appearance of being aposematic, often with black-spotted yellow bodies and yellowish collars or wing bases. The wings are commonly white with numerous black spots or maculae as in *Abraxas*, although the *Ligdia* species described here has simplified coloring without the yellow; but it retains in muted form the black-peppered whitish wings and has contrasting transverse black and white dorsal bands at the base of the abdomen, separating the nearly

black thorax from the light gray abdomen. Some Old World genera of other unrelated tribes closely resemble species of Abraxini, especially *Abraxas*, and mimicry is probably involved.

The tribal name is based on the widespread Old World genus *Abraxas* Leach, which has as its type species the European *Abraxas grossulariata* (Linnaeus).

The tribe occurs across the whole of Eurasia and southward into the Malay Archipelago, Australia, and southern Africa, and is now known from two sites in the Great Smoky Mountains, Tennessee.

GENUS

Ligdia Guenée

Ligdia Guenée, 1857 [1858], in Boisduval and Guenée, *Histoire naturelle des Insectes, Species général des Lépidoptères*, **10**: 209.

Type species: *Geometra adustata* [Denis and Schiffermüller], 1775, *Ankündigung syst. Werkes Schmett. Wienergegend*: 114, by original designation.

Type locality: vicinity of Vienna [Austria].

Harpicostia Wehrli, 1936, *Ent. Rdsch.*, **53**: 514.

Type species: *Harpicostia extratenebrosa* Wehrli, 1936. China

Macaria-sized moths with a generally bold, black or brown and white pattern on forewing, commonly consisting of a whitish median space and dark basal and distal areas; hindwing paler, with weak transverse bands and more or less numerous black maculae; a sprinkling of modified scales, mainly in dark basal area of forewing, may be clear, smooth, and curled in such a way as to reflect light brightly and thus appear as metallic reflections. Underside whitish to yellowish with upperside markings repeated in part and more numerous dark maculae; such markings usually paler or more diffuse than on upperside.

Eyes large; frons square, smooth, not protuberant; antennae simple, slightly compressed, heavily setose beneath, with or without pale annulations; palpi moderate, exceeding front slightly, yellow brown; haustellum well developed; legs normal, hindtibia slightly swollen, clavate, with all spurs; leg color blackish with white or light brown annulations and maculae, or pale with black or brown markings; chaetosema small

and difficult to see if all covering scales are in place.

Male genitalia of abraxine type as described above but less complex than those of *Abraxas*. Valve with two or three lobes and few large or modified setae, although with some large setae on juxta. Gnathos well developed; aedeagus with thornlike external point near distal end in some species, and vesica with several elongate, medium-sized cornuti. Female genitalia simple and without notable features.

In addition to the one North American species, the genus includes 10 currently recognized species distributed across Eurasia from western Europe and Asia Minor to China and Japan, northern India, and southern Africa. The type species occurs in Europe from southern Scandinavia to the Mediterranean, and eastward to Central Asia (Skou, 1986). Hosts for only three species are recorded: *L. adustata* on spindle, *Euonymus europaeus* Linnaeus; *L. japonaria* Leach on winged spindle-tree, *Euonymus alatus* (Thunb.) Siebold and *E. oxyphylla* Miq. (Celastraceae) in Japan; and *L. interrupta* Warren on *Acacia karroo* Hayne (Fabaceae) in South Africa (Scoble et al., 1999: 541, 542).

Ligdia wagneri Ferguson and Adams, NEW SPECIES

PL. 1, FIGS. 1–3 (adult); TEXT FIG. 5 *a*, *b* (♂ gen.); TEXT FIG. 5 *c* (venation).

Type locality: Great Smoky Mountains National Park, ca. 3,100', Tennessee. [USNM]

NOTE—The type locality and main site where we found this species was part way up the road between Gatlinburg, Tennessee and Indian Gap, at the cove forest turn-off. This is the only parking area with a grassy island, and it is 1.8 miles past the Chimney Tops picnic area, and 0.2–0.3 miles before the first tunnel on this road. This description applies only to the male as no females were collected.

Most external features as described for genus. In appearance closest to type species, *L. adustata*, but smaller and with the wing pattern and color not as bright. Antenna compressed, the segments (flagellomeres) rectangular in profile, their greatest length about $1.5 \times$ width, tightly fitted together, yellowish brown, setose with setal length equal to or greater than vertical thickness of shaft; shaft clothed dorsally with gray-brown scales with pale-brown maculae at irregular intervals; scape yellowish. Eyes large, leaving almost none of gena exposed; frons square, flat, very smoothly

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scaled, deep brown with a single row of whitish scales along ventral margin; palpi brown to yellow brown, loosely scaled, slightly upcurved, surpassing frons beyond about middle of second segment; haustellum well developed; vertex, collar, and thorax deep, rich gray brown. Abdomen silvery gray dorsally with white scales along posterior margin of each segment and a white transverse band at base contrasting sharply with the almost black scales of adjoining thorax. Underside of body pale, mostly whitish, but becoming yellowish beneath head and laterally behind eyes. Legs mostly brownish gray with pale yellowish to whitish maculae at ends of segments and on sides of middle tibia; hindleg whitish, liberally dappled with light gray; hindtibia clavate, with a large recessed hair pencil. Third abdominal sternum without a pecten (setal comb), which is usually present in Ennominae when there is a tibial hair pencil. Forewing with wide, white median space and dark basal and distal thirds, quite resembling that of the larentiine, *Mesoleuca ruficillata* (Guenée), which is present in the same mountain range. Basal area nearly black with a few scattered shiny scales, giving the effect of metallic reflections; basal area sharply delimited outwardly by evenly convex antemedial band. Both antemedial and postmedial bands double, each comprised of two thin, closely parallel blackish lines, with a narrow rust or orange-brown band sandwiched between them, but any of the components of the transverse bands may be obsolescent. This is within the normal range of variation. Traces of a medial band represented by an often squarish dark gray patch near middle of costa, and smaller spots on stem of $M_3 + Cu_1$, and at inner margin; a diffuse gray discal spot and small, dark maculae or striae may be present elsewhere in median space. Postmedial band almost erect from inner margin, curving outward in an even curve at M_1 , then inward again to meet costa at less than 90° . Darker outer third variegated with black, white, and gray, with crenulate whitish subterminal band, having some of its lobes filled with black on proximal side; terminal line thin, black, interrupted; fringes with light and dark checkering. Hindwing light gray but often whitish toward base, where it is marked by numerous small, faint, gray dots and striae; weak discal spot present, and faint, fragmentary medial band may be present; outer area of wing light gray, traversed by crenulate whitish subterminal band parallel to outer margin; black terminal line

fragmentary, preceded proximally by a more complete crenulate whitish border, present even where terminal is absent; outer margin crenulate with two or three intervenular concavities on anterior half, lined with black remnants of terminal line. Fringes gray. Undersurfaces essentially a repetition of dorsal surfaces but much simpler and diffuse; numerous dark maculae, characteristic of many Abraxini, more evident on undersides of both wings. Wing length: male, 11–12 mm.

Male genitalia (text fig. 5 *a, b*) with broad, triangular uncus, a well-developed gnathos without a distal tooth or process, a long, slender, free costal lobe of valve, and two patches of relatively large setae on juxta, all features that agree with those of the closely similar Palearctic *Ligdia adustata*. However, saccular (ventral) lobe of valve very different, being elongate and triangular, with apex deeply bifid almost halfway to base of valve. Bifid apex with its more dorsal half tapered to an extended, narrowed, but finely rounded tip; ventral process more lobelike. Saccus more produced than that of *adustata*. Elongate, pointed process arising from costal margin of saccular lobe in *adustata*, apparently missing in *wagneri*, is probably homologous to the nearer (more dorsad) of the two apical tips of the saccular lobe in *wagneri*. Aedeagus long, considerably longer than length of genitalia from tip of uncus to saccus, as mounted on slide, and vesica with five large, sharp cornuti. Subapical, external, thornlike process seen on aedeagus of some Abraxini, including *L. adustata* and species of *Abraxas*, secondarily lost in *wagneri*. Eighth sternum, as in other Abraxini, entire, not incised as in most Macariini. Probably because of the large, sharp cornuti crowded into a slender aedeagus, I was unable to evert the vesica of this species. Female genitalia unavailable.

The male genitalia of *Ligdia* are simpler than those of many Abraxini, lacking accessory processes and modified setae such as seen in *Abraxas*. There is little that would exclude *Ligdia* from the Cassymini, except perhaps that the costal lobe is an integral part of the valve, not a separate, flexible process as in many Cassymini.

The tympanic cavi are not reduced in this species as in *Abraxas* (see Cook and Scoble, 1992: 227), but of normal size or even larger. The pupa of *adustata* has the “cremaster a conical spike, tipped with several minute hooked bristles” [setae] (Barrett, 1900: 273).

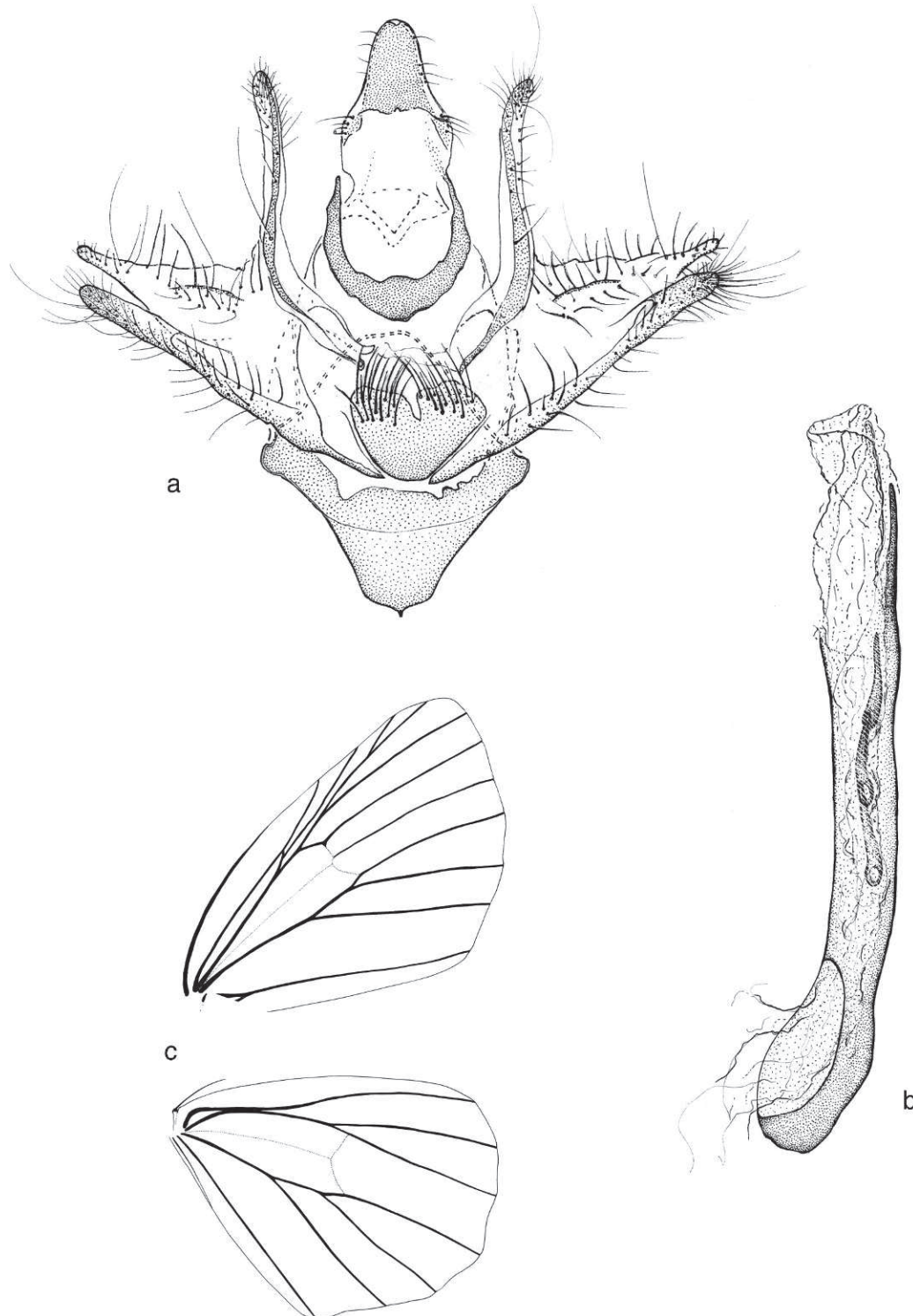


FIGURE 5: STRUCTURAL FEATURES OF *LIGDIA WAGNERI*

a. Male genital capsule; Chimney Tops Area, GSMNP, Tennessee (USNM 58052); *b.* aedeagus (USNM 58052); *c.* venation; New Found Gap Road, 1.8 E Chimney Tops Picnic Area, Sevier County, Tennessee (83225).

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By extrapolating from what is known about its Old World counterpart, *L. adustata*, we can guess that the food plant of *wagneri* will prove to be a species of *Euonymus* (Celastraceae), probably *E. obovatus* Nuttall, a low, prostrate species that grows in the vicinity of the type locality. *Ligdia adustata* in Europe has two broods, the first in May, and “a more or less partial second generation at the end of July, August, or even September” (Barrett, 1900: 272).

TYPES. Holotype ♂. Newfound Gap Road, 1.8 road mi E of Chimney Tops Picnic Area, ca. 3,200', GSMNP [Great Smoky Mountains National Park], Sevier Co., TN [Tennessee]; 19 May 2001; Wagner, Brown, & Ferguson. USNM. Paratypes (11 ♂). Tennessee. Same locality, 16, 17 May 2001, James Adams (4 ♂). Same locality; 19 May 2001; D. C. Ferguson & D. L. Wagner (1 ♂). Same data as for holotype (3 ♂). Same data as for holotype; 22 May 2001; D. C. Ferguson, D. L. Wagner, and J. Brown (2 ♂). ATBI House nr. Cosby, Cooke Co., GSMNP, 533 m, 35° 46.66'N 83° 12.82'W; 22–25 June 2001; D. & M. Davis (1 ♂). GNSP, JKA, UCMS, USNM.

Specimens were collected mostly at sheets illuminated with 18 watt UV tubes or mercury vapor lamps near or down the slope from the parking lot, except one that was flushed just before dark from low, streamside vegetation at the bottom of the ravine; four taken in a light trap up the wooded slope on the other side of the road; and one in a light trap at the much lower Cosby site.

Ligdia wagneri is one more of the many plant and animal species that owe their presence in North America, especially in the southern Appalachians, to the Arcto-Tertiary biotic interchange across the Bering Land Bridge, which ended in the late Eocene. Because no other species of the group occur in the New World, we can assume that it has been isolated from Eurasian relatives for at least 12,000,000 years (see Pielou, 1979). The sister species is probably *Ligdia adustata*.

We are pleased to name this species for David L. Wagner of the University of Connecticut, one of its three initial collectors. Dr. Wagner has broken new ground in the study of larval biology and continues to contribute immensely to our knowledge in this field. He has been making a dedicated effort to find the larva of this species.

TRIBE

Cassymini Holloway, 1993

Cassymini Holloway, 1993, *Moths of Borneo*, part 11: 117.

Type genus: *Cassyma* Guenée, 1857 [1858].

This tribe was established to accommodate a group of mainly Old World genera, but there are a few in the New World also; namely *Protitame* McDunnough, *Taeniogramma* Dognin, *Nematocampa* Guenée, and probably other genera in the Neotropics related to the last two but in need of investigation. They share certain morphological features with the Macariini, such as the bilobed valve, and at times it may seem that separation of the two tribes is unsatisfactory. I include *Nematocampa* in the Cassymini because it has what are thought to be the right morphological features and fits nowhere else. This follows Holloway (1993), who assigned its Southeast Asian relatives to the Cassymini.

The Cassymini were defined primarily as having a long, slender process arising from the base of the dorsal margin of the valve. Although almost certainly representing the costal lobe of the valve, it may appear as a different structure quite separate from the apparent base of the sacculus. It may be articulated at its base in such a way as to be flexible, or attached as an integral part of the valve and thus a more typical costal lobe. Both conditions occur in the Neotropical *Taeniogramma* complex, and may be indicative of different genera. The pecten on the third sternum, and the fovea near the base of the forewing may be present or absent, and the fovea may be in different places; i.e., bounded by different veins (Holloway, 1993: 117), a situation also seen in a few American Macariini. The forewing radial veins are usually reduced in number, probably through a fusion of R_1 and R_2 . The male antenna is variable, and the chaetosemata widely separated and normal, not extended toward each other behind the head as in most Macariini. The eighth sternum is nearly always unmodified. The Cassymini lack the hornlike setae on the uncus found in many Macariini, but usually have a corema on the base of the valve, lacking in Macariini. The sclerotized ornamentation of the vesica varies from light scobination to a single large spine. The female genitalia show nothing definitive or consistent except perhaps the radially asymmetrical stellate signum with longer points on one side or at one end.

The Old World fauna is diverse. Holloway (1993) treated 12 genera from Borneo, and the tribe includes the very large, mainly African genus *Zamarada* Moore (revised by Fletcher, 1974).

Zamarada adults are partly green in both Africa and Southeast Asia and resemble Geometrinae, but their genitalia place them clearly in the Cassymini. There are relatively few Cassymini in the New World, and I have recognized only three small, extremely dissimilar genera in the United States, obviously remnants or outliers of disparate groups.

The genitalia of *Nematocampa* show what would seem to be unmistakable similarities to those of some species of *Heterostegane* Hampson and *Peratophyga* Warren as illustrated from Borneo by Holloway (1993:126, 131, figs. 246–273). Striking resemblances may be seen in the nature of the bilobed valve and its similarly slender and angled costal lobe, and in the signum of females. The genus *Taeniogramma* in the Neotropics appears to embrace a substantial complex, which may prove to include additional genera when they are studied. *Protitame* is a unique little genus, occurring only in North America. The tribe seems best developed in Tropical Asia.

Differentiation of the two tribes is far from clear. For example, the Neotropical genus *Semiothisa* has the long, spinelike process in place of the more usual costal lobe and a radially asymmetrical signum, and on those bases would be a cassymini. However, it has the extended chaetosema, modified, incised eighth sternum, and often the extramedial spot on the forewing, all features of the Macariini; and it certainly has the appearance of a macariine.

I had particular difficulty in deciding whether *Heliomata* should be treated as a cassymini or macariine, but the weight of morphological evidence tilts toward the Macariini. Although a highly modified genus, the costal lobe of the valve is of the macariine type. It fits well within the Macariini.

The early stages, from what little is known, are not helpful in characterizing the Cassymini of either hemisphere. The larva of *Nematocampa* (plate 9, figure 1) (a very general feeder), with its two pairs of large dorsal filaments, is bizarre; and that of *Protitame* (plate 9, figures 3–5) (on Salicaceae), although not very distinctive, is unlike any known macariine. The distinctive larva of *Taeniogramma tenebrosata* is not at all like those of the other Cassymini or Macariini, and its pupa (described under the species) has extraordinary features.

KEY TO GENERA OF THE TRIBE CASSYMINI

1. Male genitalia (text figure 6 *a, c*) with uncus as in most Geometridae, consisting of a broad base and an elongate, more or less linear process; slender costal lobe of valve angled near middle; third abdominal sternum without pecten; inner preapical spur of hindleg curiously enlarged and clavate (except in *baggetaria*); wings usually with an irregularly reticulate pattern of dark brown on a yellow or whitish background; medial band, if present, far out, often touching or partly uniting with postmedial band. Widespread *Nematocampa*
p. 27
- Male genitalia with uncus closer to the macariine type, broad, subconical, without an extended linear process; pecten of third abdominal sternum present or absent; hindleg with all spurs normal; wings without a dark reticulate pattern; medial band not especially far out 2
2. Male genitalia (text figure 8 *a–e*) with uncus elongate conical; costal lobe of valve relatively stout, tapering, not sicklelike but curved distally; sacculus of valve simple, subtriangular; female genitalia with signum small, stellate; small white or light brownish moths with rounded (not angulate) wings, with or without weak brownish transverse markings; male antenna bipectinate; pecten of third abdominal sternum absent; widespread. Associated with *Populus* *Protitame*
p. 39
- Male genitalia (text figure 7 *a–d*) with uncus broad, rounded, with short, nipplelike apical process; costal lobe of valve long, slender, pointed, with sicklelike curvature; sacculus of valve complex, with humps, processes, and abundant nondeciduous setae; female genitalia with signum transversely elongate, pointed and hornlike at each end; small to medium-sized gray-brown to buff colored or whitish moths with pattern of transverse bands; male antenna simple; pecten of third abdominal sternum present; southwestern and Mexican *Taeniogramma*
p. 34

GENUS

Nematocampa Guenée

Nematocampa Guenée, 1857 [1858], in Boisduval and Guenée, *Hist. Nat. des Insectes, Species Général des Lépidoptères*, **9**: 120.

Type species: *Nematocampa filamentaria* Guenée, *ibidem* **9**: 121; 1858, *ibidem*, Atlas: pl 2, fig 3, pl. 5, fig. 1, by monotypy.

NOTE—*Nematocampa filamentaria* is a junior subjective synonym of *Microgonia resistaria* Herrich-

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Schäffer, [1855], *Sammlung neuer oder wenig bekannter aussereuropäischer Schmetterlinge*, p. 41, pl. [65], fig. 368.

Nematocampa is almost unique within the macariine triad of tribes treated here because it preserves the pupal character of an 8-hooked cremaster, believed to be primitive. A bifid cremaster of the boarmiine type is considered apomorphic (Holloway, 1993). At first I thought that this would exclude *Nematocampa* from the Cassymini, but then I found an 8-hooked cremaster in *Mellilla*, albeit of a unique, specialized type (text figure 4 g). Species of *Nematocampa* may nearly always be recognized by the characteristic wing pattern. The dark medial line of the forewing is unusually far out, partly touching or confluent with the postmedial line or missing; in *N. resistaria* and *brehmiata* these lines touch near the inner margin and at vein M_2 , thereby making a closed cell between them near the middle of the wing. Neotropical species, however, do not have a well-developed, closed cell, or it may not show in poorly marked specimens. The outer third of both wings has conspicuous areas of brown or purplish-brown shading in most species. The pale ground color varying from whitish to deep orange yellow, is often striated transversely with multiple, fine, short streaks, and marked longitudinally with fine, dark lines on the veins, giving a reticulated effect. Length of forewing: males, 7–14 mm; females, 7–16 mm.

Other features of *Nematocampa* are as follows: male antenna prismatic, compressed, finely setose; female antenna filiform, finely setose; chaetosemata small, with 5–6 bristles; front smooth; palpus short, only slightly surpassing front; male hindtibia much enlarged, with preapical spur on inner side curiously modified in most species, elongated almost to end of tibia, claviform, enlarged distally to 2–4 × thickness of normal, linear spur; fovea absent; pecten of third abdominal sternum absent. Larva (*resistaria*) unique in having two pairs of pale tipped, extensile, tentacle-like filaments arising from the dorsum of A2 and A3. Pupa without a transverse dorsal groove between A9 and A10.

Male genitalia with end of gnathos laterally compressed in typical group, dorsoventrally compressed in some Neotropical species; juxta large and elongated dorsally (toward uncus), where it becomes notched or bifurcated in all North American species and some Neotropical ones; valve in

all North American and some Neotropical species divided into a long, slender costal lobe and shorter, rounded, saccular lobe, as in the tribe Macariini. Other Neotropical species, typical of the genus in other respects, have the valve undivided. Most Neotropical species, those with an undivided valve, have a pair of short, spinose processes (resembling a furca) arising from the juxta, one on each side; in those with a bilobed valve, the spinose processes have degenerated to a pair of simple sclerites flanking the juxta and apparently forming narrow bridges between the juxta and transtilla. A long, hairy corema arises laterally from near the base of each valve in most species, but may be reduced or vestigial. The female genitalia typically have a longitudinally ovate signum, with an indeterminate number of dentate processes radiating from its margin.

Nematocampa in the broad sense has three main species-groups, which I listed in somewhat more detail in an earlier paper (Ferguson, 1993). Only the first group concerns us here—those with or without a modified hindtibial spur but always with a bilobed valve, degenerate furca, strongly bifurcate juxta, and one cornutus. This group includes the three species that occur north of Mexico and two closely related Neotropical species that I could identify, namely *N. evanidaria* Schaus and *N. arenosa* Butler (plus other Neotropical species apparently undescribed).

KEY TO SPECIES OF *NEMATOCAMPA* OF THE UNITED STATES AND CANADA

1. Male with hindtibia enlarged and inner preapical spur curiously modified, long, clavate; ground color of wings whitish or yellow; wing length generally more than 10 mm; widely distributed 2
- Male with hindtibia not enlarged and preapical spurs unmodified; ground color of wings orange brown to yellowish; moths small, wing length less than 10 mm; southeastern United States ..
..... *baggettaria*
p. 33
2. Females with ground color white or nearly so; males with clavate hindtibial spur longer than first tarsal segment, conspicuously swollen to 3–4 × thickness of other preapical spur; transcontinental, widespread *resistaria*
p. 29
- Females with ground color yellow (a few females of *resistaria* from Oregon with yellow ground color will key here); males with clavate hindtibial spur swollen only to twice thickness of other preapical spur; California *brehmeata*
p. 32

Nematocampa resistaria (Herrich-Schäffer)

PL. 1, FIGS. 4–7 (adult); PL. 9, FIG. 1 (larva); TEXT FIG. 6 *a*, *c* (♂ gen.); TEXT FIG. 6 *b* (♀ gen.); TEXT FIG. 6 *d* (venation) (RWH 7009, 7010).

Phalaena limbata Haworth, 1809, *Lepidoptera Britannica*, Pt. 2: 346. HOMONYM.

Type locality: England (“Angliae rarissime”). Presumed to be a false type locality.

NOTE—*Phalaena limbata* Haworth is a junior primary homonym of *Phalaena limbata* Linnaeus, 1767, *Systema Naturae*, ed. 12, p. 873, which is the European species now known as *Evergestis limbata* (Linnaeus) (Crambidae). According to the *International Code of Zoological Nomenclature* (1985, Art. 59a), “a species-group name that is a junior primary homonym must be permanently rejected.”

Microgonia resistaria Herrich-Schäffer, 1855, *Sammlung Aussereuropäischer Schmetterlinge*, p. 41, pl. [65], fig. 368.

Type locality: not given.

Microgonia vestitaria Herrich-Schäffer, 1855, *ibidem*, pp. 63, 82, pl. [65], fig. 368.

Type locality: Brazil (considered to be a locality error. For discussion of this problem, see Ferguson (1993: 67)).

Nematocampa filamentaria Guenée, 1857 [1858]. *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 9: 121; Atlas, pl. 5, fig. 1; pl. 2, fig. 3 (larva).

Type locality: Canada (by lectotype designation (Ferguson, 1993)).

Nematocampa expunctaria Grote, 1872, *Can. Ent.*, 4: 101.

Type locality: Alabama. [ANSP]

Eugonobapta brunneolineata Hulst, 1900, *Jour. New York Ent. Soc.*, 11: 218.

Type locality: Hastings, Florida. [AMNH]

Ania limbaria var. *chagnoni* Swett, 1913, *Can. Ent.*, 45: 76. (Melanic form)

Type locality: Isle Ste. Thérèse, St. Johns County, Quebec. [MCZ]

Nematocampa limbata orfordensis Cassino and Swett, 1922, *The Lepidopterist*, 3: 156.

Type locality: Port Orford, Oregon. [MCZ]

This widespread, transcontinental species is distinguished by the pale off-white ground color of the females (with rare exceptions) as compared

to the yellow males; the swollen male hindtibia and the large size of the modified male hindtibial spur, which is swollen to three × the thickness of the other spurs; the combination of long, nearly straight, divergent prongs on the bifurcate juxta and the large coremata of the male genitalia; and the combination of large, spiny signum but otherwise unsclerotized bursa copulatrix in the female genitalia.

Male with outer margin of forewing variable from rounded to angulate, hindwing usually rounded; ground color pale to deep yellow, with brown or purplish-brown markings well developed to obsolescent and geographically variable. Hindtibia much enlarged, apparently containing a large hair pencil that seems never to be fully extruded in museum specimens; hindtibia also with curiously modified, clavate, inner preapical spur twice as long as, and distally widened to at least three × as wide as outer preapical spur; modified spur longer than metatarsus. Female with outer margins of both wings angulate, that of forewing quite strongly so and concave between terminus of M_3 and apex. Ground color whitish to cream colored, with reddish-brown markings much less variable geographically than those of male. Both sexes with scales of front, antennae, palpi, and body light brown, legs and vertex somewhat paler. Undersurfaces of wings of both sexes paler and with markings less distinct than above. The reticulate nature of the wing pattern is more emphasized in females than in males because the longitudinal veins are more strongly outlined. Length of forewing: males, 10–14 mm; females, 12–14 mm (reared specimens may be smaller).

Male genitalia (text figure 6 *a*, *c*) similar to those of the Californian *N. brehmeata* but with saccular lobe of valve more narrowed distally, prong of bifurcate juxta nearly straight and somewhat divergent, not incurved distally as in *brehmeata* (Ferguson, 1993, fig. 32), and with gnathos more produced distally; they differ obviously from those of *N. baggettaria* in having large coremata (*baggettaria* has almost none) (Ferguson, 1993, fig. 30), a longer, more produced saccular (ventral) lobe on valve, and prongs of bifurcate juxta that are nearly as long as entire gnathos.

Female genitalia (text figure 6 *b*) characterized by combination of large, stellate signum, about three × wider than narrowest constriction of ductus bursae and often larger than that of *brehmeata*; an ovoid corpus bursae, twice as long as wide and with little sclerotization of its surface; and an

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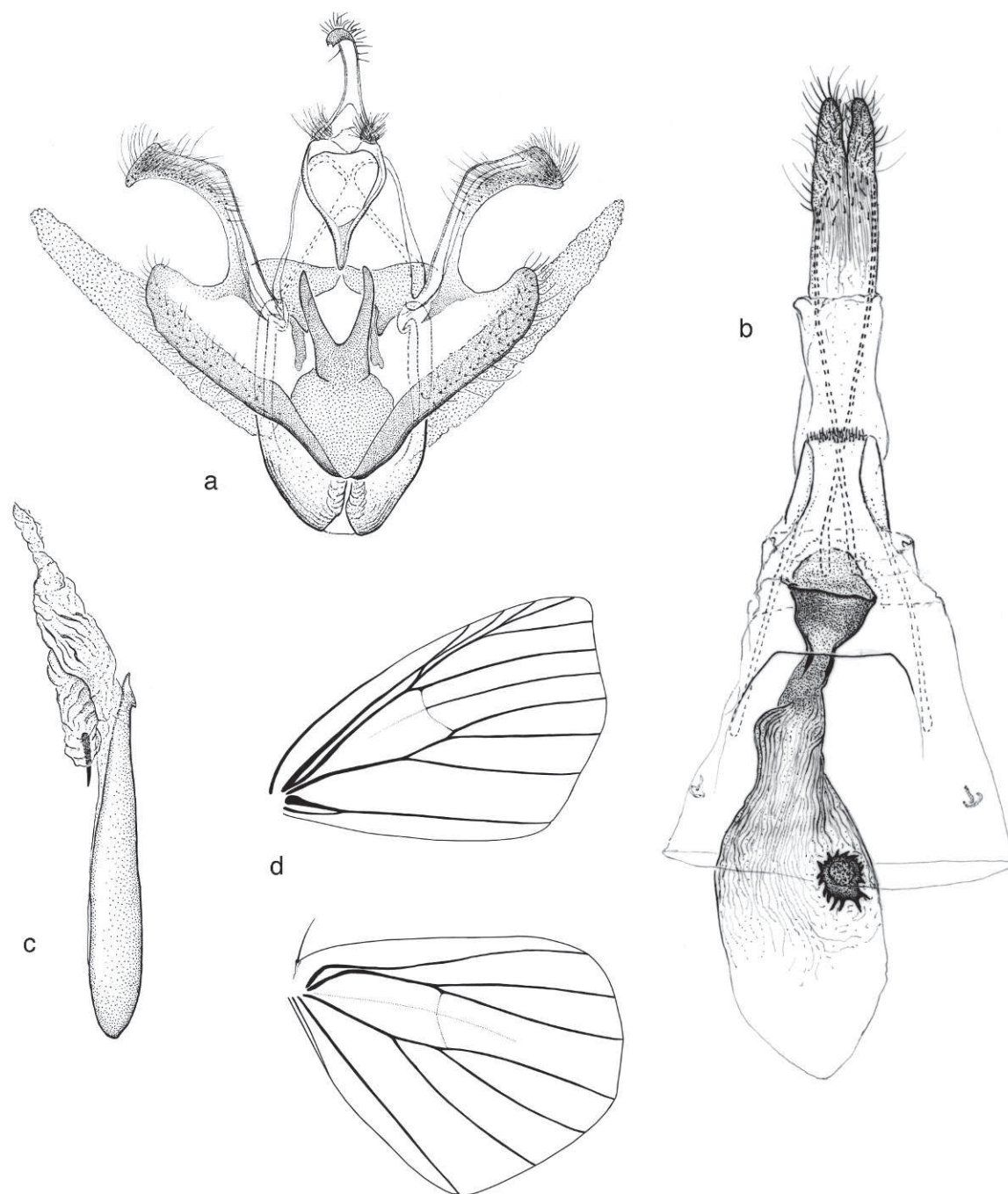


FIGURE 6: STRUCTURAL FEATURES OF *NEMATOCAMPA RESISTARIA*

a. Male genital capsule; McClellanville, Charleston County, South Carolina (USNM 56766); *b.* female genitalia; Okefenokee Swamp, Georgia (USNM 57524); *c.* aedeagus (USNM 56766); *d.* venation; Cornell Campus, Ithaca, Tompkins County, New York (USNM 83223/4).

ostial funnel whose widest dimension is considerably less than width of seventh segment at that point. By comparison, *N. brehmeata* has a wider ostial funnel, nearly as wide as the integument of the segment; more sclerotization on corpus bursae

between signum and ductus bursae (Ferguson, 1993, fig. 35); and smaller signum only twice as wide as ductus bursae. In *baggettaria*, the corpus bursae is almost globular, and the small, differently shaped signum is hardly wider than narrow-

est constriction of ductus bursae (Ferguson, 1993).

The larva of *N. resistaria* (plate 9, figure 1), sometimes known as the "filament bearer," has been described and figured many times, beginning with Guenée (1858, pl. 2, fig. 3) and Packard (1876, pl. 13, fig. 8). For more comprehensive descriptive and foodplant information, see Ferguson (1993). The various illustrations and descriptions do not always agree, and the larva is assumed to be variable in color. The body basically has a subdued pattern in various shades of brown from light reddish brown to deep purplish brown and is of medium to somewhat stout form; head variable from rust brown to mostly dark brown, sometimes marbled with paler shades, not shiny; conspicuous, paired, extensile, dorsal filaments arising from near posterior margins of segments A2 and A3, the anterior pair being the longer and, when extended, nearly equal to the combined lengths of the first four body segments; filaments nearly straight when extended, bent and coiled at the tips when retracted, brown but conspicuously white tipped, their surfaces minutely pubescent; low, wartlike, subdorsal humps on A1 and A2; segment A8 elevated to an obtuse angle dorsally above spiracle, then sloping away abruptly to the pointed posterior tip of anal plate. Thorax may have a weak, irregular, white lateral line, projected forward onto side of head; and segments A6 to A8 have a white dorsolateral stripe, which sharply angles ventrad on A6 to run down lateral side of first anal proleg. This is a composite description mainly to cover larvae that I reared from eggs in 1994 on American elm, *Ulmus americana* Linnaeus (Ulmaceae), in Maryland. These differed only slightly from larvae from Albany County, New York that I described earlier (1993: 70). The larva was illustrated by Wagner et al. (2001: 156), and by Ives and Wong (1988), who published two colored photographs, one showing the filaments coiled, and the other showing them extended and straight. The filaments look like sensory organs, but their function is unknown.

Nematocampa resistaria has been reported to feed on more than 60 species of trees and shrubs representing over 20 plant families. These include most of the common deciduous species as well as pine, hemlock, spruce, fir, larch, and Douglas-fir.

This species occurs in suitable habitats throughout southern Canada from Nova Scotia to

Vancouver Island, British Columbia, and southward in the United States at least to Hernando County, Florida; Mississippi; southern Louisiana; Harris, Jackson, Colorado, and Blanco counties, Texas; and southward in the West to Colorado, Utah, and southwestern Oregon. It is replaced in California by *N. brehmeata*. In mountainous or semiarid regions it is a species of low elevations and riparian habitats.

It is single brooded in Canada and most of the northern United States, flying mainly in July and August. It becomes double brooded in the middle states, emerging in May and again in late July (e.g., in Maryland), but it seems to be no more than double brooded in the South. The many specimens in the USNM from South Carolina, Georgia, northern Florida, and Texas were collected in April and May, which might, of course, reflect the activity of collectors. In Louisiana and Mississippi it was collected in April, May, June, and July, based on many records from year-round light trapping (Brou and Mather collections). The flight period in the Northwest is also mainly in July and August, rarely in June, but with a few September and early October records for western Oregon.

Nematocampa resistaria has two main geographical variants distinctive enough to have been named and treated for some time in the literature as species or subspecies. These are *N. expunctaria* (= *brunneolineata*) in the Southeast and subspecies *orfordensis* in the Pacific Northwest. The former was regarded by Grote (1872, 1882), Capps (1943), and the present author (1983) as a distinct species in which the wing pattern of the male is reduced to little more than the antemedial and postmedial lines, although the female remains unchanged. Capps, having no specimens of *expunctaria* other than the type, further described what he thought were differences in the genitalia. A reevaluation based on more material convinced me that *expunctaria* is the same species as *resistaria*, at best a weak subspecies occupying a narrow coastal zone from South Carolina to northern Florida and westward through southern Louisiana to East Texas. Intermediate forms of every degree may be found. Where the range of the species continues westward into Texas, the moths revert to the more normal, well-marked form of *resistaria*.

The population of *N. resistaria* localized in coastal Oregon, Washington, and Vancouver Island was named *orfordensis*. Adults are as large

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as those of *brehmeata* (wing length: males, 13–14 mm; females, 15–16 mm) and sometimes, like that species, a deep shade of yellow. A size gradient is apparent between populations of the coastal region and the interior, those from eastern Oregon and Washington hardly differing from northeastern specimens. I can only guess that this population is a result of past introgression between *resistaria* and *brehmeata*, especially inasmuch as a few of the females are yellow, like those of *brehmeata*. Three such females in the USNM were collected in Clatsop County, Oregon in early September. It is not a seasonal form because normal *resistaria* females with white ground color were collected with them. These are the only yellow females of *N. resistaria* that I have seen, although *N. brehmeata* always has yellow females. Specimens of *orfordensis* that I dissected have genitalia like those of *resistaria*.

Nematocampa brehmeata (Grossbeck)
PL. 1, FIGS. 8–11 (adult) (RWH 7011).

Ania brehmeata Grossbeck, 1907, *Trans. Amer. Ent. Soc.*, **33**: 343.

Type locality: Cazadero, Sonoma County, California. [AMNH]

This Californian species resembles *N. resistaria* but is usually larger, and both sexes are yellow. The females, instead of being whitish, are often an even deeper shade of yellow than the males. The dark markings of the outer third of both wings in males are more broken up by encroachments of pale ground color and in females are lacking entirely. These yellow females, without dark submarginal markings, are very different in appearance from most females of *resistaria*. Diagnostic differences in the hindtibial spurs were noted in the key. In the male genitalia, the prongs of the bifurcate juxta are incurved distally, not straight, and the female has a larger ostial funnel. This species occurs in northern and central California west of the Sierra Nevada. It appears to be the only species of *Nematocampa* in that region, although *resistaria* occurs in nearby Oregon.

Body, head, antennae, and legs similar to those of *resistaria* except that the modified hindtibial spur of male is more slender, distally swollen to not more than twice thickness of the other preapical spur, and slightly shorter than metatarsus. Wing shape and pattern similar to those of *resistaria* except that the dark, purplish-brown shading in outer third of wings in males tends to ap-

pear reduced, narrowed, or otherwise broken up, frequently faded, and further reduced or lost on the hindwing. Dark shading of outer third of wings lost entirely in the four females examined. Ground color variable from light yellow to intense orange yellow in both sexes, but males are mostly light (9 of 11), and females may more often be deep yellow (2 of 4). Length of forewing: males, 12–14 mm; females, 13–14 mm.

Male genitalia (Ferguson, 1993, fig. 32) differ from those of *resistaria* in slightly wider saccular lobe of valve; shorter coremata, only about half as long; narrower overall shape of juxta, with its two bowed prongs diverging basally, but curving toward each other distally; and two free sclerites laterad of base of juxtal prongs thicker, and also bowed, not straight like those of *resistaria*.

Female genitalia (Ferguson, 1993, fig. 35) with ostial funnel very large, almost as wide across opening as width of seventh segment at that point; about twice as large as ostial funnel of *resistaria*. Bursa copulatrix quite heavily sclerotized in zone between signum and ductus bursae; integument in this area pleated or rugose in both species, but not sclerotized in *resistaria*. Ovipositor wider and less elongated than that of *resistaria*, the lobes (papillae anales) being shorter than ostial funnel is wide (longer than width of funnel in *resistaria*).

The only noteworthy variants are three males from near the town of Mt. Shasta, Siskiyou County, California which are small (wing length: 12–13 mm), slightly paler yellow, and with all dark markings intensified, although specimens from Shasta and Del Norte counties are large and normal for the species. The Mt. Shasta specimens could be mistaken for *resistaria*, but in pattern and structure they are *brehmeata*. Perhaps it is a seasonal difference, because summer-brood geometrids are nearly always smaller than spring ones. As mentioned under *resistaria*, there appears to be some intergradation in wing color and pattern in a narrow zone of contact between the two species, which approximates the Oregon-California border, but I have not seen intermediate genitalia.

The early stages of *N. brehmeata* appear to be unknown.

Nematocampa brehmeata is uncommon in collections and appears to have a limited distribution only in northern California. I have seen specimens from the following counties: Del Norte, Siskiyou, Shasta, Placer, Butte, Plumas, Mendocino,

Lake, Sonoma, Napa, Marin, Santa Clara, and Santa Cruz. My only observations on the habitat are based on the three males that I collected one night in a riparian habitat on the outskirts of the town of Mt. Shasta, in a small nature preserve on the road to Lake Shasta. The site was in a moist stream bottom with abundant willows, dogwood, and alder, mixed conifers nearby, and a pond fringed with *Typha* marsh. The flight period based on the 35 specimens examined is 20 June–27 August.

Nematocampa baggettaria Ferguson
PL. 1, FIGS. 12–15 (adult).

Nematocampa baggettaria Ferguson, 1993,
Jour. Lep. Soc., **47**: 73.

Type locality: Torreya State Park, Liberty County, Florida. [USNM]

This southeastern species is the most distinct and smallest of the three members of the genus in our fauna, with wing margins rounded, not angulate, wings mostly orange brown, but with dark, purplish-brown shading in most of the outer third in females. The pattern is simplified, with two regular lines on the forewing, one on the hindwing, and almost no reticulation of lighter areas in either sex. It is the only species of *Nematocampa* in the United States without a swollen, clavate, hindtibial spur.

Head, antennae, and legs similar to those of *resistaria* except that the male hindtibia is not swollen, and lacks the specialized, clavate spur; all spurs are small and normal. Front in both sexes light yellowish brown, variably sprinkled with bright red-brown scales or with a diffuse red-brown border on each side.

Male with outer margin of wings rounded like those of some southeastern *resistaria* or more so, and with apex less acute; wings almost uniformly ochreous orange brown, or variably tinged with purple in outer third; forewing with antemedial a thin, dark, regular, convex line; postmedial line similar, curved subparallel to outer margin or nearly straight; hindwing with slightly curved postmedial line bisecting wing nearly in middle; small, rounded, dark, discal dot on each wing; fringes dusky; wings faintly dusted with a few dark scales but without reticulation or any sign of a medial band in median space. Underside darker, with markings reduced, although postmedial of hindwing may be closely preceded for most of its length by a faint, thinner, subparallel

line. Spring brood (April) specimens with tendency to be slightly larger and paler than summer (June–August) specimens. Length of forewing: males, 7–8 mm.

Female with apex of forewing somewhat produced but with outer margins rounded like those of male, unlike females of other species. Ochreous orange-brown ground color of wings dusted with reddish-brown scales that outline veins of median space in some specimens, giving a suggestion of the reticulate pattern seen in pale wing areas of other species. Forewing with antemedial line thicker than that of male and purplish; postmedial line curved or nearly straight, blackish, commonly indented in cubital fold; postmedial of hindwing slightly curved to nearly straight, bisecting wing near middle. Discal spots small but prominent. Outer third of both wings dark purplish brown except for orange-yellow patch toward apex of forewing and variable indications of same color in form of a diffuse, mesial, transverse band in outer third of hindwing; fringes unicolorous. Underside similarly marked but with lines thickened and diffuse, and all paler areas more or less suffused with gray or purplish brown. Little seasonal variation is apparent. Length of forewing: 7–9 mm.

Male genitalia (Ferguson, 1993, figs. 31, 31, 37, 38) similar in general form to those of *resistaria* and *brehmeata* but with two obvious differences. The long, hairy corema that arises near base of saccular lobe in other species all but absent (vestiges remain), and prongs of bifurcate juxta are short in *baggettaria*. Prongs shorter than paired, longitudinally parallel sclerites lying off to each side of “neck” of juxta, whereas in *resistaria* the prongs are much longer than these sclerites. Overall, genitalia smaller and more delicate, saccular lobe less produced, and vesica of aedeagus with smaller cornutus.

In the female genitalia (Ferguson, 1993, fig. 36, 39), the signum is of the small, simple, two-pointed type found in some Neotropical species. Signa of *resistaria* and *brehmeata* differ in being slightly elongate disks bearing small surface points and fringed marginally with many more sclerotized points that form a dentate margin on the signum, which is widest toward the anterior end.

The early stages of *Nematocampa baggettaria* are unknown.

I have seen this species only from the Apalachicola National Forest and Torreya State Park,

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Liberty County, Goose Pasture, Jefferson County, and Manatee Springs and Cedar Key, Levy County, Florida; Abita Springs, St. Tammany Parish, Louisiana; and Lumberton [Robeson County], North Carolina. The last mentioned is a single specimen that may have been mislabeled. The species has been collected in every month from April to November but is rare in collections. I have seen only the original type series of 26 specimens.

GENUS

Taeniogramma Dognin

Taeniogramma Dognin, 1913, *Ann. Ent. Soc. Belgique*, **57**: 408.

Type species: *Taeniogramma costimacula* Dognin, *ibidem*, by monotypy. [USNM]

NOTE—*Taeniogramma* was overlooked by Fletcher (1979) in the world catalogue of geometrid genera, but it is a valid name and the oldest available for the present group. The holotype of *costimacula* (USNM, gen. slide 57,408), from Lino, Panama, 800 m, is closely related to *T. odrussa* (Druce), from Mexico, Guatemala, and Costa Rica. According to the genitalia, however, it is a distinct species, not a synonym of *odrussa* as listed by Scoble et al. (1999: 921), unless the USNM material of *odrussa* is misidentified, or the syntypes in the BMNH are not what I think they are.

Prophasiane McDunnough, 1939, *Can. Ent.*, **71**: 258. REVISED SYNONYMY.

Type species: *Semiothisa octolineata* Hulst, 1887, *Ent. Americana*, **2**: 190, by original designation.

This is a small genus of about 10 known species concentrated in arid regions of Mexico and Central America, but with four of them extending into the southwestern United States, and a few in South America. Our species live mainly in the well vegetated canyons of semi-arid mountain ranges at elevations of around 5,000–7,000 feet. The moths are characterized by the following combination of features: wings generally pale, pale yellowish or cream colored to light violaceous brown, with four subparallel transverse bands on forewing, one or two of which may be obsolete; bands may or may not expand to form dark spots at costa; extramedial spots characteristic of many macariine species absent; fovea absent; palpi very short; male antenna fasciculate, with fairly long setae; female antennae simple; male hindtibia enlarged; pecten of third abdomi-

nal sternum present in most (including type species), although absent in *mendicata*; male eighth sternum not incised; male genitalia of the most classic cassymine type, with costal lobe of valve spinelike with sicklelike curvature; signum of female bilaterally symmetrical with a pair of large conical processes (*octolineata*, *mendicata*), or stellate but radially asymmetrical (*tenebrosata*); larva, as described below for *tenebrosata*, distinctive in form, and with the crochets in two groups; pupa even more unusual, with what appear to be two very large, modified, thoracic spiracles, unlike any noted elsewhere (see species description); pupa without a dorsal groove and with cremastral process elongate, tapered, minutely bifurcate at tip. The early stages are known only for *tenebrosata*, which feeds on fairy duster, (*Calliandra* sp.), a low, woody-stemmed, Arizona legume (Fabaceae) with pinnately compound leaves.

The male genitalia of all species examined are very similar, showing only minor differences. The female genitalia are less consistent and appear to be of two types, one having large, lateral, conical or hornlike processes on the signum and a small shallow ostial cavity (text figure 7 c), the other a more normal signum but ovate, radially asymmetrical, with all the radiating points grouped toward the posterior side, and a much larger, deeper ostial cavity (*tenebrosata*). The larva and pupa are known only for *tenebrosata* and are described under that species. It has extraordinary pupal characters that I have not seen elsewhere.

In addition to the four species treated in this monograph, the genus includes *Acidalia odrussa* Druce, 1892 (Mexico, Guatemala, Costa Rica); *Thamnonoma punctolineata* Dognin, 1902 (Ecuador); *Physostegania melanorrhoea* Dyar, 1913 (Mexico); *Taeniogramma costimacula* Dognin, 1913 (Panama); and *Isochromodes lineata* Dognin, 1913 (Colombia). *Diastictis paulensis* Schaus, 1901 from São Paulo, Brazil is also a species of *Taeniogramma* according to the genitalia of the male holotype. *Taeniogramma lineata* may be the same species as *Tephrinopsis atomosaria* Warren, 1907. There is one undescribed species in Mexico and doubtless others that I have not recognized as belonging to this genus. *Tephrina albisepta* Warren, 1906 (Mexico); *Tephrinopsis coniararia* Dyar, 1913 (Mexico); and *Tephrina submarcata* Schaus, 1898 (Castro, Parana, Brazil) are probable synonyms of *Taenio-*

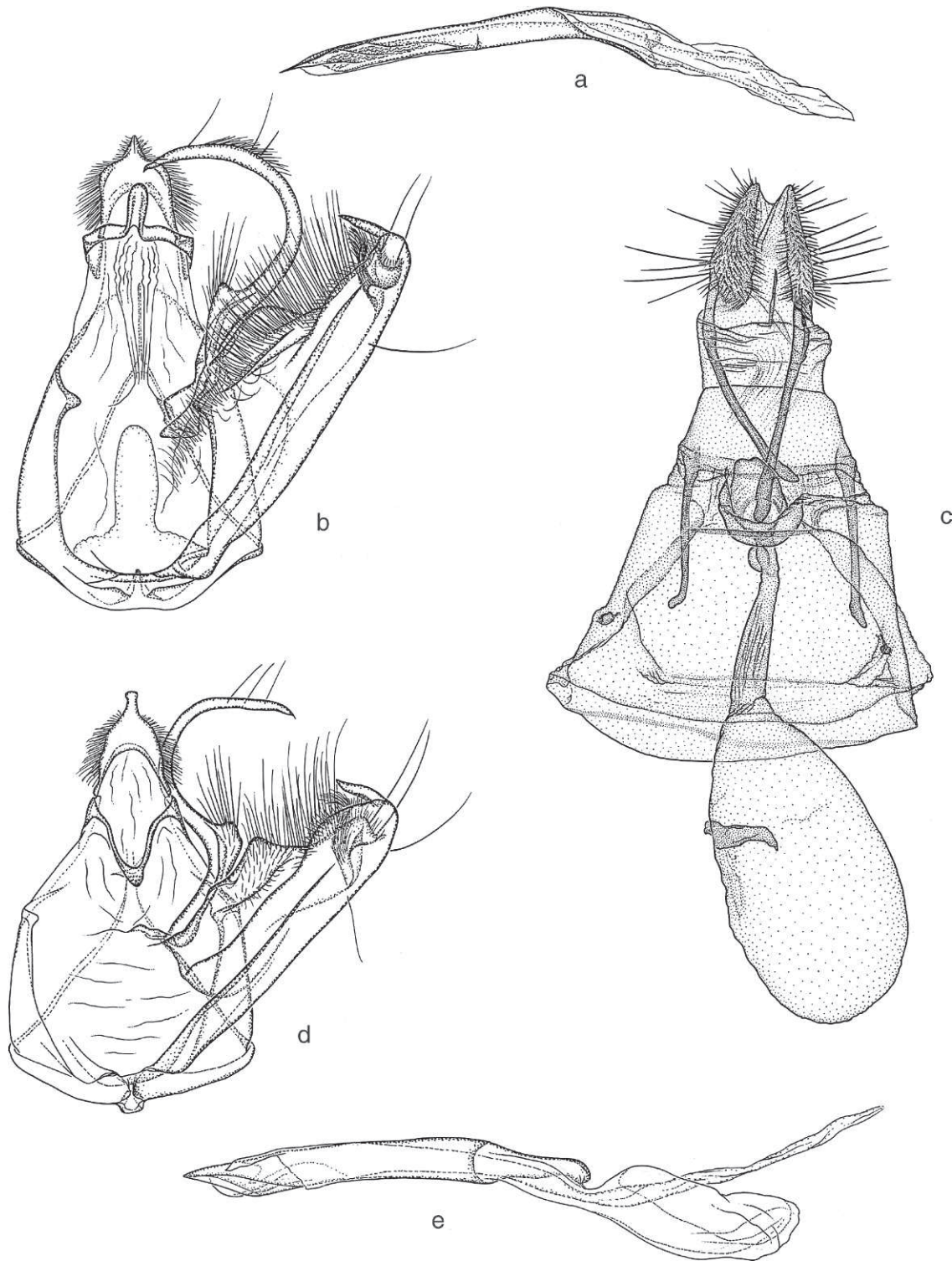


FIGURE 7: GENITAL FEATURES OF SPECIES OF *TAENIOGRAMMA*
a. T. quadrilinea, male genital capsule; Lizard Head Pass, San Miguel/Dolores County line, Colorado (USNM 56115); *b. aedeagus*; Orizaba, Mexico (USNM 56885). *c. T. tenebrosata*, male genital capsule; Superstition Mts., Maricopa County, Arizona (USNM 53368); *d. aedeagus* (USNM 53368). *e. T. mendicata*, female genitalia; Arizona (USNM 57374).

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gramma odrussa. The types of all of the above names except those of Warren are in the USNM; and all of the above names except *costimacula* and *odrussa* (see Scoble et al., 1999: 921) are NEW COMBINATIONS with *Taeniogramma*.

KEY TO SPECIES OF *TAENIOGRAMMA* THAT OCCUR IN THE UNITED STATES

1. Fringe on outer margin of forewing bicolored; subapical half dark brown, remainder neutral. 2–4 small dark spots where transverse lines meet costa; transverse lines continuous, not formed of separate dots *octolineata*
p. 36
- Fringe on forewing not noticeably bicolored; small brown spots on costa absent or, if one or two are present, postmedial line of forewing consisting of a series of small dark dots 2
2. Greatest diameter of male hindtibia much less than length of longest hindtibial spur; forewing with no transverse lines other than the postmedial, which consists of a series of dark dots ...
..... *mendicata*
p. 37
- Greatest diameter of male hindtibia about equal to length of longest hindtibial spur; forewing with 2–4 transverse lines, which may be distinct to faint 3
3. Fore- and hindwing colored nearly alike, light yellowish brown with equally distinct, nearly straight, parallel brown lines, 4 on forewing, 3 on hindwing *quadrilinea*
p. 36
- Fore- and hindwing different; forewing gray with 1–4 faint, slightly waved, transverse lines; hindwing paler, with one curved line or none
..... *tenebrosata*
p. 38

Taeniogramma quadrilinea (Schaus),
NEW COMBINATION

PL. 1, FIG. 16 (adult); TEXT FIG. 7 *a, b* (♂
gen.) (RWH 6359).

Cataspilates quadrilinea Schaus, 1901,
Trans. Amer. Ent. Soc., **27**: 170.

Type locality: Orizaba, Mexico. [USNM]

Macaria quadrifasciata Taylor, 1906, *Ent.*
News, **17**: 190. NEW SYNONYMY.

Type locality: Cochise County, Arizona.
[USNM]

This species, one of the largest members of the genus and the largest in the United States, was not recognized by McDunnough as belonging to

his new genus *Prophasiane* and was listed as *Semiothisa quadrifasciata* in the 1938 check list. Before seeing the genitalia, I followed McDunnough and made the same mistake in the check list of 1983. *Taeniogramma quadrilinea* is easily recognized by its cream-colored to pale brown wings, finely and evenly granulated with brown, and crossed by regular, nearly straight and parallel brown lines, four on the forewing and three on the hindwing. The pattern is reproduced beneath with only slightly reduced intensity. The transverse lines of the forewing are antemedial, medial, postmedial, and subterminal; on the hindwing it is probably the antemedial that is missing. Wing length: males, 19–22 mm. Female unknown.

Male genitalia (text figure 7 *a, b*) differ only slightly from those of other members of the genus that occur in Arizona, as may be seen, for example, in the shape of certain components of the valve and the prominently knobbed process on the uncus.

Nothing is known of the early stages.

This is a rare species in the United States. I have seen only three specimens from Arizona, labeled as follows: Cochise Co., Arizona, 8 July 1904 (holotype of *quadrifasciata*); Sunnyside, W side Huachuca Mountains, Cochise Co., Arizona, 10 July 1958, L. M. Martin (LACM); Sunnyside Canyon, Huachuca Mountains, 5,500', Arizona, 23 July 1982, R. Weich (Weich Coll., Tucson). More have been collected in Mexico, and I have seen the following: 1.1 road mi W of El Palmito, 6,700', Sinaloa, Mexico, 26 Aug. 1976, J. P. and K. E. Donahue (LACM) (1); Orizaba, Mexico, Coll. Wm. Schaus (Type of *quadrilinea*); Zacualpan, Mex., 11 Nov., R. Müller (USNM) (1); Mexico City, June 1919, Dognin Coll. (USNM) (1); Arroyo los Mimbres, 2,200 m, Mpio., Durango, Mexico, 14–20 Aug. 1984, E. C. Welling (AMNH) (42).

Taeniogramma octolineata (Hulst), NEW
COMBINATION

PL. 1, FIGS. 17–19 (adult); TEXT FIG. 1 *a*
(venation) (RWH 6423).

Semiothisa octolineata Hulst, 1887, *Ent.*
Americana, **2**: 190.

Type locality: Arizona. [USNM]

NOTE—The holotype is a male, without abdomen, from the Neumögen collection. It was described from one specimen.

Taeniogramma octolineata is a common, pale brown, Arizona species that may be recognized by the four regular, almost evenly spaced, nearly parallel lines crossing the forewing at right angles to the inner margin, and by a contrasting, dark-brown fringe marking the anterior half of the outer margin of the forewing. Sometimes one or more of the transverse lines may have faded out, but the unusual fringe, half dark and half light, is unique.

Wing color off-white, finely dusted with brown, giving a yellowish-brown effect; transverse lines of forewing, consisting of antemedial, medial, postmedial, and subterminal, grayish brown, thin, often slightly irregular, and with medial and postmedial often angling slightly inward near costa; hindwing with three convex, similarly parallel lines; subterminal may be a diffuse, smoky-brown band rather than a discrete line, but this is variable. As well as the half-dark fringe, already described, forewing may have three or four small dark spots marking points where lines meet costa. Undersurface of both wings strongly yellowish, with most markings repeated somewhat more boldly in light reddish brown. Underside of forewing, as on hindwing above and beneath, traversed by three rather than four bands. Scales of head and patagia somewhat ochreous. Body and legs concolorous with ground color of wings; front light reddish brown, paler toward ventral margin. Wing length: males, 9–11 mm; females, 9–13 mm.

Male genitalia extremely similar among the four species that occur in the southwestern United States. Uncus conical in outline in *octolineata* and *mendicata*, terminally papillate in other species; gnathos broadly scoop shaped in *octolineata*, narrowly so in *tenebrosata*, much elongated at the end in *mendicata* and *quadrilinea*.

Female genitalia with ductus bursae longer than corpus bursae, unlike those of other species. Signum with a papillate exterior aperture and variably flanged interior base that may be simply funnellike or shaped like a fish tail, with divergent, pointed, internal processes.

Early stages unknown.

This species seems limited to southern Arizona, where, in its season, it may be one of the most abundant moths at light in the mountains and canyons of Cochise, Santa Cruz, and Pima counties. It occurs mainly in the oak-manzanita zone, but I collected one much higher in the pine-Douglas-fir zone at 7,800 feet in the Santa Catalina Moun-

tains. It flies in July, August, and September, with most records for August. I examined a total of about 250 specimens, of which almost half are from Madera Canyon, Santa Rita Mountains, but saw probably as many more while collecting in the Huachuca Mountains in August 1991.

Taeniogramma mendicata (Hulst), NEW COMBINATION

PL. 1, FIGS. 20, 21 (adult); TEXT FIG. 7 e (♀ gen.) (RWH 6424).

Semiothisa mendicata Hulst, 1887, *Ent. Americana*, 2: 189.

Type locality: Prescott, Arizona. [USNM]

NOTE—Described from two males and nine females from Arizona in the Graef, Neumögen, and Hulst collections. I designate as lectotype a male from the B. Neumögen collection in the USNM, labeled “Prescott, Ariz.” It is in good condition except for a partly water-stained left hindwing, and antennae with the tips broken off. Two of the female syntypes are also in the USNM, and one is in the AMNH. Another female “type” in the USNM is labeled “Mont.” [Montana], a false locality.

Taeniogramma mendicata is a plain, pale yellowish-brown southwestern species in which the forewing is powdered with blackish scales and marked only by a weak, regularly curved, postmedial line that consists of little more than a series of faint dark dots. A small, dark, discal spot may also be present. The fringe is unmarked, unlike that of *octolineata*. Antemedial and postmedial lines are wanting. This species might be confused with *T. tenebrosata* of the same region, but *tenebrosata* is larger, less powdery in appearance, and somewhat differently colored, with a pale, lilac-gray forewing bearing up to three faint but continuous, gray-brown, transverse lines (not series of dots) and a faint discal spot, or none. In *mendicata* the fore- and hindwings have nearly the same pale yellowish-brown color, but in *tenebrosata* the light violaceous forewing differs noticeably from the pale-gray to whitish hindwing. The undersides of both wings of *mendicata* are strongly ochreous tinted; those of *tenebrosata* only slightly so; and the scales of the head, patagia, tegulae, and forelegs may in large part be light ochreous orange, contrasting with the pale-gray thorax. *Taeniogramma mendicata* also differs from its near relatives in having an only slightly thickened male hindtibia, the diameter of which is much less than the length of the longest hindtibial spur; whereas the width of the greatly

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swollen hindtibiae of *tenebrosata*, *octolineata*, and *quadrilinea* more nearly equals the length of the corresponding spur in each species. Wing length: males, 10–13 mm; females, 10–13 mm. Twelve mm is about average for both sexes.

The male genitalia do not differ greatly from those of *octolineata* but are a little less elongated overall, and they have a unique terminal process on the gnathos, fully as long as the gnathal arms and much longer than the corresponding process of *octolineata* and *tenebrosata*. Those two species have a very short, scooplike process much shorter than the gnathal arms, and the latter differs further in having an extended, nipplelike process on the uncus that is not developed in *mendicata*.

The female genitalia (text figure 7 *e*) have a sterigma consisting of an ovoid, somewhat elongated, sclerotized backplate extending rearward farther than the posterior edge of the eighth tergum and shallowly notched distally; the medium-sized ostial pouch is one-half as wide as an anterior apophysis is long; and the variable signum may not be reliable for separating species. *T. octolineata* has a smaller backplate not surpassing the posterior edge of the eighth tergum, and a smaller, shallower ostial pouch; whereas *tenebrosata* has no backplate but has a large ostial pouch equal in width to the length of an anterior apophysis.

The early stages and hosts of *mendicata* are not known.

This species occurs in the mountains and canyons of southern Arizona and southern New Mexico, and northward to Las Vegas, New Mexico (if the specimens are correctly labeled), and in the Davis and Chisos Mountains, Texas. Most specimens examined were from Madera Canyon, Santa Cruz County, and from various localities in Cochise County, Arizona. It is not known from Mexico but must occur there. The apparent flight period is from early June to early September, except for one record for 6 May from Big Bend National Park. About 150 specimens were examined.

Rare, unusually pale variants of *Chloraspilates minima* (Hulst) (Caberini) may closely resemble *Taeniogramma mendicata* but are easily distinguished by their pectinate rather than ciliate male antennae, unswollen hindtibiae in both sexes, and scaled gena in females.

Taeniogramma tenebrosata (Hulst), NEW COMBINATION

PL. 1, FIGS. 22, 23 (adult); PL. 9, FIG. 2 (larva); TEXT FIG. 1 *b* (venation); TEXT FIG. 7 *c, d* (♂ gen.) (RWH 6425).

Semiothisa tenebrosata Hulst, 1887, *Ent. Americana*, 2: 189.

Type locality: Arizona. [USNM]

NOTE—Described from five males and five females in the collections of Holland (CMNH), Graef (USNM), Neumögen (USNM), and Hulst (AMNH). Four of the syntypes are in the collection of the USNM, and I hereby designate one of them as lectotype. It is a male, in good condition except for a small chip out of the outer margin of the right hindwing, and labeled Arizona/Col. B. Neumögen/Collection Brkln Mus/ Type No. 34230 U.S.N.M./*Semiothisa tenebrosata* Type Hulst. A lectotype label has been added.

Diastictis lamitaria Dyar, 1913, *Proc. U. S. Natl. Mus.*, 44: 313. NEW SYNONYMY.

Type locality: Cerritos, San Luis Potosi, Mexico. [USNM]

Taeniogramma tenebrosata is a plain, faintly marked species, larger than *octolineata* or *mendicata*, with the fore- and hindwing somewhat differently colored. The forewing is pale ash gray with a faint lilac or violaceous tint; the hindwing is paler, and brownish or yellowish white tinged with gray. The forewing has two to four slightly irregular but nearly parallel, thin, transverse, grayish-brown lines perpendicular to the inner margin, and the hindwing has usually no more than one such line, which is more likely to be curved. A faint discal spot may be present on the forewing but is more often absent. The unicolorous fringes are unmarked. The postmedial line of the forewing, like the other transverse lines, is continuous, not comprised of a series of fine black dots as in *mendicata*. The underside is ochreous tinted, but usually slightly so, and is marked with one transverse line (postmedial) on each wing. The scales of the head, patagia, tegulae, and to some extent the forelegs, are ochreous orange to reddish brown, contrasting sharply with the gray thorax. *Taeniogramma tenebrosata*, unlike *mendicata*, has the male hindtibia fully enlarged to a thickness about equal to the length of the longest hindtibial spur. Wing length: males, 12–15 mm; females, 12–15 mm; average about 14 mm for both sexes.

The male genitalia (text figure 7 *c, d*) may be

recognized by the somewhat elongated, nipple-like process on the uncus (tapered to a short, usually blunt point in other species), and the short, scooplike terminal process on the gnathos, clearly shorter than the gnathal arms, resembling that of *octolineata* but unlike the others.

The female genitalia are characterized by an unusually large and deep ostial pouch equal in width to the length of an anterior apophysis, and with no or little indication of the presence a sclerotized backplate behind the ostium, a feature conspicuous in *octolineata* and especially in *mendicata*.

The larvae (plate 9, figure 2) sometimes occur abundantly in September–October on fairy duster, *Calliandra eriophylla* Benth. (Fabaceae), a low, shrubby legume. Those described below were collected in Ash Canyon, Huachuca Mountains, near Hereford, Cochise County, Arizona by N. McFarland, who kindly provided live specimens. The larva is a cryptic, gray-brown twig or stick mimic that does not resemble the upper twigs or foliage of the food plant very well, but which probably rests near the base of the plant or on the ground when not feeding. Swollen soft tissue bearing thoracic legs thickening progressively from T1 to T3 so that body appears raised or humped where thoracic and abdominal segments meet; humped appearance accentuated by greater depth of metathorax and abrupt reduction in thickness (depth) of A1 at that point; thoracic segments just above legs appearing curiously swollen and with deep folds laterally and ventrally, into which bases of thoracic legs may appear to be telescoped or recessed. This arrangement is normal in geometrid larvae except that the magnitude of the soft-tissue leg base is exaggerated in *T. tenebrosata*, especially on T2–T3. Abdomen cylindrical, of uniform thickness from T1 to posterior end, about as thick as T2. Humped or angular appearance again accentuated near caudal end where, just above spiracle of A8, the body abruptly tapers off toward anal prolegs in the manner of many noctuid larvae.

Head boldly marbled with dark brown and pinkish white; body with dorsum gray brown, finely marked with intricate reticulations of a darker shade; a fine, much fragmented, white dorsolateral stripe from head to A7 may be present; ventral area paler, white or faintly pinkish, also with a dense, fine, intricate pattern of thin lines and spots; lateral line separating darker dorsal and paler ventral areas conspicuously undulating

to crenulate from T3 to A5 or A6, rising to surround small black spiracles with whitish, but dipping well below level of spiracles intersegmentally; lateral fold much less crenulate but not straight, whitish or pale pinkish, but light reddish brown in posterior half of each segment; white lateral stripe continuous on A6–A7. Thorax similarly colored but with a much larger rusty-brown lateral patch on meso- and metathorax, and a short, wavy, oblique black band laterally between spiracle and leg on metathorax. Thoracic legs mostly dark brown; prolegs gray or gray brown with pale lateral stripes. Length: 21 mm.

The pupa is peculiar in having some extraordinary characters that I have not seen before. Color light brown; wings smooth; body pitted; callosity well developed; cremaster long, slender, without lateral setae but bifid or sometimes trifid at the end. The pupa (5 specimens in alcohol) has what appear to be very unusual spiraclelike openings, not normally present in other species. One of these is a kidney-shaped opening in the corner of the mesothorax where its posterior margin meets the wing. The other is an enormous and complex opening or vent of the order of $10 \times$ the size of the callosity straddling the line between the metathorax and first abdominal segment at the wing margin. It is transversely partitioned down the middle as though one half served each segment; and each half is set with additional sclerotized plates or partitions arranged longitudinally.

Taeniogramma tenebrosata is known only from Arizona, New Mexico (near Silver City, Grant County), southern California, and Mexico (type of *lamitaria* Dyar). I have seen about 175 specimens from the Chiricahua, Huachuca, Dragoon, Santa Catalina, Santa Rita, and Baboquivari Mountains, all in southern Arizona, and from Mint Canyon, Los Angeles County, California. The data indicate a long flight period from 25 March to 10 October, which undoubtedly represents multiple broods.

GENUS

Protitame McDunnough

Protitame McDunnough, 1939, *Can. Ent.*, **71**: 257.

Type species: *Cymatophora matilda* Dyar, 1904, *Proc. U. S. Natl. Mus.*, **27**: 907, by original designation.

NOTE—*Cymatophora matilda* is herein relegated to the synonymy of *Protitame subalbaria* (Packard).

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Sperrya Rindge, 1958, *Amer. Mus. Novit.*, No. **1,854**: 6. NEW SYNONYMY.

Type species: *Sperrya cervula* Rindge, 1958, *Amer. Mus. Novit.*, No. **1,854**: 6.

This is a strange North American genus of uncertain relationship and only three species, probably all associated with Salicaceae. Their several curious features include bipectinate male antennae whose branches are not only devoid of scales, but arise from near the base of each antennal segment rather than from near the distal end as in other genera of the tribe; widely separated chaetosemata rather than the transversely elongated type prevalent in the Macariini; very short labial palpi; and peculiar male genitalia.

Forbes (1948: 36) assigned *Protitame* to the tribe Abraxini, followed by McGuffin (1972: 10) and by me (1983), but I have since concluded that this genus belongs neither there nor in the Macariini. The valve of *Protitame* has the slender, hooklike type of costal lobe characteristic of many Cassymini, but also found in the type species of *Semiothisa* (*S. gambaria* Hübner). That resemblance is probably a result of convergence because *Semiothisa* is otherwise typically macariine. I here refer *Protitame* and *Taeniogramma* to the mainly Old World tribe Cassymini, as explained above in the discussion of that tribe.

Chaetosemata separate, not extended toward each other behind the head, as in most Macariini. Male antenna bipectinate, with short, setose but unscaled branches that arise from near proximal end of each antennae segment; female antenna simple. Front smooth scaled, rounded, not protruberant. Palpi very short, not reaching front. Tongue moderately developed, about like that of *Speranza* species. Hindtibia slightly clavate, but without a groove or hair pencil. Male abdomen without a pecten on the third abdominal sternum and without a medial incision in the posterior margin of the eighth sternum.

Male genitalia with triangular uncus, in which the produced apex is truncated and bears two small points suggestive of, but probably not homologous with, the "horns" of the usual macariine uncus; no modified setae on uncus; gnathos a complete, simple ring with distal end flattened and slightly spatulate; valve of the cassymini type, with the costal lobe cylindrical and hooklike, being bent at right angles just beyond middle; saccular lobe simple, triangular, produced and tapered outwardly to an almost pointed apex;

juxta wider than long; knoblike saccus bent backward (actually anterodorsally). Vesica always with one long, slender, tapered cornutus, and with or without a separate cluster of smaller cornuti.

Female genitalia distinctive, with a long, subcylindrical, sclerotized, longitudinally rugose "neck" on bursa copulatrix; a semi-globose, membranous corpus bursae with a round signum bearing a ring of sharp, inwardly directed points; and a very simple sterigma.

Larva, insofar as known, plain, cylindrical, usually green with a brown dorsum, but with the proportion of brown to green variable, even within the same species, and larvae sometimes may be entirely brown. Pupa with dorsal groove between segments A9 and A10; callosities apparently absent; prothoracic tibia not exposed; and cremastral process long and slender, minutely bifurcate at tip.

KEY TO SPECIES OF *PROTITAME*

1. Wings white or cream colored, with or without postmedial bands; male vesica with one long cornutus and a separate group of 5–6 smaller ones; transcontinental 2
- Wings brown to ivory, with distinct postmedial bands; male vesica with one long cornutus only; Arizona *cervula*
p. 45
2. Wings white or nearly so, sprinkled with a few blackish scales; without postmedial bands but sometimes (in Midwest and southern Plains) with blackish submarginal shading; transcontinental, but not in Pacific Coast states of U.S. *virginalis*
p. 40
- Wings cream colored, not sprinkled with blackish scales; postmedial band thin, gray, regular, distinct; matching antemedial and medial bands present or absent; in or west of Rocky Mts. only, Canada to Baja California *subalbaria*
p. 44

Protitame virginalis (Hulst)

PL. 1, FIGS. 24–26 (adult); PL. 9, FIGS. 3, 4 (larva); TEXT FIG. 1 *c* (venation); TEXT FIG. 8 *a–c*, *e* (♂ gen.); TEXT FIG. 9 *a* (♀ gen.) (RWH 6267–6270).

Cymatophora subalbaria Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 333. HOMONYM.
Type locality: Colorado. [AMNH]

NOTE—*Cymatophora subalbaria* Hulst, 1896 is a junior secondary homonym of *Acidalia subalbaria* Packard, 1873.

Cymatophora virginalis Hulst, 1900, *Jour. New York Ent. Soc.*, **8**: 218.

Type locality: Newark, New Jersey. [AMNH]

NOTE—Described from at least two specimens from Newark, New Jersey and Webster, New Hampshire. The only type found is a worn male from Newark, N.J. in the AMNH, and I designate this specimen as the lectotype.

Diastictis hulstiarum Taylor, 1906, *Can. Ent.*, **38**: 112.

Type locality: Colorado. [AMNH]

NOTE—*Diastictis hulstiarum* Taylor, 1906 was proposed as a replacement name for *Cymatophora subalbaria* Hulst, 1896, when that taxon was moved to the same genus (*Diastictis* Hübner [1823]) as *Acidalia subalbaria* Packard, 1873. Now that both are in the genus *Protitame*, *subalbaria* Hulst remains a junior secondary homonym of *subalbaria* Packard, as well as a junior synonym of *virginalis*. *Diastictis hulstiarum* Taylor has the same type specimen as *C. subalbaria* Hulst.

Protitame discalis McDunnough, 1939, *Can. Ent.*, **71**: 257. NEW SYNONYMY.

Type locality: Okemah [Okfuskee County], Oklahoma. [CNC]

Protitame albescens McDunnough, 1939, *Can. Ent.*, **71**: 258. NEW SYNONYMY.

Type locality: Taloga [Dewey County], Oklahoma. [CNC]

This is a nearly all-white or faintly cream-colored moth, lightly dusted with brown or gray scales, and sometimes with a yellowish to dark brown, somewhat irregular subterminal band on both wings, as well as dark discal spots. Specimens with well-defined markings occur mainly across the central and southern Great Plains Region and Gulf States. *Protitame virginalis* in its common, unmarked form could be mistaken for a smaller version of *Cabera variolaria* Guenée, but males of the latter species have their longest antennal branches longer than the width of the front (shorter in *P. virginalis*); labial palpi that are about as long in both sexes as the height of the front (also shorter in *virginalis*); and light rust-brown front, palpi, and forelegs. *Protitame virginalis* also superficially resembles *Lomographa vestaliata* (Guenée), but *vestaliata* is pure white and lacks the dusting of dark scales. *Protitame virginalis* is nearly transcontinental across southern Canada but seems to occur southward only to Maryland and Virginia on the East Coast, but elsewhere to

northwestern Florida, Mississippi, Louisiana, northern Texas, and the mountains of New Mexico and Arizona.

The body and wings are almost entirely white to pale cream, except for the slight dusting of dark scales and the variable markings mentioned above. However, the legs may be light brownish, and the inner sides of the forelegs and upper third of the front are dark brown. The underside of the forewing may have the costa dark shaded toward the base, especially in specimens from the mountains of Colorado, Utah and southward. Wing length: eastern, midwestern, and Canadian specimens, males, 9–13 mm; females, 10–12 mm; Rocky Mountain specimens, males, 12–15 mm; females, 12–14 mm.

In some specimens the wings may be variably marked with an irregular, dark, subterminal band parallel to the outer margins on one or both wings, and occasionally also with dark discal spots and a similarly dark or light brownish antemedial band on the forewing. Specimens so marked are known mainly from the central United States between the Appalachian and Rocky Mountains, beginning with a small proportion in Ohio or even farther east (one such example from Maine in the USNM), and continuing through Illinois, Iowa, Nebraska, and as far west as Washington County, Colorado. This form becomes increasingly prevalent southward to the Gulf States and the Oklahoma-Texas boundary region. The name *discalis* McDunnough, with *albescens* McDunnough as a synonym, could be applied in a subspecific sense to these specimens with dusky markings. It may not be a satisfactory subspecies, however, inasmuch as its distinguishing features are clinal eastward (although seemingly abrupt at the interface between the plains and the mountains in Colorado). The form named *albescens* differs from *discalis* only in that the dusky transverse bands are slightly crenulated and sometimes double. Western specimens from within the Rocky Mountain region never have dark markings but resemble northeastern ones almost exactly, except for a tendency toward larger size in the region between Colorado and Arizona. This Rocky Mountain form was formerly considered a distinct species, *P. hulstiarum* (Taylor). I have not discounted the possibility that more than one species is represented among these regional forms, but found no satisfactory way to demonstrate it.

The male genitalia (text figure 8 *a–c*, *e*), although showing some variation in the shape of

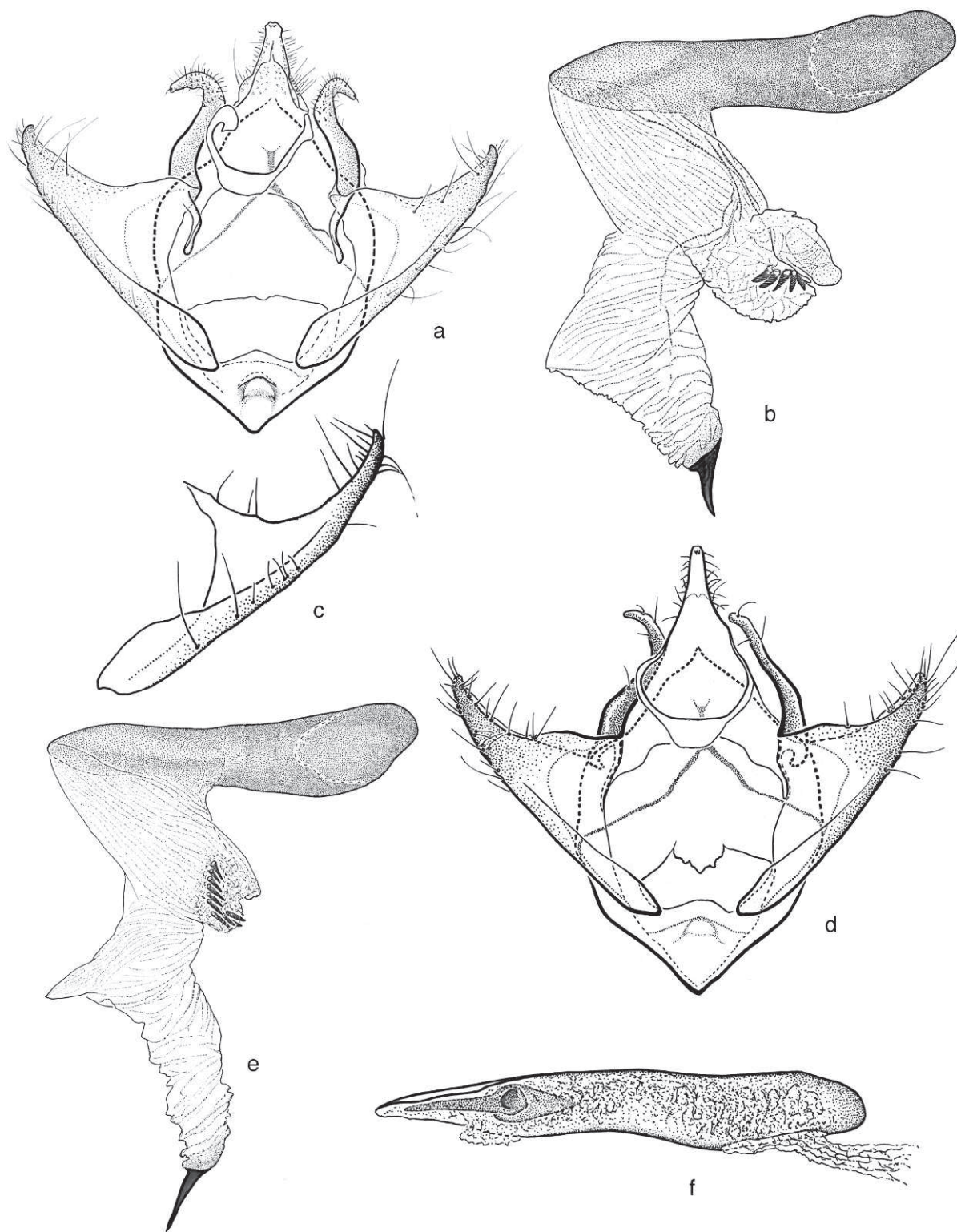
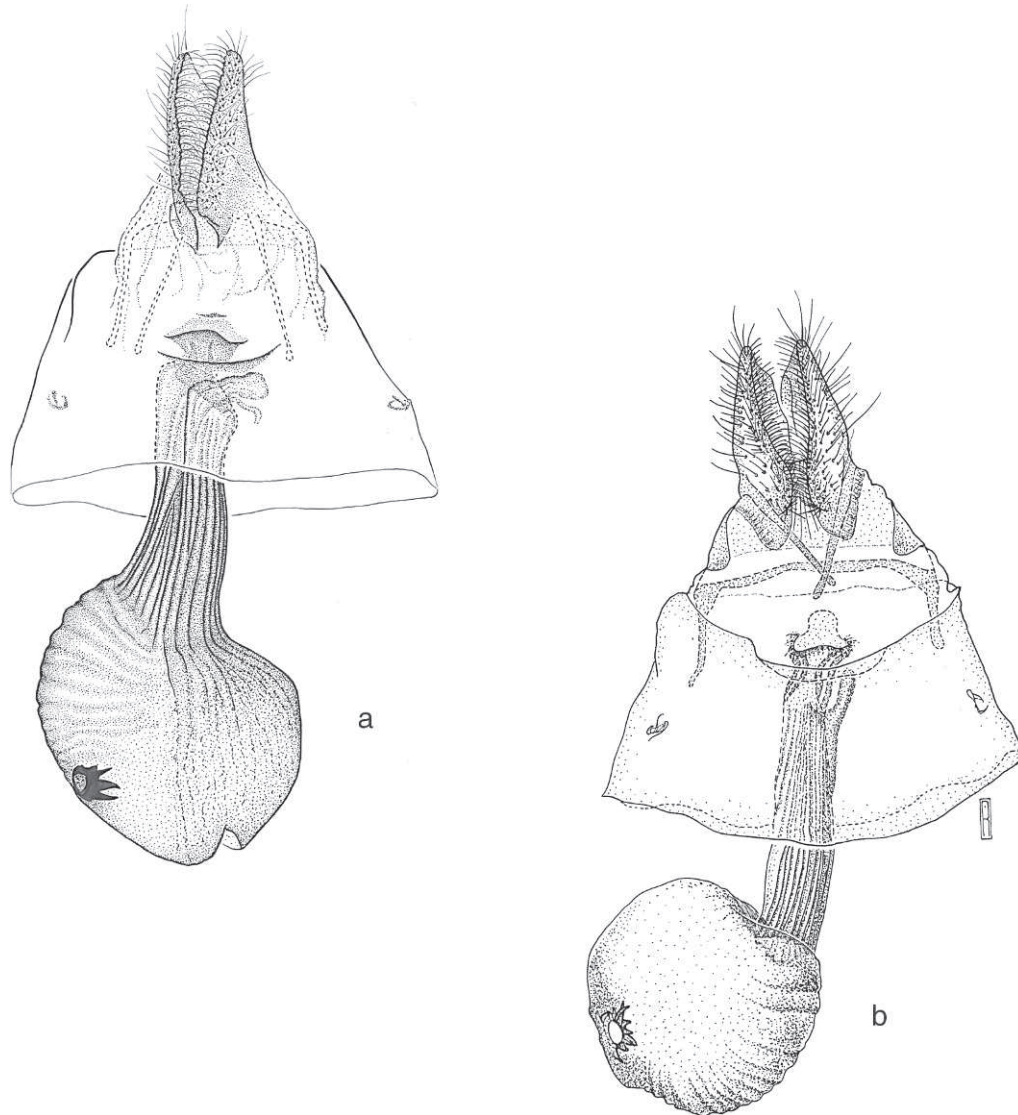


FIGURE 8: MALE GENITALIA OF *PROTITAME* SPECIES

a. P. virginalis, genital capsule; Fort Niobrara, Cherry County, Nebraska (USNM 57435); *b. right valva*; Lake Kejimkujik, Nova Scotia (USNM 57429); *c. aedeagus*; Fort Niobrara, Cherry County, Nebraska (USNM 57435); *d. aedeagus*; Lake Kejimkujik, Nova Scotia (USNM 57429). *e. P. cervula*, aedeagus; Cochise County, Arizona (USNM 57372).

FIGURE 9: FEMALE GENITALIA OF *PROTITAME* SPECIES

the valve, as illustrated, and in the length of the single large cornutus, are otherwise uniform throughout the wide range of the species, and they do not differ appreciably from those of *subalbaria*. The female genitalia (text figure 9 a), which show little variation, have a relatively short, rugose "neck" region on the bursa copulatrix, no longer than the corpus bursae. They differ in this respect from the female genitalia of *P. subalbaria*, in which the neck region is distinctly longer than the corpus bursae.

My reared larvae from Nova Scotia (plate 9, figures 3, 4) varied from light green with a broad chocolate-brown dorsal stripe to all brown with a darker brown dorsum. The dorsal stripe occupied

the entire dorsal area and was diffuse at the edges. Head light brown, darker on top. The larva of *Protitame subalbaria* differs in being more often mostly green with the dorsal stripe narrower, reduced, or absent, and more sharply defined at the edges if present. Legs generally concolorous with adjoining parts of body in both species.

The larva was also described briefly by Forbes (1948: 36), McGuffin (1972: 11), and in more detail by Wagner et al. (2001: 28). According to Forbes, the last instar is chocolate brown, with a broad, diffuse, middorsal stripe and red-brown head (not the usual form). As described by McGuffin, it is 15–20 mm long and light green with a red to brown middorsal stripe; a green

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head with russet markings; and light brown legs. The descriptions by McGuffin and Wagner et al. agree with larvae reared from Nova Scotia but without mention of the all-brown form.

The most commonly reported hosts for *virginialis* are the two species of aspen, *Populus tremuloides* Michx. and *P. grandidentata* Michx. The Canadian Forest Insect Survey (Prentice et al., 1963: 427–428) reported 166 collections from aspen, mostly from *P. tremuloides*, as well as 28 collections from *P. balsamifera* Linnaeus, five from “Carolina poplar,” and 10 collections from willow, *Salix* sp. (all Salicaceae). Of the many reared specimens in the CNC, however, I found none from willow. Although Forbes (1948) noted that larvae reared [from eggs] by L. R. Rupert refused *Populus deltoides* Bartr., this and other species of poplars or cottonwoods, and willows, would be the expected alternate hosts in southern parts of the range of *P. virginialis* where aspens are absent.

Protitame virginialis occurs across Canada from Nova Scotia to Vancouver, British Columbia, and northward to Gillam, Manitoba; Yellowknife, at Great Slave Lake and Fort Smith, Northwest Territories; and almost to the Yukon border in British Columbia. It occurs southward to Maryland, Virginia, Ohio, Illinois, Missouri, Iowa, Nebraska, South Dakota, and, surprisingly, much farther southward just west of the Appalachians, reaching Liberty County, Florida, Louisiana, Mississippi, Oklahoma, and Hemphill County, Texas as the dark marked forms described as *albescens* and *discahis*. In the West it occurs in the mountains southward through Colorado and Utah (7,800'–8,850') to New Mexico (“Rincon”), and to the White Mountains, Apache County; Hannagan’s Meadow, Greenlee County; Mt. Graham, Graham County (7,300'); and near Flagstaff, Coconino County (6,500'), Arizona. It is not known from the Pacific Coast south of British Columbia but apparently overlaps with *P. subalbaria* in British Columbia, Idaho, Montana, and Utah. I collected both in the same place on the same night, 25 June 1979, in Bonner County, Idaho.

The flight period in Nova Scotia is 14 May–27 August (n = 27), and all available eastern records fall within those dates; for example, Maine: 15 June–August 20 (n = 23); New York, 23 May–2 August (n = 45); Maryland, Virginia: 26 May–13 August (n = 5). It appears as early as April in Illinois and flies March–September in

Louisiana, with an apparent break between broods in July (V. A. Brou, in litt.). Throughout the Rocky Mountain region and the northern plains the flight period is more compressed, 15 June–28 July (n = 90), but as early as 26 May in Arizona. Such a spread of dates would seem to indicate one or two broods in the North, two or more broods in the southern Midwest, and one brood in the Rocky Mountains. Late specimens are uncommon and may represent a partial second brood.

Protitame subalbaria (Packard)

PL. 1, FIGS. 27, 28 (adult); PL. 9, FIG. 5 (larva) (RWH 6265, 6266, 6271).

Acidalia subalbaria Packard, 1873, *Proc. Boston Soc. Nat. Hist.*, **16**: 28.

Type locality: California. [MCZ]

Cymatophora matilda Dyar, 1904, *Proc. U. S. Natl. Mus.*, **27**: 907. NEW SYNONYMY.

Type locality: Kaslo, British Columbia. [USNM]

NOTE—Described from 20 specimens from the “Kootenai District,” British Columbia, although the labels on the specimens give “Kaslo” or “Kaslo Cr.” Five specimens of the type series bear red USNM type labels, and I designate as lectotype the only one of these that is in good condition. It is labeled: “vi 10/1916” [in pencil]/ Kaslo Cr., BC/HG Dyar, Collector/Type 7880 U.S.N.M. [red label], and I have added a lectotype label. The lectotype is a female, to which the abdomen has been glued.

Phasiane pallicolor Dyar, 1923, *Ins. Insc. Menstr.*, **11**: 23. NEW SYNONYMY.

Type locality: San Diego, California. [USNM]

This western species is larger than most *P. virginialis*, has a more yellowish tint, a fine, uniform dusting of gray or brown scales, and usually a thin, regular, gray or brownish postmedial line on both wings. The lines are quite close to the outer margins and nearly parallel to them. A straight to convex antemedial line is also frequently present on the forewing and sometimes on the hindwing, and one or more additional transverse lines may be present in the medial spaces of both wings, all nearly parallel to one another. Present also is a thin, regular, continuous, terminal line of the same color, before the unmarked, cream-colored or whitish fringes. Small, dark, discal spots are more likely to be apparent on the undersurfaces,

and the underside almost lacks the dusting of darker scales. It may have the same lines, but they are more blurred than on the upperside. Wing length: males, 12–14 mm; females, 10–14 mm.

The north-south geographical variation of *P. subalbaria* is that southern specimens are often smaller and more distinctly marked. This southern form was long regarded as a distinct species, *P. pallicolor* (Dyar), but the transition from northern or montane *subalbaria* to the southern *pallicolor* seems gradual and clinal. There are slight, inconsistent differences in the female genitalia, with southern females tending to have the rugose “neck” region of the bursa copulatrix slightly shorter, and the signum slightly smaller; but the overall size of the southern moths is also smaller.

The genitalia can hardly be seen to differ from those of *P. virginalis*; the males not at all, and the females only in the longer, more slender, rugose neck region of the bursa copulatrix. In *P. subalbaria* the “neck” on its shorter side nearly always decidedly surpasses the corpus bursae in length, which is not so in *virginalis*.

I reared *P. subalbaria* on trembling aspen, *Populus tremuloides* Michx. (Salicaceae), from a female collected on Lee Vining Creek, Mono County, California, 30 June 1987. The last instar larva (plate 9, figure 5) is light green, with a yellowish to light brown head. The entire dorsum may be reddish brown, forming a broad stripe that projects slightly onto the head; or the dorsal stripe may be reduced or wanting. When reduced, it becomes narrower anteriorly and may disappear first from the thoracic segments, while remaining prominent and becoming progressively wider posteriorly. The dorsal stripe is faintly edged with a diffuse, whitish, irregular, pale margin, and may be divided down the middle by a faint, pale, broken, middorsal line. The thoracic legs are green to light brown, and the prolegs are mostly green. The length at maturity is about 18 mm. The progeny of this brood partly emerged as a second generation in early August and partly overwintered as pupae to emerge the following April.

Dyar (1906) and McGuffin (1972: 10) also described the larva, slightly differently, based on material from western Canada. Larvae collected and reared by Brian Scaccia from a species of *Salix* in San Luis Obispo County, California (nine reared adults in USNM) apparently lacked the brown dorsal stripe but had faint, whitish, mid-

dorsal, subdorsal, and lateral stripes on the body, a darker brown head, and a pink supra-anal plate (from color photograph). Although most often reported on trembling aspen, this species will feed on other Salicaceae and must do so throughout much of its range. Prentice (1963: 426) listed 13 collections from aspen, three from willow, and one from black cottonwood (*Populus trichocarpa* Torr. & Gray). Adults were reared from species of *Salix* (11) and *Populus trichocarpa* (1) in Oregon by J. C. Miller.

Protitame subalbaria occurs from northern Baja California and the vicinity of San Diego to southern British Columbia and southwestern Alberta. It occurs as far eastward as Sweetgrass County, Montana; Teton County, and Cody, Park County, Wyoming; and Midway, Wasatch County, Utah. It is present in the Great Basin ranges (East Humboldt Mountains, Elko County, Nevada), but is not known from Colorado or Arizona. The recorded flight period for the northern region and Rocky Mountains is 5 May–26 June and 1 July–25 August. In northern California it flies as early as 29 March and as late as 28 September; and for southern California the dates are 27 February–14 May, 16–26 July, and 11 August–28 September.

Protitame cervula (Rindge). NEW COMBINATION

PL. 1, FIGS. 29, 30 (adult); TEXT FIG. 8 *d, f* (♂ gen.); TEXT FIG. 9 *b* (♀ gen.) (RWH 6422).

Sperrya cervula Rindge, 1958, *Amer. Mus. Novit.*, No. 1,854: 8.

Type locality: Patagonia, Santa Cruz County, Arizona. [LACM]

The relationship of this species to *Protitame* went unrecognized for many years because of its coloring, very different appearance, and because no other species of the genus was found or expected in Arizona where *cervula* occurs. The moth is about the size of *P. subalbaria* from southern California, and, although most commonly brown, it varies through all shades from gray brown and cinnamon brown to buff and ivory.

The wings are marked only by regular, pale, postmedial bands almost parallel to and quite close to the outer margins of both wings, and a similar but less distinct, convex, antemedial band on the forewing only. Faint, diffuse, lunate, discal spots may be apparent, especially on the fore-

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wing, otherwise the wings are uniformly colored, tending only to be slightly paler near the costa of the forewing and toward the base of the hindwing in some specimens. The postmedial bands are almost in the same position as those of *P. subalbaria*, but they are usually pale yellowish white and hence paler than the ground color rather than darker as in *subalbaria*; only in the palest variants are the postmedial lines outlined with yellowish gray and then darker than the ground color. The underside is paler and almost unmarked, except for weak discal spots. The front is light yellowish brown, with its upper half, more or less, colored a darker brown as in the other species of *Protitame*. The body and appendages generally match the color of the wings. No external structural differences are apparent, except that the male antennal segments (flagellomeres) are slightly longer than those of *subalbaria*, with their branches somewhat longer, as well as more widely spaced because of the longer segments. Wing length: males, 10–12 mm; females, 10–11 mm.

The male genitalia (text figure 8 *d, f*) are so close to those of *P. virginalis* and *P. subalbaria* that one might distinguish them only with difficulty were it not for the absence of the cluster of 5–6 short, stout cornuti that is always on the vesica of the other species. *Protitame cervula* has the separate long cornutus but no trace of the cluster. The valve seems a little stouter, or its tapered tip less extended, and the saccus shorter on average, but considering the overlapping variation in all three species, those points of distinction would have little value for distinguishing them.

The female genitalia (text figure 9 *b*) are similar to those of *P. subalbaria* except that the long, rugose “neck” of the bursa copulatrix is straight and cylindrical, not widening or flaring toward where it adjoins the corpus bursae. Also, its longitudinal ridges do not extend onto the corpus bursae, but, instead, a transversely rugose zone of thickened integument occupies the opposite (anterior) end of the corpus bursae, extending up one side as far as the signum. The signum is normal for the genus and doubtfully distinguishable.

The early stages of *P. cervula* are unknown. It would be expected to feed on something in the Salicaceae.

Protitame cervula is known only from Arizona and from so few localities that I list the data from all specimens examined (number of specimens in parentheses): Patagonia, Santa Cruz County, 4

May 1948 (3); 13 September 1953 (22). Near Nogales, Santa Cruz County, 15 September 1950 (3). Peña Blanca, Santa Cruz County, 11 August 1959 (1); 11 August 1999 (1). Guadalupe Canyon, 4,250', Peloncillo Mountains, Cochise County, 15 May 1976 (2). Christopher Creek, Mogollon Rim, Gila County, 17, 19, 22 June 1957 (7). Sedona, Coconino County, “4-06-48” (1). Although the species seems widely distributed in Arizona, the absence of records from other, more heavily collected sites indicates that it is localized, possibly in riparian habitats among willows or cottonwoods as its taxonomic affinities suggest.

TRIBE

Macariini Guenée, 1857 [1858]

Macaridae Guenée, 1857 [1858]

Semiothisini Warren, 1894

Fernaldellinae Hulst, 1896, in part

Although no single character consistently unites the genera of this tribe, its members may be recognized by a combination of features, one or more of which may be undeveloped, lost, or modified almost beyond recognition in some genera. Probably the most important feature of the tribe is a peculiarity of the chaetosemata, which in most macariine genera are extended transversely as a row of setae that almost meet in the middle behind the head, much as in the Larentiinae. This line of setae may be seen in a transverse parting of the scales between the head and prothorax. All North American Ennominae with chaetosemata of this type belong in the Macariinii, but five small macariine genera do not have them; namely, *Isturgia*, *Eumacaria*, *Trigrammia*, *Mellilla*, and *Heliomata*, which are the only North American exceptions that have widely separated chaetosemata like those of other Ennominae. The extended chaetosemata are also lacking in Old World species of *Isturgia* and in *Itame vincularia* (the type species of *Itame*). The pupae of nearly all Macariini have a simple cremaster that is bifurcate apically as in the Boarmiini, except for two primitive genera (*Isturgia* and *Mellilla*) in which cremastral hooks are retained.

Other group features are the bilobed or deeply emarginate valve of the male genitalia; the stout, triangular uncus, which bears at least one pair of strong hornlike setae subapically on the dorsal side in about half of the genera; a specialized

eighth sternum in the male that is deeply notched or incised in the middle of its posterior margin in all genera except *Isturgia*, *Eumacaria*, *Trigrammia*, *Mellilla*, *Fernaldella*, and a few highly modified desert species of *Rindgea*; and the wing shape and general appearance of the adults, which show certain consistencies through hundreds of species worldwide. For example, the apex of the forewing is often slightly produced, this appearance being accentuated by a shallow depression in the outer margin between M_3 and the apex that is often lined with a section of dark fringe. Species with a forewing of this shape usually also have an angulate outer margin on the hindwing. Also, a recurrent and characteristic dark patch or group of two or more blackish spots centered around or near the juncture of M_3 and the postmedial line on the upperside of the forewing occurs in most genera, or at least in some species or some specimens of those species within most genera. This is called the extramedial spot although it is usually comprised of several spots. This pattern system usually also includes a preapical costal spot.

The preapical costal spot or subapical costal spot is a persistent, intensified, often quadrate fragment of the subterminal band on the forewing, occupying the space between the postmedial line and subterminal band and which runs from the inner margin to the costa. In most Macariini the subterminal band is not an important feature because all that remains of it is the subapical costal spot and perhaps the extramedial spot, which lies in its path and may also be part of it. Although otherwise mostly lost, the subterminal band may be seen in some specimens of a few species, such as *Digrammia ocellinata* (Guenée), *D. hebetata* (Hulst) (and as a clear reddish-brown band in *Macaria distributaria* (Hübner)). The band is often more fully developed on the undersides of many species, both on the fore- and hindwings. The extramedial spot is a dusky to blackish spot on or near M_3 just distad of the postmedial line, or it may take the form of one or two black spots on the postmedial, one to several closely associated blackish spots straddling M_3 just basad of the postmedial line, or a combination of these. The extramedial spot is particularly conspicuous in *Macaria notata* (Linnaeus) and *M. promiscuata* (Ferguson). A thickening of the antemedial, medial, and postmedial lines to form black spots on the costa of the forewing is commonplace in Macariini, and if these are pres-

ent, so also, nearly always, is the subapical costal spot, which is the fourth and usually largest of the dark costal spots, situated just before the apex. As explained above, this is derived from the band that runs between the postmedial and subterminal lines of the forewing, the remainder of the band being invisible (unexpressed). The subapical costal spot is often subquadrate in shape and may in some species be brown or reddish brown rather than black. The postmedial and subapical costal spots reappear here and there across a wide spectrum of macariine genera in Eurasia, Africa, and tropical America, and similar, although probably analogous, markings often occur in other Ennominae. Species of Cassymini sometimes have a true subapical spot but not, as far as I am aware, an extramedial spot. Although possibly incorrect, my assumption is that those genera with the bridged or transversely extended chaetosemata are the more highly derived Macariini, especially because this condition shows a trend coincident with at least three more obviously derived features among the species studied, namely the development of the cleft eighth sternum, the horned uncus, and the loss of the signum. Holloway (1993) reached a similar conclusion in his treatment of the Geometridae in *The Moths of Borneo*.

The terminology for describing larvae is intended to be consistent with that of recent authors, including McGuffin (1972), Stehr (1987), Common, (1990), and others. Stripes are generally longitudinal; bands are transverse; line is used to denote a very fine stripe or band. Lateral, spiracular, and stigmal stripe are generally synonymous. Superficial features of these larvae probably are not good indicators of relationship (except among very close taxa) because they are habitat adaptations that evolve to suit the circumstances with every long-term shift to a different food plant or substrate. Ability to resemble the background is very important in determining the success of these highly cryptic caterpillars, and a special feature of many geometrid larvae is a built-in variability (polymorphism), that enables some individuals to resemble one substrate and others a differently colored substrate. This, I think, is the explanation for the green and brown forms in many species.

Three genera are well represented in the United States and Canada—*Macaria* with 25 species, *Speranza* with 51 species, and *Digrammia* with 49 species. The geographic limits of *Macaria* are

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still unclear because of differing interpretations among authors as to what should be included, but it is at least Holarctic and to some extent Neotropical; *Speranza* and *Digrammia*, although also Holarctic, are mainly Nearctic. *Digrammia* extends well into Mexico with additional species. *Psamatodes* is mainly Neotropical, but the number of species in the group has not been worked out. In addition there are two small genera, five monotypic genera, and one predominantly Old World genus (*Isturgia*) with a single Nearctic species.

Among North American Macariini, the first series of genera, namely *Isturgia*, *Eumacaria*, *Trigrammia*, *Mellilla*, and *Heliomata*, form a distinct but diverse group of related genera worthy of special comment. They share the characters of widely separated chaetosemata of the usual ennomine type; eighth sternum entire (not deeply cleft on posterior margin); a deep dorsal groove between segments A9 and A10 of the pupa; absence of enlarged, modified (hornlike) setae on the uncus; and the unexpected presence of six or eight cremastral hooks in the pupae of *Isturgia* (*dislocaria*) and *Mellilla*. These are mostly exclusive features not possessed by other members of the tribe. They also have a radially symmetrical, stellate signum in the female genitalia, except for *Heliomata*, in which it is asymmetrical. *Heliomata* differs further in having unusual male genitalia, a unique pecten on sternum A3 (text figure 10 d), larval crochets in two groups, and bold black-and-white, or black-and-yellow, coloring. In this group only *Isturgia dislocaria* (Packard) has a normal fovea; *Eumacaria* and *Trigrammia* have abnormal foveae bounded by at least one different vein; and *Heliomata* and *Mellilla* are without a fovea. The peculiar 8-hooked cremaster of *Mellilla* and the minute and fragile hooks on the cremaster of *Isturgia* are probably derived from ancestors with cremastral hooks of the most common ennomine type. It appears likely that these five genera represent the more primitive elements of the tribe.

All of these genera except *Heliomata* have such similar male genitalia that one would hardly expect them to be different genera on that basis, but because each is unique in appearance, larva, pupa, food plant, and a few other character combinations, I thought it best to keep them separate. All are monotypic or nearly so except *Isturgia*, to which 39 Old World species are currently assigned (Scoble et al., 1999: 523), with *Isturgia*

dislocaria as the sole representative of the genus in the New World.

Although *Digrammia* differs in various ways, it first came to my attention as a genus because of the absence of the signum in the female genitalia. It is one of three North American genera of Macariini in which the signum is lost, the others being *Letispe* and *Rindgea*, both new genera. Scoble et al. combined *Speranza* (the former “*Itame*”) with *Macaria*, but I have restored it for reasons explained under *Speranza*. *Fernaldella* is the most highly modified or derived member of the tribe, having a whole suite of distinctive characters. In this work I resurrect the genus *Psamatodes* for a group of mainly light yellowish-brown, legume-feeding, tropical and subtropical species that seem to have certain consistent similarities in the genitalia, including the presence of a valvula. The best known of these is *Psamatodes abydata* (Guenée) (= *Semiothisa punctolineata* (Packard) of earlier literature).

North American Macariini are extreme food-plant specialists, confining themselves, with few exceptions, to one species of tree or shrub; sometimes to one species group or to a single species. Of the 156 species of Macariini, not one could be described as a general feeder. Whole complexes of *Macaria* and *Digrammia* have evolved specialized feeding preferences for different conifers, and the same has probably occurred with legume feeders. Twenty of the 25 *Macaria* species in the United States and Canada are conifer feeders and belong to the same general group as the Palearctic type species, *M. liturata* (Clerck), which is closely related to the western *M. adonis* Barnes and McDunnough. Species on two or more plant genera include *Macaria notata* on birch and probably alder in the Nearctic, and on these same genera plus *Populus* in the Palearctic; *Macaria signaria* (Hübner) on virtually all Pinaceae (spruce, fir, larch, Douglas-fir, and pine), whereas all other members of its immediate complex have become specialized on one genus or one species of Pinaceae; and some species of the mainly Neotropical *Psamatodes*, feed on leguminous trees and shrubs of various genera.

Many North American Macariini have become host specific on unusual plants generally ignored by most geometrids. These include *Trigrammia* on native species of *Aesculus* (Hippocastanaceae); *Mellilla* on *Gleditsia* (Fabaceae); *Isturgia dislocaria* on *Celtis* (Ulmaceae); *Macaria promiscuata* on *Cercis* (Fabaceae); *Macaria aequiferaria*

Walker on *Taxodium* (Taxodiaceae); and *Digrammia colorata* (Gorte) on *Larrea* (Zygophyllaceae) (creosotebush), which might have been thought inedible. Most North American species of *Macaria* feed on Pinaceae, but in *Digrammia* various species groups each feed on Cupressaceae, Salicaceae, Fabaceae, and Asteraceae, with none on Pinaceae. All species of *Rindgea* apparently feed on Fabaceae. So many Macariini worldwide, including those in the tropics of both hemispheres, feed on woody-stemmed Fabaceae (=Leguminosae) that it seems logical to assume that these plants figured prominently as hosts of the ancestral macariines. The genus *Speranza* has major species groups dependent on *Ribes* and related plants (Grossulariaceae), Rosaceae, and Rhamnaceae, but have no known association with legumes or conifers.

KEY TO NORTH AMERICAN GENERA OF
THE TRIBE MACARIINI
(Based on multiple characters)

1. Chaetosemata of normal ennomine type (text figure 4 *a*), widely separated, consisting of a small setose papilla on each side of head behind base of antenna; pupa with dorsal transverse groove between segments A9 and A10 (text figure 4 *e*); eighth sternum of male entire, not incised on posterior margin; without a pair of stout setae on uncus 2
 - Chaetosemata bridged; i.e., transversely extended toward each other as in many Larentiinae (text figure 4 *c*), almost meeting in middle behind head, and number of setae usually diminishing to a single row toward middle; pupa without transverse groove; eighth sternum of male deeply incised on posterior margin of all except *Fernaldella*; pair of stout preapical setae on uncus present in most (text figures 23 *a*, 30 *a*) 6
2. Adults black and white or black and yellow; male with fovea at base of forewing, with hindtibia enlarged, and with abdominal pecten on third abdominal sternum present and curiously modified (text figure 10 *d*); female genitalia with signum radially asymmetrical; larva with crochets in two groups; larva on species of *Robinia* *Heliomata* p. 50
 - Not as described above 3
3. Adult small, with bright orange hindwing, darker or more brownish forewing; male forewing without fovea; female genitalia with corpus bursae greatly elongated (text figure 12 *c*); pupa with unique cremaster, having eight long hooks that are irregularly curved and in part bifurcate (text figure 4 *g*); larva on honey locust (*Gleditsia*) *Mellilla* p. 63
 - Adult without bright wing coloring, fore- and hindwings essentially colored alike; male forewing with fovea; female genitalia with corpus bursae of more normal proportions; pupa with usual bifid cremaster 4
4. Adult with large foretibial claw in both sexes; male genitalia without cornuti or other sclerotic inclusions in vesica or aedeagus; larva on species of hackberry (*Celtis*) *Isturgia* p. 56
 - Adult without foretibial claw and with or without sclerotic structures in aedeagus; larva never on hackberry 5
5. Male with antenna simple, hindtibia enlarged, a pecten on third abdominal sternum, and usually an extramedial spot on both wings; male genitalia with rodlike, pencil-shaped structure in aedeagus that is equal to three-fourths of total aedeagal length; larva on species of buckeye (*Aesculus*) *Trigrammia* p. 66
 - Male with antenna bipectinate, hindtibia not enlarged, third abdominal sternum without pecten, and never with an extramedial spot on hindwing; male genitalia without cornuti or other sclerotic structures in vesica or aedeagus; larva on species of plum and cherry (*Prunus*) *Eumacaria* p. 61
6. Small, partly diurnal species with unique and distinctive pattern on underside of hindwing; frons protruding and with complex sculpturing; eighth sternum of male entire, not incised on posterior margin; uncus short and broad, shorter than long, without pair of stout preapical setae *Fernaldella* p. 344
 - Size variable, mainly nocturnal; without distinctive pattern on underside of hindwing; frons flat or somewhat protruding but without sculpturing; eighth sternum of male almost always deeply incised on posterior margin; uncus as long as or longer than wide, usually with pair of stout preapical setae 7
7. Male genitalia with valvula (text figure 36 *a*); male antenna commonly bipectinate; with or without an extramedial spot 8
 - Male genitalia without valvula (text figures 40 *e*, 43 *a*); male antenna simple or nearly so except in *Letispe*, which, however, always lacks the extramedial spot 10
8. Male antenna bipectinate with length of branches nearly always longer than twice width of antennal shaft; hindtibia not enlarged or only

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- slightly so; third sternum of male without pecten; fovea commonly present in forewing of male 9
- Male antenna simple (with one exception, *P. trimaculata*, which has long branches); hindtibia enlarged; third sternum of male with pecten; fovea absent *Psamatodes*
p. 164
9. Hindtibia of male not enlarged; third anal vein of hindwing present; larval prolegs with crochets of mesoseries all in one group; overwinters in egg stage; adults very diverse in appearance and habitat; females of a few species partly or fully brachypterous or with reduced wings; mostly nocturnal *Speranza*
p. 69
- Hindtibia of male slightly enlarged; third anal vein of hindwing absent; larval prolegs with crochets of mesoseries separated into two groups; overwinters in pupal stage; one small, colorful, diurnal species banded with orange yellow, dark brown, and white; female with fully developed wings; in northern sphagnum bogs or western subalpine meadows *Epelis*
p. 161
10. Male antenna bipectinate; forewing with extramedial spot absent; male genitalia with knoblike process on ventral side of aedeagus near anterior end (text figure 43 c); female genitalia without signum; one southwestern species *Letispe*
p. 232
- Male antenna simple (occasionally in *Macaria* with very short branches or fasciculate); forewing with extramedial spot commonly present; aedeagus without ventral knoblike process; female genitalia with or without signum. Widespread in U.S. and Canada; many species 11
11. Male genitalia relatively simple, ventral lobe of valve with few, if any, protuberances or sclerotic structures on its inner face; genitalia extremely uniform and hardly distinguishable throughout all Nearctic species; female genitalia with signum and with simple sterigma *Macaria*
p. 178
- Male genitalia diverse, often complex, with many kinds of sclerotic processes or structures on inner face of ventral lobe of valve that provide excellent diagnostic features for species recognition; female genitalia without signum, and usually with a “winged” or otherwise complex sterigma *Digrammia*
p. 234

GENUS

Heliomata Grote and Robinson

Heliomata Grote and Robinson, 1866, *Proc. Ent. Soc. Philadelphia*, **6**: 29.

Type species: *Baptria infulata* Grote, 1863, *Proc. Ent. Soc. Philadelphia*, **2**: 67, pl. 3, fig. 4; designated by Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 325.

Pepasmenoptera Gumpfenberg, 1887, *Nova Acta Acad. Caesar. Leop. Carol.*, **49**: 331 (in key as *Smenoptera*, a misspelling), 339. Without an included species until Gumpfenberg, 1893, *ibidem*, **59**: 360.

Type species: *Geometra glarearia* [Denis and Schiffermüller], 1775, *Ankündigung systematisches Werkes Schmett. Wienergegend*: **106**, by subsequent monotypy (but included as *glarearia* Brahm, an incorrect authorship) (Type locality: vicinity of Vienna, Austria). The type species was synonymized under *Heliomata* by Scoble et al. (1999) and again by Scoble and Krüger [2002].

Heliomata is a small, highly divergent genus of uncertain affinity, here reassigned to the Macariini where its characters seem to fit best. The wings are boldly patterned in bands or spots of white or light yellow on a black or brown background and usually have a sprinkling of metallic blue scales. The metallic scales occur mainly in the black medial or subcostal area of the forewing and in the outer submarginal area of both wings, where they are arranged as two lines parallel to the outer margins. The European *glarearia*, if it really belongs here, is less colorful than the American species but structurally almost identical. Except for the very different appearance and certain modifications of the genitalia, *Heliomata* shares most structural features with species of *Isurgia* (*dislocaria*), *Eumacaria*, *Trigrammia*, and *Mellilla* (of which the first three are extremely similar structurally, such that they might almost be regarded as congeneric). These features include: posterior margin of eighth sternum entire, not incised as are those of most Macariini; chaetosemata fully separate as in other ennomine tribes, not narrowly connected by a transverse row of bristles behind the head; uncus not “horned”; pupa with deep, transverse dorsal groove between A9 and A10. Female genitalia with a signum; and valve of male genitalia without a valvula. *Heliomata* and *Mellilla* differ from other members of the group in lacking a fovea; and *Heliomata* and *Trigrammia* differ from other members of the group in that the males have a pecten on the third abdominal sternum. However, the pecten in *Heliomata* (text figure 10 d) is pe-

culiar, being a brushlike tuft of bristlelike hairs arising from a clear (lightly sclerotized), transversely ovoid depression in the third sternum, not a single transverse row of bristles as in other genera. The pecten on the third abdominal sternum usually occurs in species with a swollen male hindtibia, and this is true of *Heliomata* (*Mellilla* is an exception in having a swollen male hindtibia in the absence of a pecten on the third abdominal sternum).

The male genitalia (text figure 10 *a, c*) of *Heliomata* are distinctive, especially with respect to the overall form of the valve and the unique setose lobe or flange near the middle of the ventral margin of the costal lobe. The female genitalia have an elongate bursa copulatrix bearing a signum that is not radially symmetrical, but wider than long, and with the longest points at the anterolateral corners. The signum in the Cassymini is also radially asymmetrical, but the longest points are on one side or one end.

This genus is comprised of three American species and the one or more Palearctic species now referred to *Heliomata*. Previous American checklists gave four species, but I assign two of them to the synonymy. *Heliomata cycladata* and *infulata* are valid species, and I describe a new species closely related to *cycladata* from the Gulf States. Their genitalia are indistinguishable or nearly so. The holotype of *Heliomata fulliola* appears to be a somewhat aberrant *cycladata* with false locality as no other specimens of this or any species of *Heliomata* are otherwise known from Arizona. The genus is apparently not present in the western United States, despite the presence in the Southwest of a potentially suitable host, *Robinia neomexicana* A. Gray (Fabaceae). The type of *Heliomata elaborata*, from Virginia, was illustrated by Grote (1863, pl. 3, fig. 5), but nothing resembling it has ever again been found. Probably it is an aberration of *H. infulata*, but it might be an unidentified exotic species with false locality label. The yellow and black coloring and presence of a "metallic terminal line" suggest that it is an abnormal specimen of *infulata*.

Forbes (1948: 35) placed *Heliomata* and *Protitame* in the tribe Abraxini, and he was followed by McGuffin (1972: 9) and me (1983: 88). I no longer believe that any species of Abraxini occur in the Americas with the exception of the new species of *Ligdia* described in this work, if indeed it is a true abraxine. Nearly all of the characters of *Heliomata* would seem to relate it to the Ma-

cariini, and it shares a unique and conspicuous feature with *Eumacaria*, *Trigrammia*, *Isturgia* (*dislocaria*), and *Mellilla*—a deep, dorsal, transverse groove between segments nine and ten of the pupa (text figure 4 *e*) not present in other Macariini. *Protitame*, *Taeniogramma*, and *Nematocampa*, the only cassymines of which I have seen the pupa, lack this groove, and thus it would seem that *Heliomata* is more closely related to the group of Macariini that has the groove. There is nothing in the adult structure, larva, or pupa to exclude *Heliomata* from the Macariini, although the adult is curiously modified. The white-striped larva is typical of most Macariini and unlike those of the Cassymini that we know. *Heliomata cycladata* is one of the few nocturnal geometrids of the north temperate zone with the bold black-and-white pattern that suggests diurnal flight. *Heliomata infulata*, however, has been netted by day and does appear to be diurnal.

The genitalia of both sexes of the Palearctic "*Semiothisa*" *glarearia* [Denis and Schiffermüller] are so nearly identical to those of *Heliomata* species that there would seem to be little justification for retaining them as separate genera, and Scoble (1999: 424) agreed with my conclusion and transferred *glarearia* to *Heliomata*. The structural similarity, feature for feature, is so close, including even the peculiar pecten on the third sternum of males, that there can be no doubt about the relationship, although the wing pattern and color of *glarearia* are more cryptic. They feed on Fabaceae (=Leguminosae), *glarearia* on species of *Lathyrus* (Kirby, 1882: 320; Culot, 1919: 146), and other *Heliomata* on species of *Robinia*. This Palearctic species belongs neither to *Semiothisa* Hübner nor *Chiasmia* Hübner, where it has been placed. *Pepasmenoptera* Gumpfenberg, 1887, was proposed for *glarearia* long before its relationship to *Heliomata* was noted and is the only other available generic name for this genus. The remark by Forbes (1948: 35) that "*Heliomata* is almost identical with *Lomaspilis*," is incorrect. The genitalia of the Palearctic *Lomaspilis* Hübner do not support this.

Heliomata cycladata Grote and Robinson
PL. 1, FIGS. 31, 32 (adult); PL. 9, FIG. 6 (larva); TEXT FIG. 1 *f* (venation); TEXT FIG. 10 *a, c* (♂ gen.); TEXT FIG. 10 *b* (♀ gen.); TEXT FIG. 10 *d* (sternum, A3) (RWH 6261, 6262).

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Heliomata cycladata Grote and Robinson, 1866, *Proc. Ent. Soc. Philadelphia*, **6**: 30, pl. 4, fig. 9.

Type locality: New York. [Philadelphia Academy of Sciences]

Heliomata fulliola Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, **3**: 233, pl. 20, fig. 9. NEW SYNONYMY.

Type locality: Redington, Arizona [false locality?]. [USNM]

NOTE—The holotype is an aberrant female in which the white areas of the forewing are united as a continuous band from inner margin to costa as is commonly so in *scintillata*. I have seen only one northeastern specimen (from New York) with the black bar separating the white areas completely lost; more commonly it may be reduced but not lost. The type of *fulliola* shows nothing else to suggest that it is anything other than *cycladata*.

This species is so easily identified that it needs no detailed description. The eyes are much larger than those of *infulata*; both the width of the eye, measured horizontally across its base, and its protuberance are greater than the width of the front (less than the width of the front in *infulata*). The wings are similar to those of *infulata* except that the pale areas are almost pure white, not pale yellow; the white band occupying most of the hindwing is usually much wider than either the dark basal area or the dark outer border (the same width or narrower than the basal and outer dark areas in *infulata*, some southeastern specimens excepted; see discussion of variation below). Also, *cycladata* usually has a thin, yellow, transverse dorsal band near the base of the abdomen and at least a fragmentary orange collar that are lacking in *infulata*, and also lacking in some females of *cycladata*. The blackish areas, especially of the forewing, have a variable sprinkling of orange as well as bluish iridescent scales that show up under magnification. The wing markings are repeated on the undersurfaces, except that there is a diffuse, whitish-gray area at the bases of both wings not present on the upperside. This basal area is more yellowish in *infulata* and may be developed into a discrete basal transverse yellowish band on the hindwing in that species. *Heliomata scintillata*, n. sp., of the central Gulf States, has the outer dark border much narrowed and brownish, and the white areas expanded. Wing length of *cycladata*: males, 10–12 mm (n = 82); females, 9–13 mm (n = 73).

Specimens from the southern Appalachian region average larger, more often 12–13 mm in wing length, and darker; the white bands are narrower, leaving more extensive black areas, and those of the forewing are more regular in outline, much like the markings of *infulata*. Specimens from northern Virginia are of the northern form, those from southwestern Virginia southward, at least in the mountains, are of the southern form.

Considerable individual variation occurs everywhere, usually with respect to the extent of the white areas of the wings. The white median area of the forewing and the white subapical costal patch are separated by a curved blackish bridge of varying thickness that connects the basocostal and outer marginal black areas. Usually the two white areas of the forewing are well separated, sometimes nearly contiguous, and in rare instances, as in the type of *fulliola*, the two white areas of the forewing run together as a continuous white band from inner margin to costa. The dark outer border of the hindwing is subject to variation also, from almost as thin as that of *scintillata* to almost as wide as the median white area.

The genitalia (text figure 10 a–c) do not differ significantly from those of *infulata* or *scintillata* in either sex.

The food plant is black locust, *Robinia pseudoacacia* Linnaeus (Fabaceae). Whether the larva will feed on other species of *Robinia* is unknown. It is mentioned in the literature also as feeding on honey locust, *Gleditsia triacanthos* Linnaeus, but that food plant needs to be verified because *cycladata* does not extend much into the natural range of *Gleditsia*. The following description is based on larvae that I reared on black locust from a female collected in Loudon County, Virginia in 1991. Larva green, of a slightly blue-gray tint matching the *Robinia* leaves, or, to be more exact, a compromise between the upper and undersides of the leaves. Lateral stripe pale yellow, well defined but thin, irregular, below level of spiracles, nearly continuous from segment T1 to A9, slightly and very irregularly protruding as a lateral fold. Faint indications of other yellowish or whitish longitudinal lines also present, at least a subdorsal and another between that and spiracles; also a very faint, thin, yellowish, discontinuous line passing through spiracles and separate from the much more prominent lateral stripe below the spiracles. Spiracles pale brown, ringed with dark purplish brown. Intersegmental folds on dorsum light, dull yellowish, giving the impression of a

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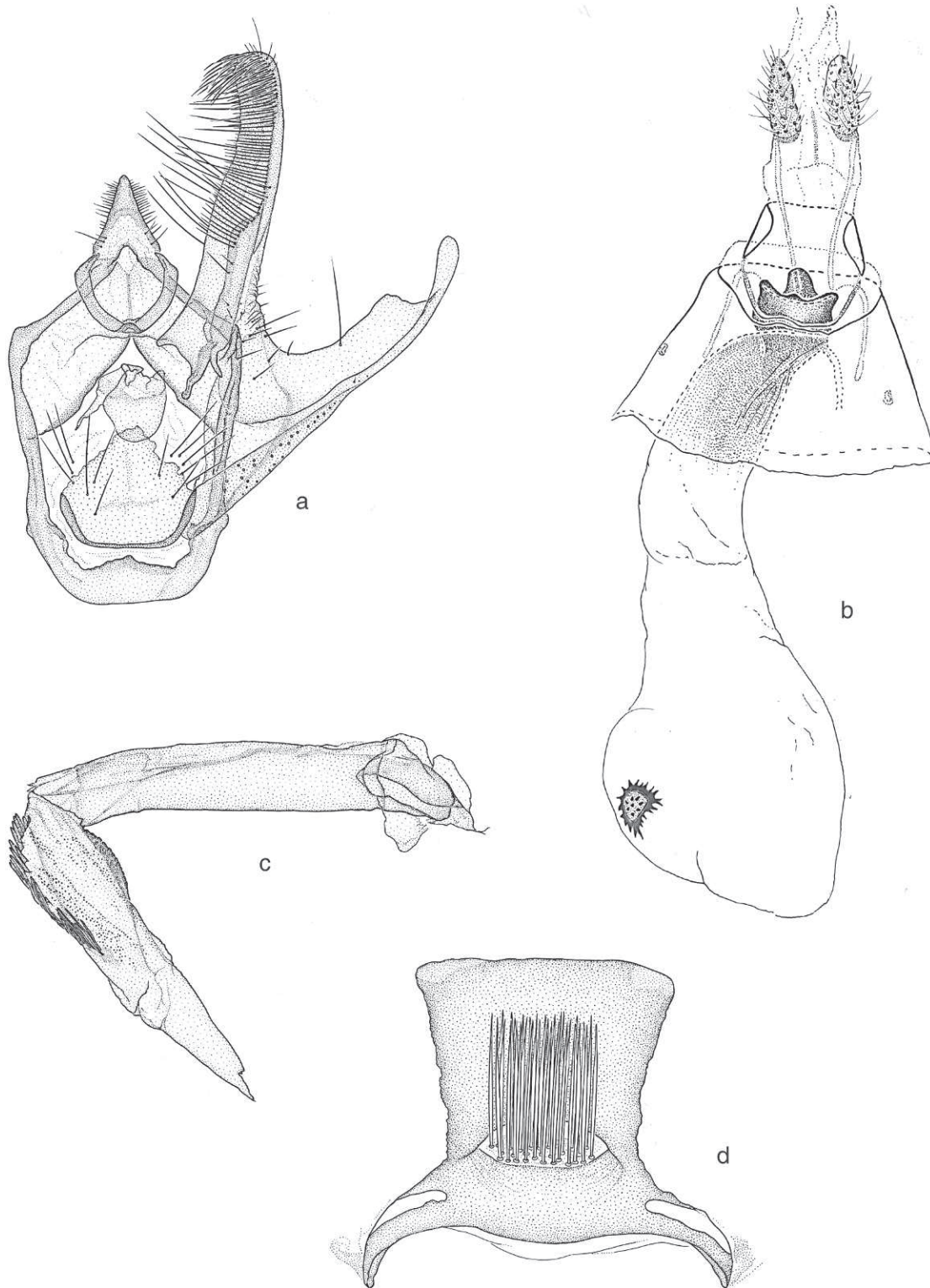


FIGURE 10: STRUCTURAL FEATURES OF *HELIOMATA CYCLADATA*

a. Male genital capsule; Seneca, Montgomery County, Maryland (USNM 57575). *b.* Female genitalia; Green Ridge, Allegany County, Maryland (USNM 56444). *c.* Aedeagus; Seneca, Montgomery County, Maryland (USNM 57575) *d.* Male A3 sternum with pecten; Montgomery County, Maryland (USNM 56442); Sycamore Landing, Montgomery County, Maryland (56443).

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series of thin, light, intersegmental rings. Venter with at least four diffuse, broken, longitudinal stripes that are more white than yellow. All legs and anal plate dull green, tinged with purple or pinkish. Antennae pinkish. Head dull gray green, shading to light yellowish brown and marked with numerous irregular blackish spots or blotches in dorsal half; each parietal lobe bearing 10–15 such blotches, which become progressively larger dorsally. Lateral yellow stripe of body does not extend onto side of head. Length 16 mm, and shape rather more stout relative to the length than is usual in the group, more stout than the larva of *Mellilla*, as an example. This species has only one brood and hibernates as a pupa.

McGuffin (1972: 9) also described the larva and indicated that it has two forms, one green and one striped and spotted with brown. The brown-spotted form was not present in the brood that I reared. He noted that this form is green with brown addorsal, subdorsal, lateral, subventral, and adventral lines, and often with brown addorsal patches on the anterior abdominal segments.

The larva of *cycladata* is easily distinguished from that of *Digrammia ocellinata*, which also feeds on *Robinia*, because *ocellinata* has a large blackish lateral spot on the segment A2 above the spiracle and lacks the conspicuous lateral stripe. *Mellilla xanthometata*, which feeds on *Gleditsia* in parts of the same region, differs in having a conspicuous extension of its white lateral stripe onto the side of the head and in lacking the dark blotches on the head. Also, its lateral stripe is wide, more regular, and predominantly white, and the addorsal, subdorsal, and spiracular lines are very distinct.

Heliomata cycladata occurs from Maine (as far north as Lincoln, Penobscot County), New Hampshire, southern Quebec, southern Ontario, Michigan, and Wisconsin to South Carolina, Georgia, Alabama, northern Mississippi, and Arkansas. It is to be expected anywhere in this region where the food plant occurs. *Robinia pseudoacacia* is thought to have been confined originally to the central Appalachian and Ozark Mountains, but it has been widely planted as an ornamental and thus introduced over a much greater area, with a corresponding range expansion of *H. cycladata*. The flight period is about 3 May–6 July in the Northeast, as early as 5 May in Maryland, and 29 April–26 June in Virginia. Early to mid-June is the peak flight period just about everywhere except in the Deep South.

Where it occurs in the Southern Appalachians, the seasons are much the same as in the Northeast.

Heliomata scintillata Ferguson, NEW SPECIES PL. 1, FIGS. 33, 34 (adult).

Heliomata scintillata Ferguson

Type locality: Bovina, Warren County, Mississippi. [USNM]

This recently discovered species is known only from a limited area east of the Mississippi River between West Feliciana Parish, Louisiana and Warren and Hinds counties, Mississippi, which are about at the latitude of Vicksburg and Jackson. It differs from *cycladata* in having the white areas of the wings expanded and the dark areas reduced, often to such an extent that the dark boundary on the forewing separating the white medial space from the preapical costal patch is nearly or entirely lost, thus uniting the white areas as a continuous band through the middle of the forewing. Another conspicuous difference is that the dark areas of the wings are not blackish but are variegated with reddish or yellowish brown, so that the dark borders of the wings have an overall brownish appearance. Further description follows.

Forewing with median area occupied by a broad white or cream-colored band, interrupted only by a narrow, oblique dark bar connecting the dark median costal area with the outer border of the wing. This dark bar may be obsolescent or is frequently absent, leaving a continuous, pale medial band running from inner margin to costa. In *cycladata* the dark bar is rarely so reduced and very rarely absent (in only two of nearly 700 specimens of *cycladata* examined—the holotype of *fulliola*, and another from New York). Basocostal area between wing base and white band dark brown, variegated with lighter brown and sprinkled with iridescent blue and orange scales (under magnification). Hindwing white or cream colored, with a slight dark basal area and an outer dark border conforming to that of the forewing. Dark outer borders of both wings not all black or blackish as in *cycladata*, but show on both wings a more complex pattern involving a beadlike submarginal string of blue-bordered blackish spots, flanked on both sides by an infusion of reddish brown. This produces the effect of a row of rudimentary ocellate spots running through the middle of the dark outer border of each wing.

Undersurfaces as above but dark areas paler, and outer dark borders of both wings longitudinally bisected or trisected by irregular, broken, yellowish terminal and/or subterminal lines, as well as patches of wide, glossy, iridescent orange or yellowish scales. Yellow transverse dorsal band at base of abdomen wider than that of *cycladata*, but rudimentary orange collar less noticeable. Abdomen otherwise pale gray brown with a yellowish tint, paler beneath. Thorax brown. Antennae, eyes, palpi, and legs as in *cycladata*. Wing length: holotype, 11 mm; other males, 10–11 mm (n = 5); females, 10–13 mm (n = 14).

The genitalia seem more delicately sclerotized than those of the other species but probably cannot be distinguished reliably.

The early stages and host are unknown, but black locust, *Robinia pseudoacacia* Linnaeus, is common where the species was collected at Weyanoke, West Feliciana Parish, Louisiana (V. A. Brou, in litt.).

TYPES. Holotype ♂. Bovina, Warren County, Mississippi; 10 May 1974; Bryant Mather. USNM. Paratypes: 5 ♂, 12 ♀, 1 sex not indicated. Mississippi. Same locality and collector, 10 April 1979, 20 April 1976, 27 April 1973 (1 ♂, 1 ♀ [1 sex not indicated]); Vicksburg, Warren County; 24, 25 April 1990, 19, 29 April 1993, 15 April 1992, 2 May 1989, 19 April 1985, 24 April 1987, 5 April 1982, 21, 27, 28 April 1981, 25 April 1969 (4 ♂, 10 ♀); Port Gibson, Claiborne County; 2 April 1967 (1 ♀). AMNH, USNM. Not all specimens examined were included in the type series.

This species is known from Hinds, Warren, Claiborne, and Wilkinson counties, Mississippi, where it was collected by Bryant Mather, Richard Brown, and B. and J.-F. Landry, and from West Feliciana Parish, Louisiana, where it was collected by Vernon Brou. The flight period is 2 April–10 May. Those from Wilkinson County are two worn males and two females collected in the Clark Creek Natural Area on 24 April and 3 May 1993 respectively.

Heliomata infulata (Grote)

PL. 1, FIGS. 35, 36 (adult); PL. 9, FIG. 7 (larva) (RWH 6263, 6264).

Baptria infulata Grote, 1863, *Proc. Ent. Soc. Philadelphia*, 2: 67, pl. 3, fig. 4.

Type locality: Northern Virginia. [ANSP]

Baptria elaborata Grote, *ibidem*, 2: 67, pl. 3, fig. 5. (Identity uncertain) NEW SYNONYMY.

Type locality: Virginia. [ANSP]

Heliomata infulata is generally an uncommon species of the Appalachians from western Pennsylvania southward, distinguished from *Heliomata cycladata* by its black and yellow coloring, its somewhat narrower, more regularly outlined pale-yellow wing markings, loss of the thin, pale transverse band at the base of the abdomen, and reduced eyes. *H. infulata* may be entirely diurnal, and it is so infrequently collected that its full distribution and early stages have not been investigated.

Both wings with pale areas light yellow instead of white and somewhat narrowed, so that the hindwing especially has a wider black outer border and wider black basal area; pale areas also more uniform in size and regular in outline, those of forewing with their angles smoothly rounded off; black areas with tendency to be more liberally marked with metallic bluish scales, especially those metallic scales that form parallel double lines, one just beyond the yellow areas, the other submarginally. Thin, pale, transverse band that marks base of abdomen in *cycladata* is lacking in *infulata*. Undersurfaces with markings repeated, and in general with the yellow band of the hindwing similarly narrower than the dark outer border as it is on the upper-side; pale band usually wider than the dark outer border in *cycladata*, and the metallic blue lines again more conspicuous beneath than they are in *cycladata*. Eyes much smaller than those of *cycladata* or *scintillata*, being both narrower and less protuberant than width of front. Eyes of *cycladata* more protuberant (in frontal view) and wider (basal width, measured horizontally across base) than width of front. The reduced eye size suggests that *infulata* is diurnal or largely so. Wing length: males, 11–12 mm (n = 10); females, 11–12 mm (n = 7).

The male genitalia hardly differ from those of the other species of *Heliomata*, but the clear depression in the third sternum bearing the pecten is larger in *infulata*, the patch of setae is wider, and the individual setae are larger. The differences are difficult to measure and may not be consistent. In the female genitalia, the only difference is that the signum is slightly larger in *infulata*.

The larva shown (plate 9, figure 7) was found by J. B. Sullivan on bristly locust, *Robinia hispida* Linnaeus (Fabaceae), one of the pink-flow-

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ered species. It differs conspicuously from that of *cycladata* in that the entire dorsal area, flanked by a pair of white subdorsal stripes, is deep brown with a few lighter orange-brown highlights. Laterally the only markings are the two very thin, wavy, whitish parallel stripes, beneath which there is a weak, pale, subventral stripe, less conspicuous than that of *cycladata*. The deep brown dorsal coloring extends onto the top of the head on each side; head otherwise bright green to yellowish green.

Heliomata infulata is a species of the central and southern Appalachians, with a limited distribution that falls within that of *cycladata*. It has been found from central and western Pennsylvania (Centre, Washington, Beaver, Allegheny, Clearfield, and Butler counties); Washington County, Maryland; Kanawha County, West Virginia; Rockbridge and Montgomery counties, Virginia; Richmond County, Buncombe County (Valley of Black Mts.), Transylvania County (Conestee Falls, near Brevard), and Watauga County (Blowing Rock), North Carolina; and "Wilmerding, Ga." [LACM].

The recorded flight period is 4 May–25 June, except for one earlier one on 18 April in Richmond County, North Carolina, and four much later ones, 16 July and 10 August in western Pennsylvania, and 18 July in Buncombe County and 13 August in Watauga County, North Carolina. Most specimens in collections are from Pennsylvania, especially from the vicinity of Pittsburgh, and the largest series (93) is in the Carnegie Museum of Natural History.

GENUS

Isturgia Hübner

Isturgia Hübner, 1816 [1823], *Verzeichniss bekannter Schmettlinge* [sic]: 297.

Type species: *Geometra conspicuata* [Denis and Schiffermüller], 1775, *Ankündigung syst. Werkes Schmett. Wienergegend*: 316, by monotypy. (Type locality: Austria).

Histurgia Agassiz, 1847, *Nomencl. zool. (Index universalis)*: 183, 197.

NOTE—*Histurgia* is an unjustified emendation of *Isturgia* Hübner, [1823].

Enconista Lederer, 1853, *Verh. zool.-bot. Ver. Wien* 3 (Abh.): 180, 226, 234.

Type species: *Fidonia perspersaria* Duponchel, 1829 [1830], in Godart et Duponchel,

Hist. Nat. Lépid. Papillons Fr., 7(2): 458, pl. 169, figs. 1, 2, by subsequent designation by Joannis, 1912, *Broteria* (Zool.), 10: 20. Joannis regarded *perspersaria* as a junior synonym of *Boarmia miniosaria* Duponchel, 1829 (*ibidem*, 7(2); 368, pl. 160, fig. 4), and it currently is regarded as a subspecies of *Isturgia miniosaria* (Duponchel). (Type locality: Montpellier, France).

Tephрина Guenée, 1844 [1854], in Duponchel, *Cat. Méth. Lépid. Eur.*: 246.

Type species: *Geometra murinaria* [Denis and Schiffermüller], 1775, *Ankündigung syst. Werkes Schmett. Wienergegend*: 105, by subsequent designation by Moore, 1884–7 [1887], *Lep. Ceylon*, 3: 470. (Type locality: vicinity of Vienna [Austria])

Bichroma Gumpfenberg, 1887, *Nova Acta Acad. Caesar. Leop. Carol.*, 49: 382, 388 (as *Dichroma*, an incorrect original spelling).

Type species: *Noctua famula* Esper, 1787, *Die Schmett.*, 4: pl. 106, fig. 4; 1789; *ibidem*, 4: 164, by monotypy. (Type locality: [Europe]).

Scoble et al. (1999: 523–526) list about 40 species in a broad concept of the genus *Isturgia*. The species occur in the Palearctic Region from Europe to Japan, in China, India, and Pakistan, the Middle East, and widely in Africa, including the Canary Islands and Madagascar, except for the one North American species, *Isturgia dislocaria* (Packard). I follow that treatment in placing *Enconista* Lederer in the synonymy of *Isturgia*, although my limited familiarity with the Old World species is such that the diagnosis given below really refers only to *dislocaria*. However, the genitalia and other obvious features of *dislocaria*, such as the foretibial claw and antennae, are very similar to those of *Isturgia miniosaria*, the type species of *Enconista*.

Isturgia, *Eumacaria*, *Trigrammia*, and *Mellilla* form a group of related genera so similar structurally and so different from most other Macarini, that they might, on the basis of genitalia alone, be considered congeneric. However, as they differ greatly in appearance as adults and larvae, have unrelated food plants, and different character combinations that are usually considered of generic importance, I think it fitting that we continue to regard them as separate genera. The possibility that they are the more primitive

members of the tribe was discussed in the introduction to the tribe Macariini.

Isturgia dislocaria is distinguished by the following combination of features: a prominently spined foretibia; a normal fovea; an accessory cell in the forewing (as in *Mellilla*); male hindtibia not enlarged; pecten on third abdominal sternum of male absent; pupa with callosity present but low, flat, not visibly setose; cremaster long, tapered, with as many as six minute hooks at end (likely to be missed because they are often broken off). The larva of our one species feeds on hackberry, *Celtis* species (Ulmaceae). The European *Isturgia miniosaria* feeds on *Genista purgans* Linnaeus and *G. scorpius* Linnaeus, *Calycotome spinosa* Linnaeus, and species of *Ulex* (Fabaceae) (Lhomme, 1923–1935: 446). Most other Old World species, whose hosts are known, also feed on Fabaceae.

Isturgia dislocaria (Packard)

PL. 1, FIGS. 37–41 (adult); PL. 9, FIG. 8 (larva); TEXT FIG. 3 *a, b* (leg); TEXT FIG. 4 *a* (head); TEXT FIG. 4 *d–f* (pupa); TEXT FIG. 11 *a, c* (♂ gen.); TEXT FIG. 12 *a* (♀ gen.) (RWH 6419).

Semiothisa dislocaria Packard, 1876, in F. C. Hayden, *Rep. U. S. Geol. Surv. Terr.* (Monograph Geometrid Moths of U. S.), 10: 282, pl. 13, fig. 48.

Type locality: Waco, Texas (Belfrage). [MCZ]

NOTE—Originally there may have been more than one syntype, but the specimen indicated as type in the MCZ is a large female labeled “Texas.” It is faded but intact. I do not designate it as the lectotype because in the description Packard mentioned and illustrated only a male.

Phasiane dislocaria malefactoria Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, 3 (4): 234.

Type locality: Paradise, Cochise County, Arizona. [USNM]

NOTE—I designate the “male type” as the lectotype.

This widely distributed and variable moth might be mistaken for a species of *Digrammia*, but a distinctive combination of external features distinguish it. The male antennae are bipectinate with medium-length branches; the chaetosemata are fully separated, without the interconnecting row of bristles behind the head as in most Ma-

cariini; and the foretibia in both sexes is short and bears a large, double claw (text figure 3 *a, b*) with a long, sharp-pointed process on the mesial side and a much shorter one on the lateral side. The male genitalia are simple and surprisingly similar to those of *Mellilla xanthometata* and *Eumacaria madopata*, which otherwise look nothing like *dislocaria*. The front is swollen and protuberant with fine, closely matted scaling. The distribution coincides with that of the foodplant, hackberry (*Celtis* species).

Most external structures as discussed in generic diagnosis. Male antenna bipectinate, that of female simple near base, somewhat serrate for most of its length, almost laminate toward tip. Otherwise, sexes nearly alike. Front protuberant in the sense that the whole frontal space between the eyes is abruptly raised and finely and densely scaled, brownish; palpi very short, brown, hardly exceeding the raised front, third segment differentiated, not concealed by scales; haustellum well developed.

Wings with ground color of both sexes geographically variable from gray to brown and, in the Southwest, to pale brown. Most have a darker brown to black, three-line pattern on forewing consisting of an antemedial, medial, and postmedial. Antemedial line or band thin, widest near costa but often obsolescent, and nearly straight to somewhat convex, sometimes slightly sinuous; medial band blackish to light brown, also nearly straight to convex and often obsolescent or represented by just a bar at costal end; postmedial band strongest, nearly straight between M_1 and inner margin, angled at M_1 to meet costa nearly at right angle, represented at least by series of blackish spots on proximal side of the thin, pale, postmedial line between costa and CuA_2 in all except some Arizona specimens, which may be nearly immaculate; these dark postmedial spots increase progressively in size and intensity toward costa, and they may be accentuated by one or two small additional spots or diffuse dark patches on distal side of the pale postmedial line between M_2 and CuA_2 . Dark markings of postmedial band usually missing between CuA_2 and inner margin and replaced by thin, pale postmedial line. Most specimens from the eastern half of the United States and a few western ones have the wing veins thinly but sharply outlined in pale yellow or whitish. Hindwing similar to forewing but almost without dark markings and showing only the postmedial, which is mostly a pale band,

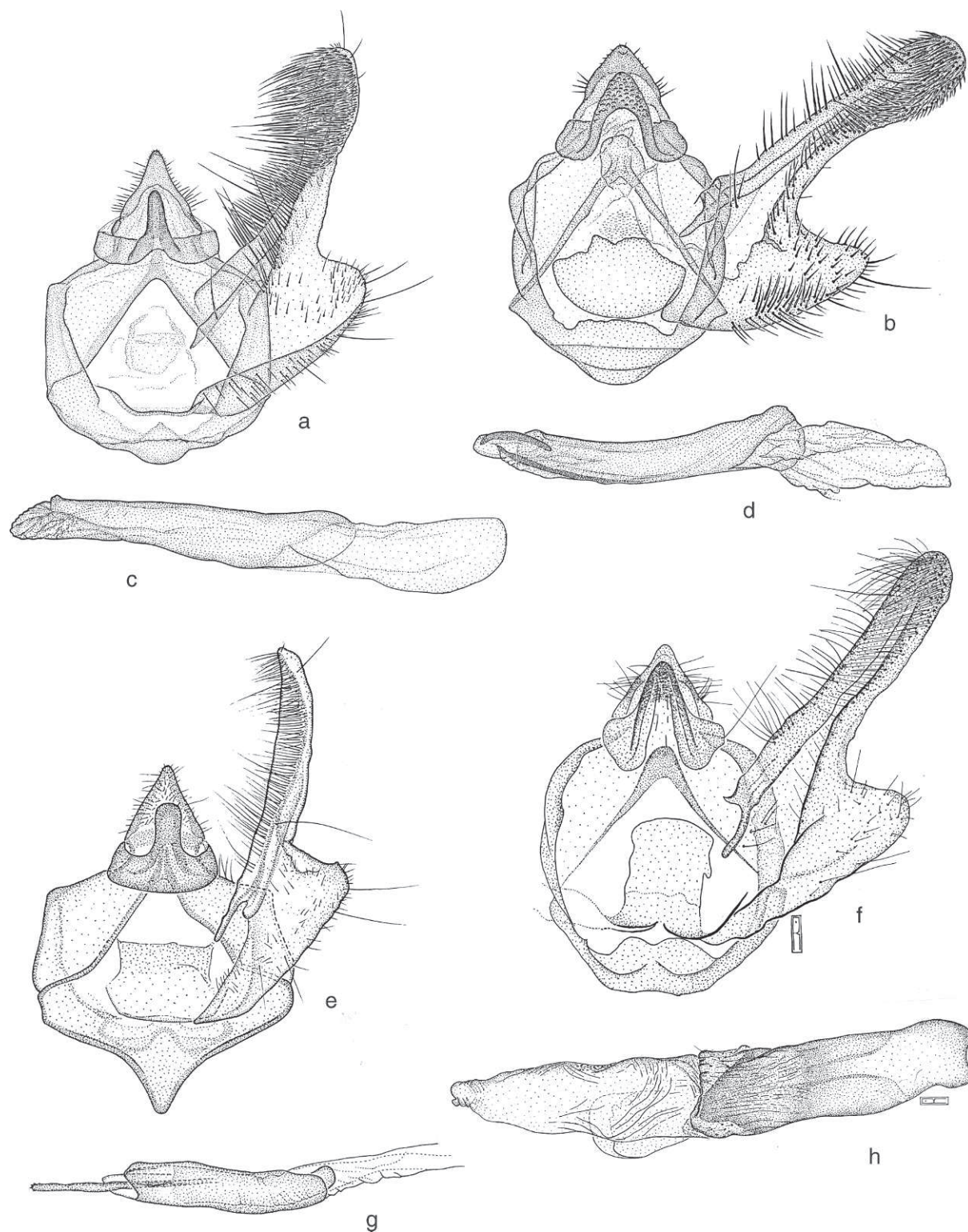


FIGURE 11: MALE GENITALIA

a. Isturgia dislocaria, genital capsule; Brownsville, Cameron County, Texas (USNM 52736). *b. Eumacaria madopata*, genital capsule; Rio Frio, Real County, Texas (USNM 57571). *c. I. dislocaria*, aedeagus; Brownsville, Cameron County, Texas (USNM 52736). *d. E. madopata*, aedeagus; Rio Frio, Real County, Texas (USNM 57571). *e. Trigrammia quadrinotaria*, genital capsule; Kerrville, Kerr County, Texas (USNM 57072). *f. Mellilla xanthometata*, genital capsule; Putnam County, Florida (USNM 57454). *g. T. quadrinotaria*, aedeagus; Kerrville, Kerr County, Texas (USNM 57072). *h. M. xanthometata*, aedeagus; Putnam County, Florida (USNM 57454).

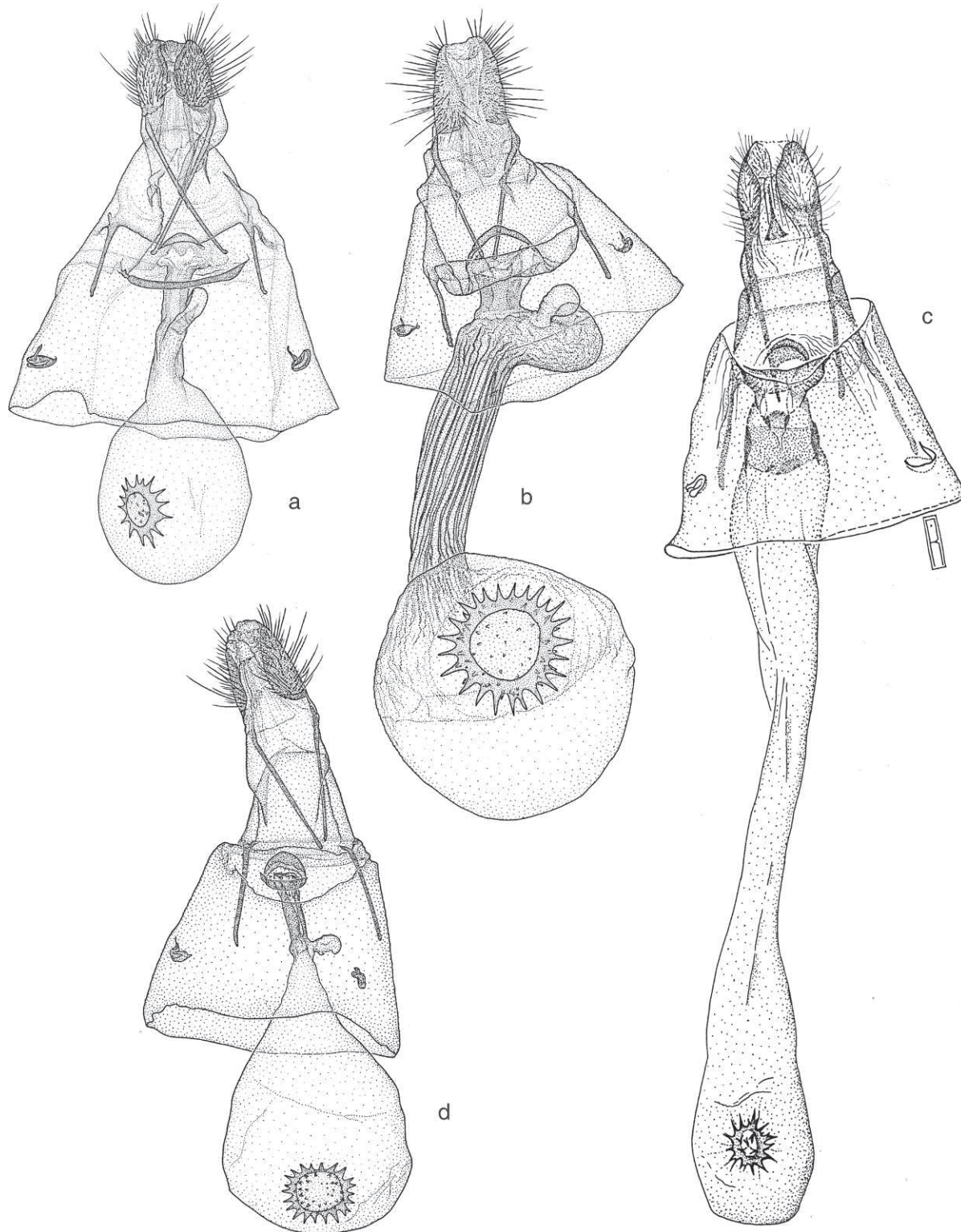


FIGURE 12: FEMALE GENITALIA

a. Isturgia dislocaria; San Augustine, San Augustine County, Texas (USNM 53319); Davis Mts., Jeff Davis County, Texas (58855).
b. Trigrammia quadrinotaria; Smyth County, Virginia (USNM 58897). *c. Mellilla xanthometata*; Welaka, Putnam County, Florida
 (USNM 57569). *d. Eumacaria madopata*; Texas (USNM 56889).

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although it may in part be slightly outlined on proximal side with dark scales. If pale veins show on the forewing, they occur on hindwing also. Terminal line very thin, pale, but often obscured in dark or poorly marked specimens. Fringes unicolorous with wings, not checkered. Underside (both wings) strongly infuscated with brown or blackish scales in eastern or midwestern specimens but leaving thin, pale postmedials showing clearly. Yellowish wing veins often more apparent on underside than upperside, although in the West they may be much reduced or lost. Wing length: males, 14–16 mm ($n = 122$); females, 15–18 mm ($n = 52$).

Male genitalia (text figure 11 *a, c*) resembling those of *Eumacaria*, *Trigrammia*, and *Mellilla* species, although differing in size in proportion to the size of the moth, and in other minor ways as illustrated. Uncus narrowly conical and bluntly pointed apically; process of gnathos slender, elongate, also bluntly pointed; vinculum not produced as it is in *T. quadrinotaria*; saccular lobe of valve reduced and varying from broadly rounded to somewhat pointed.

Female genitalia (text figure 12 *a*) most closely resembling those of *Eumacaria madopata*, but with “neck” of bursa about twice as long and stout; or, about equal in length to posterior apophyses and much longer than anterior apophyses (that of *madopata* equal to anterior apophyses).

The geographical variation in this species is complex and not easily described. Specimens from the east-central United States west to Nebraska and probably Kansas would mostly be described as gray to somewhat brownish, have relatively prominent blackish markings on the forewing, some of the wing veins outlined in pale yellow, and the postmedial band of the hindwing well developed and whitish. Specimens from Maryland and central Nebraska are alike, although many from Kansas southward are more brownish and may lack the whitish highlighting of the hindwing postmedial. Specimens from Florida tend to be brown and dark, with the outer third beyond the postmedial line on both wings contrastingly darker than the medial and basal areas, and with the black markings and pale veins reduced. Specimens from Cameron County, Texas tend to be evenly dark brownish gray, with a general reduction of all highlights, black markings, and pale veins. Specimens from West Texas are very different, generally with much lighter wings and with black markings associated with

the postmedial line in males, but commonly not in the females, which have three similar, almost parallel transverse brown lines on the forewing and because of this may resemble light brown specimens of *Digrammia respersata*. One would think that these West-Texas specimens, especially the females, belonged to another species, but they show no structural differences. Specimens of this form were taken in Aguja and Palo Duro Canyons, and in Pecos County. Curiously, specimens that I collected near Rattlesnake Springs, Eddy County, New Mexico are not of the West-Texas form but resemble gray eastern specimens in both sexes. The Arizona population that was named *malefactaria* Barnes and McDunnough is a further extreme of the pale West Texas form. Some Arizona males retain black spots along the postmedial line, but the females tend to be an almost immaculate pale brown. The transverse bands are present but obsolescent. These specimens are labeled Redington and the Baboquivari Mountains [Pima County], and Paradise and the Peloncillo Mountains [Cochise County].

Information on the early stages was first obtained from a brood that I reared from a female collected in the Fort Niobrara National Wildlife Refuge, Nebraska. The larvae refused all plants offered except hackberry, *Celtis occidentalis* Linnaeus (Ulmaceae), one of the common trees of the area, and did so well on it that this and other species of hackberry seem certain to be the natural hosts. No specimens have been collected outside the range of *Celtis* species. I have since found several larvae on *Celtis laevigata* Willd. in Marion County, Florida. Available hosts in southern Texas are *Celtis laevigata* Willd. and *C. pallida* Torr., and in West Texas, southern New Mexico, and Arizona, *C. pallida* and *C. reticulata* Torr. The colorful larva is very different from those of other Macariini, being deep gray green above and beneath, heavily sprinkled over the entire body with black spots, and bearing a wide, conspicuous, irregular, lateral band of bright lemon yellow that includes the spiracles and lateral folds. The yellow band is mainly subspiracular because the spiracles are at its upper edge. Segments A2 to A5 each have a larger, splash-shaped, lateral black blotch within the yellow band. Some of the small black spots are pinacula, but there are more spots than setae. The dorsal and dorsolateral black markings of the meso- and metathorax are arranged as a series of narrow transverse stripes. Head orange yellow with black

ommatidia and pinacula. Legs and anal plate mostly dull green. Length at maturity: 28–30 mm.

This species occurs or may be expected wherever hackberry grows from southern Ontario (Point Pelee), western Pennsylvania, Maryland, and West Virginia across the Midwest at least to central Nebraska, and southward to central Florida (Alachua, Marion, Putnam, and Highlands counties), the Gulf States, and southmost Texas, and thence westward through the Texas panhandle to southeastern New Mexico and Cochise and Pima counties, Arizona. It is uncommon in the eastern states, but many have been collected in Ohio, Illinois, Missouri, Nebraska, Kansas, and Texas. The most I have seen from any state are from Texas, where it seems to be common in suitable habitats throughout.

Isturgia dislocaria occurs mainly in May and June northward, occasionally in April; abundantly in the Nebraska sandhills in late June; in Kansas in April; February and March in Florida and most of Texas but in January and February in Cameron County; March and April in West Texas and New Mexico; and April and May in Florida and Arizona. A single fresh specimen from Raymondsville [Willacy County], Texas was taken 6 October, perhaps an accidental second-brood emergence. Otherwise the species is univoltine, even in Florida.

Isturgia dislocaria malefactaria is an available subspecific name for the pale, lightly marked Arizona specimens, although this ignores the fact that other populations, such as those of Florida and West Texas are equally distinctive.

GENUS

Eumacaria Packard

Eumacaria Packard, 1873, *Rept. Peabody Acad. Sci.*, **5**: 67.

Type species: *Eumacaria brunneata* Packard, 1873, *ibidem*, **5**: 67. Monotypy.

NOTE—*Eumacaria brunneata* is a junior subjective synonym of *Macaria madopata* Guenée, 1857 [1858], in Boisduval and Guenée, *Histoire Naturelle des Insectes, Species general des Lépidoptères*, **10**: 83 (see species synonymy following), and of *Macaria latiferrugata* Walker, 1862 [1863], *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **26**: 1,640.

This genus consists of a single North American species that is distinctive in appearance and without close relatives. It fits well within the tribe but

has a unique combination of features. The male antenna is bipectinate with long branches as in *Speranza*; the eye is fully developed; the chaetosemata, although transversely elongated, fall short of meeting medially in most specimens by a distance equal to the length of one of them; the male abdomen is without a pecten; and the legs, which are without any special features, have a slender male hindtibia without a groove down the inner side. The wing venation is normal except that the fovea at the base of the male forewing, like that of *Trigrammia*, is bounded anteriorly by a sclerite that appears to be the base of the 1st anal vein, and outwardly by a short spur from 2nd anal only. The fovea therefore occupies the angle between the bases of A1 and A2. The fovea in other genera, when present, occupies the angle between the cubital stem and A2 and is delimited outwardly by two opposing processes, one from each of those veins. In *Eumacaria*, the process from the cubital stem is wanting (text figure 1 *d*).

The male genitalia (text figure 11 *b, d*) are simple, generalized, and similar to those of *Isturgia*, *Trigrammia*, and *Mellilla*, with the same kind of wide gnathos, a stout, relatively obtuse uncus without hornlike spines or any such modified setae, a similarly reduced saccular lobe on the valve, and with a wide juxta of indefinite outline. The structure of the genitalia might place *Eumacaria* within the limits of the genus *Speranza* except for the absence of the valvula. Also, it must be noted that the eighth abdominal sternum, as in the other genera of this initial series, lacks the deeply cleft configuration characteristic of all subsequent genera of Macariini except *Fernaldella*.

The female genitalia are also simple, with a small, transversely crescentic, postostial sclerite; slender, straight ductus bursae with parallel, sclerotized sides, and a simple, membranous corpus bursae, which does, however, have a large, round, stellate signum with about 22 peripheral points.

Larva (plate 9, figure 9) as described under the species. Pupa dark brown with most of surface densely pitted with small, round depressions; callosities ovate, conspicuously elevated, densely and minutely ciliate; cremaster conical, well marked off at base by a transverse dorsal groove, and with tip produced, acuminate, minutely bifurcate at apex.

The pattern of thin, clearly defined, nearly straight and parallel lines, equally distinct on both upperside and underside, is a feature that might

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lead to confusion with members of the *Digrammia eremiata*-group were it not for the fovea and pectinate male antenna. *Eumacaria madopata* overwinters as a pupa like all our known Macariini except species of *Speranza*.

Eumacaria madopata (Guenée). NEW COMBINATION

PL. 1, FIGS. 42–45 (adult); PL. 9, FIG. 9 (larva); TEXT FIG. 1 *d* (venation); TEXT FIG. 11 *b, d* (♂ gen.); TEXT FIG. 12 *d* (♀ gen.) (RWH 6272).

Macaria madopata Guenée, 1857 [1858], in Boisduval and Guenée, *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 83.

Type locality: Brazil (incorrect locality—see below). [MNHN]

NOTE—This name was overlooked by previous North American authors because of the wrong type locality given in the original description. However, Viette (1950: 204), in a list of Guenée types, commented: “*Macaria madopata* Guenée Amérique septentrionale (Richard, 1852), type female (et non Brésil, comme l’indiqué Guenée).” I borrowed the holotype from Paris and found it to be the same species as *Eumacaria latiferrugata* (Walker). The holotype is a female of the light colored form that occurs in the southeastern United States. It bears the following labels: 3/52; Museum Paris/ Amérique Septentr/ Richard 3-52; *madopata*; TYPE [red label]; *Macaria/ madopata* Guenée/ X, p. 83.

Macaria latiferrugata Walker, 1862 [1863], *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, 26: 1,640. NEW SYNONYMY.

Type locality: East Florida. [BMNH]

Eumacaria brunneata Packard, 1873, *Ann. Rept. Peabody Acad. Sci.*, 5: 67. REVISED SYNONYMY.

Type locality: Maine, Massachusetts, Albany, N.Y., Texas. [MCZ]

NOTE—A specimen in the USNM from “Centre” [vicinity of Albany, New York]; “2-6-73,” from the Otto Meske collection, is labeled as a type, but it may not be one of the original specimens.

The diagnosis under the genus applies here also, as there is only one species. Further description follows. Ground color in pale specimens whitish, but commonly obscured by violet-gray suffusion and sometimes a thin dusting of reddish-brown or dark-brown scales. Pattern characterized by three

regular, thin, well-defined, reddish- or chocolate-brown lines on forewing and two on hindwing. Forewing with antemedial line curved, convex, or bent basad just before reaching costa; medial and postmedial lines nearly straight and subparallel, although medial may be sharply angled near costa, and postmedial may be slightly curved. Hindwing with medial line nearly straight, postmedial line convex. Discal spots, just beyond medial lines, inconspicuous, thin, elongated, that of hindwing comma shaped. Northern specimens have outer third of both wings heavily suffused with dark reddish- or chocolate brown except for wedge-shaped, gray apical patch on forewing. Within this dark outer band veins are pale yellowish, and band may also include a series of darker brown, outwardly pale bordered, lunate or almost ocellate intervenular spots just beyond postmedial line on forewing and to lesser extent on hindwing. Southern specimens have whitish ground color more dominant, and dark shading of outer third reduced or absent, imparting a different appearance to moths. One of few species of tribe in which transverse lines of underside are as well developed as on upperside. Wing length: males, 10–14 mm; females, 10–14 mm.

Canadian specimens and those from other northern areas, such as the Great Lakes States and the Northwest (Idaho, Washington) are largest and may be very contrastingly colored (plate 1, figure 44). Southern specimens are smallest. Males and females are about the same size. Southern specimens from South Carolina to Florida, westward through the Gulf States to Texas, and from the southern Midwest (Arkansas, Oklahoma, S Kansas), are often, but not always, small and pale and without strong contrasts (plate 1, figure 43), although every transitional stage occurs in intervening areas, beginning up the coast as far as the New Jersey Pine Barrens. The moths are of the northern dark form in the Nebraska sand hills (plate 1, figure 42), but those I have seen from Oklahoma are of the southern pale form. The transition, which apparently occurs in Kansas, probably coincides with the shift to bivoltine populations, as there is some evidence from collections that winter or early spring specimens in the South resemble northern specimens.

After the above was written, I reared a brood from a small, pale female collected in March in Marion County, Florida, near Ocala. The progeny, which emerged in May, are larger and dark, just like northern ones. Clearly, these forms must

be environmentally or seasonally induced and have no genetic basis.

The genitalia (text figures 11 *b, d*; 12 *d*) are as illustrated and described for the genus.

The larva feeds on species of *Prunus* and possibly on related genera such as *Pyrus* (apple, plum, and wild cherry, *Prunus pensylvanica* Linnaeus Fil., according to Forbes, 1948: 37, but he gave no reference). McGuffin (1972: 61) described different instars of the larva but did not specifically identify the host. I reared *madopata* from a female collected in the Fort Niobrara National Wildlife Refuge, Cherry County, Nebraska, and the larvae did well on *Prunus serotina* J. F. Ehrh. The frequent absence or rarity of *E. madopata* where this tree is abundant in the eastern United States suggests that it may not be the usual host. The preferred food is more likely to be chokecherry, which is often present where *madopata* occurs.

Mature larva about 22 mm long, thickest at prolegs, tapering slightly toward anterior end. When larva is at rest, head is thrust forward in prognathous posture, and often with head and first two thoracic segments bent backward so that thoracic legs are foremost. Body dark reddish brown; integument smooth but dull, not glossy. Usual whitish longitudinal stripes present but largely obscured by and fragmented by dark coloring. Only on metathorax and segments A1–6 are pale markings noticeable, being in the form of white, lateral, elongate patches of indefinite outline, disappearing in middle of each segment and progressively diminishing in size posteriorly. Body with remnants of whitish lateral or subspiracular stripe. Segments A1 and A2 each bears large, rounded blackish lateral patch surrounding spiracle. Spiracles black, thoracic legs blackish, and head and prolegs mainly concolorous with body. Side of head bears white lateral stripe from posterior margin of head capsule, level with prothoracic spiracle, to base of antenna.

Eumacaria madopata occurs across Canada from Nova Scotia to the southern interior of British Columbia, and northward at least to central Saskatchewan. In the United States, it occurs from Maine to central Florida (Orlando, Lakeland, St. Petersburg), and westward to the Dakotas, Nebraska, Wyoming, Colorado (Denver, Golden), and New Mexico; it is present in eastern Kansas, central Oklahoma (Murray County), Arkansas, and Texas as far west and south as Cottle, Kimble, Kerr, Uvalde, Cameron, and Hidalgo

counties. It reappears west of the Rocky Mountains in northern Idaho (Bonner Co.) and in Washington (Stevens, Okanogan, and Walla Walla counties), apparently as a southward extension of the range in British Columbia. The flight period is usually from late June through July in Canada and the northernmost states, with rare August records; May and June in the Middle Atlantic States westward to Nebraska and Kansas, with some second brood emergences (e.g., 7 May–3 August at Ithaca, New York); March–August in much of the South, but as early as February in Florida and at Ozark, Alabama (JGF coll.), mostly February–April, June–July, August, and October in Florida; March, April, July, September, and once in December (Hidalgo County) in Texas. This species apparently has two or more broods in the South and partial second brood emergences northward.

Despite its wide distribution and the frequent presence of potential food plants, *E. madopata* is generally uncommon to rare except in some parts of the Midwest. Although I collected it in many places across the continent, I saw it at light abundantly only in Nebraska. The presence or absence of specimens in collections generally confirms this pattern. In the North and West it seems to be associated with riparian habitats, moist shrubby meadows and forest edges, and mixed meadow and gallery forest along prairie creeks.

GENUS

Mellilla Grote

Mellilla Grote, 1873, *Bull. Buffalo Soc. Nat. Hist.*, **1**: 12.

Type species: *Mellilla chamaechrysaria* Grote, 1873, *ibidem*, **1**: 13, figs. 1–3, by monotypy; now considered a junior subjective synonym of *Fidonia xanthometata* Walker, 1862, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **24**: 1,038

Gonilythria Gumpfenberg, 1887, *Nova Acta Acad. Caesar. Leop. Carol.*, **49**: 323 (key). Without an included species until Gumpfenberg, 1896, *ibidem*, **65**: 302.

Type species: *Lythria rilevaria* Packard, 1876, Monograph of the geometrid moths or Phalaenidae of the United States, in F.V. Hayden, *Rep. U. S. geol. Surv. Terr.*, **10**: 221, pl. 9, fig. 43, by subsequent monotypy.

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Lythria rilevaria is a junior subjective synonym of *Fidonia xanthometata* Walker, 1862, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **24**: 1,038.

This genus of only one colorful little species is limited to the eastern and midwestern United States, where it is associated with species of *Gleditsia* (Fabaceae). Superficially, the moths appear closest to species of *Speranza*, especially *S. inextricata*, but they differ in so many important details that they could not be considered closely related. *Mellilla* is characterized by the following combination of features: chaetosemata well separated, not transversely extended toward each other behind the head; male antennae bipectinate; eighth sternum entire as in *Eumacaria*, *Enconista*, *Trigrammia*, and *Heliomata*; male genitalia without a valvula and without hornlike setae on uncus; female genitalia with a stellate signum of the *Speranza* and *Macaria* type; male hindtibia enlarged and with a groove containing a hair pencil, although there is no pecten on the third abdominal sternum; male forewing without a fovea; pupa with the deep, dorsal, transverse groove near base of cremaster characteristic of this series of genera; and curiously modified cremastral hooks (see Key and text figure 4 g); hibernation in the pupal stage. The condition of the chaetosemata and lack of an incised eighth sternum in the male separate *Mellilla* from all Macariini except *Isturgia*, *Eumacaria*, *Trigrammia*, and *Heliomata*; and the unique hooks on the cremaster, if not broken off, distinguish it from all other genera. It also differs from *Eumacaria* in lacking the fovea, having an enlarged hindtibia, in overall shape of certain components of the genitalia, and very elongated female genitalia; from *Enconista* in lacking the foretibial claw, lacking the fovea, having an enlarged hindtibia, somewhat differently shaped male genitalia, and the elongated female genitalia; from *Trigrammia* in having pectinate male antennae, lacking the fovea and the pecten on the third abdominal sternum, having somewhat differently shaped male genitalia and elongated female genitalia; it differs from *Heliomata* in having pectinate male antennae, lacking the peculiar or any pecten on the third abdominal sternum, having a radially symmetrical signum, in having the crochets in one rather than two groups; and from all of them in having entirely lost the third anal vein of the hindwing.

Also, the adults of *Mellilla*, *Heliomata*, *Trigrammia*, *Enconista*, and *Eumacaria* all differ so greatly from one another in outward appearance, as well as hosts, and no one has ventured to treat them as congeneric.

The larva is described under the species and illustrated (plate 9, figure 10).

The genus *Mellilla* is limited to the eastern and midwestern United States and the southernmost tip of Ontario. Its distribution is tied to that of its host, *Gleditsia*.

Mellilla formerly included a second species, *inextricata* Walker (e.g., McDunnough, 1938: 157), but in the 1983 checklist I transferred *inextricata* to the genus *Itame* (and now to *Speranza*).

Mellilla xanthometata (Walker)

PL. 1, FIGS. 46–50 (adult); PL. 9, FIG. 10 (larva); TEXT FIG. 1 *e* (venation); TEXT FIG. 4 *g* (pupa); TEXT FIG. 11 *f, h* (♂ gen.); TEXT FIG. 12 *c* (♀ gen.) (RWH 6322).

Fidonia? xanthometata Walker, 1862, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **24**: 1,038. Type locality: Not given [North America]. [BMNH]

NOTE—Holotype is a male of the summer form.

Mellilla chamaechrysaria Grote, 1873, *Bull. Buffalo Soc. Nat. Hist.*, **1**: 13, pl. 1, fig. 1.

Type locality: Buffalo, New York. [BMNH]

NOTE—Holotype is a male of the spring form, with wings of the right side missing when I saw it in 1993.

Lythria rilevaria Packard, 1876, Monograph geom. moths or Phalaenidae of the United States, in F.V. Hayden, *Rept. U. S. geol. Surv. Terr.*, **10**: 221, pl. 9, fig. 43.

Type locality: Central Missouri. [USNM]

NOTE—Described from several specimens from central Missouri (Riley) and Dallas, Texas (Boll), of which I found one male in the MCZ, without locality label and with abdomen and right forewing missing; and another more nearly intact male from “C. Mo.” in the USNM. The latter specimen, which I designate as the lectotype, is from the C.V. Riley collection and is marked as having been sent to Packard on 2 June 1874; then apparently it was returned and reached the U. S. National Museum of Natural History by way of the Riley collection. It represents the spring brood.

Lythria snoviaria Packard, 1876, *ibidem*, **10**: 222, pl. 9, fig. 42.

Type locality: Lawrence, Kansas. [MCZ]

NOTE—The holotype is a summer brood male with the right hindwing missing. It is labeled “Kansas. Snow.”

With its bright orange hindwings, this species perhaps is the most colorful as well as nearly the smallest of North American Macariini. One would think that the colors were those of a diurnal species, yet it comes to light and is entirely nocturnal as far as I could determine. Its fully developed eyes further confirm its nocturnal habits. It has at least two broods, and in the South probably third and fourth broods. Specimens of the spring brood differ considerably from those of the summer broods in appearance and in the greater length of the hindtibia, and the two forms were long thought to be different species (e.g., Forbes, 1948: 49–50), although they had been listed as synonyms by McDunnough (1938). The forms differ as follows: **Spring brood male**—Forewing deep reddish or purplish brown, dark and almost uniformly colored beyond the nearly straight postmedial line, somewhat paler and more grayish or purplish basad of postmedial line; antemedial and medial bands deep reddish brown, parallel and often closely spaced, not boldly contrasting because entire wing is quite dark. Hindwing bright, clear, ochreous orange, with a thin, dark mottled inner margin and with or without a partially darkened outer marginal fringe. Undersurface of forewing dull orange with dusky apex and fringe; undersurface of hindwing variable from dull ochreous orange to purplish brown, sometimes mottled in lighter and darker shades, sometimes clear ochreous and dusted with a few dark scales, and with a small, brown discal spot and thin, brown, regular, convex postmedial band (or none). Hindtibia of male less than twice length of tarsus. Wing length: 9–11 mm (n = 50). **Spring brood female**—Similar to male but larger, with forewing paler, light gray brown basad of postmedial line, and with outer third not uniformly dark but shading to light gray brown toward outer margin; fringe light gray brown, slightly shaded with blackish. Hindwing bright ochreous orange with dusting of dark scales and sometimes gray-brown shading on inner margin; fringe of outer margin light gray brown. Undersurfaces as in male but paler. Wing length: 10–13 mm (n = 23). **Summer brood male**—Forewing bright reddish brown, with or without a violaceous tint; without the gray/brown

contrasts of the spring male because wing is almost uniformly reddish brown; usually distinguished by a blackish spot about the middle of the outer third, just beyond postmedial line, this being a visible component of the otherwise obsolescent subterminal band. Hindwing as in spring form but with more dark shading in anal angle, and without a blackish fringe. Undersurfaces clear, bright ochreous orange with one or two thin, dark transverse lines on hindwing. Hindtibia more than twice length of tarsus. Wing length: 9–12 mm (n = 120). **Summer brood female**—Larger and paler than any of those described above. Forewing light gray brown, sometimes with a faint olivaceous tint and a sparse sprinkling of dark scales, and with three subparallel transverse reddish-brown lines, of which the antemedial and medial, and sometimes also the postmedial, may be obsolescent; blackish spot in outer third, as in male, frequently present. Hindwing ochreous orange with grayish shading, and with or without blackish remnants of two or three transverse lines at inner margin, the largest of which is at anal angle. Undersurface of forewing dull ochreous with gray-brown shading toward apex and outer margin; of hindwing, light reddish-tan, thinly dusted with dark scales, and with or without one or more thin, brown, transverse lines; small discal spots present or absent; fringes gray. Wing length: 11–13 mm (n = 24).

Spring and summer specimens are nearly always easily distinguished, with the possible exception of some from Florida, where some early season females may resemble summer ones. Otherwise there is no appreciable geographic variation.

Male genitalia remarkably similar to those of *Isturgia dislocaria*. Female genitalia not at all like those of *Isturgia*, but distinguished by an extraordinarily elongated bursa copulatrix.

I reared *Mellilla xanthometata* in 1985 from a summer brood female collected in the Shawnee National Forest in southern Illinois, obtaining 39 typical spring-brood offspring from the overwintering pupae. The larvae fed on honey locust, *Gleditsia triacanthos* Linnaeus, which had been determined as the host by J. H. McDunnough about 70 years previously, judging from a reared series of 13 adults and three inflated larvae from Decatur, Illinois in the U. S. National Museum of Natural History. Mention of the host and larva by Forbes (1948: 49) (“Caterpillar green with a tawny head, on honey locust”) was based on Mc-

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Dunnough's specimens. It was also reared from a larva on honey locust near Clarke Creek, Dauphin County, Pennsylvania, 1 August 1982 (Karl Valley), and from a larva on water locust, *Gleditsia aquatica* Marsh. in Florida, 1982 (H. D. Baggett, in USNM). The larvae are dimorphic with green and brown forms, which I describe separately. **Green form**—Mature larva leaf green, with a prominent white lateral stripe on lateral fold, slightly yellow tinted toward its dorsal edge, running from side of head to posterior end of body and down outer side of anal proleg. Spiracles lie at upper margin of lateral stripe. Dorsal area occupied by thin yellowish addorsal and subdorsal lines, and, between subdorsal and lateral stripes on each side, a thinner, often whitish, broken and somewhat wavy dorsolateral line. Ventral area marked with corresponding lines, but they are faint and discontinuous. Head leaf green to yellowish green, except for white lateral stripe and brownish mouth parts, and sometimes pinkish-brown shading above the white stripe; stemmata, tips of antennae, and spiracles brown; thoracic legs green; prolegs green except that first pair are tinged with pinkish purple laterally, actually on the integumental fold that overlaps base of proleg. Body of about average shape for the tribe, with head held in a prognathous position in repose, this position being further emphasized by the straight continuation of the white lateral stripe along the lateral margin of the head to the base of the antenna and mandibles. Length: 16–18 mm. **Brown form**—Variable from greenish brown to deep reddish brown or chocolate brown, with longitudinal lines as described for the green form clearly visible but somewhat reduced or darkened, to greatly reduced or obsolescent. White lateral stripe generally makes its appearance on the prothorax, the side of the head, and on the outer side of the anal proleg in even the darkest specimens. Head otherwise heavily tinted with the same shade of brown as the body, with little of the green color showing through; sometimes with a dark brown streak parallel to and above pale lateral area. Legs mostly concolorous with body.

Mellilla xanthometata occurs from southernmost Canada (Pele Island, Lake Erie—McGuffin, 1972: 14), Michigan, Illinois, Indiana, Ohio, Pennsylvania, and New Jersey to Florida and the Gulf States, and westward to Iowa (Marshall County, Polk County), Nebraska (Platte County), and to the eastern counties of Kansas,

Oklahoma, and Texas. The westernmost records are from Columbus, Platte County, Nebraska; and Plano, Collin County, Texas, just north of Dallas. The southernmost records are from Tampa, Florida and Montgomery County, Texas. The species is localized and obviously dependent upon the presence of the food plant. Honey locust is primarily a Mississippi Valley tree, native west of the Appalachians but widely planted as a shade tree elsewhere. The moth has extended its range accordingly; but much of its range in the Southeast may depend on the presence of water locust. The largest numbers in collections are from areas where *Gleditsia triacanthos* is native or common, as in Ohio, Illinois, Missouri, and Texas.

The spring brood flies mostly in May and perhaps into early June toward its northern limits, in April and May in the middle States, and as early as March from South Carolina southward, including Texas. The second brood appears in late June and July in the more northerly and middle states, and I am guessing that the many records for August throughout the distribution of the species are at least partly third brood emergences. With the much longer season southward, the records become confused, and records for March to September in Texas may represent at least four generations. In Louisiana, specimens were collected in every month except November, December, and February (V. A. Brou, in litt.); and in Ohio 5 April–1 June and 23 June–3 September (E. Metzler, in litt.).

GENUS

Trigrammia Herrich-Schäffer

Trigrammia Herrich-Schäffer, 1850–1858 [1855], *Samml. neuer oder wenig bekannter aussereur. Schmett.*, 1 (1): wrapper, pl. 62, fig. 347; [1856], *ibidem* 1: 28, 41.

Type species: *Trigrammia quadrinotaria* Herrich-Schäffer, [1855], *ibidem* 1 (1): wrapper pp. 63, 82, pl. 62, fig. 347. Monotypy.

This distinctive genus of the eastern United States presents a dilemma because the one recognized species has at least three very different geographic entities. Insufficient biological information is available to make a clear judgement, and until that need is fulfilled, I chose to follow a conservative approach in treating the complex as one polytypic species. As in the preceding genera, the chaetosemata deviate from the macariine norm in

being well separated, not connected by a continuous transverse row of setae crossing the midline behind the head. The pecten on the third abdominal sternum is wanting, and the eighth sternum lacks the usual deep notch or incision in its posterior margin. The hindtibiae of both sexes are only slightly swollen, those of the male more so than the female. The male genitalia are simplified and do not have the usual hornlike setae on the uncus. The unique vesica has one large, linear cornutus about three-fourths the length of the aedeagus (text figure 11 g). The female genitalia resemble those of *Speranza* species, with a large, stellate signum. The larva (plate 9, figure 11) is similar to that of *Macaria* but is distinctively marked with purplish spots and patches. The pupal characters are given in the key (p. 17). The species is host specific on species of *Aesculus* (Hippocastanaceae). Overwintering occurs in the pupal stage.

Trigrammia quadrinotaria (Herrich-Schäffer)

PL. 1, FIGS. 51–57 (adult); PL. 9, FIG. 11 (larva); TEXT FIG. 4 b (head); TEXT FIG. 11 e, g (♂ gen.); TEXT FIG. 12 b (♀ gen.) (RWH 6360).

Trigrammia quadrinotaria Herrich-Schäffer, 1850–1858 [1855], *Sammlung neuer oder wenig bekannter aussereuropäische Schmetterlinge*, I (1): wrapper, pp. 63, 82, pl. 62, fig. 347.

Type locality: North America.

NOTE—The specimen figured by Herrich-Schäffer is of the common, pale, distinctly but lightly marked form such as occurs across the Midwest from Ohio to Missouri.

Macaria quadriguttaria Walker, 1861, *Catalogue of Specimens of lepidopterous Insects in the Collection of the British Museum*, 23: 942.

Type locality: Not given. [BMNH]

NOTE—*Macaria quadriguttaria* is based on two syntypes, of which Walker described only a female, as though both were females. However, the surviving syntype examined proved to be a male in good condition. It is of the relatively rare, boldly marked, southern spring form illustrated (plate 1, figures 56, 57).

Macaria determinataria Walker, 1863, *Catalogue of Specimens of lepidopterous Insects*

in the Collection of the British Museum, 26: 1,654.

Type locality: Not given. [BMNH]

NOTE—Described from one female specimen, which represents the dark-suffused, southern spring form illustrated (plate 1, figure 55).

Deileia septemfluaria Grote, 1881, *Papilio*, 1: 41.

Type locality: Ohio [Dayton] (from G. R. Pilate). [BMNH]

NOTE—The holotype, which is a normal Ohio female of *quadrinotaria*, is labeled *D. septemlinearia*. The name *Deileia septemlinearia*, treated by authors as having been proposed by Grote (1882: 47), continued to appear without explanation in check lists up to and including the geometrid list by me (in Hodges et al., 1983). Upon rechecking, however, I found no original description and concluded that *septemlinearia* is an unjustified emendation or a misspelling of *septemfluaria* Grote, 1881.

Trigrammia quadrinotaria is a unique and easily recognized species of the eastern and midwestern United States with a milk-white to grayish-white ground color, variably dusted with dark brown, and with regular, often light brown, subparallel transverse lines. The medial line is usually prominent and nearly straight on both wings. A single or double extramedial black spot is usually present in the outer third of the forewing opposite the discal cell, and, unlike nearly all other Macariini, a corresponding spot may occur on the hindwing. The wing pattern is repeated, somewhat less intensely, on the undersurfaces. The wings are only slightly angulate but are much more so in Georgia and Florida. The moths are remarkably polymorphic geographically and perhaps in response to climate and elevation, and they may represent more than one species. Further description of the different forms follows:

COMMON FORM (PLATE 1, FIGURES 51–53). The form best represented in collections occurs mainly in or west of the Appalachians from southwestern Pennsylvania, West Virginia, and western Virginia through Ohio, Indiana, Illinois, Tennessee, Kentucky, and Missouri to Alabama, Arkansas, and eastern Kansas. I have also seen it from coastal South Carolina, from the Gulf States, and as a single record from Maryland. This form is commonly pale with discrete markings, agreeing with the type of *quadrinotaria* as illustrated by Herrich-Schäffer ([1855]), but in some the wings are uniformly suffused with a fine

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dusting of dark scales (as in the types of *quadriguttaria* and *determinataria*) or more coarsely so in specimens that seem intermediate to the following form from the Southern Appalachians. The moths fly from April to July, depending on latitude and elevation, and there is little or no evidence of more than one brood, regardless of the length of the season. No seasonal variation is apparent in this form. Wing length: males, 12–15 mm; females, 12–15 mm.

SOUTHERN APPALACHIAN FORM (PLATE 1, FIGURES 54, 55). Specimens that occur between 3,200' and 6,000' in the Appalachians of North Carolina and Tennessee to Virginia and West Virginia are unusually large, coarsely and sparsely dusted with dark scales, have the transverse lines diffuse and tending toward obsolescence, the black spots in the outer third of the wings large and often diffuse, and the outer margins rounded. This form is very different in appearance and would seem to be a distinct species except that there are no structural differences to distinguish it, and specimens from other mountainous areas in Kentucky and in Grayson County, Virginia, appear to be intermediate. Only by more extensive sampling and comparative rearing will it be determined whether this Southern Appalachian form is a species. Many specimens were collected at the following North Carolina sites, where it was common: Richland Balsam Mt., 6,000', Jackson-Haywood County line, 30 June–4 July 1967; Grandfather Mountain, Avery Co., 5,280', 14 July 1974; Balsam, Jackson Co., ca. 3,500', 21–24 June; same locality, 9–12 July 1974; and Waterrock Knob, 5,800', Jackson Co., 17 July 1974. Other specimens were collected on the Tennessee side of Great Smoky Mountains National Park near Gatlinburg and the Chimney Tops area, ca. 3,100 feet, and in Haywood Co., North Carolina (April, May). I have also seen it from West Virginia. Dates from April to mid-July suggest two broods, and some early specimens are darker than summer ones, although elsewhere this species is univoltine. Wing length: males, 15–17 mm; females, 16–17 mm.

SOUTHEASTERN FORM (PLATE 1, FIGURES 56, 57). A third, rather elegant form that will attract attention is known from only a few spring specimens from several counties in northern and central Georgia, western Florida (Pensacola), and possibly Mississippi. It has sharply defined, cin-

namon-brown lines on a whitish background, and the wings are uniformly dusted with scales of the same color. An oblique, crescent-shaped discal marking between the antemedial and postmedial lines of the forewing is well developed (obsolescent or absent in other forms), and a dark brown terminal line is also unusually well developed, as are the boldly checkered fringes. The outer margin of the hindwing is quite strongly angled at CuA₁. All markings are repeated just as sharply on the underside. The specimens were collected in February and March (Florida), April, and early May. The types of both *Trigrammia quadriguttaria* and *T. determinataria* are of this form and may have been Abbot specimens from Georgia.

The genitalia of *T. quadrinotaria* are as described for the genus and figured (text figures 11 *e*, *g*; 12 *b*). The male genitalia show no particular similarity to those of any other species, and the female genitalia are generalized, with features thought to be primitive within the tribe, such as a large stellate signum and simple sterigma.

The species was first reared (1991) by J. E. Rawlins (pers. comm.) from larvae found on sweet buckeye, *Aesculus octandra* Marsh. (Hippocastanaceae), in western Pennsylvania. In June of the following year I collected females on Walker Mountain near Marion, Smyth County, Virginia, and reared several broods from eggs on sweet buckeye. I also found one larva on the same species of tree and reared an adult from it. Although Rawlins reported (pers. comm.) that his larvae would also accept the introduced European horsechestnut, my broods rejected two hybrid cultivars involving Palearctic horsechestnuts from a local botanical garden and would feed only on *Aesculus octandra* and on red buckeye, *A. pavia* Linnaeus, showing no discrimination between them. The distribution of *T. quadrinotaria* coincides so well with that of the eastern species of *Aesculus* that there would seem to be no other host. The description that follows is based on live larvae from Smyth County, Virginia.

The larva occurs in two forms, one being green with deep reddish-purple segmental spots or patches, and the other green with few or no dark markings. Every degree of intergradation between the two extremes may be present in the same brood, but larvae with purplish markings are more numerous than those without. The larvae are unusual for the tribe in having a smooth, shiny, translucent integument, and in being very active, readily dropping from the foliage when

disturbed and hanging by a silken thread, at least in early instars. All larvae turn pinkish brown when ready to seek a pupation site. Length at maturity: 23–28 mm. **Well-marked larvae**—Head dull yellow brown or yellowish green, with parietal lobes marked anterodorsally and ventrally (between stemmata and antennae), or entirely, with dark chestnut brown; clypeus yellowish. Body green with the thin, darker green dorsal vessel showing through translucent integument as a middorsal line; a white subdorsal line beginning on T1; and a yellowish lateral stripe beginning on A1 that may be interrupted or obsolescent. Conspicuous vinaceous or reddish-purple markings on each segment, comprised of the following parts: a dark patch or blotch occupying space between lateral stripe and subdorsal line and centered above spiracle; and beneath this and bearing the L3 and SV3 setae, a raised, dark, longitudinal bar evidently representing the enlarged and confluent pinacula of those setae. These dark purplish markings partly connected by less intense purplish shading across lateral area, often interrupting yellowish lateral stripe, and sometimes continuing faintly into dorsal area dorsad of white subdorsal line, thus making an almost complete dark but irregular transverse band around body in middle of each segment, leaving only ventral area clear green. Thoracic legs tinged with purple; prolegs deep purplish laterally, the color on first pair almost black, that on anal prolegs lighter, but bordered with blackish on each side down outer side of proleg. Anal plate yellow brown with small vinaceous pinacula. **Unmarked larvae**—Similar except that nearly all of the dark purplish markings are missing. Some of the subventral pinacula on the abdominal segments only, especially on the first proleg, remain purple. SV1 pinaculum at base of the A6 proleg is largest and shows as a raised black spot surrounded by reddish purple. All legs otherwise yellowish green. Head pale yellow brown, without dark markings except the black stemmata. Overall appearance of this form is of a plain green spanworm with thin white subdorsal line and somewhat thicker but interrupted whitish to yellow lateral stripe, and smooth, shiny, very translucent integument through which the pulsating motions of the dorsal vessel show clearly. The plain form without purple markings seems relatively uncommon, amounting to no more than 10 percent of those reared, although the one larva that I chanced to

collect from foliage of *Aesculus octandra* was of this form.

Trigrammia quadrinotaria is known from western Pennsylvania, West Virginia, the mountains of western Virginia and western North Carolina, and from Ohio, Indiana, Illinois, Tennessee, Kentucky, Missouri, South Carolina, Georgia, northwestern Florida, Alabama, Louisiana, Arkansas, eastern Kansas, and Kerrville, Texas. The last is the only one I saw from Texas (11 April 1907, F. C. Pratt, in USNM) and might be considered doubtful were it not that *Aesculus pavia* Linnaeus has been reported from Kerrville, Kerr County (Sargent, 1922: 707, 710, as *A. discolor* Pursh.). *Aesculus glabra* Willd. also occurs in Texas. The Florida records are from Pensacola and from Torreya State Park, Liberty County. This moth may be expected almost anywhere in the eastern United States where native species of *Aesculus* occur.

Trigrammia quadrinotaria flies from February to July, varying with latitude and altitude, but I am aware only of records for February, March and April in Florida; April and May in Georgia; and March and April in Louisiana. Despite the wide range of dates, the species appears to be single brooded. Those that I reared from females collected in May produced no emergences until the following spring. The dates for the southern Appalachians, from mid-April to mid-July, are from sites at different altitudes and very different life zones.

GENUS

Speranza Curtis

Diastictis Hübner, 1816 [1823], *Verzeichniss bekannter Schmettlinge* [sic]: 288.

Type species: *Geometra artesiaria* [Denis and Schiffermüller], 1775, by monotypy. HOMONYM.

NOTE—*Diastictis* Hübner, [1823] is a junior homonym of *Diastictis* Hübner, 1818, *Zuträge Samml. exot. Schmett.*, 1: 21, in the Lepidoptera, Crambidae.

Speranza Curtis, 1828, *British Entomology*, 5: 225.

Type species: *Speranza sylvaria* Curtis, 1828. Original designation.

NOTE—*Speranza sylvaria* is a junior synonym of *Geometra brunneata* Thunberg, 1784, *Diss. Ent. sistens Insecta Suecica* (1): 9.

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Halia Duponchel, 1829 [4 April], in Godart and Duponchel, *Hist. nat. Lépid. Papillons Fr.*, **7**: 107; 1829 [12 December], *ibidem*, **7**(2): 400. HOMONYM.

Type species: *Phalaena wauaria* Linnaeus, 1758. Original designation but cited by Duponchel as *wavaria*, an incorrect subsequent spelling.

NOTE—*Halia* Duponchel is preoccupied by *Halia* Risso, 1826, *Hist. nat. Eur. méridionale*, **4**: 52 (Mollusca).

Grammatophora Stephens, 1829 (June), *Nom. British Insects*: 44.

Type species: *Phalaena wauaria* Linnaeus, 1758, designated by Hulst, 1896, *Trans. Am. Ent. Soc.*, **23**: 331, but cited as *wavaria*, an incorrect subsequent spelling.

Eupisteria Boisduval, 1840, *Genera Index meth. eur. Lep.*,: 102.

Type species: *Geometra quinquaria* Hübner, [1822] 1796, designated by Fletcher, 1966, *Entomologist's Gazette*, **7**: 15.

NOTE—*Geometra quinquaria* is a junior subjective synonym of *Geometra brunneata* Thunberg, 1785, *Diss. ent. sistens Insecta Suecica*, (1): 9.

Thamnonoma Lederer, 1853, *Verh. zool.-bot. Ver. Wien*, **3** (Abh.): 179, 227, 232.

Type species: *Phalaena wauaria* Linnaeus, 1758.

NOTE—*Thamnonoma* was proposed as an objective replacement name for *Halia* Duponchel, and it has the same type species.

Fidonia Herrich-Schäffer, 1855, *Syst. Bearbeitung Schmett. Eur.*, **6**: 111, 128. HOMONYM.

Type species: *Geometra pinetaria* Hübner, [1799] 1796, which is a junior synonym of *Geometra brunneata* Thunberg, 1784.

NOTE—*Fidonia* Herrich-Schäffer, 1855 is preoccupied by *Fidonia* Treitschke, 1825 (Geometridae: Ennominae).

Eufitchia Packard, 1876, *Rep. U. S. Geol. Geog. Surv. Terr.* [Monograph Geometrid Moths of the U. S.], **10**: 200, 247.

Type species: *Abraxas ribearia* Fitch, 1848, *Trans. New York St. Agric. Soc.*, **7**: 461, figs. 1–11, by monotypy.

Catastictis Gumpfenberg, 1887, *Nova Acta Acad. Caesar. Leop. Carol.*, **49**: 329, 343, 370.

Type species: *Abraxas ribearia* Fitch, 1848.

NOTE—Proposed unnecessarily as a replacement name for *Eufitchia* Packard, 1876 and has the same type species.

Elpiste Gumpfenberg, 1887, *Nova Acta Acad. Caesar. Leop. Carol.*, **49**: 329 (key).

REVISED SYNONYMY.

Type species: *Halia tripunctaria* Packard, 1873, by subsequent monotypy.

NOTE—*Elpiste* was nomenclaturally available, but without included species until Gumpfenberg, 1896, *ibidem*, **65**: 297. *Halia tripunctaria* is a junior synonym of *Tephрина lorquinaria* Guenée, [1858] 1857.

Physostegania Warren, 1894, *Novit. Zool.*, **1**: 406.

Type species: *Stegania pustularia* Guenée, [1858] 1857, in Boisduval and Guenée, *Hist. nat. des Insectes, Spec. gen. des Lépidoptères*, **10**: 49. Original designation.

Dysmigia Warren, 1895, *Novit. Zool.*, **2**: 134, REVISED SYNONYMY.

Type species: *Fidonia loricaria* Eversmann, 1837, *Bull. Soc. imp. Nat. Moscou*, **1837**(6): 59. Original designation.

Sympherta Hulst, 1836, *Trans. Am. Ent. Soc.*, **23**: 320, 338. HOMONYM.

Type species: *Halia tripunctaria* Packard, 1873. Original designation.

NOTE—*Sympherta* Hulst is preoccupied by *Sympherta* Förster, 1868, *Verh. naturh. Ver. preuss. Rheinh.*, **25**: 196 (Hymenoptera), and is a junior objective synonym of *Elpiste* Gumpfenberg, 1887.

Gladela Grossbeck, 1909, *Ent. News*, **20**: 353.

Type species: *Halia tripunctaria* Packard, 1873. Original designation (for *Sympherta* Hulst, 1896).

NOTE—*Gladela* was proposed as a replacement name for *Sympherta* Hulst, 1896, and it is a junior synonym of *Elpiste* Gumpfenberg, 1887.

Proutictis Bryk. 1938, *Parnassiana*, **5**: 54.

Type species: *Geometra artesiaria* [Denis and Schiffermüller], 1775. Objective replacement name for *Diastictis* Hübner, [1823], which is preoccupied by *Diastictis* Hübner, 1818.

Speranza is a mainly North American group formerly included in the genus *Itame* Hübner, “1816” [1823]. The type species of *Itame* is the European *Geometra vincularia* Hübner, “1796”

[1823], subsequently designated by Hulst (1896: 331). It became apparent to me early in this revision that *vincularia* represents a different taxon, not the “*Itame*” of North American collections; thus, it became necessary to restrict the use of *Itame* to *vincularia* and perhaps a few related Palearctic forms. This meant transferring to another genus the whole American assemblage of about 50 species, plus the four or five Palearctic or Holarctic species related to them. Scoble (1999) reached a similar conclusion with respect to *vincularia* but included the others plus *Epelis* within an expanded concept of *Macaria*. I chose to retain a separate genus for what we used to know as *Itame* in North America. Of the many synonyms, the next available name is *Speranza* Curtis, 1828, whose type species is none other than our familiar transcontinental and holarctic *Speranza brunneata* (Thunberg). Despite its rust-brown color and mainly diurnal habits, *brunneata* typifies well the majority of New World *Speranza* species.

Itame vincularia differs from all species of *Speranza* in having large chaetosemata that are widely separated as in *Isturgia*, *Eumacaria*, *Trigrammia*, and *Mellilla*; bipectinate female antennae with branches about half as long as the very long branches of the male; relatively elaborate male genitalia with a unique pattern of conspicuous ridges on the inner face of the sacculus, which also is unusual in having a somewhat angular shape; no apparent valvula; a curiously shaped tegumen with wide “shoulders” where the abruptly narrower uncus and gnathos are attached; a broad vinculum so deeply emarginate ventromesially as to appear bilobate; an unusual aedeagus with wide, flared sides at the proximal end; distinctive female genitalia with a complex sterigma, ostium, and wide, sclerotized “neck” but no real ductus bursae, the whole more suggestive of the *s-signata*-group of *Rindgea* than of *Speranza* except that a signum is present. *Itame* agrees with *Speranza* in lacking the pecten on the third abdominal sternum, having an incised eighth sternum, a slender hindtibia, wide pectinate antennae, and a stellate signum.

Speranza differs from *Macaria* in having bipectinate male antennae with quite long branches (a few *Macaria* species do have bipectinate antennae with very short branches; for example, *aequiferaria*); in the presence of a valvula in the male genitalia; in being univoltine, even in warm climates, with the exception of the atypical *gra-*

phidaria- and *pallipennata*-groups of the Southwest; in overwintering in the egg stage rather than as a pupa; in having a greater degree of sexual dimorphism, including even brachyptery in females of some species groups, such that they are assumed to be flightless or nearly so; greater diversity in larval markings and coloring, including apparent aposematic coloring in some species; and in multiple prespiracular furrows on segment A2 of the pupa in most species (present also in *Digrammia* but not in *Macaria* or *Psamatodes*). *Speranza* has greater diversity in the appearance of the larvae than *Macaria* or *Psamatodes*. *Epelis* is almost a *Speranza* but lacks the third anal vein of the hindwing, has the crochets of the larva divided into two groups, a pupal diapause, the maxillae of the pupa extending as far as the tips of the antennae, and is considerably modified for diurnal flight. *Psamatodes*, which is also in this group of interrelated genera, has its own combination of characters that are discussed under that genus.

Within *Speranza* I recognize at least 10 species-groups with four species unassociated with a group. I provide introductory discussions of them in the text. Members of some species-groups are highly diverse in appearance but with only minor structural differences. Distinct among them are three groups with tropical or Mexican affinities; namely the *varadaria*-, *graphidaria*-, and *pallipennata*-groups. The latter two are primarily inhabitants of the southwestern desert regions from West Texas to southern California and thence into Mexico. The *varadaria*-group is southeastern, western, and Mexican but has only two species in the United States. I suspect that these groups are further differentiated from the bulk of the species than the usual morphological characters suggest. Some groups consist of a single species, such as *Speranza lorquinaria*, type species of *Elpiste*; but it appears to be a true *Speranza*, which is why *Elpiste* is now listed as a junior synonym. One of the three species previously included in *Elpiste* did prove to be generically distinct but without an available name. It appears in this work as *Letispe metanemaria*.

The species of *Speranza* are distributed across temperate North America from Florida and northern Mexico north almost to the limit of trees. Few species are present on the southeastern coastal plain, but they are richly represented in the northern states and southern Canada and especially so throughout the West. They diminish rapidly in

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peninsular Florida and south of the Mexican border, and only a few species that I think are related to *varadaria* reach Central America or farther. Species of *Speranza* are mainly host specific, as are other Macariini, and have species groups associated with *Ribes* (Grossulariaceae), *Ceanothus* and *Rhamnus* (Rhamnaceae), *Vaccinium* and a few other heaths (Ericaceae), *Prunus*, *Cercocarpus*, *Physocarpus* and related trees and shrubs (Rosaceae), *Baccharis* (Asteraceae), and individual species on a few other plant genera. Species of *Ribes* host several major species-groups. Conifers and Fabaceae, much favored by many other Macariini, seem to be shunned by all *Speranza* species.

Most species of *Speranza* appear to be flourishing, at least in suitable, unimpacted habitats, but two Arizona species are unaccountably rare. *Speranza trilinearis* (Grossbeck) and *S. perornata* (Barnes and McDunnough) have not been collected for many years, and *trilinearis*, once abundant throughout Arizona, appears to be extinct.

The *varadaria*-GROUP

These moths form an isolated group of three or more species, which might, with some justification, be regarded as a distinct genus or subgenus. I chose not to treat them as a genus because their group characters probably would seem minor and unconvincing. Their connections appear to be with the Neotropical fauna; most species of *Speranza* are more northern and cool temperate. Members of the group share following features: relatively plain, unicolorous gray-brown wings and a tendency to have a wide, convex, reddish-brown band on the underside of the hindwing, between the postmedial and subterminal lines (obsolescent in *varadaria*); certain similarities in the genitalia; and larvae that feed exclusively on shrubs of the genus *Baccharis* (Asteraceae) as far as is known. These moths have a fovea in the male, and two of the species (*marcescaria* and *imitata*) have unusually long palpi.

The *varadaria*-group includes *Speranza varadaria* (Walker) (southeastern U. S.), *S. marcescaria* (Guenée), which was formerly placed in *Elpiste* (California), *S. imitata* (Druce) (Mexico and Guatemala), and possibly also *Cataspilates cinerea* Thierry-Mieg, 1910 (Brazil and Cayenne), and *Tephrotripsis semipallida* Warren, 1897 (Brazil), of which the last two appear to be

the same species. Both *Speranza marcescaria* and *S. imitata* are new combinations in this work.

The male genitalia of the *varadaria*-group are uniform, simple, and possibly primitive, as they retain features in common with several other genera. The uncus is of the *Macaria* type, with the usual pair of stout, dorsoapical setae. This series of species may reveal the derivation of the valvula, a small accessory lobe characteristically situated in the angle between the costal and saccular lobes of the valve. It would appear to be homologous with part of the subperipheral ridge of the inner face of the saccular lobe (as it occurs, for example, in *Macaria*), which separated, enlarged, and migrated toward the angle between the lobes, where it is located in most species of *Speranza*. In the *varadaria*-group, however, the migration was incomplete, and it remains part way out on the margin of the saccular lobe. The setose papilla on the inner face of the saccular lobe, as seen in *Macaria* species of the *signaria*- and *notata*-groups, is present, often only as a vestige, although it is fully developed in *S. imitata*.

The larvae (*varadaria*, *marcescaria*) are much alike and similar in their markings to larvae of many species of *Macaria*. Those of *marcescaria* have the usual green and brown forms, but for *varadaria* only green larvae are known. The Mexican species, *S. imitata*, was reared from *Baccharis conferta* H. B. & K. in Veracruz and Morelos by W. A. Palmer in 1989, as part of a program to find natural enemies that might be introduced to help control *Baccharis* in Australia. Reared adults from those rearings are deposited in the U. S. National Museum of Natural History.

Speranza varadaria (Walker), NEW COMBINATION

PL. 1, FIGS. 58–61 (adult); PL. 9, FIG. 12 (larva); TEXT FIG. 13 *a*, *c* (♂ gen.); TEXT FIG. 13 *b* (♀ gen.) (RWH 6314).

Caberodes? varadaria Walker, 1860, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **20**: 251.

Type locality: Georgia. [BMNH]

Macaria inaptata Walker, 1861, *ibidem*, **23**: 886.

Type locality: United States. [BMNH]

Aspilates abbreviata Walker, “1862” [1863], *ibidem*, **26**: 1673.

Type locality: Georgia. [BMNH]

Diastictis florida Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 334.

Type locality: Florida. [AMNH]

NOTE—Hulst did not indicate a holotype or mention the number of type specimens. As I wrote earlier (1973: 289), three specimens labeled as types exist, one in the AMNH and two in the USNM. Hulst was notorious for labeling additional specimens not mentioned in the original description as types (Rindge, 1955: 96). Therefore, I designate as the lectotype the one male specimen originally retained in the Hulst collection, now in the AMNH.

NOTE—The name *Aspilates donataria* Walker, "1862" [1863], doubtfully included in the synonymy of *S. varadaria* by me (1983: 89), is really a *nomen obscurum* (Ferguson, 1973: 289), as the type is lost, and it cannot be identified.

Speranza varadaria is the only brown species of the tribe in the Southeast with the following features: chaetosemata transversely elongated and very nearly meeting in the middle behind the head; male antennae bipectinate; foretibiae without an apical spine; hindwings not yellow, orange, or red, and wing pattern as illustrated (plate 1, figures 58–61). The food plant is groundsel-tree, *Baccharis halimifolia* Linnaeus (Asteraceae).

Forewing with apex slightly produced and pointed. Wing color yellowish brown to gray brown with dark brown transverse bands, and hindwing usually somewhat lighter than forewing; forewing with antemedial band thin, weak, roundly convex or slightly angled at discal cell; medial band weak, diffuse, almost straight and erect from inner margin; postmedial band nearly straight or outwardly concave, subparallel to outer margin, dark, bold, shaded outwardly with dark brown, which fades into a diffuse, reddish-brown subterminal shade. Hindwing similar but usually with postmedial band only; discal spots usually faint; fringes unicolorous gray brown. Underside darker, often with a gray-frosted appearance, and with forewing marked only by postmedial band and discal spot; hindwing with discal spot and a wide, well-defined but not contrasting, reddish-brown subterminal band immediately beyond postmedial band. Male antenna with longest branches equal to combined length of three antennal segments; front with prominent crest of long scales in lower half pointing straight forward and touching upper surfaces of palpi; palpi surpass anterior edge of eye by distance

equal to or more than greatest width of front. Hindtibia of male not enlarged. Wing length: males, 9–12 mm; females, 11–13 mm.

The sexual and seasonal dimorphism of this species is worth noting. Females are always grayish, much less distinctly marked than males, and relatively consistent in size the year round. Males are largest and darkest in the cool seasons (late fall, winter, early spring) (plate 1, figure 59), smaller and much more yellowish in summer (plate 1, figure 60). Both gray and yellowish males may occur together between seasons (e.g., in October). No geographical variation is apparent.

Male genitalia (text figure 13 *a, c*) clearly distinguishable from those of all other species in the Southeast, and from those of most other species of *Speranza* by the reduction and elongation of the valvula. Only in *L. marcescens* in our fauna has the valvula been so modified, and in that species it has migrated from its usual position in corner to a point farther out on margin of saccular lobe. In *varadaria* it appears to have begun this migration by extending well out along margin of saccular lobe.

Female genitalia (text figure 13 *b*) typical of and similar to those of *marcescens*, except that ostial pouch and sclerotized plate behind ostium are differently shaped, as shown.

Speranza varadaria has recently been reared extensively in connection with weed control research, and it has been approved for introduction into Australia to help control *Baccharis halimifolia*, an eastern North American shrub that has become a serious weed in Australia. This plant proved to be its only host. I reared *S. varadaria* from eggs laid by a female collected at the Archbold Biological Station, near Lake Placid, Florida, on 22 February 1985. Those larvae made possible the illustration (plate 9, figure 12) and the following description of the last instar. Mature larva 21–22 mm, slightly fusiform in its stretched-out resting posture, with head thrust forward prognathously, and anal prolegs somewhat extended posteriorly. Body green, with a wide white lateral stripe and narrow white subdorsal and ventrolateral stripes, which are better developed in some than in others. Spaces between white stripes occupied by many fine, wavy, parallel, longitudinal lines, mostly of a darker shade of green, but space between lateral and subdorsal stripe contains two or more thin, irregular, closely parallel, blackish lines, with the nar-

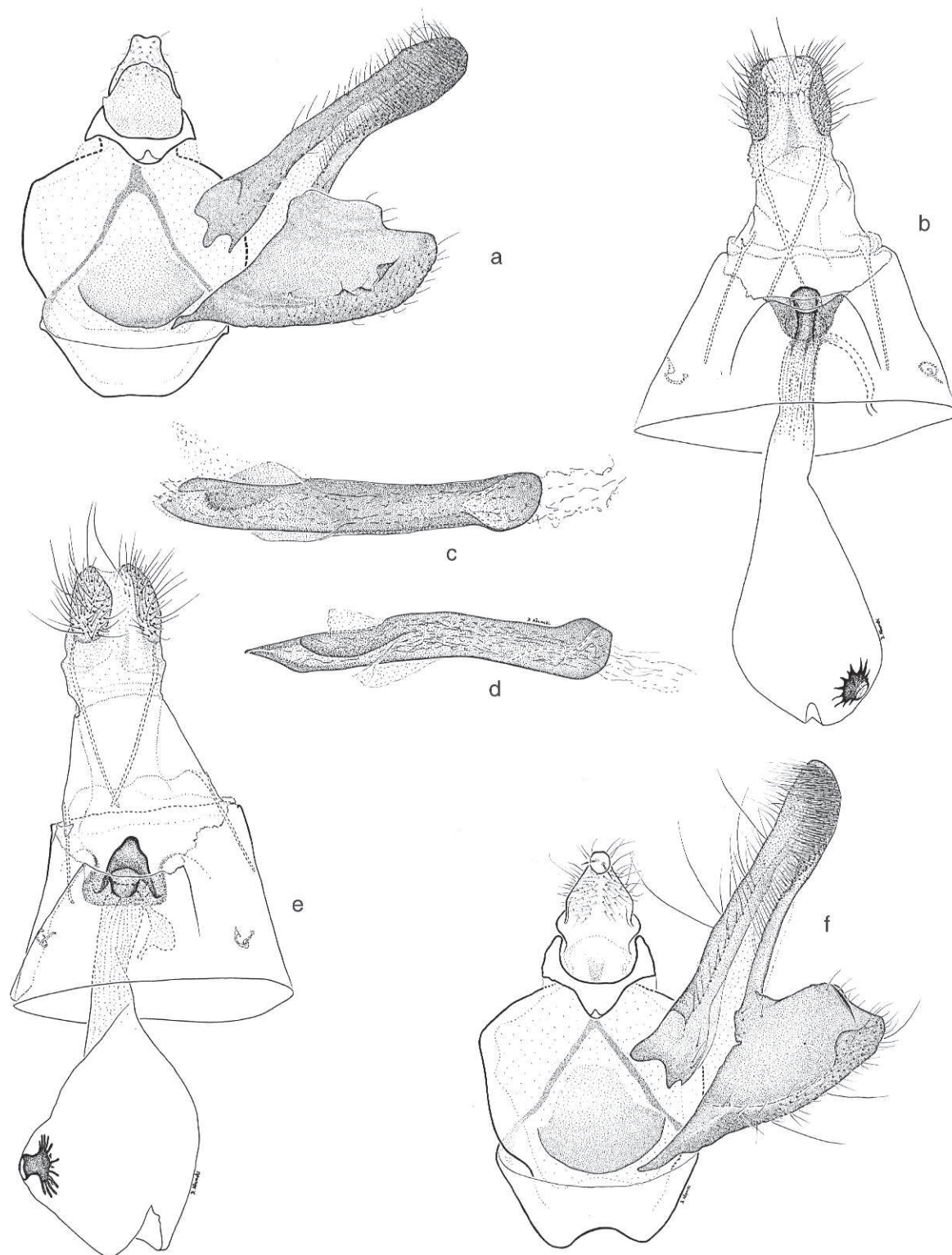


FIGURE 13: GENITALIA OF *SPERANZA* SPECIES

a. S. varadaria, male genital capsule; McClellanville, Charleston County, South Carolina (USNM 52133). *b. S. varadaria*, female genitalia; Lake Placid, Highlands County, Florida (USNM 57477). *c. S. varadaria*, aedeagus; McClellanville, Charleston County, South Carolina (USNM 52133). *d. S. marcescaria*, aedeagus; Napa County, California (USNM 57447). *e. S. marcescaria*, female genitalia; Napa County, California (USNM 57448). *f. S. marcescaria*, male genital capsule; Napa County, California (USNM 57447).

row space between them greenish white. A very fine whitish addorsal line may also be apparent. Spiracles brown. Head whitish to purple with pattern of many broken black bars or spots in upper half of parietal lobe, a whitish extension of lateral stripe on side of head, and a greenish patch frontally and continuing up epicranial suture. Thoracic legs dull greenish to brown; abdominal legs pink or purplish laterally. The larvae pupated in late March, and adults emerged a little more than two weeks later, on 13–15 April 1985.

Speranza varadaria occurs throughout Florida, including Key Largo, up the Atlantic Coast at least to the Santee River, South Carolina, and westward across the Gulf States to the vicinity of Houston, Texas and down the coast of Texas to San Patricio County. The distribution is mainly coastal, where the food plant may grow abundantly, although some specimens, including my reared brood, came from the middle of the Florida Peninsula, where some *Baccharis* is also present. The species may be present farther up the East Coast, as the range of *B. halimifolia* extends to Massachusetts.

The species is multiple brooded, flying throughout the year in Florida; from March to October in coastal South Carolina and Louisiana, and as late as December at Houston, Texas.

Speranza marcescaria (Guenée), NEW COMBINATION

PL. 1, FIGS. 62–64 (adult); PL. 9, FIGS. 13, 14 (larva); TEXT FIG. 13 *d, f* (♂ gen.); TEXT FIG. 13 *e* (♀ gen.) (RWH 6323).

Halia marcescaria Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 92.

Type locality: California. [USNM]

NOTE—Described from five males and one female, “Coll. Bdv. et Gn.” I designate as lectotype a male in the USNM from the Guenée collection that is labeled in red type on a red-bordered label: “Typicum Specimen.”

Halia cineraria Packard, 1871, *Proc. Boston Soc. Nat. Hist.*, 13: 392.

Type locality: California. [MCZ]

NOTE—Three syntypes survive in the MCZ; no lectotype has been designated. One male in the USNM from the Guenée collection is labeled: “*Halia cineraria* Pack. Type,” but it is probably a spurious type.

Speranza marcescaria is a pale yellowish to pale gray-brown, indistinctly marked, Californian spe-

cies formerly placed in the genus *Elpiste* Gumpenberg. The wings have a drab, faded, washed-out appearance. Some specimens, especially if worn, are almost immaculate on the upperside, but the wide brown band on the underside of the hindwing is usually apparent. This species is also peculiar in having long, porrect, pointed palpi in both sexes, similar only to those of *S. lorquinar-ia*. The palpi extend forward beyond the eyes a distance about equal to three-fourths the length of the foretibia. Both adults and larvae should be recognized easily from the illustrations and by their association with *Baccharis pilularis* DC.

Ground color as described above, with only the following markings, all of which may be obsolescent: forewing with thin, dark, convex ante-medial band situated close to wing base, a nearly straight, similarly thin or diffuse, incomplete postmedial band, and a small, transversely elongated discal spot; space between postmedial and subterminal bands may be partly shaded with dark scales, forming a wide but usually faint band, which may be emphasized by a straight or double, diffuse patch of black scales opposite discal cell, and by a brown patch at costa. Forewing somewhat falcate, with a dark fringed concavity on outer margin just behind the acute apex. Hindwing prominently angled in middle of outer margin, unmarked or with faint postmedial band. Underside of forewing with faint, brown, medial and postmedial bands, a dark brown, subapical patch marking place where postmedial band reaches costa, and pale, sometimes whitish shading between subapical patch and apex. Underside of hindwing with thin, diffuse, brown, convex medial band, and a uniformly wide, convex, well-defined, dark brown postmedial band, often variegated with light reddish or yellowish brown. Fringes unicolorous above and beneath except for at least partial darkening in concavity of forewing outer margin.

Male antenna bipectinate with length of branches about equal to twice thickness of shaft; female antenna not quite simple but appearing serrate because of extended points at distal corners of each segment. Palpi long, as described in opening paragraph above. Legs slender, including hindtibia. Body concolorous with wings, but abdomen marked dorsally with minute, paired, black, segmental dots that become progressively smaller posteriorly. Wing length: males and females, 13–17 mm. Early season specimens

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(March–June) generally larger than later ones (July–September).

No geographical variation is apparent except for a dark, sooty form represented by two specimens from the Point Reyes Peninsula, Marin County, California.

Male genitalia (text figure 13 *d, f*) most like those of *Speranza varadaria* except that tip of uncus is narrower; accessory lobe that is normally present at juncture of costal and saccular lobes is missing, or rather appears farther out on margin of saccular lobe (*varadaria* shows intermediate stage); outer margin of vinculum more deeply emarginate; and vesica has a larger sclerotized strip. Eighth sternum is similar but longer in *marcescaria*.

Female genitalia (text figure 13 *e*) have a distinctive, elongated, subtriangular, postostial plate; a wide, shallow, ostial pouch; and the ductus bursae shortened to point where there is almost none; stellate signum small, but with its center much extruded.

Many larvae found on *Baccharis pilularis* at Jenner, Sonoma County, were reared to adults by B. Scaccia, who supplied specimens and photographs. It was also reared from this plant at El Sabrante, Contra Costa County (1958) and Alpine lake, Marin County (1974) by J. A. Powell. The larvae occur as very different green and brown forms. Green form with body bright green, marked with numerous slightly irregular, broken, parallel, longitudinal white lines, all very fine lines except the wider, white to yellowish-white lateral stripe; lateral stripe also much interrupted and of indefinite outline when viewed under magnification. This variegated lateral stripe includes a characteristic white ring around seta L1 on segments A1 to A9. The usual dorsal, addorsal, and subdorsal stripes and their ventral counterparts are geminate, resulting in a multiplicity of fine lines. Spiracles light brown with a dark periphery. Head yellowish green, marbled with dark brown, at least dorsally. Stemmata dark. Thoracic legs dull gray green; prolegs green, but first pair with purplish-brown lateral patch. Brown form similar but with green ground color replaced by pinkish or purplish brown, and the pale markings pinkish or brownish tinted, not white. Abdominal segments with seta L1 also surrounded by a pale ring, and L2 sometimes similarly marked by a smaller ring. Vaguely delimited, wide, segmentally interrupted, dark subdorsal (supraspiracular) band, or segmental series of patches, may be present in

brown form. Head concolorous with body but more heavily marked with blackish spots or blotches than that of green form.

Speranza marcescaria is a common species wherever the food plant grows west of the Sierra Nevada in California from Mendocino, Sonoma, and Napa counties to San Diego, and it is present in Baja California Norte. It seems less common northward, but I have seen specimens from Klamath and Smith River, Del Norte County, and from Salem, Oregon. There are also records from Yosemite and from Lobo Canyon, Santa Rosa Island, Santa Barbara County, California. Material in collections is nearly all from coastal counties, especially from the region surrounding San Francisco Bay, where it can be abundant. I have seen records for every month except January, August, and November. Ten larvae collected by Brian Scaccia in Sonoma County on 23 September 1990 pupated in October and produced adults 9–15 days later. Adults that I collected in Napa County (plate 1, figure 63) were taken 15–16 September 1985 in a light trap set among thickets of *Baccharis*. It was taken at Salem, Oregon on 9 March 1955 (J. H. Baker), and on Santa Rosa Island on 23 May 1977 (S. E. Miller).

The *brunneata*-GROUP

This group includes five species (*brunneata*, *inextricata*, *exonerata*, *sulphurea*, and *amboflava*). In the male genitalia the ventral margin is heavily sclerotized and extended beyond the apex of the sacculus as a rounded lobe; a smaller interlobular process is in the notch between the ventral and posterior lobes of the valve, and the ventral plate formed by the eighth sternum is tapered evenly to the two posterior lobes of the plate. In other species groups the lateral margin of the sternal plate is flanged laterally with a posterolateral notch near the apex of the plate giving the two posterior lobes a shouldered effect. The posterior notch on the sternal plate is broad and V-shaped or U-shaped in *brunneata*, *sulphurea*, and *amboflava*, but is narrow and slitlike in *inextricata* and *exonerata*. In the female genitalia the sterigma is very small and inconspicuous. The adults frequent open bogs and barrens where the larval host plants in the Ericaceae, Betulaceae, and Salicaceae abound.

Speranza brunneata (Thunberg) The Ran-
noch Looper (U.K.); The Rusty *Speranza*,
NEW COMBINATION

PL. 1, FIGS. 65–70 (adult); PL. 9, FIG. 15 (larva); TEXT FIG. 2 *b* (venation); TEXT FIG. 14 *a, c* (♂ gen.); TEXT FIG. 14 *b* (♀ gen.) (RWH 6286).

Geometra brunneata Thunberg, 1784, *Dissertatio Entomologica sistens Insecta Suecica*, (1): 9.

Type locality: Upsala, Sweden.

Phalaena fulvaria Villers, 1789, *Caroli Linnaei Entomologica, Faunae Suecicae Descriptionibus Aucta*, 2: 329.

Type locality: Europe.

Geometra pinetaria Hübner, 1796 [1799], *Samml. eur. Schmett.*, 5: pl. 24, fig. 130.

Type locality: Europe.

Geometra quinquaria Hübner, 1796 [1822], *Samml. eur. Schmett.*, 5: pl. 100, figs. 516, 517.

Type locality: Europe.

Speranza sylvaria Curtis, 1828, *British Entomology*, 5: 225.

Type locality: Black Wood, Loch Rannoch, Scotland.

Eupistheria [sic] *ferruginaria* Packard, 1873, *Ann. Rept. Peabody Acad. Sci.*, 5: 78.

Type locality: Maine. [MCZ?]

Speranza brunneata is the only species of the genus with bright rust-colored wings, an apparent adaptation to diurnal flight. The males are deep rust and nearly without markings, and plain, bright ochreous beneath; and the females lighter and highly variable geographically, often light ochreous yellow with a full set of reddish-brown transverse bands. On the undersurfaces, the transverse bands in males are poorly developed, but in females they may stand out boldly on a yellow background, especially the evenly rounded post-medials. The male antennal branches are short, no longer than the combined length of two antennal segments. The eyes are slightly reduced but not as much as would be expected of a diurnal species. The species is holarctic, occurring also from northern Europe to eastern Siberia and Japan, and, like many northern moths, the adults are both nocturnal and diurnal. The size varies considerably, and wing length is given in the following discussion of geographical variation.

The moths vary little across most of the northern regions from the Atlantic Provinces and New

England to Alaska, in general closely resembling specimens from Europe. Wing length of northern specimens: males, 10–14 mm; females, 10–13 mm. Sexual dimorphism is least developed in specimens from the Atlantic Provinces, where some females are almost as dark as males, and these eastern specimens are also the smallest, not exceeding 12 mm in wing length. Those from the central region, e.g., from Michigan, Wisconsin, and Ontario, average somewhat larger and almost exactly match European specimens. Those from Alberta and British Columbia begin a Rocky Mountain trend toward still larger size and lighter, brighter females that continues southward to Colorado. Even some of the males from this region are pale and better marked (plate 1, figure 66), although not as boldly banded as females. The species reaches its largest size in Colorado (plate 1, figures 67, 68). The few seen from Washington and Oregon are not as large as those from Idaho, Montana, Wyoming, or Colorado, although the females may be unusually pale. Size range for Rocky Mountain specimens, British Columbia to Colorado: males, 13–15 mm; females, 12–16 mm.

The male genitalia of *S. brunneata* are small, with a short saccular lobe and disproportionately large interlobular process, which resembles a third lobe. The unit comprised of uncus and gnathos also seems relatively large and stout. The genitalia differ from those of *inextricata* and *exonerata*, to which I thought *brunneata* related, in that certain components, such as the saccular lobe of the valve, the uncus, and vinculum, tend to be shortened and widened. The aedeagi are almost identical. One noticeable difference is found in the shape of the incision of the eighth sternum—wide and V- to U-shaped in *brunneata*, reduced to a narrow slit in *inextricata* and *exonerata*.

The female genitalia hardly differ from those of *exonerata* or *inextricata* except for their smaller size and slightly more extensile ovipositor. The size of the signum is variable.

The larva has been described and illustrated in the European literature; for example, by South (1961: 315), who said that “the caterpillar is reddish brown with a black-edged dark-green irregular line along the middle of the back [middorsal line]; a white line on each side of the central one, and following this are a dark-brown, shadelike stripe and some brownish-green lines; the line along the spiracles [lateral stripe] is whitish, inclining to yellow. In general appearance it closely

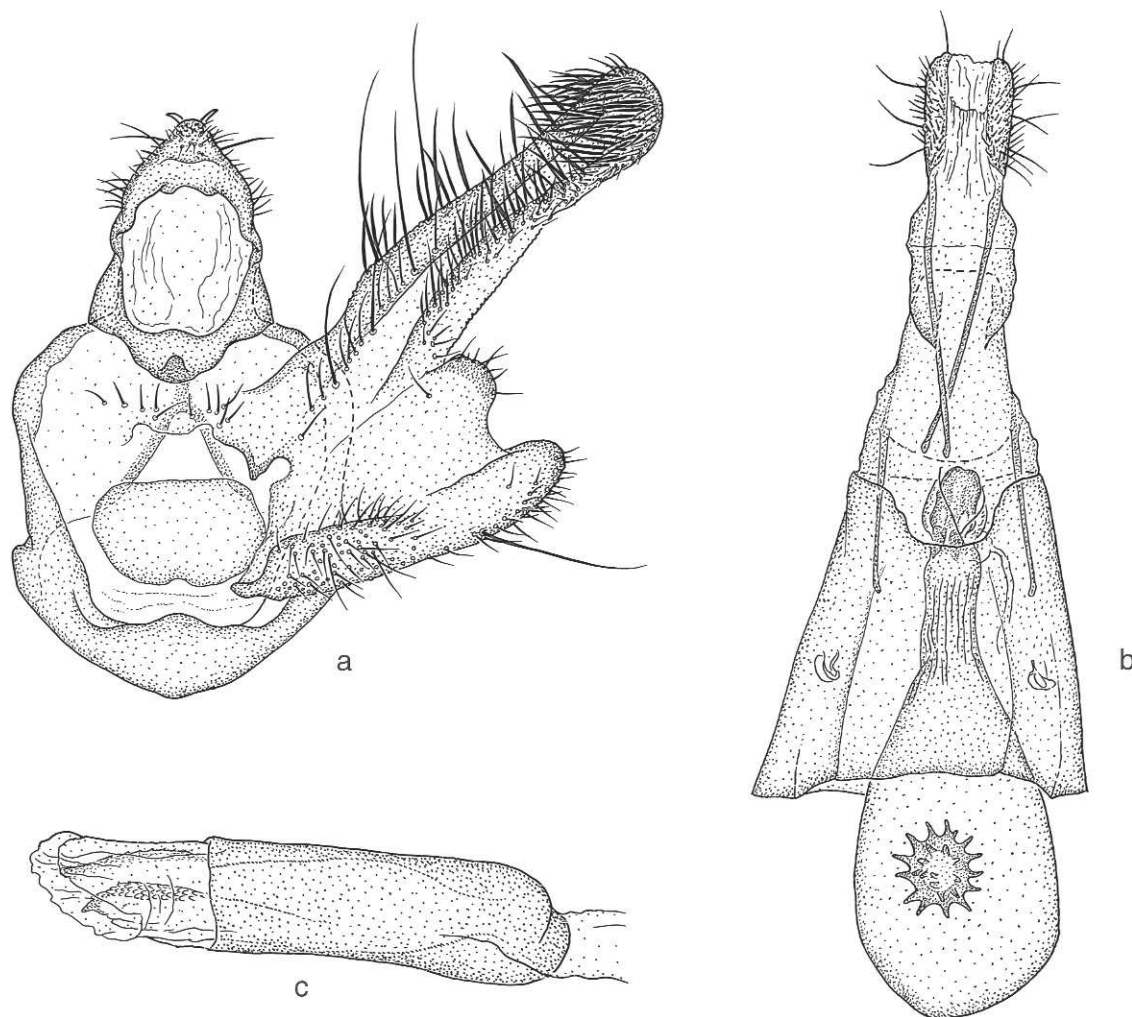


FIGURE 14: GENITALIA OF *SPERANZA BRUNNEATA*

a. Male genital capsule; Bartibog, New Brunswick (58014). b Female genitalia; Nipigon, Ontario (USNM 58015). c. Aedeagus; Nulato.

resembles a twig of bilberry [*Vaccinium myrtillus* Linnaeus] (Ericaceae), upon the foliage of which plant the caterpillar feeds in the spring." Prout (1915: 402) described it as having "a multitude of longitudinal lines, mainly green dorsally but with reddish-brown subdorsal stripe, white tinged with yellow laterally, dirty white ventrally." Nordström *et al.* (1941: 301) also described the larva (in Swedish) and illustrated it in color showing a rather dark purplish-brown dorsum, darkest dorsolaterally, and with thin, pale, longitudinal lines, a yellowish-white spiracular (lateral stripe), and dull whitish or grayish venter. The head is shown as dark brown. The pinacula are not black and conspicuous like those of *S. wauaria*. All European authors agree in listing as food plants species of *Vaccinium*, usually bilberry, *V.*

myrtillus Linnaeus or bog whortleberry, *V. uliginosum* Linnaeus, or both (e.g., Skou, 1986: 222). However, Nordström *et al.* (1941) mentioned birch ("in exceptional cases").

Little is known about the food plants in North America. The rearing of one adult from a larva on blueberry, *Vaccinium* sp., was reported by Wood (1951); and *Betula papyrifera* Marsh. (Betulaceae) was mentioned by Wong and Melvin (1969). McGuffin (1972) added *Populus tremuloides* Michx. (Salicaceae) and *Shepherdia canadensis* (Linnaeus) Nutt. (Elaeagnaceae), without giving details. As *S. brunneata* is mainly a species of open acid-soil habitats such as bogs, heaths, and blueberry barrens, both in Europe and North America, *Vaccinium* species would be likely hosts.

Speranza brunneata occurs across northern North America from Newfoundland and Labrador to Alaska, thence southward to Massachusetts, Michigan, Wisconsin, Minnesota, and eastern Oregon, and through the Rocky Mountain states of Montana, Idaho, Wyoming, and Colorado. The southernmost records seen are from high elevations at Silverton, San Juan County, Colorado. The flight period is about 27 June–12 August almost everywhere, although August specimens are mostly worn stragglers. The species is active by day, flying in bright sunlight when its fast, erratic flight is difficult to follow with the eyes. It is partly nocturnal and most specimens in collections were probably taken at light. I have collected it both ways.

Speranza inextricata (Walker), NEW COMBINATION

PL. 1, FIGS. 71–73 (adult); TEXT FIG. 16 c (♀ gen.) (RWH 6285).

Macaria inextricata Walker, 1861, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, 23: 889.

Type locality: East Florida. [BMNH]

NOTE—Described from one female, which I examined and found to have the typical orange hindwing coloring of Florida specimens. Walker described the color only as “luteous,” which reads as though it should refer *S. exonerata*, n. sp. Walker’s inadequate description, plus the scarcity of both species, led to many decades of uncertainty as to how the names should be applied, and the name *inextricata* was often used for the northern species, and *floridensis* Hulst for the southern one, even though both had been described from Florida.

Diastictis floridensis Hulst, 1898, *Can. Ent.*, 30: 164.

Type locality: “South Florida (Rautenberg).” [AMNH]

NOTE—Described from one female specimen. Others labeled as types, as, for example, one male in the collection of the Illinois Natural History Survey, are spurious.

As one of only three species of *Speranza* known to occur in Florida, and the only species restricted to Florida, *inextricata* is easily identified by its dark speckled orange hindwing and light brown, lightly banded forewing. It is closely related and similar to the more northern *Speranza exonerata*, which I describe as new, although the hindwing is orange instead of yellow.

Forewing light tawny brown, crossed by three regular, convex, darker brown, convex lines, of which often only the postmedial is distinct; postmedial often appears as a double line; discal spot faint; a round, dark brown spot often present in middle of outer third of forewing between M_3 and CuA_1 ; terminal line a series of small dark dots; fringes dusky, especially in anterior half of outer margin. Hindwing orange, crossed by three somewhat diffuse, convex, dark brown bands, a medial, postmedial, and subterminal, of which the postmedial is usually most prominent; discal spot slightly larger than on forewing, and spot marking middle of outer third of forewing in space beyond postmedial line is often repeated at corresponding position on hindwing, where it is obvious as the most prominent point in chain of spots or smudges comprising subterminal band; terminal line a series of separate dark spots, some of them in form of concave crescents between veins; fringes of hindwing faintly checkered in light and darker brown. Undersides of both wings orange to orange yellow, with essentially the same markings as above. Females brighter and more boldly marked than males, with more color contrast between forewing and hindwing. Wing length: males, 11–12 mm; females, 10–13 mm.

Male genitalia differing from those of *exonerata* only in the less developed preapical hump on inner face of saccular lobe, which, in *exonerata* (text figure 15 e), may be nearly as large as accessory lobe that is situated in angle between costal and saccular lobes. In *inextricata*, the preapical hump is decidedly smaller but may be variable. Sclerotized inclusion in aedeagus smaller and less sclerotized than that of *exonerata*.

Female genitalia of the two species hardly distinguishable, but *inextricata* appears to have a smaller sterigma and slightly less sclerotized, less rugose “neck” on bursa copulatrix. These slight differences were consistent in the three females of *inextricata* and two females of *exonerata* examined.

The early stages of *Speranza inextricata* are unknown.

Most records are from the central part of the Florida peninsula but only from as far south as Highlands, Sarasota, Charlotte, Lee, and Martin counties. Records from north of Volusia County are rare, but the holotype of *inextricata* was probably collected by Edward Doubleday during his 1838 sojourn at St. Johns Bluff, Duval County; and Kimball (1965: 178) reported it from Escam-

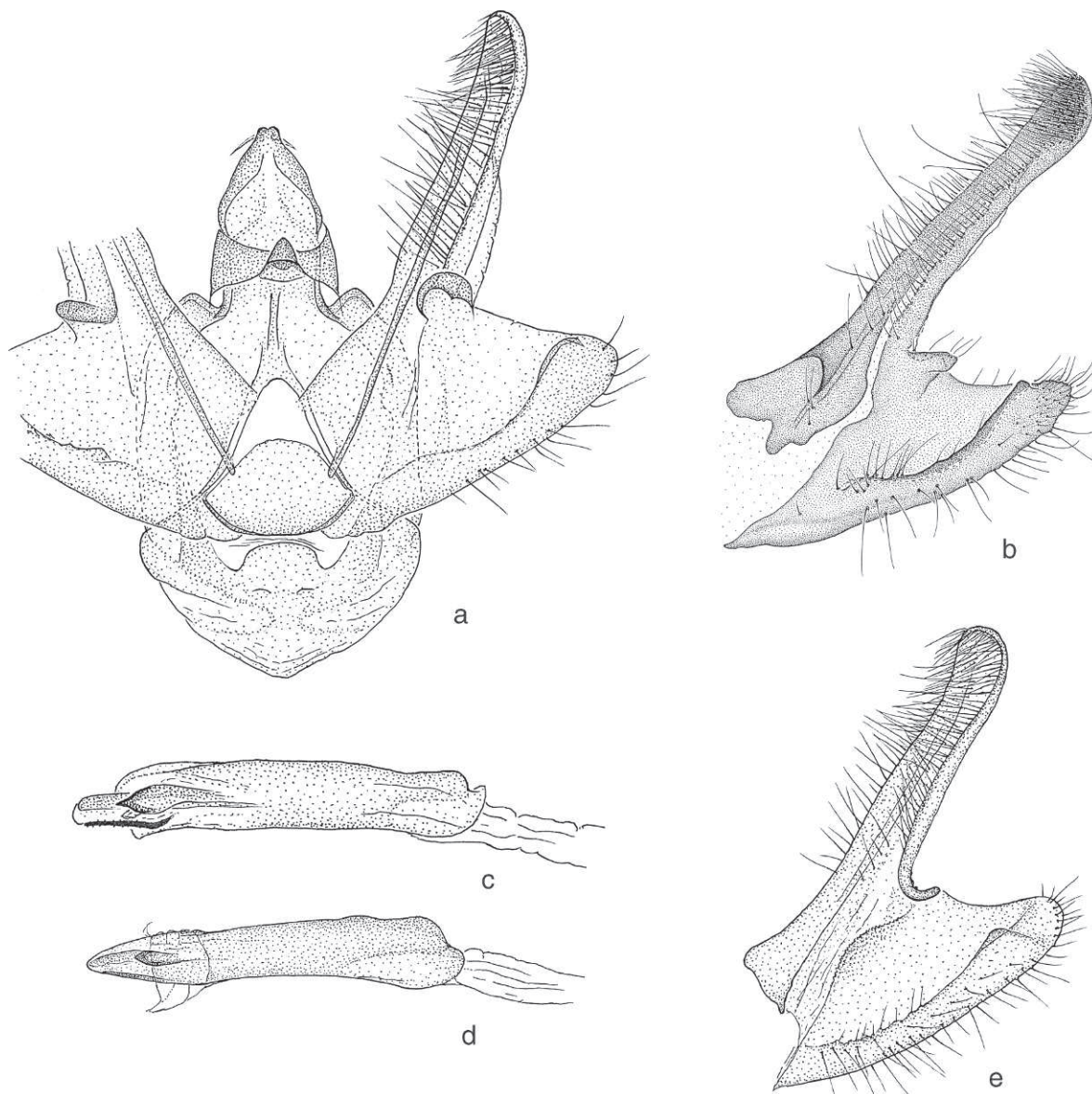


FIGURE 15: MALE GENITALIA OF *SPERANZA* SPECIES

a. S. sulphurea, genital capsule; Cape Breton Highlands National Park, Nova Scotia (USNM 58012). *b. S. amboflava*, right valva; British Columbia (USNM 57467). *c. S. sulphurea*, aedeagus; Cape Breton Highlands National Park, Nova Scotia (USNM 58012). *d. S. exonerata*, aedeagus; Lakehurst, Ocean County, New Jersey (USNM 58047). *e. S. exonerata*, right valva; Lakehurst, Ocean County, New Jersey (USNM 58047).

bia and Okaloosa counties in northwestern Florida. I have not seen those specimens. Little can be said of the habitat, except that the species occurs in the central Florida sand scrub at the Archbold Biological Station, Highlands County.

All material of this species was collected in the period March–May, mostly in April and May, which indicates that it is univoltine. I examined 68 specimens. Although the brightly colored hindwings might be thought to indicate diurnal

flight, most of the available specimens evidently were collected at light.

Speranza exonerata Ferguson, NEW SPECIES

PL. 1, FIGS. 74–76 (adult); TEXT FIG. 15 *d*, *e* (♂ gen.); TEXT FIG. 16 *b* (♀ gen.).

Speranza exonerata Ferguson.

Type locality: West Tisbury, Martha's Vineyard, Massachusetts. [USNM]

This is the mainly northeastern and middle Atlantic species that has long been identified as *Speranza inextricata* in collections. It is superficially similar to the true *S. inextricata* of Florida except that the ground color of the hindwing and underside is light yellowish, not orange; and all wing surfaces have a more densely granular appearance, especially in females. The males might be mistaken for those of *S. sulphurea*, except that the hindwings and undersurfaces of *sulphurea* are not predominantly yellowish. The fore- and hindwings of *exonerata* are different dorsally but colored alike ventrally. In males of *S. sulphurea* the wings are more nearly alike dorsally, the hindwing being only slightly lighter and not yellow, but different ventrally, where the forewing is darker than the hindwing.

Forewing light gray brown, often appearing slightly granulated or mottled because of a mixture of lighter and darker scales; transverse lines of forewing as in *inextricata* but less distinct to obsolescent, diffuse, most apparent toward costa; usually with no transverse line consistently standing out as more distinct than the others, and with postmedial appearing double in fewer than half the specimens; discal spot nearly absent; small dark spot in middle of outer third, between M_3 and Cu_1 , often apparent but weak, not as conspicuous as that of *inextricata*; terminal line a series of minute dark dots; fringes unicolorous, slightly darker gray toward apex. Hindwing dull, light yellow, heavily and uniformly sprinkled with dark gray-brown scales or aggregations of dark scales, of which the latter may be lined up to form irregular transverse bands, especially in females, corresponding to those of *inextricata* but less definite; discal spot not conspicuous; dark spot in middle of outer third present or absent, not as obvious as that of *inextricata*; terminal line appearing as a few irregular dark dashes; fringes light gray brown to yellowish, faintly checkered. Undersurfaces of both wings light yellow, uniformly dark speckled; transverse bands dark gray brown to reddish brown, present or absent, usually obsolescent in males, conspicuous in females; postmedial band usually the best-defined band on both wings, and that of forewing sometimes double; underside of fringes yellowish, darker toward apex on forewing. Structure of head, antennae, palpi, legs as in *inextricata*. Wing length: holotype, 13 mm; other males, 11–13 mm; females, 11–13 mm. This species is slightly

larger than *inextricata*, the wing length averaging about one mm more in both sexes.

In the male genitalia (text figure 15 *d, e*), the preapical hump on the saccular lobe of the valve is better developed than that of *inextricata*, being nearly comparable in size to the small accessory lobe that occupies the angle between the costal and saccular lobes; also, the sclerite in the aedeagus is larger in *exonerata*, its more heavily sclerotized part being about twice as extensive.

Differences in the female genitalia are barely discernible, but *exonerata* seems to have a slightly larger, more densely sclerotized sterigma and more sclerotization marking base of ductus seminalis. "Neck" region of bursa copulatrix consists of slightly thicker, more rugose integument.

The early stages of *Speranza exonerata* are unknown.

TYPES. Holotype ♂. USNM. West Tisbury, Martha's Vineyard, Dukes County, Massachusetts; 20 July 1947; D. C. Ferguson. Paratypes: (16 ♂, 47 ♀, 81 sex not indicated). Massachusetts. Same locality as holotype; 18 July 1947; L. R. Rupert (1 ♂). Barnstable, Barnstable County; 22 July 1950, 12 July 1952; C. P. Kimball (2 ♀). E Wareham, Plymouth County; 4 July 1968 (1 ♂). New Jersey. Lakehurst, Ocean County; 17 June–10 July; F. Lemmer (9 ♂, 21 ♀). Same locality; 22 June–3 July 1955; J. G. Franclemont (81 sex not indicated). Same locality; 29 June 1937, 8 July 1940; L. R. Rupert (2 ♀). Same locality; 16 June 1955, 27 June 1951, 26 June 1965, 1 July 1964; J. Muller (5 ♀). Short Hills, Lakehurst, Ocean County; 19 June 1949, 13 June 1950 (7 ♀). New Lisbon, Burlington County; 28 June 1941, E. P. Darlington (2 ♂). Whitesbog, Burlington County; 30 June 1940; E. P. Darlington (1 ♀). Milltown, Middlesex County; 13 June; ex larva (host not given); J. A. Grossbeck (1 ♀); Batsto, Burlington County; 2 July 1972, D. Schweitzer (1 ♀). Ocean County; 26 June 1949, 26 June 1952, 3 July 1950; O. Buchholz (1 ♂, 5 ♀). New York. Central Park, New York County; 4 July 1912; C. Kirschner (1 ♂). Orient, Long Is., Suffolk County; 17 July 1949, R. Latham (1 ♀). Pennsylvania. Mt. Pocono, Monroe County; 10 July 1965; T. N. Freeman (1 ♀). West Virginia. Lost River State Park, Hardy County; 28 June 1968, J. F. G. & T. M. Clarke (1 ♂). AMNH, CNC, CU, USNM.

Not all specimens examined are included in the type series. I saw additional specimens from Madison, Carroll County, New Hampshire; "pitch pine-scrub oak barrens"; 17 July 1985 and Resica Falls Scout Reserve, Monroe County, Pennsylvania; 12 June 1971, as well as more from some of the localities listed. All of the New Jersey localities are in the Pine Barrens region.

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Speranza exonerata is known from pine woods areas in New Hampshire, Massachusetts, southeastern New York, New Jersey, eastern Pennsylvania, and West Virginia. The flight period, 12 June–22 July, indicates that the species has a single, early to mid-summer flight period like most others of this genus. The moths are nocturnal and were nearly all collected at light as far as is known.

Although structural differences between *Speranza exonerata* and *S. inextricata* seem minimal, and some doubt might remain as to whether they are distinct species, all specimens are easily distinguished by wing color and external appearance. Also, there is about a 750-mile distribution gap separating them, although future collecting may narrow this distance.

Speranza sulphurea (Packard), NEW COMBINATION

PL. 2, FIGS. 1–5 (adult); PL. 10, FIG. 1 (larva); TEXT FIG. 15 a, c (♂ gen.) (RWH 6283).

Eupistheria sulphurea Packard, 1873, *Annual Rept. Peabody Acad. Sci.*, **5**: 77.

Type locality: Brookline and Natick, Massachusetts. [MCZ?]

NOTE—No lectotype has been designated. The only specimen in the MCZ with a type label is a male of *amboflava* from the Graef collection, obviously a spurious type of *sulphurea* because *amboflava* is western.

Thamnonoma sulphuraria Packard, Monograph of the Geometrid Moths or Phalaenidae of the United States, in Hayden, F.V., *Rept. U. S. Geol. Surv. Terr.*, **10**: 255. UNJUSTIFIED EMENDATION.

Diastictis olivalis Hulst, 1898, *Can. Ent.*, **30**: 164.

Type locality: not given. [USNM]

NOTE—The type is clearly a male of *sulphurea*, not *argillacearia* as listed by McDunnough (1938) and later by me (1953: 461). I corrected this synonymy in the last check list (Hodges et al., 1983: 89).

Speranza sulphurea is a sexually dimorphic, eastern, bog-dwelling species, of which the male is nearly the color of *Speranza argillacearia*, and the female somewhat resembles the bright-yellow form of *occiduaria*, although it is smaller, with the markings differently arranged. The yellow females have a characteristic brown-spotted ap-

pearance and are easily recognized; the males usually may be separated from those of *argillacearia*, *andersoni*, and others by the frequent presence of a forewing discal spot in the form of a small dark ring with a pale center. Some males that have the discal spot solid or absent cannot be distinguished by their appearance, but such specimens may be identified easily by the partial removal of scales from the underside of the eighth abdominal segment to expose the incision of the sternum (see below). Cranberry bogs are a favored habitat of this species. It is replaced in the West by the closely related *Speranza amboflava*, in which the sexes are alike and resemble females of *sulphurea*.

Male with forewing uniformly gray brown, or faintly tinted with olivaceous if very fresh, sometimes finely variegated with a paler shade that may show most clearly at costa as gray-brown and pale yellowish scales intermixed. One or two of the usual dark costal spots may show faintly, as well as a diffuse, dusky fragment of a postmedial band toward the inner margin. Discal spot a small dark ring, obsolescent in some specimens. Fringes concolorous with wing, not checkered. Hindwing usually paler than forewing, finely dusted with gray-brown scales, and also with a diffuse suggestion of postmedial band toward inner margin. Fringes gray brown. Underside similar, perhaps a little more coarsely mottled with yellowish, often becoming reddish brown toward apex; otherwise unmarked except for a broad, contrasting pale zone along inner margin of forewing that is not as noticeable in any other similarly colored species.

Female deep, bright yellow with paler hindwing, fading to pale yellow with age. Transverse bands of both wings each broken into one or two separate brown spots or chainlike series of dots. Subterminal band may be a complete or incomplete series of brown dots or a continuous band curved parallel to outer margin on both wings. Discal spot as in male but more prominent on hindwing than that of male. Fringes contrastingly darker, gray brown, sometimes with a violaceous tint. Underside much like upperside, with some of the dark markings better developed. Wing length: males, 11–15 mm; females, 10–13 mm.

The male genitalia are similar to those of *amboflava* but the valvula appears to be wider. Although adult males of *sulphurea* are often confused with those of *argillacearia* and *andersoni*, they are distinguished by two features of the

valve—the much more slender costal lobe, and the absence of the flap or papilla present in other species near the ventral margin of the saccular lobe, opposite the valvula. Another point of distinction is the shape of the notch in the posterior margin of the eighth sternum. The sides of the notch are widely divergent, giving it an open V shape in *sulphurea* and *amboflava*, rather than narrowly parallel basally and increasingly divergent posteriorly as in the other species. The differences are so conspicuous that virtually all males of *sulphurea* may be distinguished from closely similar specimens of *argillacearia* or *andersoni* under a dissecting microscope by gently brushing away the scales from the underside of the last abdominal segment before the genitalia.

In female genitalia, *sulphurea* seems to differ from species of the *argillacearia-andersoni-occiduaria*-complex mainly in having a larger signum. I have been unable to find distinguishing characters to discriminate between the female genitalia of *sulphurea* and *amboflava*.

I reared five adults of this species from larvae found on *Myrica gale* Linnaeus (Myricaceae) in a Nova Scotian peat bog in 1950 (plate 2, figures 4, 5), but kept no description other than to note that they were green with pale stripes. The specimen illustrated (CNC) (plate 10, figure 1) shows a green larva with a wide white lateral stripe running from side of head to anal proleg; dorsum with numerous thin, parallel, white lines; venter similar but a little paler or more yellowish than dorsum; spiracles inconspicuous; head light brown; thoracic legs yellow brown; prolegs green except for small reddish markings on anal proleg. The larva had been described earlier by Franklin (1907), who investigated the insect pests of commercial cranberry (*Vaccinium macrocarpon* Ait.) (Ericaceae) in the Cape Cod region of Massachusetts. Full-grown larva 18–20 mm; body green with fine, distinct, full-length, longitudinal whitish lines dorsally and less distinct ones ventrally, and a cream-colored lateral stripe just below the spiracles. Ventral surface lighter than sides or dorsum. Spiracles small, chestnut brown. Setae and their pinacula apparent but not conspicuous. Head less distinctly green than body, marked only with a forward extension of the cream-colored lateral body stripe that reaches the base of the mandible.

The larvae were so abundant in one Massachusetts bog that they considerably reduced the harvest of cranberries. They fed almost exclusively

on the tender terminal buds of the upright shoots in May or early June before the buds had developed to form new growth, either eating out the central portion, leaving only an outer shell, or devouring the entire bud. Most of the larvae found in early June pupated by the middle of the month. Pupation on the bog took place in the sand beneath the cranberry plants.

Adults were found flying in every bog visited in the vicinity of Carver, Wareham and Falmouth. Franklin claimed that *S. sulphurea* was double brooded, with adults of the first brood emerging from mid-June into July, and the second brood emerging in late July and early August. However, two broods would be unusual for a northern species of *Speranza* especially as *sulphurea* elsewhere seems always to be single brooded. Franklin described the adults and their sexual dimorphism in a manner that leaves no doubt as to the identity of the species that he studied.

Speranza sulphurea occurs from Newfoundland and southern Labrador to Massachusetts, Rhode Island, and Connecticut, westward to Michigan, Wisconsin and through most of Ontario; it would be expected in northern New York and perhaps New Jersey, but I found no records. It was taken at Orient, Long Island by Roy Latham, and I collected four specimens in Beckley bog, a very isolated sphagnum bog in Norfolk County, Connecticut, on 21 June 1965. The Long Island specimens may be the most southerly records. The overall flight period is about 10 June–19 August, but for any given region it is likely to be shorter. Some specific area flight periods are as follows: Newfoundland: 24 July–12 August; Nova Scotia: 8 July–2 August; Maine: 4 July–19 August; Great Lakes Region, including Michigan and Wisconsin: 10 June–10 August.

A series of both sexes (6 of each) from 6 miles east of Rennie, Whiteshell Provincial Park, Manitoba show signs in the males of being intermediate between *sulphurea* and *amboflava*. Four males are normal *sulphurea*, but the other two have partly developed markings of *amboflava* although the moths are essentially gray, not yellow. The females are normal *sulphurea*. These specimens are more like *sulphurea* than *amboflava*, however, and this must be reconciled with what I said about *amboflava* in Manitoba, where large, pure yellow males of *amboflava* are otherwise prevalent. Two males from Clay County, Minnesota (AMNH) are also pure *amboflava*. Appar-

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ently a narrow zone of hybridization occurs near the Ontario-Manitoba boundary.

Speranza amboflava (Ferguson), NEW COMBINATION
PL. 2, FIGS. 6–9 (adult); TEXT FIG. 15 *b* (♂ gen.); TEXT FIG. 16 *a* (♀ gen.) (RWH 6284).

Itame sulphurea amboflava Ferguson, 1953, *Can. Ent.*, **85**: 460.

Type locality: Calgary, Alberta. [CNC]

NOTE—I originally described this taxon as a new “race” of *sulphurea* but later (1983: 89) raised its status to species.

Speranza amboflava is the obvious sister species of *sulphurea*, replacing the latter species in the West. It lacks the conspicuous sexual dimorphism of the eastern species; both sexes are bright yellow and closely resemble females of *sulphurea*, although usually larger. The male genitalia of the two species are slightly different, and the habitats may be very different because there is nothing resembling a peat bog in most of the places where *amboflava* has been collected.

Sexes nearly alike; wings yellow, dusted or minutely striated with brown, and with all markings the same shade of light chocolate brown. Forewing with three costal spots, marking the costal ends of the antemedial, postmedial, and subterminal bands; a usually larger, round to wedge-shaped patch where postmedial line meets the inner margin; and a discal spot, which may be a ring with a pale center, or solid; transverse lines usually incomplete or obsolete; postmedial or subterminal, or both, sometimes in the form of a weak chain of dots or (rarely) a diffuse brown band; fringe almost solidly brown. Hindwing slightly paler yellow, with postmedial and subterminal bands and fringe corresponding to those of forewing. Underside similarly colored but more heavily dusted with dark scales. Like *sulphurea*, this species is bright or deep yellow when freshly emerged but may fade to a pale whitish shade when old. Wing length: males, 12–15 mm; females, 13–14 mm.

Speranza amboflava is subject to some geographic variation in color and size. However, the only really off-color specimen noted is one male (of several otherwise normal ones) from The Pas, Manitoba that has a pale grayish ground color, although the specimen is apparently fresh. It does not resemble *sulphurea* because it is marked like a female. Corresponding color variation occurs in

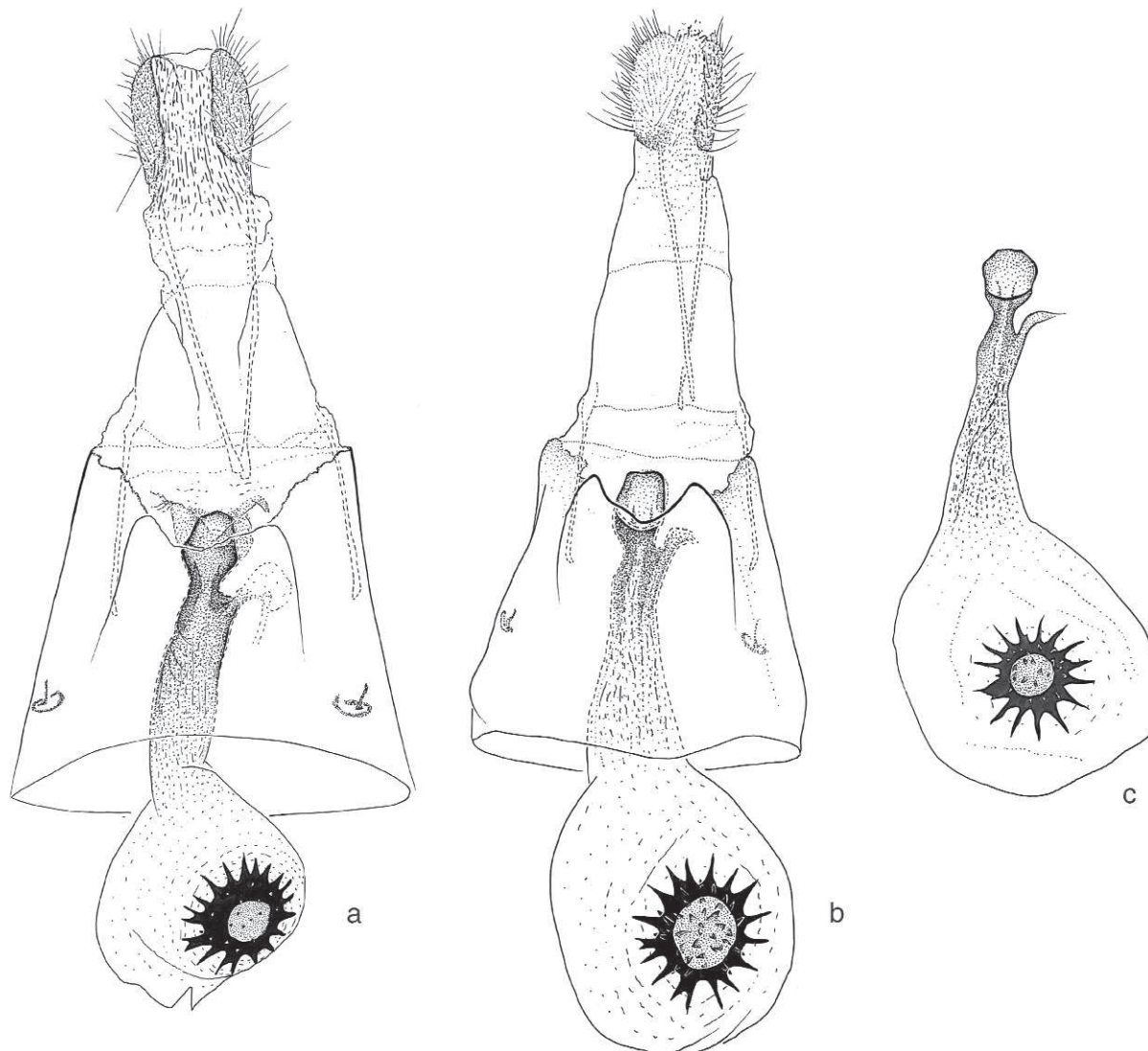
sulphurea in Wisconsin, where some of the normally yellow females may be pale grayish, while retaining female markings, unlike the gray males. Some females from Utah, California, and occasionally Colorado are intensely yellow but faintly marked, especially those from Utah. The largest specimens are northern, from western Canada, Montana, and Washington.

The male genitalia differ from those of *sulphurea* mainly in the nature of the valvula. In this as well as other species, it is in the form of an erect flange that appears to be an extension of the ventral margin of the costal lobe of the valve. However, the valvula is narrower in *amboflava*, extending outward along the costal margin of the saccular lobe only about half as far as that of *sulphurea*, forming a narrowed, somewhat tapering process rather than the broadly truncated process of *sulphurea*. The female genitalia cannot be seen to differ in any consistent way. Three males and three females of each species were dissected.

The early stages of *S. amboflava* have not been described, but I have seen two reared specimens. One is a fragmentary adult in the USNM reared from bearberry, *Arctostaphylos uva-ursi* (Linnaeus) Spreng. (Ericaceae) at Aweme, Manitoba (N. Criddle). The other is a reared adult from a larva on wild licorice, *Glycyrrhiza lepidota* Pursh (Fabaceae) near Nunn, Weld County, Colorado (R. Lavigne). The latter was collected as a larva 8 August, pupated 21 August, and emerged 25 August 1976 (Central Plains Experimental Range).

Speranza amboflava is known from Manitoba as far north as The Pas, and southward through Minnesota (Clay County), Iowa, the Dakotas, Nebraska, Kansas (Scott County), the Rocky Mountain states from Montana to New Mexico and Utah (not seen from Arizona), and thence westward at least to eastern Washington, Oregon, Modoc County, California, and in the Sierra Nevada to Nevada, Mono, and Tuolumne counties. There is no evidence that it is present in the Coast Ranges. I also saw specimens from Saskatchewan, Alberta, Idaho, Wyoming, Colorado, and Nevada. Most Californian records are from Mono County, and I collected it there at light in the canyon of Upper Lundy Creek, near Mono Lake.

The flight period extends from 26 May (Pateros, Washington), 15 June (South Dakota), and 20 June (Manitoba) to 26 August (Saskatchewan), with little apparent change from one region to another except that emergence tends to be earlier

FIGURE 16: FEMALE GENITALIA OF *SPERANZA* SPECIES

a. *S. amboflava*; Saskatchewan (USNM 57475). b. *S. exonerata*; Lakehurst, Ocean County, New Jersey (HWC 1782). c. *S. inextricata*; Venice, Sarasota County, Florida (HWC 1780).

southward. Some unusually late collection dates leave one guessing as to whether there is a second generation southward in the West. These are: 24–25 September 1999 (large series taken by G. Balogh in Scott County, Kansas), 1 September 1989 (Fort Collins, Colorado), and 2 September 1913 (Vineyard, Utah).

The *abruptata*-GROUP

This group includes *abruptata* and *umbriferata*, the only two species of Macariini associated with ninebark (*Physocarpus* spp., Rosaceae) as the larval host plant. The forewing in *abruptata* has

prominent black patches in the postmedial line that gives it the appearance of a species of *Macaria*, unlike other species of *Speranza*; these spots usually are in *umbriferata* also but are less obvious. The male genitalia are characterized by the relatively simple saccular lobe in which the raised, heavily sclerotized ventral margin does not reach the apex and there is no interlobular process; those of the female are characterized by the simple ductus bursae and ostial funnel, and the corpus bursae has an unusually large signum. The genitalia of the two species are indistinguishable and are described under *umbriferata*.

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Speranza abruptata (Walker), NEW COMBINATION
PL. 2, FIGS. 10–12 (adult) (RWH 6294, 6297).

Campptogramma? *abruptata* Walker, 1862, *Catalogue of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **25**: 1,326.

Type locality: St. Martin's Falls, Albany River, Hudson's Bay [Ontario]. [BMNH]

Diastictis pallidula Hulst, 1896, *Trans. American Ent. Soc.*, **23**: 334. NEW SYNONYMY

Type locality: Colorado. [AMNH]

NOTE—The holotype of *pallidula* is in poor condition, with no head, no abdomen, and no locality label. However, when I saw this specimen in September 1993, I identified it as a female of *abruptata*. Another possibility is that it is *S. umbriferata* as the two species are similar, but *umbriferata* has not been found anywhere near Colorado either. A possible foodplant for both, prairie ninebark, *Physocarpus intermedius* Rydb. is reported from Colorado.

This is an inconspicuous species of very localized occurrence in Ontario, Quebec, and the north-eastern and Midwestern United States, and it is the only species of Macariini known to be associated with ninebark, *Physocarpus opulifolius* (Linnaeus) Maxim. (Rosaceae). It is a small to medium, pale gray, to gray-brown, faintly brown-banded moth, whose most obvious wing marking is a black extramedial spot of two or more parts just distad of the intersection of M_3 and the postmedial line on the forewing. The species is easily confused with those of the *Macaria signaria*-group; and indeed, the name remained listed as a nonentity in that group for nearly a century until Rindge (1961: 1) showed it to be a species of *Itame* (now *Speranza*). The holotype, which I illustrated (Ferguson, 1974b: fig. 235), agrees with the specimens herein shown on plate 2, figures 10–12.

Sexes alike, except that female may be slightly darker than male. Forewing ground color light gray to nearly white, variably sprinkled or shaded with light, yellowish, gray brown to bluish gray, with nearly all the ground color obscured in darker specimens; yellowish-brown to dusky antemedial, medial, and postmedial bands present, the medial widest and often nearly straight; others only slightly convex from inner margin to near costa, then bending basad at about 45° to meet

costa; a less distinct subterminal band of same color may also be present, preceded and followed by some whitish shading, and distad of this again some dusky marginal shading; a black patch approximately at intersection of postmedial line and M_3 and dissected thereby into two to four parts, is characteristic feature of species, although similar spots are present in many other Macariini. Hindwing with more whitish ground color showing, crossed by three roundly convex, variably diffuse, subparallel, brownish transverse bands. Discal spot absent on forewing, nearly so on hindwing. Interrupted, thin, black terminal line may be present, and the concolorous fringes may be plain or somewhat checkered on both wings. Underside often showing stronger contrasts on both wings between heavily brown-dusted whitish ground and more boldly defined yellowish- to reddish-brown transverse bands. Bands on underside sometimes partly broken into series of spots. Male antenna bipectinate but with short branches, the longest being hardly equal to twice thickness of shaft. Wing length: males, 10–13 mm; females, 11–12 mm.

Neither the male nor female genitalia can be seen to differ appreciably from those of *umbriferata*, although the moths are so different in appearance and their distributions so widely separated that there can be little doubt that they are different species.

Larva whitish to light brown, with the usual longitudinal stripes gray dorsally and brown ventrally; lateral stripe wide, whitish, suffused in part with brown and bearing an oblong brown patch or streak in the middle of each segment beneath spiracle; head brown, lighter brown on parietal lobes; on *Physocarpus opulifolius* (Linnaeus) Maxim. (Rosaceae) in early June in Ontario; pupal period 17–20 days (McGuffin, 1972: 52, fig. 224e–1). Many specimens in the Cornell University Collection were reared from larvae on the same species of plant by E. R. Hoebeke (1980: 132) at Salmon Creek, Ludlowville, and Taughannock Falls State Park, both in Tompkins County, New York; near Harrisburg, Pennsylvania; and Fishing Creek valley School, Pennsylvania in 1979 and 1980. These larvae were collected in mid-May and produced adults 26 May–23 June, after a pupal period as short as 11 days.

Speranza abruptata has been such a poorly understood species that I list the localities of all specimens examined (in CNC, CMNH, USNM, CU, LACM), as follows: Quebec: Montreal. On-

tario: St. Martin's Falls, Albany River; Thunder Bay (on Georgian Bay); Asneritos Island, Georgian Bay; Stokes Bay, Pikes Bay, and South Sauble Beach, all on west side of Bruce Peninsula, Lake Huron; Port Franks; Arkona. New York: Ludlowville, Tompkins County; Taughannock Falls State Park, Tompkins County. Pennsylvania: near Harrisburg; Fishing Creek; Butler; Slippery Rock, Lawrence County; Clarion; Warrendale; Pittsburgh. Maryland: Fifteen-mile Cr., Green Ridge State Forest, Allegheny County; Sideling Hill, Washington County. West Virginia: 4 mi SW of Grand Cacapon, Morgan County. Michigan: Atlanta [Montmorency County]; Franklin [Oakland County] (USNM). Illinois: Chicago. Wisconsin: Nelson Dewey State Park, Grant County. Minnesota: Long Prairie, Todd County. Missouri: Pinewoods Lake, near Elsinsore, Carter County; Victoria Glade, 2.5 mi SE Hillsboro, Jefferson County. Colorado: locality unknown (type of *pallidula*).

McGuffin (1977) made a study of how the known distribution of *abruptata* fits that of the food plant, illustrated by a range map.

The recorded flight period is 26 May–30 July, mostly in June in the eastern and central United States, in July in Ontario.

The day before adding this paragraph to the manuscript, I encountered *abruptata* in the field for the first time while deliberately searching for it, collecting one adult (plate 2, figure 10) and losing two others on the banks of Fifteen-mile Creek, Allegany County, Maryland. Ninebark grows there, in its usual eastern habitat on or near river banks, including the rocky banks of clear mountain streams, and the shrubs may overhang the water or grow with willow and alder in open sunny places on the bank or on emergent gravel deposits at the side of the stream bed. The bedrock at this site is shale. The adults fly when the ninebark is in full bloom, and, although nocturnal, they may be flushed by day from the bushes or from the rank herbage growing near the food plant. The moths were easily confused in flight with similarly colored, readily disturbed small noctuids, such as *Zanclognatha pedipilalis* (Guenée) and *Chytolita morbidalis* (Guenée), which were common in the same habitat. The ninebark showed little evidence of larval feeding.

Speranza umbriferata (Hulst), NEW COMBINATION
PL. 2, FIGS. 13–15 (adult); TEXT FIG. 19 *e*

(♂ gen.); TEXT FIG. 18 *e* (♀ gen.) (RWH 6293).

Semiothisa umbriferata Hulst, 1887, *Ent. Americana*, **2**: 189.

Type locality: Soda Springs [Siskiyou County], California. [AMNH]

Semiothisa Diastictis umbrifasciata Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 332, NOMEN NUDUM (unjustified emendation).

This is a nondescript gray to gray-brown species of the northwestern states from central California to Washington and Montana. It is sexually dimorphic; males more so than females have a slightly angled hindwing outer margin, checkered fringes, and the wings only faintly marked with transverse bands; females have more prominent transverse bands. Females may closely resemble the non-dimorphic eastern *S. abruptata* except that the postmedial black forewing patch of that species is less conspicuous or missing in *umbriferata*. A close relationship between *umbriferata* and *abruptata* is further supported by their congeneric foodplants, their similarly short male antennal branches, and almost indistinguishable genitalia, including the shape of the eighth sternum. *Speranza umbriferata* is the only species of the genus in the Pacific Northwest with male antennal branches that are hardly longer than the width of the antennal shaft.

As the sexes are not alike, they are described separately. **Male**—Forewing dull gray to gray brown, with a thin, darker brown, regular, slightly concave postmedial, erect from inner margin, turning in and thickening slightly just before costa; antemedial, medial, and subterminal lines also marked as very weak brown spots at costa but otherwise obsolescent; outer third of forewing suffused with brownish toward outer margin, this dusky zone bounded proximally by a vague, zigzag, pale band representing a subterminal band. Hindwing paler, the dull whitish ground color dusted with gray-brown scales, and with a convex, fairly distinct postmedial band near middle of wing. Both wings with minute dark discal dots and somewhat checkered fringes. Underside of both wings yellowish brown, variegated with pale ground color showing through; most distinctly yellowish toward costa and apex of forewing; minute discal spots present on both wings. Male antenna bipectinate with short branches, the longest hardly longer than width of antennal shaft, as in

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abruptata. **Female**—Wings with more whitish ground color, more heavily dusted with dark scales than those of male, and with transverse bands more boldly emphasized; hindwing with two or three transverse bands instead of one as in male; black patch or spot that marks juncture of M_3 with subterminal band and/or postmedial band in outer third of forewing in both sexes of *abruptata* (and many other species of the tribe) also present in females of *umbriferata*, but always reduced and not boldly marked (further reduced to vestige in male). Underside of female similar to that of male but with transverse bands more heavily emphasized in dark brown to yellowish brown. Wing length: males, 12–14 mm; females, 12–14 mm.

Male genitalia as illustrated (text figure 19 e); saccular lobe simple, with elevated ventral margin highest at distal end, although not forming the prominent hump seen in many species. Most distinctive feature (shared with *abruptata*) is shape of posterior margin of eighth sternum; this forms a pair of characteristically rounded lobes with wide notch separating them.

Female genitalia with slender, simple ductus bursae and simple, narrow, ostial funnel; stellate signum unusually large like that of *abruptata*.

Several adults of *S. umbriferata* were reared in Oregon from larvae on *Physocarpus capitatus* Pursh (Kuntze) (J. C. Miller, Oregon State University), but no description or photograph is available.

I have seen relatively few specimens of this species and list all of the localities. Washington: Bonneville, Clark County. Oregon: Salem; Lyons, Linn County; French Creek, Detroit Lake, Marion County; Little Santiam River, 5–8 mi W of Mill City, Marion County; Metolius River bank, Metolius Basin, Jefferson County; Allen Springs, Metolius River; McKenzie Bridge, Lane County; Prospect, Jackson County. Montana: Glacier National Park; Belton. California: Soda Springs (type locality); Crescent City, Del Norte County; Burney Mountain, Shasta County; Davis Creek, Modoc County; Sacramento River, and South Fork Sacramento River, 4,000', Siskiyou County; Castle Lake, Siskiyou County. Laytonville, Mendocino County; Glen Ellen, Sonoma County; Alameda County. Old specimens from the Henry Edwards collection (AMNH) are labeled Napa County (3) and Marin County (1). The data labels indicate a flight period of 21 June–18 August, with individual early and late

records on 6 June (Mendocino County) and 2 September (Siskiyou County).

Barnes and McDunnough (1917: 237, pl. 24, figs. 3, 4) specified Castle Lake as the source of material collected by McDunnough and illustrated two specimens (now in USNM), although their data labels give only the county. They wrote: "Dr. McDunnough found the species quite common on the borders of Castle Lake, Siskiyou Co., Calif., a small lake, some 6,000 ft. in altitude, situated about 8 miles north-west of Soda Spgs.; as this lake was one of the favorite hunting grounds of Behrens, from whom Hulst received his type specimen, we should not be surprised if it were captured here rather than at Soda Spgs., a small resort which Behrens made his headquarters, situated in the Upper Sacramento Valley at an altitude of about 2,300 ft.; in any case Dr. McDunnough found no trace of *umbriferata* in the valleys."

The *exauspicata*-GROUP

This group includes *anataria*, *boreata*, *coloradensis*, *exauspicata*, *confederata*, and *extemporata*. In the male genitalia the saccular lobe is rounded ventrally and the sclerotized ridge on or near the ventral margin bends away from the margin before the end of the lobe. As for the *brunneata*-group, there is a prominent interlobular process. The sternal plate has a V-shaped posterior notch that tapers abruptly to a narrow slit. The female genitalia are similar to those of the *brunneata*-group. The adults are found in scrubby areas where the larval hosts plants in the Rosaceae, Salicaceae, and Betulaceae abound.

Speranza anataria (Swett), NEW COMBINATION

PL. 2, FIG. 16 (adult); TEXT FIG. 17 a, c (♂ gen.); TEXT FIG. 18 a (♀ gen.) (RWH 6287).

Diastictis anataria Swett, 1913, *Can. Ent.*, **45**: 25.

Type locality: Half-way House, Mt. Washington, New Hampshire. [MCZ]

Speranza anataria is a generally uncommon northeastern species of the Atlantic Provinces, northern New England, Quebec, and Ontario. All records in the literature for western Canada refer to *Speranza boreata*. Specimens of *anataria* and *S. exauspicata* in poor condition are often confused, but different aspects of the wing pattern are emphasized in the two species, providing fea-

tures by which they may be distinguished easily if the pattern has not been rubbed off. All transverse lines of the forewing are lost or nearly so in *anataria* although the four costal spots are usually more boldly emphasized, and the discal spots more distinct than those of *exauspicata*. The forewing is light powdery blue gray in males, light yellowish brown in females; and the main central portion of the subterminal area is broadly shaded with brown, this being mostly dusky in males, bright reddish brown in females. The male antennal branches are much shorter in *anataria*, the longest being equal to the length of three antennal segments in *anataria*, to three or four antennal segments in *exauspicata*. Also, the male genitalia readily distinguish the two species from each other and from *S. boreata*. The main obstacles to characterization of *anataria* are removed by recognition of *S. boreata* as a separate species across the Hudsonian Zone in Canada and Alaska. Good specimens of *anataria* should be identified easily by comparison with the colored illustrations. Wing length: males, 13–16 mm; females, 13–15 mm.

Specimens from Nova Scotia ($n = 27$) show a tendency to be more brightly colored and more often reddish brown than gray when compared to specimens from elsewhere, including topotypical material from New Hampshire ($n = 12$). Another deviation from the norm is that the coloring of most males in the Nova Scotian sample is similar to that of females. Specimens from Maine are intermediate.

The male genitalia of *anataria* differ from those of *exauspicata* in the shape of the saccular lobe of the valve, which is narrower and more evenly rounded and less produced at the distal end, and it is sculptured with a more elevated ventral margin that gives the central surface of the saccular lobe a quite deeply concave aspect. This could, of course, appear flattened in some slide preparations. A difference in the shape of the saccus may be of greater significance; in *anataria* the saccus is hardly produced and broadly rounded; in *exauspicata* the saccus is considerably produced and mesially emarginate, or concave, at its anteroventral end. The male genitalia differ from those of *boreata* mainly in the relative length of the saccular lobe of the valve, which is longer in *anataria* and not apically truncated.

The female genitalia appear to differ from those of *exauspicata* only in having a very slightly larger and differently shaped ostial opening.

The female of *S. boreata* is not available for comparison.

The only description of the larva that I found is by Mosher (1917: 53), based on larvae collected from gray birch [*Betula populifolia* Marsh.] in Maine. She wrote: "They were about an inch long, colored dull red, marked with black in an irregular marbled pattern with a whitish spot in front of each spiracle." They were collected the last week of June, pupated about two weeks later, and adults emerged 25 July. Larvae described as *anataria* by McGuffin (1956: 13; 1972: 55) from Alberta would be expected to belong to the new species, *S. boreata*. Indeed, McGuffin's description of gray larvae with geminate black lines would seem to be of something different from Mosher's larvae from Maine, but larval polymorphism in *Speranza* is so nearly universal that those differences need not be significant. I have seen an adult reared from white birch, *Betula papyrifera* Marsh in New Brunswick, and another from "birch" in Quebec (CNC). The several other hosts listed for *anataria* by Prentice *et al.* (1963: 422), and McGuffin (*op. cit.*) are based on a composite treatment of *anataria* plus *boreata*, which cannot be sorted out from the literature; most of the foodplants are referable to *boreata*. Mosher (1917: 52, 53) also described the pupa.

Speranza anataria occurs from southern Labrador and northern Newfoundland through the Maritime Provinces, southern Quebec, and southeastern Ontario to Wisconsin, and southward in the eastern states to the White Mountains, New Hampshire, the Adirondack Mountains, New York, and the Berkshire Mountains, Massachusetts. Its limits in Ontario or the Great Lakes Region are uncertain because of confusion with *boreata*. I have seen a series from Wisconsin collected by H. M. Bower (LACM), but *boreata* is also known from Wisconsin. Most specimens examined are from Nova Scotia, Maine, and New Hampshire, but it occurs at least to southern Manitoba. Its western limit is uncertain. Some specimens from Alberta and British Columbia have the brownish coloring of *anataria*, but I suspect that they are variants of *boreata*. The recorded flight period in Nova Scotia is 28 June–10 August, and in Quebec, 1 July–31 August; and the dates noted for localities elsewhere fall within those limits. Dates later than mid-August are unusual, and the specimens mostly worn. It is a species of upland habitats where white and gray birch grow, perhaps with acidic soils, but in my experience it is not partial to sphagnum bogs.

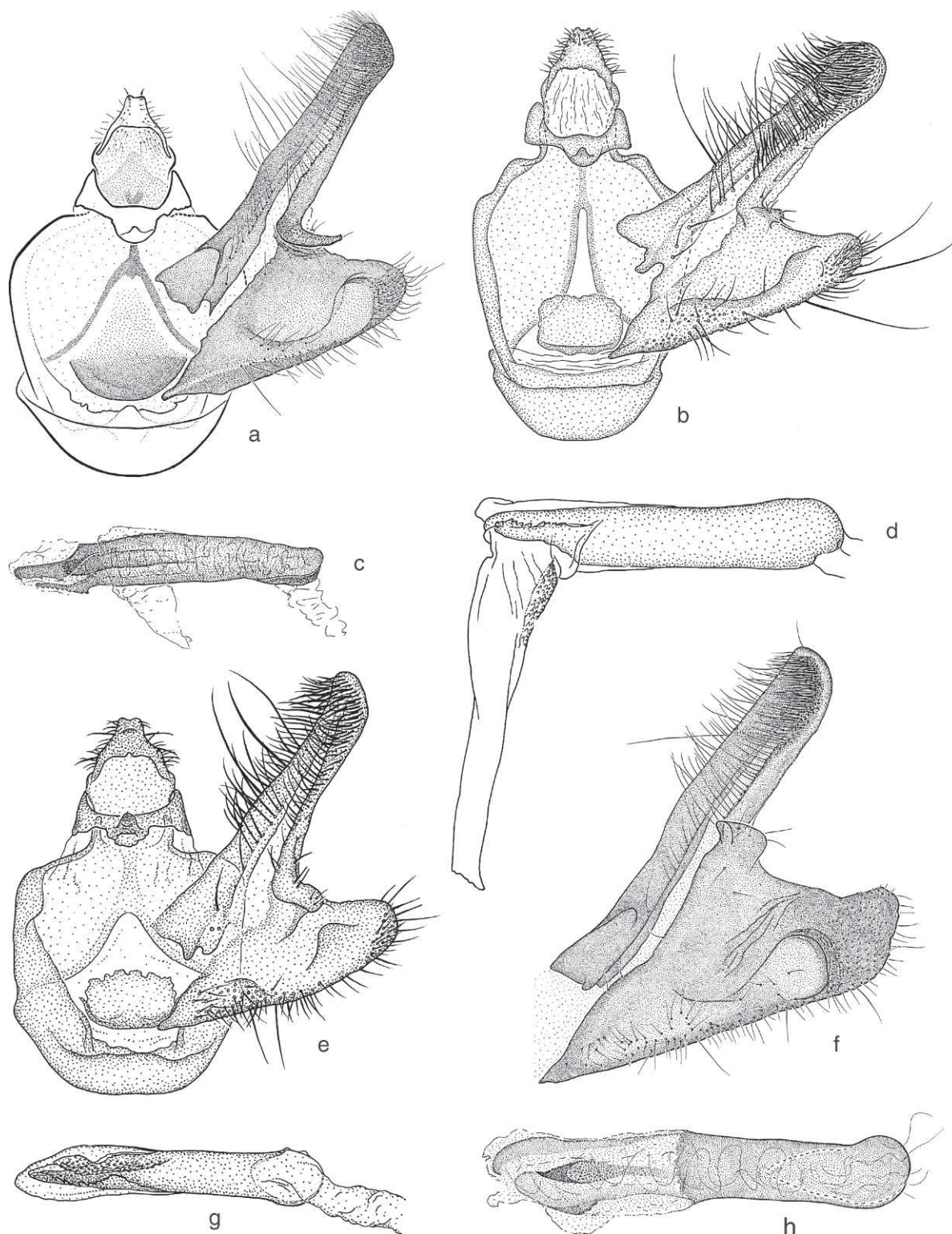


FIGURE 17: MALE GENITALIA OF *SPERANZA* SPECIES

a. S. anataria, genital capsule; New Hampshire (USNM 57485). *b. S. boreata*, genital capsule; Hopedale, Labrador (DCR 1685). *c. S. anataria*, aedeagus; New Hampshire (USNM 57485). *d. S. boreata*, aedeagus; Hopedale, Labrador (DCR 1685). *e. S. coloradensis*, genital capsule; Pine, Jefferson County, Colorado (USNM 57644). *f. S. exauspicata*, right valva; South Park, Park County, Colorado (DCF 1508). *g. S. coloradensis*, aedeagus; Pine, Jefferson County, Colorado (USNM 57644). *h. S. exauspicata*, aedeagus; South Park, Park County, Colorado (DCF 1508).

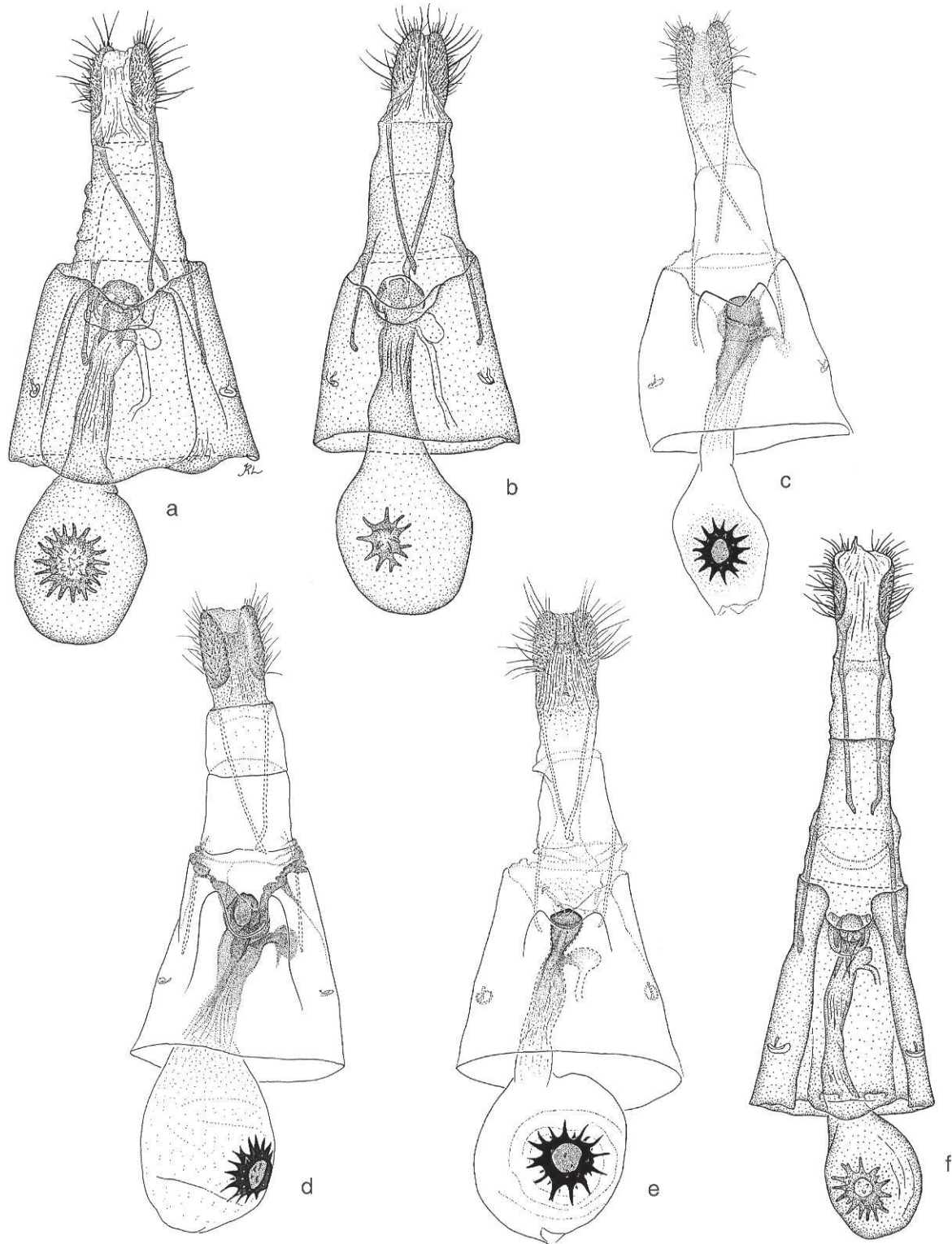


FIGURE 18: FEMALE GENITALIA OF *SPERANZA* SPECIES

a. S. anataria; Armdale, Halifax County, Nova Scotia (USNM 57494). *b. S. boreata*; Hopedale, Labrador (DCF 1686). *c. S. exauspicata*; Siskiyou County, California (HWC 1510). *d. S. confederata*; Utah County, Utah (USNM 57442). *e. S. umbriferata*; Siskiyou County, California (USNM 57453). *f. S. extemporata* San Diego, San Diego County (USNM 56917).

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Speranza boreata Ferguson, NEW SPECIES
PL. 2, FIGS. 17–19 (adult); TEXT FIG. 17 *b*,
d (♂ gen.); TEXT FIG. 18 *b* (♀ gen.).

Speranza boreata Ferguson.

Type locality: Nordegg, Alberta. [USNM]

This is a northern species occurring from Labrador to western Canada and Alaska and possibly in a few isolated habitats farther south, as indicated by one specimen from a spruce-larch bog in northern Wisconsin. It was formerly thought to be part of *S. anataria*, but its consistently different appearance, shorter male antennal branches, and slightly different male genitalia suggest that it is distinct from *anataria*. *Speranza boreata* resembles *S. coloradensis* (Hulst) of the southern Rocky Mountains except for its much smaller size. The wing color is bluish gray, without strong reddish-brown tints, the dark costal spots are reduced, and the postmedial line is more definite than that of *anataria*. Although I have not seen enough material to be certain, it appears likely that specimens identified as *anataria* from northern Manitoba westward belong to this species. True *anataria* appears to be present in southern Manitoba. Some western specimens of *exauspicata* are easily confused with *boreata*, but males of *exauspicata* are easily distinguished by their longer antennal branches, the longest being equal at least to the length of three antennal segments (those of *boreata* equal only two). The longest branches are equal in length to the sum of two spaces between branches in *boreata*, two and one-half to three spaces in *anataria*, and nearly four spaces in *exauspicata* and *confederata*. Females are more difficult, and one that I collected near Lillooet, British Columbia illustrates this. At first I took the specimen to be a female *boreata*, although the locality seems too far south for that species, and it seems more likely to be an unusually well-marked, blue-gray example of *exauspicata*. Lightly marked males of *boreata* might also be confused with *Speranza quadrilinearia*, a mainly more southern species on *Ceanothus*, and with different genitalia and shorter palpi.

Male forewing powdery bluish gray, with reddish-brown tints usually much subdued relative to those of *anataria* and mainly confined to space between the postmedial and subterminal bands; some brown shading may encroach upon the space between subterminal band and middle of outer margin in some specimens. Dark costal spots commonly reduced nearly to obsolescence,

but not always, and that marking costal terminus of subterminal band, although still most prominent, commonly averages only half the size of corresponding spot in *anataria*. Dark transverse lines more prominent than those of *anataria*, and postmedial nearly always present and complete, although it may be weak. Antemedial and medial bands visible in most specimens, and one or both sometimes distinct. Small black discal spot usually present. Fringes essentially unicolorous, faintly checkered. Underside powdery with more of a brown or reddish-brown tint than above, markings diffuse, obsolescent; but dusky, roundly convex postmedial band distinct in some specimens. Rarely collected female may resemble male, being as well marked or less so. Of about 100 specimens examined, 15 were females. Wing length: males, 10–15 mm; females, 11–15 mm.

Some of the specimens from British Columbia have considerably more reddish brown on the forewing and may be very large, with the wing length up to 15 mm in both sexes, although their size varies greatly. Specimens from Alaska, as might be expected, are smaller and darker than those from elsewhere. Eastern specimens from Labrador are normal *boreata*, agreeing in male antennae and genitalia, although their females may be more yellow brown and resemble dwarfed *anataria*.

Male genitalia of *boreata* differ from those of *anataria* in having apex of saccular lobe wider and somewhat truncated, and subapical prominence of its elevated margin nearer to apex than in *anataria*. Saccular lobe of *anataria* more evenly tapered, apically rounded, and with raised prominence set back farther from apex. It remains to be seen whether these differences will be constant throughout the range. The signum of *boreata* has relatively few radiating spines or denticles on the signum (text figure 18 *b*) as compared with the signum of *anataria* (text figure 18 *a*).

McGuffin (1956: 13) described the larva (as *anataria*), based on 25 specimens found on “scrub birch” at Harmon Valley, Alberta. Last instar 18 mm long, pale gray to gray green with a whitish spiracular stripe, and with the spiracles in or adjacent to black patches. Longitudinal lines consisted of brown to black middorsal, subdorsal, suprspiracular, subventral, and midventral stripes, which had been geminate in penultimate instar but tended to become solid stripes in last instar. Middorsal line broken between dorsal setae. Head pale gray to pale brown with brown to

blackish herring-bone patterns on upper parietal lobes; lower face brownish with pale transverse bar; clypeus with fine dark dots. McGuffin (1972: 55, figs. 228i–m) later redescribed the larva in slightly different form, adding: Thoracic plate unicolorous; anal plate light brown with brown markings; thoracic legs light gray and black; prolegs brown. It is uncertain whether the later description was based on the same larvae or was a composite involving eastern specimens (*anataria*) as well. The food plants listed were birch (*Betula* species), alder (*Alnus* species) (both Betulaceae); shrubby cinquefoil (*Potentilla fruticosa* Linnaeus) (Rosaceae); willow (*Salix* species) and poplar (*Populus* species) (Salicaceae) (McGuffin, 1956, 1972). The same hosts were listed by Prentice *et al.* (1963: 422), also referring to a mixture of *Speranza anataria* and *boreata*.

TYPES. Holotype ♂: Nordegg, Alberta; 23 July 1921; J. McDunnough. USNM. Paratypes: 21 ♂. Alberta. Nordegg; 20, 23 July 1921; J. McDunnough (8 ♂). Same locality; 21 July 1921; K. Bowman (5 ♂). Head of Pine Creek, Calgary; 31 July 1905, 15 August 1903; F. H. Wolley Dod (2 ♂). Near Billings' Lumber Mill, Calgary; 20 July 1903, F. H. Wolley Dod (1 ♂). W of Williams, Calgary; 11 August, 1895; F. H. Wolley Dod (1 ♂). Alaska. Ester Dome, 64°54'N, 148°03'W, 2,300'; 24 July 1976; K. W. Philip (1 ♂). Murphy Dome, near Fairbanks; 23 July 1988; "leg. D. E. B." (2 ♂). Peak 3.25 mi NE of Lazy Mts., nr. Palmer; 28 July 1970; leg W. Phillips (1 ♂). [Distribution of the paratypes was not indicated. Likely they are in the CNC and USNM, ed.] Eight specimens seen from Hopedale, Labrador are not included in the type series.

This species occurs widely in Alaska, the Yukon and Northwest Territories, to near the U.S. border in Alberta and British Columbia, in Labrador, and evidently in bogs in northern Wisconsin (based on a male taken in Forest County by Hugo Kons, Jr., 24 June 1995). Whether it occurs in the more eastern Prairie Provinces and in Ontario and Quebec remains uncertain. The recorded flight period is 2 July–15 August in Alberta and British Columbia; 15 July–3 August at Cameron Bay, Great Bear Lake, Northwest Territories; and 7–28 August in Labrador.

Speranza coloradensis (Hulst), NEW COMBINATION

PL. 2, FIG. 20 (adult); TEXT FIG. 17 *e*, *g* (♂ gen.) (RWH 6289).

Sympherta coloradensis Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 338.

Type locality: Colorado. [AMNH]

Macaria aegaria Strecker, 1899, *Lep. Rhop. Het., Suppl.* **2**: 9.

Type locality: Colorado. [MSU]

Speranza coloradensis is a large, easily recognized, blue-gray species from the mountains of Colorado and New Mexico. It has a nearly full complement of brown transverse lines on the forewing, with reddish-brown shading in the space between the postmedial and subterminal lines that forms a wide brown band across the wing somewhat like that of *S. loricaria*, although more sharply defined (the markings of *loricaria* are diffuse). The well-developed transverse banding, especially the wide, rust-tinted subterminal band, serve to distinguish this species from the otherwise similarly colored *S. quadrilinearia*. Its large size and more southern distribution distinguish *coloradensis* from *S. boreata*, which may be the nearest relative. The rarely collected female of *coloradensis*, described below for the first time, has somewhat reduced wings that are differently shaped from those of the male.

Male of *coloradensis* with lines or bands of forewing discrete, almost evenly spaced, nearly straight and perpendicular to inner margin, although curving inward somewhat toward costa. Hindwing gray to gray brown and hardly marked; fringes unicolorous on both wings and not checkered. Underside with strong overall reddish-brown tint, brightest toward apex of forewing, and underside of hindwing may show faint, diffuse transverse banding. Branches of bipectinate male antenna only moderately long, the longest slightly exceeding the sum of two spaces between branches. Female, of which I saw only one, smaller than male and with acutely pointed forewing, leaving anterior half of outer margin shallowly concave. Coloring resembles that of male but transverse lines of forewing are vague and more diffuse, and fringes are checkered. Underside tinted with reddish brown like that of male. Wing length: males, 17–18 mm; female, 15 mm.

Male genitalia (text figure 17 *e*) almost exactly like those of *S. anataria* (text figure 17 *a*) except for a well-defined difference in the interlobular process. This process, rather than being a simple, flattened, flangelike, erect protrusion as in *anataria*, is buttressed by a ridge that adjoins it distally at nearly 90° and which is directed toward

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the center of the saccular lobe or, more precisely, toward the basoventral corner of the valve, although shortly tapering off and disappearing in the central depression of the saccular lobe. Also, instead of being erect or even somewhat flexible, the interlobular process appears to be drawn down by and toward the buttress to a depressed position nearly in the same plane as the valve.

The female has the sclerotized structures associated with the ostium reduced and more delicate than those of *anataria*, the neck of the bursa copulatrix only two-thirds as long, and the signum reduced to no more than half the diameter of the signum of *anataria*. The radiating spines or denticles on the signum, although large, amount to only nine in the female of *coloradensis*, to 15–20 in *anataria*.

The early stages of *coloradensis* are unknown.

I have seen specimens of *coloradensis* from the following localities in Colorado: Estes Park, Larimer County, 7,800'; Big Springs Ranch, Florissant, Teller County, 8,640'; Pine [Jefferson County]; Lump Gulch and Gilpin Gulch, Gilpin County; Homestake Campground, 11 mi S Jct. Hwys. 6 and 24, Eagle County; Hall Valley [Park County]; St. Louis Cr. Rd., 4.2 mi SW of Fraser, 9,000', Grand County; and Durango. A single male in the USNM is labeled "Taos Mt., N. M., July 16–25 01," and has another label indicating that it was compared with the type of *Macaria aegaria* Strecker (a synonym of *coloradensis*) by J. H. McDunnough. The dates indicate a flight period of 20 June–2 August, except for one much later record on 24 August (Eagle County).

The female from Hall Valley in the USNM bears a Hulst type label indicating it to be the female type of *Sympherta julia* Hulst, and it was illustrated as such by Barnes and McDunnough (1912: pl. 15, fig. 5). *Sympherta julia* is a junior synonym of *Speranza loricaria* (Eversmann), and the name *julia* has been used for the North American subspecies of *loricaria*. Hulst mistook the female of *coloradensis* for *loricaria*, unaware that the female of *loricaria* is unusual in being brachypterous, with only little pads for wings.

Speranza exauspicata (Walker), NEW COMBINATION

PL. 2, FIGS. 21–23 (adult); PL. 10, FIGS. 2, 3 (larva); TEXT FIG. 17 *f, h* (♂ gen.); TEXT FIG. 18 *c* (♀ gen.) (RWH 6292).

Macaria exauspicata Walker, 1861, *Cata-*

logue of the Specimens of lepidopterous Insects in the Collection of the British Museum, 23: 889.

Type locality: United States. [BMNH]

This widespread species, which occurs from Maine and Quebec to West Virginia and westward almost to the Pacific Coast, is of nondescript appearance and not easily described. It is easily confused with *anataria* in the East and with *confederata* in the West, and it was even synonymized to *Macaria granitata* by early authors such as Packard and Hulst. It is a variable, mixed and dappled, light gray and brown moth with the usual forewing costal spots and transverse lines, none of which can be depended upon always to be complete, or even present. Males are easily distinguished from those of *anataria* by the longer antennal branches, equal in length to the sum of four spaces between branches on the shaft (three spaces in *anataria*; two spaces in *boreata*). However, the male antenna of *confederata* has equally long branches. At least three features of the male genitalia distinguish *exauspicata*, especially the extended saccus. Females are distinguishable only by wing color and pattern.

Ground color of male forewing pale gray, finely dusted with dark scales; four dark reddish-brown to gray-brown costal spots, roughly wedge shaped, variably reduced, sometimes obsolescent; subapical spot not as large relative to others as that of *anataria*; antemedial, medial, and postmedial bands dark brown, sometimes rust tinted, variably developed; postmedial more likely to be present and complete than that of *anataria*; medial subterminal brown spot or patch usually present in *exauspicata*, much less frequently so in *anataria* and *confederata*; discal spot often present but weak; subterminal area with variable reddish-brown to gray shading. Male hindwing pale brownish to yellowish white, dusted with gray, and crossed by one or two complete or incomplete, convex, gray transverse bands. Fringes of both wings grayish, almost uncheckered. Underside yellowish, heavily irrorated with gray, tinted with orange or reddish brown toward forewing costa; hindwing often with one or two diffuse, convex, gray, transverse bands. Female like male but tending to be more heavily marked with transverse bands, and in subterminal area with heavier patches of gray or brown. Wing length; males, 11–16 mm (except for one exceptionally

large reared male of 17 mm from Placer County, California); females, 12–16 mm.

This species shows little geographic variation except in size. The largest specimens are western, including some of 16 mm and more from Colorado, Oregon, and California, although not all western specimens are large. The smallest are from the northern Midwest (Illinois and Wisconsin). Most eastern specimens are about average.

Male genitalia (text figure 17 *f, h*) differ from those of all other sympatric species with which *exauspicata* might be confused by the considerably extended, emarginate saccus. Relative to that of *anataria*, saccular lobe of valve appears wider across base; raised, subapical prominence more rounded (a sharper ridge or more nearly conical in *anataria*); and interlobular process larger. In female, ostial funnel is smaller and narrower in *exauspicata*, but this is not easily appreciated without genitalia slides of both for direct comparison.

The larva was described by McGuffin (1956: 13) from two specimens collected from willow at Fort Garry, Manitoba on June 6. Length at maturity 25 mm; body white with yellow suffusion on dorsum and intersegmental areas and black longitudinal lines, except for a yellow-white spiracular stripe and a pale midventral line; a black patch below spiracle; prothoracic plate concolorous with body; anal plate white with black dots. Thoracic legs black with white ring on each coxa; abdominal legs pale gray. Upper part of head white with black dots, which may or may not be arranged in a herring-bone pattern along epicranial suture; clypeus white with black dot in upper corner and black cross at base.

The larva (plate 10, figure 2) is one of several found by Brian Scaccia on *Prunus emarginata* (Dougl. ex Hook.) Walpers at Blue Canyon, Placer County, California and which, when reared, produced large adults of *S. exauspicata*. The black areas of the body are exaggerated, and it does not seem to fit McGuffin's description very well. The larva of *exauspicata* has been reported to feed on species of *Prunus* and *Crataegus* (Rosaceae); *Betula* and *Alnus* (Betulaceae); *Salix* and *Populus* (Salicaceae); on *Ulmus americana* Linnaeus (Ulmaceae); and other plants (Prentice *et al.*, 1963: 424; McGuffin, 1956: 14, 1972: 56).

Speranza exauspicata occurs from Maine, western New Brunswick, and southern Quebec to the mountains of western Maryland (Frostburg) and West Virginia, thence westward across Can-

ada to the interior of British Columbia, and across the northern half of the United States at least to Stevens County, Washington, Baker County, Oregon, and Siskiyou and Placer counties, California. It is common in central New York, and present in Ohio, Illinois, Indiana, Iowa, South Dakota (Black Hills), Colorado, and Idaho. In Canada it extends far to the north in Alberta and British Columbia, almost reaching their northern borders. I did not collect it in Nova Scotia. The flight period in the East is about 27 June–3 August, and nearly the same in the West, 1 July–9 August, except that one reared specimen from California emerged 15 June.

Speranza confederata (Barnes and McDunnough), NEW COMBINATION

PL. 2, FIGS. 24–26 (adult); TEXT FIG. 19 *a, c* (♂ gen.); TEXT FIG. 18 *d* (♀ gen.) (RWH 6295).

Itame confederata Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, 3(4): 237, pl. 24, figs. 5, 6.

Type locality: Glenwood Springs, Colorado. [USNM]

NOTE—Described from four male and six female syntypes, of which I hereby designate as lectotype the specimen labeled "Type male" and illustrated by Barnes and McDunnough, 1917: pl. 24, fig. 5.

There was uncertainty when I began as to whether this should be regarded as a distinct species or a subspecies of *exauspicata* in the western United States. However, their consistently different appearance and differences in male genitalia, as well as evidence that the two taxa overlap in distribution without losing their separate identities, indicate that they are species. *Speranza confederata* is more distinctly marked than *exauspicata*, with complete transverse lines on wings of a more generally reddish-brown color.

Male, which may resemble *exauspicata* more closely than female, differs in having a more discrete, less confused pattern. Forewing of male with ground color cream to light brown; antemedial and postmedial bands dark brown to light rust, regular, distinct, evenly convex except that postmedial band may angle inward somewhat before reaching costa; medial band also usually present, situated mid-way between the other two, erect from inner margin; small black discal spot present; outer third of forewing variably shaded with gray brown to reddish brown, with mid-ter-

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minal dark spot present, not prominent, often obscure; fringe gray brown, not checkered. Hindwing paler, dusted with brown scales, and usually with a complete but diffuse, dusky, convex, post-medial band. Antennae and other appendages similar to those of *exauspicata*. Female often smaller and with more acutely pointed forewing; pattern of transverse lines more boldly emphasized than that of male, and color variable from pale, rather like that of *exauspicata*, to very dark; sometimes with only outer third of forewing dark, contrasting strongly with lighter medial and basal areas; sometimes entire forewing deep reddish brown with darker lines. Hindwing with post-medial band more prominent than that of male. Underside (both sexes) yellow to reddish, heavily irrorated with clumps of dark scales. Wing length: males, 14–15 mm; females, 12–15 mm.

Specimens of the type series from Glenwood Springs and Durango, Colorado are much paler than specimens from Utah, northern California, or elsewhere, but their color may partly be a result of fading.

Male genitalia (text figure 19 *a*, *c*) differ from those of *exauspicata* in several ways. Saccular lobe of valve tends to be slightly narrower, and prominence just distad of middle of its inner face is smaller and more conical or sharp edged, not shaped like the rounded hump seen in *exauspicata*. Apex of uncus more narrow, although similarly notched; saccus not as long as that of *exauspicata*, and not or hardly emarginate, whereas that of *exauspicata* is prominently emarginate. Aedeagus slightly more slender, and dentate lateral ridge toward its distal end less protruberant than that of *exauspicata*. Female genitalia not appreciably different from those of *exauspicata*.

No larval description or photo is available, but adults were reared from larvae on chokecherry, *Prunus virginiana* Linnaeus in Jefferson County, Oregon, and from bitter cherry, *Prunus emarginata* Dougl. ex Eaton, also in Oregon (Oregon State University, coll., J. C. Miller).

This species occurs, evidently very locally, in Colorado, Utah, northern California, and Oregon. Three specimens from Sweetgrass County and Glacier National Park, Montana also seem to belong here. Such a disjunct distribution probably indicates inadequate collecting in intervening areas. For some reason it is rarely encountered. I have seen specimens from the following places: Glenwood Springs and Durango, Colorado; sites between 6,300' and 8,850' in Ephraim Canyon

on the Great Basin side of the Wasatch Mountains, Sanpete County, and from the vicinity of Midway, Wasatch County, Utah; from Nelson Creek Road (near Sierra County line), 13 mi N of Yellow Creek, Plumas County, Davis Creek, Modoc County, and Carrville, Trinity County, California; and from near Lorane, Lane County, and the Metolius Basin, Jefferson County, Oregon, as well as the Montana localities and the reared specimens from Oregon mentioned above. Barnes and McDunnough (1917: 237) mentioned that McDunnough "took a couple of specimens" of *confederata* in the vicinity of Soda Springs, Siskiyou County, California, but I have not found these specimens. The collection dates are 20 July–6 August in the Rocky mountains; 31 May and 2 July–23 August (mostly in July) in California. The date for May would seem to represent an anomaly in this group of normally single-brooded species and may have been a labeling error.

Speranza extemporata (Barnes and McDunnough), NEW COMBINATION
PL. 2, FIGS. 27, 28 (adult); PL. 10, FIG. 4 (larva); TEXT FIG. 19 *b*, *d*, *f* (♂ gen.); TEXT FIG. 18 *f* (♀ gen.) (RWH 6298).

Itame (Diastictis) extemporata Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, 3(4): 236.

Type locality: Havilah, California. [USNM]

NOTE—This species was described from one male and one female, of which I designate as lectotype the specimen that was labeled "Type male" and illustrated by Barnes and McDunnough (1917, pl. 23, fig. 10).

One would think from the appearance of this gray-brown, *Cercocarpus*-feeding, Californian species that it should belong in the *quadrilinearia*-group, as sometimes it is close enough in appearance to be confused with *quadrilinearia*. However, the genitalia show it to be a member of the *exauspicata*-group. Any transverse lines present on the forewing are likely to be more diffuse than those of *quadrilinearia*, and the three or four dark costal spots on the forewing are more boldly and uniformly defined, almost as in *coartaria* or *hesperata*. Unusually dark specimens of *hesperata* from the west slope of the Sierra Nevada (Plumas and Eldorado counties) could be mistaken for *extemporata*, except that *extemporata* does not seem to occur there.

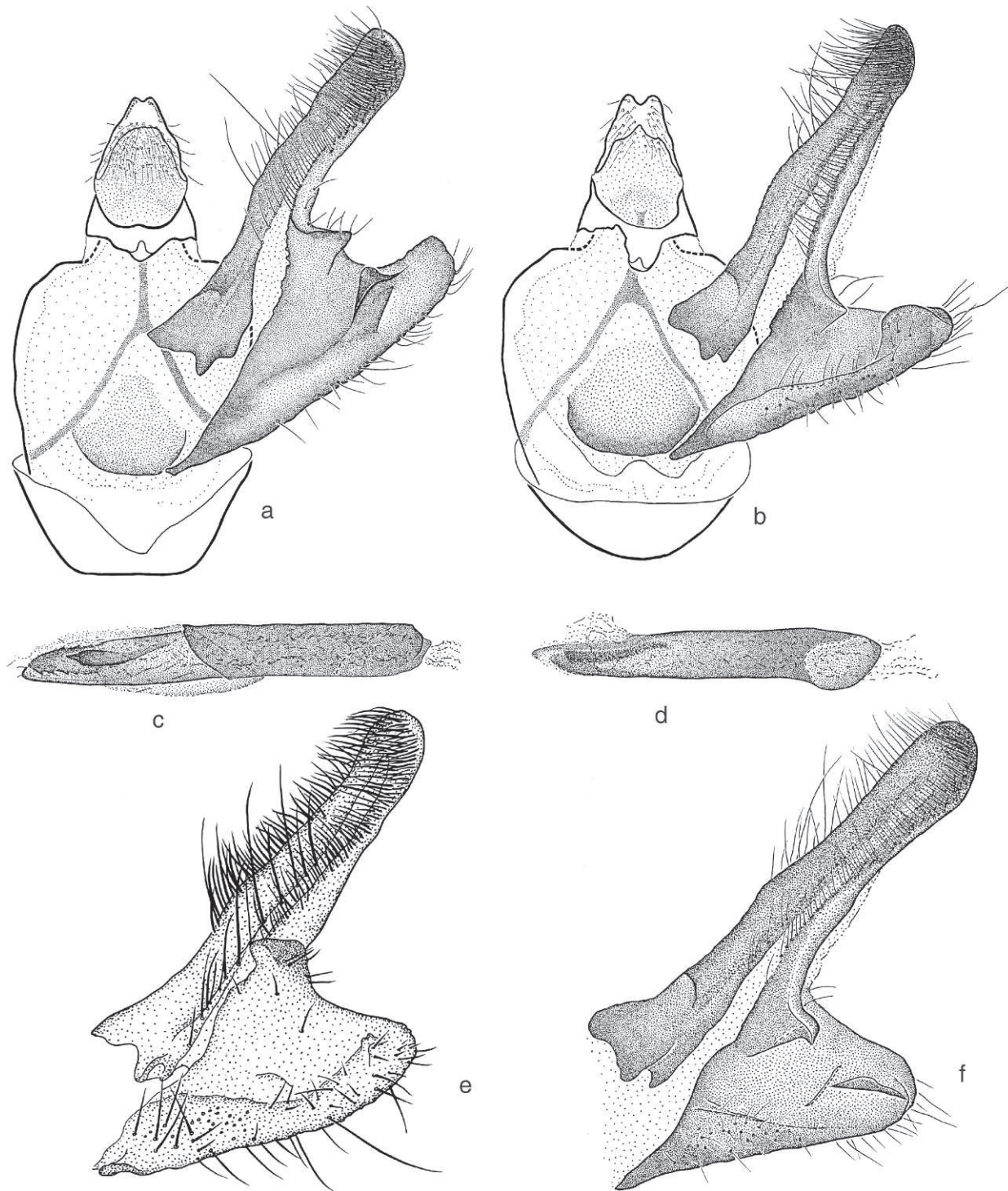


FIGURE 19: MALE GENITALIA OF *SPERANZA* SPECIES

a. S. confederata, genital capsule; Ephraim, Sanpete County, Utah (USNM 57441). *b. S. extemporata*, genital capsule; San Diego, San Diego County, California (DCF 1587). *c. S. confederata*, aedeagus; Midway, Wasatch County, Utah (USNM 57440). *d. S. extemporata*, aedeagus; San Diego, San Diego County, California (DCF 1587). *e. S. umbriferata*, right valva; Siskiyou County, California (USNM 57452). *f. W. extemporata*, right valva—variant; San Diego, San Diego County, California (USNM 57438).

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Forewing ground color violaceous gray to gray brown, with such transverse bands as might be present appearing diffuse, shadowlike, dusky, or dark gray brown, with those of postmedial and subterminal areas best developed; postmedial line sometimes represented by incomplete series of small, blackish dots; outer marginal area beyond position of subterminal area often broadly shaded with reddish brown or dusky brown; three or four blackish or dark brown costal spots, characteristic of *coortaria*, also quite well developed in *extemporata*, distinguishing it from *quadrilinearia*; discal spot of forewing minute, nearly absent; fringe variable, concolorous with adjoining area of wing, not checkered. Hindwing pale brownish; without discal spot; slightly irrorated with dusky scales near inner margin; fringe grayish, usually not checkered. Underside of forewing luteous to reddish brown near costa and apex, of hindwing luteous to reddish brown uniformly over entire surface; discal spots absent. Body concolorous with upper surfaces of wings. Although sexes are nearly alike, females more often have dark shading on forewing than do males. Palpi long as in other species of *exauspicata*-group, exceeding eye by distance clearly greater than width of front in both sexes (by distance about equal to width of front in *quadrilinearia*). Male antennal branches also long, equal at least to combined length of four antennal segments. Wing length: males, 12–15 mm; females, 10–16 mm. Unusually variable in size.

The northernmost specimens, from Mendocino County, are a uniform, light, powdery gray brown, different from southern specimens, and at first I expected that this form would prove to be a new species. However, no structural differences support this hypothesis. Reared specimens from Solano County are also quite uniformly gray brown, but darker. Specimens from southern California differ from the above in having the forewing commonly more variegated in different shades of gray and smoky brown, and the variegated coloring is more prevalent in females than males.

Male genitalia of the *exauspicata* type, but with apex of uncus more deeply emarginate; process of gnathos more slender; subapical prominence on saccular lobe of valve situated farther out, (resulting from shortening of lobe), forming rounded, knife-edged ridge or flange immediately before apex; and with a longer, straplike, finely dentate band on vesica. Notch in eighth sternum

tends to be relatively shallow and more divergently V-shaped than that of *anataria*, but also more variable.

Female genitalia unique in being unusually elongated, with lengthening of nearly all components; i.e., ovipositor lobes, apophyses, seventh and eighth abdominal segments, ductus bursae, and neck region of corpus bursae. Ostial funnel simple but with a drooping, sclerotized, winglike apophysis on each side, seen also in less obvious form in *anataria*. Neck of corpus bursae slightly sclerotized for about half its length.

Although long unidentified or misidentified in most collections, this species was taken by many California collectors and was reared from larvae on *Cercocarpus* species (Rosaceae) by J. A. Comstock in 1937, C. Henne in 1939, 1941, and 1964 (LACM, USNM), and by B. Scaccia in 1989 (USNM). The last mentioned were reared from larvae on birchleaf mountain mahogany, *Cercocarpus betuloides* Nutt., at Lake Solano, Solano County, California, and the following description is from a colored photograph of one of them: Ground color white to light gray, largely obscured by dense sprinkling of interconnected blackish spots or patches; contrasting, rust-brown intersegmental shading dorsally on thorax and from abdominal segments one to between five and six, that on abdomen divided into paired subdorsal patches separated by an intervening, wedge-shaped white area. Many of the pinacula shining black, fairly large, especially that of seta L1, which is noticeably elevated on A1–A8, giving the larva a tuberculate appearance. Thoracic segments gray laterally, with large segmental black spots that continue to A8 (each incorporating the L1 pinacula). Segments A6–A9 and anal prolegs pale gray, densely and uniformly mottled or reticulated with darker gray and black. Head whitish, heavily marbled with light reddish brown, with a dusky transverse patch across middle of clypeus, and a greenish shade beneath it. Mouthparts reddish brown. The color and rough texture of the larval integument is an almost perfect match for the bark on the twigs of *Cercocarpus*. The larvae were in the last instar in mid- to late April, and four adults emerged 13–18 days after pupation, according to specimens in USNM. Fourteen specimens reared in Los Angeles and San Bernardino counties were somewhat later, having been collected as larvae in May or perhaps early June and emerging 28 May–1 July.

Speranza extemporata has been collected in

most of the counties of California west of the Great Central Valley and Mojave Desert, from San Diego to Sonoma, Lake, and Mendocino counties. Although there are many records from San Diego, San Bernardino, and Los Angeles counties, I saw none from the coastal region between San Luis Obispo County and Sonoma County, including the San Francisco Bay area, except those from farther inland in Solano County.

The flight period is 8 April–27 July, with one later record for 3 August; most were taken between late May and early July.

The *coortaria*-GROUP

This group includes *coortaria*, *hesperata*, and *prunosata*. In the male genitalia, the sacculus lobe is rounded ventrally with the sclerotized margin of the lobe expanded toward to ventral extremity of the lobe, which is inflated. The sternal plate is deeply cleft to the middle of the plate. Where known, the larvae are associated with cherry (*Prunus* spp.) and hawthorn (*Crataegus* spp.) in the Rosaceae.

Speranza coortaria (Hulst), NEW COMBINATION
PL. 2, FIGS. 29, 30 (adult); PL. 10, FIG. 5 (larva); TEXT FIG. 20 a (♂ gen.) (RWH 6299).

Thamnonoma coortaria Hulst, 1887, *Ent. Americana*, 2: 191.

Type locality: Texas. [AMNH]

NOTE—Described from one male and two females from “Tex.,” of which only one female can be found. Barnes and McDunnough’s comment (1917: 236) that this specimen will “hold the name” is interpreted as the equivalent of a lectotype designation.

Itame coortaria enigmata Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, 3(4): 236.

Type locality: Chicago, Illinois. [USNM]

NOTE—The type series of *enigmata* consisted “of 2 males from New Brighton, Pa., 2 males from Chicago, Ill., 2 females from Chicago, Ill., 1 female, Edgebrook, Ill. (Beer) and 1 female, Quincy, Ill. (Poling),” of which seven of the original eight syntypes are in the USNM. I hereby designate as lectotype the male labeled as the “male Type” and illustrated by Barnes and McDunnough (1917: pl. 24, fig. 2). Although the specimen label gives only

“Ill., 6:17,” it must be one of the two males listed from Chicago.

NOTE—Barnes and McDunnough proposed *enigmata* for the eastern form, believing that the name *coortaria* Hulst, based on specimens from Texas, should be reserved for a “Rocky Mountain” subspecies of which they had material from Utah. However, all specimens that I have seen from Texas, including the lectotype of *coortaria*, agree with those from the eastern and midwestern states, not with the western form. The western taxon, which is clearly a distinct species, is without a name and is described herein as *Speranza hesperata*.

Speranza coortaria is easily recognized by its plain, cream-colored to pale gray-brown forewing, marked only by four distinct, dark, costal spots of roughly equal spacing and size, except that the outermost spot is often smaller than the others. Although it occurs from Maine to Saskatchewan and southward to Virginia in the East and to East Texas in the central region, it is not very commonly collected. The larva seems limited to certain rosaceous trees and shrubs.

Forewing pale gray brown to almost whitish, slightly more brownish toward outer margin; although all transverse lines are absent or nearly so, costa is distinctly marked with usually four blackish, wedge-shaped spots marking points at which antemedial, medial, postmedial, and subterminal lines would meet costa, were they present; outermost of these spots usually smallest; small discal spot usually present, nearly touching second (medial) costal spot; fringe brownish. Hindwing whitish to faintly yellowish, unmarked except for slight dusting of dark scales near inner margin; fringe faintly brownish. Underside of forewing with costal spots faint, yellowish brown; of hindwing pale with dusting of pale, yellow-brown spots that may be obsolescent, or sometimes clustered to form pale brownish subterminal band parallel to outer margin. Wing length: males, 11–13 mm; females, 13–14 mm. No geographic variation apparent.

It is doubtful whether the genitalia of either sex are distinguishable from those of *hesperata* or *prunosata*, although the genitalia of the three species as a group are very characteristic (text figure 20 a–f). In the female of *coortaria*, the genital plate, or sterigma, and the signum are not usually as large as in the other two species, but the range of variation in size and shape seems about the same in all of them.

The larva is undescribed other than a brief re-

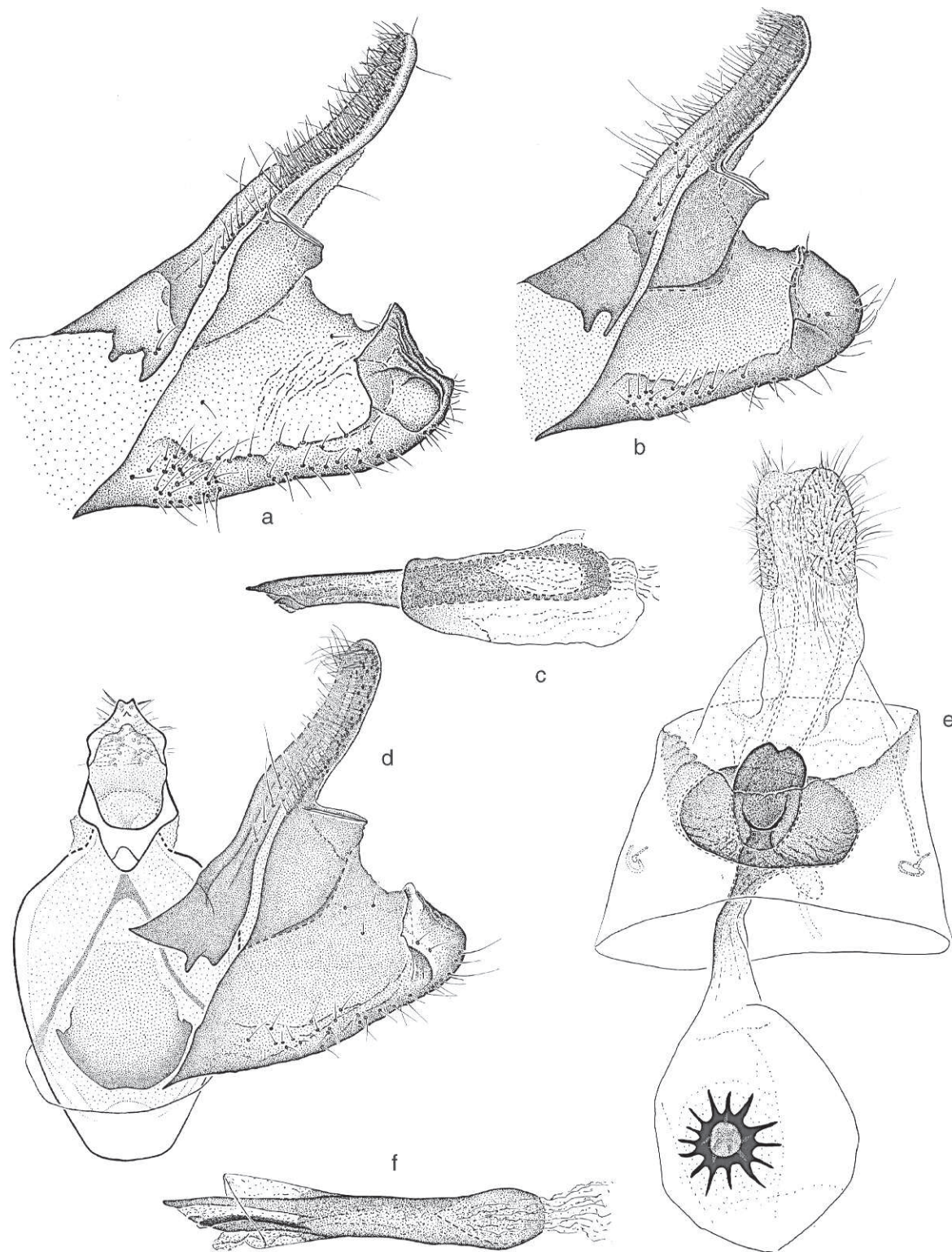


FIGURE 20: GENITALIA OF *SPERANZA* SPECIES

a. S. coortaria, right valva; Chicago, Cook County, Illinois (USNM 56904). *b. S. hesperata*, right valva; Elko County, Nevada (USNM 56906). *c. S. hesperata*, aedeagus; Elko County, Nevada (USNM 56906). *d. S. prunosata*, genital capsule; Grand County, Colorado (USNM 57412). *e. S. prunosata*, female; Mesa Verde, Montezuma County, Colorado (USNM 57488). *f. S. prunosata*, aedeagus; Grand County, Colorado (USNM 57412).

mark by Forbes (1948) that it is "smooth and green." However, Ives and Wong (1988, fig. 88F) provided a good colored photograph of a larva from southern Manitoba that is neither smooth nor green. The body is dark reddish brown to purplish brown with transverse dorsal black bands, preceded by variable, irregular white rings on A1, and A6–8; thoracic segments and A6–8 gray to reddish brown with a dusting of white, transversely rugose; A9 and anal prolegs blackish; first pair of prolegs concolorous with body laterally; middle body segments from black band on A1–A5 densely dotted or dusted with white laterally to A4, dorsally and laterally on A2, and with one or more small white dorsal spots near anterior edge of A2–A4; spiracles reddish brown with pale center; head brown, the shade somewhat variegated, paler on parietal lobes, and with transverse pale markings frontally; most of clypeus and mouthparts blackish. Underside does not show in published illustration. This illustrated larva (plate 10, figure 5) may, of course, represent only one color form of a variable species.

The larva from Manitoba discussed above was found on chokecherry, *Prunus virginiana* Linnaeus, and it was also reported on chokecherry by McGuffin (1972: 54). Four adults in the Cornell University collection were reared from larvae on a *Crataegus* species at Sardinia, New York by L. R. Rupert; two from Ft. Walton, Florida (AMNH) were also reared from *Crataegus*; and one adult in the USNM was reared from apple (all Rosaceae).

I have seen this species from most eastern states and provinces from Maine, Quebec, and Ontario to Virginia; from Michigan, Illinois, Wisconsin, Minnesota, Manitoba, North Dakota, Arkansas, northern and western Florida (Gainesville, Ocean City, and Ft. Walton, Okaloosa County); from Texas (Anderson, Brazoria, Montgomery, Montague, Morris, and Kerr counties); and from Colorado (Denver, Golden, Fort Collins, Rock Creek Canyon, and Platte Canyon). It was also reported from Saskatchewan (McGuffin, 1972: 54). The most specimens seen in collections are from New York and Illinois. It reaches the Atlantic Coast region on Martha's Vineyard, Massachusetts, Long Island, New York, and in the New Jersey pine barrens. I did not see it in places where I collected intensively in Nova Scotia or Maryland. The flight period in the north is 19 June–1 August, although it was collected as early as 9 June in Illinois and as late as 14 August

in Colorado. It was taken 28 June in Arkansas, in April, May and November in Florida, and 22 April–31 May in Texas, all dates that indicate one generation, except the November date for Florida.

Speranza hesperata Ferguson, NEW SPECIES

PL. 2, FIGS. 31, 32 (adult); TEXT FIG. 20 *b*, *c* (♂ gen.).

Speranza hesperata Ferguson.

Type locality: Willow Creek Road, 7,500' [off Ephraim Canyon Road], near Ephraim, Sanpete County, Utah. [USNM]

This western species from Colorado, Utah, New Mexico, Nevada, and from the Sierra Nevada foothills and Siskiyou Mountains, California, was long accepted as conspecific with *coortaria* after being so regarded by Barnes and McDunnough (1917). It was treated as the nominate subspecies because the types of *coortaria*, from Texas, were thought to be "western," and thus more likely to be related to specimens from the far West than to those of the Northeast. However, a gap of 1,000 miles of arid to semi-arid habitat separates *S. hesperata* from the nearest known population of *coortaria* in Texas. Although there are no significant differences in the genitalia, *hesperata* is distinctive in appearance and is usually recognized by its powdery violaceous tint, reddish shading in the outer part of the forewing, somewhat reduced dark costal spots, and more yellowish hindwing. The closely related *S. prunosata*, n. sp., of Colorado and Wyoming takes all of these trends still further and has a more intensely colored, purplish-red or plum-colored forewing.

Sexes alike; forewing blue gray, finely dusted with dark scales; transverse lines, especially medial lines and subterminal band, sometimes visible but faint; subterminal band, if developed, often crenulate or dentate, reddish brown, parallel to outer margin; space between subterminal band or sometimes postmedial line and outer margin, variably shaded or often filled in with reddish brown; costal spots black to dark reddish brown, more narrowly wedge shaped than those of *coortaria*, and usually numbering only three, as the outermost spot (subterminal) is lost or nearly so; discal spot small, blackish, transversely elongated, touching medial costal spot or almost so. Hindwing yellowish, with a dark-dusted, violet-gray strip along inner margin, which is colored like forewing; fringes of the two wings similar,

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or purplish gray brown if fresh. Underside ochreous, like upperside of hindwing or darker, heavily overshadowed or granulated with light reddish brown on entire hindwing, and near costa and apex of forewing; diffuse, reddish discal spot on hindwing; fringes as above. Body light violaceous gray, about same color as ground color of forewing on upperside. Antennae, legs, and other external structures as in *coortaria*. Wing length: holotype, 14 mm; other males (n = 18), 13–15 mm; females (n = 23), 13–16 mm.

The few Californian specimens of *S. hesperata* are darker or at least less brightly colored than the others, especially a male from South Lake Tahoe. These might easily be mistaken for *S. extemporata*, but they have the shorter palpi and distinctive male genitalia of the *exauspicata*-group.

The genitalia do not differ significantly from those of *Speranza coortaria* in either sex.

The early stages and hosts are unknown, but chokecherry, *Prunus virginiana* Linnaeus, was present in the localities where I collected this species in Utah and Nevada, and it seems a likely food plant.

TYPES. Holotype ♂. Willow Creek Road, 7,500' [off Ephraim Canyon Road about 1,000' lower than what was formerly the Great Basin Experiment Station, U. S. Forest Service], near Ephraim, Sanpete County, Utah; 26 July 1981, D. C. Ferguson. USNM. Paratypes: 19 ♂, 20 ♀. Utah. Same locality and date as holotype (1 ♂). Ephraim Canyon, 6,000', Sanpete County; 23, 31 July 1981; D. C. Ferguson (1 ♂, 5 ♀). Lower Ephraim Canyon, 6,300', Sanpete County; 6 August 1981; D. C. Ferguson (3 ♀). Mouth of Ephraim Canyon, 5,800', Sanpete County; 27 July 1981 (1 ♀). Great Basin Experiment Station, 8,850', near Ephraim, Sanpete County; 5 August 1981 (1 ♀); Major's Flat, 7,100', near Ephraim, Sanpete County; 24 July 1980; D. C. Ferguson (1 ♀). Snake Creek, ca. 3 mi NW of Midway, Wasatch County; 1 August 1971; D. C. Ferguson (1 ♂, 1 ♀). Oak zone, Wasatch Mts., ca. 5 mi SW of Midway, Wasatch County, Utah; 29 July 1971; D. C. Ferguson (1 ♂); Provo, Utah County; 14 July 1909 (1 ♂). North Fork Provo Canyon, Wasatch County, 16 August; T. Spalding (1 ♀). Stockton, Tooele County; 16 July, 11, 16 August 1914; T. Spalding (2 ♂, 2 ♀). Eureka, Juab County, Utah; 22 July, 1, 19 August 1911; T. Spalding (5 ♂, 4 ♀). Beaver Creek Hills, Beaver County; June (1 ♂, 1 ♀). Nevada. Angel Creek, 7,000', E Humboldt Mts. SSW of Wells, Elko County; 25 July 1971; D. C. Ferguson (2 ♂); Angel Lake Road above Wells, 7,000', Elko County; 17, 22 July 1971; D. C. Ferguson (4 ♂). AMNH, USNM, and others.

Speranza hesperata was identified from the following additional localities: 7 miles E of Jacob Lake, Coconino County, Arizona, 6,800'; High Rolls, Otero County, New Mexico; Helper, Carbon County, St. George, Washington County, and Springdale, Utah; "Colorado"; Johnsville, Mohawk, and Nelson Creek, Plumas County, Davis Creek, Modoc County, Ward Creek, 2 mi S of Tahoe City, Placer County, and Coleville, Mono County, California; and several males that I collected at about 2,400' in the Siskiyou Mountains, near Smith River, Del Norte County, California, 20–27 July. I omitted them from the type series because they are atypical, with dull coloring and reduced costal spots. It appears to be a montane species occurring at medium elevations of about 5,800–8,800 feet, except for the lower site in Del Norte County. Most Utah specimens are from the Great Basin side of the Mountains, and all that I collected were from moist areas within the pinyon-oak zone or among cottonwoods or aspen. The recorded flight period is 14 July–19 August in Utah and Arizona, and 30 June–23 August in California. The earliest record noted was for 21 June in Railroad Canyon, White Pine County, Nevada. Most were taken in the last week of July or first week of August.

Speranza prunosata Ferguson, NEW SPECIES

PL. 2, FIGS. 33, 34 (adult); TEXT FIG. 20 *d*, *f* (♂ gen.); TEXT FIG. 20 *e* (♀ gen.).

Speranza prunosata Ferguson.

Type locality: Co[unty] R[oad] 50 (Beaver Creek Rd.), Grand County, Colorado, R78W, T1N, Sec. 15, elev. 7,600'. [USNM]

Although similar in structure and basic pattern to *S. coortaria* and *hesperata*, this new species presents a different aspect because of its dark purplish or plum-colored forewings and contrasting, pale ochreous hindwings. Although *Speranza hesperata* displays the beginnings of such coloring, its forewing is mostly much paler. *Speranza prunosata* is known from Colorado and southeastern Wyoming.

Sexes nearly alike; forewing deep, powdery, purplish gray mottled or dusted with lighter and darker scales; dark brown transverse lines erect from inner margin, varying from distinct to faint, diffuse, or absent; lines when present nearly parallel, expanding at costa into three usually slender, deep cinnamon-brown spots; subterminal a

brighter, cinnamon-red band, nearly straight and parallel to outer margin, varying from a discrete, crenulate or dentate band to a wider, diffuse band coloring most of the space between subterminal band and outer margin, but usually reverting to a discrete, bright cinnamon band just before reaching costa; discal spot small, blackish, as in related species; fringe unicolorous. Hindwing light buff yellow, granulate purplish gray on inner margin; without discal spot; fringe gray from tornus to M_1 or R, becoming yellowish at outer angle. Under-side dull yellowish to dusky, bright reddish brown toward apex of forewing, densely variegated with light reddish brown on entire under-surface of hindwing; discal spot faint; fringes gray to purplish gray on both wings. Body concolorous with adjoining areas of wings. Wing length: holotype, 14 mm; other males ($n = 6$), 13–14 mm; females ($n = 4$), 13.0–13.5 mm.

Genitalia (text figure 20 *d–f*) not differing significantly from those of *coortaria* or *hesperata*.

Early stages unknown.

TYPES. Holotype ♂. Co[untyl R[oa]d 50 (Beaver Creek Rd.), R78W, 71N, Sec. 15, elev. 7,600', Grand County, Colorado; 22 July 1987, T. S. Dickel (mercury vapor lamp). USNM. Paratypes: 4 ♂, 2 ♀. Colorado. Radium State Wildlife Area, Co. Rd. 11, R82W, T1S, Sec. 22, elev. 7,120', Grand County; 3 August 1982; T. S. Dickel (1 ♂). Radium State Wildlife Area, Co. Rd. 11 and Blacktail Cr., R82W, T1S, Sec. 22, elev. 7,040', Grand County; 19 July 1987; T. S. Dickel (1 ♂). Glenwood Springs, Garfield County; July 16–23; W. Barnes (1 ♂). Glenwood Springs, Garfield County (1 ♀). Mesa Verde National Park, Montezuma County; 19 July 1937, A. B. Klots (1 ♀). Wyoming. 1.5 mi NW of Woods Landing, Fox Cr., 7,875', Albany County; 2 August 1991; J. S. Nordin (1 ♂). CU, JSN, USNM.

The localities listed for the types represent the entire known distribution of this species. The recorded flight period is 19 July–3 August.

The *bitactata*-GROUP

This group of six species includes *bitactata*, *wauaria*, *subcessaria*, *denticulodes*, *semivolata*, and *decorata*. All feed on species of *Ribes* (Grossulariaceae), and all have quite similar genitalia, which differ only slightly in males of some species and in females hardly at all. The first four are closely related; the rest are more diverse, at least in appearance. *Speranza sulphurea* and *amboflava* are not very different, having certain similarities to *decorata* in the wing pattern elements

as well as similar genitalia. However, their bright yellow coloring and different hosts (cranberry and sweet gale (*Myrica*)) for *sulphurea*; bearberry and wild licorice (*Glycyrrhiza*) for *amboflava*, suggest that they may not belong here.

Speranza bitactata (Walker), NEW COMBINATION

PL. 2, FIGS. 35–38 (adult); PL. 10, FIG. 6 (larva); TEXT FIG. 21 *b* (♂ gen.); TEXT FIG. 22 *b, c* (♀ gen.) (RWH 6304).

Thera? *bitactata* Walker, 1862, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **24**: 1264. Type locality: St. Martin's Falls, Albany River, Hudson's Bay. [BMNH]

Heterophleps atrosignata Walker, 1862, *ibidem*, **25**: 1457.

Type locality: St. Martin's Falls, Albany River, Hudson's Bay. [BMNH]

NOTE—Misspelled “*astrosignata*” by me (1983: 89).

Halia packardaria Möschler, 1883, *Stettiner Entomologische Zeitung*, **44**: 119.

Type locality: Southern Labrador.

Itame epigenata Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, **3**: 238, pl. 23, fig. 5.

Type locality: Truckee, California. [USNM]

NOTE—Described from six male and three female syntypes, of which I designate as lectotype the specimen labeled by McDunnough as the “Type male.”

Of the species in this group, *Speranza bitactata* is the most widespread, variable, and difficult to characterize. Indeed, the species may be recognized by its variability, especially as this affects the black medial band of the forewing. The medial band is often broken or divided in such a way that the discal spot stands out separately or partly so, although the medial band is also more likely to be complete from costa to inner margin in this species than in any of its relatives. Also, complete blackish antemedial and postmedial bands may be present, especially in western specimens.

Speranza bitactata differs from *S. subcessaria* in the darker or more variegated gray coloring of both wings, and in the much less consistent pattern. In *subcessaria* the hindwings are less often gray than very pale brown to faintly yellowish,

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and the medial band of the forewing is a discrete black bar that overlies and includes the discal spot; usually there is no angulate band as in *bitactata* and *wauaria*. *Speranza bitactata* differs from *S. wauaria* in its pure gray coloring, without reddish-brown tints, and in the less discrete, less acutely angled but often more complete medial band. Several other subtle differences are discussed under *wauaria*.

Speranza bitactata is subject to considerable geographic variation. Eastern populations (*bitactata*) and western ones (*epigenata*) might be distinct species, especially as they show some overlap in distribution westward. However, the differences are too nebulous and too continuously variable for the distinct species argument to be very convincing, and I chose not to pursue it.

Speranza bitactata differs from the fourth member of the group, *S. denticulodes*, in its gray rather than mottled tawny-brown wing color, more extensive black bands on the forewing, the lack of any complete transverse lines or bands on the hindwing above or beneath, and in its much wider distribution. *Speranza denticulodes* is known mainly from Colorado and New Mexico and is very distinctive.

Although the colored illustrations should eliminate most identification problems in this group, variation in *bitactata* and *subcessaria*, and especially the differences between eastern and western populations of *bitactata*, might continue to cause confusion. Eastern *bitactata* differ most noticeably from western populations in a reduction of the black transverse bands of the forewing. In about half of the eastern specimens, none of the three transverse bands is complete. In the rest the medial band and sometimes the antemedial band may be complete from the costa to the inner margin. The postmedial line, or band, is nearly always wanting.

In most western populations, however, all three transverse bands are better developed, the postmedial is commonly a complete black line from costa to inner margin, and the moths tend to be larger. Where such well-marked specimens prevail, as in the Rocky Mountains from western Canada to Arizona and New Mexico, in the Great Basin ranges, and in the Cascades and Sierra Nevada, the moths are easily distinguished from eastern specimens as well as from everything else. This is *epigenata*, if one chooses to recognize it as a subspecies. The colored figures in McGuffin's work (1972) show clearly the differ-

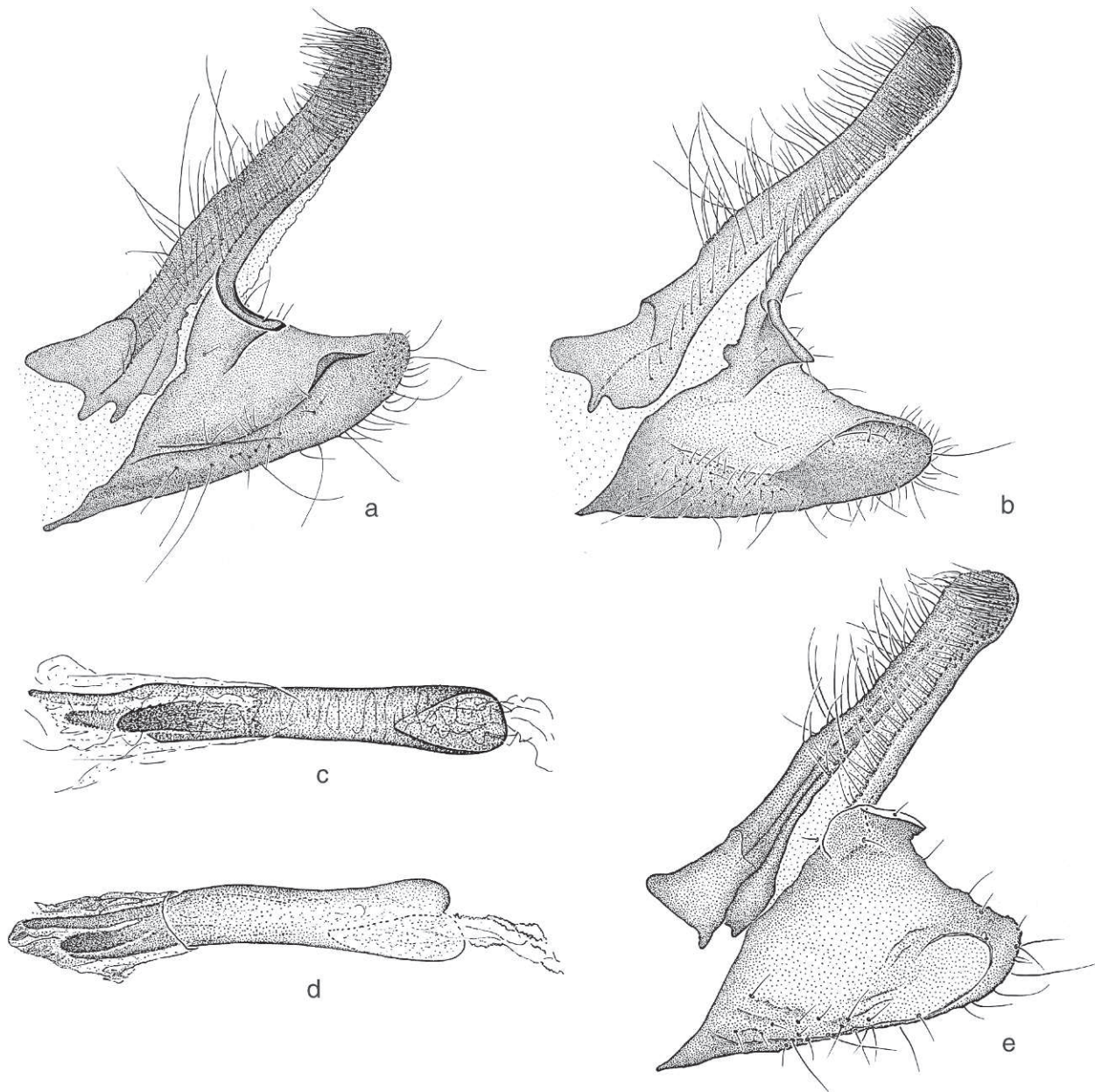
ences between eastern and western specimens. Figures 164, 165 and 166, 167 are typical of western and eastern specimens respectively.

Populations of moths resembling eastern *bitactata* also occur in the West. Those of the Black Hills, South Dakota (plate 2, figures 37, 38) are almost exactly like specimens from Maine; those from eastern Oregon and Washington are also somewhat like eastern specimens. Further regional differences are also apparent in the West. Specimens from Sweetgrass County, Montana and Sanpete County, Utah are alike in being lightly marked; whereas those from Colorado are dark and heavily marked. Specimens from the Sierra Nevada, California are average western specimens in markings but tend to be unusually large.

Curiously, northeastern *bitactata* are more likely than western ones to resemble the species with which they are sympatric—*subcessaria* and the introduced *wauaria*, although the distinguishing features already discussed should be adequate. A small proportion (3%) of *subcessaria* have the black medial costal bar broken into three spots, but these individuals can be recognized by association with normal specimens from the same locality, or by the other reduced black markings and lighter ground color characteristic of that species.

Wing length: males, 11–15 mm (n = 23); females, 13–15 mm (n = 3) (Maine). Males, 14–16 mm (n = 4); females, 15–16 mm (n = 6) (South Dakota). Males, 14–17 mm (n = 69); females, 15–16 mm (n = 16) (Colorado). males, 14–18 mm (n = 24); females, 14–17 mm (n = 16) (Utah). Males, 13–16 mm (n = 22); females, 13–16 mm (n = 11) (Oregon, Washington). Males, 14–19 mm (n = 28); females, 15–17 mm (n = 15) (California).

It seems doubtful whether the genitalia of either sex can be distinguished reliably from those of *wauaria* or *subcessaria*, assuming that allowances are made for variation. I concluded that there is no way to separate the males; however, in females, the sterigma is more clearly quadrate or rectangular than that of *wauaria*, the stellate signum is not as large, and the sclerotized zone on the neck of the bursa copulatrix is less extensive but perhaps more sclerotized than that of *wauaria* (dissections examined: 6 males, 2 females *bitactata*; 3 males, 2 females *wauaria*). The female genitalia of *subcessaria* are like those of *bitactata* but with a more extensively sclerotized zone in the neck region and a truncated ste-

FIGURE 21: MALE GENITALIA OF *SPERANZA* SPECIES

a. *S. wauaria*, right valva; United States (USNM 56933). b. *S. bitactata*, right valva; Oquossoc, Franklin County, Maine (USNM 56926). c. *S. wauaria*, aedeagus; United States (USNM 56933). d. *S. denticulodes*, aedeagus; Four Mile Creek, Chaffee County, Colorado (USNM 57419). e. *S. denticulodes*, right valva; Four Mile Creek, Chaffee County, Colorado (USNM 57419).

rigma with sloping sides. The genitalia of *denticulodes* show greater differences and are discussed under that species.

The larva (plate 10, figure 6) may be green or brown, and both forms were described by McGuffin (1972: 57). The mature larva that I illustrate from Jefferson County, Oregon was of the brown form and about 20 mm long. Head light brown, mottled or blotched with darker reddish

brown frontally and with a white patch laterally; body reddish brown, with numerous slightly sinuous or geminate longitudinal whitish lines and large, whitish, lateral segmental patches. Some setae are on large, raised, conspicuous, dark brown pinacula that are almost tuberculate, especially that bearing seta L1 from the metathorax to A5. Those on A6–A7 smaller but still conspicuous, as are the pinacula of some dorsal and

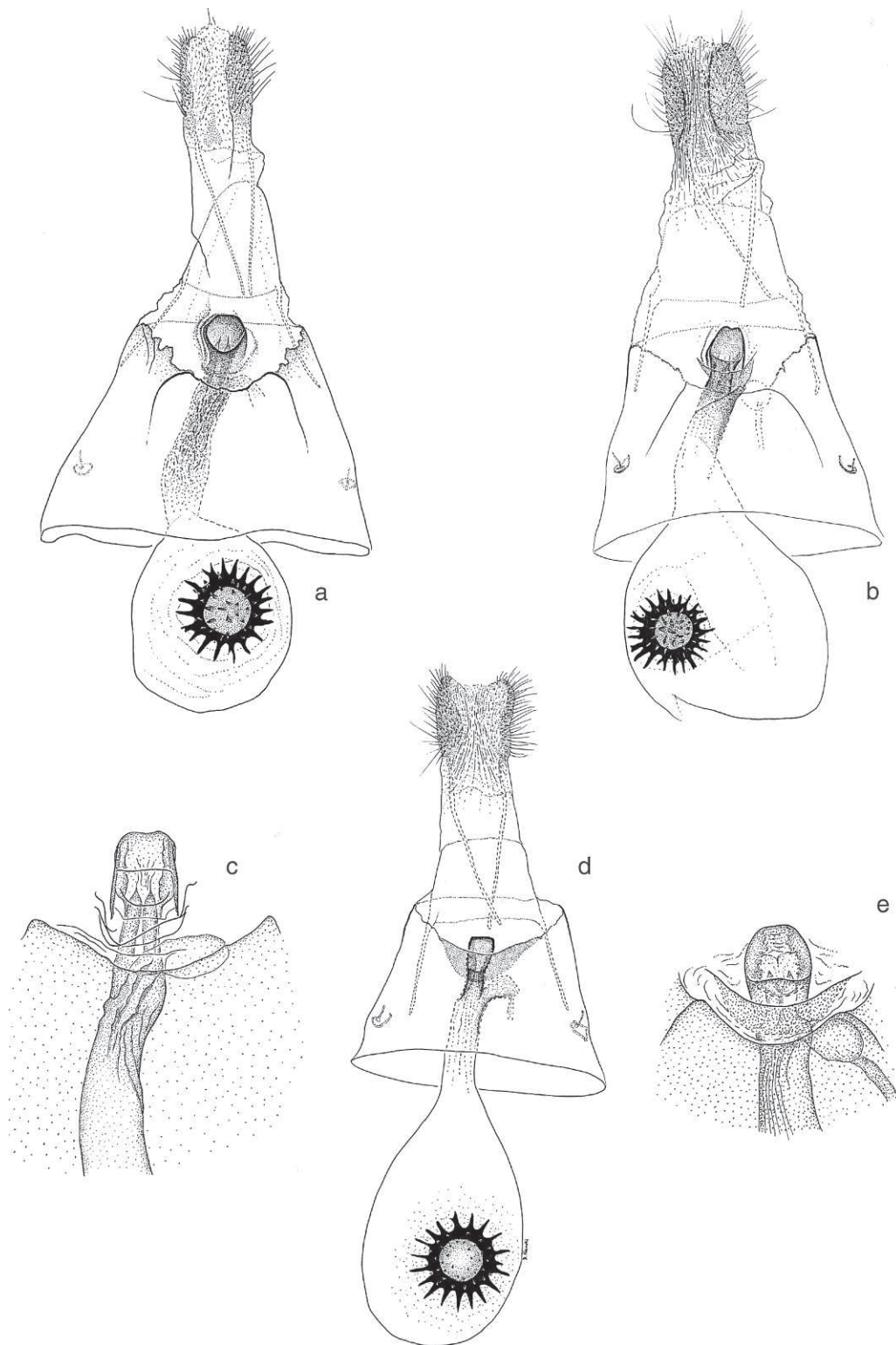


FIGURE 22: FEMALE GENITALIA OF *SPERANZA* SPECIES

a. S. wauaria; Europe (USNM 56934); unknown locality (USNM 56935). *b. S. bitactata*; Mono County, California (USNM 56931).

c. S. bitactata, S8, ostium bursae and ductus bursae; Tim Pond, Franklin County, Maine (USNM 56927). *d. S. semivolata*; San

Diego, San Diego County, California (HWC 823). *e. S. denticulodes*, S8, ostium bursae and ductus bursae; Jemez Springs, Sandoval County, New Mexico (USNM 57631).

subventral setae on the abdomen. The L1 pinaculum is part of an irregular, oblique, dark brown patch just behind spiracle on A1–A5, and spaces between the oblique markings mostly whitish. Thoracic segments and posterior abdominal segments from middle of A6 to the end of the body are without white lateral patches and are contrastingly brown, but show more clearly the whitish subdorsal and spiracular bands largely obliterated on A1–A5 and anterior half of A6. Thoracic legs light brown with some dark brown markings; prolegs brown laterally, with a white stripe down the middle of the outer side of each. The 5th instar green form was described by McGuffin (1972: 57) as follows: Head light russet green, with lighter frons; body green with white geminate dorsal lines, a white supraspiracular, and a yellow spiracular stripe.

This species would be expected to feed exclusively on currant or gooseberry like its close relatives *wauaria* and *subcessaria*, and there are many records of larvae found on species of *Ribes* (Grossulariaceae). However, Prentice et al. (1963: 425) listed 21 collections from *Alnus* and eight from *Ribes* (species not given) in Saskatchewan, Alberta, and British Columbia. The records from alder are doubtful and need verification. It was reared from larvae on a *Ribes* species by J. H. McDunnough near Silverton, Colorado (1917: 239; 3 specimens in USNM); from *Ribes cereum* Dougl. at Mt. Pinos, 8,200', Kern County, California by C. Henne (11 specimens, LACM); on *Ribes inebrians* Lindl. (= *R. cereum*) by J. G. Franclemont in Arizona (9 specimens, Cornell); and on *Ribes cereum* and *Ribes* sp. at localities in Chaffee and Park counties, Colorado; Jackson County, Oregon; and Placer and Plumas counties by B. Scaccia (14 specimens, USNM); and from larvae on *Ribes cereum* (13) and *R. viscosissimum* (4) in Oregon by J. C. Miller.

Speranza bitactata is unaccountably rare, local, and boreal in the East, more common and much more widespread across more diverse habitats in the West. I have seen eastern specimens only from Labrador; St. Anthony, Newfoundland; Maine (26 from the A. E. Brower collection, USNM); Quebec; Ontario; and Wisconsin. It should be in all of the border states and Canadian provinces, but may be absent in some regions. For example, none turned up in more than 100,000 moths collected in Nova Scotia, and I never personally encountered it anywhere in the East except in northern New Brunswick. Most

published records for the East Coast south to Philadelphia (e.g., Packard, 1876: 254; Forbes, 1948: 41; Ferguson, 1954: 311, pl. 15, fig. 19) refer to the introduced *S. wauaria*. In the West, *S. bitactata* occurs from Saskatchewan to Vancouver, British Columbia, northward to Great Bear Lake, Northwest Territories, Dawson, Yukon Territory, and Skagway, Alaska; and southward through all western states to northern New Mexico (Frijoles Canyon, in Bandelier National Monument, Los Alamos County and Taos Canyon, Taos County); Coconino and Yavapai counties, Arizona; to the southern end of the Sierra Nevada in Kern County and Big Bear Lake, San Bernardino County, California. It appears to be absent from the Coast Ranges of California. One old specimen in the USNM from the Davis Mountains, Texas, may be mislabeled.

The recorded flight period in Maine is 7 July–2 August, and most other northern material is dated within the period mid-July to mid-August. Records for the western part of the continent are mostly for late June to early August; specific flight periods recorded for various regions from which adequate samples are available are as follows: Montana, 26 June–19 August; Colorado, 20 June–18 August; Utah, 14 July–19 August; Washington, Oregon, mainly 31 June–31 August, but with a few collected as late as 28 September (the latest is one that I collected at light near Ft. Klamath); California, 1 July–21 August, and also a few in September. In Arizona it also flies from late June to August.

Speranza wauaria (Linnaeus), NEW COMBINATION

PL. 2, FIGS. 39, 40 (adult); TEXT FIG. 21 a, c (♂ gen.); TEXT FIG. 22 a (♀ gen.).

Phalaena wauaria Linnaeus, 1758, *Systema Naturae* (Ed. 10), 1: 522.

Type locality: not given [Sweden?]

Phalaena fuscaria Thunberg, 1792, *Dissertatio Entomologicae sistens Insecta Suecica*, pt. 4: 58. Preoccupied by *Phalaena fuscaria* de Villers, 1789. HOMONYM.

Type locality: not given [Sweden?]

NOTE—Apparently a melanic specimen of *wauaria*.

Itame v-nigraria Haworth, 1809, *Lepidoptera Britannica*, (2): 282.

Type locality: London, England

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Geometra wauaria Haworth, 1809, *Lepidoptera Britannica*, (2): 284.

NOTE—*Geometra wauaria* Haworth is an emendation of *Phalaena wauaria* Linnaeus.

Itame wauaria chinensis Sterneck, 1928, *Dt. ent. Z. Iris*, **42** (2): 236. SUBSPECIES.

Type locality: Sungpanting, western China.

Itame wauaria africana Zerny, 1934. *Z. öst. Ent. Ver.*, **19** (7/8): 52, pl. 5, figs. 11, 12. SUBSPECIES.

Type locality: Tachdirt, 2,300–2,700 m, Morocco.

Itame wauaria koreaebia Bryk, 1949, *Ark. Zool.*, **41A** (1): 213. SUBSPECIES.

Type locality: Shuotsu, Korea.

This Palearctic species was introduced more than a century ago and had become locally common from eastern Canada to the Middle Atlantic States by the mid to late 1800's. It has since died out except for colonies that still flourish in Quebec; near Ottawa, Ontario; and possibly on Cape Breton Island, Nova Scotia. *Speranza wauaria* is similar to *S. bitactata*, but the overall coloring is usually more brown than gray, especially in males. Females may be quite gray, but they are lighter and less heavily marked with black than those of *bitactata*. The angle in the dark medial band of the forewing is 90° or less, thus usually more pointed than that of *bitactata*, forming a conspicuous V-shaped mark near the middle of the forewing. The subapical costal spot is partly bright reddish brown, and the undersides of both wings are much more likely to be tinted with reddish or yellowish brown than those of *bitactata*. However, the wing pattern most closely resembles that of *bitactata*; *wauaria* is less likely to be confused with the light gray *subcessaria*. The branches of the male antennae are distinctly longer than those of *subcessaria* and very often longer than those of *bitactata*, but the differences are too slight for easy measurement. Wing length: males, 15–17 mm; females, 15–16 mm. *Speranza wauaria* averages slightly larger than eastern *bitactata*.

The genitalia are discussed under *S. bitactata*. The male genitalia are doubtfully distinguishable from those of *bitactata*, but the female (text figure 22 a) has a larger signum and a more rounded rather than quadrate sterigma.

The early stages have not been described in North America, but they are well known in Europe and were discussed in some detail by Barrett

(1900: 383; pl. 276, fig. 2e, larva), writing on the British fauna. He described the larva as “stout, bristly, the usual spots [pinacula] raised, the incisions between the segments well marked, otherwise moderately cylindrical; head lead colored and streaked with black; color of the body yellowish green or some darker shade to bluish green, violet brown, purplish brown, or leaden brown; dorsal line white, double, both duplicates [addorsals] very slender; subdorsal lines thread-like, waved, white; spiracular stripe broad, yellow, rather extended into a blotch in the middle of each segment; usual raised spots [pinacula] black and conspicuous, each furnished with a short bristle [seta]; undersurface yellow green or deep green, with two conspicuous, yellowish or white longitudinal lines; legs black; prolegs dull brownish black. Sometimes the slender longitudinal lines are smoky black instead of white. The green individuals usually become reddish brown just before entering the pupa state.”

The larva was illustrated in color somewhat differently by several European authors. For example, Nordström et al. (1941: pl. 44, fig. 11L) showed it as being purplish brown dorsally, green ventrally, with a broken, bright-yellow lateral stripe sharply delimiting the contrasting dorsal and ventral areas, and with a greenish head. Eckstein (1923: pl. 54, fig. 7a) showed an all-green larva except for the yellow lateral stripe and a brown head. Porter (1997: pl. 21F) shows a larva like that of Nordström except for large, dark brown patches on the head. All illustrations show the conspicuous black pinacula described by Barrett, as do preserved specimens in the U. S. National Museum of Natural History.

The larva is found “April to June on gooseberry, currant—especially red-currant—and other species of *Ribes*; feeding at night on the younger shoots, and resting by day on the undersides or petioles of leaves. Especially attached to gooseberry or currant bushes which are trained against a wall, sometimes stripping these of their leaves, while bushes standing in open ground are comparatively neglected. Very timid and sensitive, dropping instantly when touched, and remaining suspended by a thread. Dr. A. G. Butler has noted that this larva is distasteful to frogs. The winter is passed in the egg-state” (Barrett, 1900: 383).

Barrett also observed that “the moth hides during the day in gooseberry and currant bushes, or sits on a wall in their vicinity, and is easily disturbed, flying quickly about the bushes to a sim-

ilar hiding place. At dusk it is lively and active. From the nature of its food-plants it is almost confined to gardens, and is in them often very common; and its larva destructive, stripping the leaves so as seriously to injure the crop of fruit and the growth of the plant." These observations are quoted at length to assist readers in recognizing the larva and the habitat, and thus determine in more detail the present range of *wauaria* in North America.

Speranza wauaria still occurs commonly in the vicinity of Ottawa (CNC), Montreal, Quebec City, and around various towns and villages on both sides of the St. Lawrence River and up the Saguenay River as far as Alma, near Lac St. Jean (L. Handfield, pers. comm.). Handfield (1999, fig. 6304) illustrated one as *bitactata* from Mt. St. Hilaire, Quebec taken in 1970, and I made the same mistake (1954, pl. 15, fig. 19), illustrating one taken in Nova Scotia in 1906. It was formerly more widely distributed.

The following data from old specimens in collections will document the former distribution of *wauaria* in North America. **Newfoundland:** St. Johns (James), 4 specimens (BMNH), plus one other without data but apparently Canadian as it is labeled "prob. var. *packardaria* Mösch." **Nova Scotia:** MacNab's Island [mouth of Halifax Harbour], 30 July 1906 [Joseph Perrin], 1 ♀ (CNC); same locality and collector, 12 August 1907, 1 ♂ (USNM); Stellarton (Pictou County), 1 ♂, (USNM); Digby [Digby County], 22 July 1905 [John Russell], 1 ♂ (NSM), "C.T. Hills, N.S." [probably refers to C.B. Hills, who collected at Stellarton, Nova Scotia and Belle Island in Conception Bay, Newfoundland in the early 1900's], 1 ♂ (CNC); "Nova Scotia/Coll. Hy. Edw.," 1 ♀ (AMNH); "Nova Scotia, Redman," 6 specimens (BMNH) (1860 or earlier). **New Brunswick:** St. John, 9 August 1900, one ♂ (USNM). **Maine:** Bangor, "at sugar," [no date], Frederick Allen Eddy collection, 1 ♂ (MCZ); "Me.," 2 ♂ (AMNH, USNM). **New Hampshire:** White Mts., Mrs. A. T. Slosson, 1 ♂. **Massachusetts:** Boston, 5 July 1885, 1 ♂ (USNM). **New York:** "N. York/Coll. Hy. Edw.," 2 ♂ (AMNH); "N.Y./Coll. G. D. Hulst," 1 ♂ (AMNH). **United States:** "Etats-Unis (Owen)," from Dognin Coll., 2 ♂ (USNM). Packard (1876: 254), who knew the difference between *wauaria* and *subcessaria*, reported 11 specimens of *wauaria* from Gorham, Maine; Salem, Brookline, Medford, and Andover, Massachusetts; Brooklyn, New York; and Philadelphia,

Pennsylvania, but the few surviving specimens in the Packard collection at the Museum of Comparative Zoology mostly have no data labels other than those indicating that they are from the Packard, Thaxter, and C. J. Paine collections. In discussing *wauaria*, Packard remarked: "This species, apparently imported from Europe, differs from our native *subcessaria* by the three scallops on the hind wings, the more broadly pectinated antennae, the chocolate color of the fore wings, and the yellowish underside of both pairs." Judging from what we now know of the more northern distribution of *bitactata*, nearly all of the localities listed by Packard must indeed have been based on records of *wauaria*. He was unaware of *bitactata*, but only his record from Maine could refer to that species.

In The Natural History Museum, London, I saw the six specimens listed by Walker (1861: 944) from "Nova Scotia, Redman." A Lieut. Redman collected moths in Nova Scotia sometime prior to that date, and many of his specimens became types of new species described by Walker.

To summarize, we can be sure that *Speranza wauaria* was present and not uncommon from the mid-1800's until after the turn of the century on the East Coast between Newfoundland and Philadelphia, although it was dismissed as an error of identification for *bitactata* by nearly all authors subsequent to Packard (1876). In this century only Forbes (1948: 41) thought that he had "seen the real thing," but did not elaborate. The Medford, Massachusetts record cited by Packard was attributed to Leopold Trouvelot, a contemporary of Packard notorious for his accidental introduction of the gypsy moth (Ferguson, 1978: 93), but who was also an accomplished illustrator who created the exquisite moth drawings in the Packard (1876) monograph. For *wauaria* to have been so widespread and common by the 1860's, it may have arrived decades earlier. The eggs, which overwinter on the plant stems, could easily have been brought over on currant and gooseberry bushes from Europe. The name was commonly spelled "*wavaria*," "*vauaria*," or "*vavaria*" in early literature (e.g., Haworth, 1809; Walker, 1861; Packard, 1876). In the Palearctic Region, *wauaria* occurs throughout most of Europe and supposedly across Eurasia to China, Korea, and Kamchatka. Specimens from the Atlas Mountains, Morocco, described as *Itame wauaria* f. *af-*

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ricana Zerny, 1935, are very similar to European specimens.

In Europe, *Speranza wauaria* is reported mainly on cultivated Eurasian species of *Ribes*; namely, red and white currant, which are varieties of the same species [*R. rubrum* Linnaeus], black currant [*R. nigrum* Linnaeus], *Ribes alpinum* Linnaeus (a popular hedge plant northward), *Ribes aureum* Pursh (a Californian species grown as an ornamental), and gooseberry [*R. uva-crispa* Linnaeus (= *R. grossularia*)]. A few have been reared recently in the vicinity of Ottawa from *Ribes alpinum* (J. D. Lafontaine), and one from Sydney, Cape Breton County, Nova Scotia was reared 11 July 1972 from a larva on black currant (K. Bolte).

To my eye, specimens of *Speranza wauaria* from northern Europe (Scandinavia) appear different (gray and not as well marked) from those from Britain and Central Europe (brown and well marked), in a way analogous to the differences between *bitactata* and *wauaria* in North America. They look like *bitactata*. This north European form also occurs in the Alps. American specimens of *wauaria* are of the form that occurs in Britain, France, and Germany.

Speranza subcessaria (Walker), NEW COMBINATION

PL. 2, FIGS. 41, 42 (adult); PL. 10, FIGS. 7, 8 (larva) (RWH 6303).

Halia subcessaria Walker, 1861, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, 23: 945.

Type locality: Trenton Falls, New York. [BMNH]

NOTE—Described from four specimens from Trenton Falls and one from “Orilla, West Canada” [Orillia, Ontario]. Two surviving specimens from the type series are a large female labeled “U.S.” and a smaller male labeled Trenton Falls/New York. I designate as lectotype the latter because its locality is as given in the original description.

Thera? perarcuata Walker, 1862, *ibidem*, 24: 1,264.

Type locality: “United States. In Mr. Saunders’s collection.”

NOTE—Believed to be this species, but the type was not found.

Speranza subcessaria is an eastern species that differs from *S. bitactata* and *S. wauaria* in its uniformly light gray forewing; contrastingly dif-

ferent, pale, whitish-brown to yellowish-brown hindwing; and by the consistent nature of the black medial bar on the forewing, which runs from the costa to a point just short of the middle of the wing, specifically to the fork of M_3 and Cu_1 . The black bar is usually a regular, elongate rectangle, or sometimes rounded at its posterior end, and it usually terminates at what would be the V-shaped angle in the medial band of *wauaria* or *bitactata*. In those few specimens in which the medial band does continue posterad of the cubitus, it does so as a much diminished or obsolescent line to the inner margin, and the angle formed at the cubitus is very obtuse, even more so than that of *bitactata*, and it would hardly be described as V-shaped. The black medial bar originating at the costa nearly always incorporates the discal spot; only rarely is it reduced or fragmented so as to leave the discal spot standing separately as it commonly does in *bitactata*. The fringes are less conspicuously checkered than those of *bitactata*, and the underside is lighter, being often quite coarsely speckled or dappled with light reddish brown to yellowish brown on a whitish background. Differences in the antennae and other external structures are too slight to be useful for identification. Wing length: males, 13–15 mm; females, 13–15 mm.

The male genitalia probably are not distinguishable from those of *bitactata* or *wauaria*. The female genitalia differ from those of *bitactata* in having a more extensively sclerotized zone in the neck region of the bursa copulatrix and a posteriorly truncated sterigma with sloping sides. They are very similar to the female genitalia of *S. wauaria* except that the signum is smaller, its diameter less than the distance between the bases of the anterior apophyses, whereas it is about equal to that distance in *wauaria*.

The larva of *subcessaria* was not described prior to Wagner et al. (2001: 36), although a few were reared earlier. An old specimen in the USNM from the Wm. Saunders collection, presumed to be from Ontario, is labeled “Feeds on red currant” [*Ribes rubrum* Linnaeus]. Forbes (1948: 41) mentioned wild currant and gooseberry as hosts. It occurs in the usual green and brown forms. **Green form** (plate 10, figure 7)—Body leaf green with moderately wide, slightly irregular, light yellow, full-length lateral stripe from T1 to lateral side of anal proleg, and interrupted segmentally by series of conspicuous black spiracles on A1–A5; dorsum with seven

slightly sinuous white stripes, of which three are extremely thin, and the remainder, including subdorsal stripe, wider, but not as wide as lateral stripe; venter with similar thin white stripes; dorsal setae on pale, raised, tuberclelike pinacula; head and legs green, head unmarked. **Brown form** (plate 10, figure 8)—variegated light brown to dark brown, with setal bases black; lateral stripe mostly missing, but a thin, white, interrupted subdorsal stripe is present; large, oblique, lateroventral white patches on segments A1–A5; head pale brown with dark brown shading down mesial side of parietal lobe at frontal suture; frontal triangle pale; thoracic legs reddish brown; prolegs with wide, vertical, black band down lateral side of each, that of anal proleg preceded by pale band that is remnant of lateral stripe. These larvae were collected from wild *Ribes* plants at 2,000' on Spruce Knob, West Virginia and identified from a reared adult (D. Wagner, E. Hossler).

Speranza subcessaria occurs locally and mostly uncommonly from New Brunswick, Maine, southern Quebec and Ontario, Michigan, Wisconsin, and Minnesota to Massachusetts, New York, Pennsylvania, western Maryland, West Virginia, Virginia, Ohio, Illinois, and Iowa. Recent records from much farther south at Cameron Bluff, Magazine Mountain, Logan County, Arkansas, from Alabama, and from Rabun and Towns counties, Georgia may indicate disjunct populations, although the appearance of the moths is no different. The recorded flight period in Canada and most border states is about 28 June–30 July, with stragglers as late as 15 August; from central New York and Pennsylvania to Iowa and southward, it is about 21 June–25 July. Six were collected in Arkansas 1–21 June 1989. Exceptionally early and late dates are recorded for 22 May in Ohio (E. Metzler, in litt.), and 20 August in Wisconsin (Covell, 1970: 176).

Speranza denticulodes (Hulst), NEW COMBINATION

PL. 2, FIG. 43 (adult); TEXT FIG. 21 *d, e* (♂ gen.); TEXT FIG. 22 *e* (♀ gen.) (RWH 6305).

Diastictis denticulodes Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 332.

Type locality: Colorado. [AMNH]

NOTE—Described from male and female syntypes, but as is usual with Hulst types, extra specimens not specifically mentioned in the original description bear Hulst type labels (one male, one female in

USNM; one additional male, labeled “N.Y.” in AMNH). I designate as lectotype the male in the AMNH labeled as from Colorado, this being the specimen considered to be a valid syntype by Rindge (1955: 141).

Speranza denticulodes is a distinctive but rare and often misidentified species from Colorado, New Mexico, and the White Mountains, Arizona. The light brown (pale beige) forewings are variegated with somewhat darker shades and bear the usual four black costal spots, but the species may be recognized by the curved, crescent shape (outwardly concave) of the medial and subapical costal spots.

The light brown wings are variably marked with irregular patches or bands of medium brown and sparsely flecked with blackish brown. Of the the four black costal spots or bars, that marking the medial band is longest and has a characteristic shape; it is curved outward toward the posterior end and thus crescentic or comma shaped. Both the medial bar and the subapical costal spot are concave on their outer (distal) sides, this being a feature by which the species may be recognized. The discal spot is incorporated into the medial bar. No transverse blackish bands or extensions of the costal spots are present posterad of the immediate costal area or discal spot, although the antemedial and medial black costal marks may be connected to the inner margin by vague, irregular, medium-brown bands that do not contrast strongly with the ground color. The hindwing is whitish, paler than the forewing, with irregular light grayish-brown patches and bands, which may or may not resolve themselves into distinct medial, postmedial, and subterminal lines or bands. Two dark spots mark the points where the medial and postmedial lines meet the inner margin, and a small discal spot is apparent. The terminal line is unusually well marked by a series of disconnected dark spots on the forewing and crescents on the somewhat crenulate outer margin of the hindwing. The fringes are checkered with whitish and medium brown. On the underside the same markings are repeated less distinctly and appear diffuse. The costal area of the forewing and fringes of both wings are light yellow. The male antennae differ from those of *bitactata* in having slightly shorter branches, whereas the female antennae are not simple as in *bitactata* but have short branches about as long as the thickness of the shaft. Wing length: males, 14–15 mm; females, 16–17 mm.

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The male genitalia differ from those of *bitactata* in having a more uniformly sclerotized and flattened saccular lobe, without the conspicuously thickened ventral margin, without the deep trough in the middle, and with a nearly straight rather than concave outer margin. The saccular lobe also appears wider, or larger, because its outer margin meets the costal lobe almost halfway out; in *bitactata* this juncture is decidedly less than halfway out the costal lobe. The sclerotized part of the eighth sternum is larger, and the incision deeper and narrower with the sides parallel; in *bitactata* the sides of the incision are divergent, making it appear V-shaped.

The female genitalia differ from those of *bitactata* and other members of the group in having the integument of the entire neck region of the bursa copulatrix more thickened, rigid, and longitudinally rugose, with the parallel wrinkles or ribs extending onto and enveloping most of the corpus bursae; a larger, more rounded sterigma; a small signum not much larger than the sterigma; and many more persistent scales on the eighth segment that do not brush off during dissection.

The early stages of *S. denticulodes* are unknown, although there is a strong possibility that the food plant will prove to be *Ribes* as for others of the group.

I have seen this species from various localities in Colorado (Almont, Gunnison County; Platte Canyon, Park County; Boulder Canyon, Boulder County; and near Buena Vista, Chaffee County), New Mexico (18 miles east of Alma, 9,000', Catron County; Frijoles Canyon, Bandelier National Monument, Sandoval County; Jemez Springs, Jemez Mountains, 6,600', Sandoval County; and Las Vegas, San Miguel County), and Arizona (Diamond Rock, White Mountains, Apache County and Sprucedale, 7,000', White Mountains, Greenlee County). Specimens purportedly from Wallace, Idaho and Port Orford, Oregon (MCZ) may have been mislabeled. I collected eight males on Fourmile Creek, 8,500', 4 mi N of Buena Vista, Chaffee County, Colorado on 14, 19 July 1982. Several other sites in Chaffee and Alamosa counties were sampled repeatedly on the same field trip, but *denticulodes* was seen only in the one place. I recall nothing special about the site, which had the usual cottonwood, willow, aspen, *Symphoricarpos*, and doubtless *Ribes* and other shrubs along a small creek, with open grassland and sagebrush nearby. The flight period

based on all specimens examined is 19 June–21 August, but mostly in July.

Speranza semivolata (Dyar), NEW COMBINATION

PL. 2, FIGS. 44, 45 (adult); TEXT FIG. 22 *d* (♀ gen.) (RWH 6291).

Phasiane semivolata Dyar, 1923, *Ins. Insc. Mens.*, **11**: 23.

Type locality: San Diego, California. [USNM]

Speranza semivolata of southern California is structurally similar and closely related to *S. decorata* but presents a very different appearance. The ground color is whitish but in some specimens it is completely obscured by brownish overlay. The antemedial and medial bands of the forewing are nearly missing except for the spots that remain at the costa. The dark shading between the postmedial and subterminal lines, often forming a wide and contrasting dark band in *decorata*, is weak and usually gray brown rather than black. However, when relatively well developed (as it is in perhaps half the specimens), this band presents the diagnostic feature of being angled in the middle. In dark specimens it may have the added feature of a whitish border outwardly. In some specimens an inconspicuous ochreous-yellow patch occurs in the postmedial band between veins M_3 and CuA_1 . Overall, the moths are more brown than gray, and the underside has an especially strong yellowish- or reddish-brown tint. Wing length: males, 13–16 mm; females, 13–16 mm.

Geographical variation between central and southern California is very noticeable in this species, but as most of the material examined was reared, differences may be less than noted. Specimens from Alameda and Monterey counties are brown and relatively dark, with little of the whitish ground color showing. Specimens from Kern County southward (plate 2, figures 44, 45) are much lighter, more grayish, and show considerably more of the pale ground color on both wings. The female holotype from San Diego is similarly pale, but has an unusually well-developed, dark band between the postmedial and subterminal lines.

The genitalia appear to be indistinguishable from those of *decorata* in both sexes.

Although reared at various times by J. A. Comstock, C. Henne, and J. Powell, the species remained unrecognized and unidentified in collec-

tions until recently. No illustration or description of the larva is available. Comstock reared adults from larvae on a *Ribes* sp. (Grossulariaceae) at Lebec, Kern County in 1937 (USNM, CNC). Henne reared three specimens from larvae on *Ribes californicum* Hooker and Arnott at Pine Canyon, Los Angeles County in 1941, and nine specimens from larvae on *Ribes velutinum glanduliferum* Jepson in the Walker Pass area, Kiavah Mountains, Kern County, 3,600', in 1964 (LACM). Powell reared seven from larvae on *Ribes aureum* Pursh from the Salinas River at King City, Monterey County, and two from larvae on *Ribes menziesii* Pursh in the Patterson Preserve, Del Valle Lake, Alameda County, both in 1974 (UCB).

In addition to the localities mentioned, including the type locality, I have seen *Speranza semivolata* only from Benedict Canyon, near Beverly Hills; Oak Pass Road, 5 mi N of Beverly Hills in the Santa Monica Mountains, 1,100', Los Angeles County; and Bear Creek, Contra Costa County. The flight period indicated by field-collected adults is 3 June–6 July; reared specimens emerged 15–17 June (southern California), and 20–28 May for the San Francisco and Monterey areas.

Speranza decorata (Hulst), NEW COMBINATION

PL. 2, FIGS. 46–49 (adult) (RWH 6306).

Diastictis decorata Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 333.

Type locality: Platte Canyon, Colorado. [AMNH]

Speranza decorata is a variable, plain to well-marked gray species of the West, frequently with a full complement of three or four dark transverse bands on the forewing. Some specimens are easily mistaken for *Macaria unipunctaria* or *M. signaria* of the same regions, and I have sometimes mistaken them in the field; females, especially, are often misplaced in collections. However, the conspicuously bipectinate antennae of the male remove it from *Macaria*, and the male genitalia show that the species belongs in the *bitactata*-group of *Speranza*. The ground color is nearly white but usually so densely irrorated with dark scales that the overall effect is gray with dark brown (blackish) markings. The most closely related species, *S. semivolata* of southern California, is less heavily marked, with the antemedial

and medial bands obsolescent and with more of a yellow-brown tint, especially on the underside.

Antemedial and postmedial bands of forewing usually well-developed blackish lines, complete or incomplete, nearly straight or slightly waved, nearly perpendicular to inner margin. Postmedial and subterminal lines nearly parallel to each other and to outer margin, and the space between them variably shaded with blackish. Discal spot present but not conspicuous, often incorporated into medial band. Hindwing with markings largely obsolescent. Underside darker, with a slight reddish-brown tint, markings usually obscured, but postmedial and subterminal bands may be evident. Fringes may be checkered, especially beneath, but this is variable. Wing length: males, 14–19; females, 12–17 mm.

Although consistent in appearance over wide areas, this species does show some local variation. Specimens from Mono and Siskiyou counties, California (plate 2, figures 48, 49), Montana, and Alberta are more lightly marked and paler than those from Colorado (plate 2, figures 46, 47) and of average size, whereas those from Truckee and Lake Tahoe are better marked than those from nearby Mono County and are among the largest seen. They more closely resemble specimens from Utah than they do those from either Mono County or Colorado. Colorado specimens ($n = 48$) are the darkest by a noticeable margin.

The genitalia of both sexes are so similar to those of *S. bitactata*, *wauaria*, *subcessaria*, *denticulodes*, and *semivolata* that all clearly belong together as one species-group. The inner face of the valve of *decorata* is smoother (i.e., less boldly sculptured) than those of *bitactata* and *wauaria*, but about the same as those of *subcessaria*, *denticulodes*, and *semivolata*. The female genitalia of all these species are hardly distinguishable.

The larva was described by McGuffin (1972: 57). In last instar body is tuberculate, with black setigerous tubercles (raised pinacula); light gray, often with geminate gray middorsal stripe; often a white H-shaped marking on A2–A5 inclusive between D2 setae; subdorsal stripe gray and may be yellow orange at the edges; midventral a geminate gray line within a light gray stripe. Prothoracic plate gray with black spots; anal plate mottled brown, black, and gray. Head light brown with black band across parietal lobes and clypeus, and black patch on vertex of each lobe. Legs black. Reared from larvae on species of *Ribes* (Grossulariaceae) in western Canada by Mc-

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Guffin (1972: 58) and in 1990 from *Ribes* in Alpine County, California by B. Scaccia (vouchers in USNM).

Speranza decorata occurs widely in the mountainous regions of the West from Colfax County, New Mexico, Alamosa County, Colorado, central Utah, and Mono, Nevada, Alpine and Plumas counties, California northward through Wyoming, Montana, Idaho, Oregon, and Washington to central Alberta and British Columbia as far north as Mt. Robsen on the Alberta-British Columbia border. Toward the Pacific Coast it is present in the Sierra Nevada and the Cascades, but apparently not the Coast Ranges, except that two very pale specimens were collected at Cecilville, Siskiyou County, California, on 23 June 1980 (J. Powell and J. DeBenedictis).

Speranza decorata has a long flight period, in most regions about 21 June–25 August. The earliest records noted were for Klamath Falls, Oregon, where it was collected on 5 and 11 June (USNM); and for western Canada, for which McGuffin (1972: 58) recorded the flight period as 6 June–18 August. The dates for the central Rocky Mountains of Utah, Colorado, and Wyoming, where many were collected at 7,000'–10,500', are 21 June–25 August; and for the Sierras, 3 July–19 August. I collected 12 fresh specimens near Lee Vining, 6,700', Mono County, California, on 3–5 July 1987, indicating recent emergence on those dates. Although it occurs much lower northward, it seems mainly a subalpine species. The wide range of dates can be attributed to habitat altitude and to seasonal differences in weather and snowmelt conditions.

The *colata*-GROUP

Although characteristic of the genus in nearly every respect, the one species belonging to this group is distinctive and not easily placed elsewhere. The special pattern of dark transverse bands on a light gray to tan, transversely striated forewing, unusually long branches on the bipectinate male antennae, the distinctively colored larva, and its restriction to certain shrubby western Rosaceae set the species apart. In the genitalia, however, the narrow saccular lobe of the valve with a disproportionately large, erect interlobular process in the male and very large stellate signum in the female would seem to link *colata* most closely to *decorata* and *semivolata*. Indeed, the genitalia are hardly distinguishable. *Speranza*

colata is also unusual for the long, continuous flight period of the adults, from May to October in the southern parts of its range. I do not know how to interpret this in terms of generations, but it would be uncharacteristic of a temperate-zone species of *Speranza* to be more than univoltine. Despite the similarity in genitalia, *colata* seems so distinctive in appearance and in other ways that it is hard to imagine it as the sister-species of *decorata* and *semivolata*.

Originally I intended to treat the *colata*-group as two allopatric species, with the populations of Arizona and southern California as the true *colata* and everything north of about the 35th parallel as *correllata*, but in the end reduced them to subspecies. Except for transitional specimens from a narrow boundary zone in California and across southern Nevada and Utah, moths of the more northern and southern regions are easily distinguished. The differences were recognized by early authors, although not without bickering over the names and whether there are two species (Grossbeck, 1907a: 150; 1907b: 341; 1909: 354; Dyar, 1907: 205). They were synonymized by Barnes and McDunnough (1918: 149), but apparently without reference to Arizona material and thus without full appreciation of the differences. Confusion persists because of the two entities of different appearance under one name.

Speranza colata (Grote), NEW COMBINATION

PL. 2, FIGS. 50–54 (adult); TEXT FIG. 23 *a*, *c* (♂ gen.); TEXT FIG. 23 *b* (♀ gen.) (RWH 6308).

Phasiane colata Grote, 1881, *Papilio*, 1: 167
Type locality: Tucson, Arizona. [USNM]

NOTE—Described from the Berthold Neumögen collection, which was later acquired by the USNM. The type locality, although not mentioned in the original description, is given in the introduction to Grote's paper. Male and female "types" in the AMNH from Colorado and Senator, Arizona, must be regarded as spurious.

Selidosema correllatum Hulst, 1896, *Trans. Amer. Ent. Soc.*, 23: 355. SUBSPECIES.
Type locality: Colorado. [AMNH]

NOTE—Described from an unspecified number of syntypes from Colorado, California, and Oregon. The male from Colorado and a female from California are in the AMNH, and males labeled as types from Placer County, California and Klamath, Oregon are in the USNM. The Colorado specimen

was in effect made the lectotype by Grossbeck (1907a: 150), who wrote: "The Colorado type is, therefore, left to represent Hulst's species [*correllatum*], and the California specimen is herewith described as new." He then proceeded to describe the Californian paralectotype of *Selidosema correllatum* as a new species, *S. pallescens* (a junior synonym of *Speranza quadrilinearia*).

Diastictis sericeata Hulst, 1898, *Can. Ent.*, **30**: 191.

Type locality: Prescott, Arizona (by present lectotype designation). [USNM]

NOTE—Described from an unspecified number of syntypes. Two females labeled as types from the Colorado Desert and Senator, Arizona are in the AMNH, and two females from Senator and Prescott, Arizona are in the USNM. I hereby designate as the lectotype of *sericeata* the specimen in the USNM from Prescott, Arizona. It is a worn female without abdomen but is easily recognized as the same subspecies as *colata*.

This species was briefly characterized in the discussion of the *colata*-group. The genitalia of both sexes are similar to those of *Speranza decorata* and *S. semivolata*. In the male the valvula is large relative to the small size of the valve, sclerotized and rigid, rounded but somewhat wrinkled, and broadly attached to the basal end of the costa of the saccular lobe; that of *semivolata* is similar but not as large relative to the size of the valve; that of *decorata* is narrower and regularly V-shaped or conical in outline and is attached more at the base of the costal lobe than to the saccular lobe. All are variable, however, and I dissected one *decorata* male that really could not be distinguished from *colata* except for the attachment of the valvula to the costal lobe. The rigid and erect valvula (directed edgewise toward viewer as usually mounted) makes it difficult to mount the male genitalia for a consistently flat view of the valve, and this accounts for much variation between slide mounts that is more apparent than real. For example, the saccular lobe is often obliquely oriented toward the viewer, making it appear more tapered and pointed apically, whereas it is really wider and apically rounded when seen in a perpendicular view.

It is doubtful whether the female genitalia of *colata* can be distinguished from those of *decorata* or *semivolata*, although the moths are so different superficially that they need never be confused.

Speranza colata occurs throughout most of the

intermountain region west of the Rockies and east of the Coast ranges from Arizona and southern California to the dry southern interior of British Columbia. The larvae feed on species of *Purshia* and related Rosaceae.

The two subspecies are distinguished as follows.

Speranza colata colata (Grote)

PL. 2, FIGS. 50–52 (adult); TEXT FIG. 23 *a*, *c* (♂ gen.); TEXT FIG. 23 *b* (♀ gen.) (RWH 6308, part).

Phasiane colata Grote, 1881.

Type locality: Tucson, Arizona. [USNM]

Diastictis sericeata Hulst, 1898.

Type locality: Prescott, Arizona. [USNM]

The nominate subspecies occupies Arizona and southern California and differs from subspecies *correllata* mainly in the more extensive reddish-brown to tan coloring on the forewings of many (but not all) specimens; the more nearly straight antemedial and postmedial bands, which are accompanied by much less of the dark shading characteristic of *correllata*; the obsolescent nature of the postmedial line; and the more conspicuous, transverse, gray-brown striation of the median space of the forewing. As in the case of *correllata*, the long male antennal branches, together with the general aspect of the moths as figured (plate 2, figures 50–52), should provide for the identification of this subspecies without recourse to detailed description. Wing length: males, 12–14 mm; females, 11–13 mm.

Larvae from Lebec and Phelan, California were described and illustrated by Comstock (1935). The mature larva is green with a dark green middorsal line, somewhat broken and edged outwardly with a narrow, white, crenulated (addorsal) line. The subdorsal line is a wide band, part yellow and part white, broken into a series of wide dashes. A subtriangular white dash, posteriorly tipped with yellow, lies beneath or partly surrounds each spiracle, and the spiracles are orange brown with blackish rims. The subventral and ventral areas are mottled green with remnants of broken white or yellowish lines. The thoracic legs are yellowish, the prolegs green. The setae of the body are black and arise from raised, black-tipped pinacula.

The nominate subspecies of *Speranza colata* was reared from larvae on *Purshia glandulosa*

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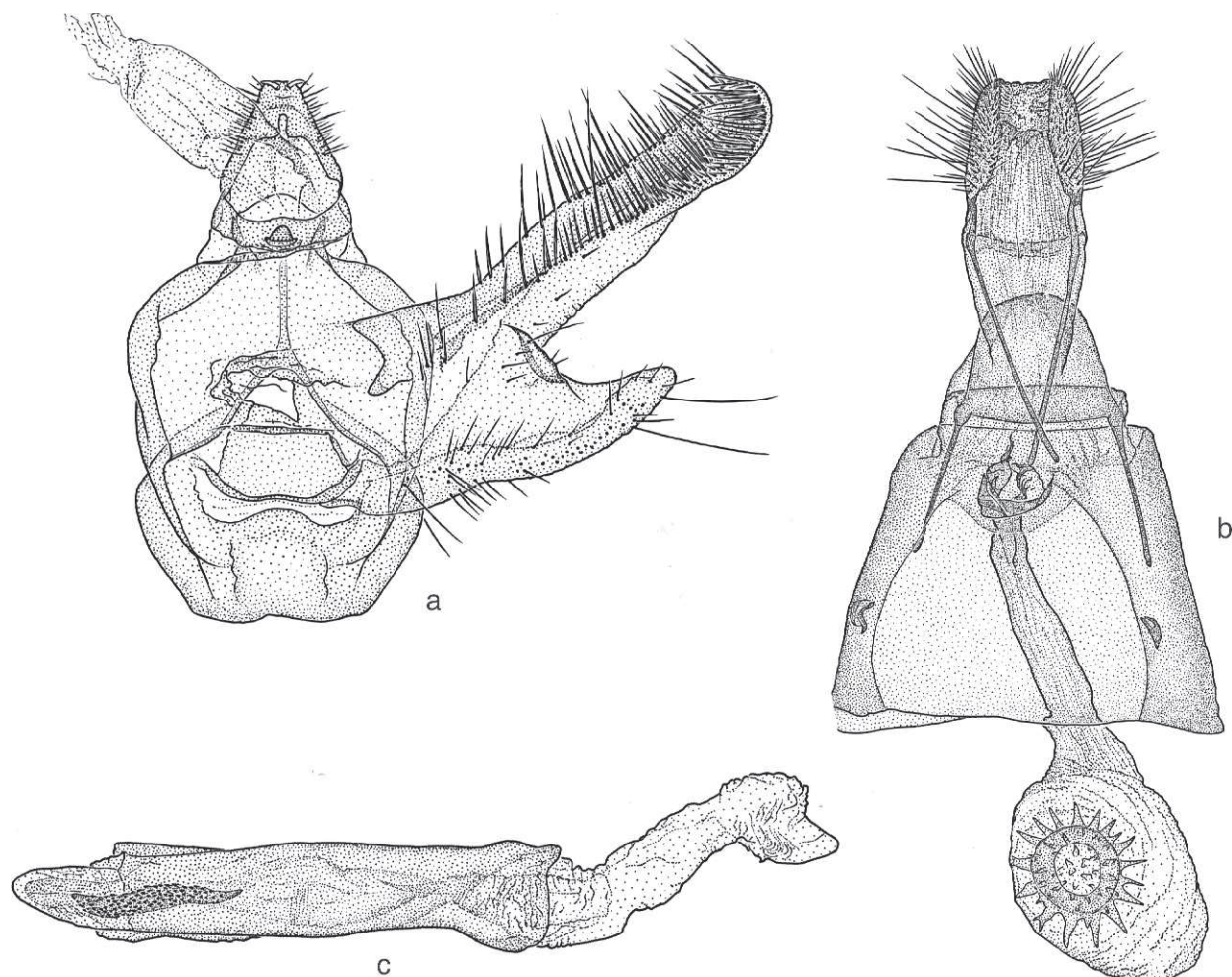


FIGURE 23: GENITALIA OF *SPERANZA COLATA*

a. Male genital capsule; Inyo County, California (USNM 57656). *b.* Female; Mohave County, Arizona (USNM 57653). *c.* Aedeagus; Inyo County, California (USNM 57656).

Curran (Rosaceae) in the Mohave Desert region at Phelan, San Bernardino County and Lebec, Kern County (Comstock, 1935); Sheep Creek, San Diego County (C. M. Dammers, C. Henne); Juniper Hills, Los Angeles County (C. Henne); and from a "green and yellow banded larva on *Purshia* sp. at Williams, Arizona (USNM). Henne also reared a specimen from *Cercocarpus betuloides* Nutt. near Valyermo, Los Angeles County. Specimens from these rearings are in the Los Angeles County Museum or USNM. Another was reared from *Cowania stanburiana* (Torr.) Jeps. (Rosaceae) at Walnut Canyon, near Flagstaff, Arizona (J. G. Franclemont). The larvae in southern California were collected in late May and early June and produced adults between mid-June and early July. The reared specimen from Arizona emerged 15 August 1964.

Speranza colata colata occurs throughout Arizona and in California from the Mohave Desert (Lebec, Kern County to the Providence Mountains) and Los Angeles County southward, wherever suitable food plants occur up to about 7,000'. Specimens from Olancha, Owens Valley, and northward are subspecies *corellata*. The flight period is a long one, 30 May–2 October, indicating multiple broods, which would be unusual for this genus.

Speranza colata correllata (Hulst), RE-
 VISED STATUS, NEW COMBINATION.
 PL. 2, FIGS. 53, 54 (adult) (RWH 6308,
 part).

Selidosema correllatum Hulst, 1896, *Trans.*
Amer. Ent. Soc., **23**: 355.

Type locality: Colorado. [AMNH]

The adults of subspecies *correllata* are light grayish with heavy blackish shading associated with both the antemedial and postmedial bands of the forewing. The ground color of the paler areas is nearly white, finely sprinkled and streaked with dark brown, and without the coarsely gray-striated appearance typical of *colata*. The overall gray and black aspect may suggest that of *Speranza decorata* except for heavier dark shading of the transverse lines and the usual presence of some reddish-brown coloring in the middle of the postmedial band. Subspecies *correllata* is distinguished from *colata* by its curved rather than straight transverse bands; distinct forewing postmedial line (obsolescent in *colata*); only faintly striated ground color where this feature is most apparent in the median space; reduction of the reddish-brown shading associated with the postmedial band, shading that may in *colata* extend to the costa and encroach into the median space; and the equal or greater amount of blackish shading in the postmedial band relative to the antemedial band (antemedial band often the more prominently blackened band in subspecies *colata*). The undersurfaces of the wings in both subspecies have a white-frosted appearance on the entire hindwing and costal area of the forewing, and the hindwing has a dark subterminal band curved parallel to the outer margin. The under-surface features tend to be more pronounced in *correllata* than *colata*. Wing length: males, 12.0–14.5 mm; females, 10.5–14.0 mm.

Specimens of subspecies *correllata* from the northwestern region, including Idaho, and from most of California, are darker than those from the Great Basin, having a gray rather than white ground color. Those from near the boundary with *colata* in southern Utah and in Inyo County, California tend more to assume the appearance of *colata*, although few that I have seen are fully intermediate.

As with so many Macariini, the larva has two or more color forms, usually green and brown but in this case green and gray. Both larvae described below were collected from *Purshia tridentata* (Pursh) DC. (Rosaceae). **Green form**—The following larval description of subspecies *correllata* is based on a last-instar larva from Alpine County, California (plate 10, figure 9), reared and photographed by Brian Scaccia, and the adults identified by me. Larva stout, similar in shape to that

of the gray form but very different in color and pattern, which are more leaflike than lichenlike. Body stout, wrinkled, with what appears to be the spiracular stripe in form of a disconnected series of thick, white bars, obsolescent on thorax, well developed on abdominal segments, but diminishing on A7–A9. White or pale yellowish subdorsal stripe present, and light yellow blotches ventrolaterally beneath the white segmental bars on segments A2–A5. Head dull yellowish green except for thin, whitish extension of spiracular stripe laterally. Legs green with white lateral bar down side of anal proleg. Black pinacula that are sometimes large and conspicuous are much reduced or absent in this individual. **Gray form**—The colored photograph of another larva reared by J. C. Miller in Oregon (plate 10, figure 10) shows a quite different form. Larva stout, with a much wrinkled integument and a complex, spotted and mottled, gray, black, and white pattern that makes it look like a lichen mimic. Black pinacula prominent. Head and legs mostly concolorous with body; spiracular stripe a disconnected segmental series of large, pale blotches on A1–A6 only. Larvae of the two forms have the appearance of different species, but my impressions are based on only one photographic image of each.

Many adults were reared by Brian Scaccia in 1990 from larvae collected from *Purshia tridentata* (Pursh) DC. (Rosaceae) at Truckee, Nevada County and three miles east of Woodfords, Alpine County; and from *Purshia glandulosa* Curren six miles west of Olancha, Inyo County, all in California. Many more were reared from *P. tridentata* in Oregon by J. C. Miller. The more northern larvae pupated 23 July–7 August, and adults emerged 30 July–15 August. Those from near Olancha pupated in late June and emerged also in July and August.

Speranza colata correllata occurs in the intermountain region from Utah and Nevada to the dry southern interior of British Columbia. It ranges westward into the Sierras, including Mono, Tulare, Kern, Placer and Lassen counties, as well as Modoc, Shasta, and Siskiyou counties northward, and thence through eastern and central Oregon (Klamath, Deschutes and Jefferson counties) and Washington to Oliver, British Columbia. I have seen it from no farther east than Mesa Verde National Park, Colorado. Collection dates are mostly in July but range from late June to late September, the latest being a fresh female that I collected at Fort Klamath, Oregon, 28–30 September 1978.

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It is sometimes abundant when found, and there are many hundreds of specimens in collections.

The *ribearia*-GROUP

This group includes eight species (*occiduaria*, *andersoni*, *argillacearia*, *evagaria*, *flavicaria*, *helena*, *ribearia*, and *simplex*). The group divides in two on the basis of larval host plants with the first three species associated most commonly with blueberry (*Vaccinium* spp., Ericaceae), although *occiduaria* apparently has many additional host plants, mainly in the Betulaceae, Rosaceae, and Salicaceae. The second group with five species is restricted to currents and gooseberries (*Ribes* spp., Grossulariaceae). The genitalia, however, unite the two groups with those of the first four species being indistinguishable. The sacculus lobe is pointed posteroventrally and the sclerotized ridge on the ventral margin usually ends about one-third before the apex if the lobe in a raised, angular process projecting inward. The sternal plate, like those in the *brunneata*-group, is evenly tapered posteriorly, without the lateral flanges and posterior "shoulders" of most other groups of *Speranza*. The female genitalia are similar to those in the *brunneata*-group, except for *ribearia* itself, which has a greatly enlarged and heavily sclerotized sterigma.

Speranza occiduaria (Packard), NEW COMBINATION

PL. 2, FIGS. 55–58 (adult); TEXT FIG. 24 *a*, *c* (♂ gen.); TEXT FIG. 25 *a* (♀ gen.) (RWH 6279).

Caulostoma occiduaria Packard, 1874, *Ann. Rept. Peabody Acad. Sci.*, 6: 52.

Type locality: Colorado Territory. [MCZ]

NOTE—Described from two males from Oregon and Colorado, both of which are in the MCZ. I designate as lectotype the Colorado specimen, which comes from a region where the species occurs commonly as the bright-yellow form that Packard described. The presence of this species in Oregon is doubtful, raising the question as to whether the Oregon syntype is really this species or *S. helena*, which often may be distinguished only by the male genitalia. Packard, two years later (1876: 473), illustrated a specimen with the typical markings of *occiduaria* but without indicating whether it was a syntype. By that time he had acquired other specimens.

Although *Speranza occiduaria* can have about the same wing markings as *evagaria* and *andersoni*, it is usually distinguished by its bright yellow

color, which is consistent throughout most of the region where it occurs. However, specimens of an intermediate, yellowish-gray coloring become prevalent in some parts of the zone of contact between *occiduaria* and the more northern *andersoni* in western Canada and the Great Lakes Region, and these not only present an identification problem, but raise the issue of whether the two really are distinct species (see subsequent discussion).

Not every yellow western specimen of this group can be assumed to be *occiduaria*, because *S. helena* has males that are very similar superficially. *Speranza ribearia* and *S. amboflava* are also yellow, although more easily recognized in other ways. To distinguish *occiduaria* from *helena*, it may be necessary to make genital dissections of the males. All males that I examined from Washington and Oregon that were passing as *occiduaria* proved, upon dissection, to be *helena*. Females of these confusing species are more easily identified than males but are so rarely collected that they may not be of much help in establishing the identity of associated males. *Speranza occiduaria* is the only species in which the females are both considerably smaller than males and have bright-yellow forewings like those of the male. Otherwise, only *ribearia* has a predominantly yellow female, but it is differently marked and usually at least as large as the male. The female of *helena* has the basal and medial areas of the forewing dull yellow, but the outer third is reddish brown. The female of *andersoni*, also very reduced in size, is yellowish to grayish brown with brown markings. The proportion of male to female *occiduaria* in collections is nearly 100 to one, and I saw only six females. A female from Riding Mountain National Park, Manitoba was figured by McGuffin (1972). Wing length: males, 15–17 mm; females, 10–12 mm.

The species is geographically variable mainly with respect to the intensity of the yellow coloring. Specimens from Colorado, Wyoming, and the Black Hills, South Dakota are bright or deep yellow; a few may be paler but not gray. Toward the periphery of the distribution, mainly northward but also eastward in the Great Plains (Nebraska, North Dakota), the proportion of dull-yellow and grayish-yellow specimens increases, although some bright-yellow ones continue to be present northward at least to Lloydminster, Alberta and The Pas, Manitoba, and as far eastward as Ontario. Canadian specimens from Manitoba

to Alberta are mixed, sometimes with most showing the dull yellow to grayish color approaching that of *andersoni*, but those from the southern interior of British Columbia are still about as bright as the typical form from Colorado.

Speranza occiduaria and *andersoni* are therefore very nearly the same species, as suggested by the apparent zone of hybridization or introgression where they meet in western Canada and the Great Lakes Region. The blend zone could be interpreted as hybridization between close but distinct species, a clinal shift of color and host within one geographically variable species, or a lessening of the selective advantage of yellow coloring in northern-fringe populations of *occiduaria*. I cannot prove which explanation is correct, and so leave *occiduaria* as previously treated, more or less in conformity with McDunnough's (1924) views on the group and my own earlier conclusions (1953). I have been influenced by the differences in habitat and in hosts, *Vaccinium* for *andersoni*, and various other shrubs for *occiduaria*.

The genitalia are indistinguishable from those of *Speranza andersoni* and usually of *argillacearia* in both sexes. I failed to find any reliable differences. Males of *Speranza occiduaria*, and even more so *andersoni*, are inclined to have a somewhat narrower and more pointed saccular lobe than *argillacearia*, in extreme cases attaining a shape rarely seen in the last species, but if one makes enough slides, all degrees of roundness or pointedness may sooner or later be found in each of the species. Differences in the length of the free end of the costal lobe of the valve relative to the basal section of the costa may constitute the most reliable character, because the free end is usually slightly longer, as well as narrower, in *occiduaria* and *andersoni* than in *argillacearia*. Also, where the inner margins of the two sides of the tegumen meet in the middle, the V so formed tends to have a rounded apex in *occiduaria* and *andersoni*, a more pointed apex in *argillacearia*. The male genitalia were illustrated by McDunnough (1924: pl. 6, fig. 4) and the male and female genitalia by McGuffin (1972: fig. 222f-j).

Although this species can be very common in the West, no larval illustration or recent description is available. The following larval description is paraphrased from Dyar (1903: 390), who acquired material while on a field trip to Colorado in 1901. Last instar dull whitish, with many black

marks and two brick-red stripes. Dorsal and lateral stripes diffuse, red, the latter broken at the spiracles by the whitish ground color. Numerous black spots, some of them large, marking the bases of the setae, and a continuous, black, subventral stripe, below which the venter is pale gray, dotted by scattered black pinacula, and becoming pinkish medially. Thoracic legs and spiracles black; prolegs gray with black pinacula. Setae black, short, stiff. Head whitish, with large black patch covering vertex of each lobe and extending half way down the sides and front, leaving median suture broadly pale; an angled patch over ommatidia and one on lower part of clypeus, pointed above. Mouthparts black. "Found by Mr. Oslar on the ground under willows near Denver. They did not feed, being matured. Moth, May 30." An account of Dyar's trip, on which he was accompanied by A. N. Caudell, is given on pp. 369-370 of the paper cited. Eight specimens of *occiduaria* in the USNM, with little data but labeled "Dyar and Caudell," and with one labeled "Colo., 1901," apparently date from that rearing. The description indicates a larva rather similar to those of *andersoni* and *argillacearia*, as would be expected.

This species has been reared from larvae on various hosts. McDunnough (1924) reared one from a larva on *Amelanchier* (Rosaceae) in Waterton Lakes National Park. The early 20th century Manitoba naturalist, Norman Criddle, reared it from larvae on *Arctostaphylos* (Ericaceae) (two in CNC); and there is a record from *Ribes* (Grossulariaceae), which I (1953) attributed to McDunnough, although I gave no reference and now do not know where I found the information. McGuffin (1956: 12) listed as food plants: *Betula glandulosa* Michx. (Betulaceae); *Potentilla fruticosa* Linnaeus (Rosaceae), and *Populus tremuloides* Michx. (Salicaceae). McGuffin also reported *Pinus flexilis* James (Pinaceae), an error that he (1972: 50) later eliminated. The only new data that I can add is from a female reared from *Heuchera parvifolia* Nutt. (Saxifragaceae), 12 July 1979, by R. E. Dietz (UCB). The larva was collected on Upper Blacktail Creek, Yellowstone National Park, Wyoming. I once encountered *Speranza occiduaria* (all males) coming to light abundantly in the Black Hills, South Dakota, where there were thickets of *Ribes* in the immediate vicinity. At the time I felt sure of their association with this plant but might have been mistaken.

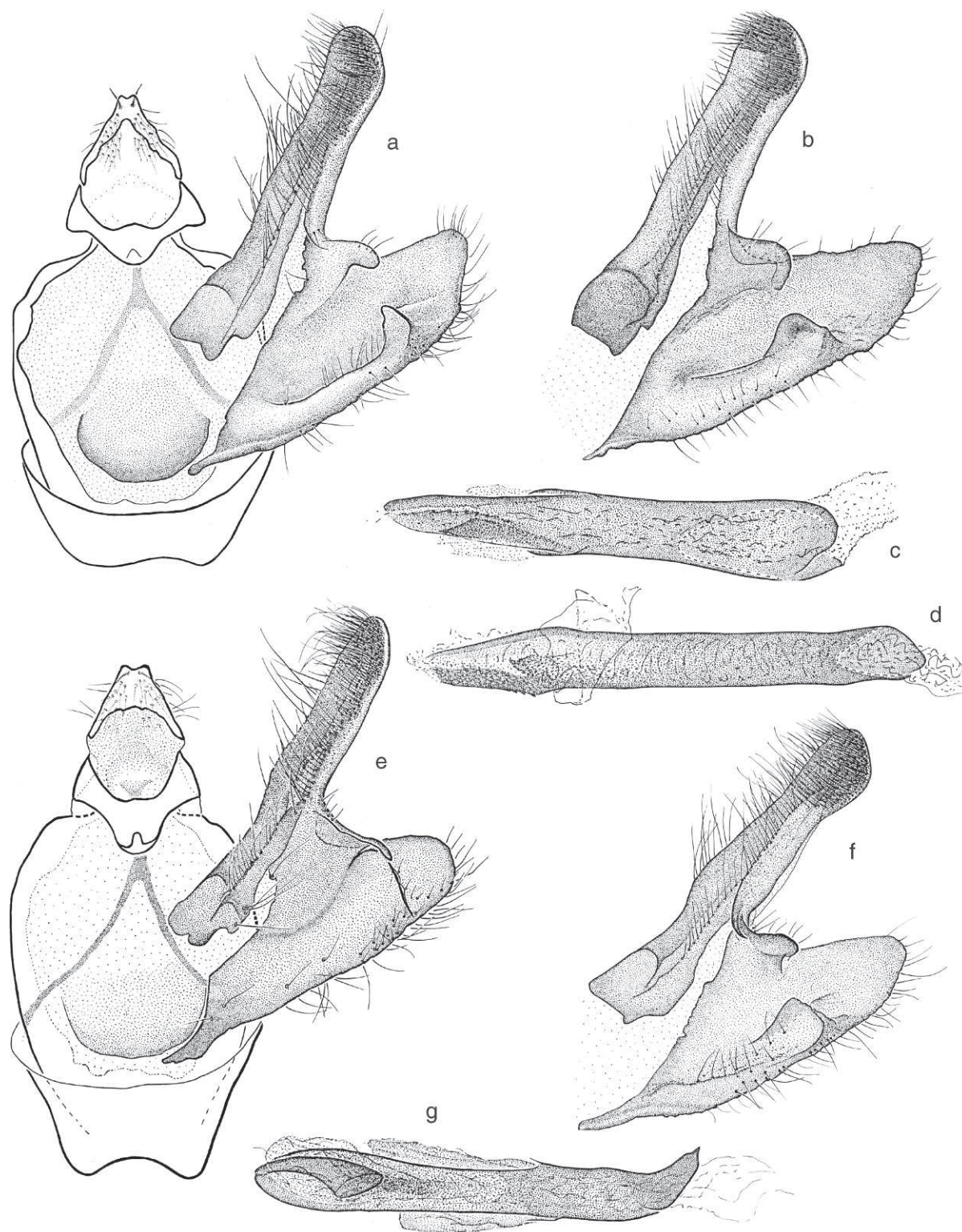
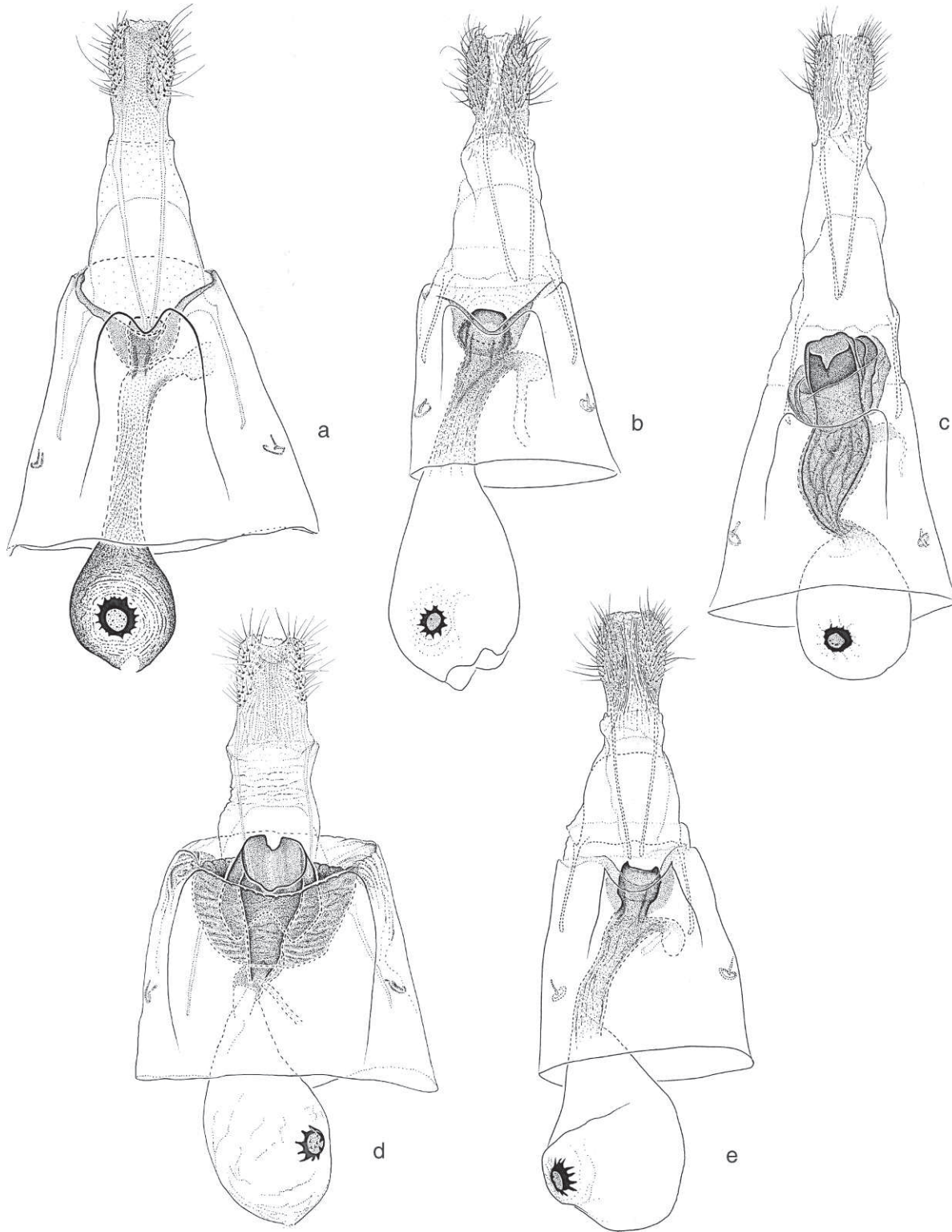


FIGURE 24: MALE GENITALIA OF *SPERANZA* SPECIES

a. *S. occiduaria*, genital capsule; Black Hills, South Dakota (USNM 57455). b. *S. argillacearia*, right valva; Augusta, Kennebec County, Maine (USNM 57491). c. *S. occiduaria*, aedeagus; Black Hills, South Dakota (USNM 57455). d. *S. argillacearia*, aedeagus; Augusta, Kennebec County, Maine (USNM 57491). e. *S. helena*, genital capsule; Vineyard, Utah County, Utah (USNM 57425). f. *S. evagaria*, right valva; Nebraska (USNM 57464). g. *S. helena*, aedeagus; Vineyard, Utah County, Utah (USNM 57425).

FIGURE 25: FEMALE GENITALIA OF *SPERANZA* SPECIES

a. S. occiduaria; Colorado (USNM 57424). *b. S. evagaria*; Madison, Dane County, Wisconsin. *c. S. flavicaria*; Frijoles Canyon, Los Alamos County, New Mexico (USNM 57459). *d. S. ribearia*; Mason County, Illinois (USNM 57417). *e. S. simplex*; Glacier National Park, Montana (USNM 57456).

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Speranza occiduaria occurs in the Dakotas, Nebraska, Colorado, Wyoming, Montana, and in British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario. I have not identified it from any other western states, where, at least in Utah, Oregon, and Washington, *helena* has been mistaken for it. Considering that *occiduaria* is common in southern British Columbia, it is likely to be present also in Washington. Bright-yellow specimens have been taken as far east as Sudbury, Trenton, and Grand Bend (south of Goderich on Lake Huron); among the dunes on Lake Huron at Pinery Provincial Park, Lambton County, Ontario; and one in the Cornell University collection is labeled Ithaca, New York, 17 July 1931. Only typical gray *andersoni* occurs near Ottawa and eastward in Canada. Those from One-sided Lake Provincial Park, western Ontario, are not yellow but have a pale, washed-out appearance. The population near Calgary, Alberta is mixed; whereas those from Nordegg, farther north in the foothills country, are all pure *andersoni*. However, the northernmost records for pure yellow *occiduaria* noted are eight specimens from Lloydminster, Alberta and three from The Pas, Manitoba; and dull grayish-yellow specimens have been collected as far south as Colorado, a distribution pattern that does not seem to make sense. The flight period of *occiduaria* extends from mid-June to mid-August, but most specimens in collections bear dates in July.

Speranza andersoni (Swett), NEW COMBINATION
PL. 2, FIGS. 59–61 (adult); PL. 10, FIG. 11 (larva) (RWH 6280).

Diastictis andersoni Swett, 1916, *Can. Ent.*, **48**: 251.

Type locality: Atlin, British Columbia. [MCZ]

Itame andersoni orientis Ferguson, 1953, *Can. Ent.*, **85**: 457.

Type locality: Auburn, Kings County, Nova Scotia. [CNC]

Speranza andersoni is typically a drab, gray, northern, *Vaccinium*-feeding species that occurs from northern Maine, the Atlantic Provinces, and southern Labrador across the continent in the Canadian and Hudsonian zones to Alberta, northern British Columbia, and the Yukon. It also occurs in the Great Lakes Region in northern Michigan,

Wisconsin, and probably Minnesota. The species is structurally indistinguishable from *S. occiduaria*, and yellowish-gray specimens seemingly intermediate between them occur in some parts of the contact zone where they meet in the Great Lakes Region and western Canada. As suggested earlier, *andersoni* and *occiduaria* might really be the same species, although the larvae and host preferences are somewhat different. *Speranza andersoni* has often been confused with the less variable, plain, unicolorous gray *argillacearia*, which is clearly a distinct species. Although the ranges of these two species may overlap slightly in Maine and the Great Lakes Region, and both are associated with blueberry, they do not hybridize.

The males vary from light mouse gray to a pallid yellowish gray, nearly always with diffuse, gray-brown markings that are better developed than those of *argillacearia*. The forewing markings consist of three or four dark costal spots marking the points at which the transverse lines meet the costa, even though the lines or bands themselves may be absent; and one or two (rarely three) weak, diffuse, transverse bands, of which the postmedial, often broadly shaded with gray on the outer side, is most likely to be present. The section of dark fringe on the outer margin between the apex and M_3 may be developed or obsolescent. The hindwing is similarly colored and with or without a weak, dark, postmedial band, and sometimes a partial subterminal band. The terminal line is very weak; the fringes gray to yellowish, hardly checkered. On the underside the forewing is mostly darker, and the hindwing usually with better developed transverse banding than on the upperside. Old specimens in collections have generally faded from true gray to a light brownish gray.

The female also varies from gray to pale brownish gray, dusted or marked with light reddish brown, with or without the costal spots of the forewing, but nearly always with a gray to light reddish-brown postmedial band on both wings. The fringes are more diffuse. Overall, the female presents a lighter, more reddish- or yellowish-brown, somewhat better marked appearance than the male and is much smaller, with narrower wings. The wings are sufficiently reduced that the female is probably flightless or nearly so. Wing length: males, 11–14 mm in the East, 12–16 mm in the West; females, 10–12 mm.

The moths are fairly consistent in appearance

except that those from Wisconsin, and the vicinity of the Great Lakes in Ontario, have more of a yellowish or olivaceous tint than those from farther east or west. A few of these are so bright that they resemble western *occiduaria*. Western specimens, at least those from Nordegg, Alberta northward, are darker and more consistently gray, and also are inclined to be larger than eastern ones, except that those from the northern limits of the range are again smaller.

The genitalia of *andersoni* and *occiduaria* are indistinguishable, but in the male they differ from those of *argillacearia* in their tendency toward a narrower, more pointed saccular lobe and narrower costal lobe. I found no consistent differences among the females of *andersoni*, *occiduaria*, or *argillacearia*.

The colorful larva (plate 10, figure 11) is distinctive but so similar to that of *argillacearia* (plate 10, figure 12) that one must look hard to see any differences at all. The orange bands appear to be narrower in *andersoni*, the white markings are reduced, and the individual black spots and patches are less prominent, but these differences may not prove to be consistent.

A larva that I found on blueberry (*Vaccinium* species) (Ericaceae) in a sandy pine-woods area at Coldbrook, Kings County, Nova Scotia in 1951 produced a female of *andersoni* (the allotype of *orientis*, now a synonym), and I kept a larval description of it. Body black with a pink dorsal stripe; a wider orange-pink lateral stripe broken on each segment by a white patch marked by three small black spots (pinacula). Black dorso-lateral area divided down the middle by a very fine pinkish-white stripe and also broken by a few obscure mottlings of the same color. Ventral area dirty pink with small black dots. Thoracic legs blackish laterally; prolegs unicolorous; head black with horizontal bar of pinkish white on sides, joining in front. Integument of body visibly setose and tuberculate (raised pinacula). It may have begun to change color in preparation for pupation by the time the description was written. In addition to the specimen that I reared, several others have been reared, also from larvae on blueberry, at Constance Bay, Ontario, 11–21 June 1933 (G. S. Whalley) (CNC, USNM).

The above description may in part be reconciled with Dyar's (1903: 390) description of the larva of *occiduaria* from Colorado, except that the ground color of *andersoni* was more nearly black than "sordid white," and it had a "very

fine, pinkish-white" subdorsal stripe not mentioned by Dyar. Also, Dyar mentioned a continuous, black, subventral stripe not apparent in *andersoni*, probably because of its dark ground color. The dorsal and lateral stripes that were pink in my larva were described as brick red by Dyar, and in both cases the reddish lateral stripe was described as interrupted segmentally by a whitish spiracular patch. I emphasize these differences because of the continuing difficulty of distinguishing these two taxa as species.

Speranza andersoni has been collected in all of the Atlantic Provinces and Labrador (Cartwright); northern Maine; Quebec north to James Bay and Knob Lake, near Schefferville; Ontario; Manitoba from Brandon to Churchill; Alberta (Nordegg and northward); northern British Columbia; the Northwest Territories to Great Bear Lake; and the Yukon Territory to Rampart on the Porcupine River (Alaskan border). Not much is known about its distribution in the Great Lakes states except that a large series was collected at Lake Katherine, Oneida County, Wisconsin by H. M. Bower (LACM). Possible hybridization with *occiduaria* in the contact zone in the Great Lakes Region and western Canada was discussed under *occiduaria*.

The flight period for the Atlantic Provinces is 30 June–2 August; southern Quebec, Ontario, and Great Lakes Region, 16 June–1 August; Alberta, 4–23 July; Northwest Territories and Yukon, 7 July–23 August. The species may be locally abundant in its heath and blueberry barren habitats. I sometimes found it so in Nova Scotia; and the A. E. Brower collection (USNM) contained 144 specimens from Maine. Females are rarely collected at light.

Speranza argillacearia (Packard), NEW COMBINATION
PL. 2, FIGS. 62, 63 (adult); PL. 10, FIG. 12 (larva); TEXT FIG. 24 *b, d* (♂ gen.) (RWH 6282).

Tephrina argillacearia Packard, 1874, *Ann. Rept. Peabody Acad. Sci.*, 6: 48.

Type locality: Brunswick, Maine. [MCZ]

NOTE—Described from 10 male syntypes, of which seven are in the MCZ. No lectotype has been designated.

Tephrina modestaria Hulst, 1895, *Ent. News*, 6: 11.

NOTE—This was a Packard manuscript name first

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published by Hulst in the synonymy of *argillacearia* and cited repeatedly since then as a synonym of *argillacearia*. Names first published as synonyms are not recognized by the *Code of Zoological Nomenclature* as nomenclaturally available.

Speranza argillacearia is a northeastern species whose males differ from those of *evagaria* in their more nearly immaculate, mouse-gray wings, which do, however, fade to a more brownish gray with age. Fresh *Speranza andersoni* also are gray but are more likely to have markings, are usually smaller, with slightly more angulate wing margins, and *andersoni* has a more northern bias to its distribution. The range of *argillacearia* does not extend as far north as that of *andersoni*, which, in turn, does not extend as far south as that of *argillacearia*. *Speranza argillacearia*, with the most restricted distribution of the three species, is confined to the Great Lakes Region and the Northeast from West Virginia and Pennsylvania to southern Quebec and Ontario. It is broadly sympatric with *S. evagaria* in this area, but probably not in the same habitats.

The females, like the males, are almost unmarked except for one or two weak, brown costal spots on the forewing. They also are slightly paler than males. The females of *evagaria* and *andersoni* have better developed wing markings, and females of *argillacearia* can mostly be recognized by their much reduced markings alone. The female wings are more reduced than those of *evagaria*, about to the same degree as those of *andersoni*, and it is doubtful whether the females can fly. Females of *argillacearia* are so uncommon in collections that they obviously come to light rarely, if ever.

The moths are so devoid of distinguishing features that further description would serve no purpose; readers had best rely on the illustrations and on knowledge of distribution and habitat. Wing length: males, 12–15 mm; females, 11–14 mm.

The genitalia do not differ significantly from those of *evagaria* in either sex. The valve is quite wide in these two species, enough so that their male genitalia may usually be distinguished from those of *andersoni* and *occiduaria*, in which it averages narrower and shorter. The difference was earlier illustrated by me (1953), and in several variations by McGuffin (1972: figs. 223a–d, h–k).

The seemingly aposematic black, orange, and white caterpillar of *argillacearia* (plate 10, figure 12) is very similar to that of *andersoni*, and the

differences were mentioned under that species. The food plant, as long suspected, proved to be blueberry, *Vaccinium* species (Ericaceae). The larva illustrated was collected from blueberry, and the adult was reared. Earlier reports of blueberry as the host are difficult to interpret because of confusion with *andersoni*. A long history of confusion in the identification of *argillacearia*, *evagaria*, and *andersoni* does not allow acceptance of published records at face value. Voucher specimens are needed. For example, although McDunnough (1924: fig. 5) knew the species of this genus better than anyone else in his time, he appears to have confused *argillacearia* with eastern specimens of *andersoni*; and reports of the rearing of *argillacearia* and *evagaria* from commercial blueberry fields in New Brunswick (Wood, 1951) may both refer to *andersoni*, because it is the only one of the three known from the Atlantic Provinces. The association of *argillacearia* with acid soil habitats such as peat bogs, pine barrens, and blueberry barrens, where species of *Ribes* are usually absent, adds to the probability that it is an obligate *Vaccinium* feeder.

Speranza argillacearia occurs in all of the New England states north at least to the Passadumkeag Bog, Penobscot County, Maine; New York, including Long Island and central New York (Horseheads, Chemung County); New Jersey (pine barrens); Pennsylvania (Tioga County and Scotia Barrens, Centre County); West Virginia (Spruce Knob, 4,861'), southern Ontario (Lake Simcoe, Trenton, and on the Mer Bleue, a famous bog near Ottawa); and in Michigan and Wisconsin, where it is locally common. The flight period is 29 May–20 July. Males come to light, the females rarely do.

Speranza evagaria (Hulst), NEW COMBINATION

PL. 2, FIGS. 64–67 (adult); TEXT FIG. 24 *f* (♂ gen.); TEXT FIG. 25 *b* (♀ gen.) (RWH 6278).

Cymatophora evagaria Hulst, 1900, *Can. Ent.*, **32**: 106.

Type locality: St. Cloud, Minnesota. [AMNH]

NOTE—Described from “Wis., Min., Ont.” I hereby designate a syntype in the AMNH from St. Cloud, Minnesota as the lectotype, and it is so labeled.

Speranza evagaria is a pale, yellowish-brown *Ribes*-feeding species of the East and Midwest in

which the background of the wings is somewhat more variegated or mottled with pale grayish overlay than is apparent in *argillacearia*. *Speranza argillacearia* and similarly plain eastern specimens of *evagaria* are often confused in collections, although the wing coloring of *argillacearia* has a more finely textured appearance that is almost solidly gray. The wings of *evagaria* are more angulate than those of *ribearia* or *argillacearia* in both sexes and more likely to have a strip of dark fringe on the forewing between the apex and the end of M_2 . Females are inclined to be more yellowish and better marked with gray-brown transverse bands and costal spots than are males, and their wings are more reduced than those of *ribearia*, but not as much so as those of *argillacearia*, *andersoni*, or *occiduaria*. Even with reduced wings, the females still fly and come to light. Wing length: males, 14–22 mm; females, 12–15 mm.

This species has distinctive northeastern and midwestern forms. Eastern and northern specimens (plate 2, figure 64), including those from Quebec and Ontario, New England, New York, Pennsylvania, Ohio, Michigan, Wisconsin, and Minnesota are plain, often nearly immaculate or with only faint and fragmentary transverse bands; specimens from Illinois, Missouri, Iowa, Nebraska, and Kansas (plate 2, figures 65–67) are heavily marked, often with complete and conspicuous antemedial and postmedial bands in males, and antemedial, medial, and postmedial bands in females. Midwestern specimens are also more yellowish, but no different in size. The latter form has been confused in collections with *S. flavicaria*. I considered the possibility that the two forms are distinct species, especially inasmuch as no clear zone of transition between them has as yet been found, but found no other justification for separating them.

Neither the male nor female genitalia are noticeably different from those of *argillacearia*.

Last instar larva about 14 mm; body pale with black spots in the longitudinal gray stripes of the subdorsal region, and a black stripe in the subventral region. Anal plate with large black spot posteriorly. Head whitish with black patches. Thoracic legs blackish; prolegs light, with black spots (McGuffin, 1972: 49). McGuffin mentioned *Ribes* as the host. McDunnough (1924: 276) reared a series from larvae found on "wild gooseberry" at Aylmer, Quebec, and these are in the Canadian National Collection.

In the Fort Niobrara National Wildlife refuge, Nebraska, where I collected a large sample of *evagaria*, many moths were flying about thickets of *Ribes* in the evening before dark and also came to light (both sexes). Mention in the literature of *Vaccinium* as a second host is almost certainly a result of confusion with *andersoni* or *argillacearia*.

Speranza evagaria of the plain or lightly marked eastern form is known from southern Ontario and Quebec (Mont St. Hilaire), New York, Massachusetts, Pennsylvania, Ohio, Michigan, Wisconsin, and Minnesota; and the more heavily marked form is known from Illinois, Missouri, Kansas (Pottawatomie County), Iowa, Nebraska, and possibly Colorado, although one very dark specimen in the U. S. National Museum of Natural History from Glenwood Springs, Colorado is probably mislabeled. My material from Cherry County, Nebraska represents the westernmost records that are authentic.

The flight period northward is about 8 June–28 July, but slightly earlier records occasionally occur; most records in collections are for the latter half of June. Farther south, as in Illinois or Missouri, emergence begins in late May.

Speranza flavicaria (Packard), NEW COMBINATION

PL. 3, FIGS. 1, 2 (adult); TEXT FIG. 25 c (♀ gen.) (RWH 6276, 6277, part).

Thamnonoma flavicaria Packard, 1876, Monograph of the Geometrid Moths or Phalaenidae of the United States, in Hayden, F.V., *Rept. U. S. Geol. Surv. Terr.*, **10**: 256, pl. 13, fig. 49.

Type locality: Manitou, Colorado. [MCZ]

NOTE—Described from two males and three females from Manitou, Colorado and Salt Lake City and Farmington, Utah. The type was "restricted" to one of the males from Colorado by McDunnough (1924: 274) in reporting a communication from L. B. Swett concerning the three surviving types in the Packard Collection. This is the specimen labeled "Manitou, July 16," and it should be considered the lectotype. It is in good condition except that the abdomen is missing.

Diastictis subfalcata Hulst, 1896, *Trans. American Ent. Soc.*, **23**: 335. REVISED SYNONYMY.

Type locality: Platte Canyon, Colorado. [AMNH]

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NOTE—Described from three female syntypes, of which one was “restricted” as the type by Barnes and McDunnough (1916: 183). It is labeled Platte Canyon, Colorado, June 23, 1891, W. Barnes. As their statement concerning this type is questionable as a lectotype designation, I hereby redesignate the Platte Canyon female as the lectotype. It is one of the yellowish females that I believe to be correctly associated with males of *flavicaria* and agrees with a second Colorado female labeled as a type of *subfalcata* in the USNM. The third syntype, in the AMNH, belongs to a different species.

Speranza flavicaria is mainly a Colorado species of which the males are light yellowish brown, variably but often heavily dusted with dark brown scales, with a dark forewing discal spot, variable but often distinct antemedial and postmedial lines or bands, and an incomplete, wide, grayish-brown, transverse shade occupying the space between the postmedial and subterminal lines of the forewing. The males are easily recognized, especially by the brownish rather than bright-yellow wings; females are distinguished from those of *ribearia* by their reduced and more pointed ochreous-brown wings, and from those of *helena* by the absence of a darker outer third on the forewing. Females of *occiduaria* have their wings still further reduced and yellow rather than brown. The genitalia readily distinguish *flavicaria* from all species except *helena*.

The dark transverse shade in the space between the postmedial and subterminal lines of the forewing may be a nearly complete dark band or reduced to the point where only one or two diffuse spots remain. It frequently appears on the hindwing and on both wing surfaces beneath as one mesial, diffuse spot or patch. Although they may have a wide, dark, transverse band on the underside of the hindwing (like eastern *ribearia* and *helena* but unlike *occiduaria*), the male forewing is a little more acute than that of *ribearia* and is marked with three or four dark costal spots that persist even in the palest specimens. The more acute forewing apex and dark costal spots mentioned above usually provide all that is needed to separate *flavicaria* from *ribearia*, and the presence of a dark band or partial band on the underside of the hindwing usually distinguishes them from *occiduaria*. Another difference is that *flavicaria* has only two or three simple (i.e., non-pectinate) segments toward the tip of the male antenna, whereas *occiduaria* has five to eight. (*Speranza ribearia* and *evagaria* have about five

apical segments that are simple). The grayish or more olivaceous-colored *evagaria* might also be confused with *flavicaria*, but their ranges overlap only slightly, if at all. Wing length: males, 16–18 mm.

Most species of this group are sexually dimorphic, and females are more easily identified than males. Although their coloring corresponds somewhat to that of males, all females except those of *ribearia* have reduced, narrower, and more acutely pointed wings and in size and shape present a different appearance. The females of *flavicaria* are also light yellowish brown but somewhat more deeply colored than the males, lightly dusted with dark scales, and with the hindwing paler. Discal spots are present on both wings, and the transverse lines of the forewing are thin, distinct, and often complete. The dark markings may be more intensified and concentrated in some specimens, and a male from Mesa Verde National Park is much darker than usual, having the forewing uniformly suffused with brown, and the hindwing brownish as well. Five males from the north rim of the Grand Canyon are similarly dark. The ground color is essentially uniform from base to outer margin. Females with the outer part of the forewing beyond the postmedial line contrastingly shaded with reddish brown, and with the remainder of the wing yellowish, are likely to belong to *helena*, not *flavicaria*. Wing length: females, 13–16 mm.

The distinctive male genitalia have both the vinculum and tegumen somewhat elongated; the apex of the ventral (saccular) lobe of the valve rounded, delimited by a sharp, raised, transverse ridge across the inner face of this lobe, with the apex of the lobe not projecting far outward beyond the angle between the costal and ventral lobes; and also in the presence of a very large, curved, thorn- or clawlike spine in the aedeagus. *Speranza ribearia* also has a large spine in the aedeagus, but it is an outgrowth of the cylindrical wall of the aedeagus, whereas that of *flavicaria* seems to be a true cornutus attached to the vesica.

The female genitalia (text figure 25 c), also distinctive, have a large, extruded, sclerotized, tunnel-like ostium, a fairly deep, narrow, ostial pouch, and a very thick, heavily sclerotized, slightly convoluted or helical ductus bursae.

The early stages of *flavicaria* have not been described, but it would be expected to be a *Ribes* feeder. Where I found *flavicaria* commonly on the bank of Poncha Creek and near Buena Vista,

Chaffee County, Colorado, *Ribes* was growing abundantly. The closely related *helena* has been reared from "currant."

This species is known mainly from 7,000'–8,800' in the Rocky Mountains, Colorado, but I have also seen specimens from New Mexico, Utah, Arizona, and from as low as 6,050' in Frijoles Canyon, New Mexico. It appears to be replaced in western Colorado, Wyoming, Montana, eastern Washington, and eastern Oregon by the closely related *Speranza helena*. The flight period is late June–early August.

Speranza helena Cassino. REVISED STATUS, NEW COMBINATION
PL. 3, FIGS. 3–5 (adult); TEXT FIG. 24 *e, g* (♂ gen.) (RWH 6277, part).

Itame helena Cassino, 1928, *The Lepidopterist*, 5: 5.

Type locality: Vineyard, Utah. [MCZ]

NOTE—The holotype is a yellow male typical of the present taxon, but the 18 paratypes are a mixture, including ordinary *flavicaria* from Colorado and New Mexico.

Speranza helena is an uncommon, little-known western species closely related to *flavicaria*, but with clear, light yellow males that are often lightly marked, and usually with bicolored females, in which the outer third of the forewing is darker than the basal two-thirds. Although the genitalia are similar to those of *flavicaria*, the male moths by appearance are more likely to be confused with those of *ribearia* or *occiduaria*.

Males, relative to those of *flavicaria*, present a very different appearance with their light yellow ground color, essentially lacking the dusting of dark scales, and the variable reduction and lightening of the dark markings. In some examples (plate 3, figure 3), only the four brown costal spots of the forewing remain. The yellow ground color is generally not as bright as that of many *occiduaria*, *sulphurea*, or *amboflava*, but the resemblance to western males of *ribearia* and some *occiduaria* is so close that examination of the genitalia may be necessary for identification. Wing length: males, 15–17 mm.

Females of *helena* nearly always have the outer third of the forewing, the part distad of the post-medial line, shaded with reddish brown. A few variants may not have the entire outer third filled with reddish brown, or, at the opposite extreme, some of the reddish-brown shading may invade

the basal two-thirds. Three females from Walla Walla, Washington, which apparently were associated with the usual yellow males, do not have a well-defined dark outer border. However, the division of the forewing into contrasting darker and lighter brown areas can usually be relied upon to distinguish *helena* females from those of all other sympatric species of *Speranza* except *confederata*, in which the wings are differently shaped and colored. Wing length: females, 12–14 mm.

Features of the genitalia in both sexes (text figure 24 *e, g* [♂]) distinguish *Speranza helena* from everything except *flavicaria*.

The early stages have not been described, but two reared females in the USNM from Ogden, Utah are labeled "larva on currant."

Although uncommon in collections, *Speranza helena* occurs widely from Montana to New Mexico and westward to eastern Washington, eastern Oregon, and in Utah. It is not known from Nevada or Arizona. I have seen specimens from Wyoming (no locality); western Colorado (Routt and Moffatt counties); Sweetgrass and Hill counties, Montana; Twin Falls, Idaho; Pullman and Walla Walla, Washington; Baker and near Prairie City, Oregon; Ogden, Richfield, Midway, Stockton, and Vineyard, Utah; and Raton, Colfax County, and Frijoles Canyon, Bandelier National Monument, New Mexico. Two females clearly belonging to this taxon in the USNM, one of them falsely labeled as a type of *Diastictis subfalcaria* (sic) Hulst, are labeled "Col.[orado]," possibly in error. It appears to be replaced in most of the mountainous part of Colorado by *flavicaria*.

The label dates of 52 specimens examined indicate a flight period of 29 June–8 August, the earliest being from Washington and the latest from New Mexico.

Speranza ribearia (Fitch), NEW COMBINATION (Currant Spanworm, Gooseberry Spanworm)

PL. 3, FIGS. 6–9 (adult); PL. 10, FIG. 13 (larva); TEXT FIG. 26 *a, c* (♂ gen.); TEXT FIG. 25 *d* (♀ gen.) (RWH 6274, 6275).

Abraxas? ribearia Fitch, 1848, *Trans. New York State Agric. Soc.*, 7: 466

Type locality: New York. [type lost?]

Aspilates sigmaria Guenée, 1857 [1858],

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Histoire Naturelle des Insectes, Species Général des Lépidoptères, **10**: 184.

Type locality: "Amérique septentrionale." [USNM]

Ellopiia annisaria Walker, in D'Urban, 1860, *Canadian Naturalist and Geologist*, **5**: 260.

Type locality: Vicinity of Montreal, [Quebec]. [CNC]

Ellopiia anisaria Walker, 1863, *Catalogue of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **26**: 1507.

Type locality: Canada. [CNC]

NOTE—D'Urban inadvertently validated the spelling *annisaria* by prior publication of some excerpts from the manuscript of Walker's part 26 (1863) that were of special interest to him, because they described new species in D'Urban's collection. He attributed the names to Walker. The two junior synonyms, *annisaria* and *anisaria*, which were obviously intended to be the same word although spelled differently, have the same type specimen and type locality.

Thamnonoma fascioferaria Hulst, 1887, *Ent. Americana*, **2**: 191. REVISED SYNONYMY.

Type locality: Col[orado]. [AMNH]

NOTE—A female from the Hulst Collection, collected in Colorado by David Bruce and listed as a type by Rindge (1955: 142), is hereby designated as the lectotype. It has a complete, wide, dark, postmedial band on a yellow background, and fully developed wings typical of *ribearia*.

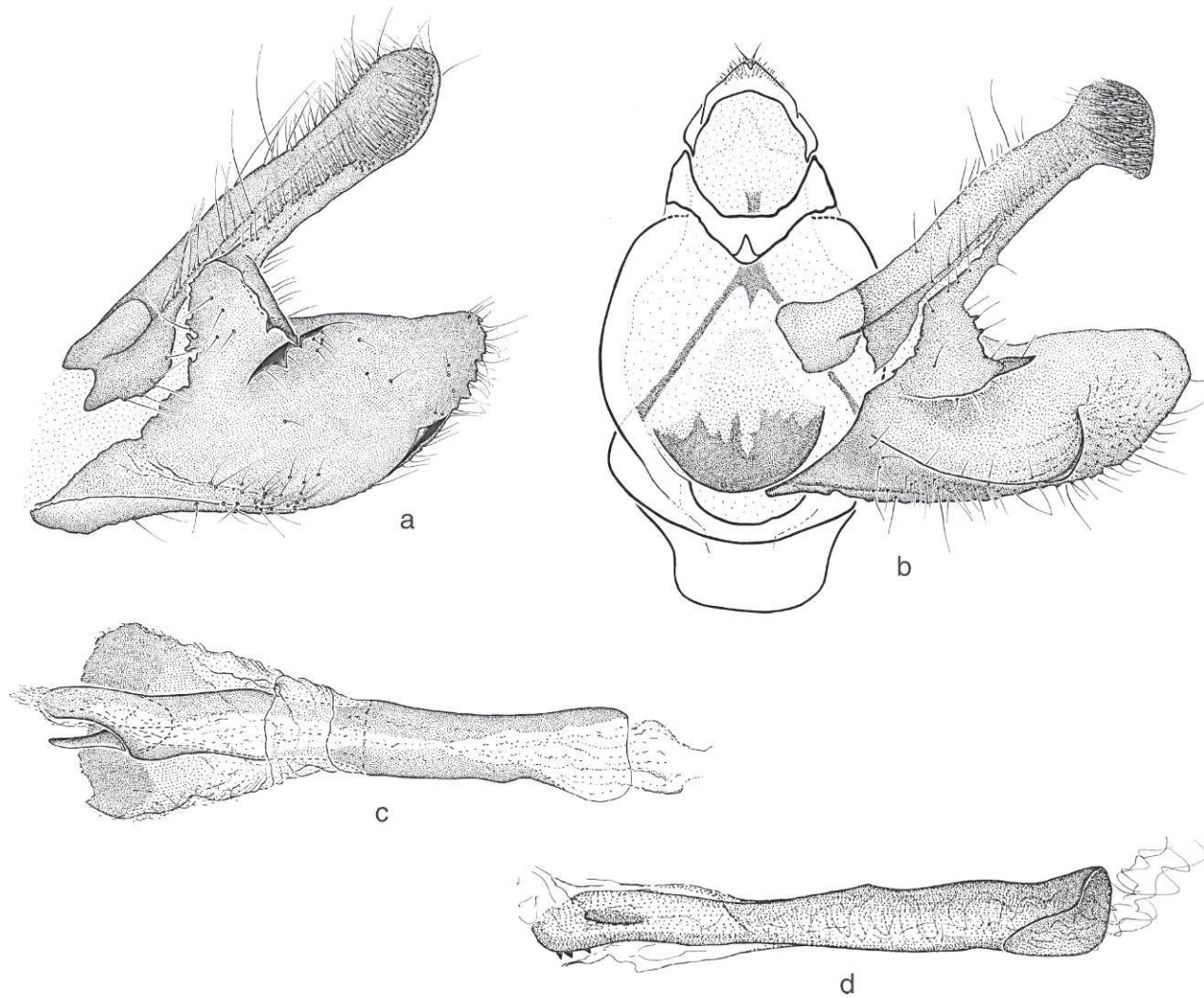
Speranza ribearia is a large yellow species with a nearly transcontinental distribution across the northern half of the United States and southern Canada. The wings are full and rounded in both sexes, not angulate or produced apically, and they may be marked above and beneath by a wide, diffuse, dark, usually incomplete subterminal band, which, if present, is likely to be the principal or only feature of the pattern. This is the only yellow species of *Speranza* in which the females closely resemble males, with the possible exception in the West of the easily recognized *amboflava*; and *ribearia* is also the only yellow species occurring east of the Great Lakes Region with the exception of females of *sulphurea* (males of *sulphurea* are not yellow). In the West, *occiduaria*, *amboflava*, and *helena* are also yellow, but usually these species have dark costal and discal spots on the forewing that are lacking in *ribearia*. Also, *occiduaria* and *helena* show

conspicuous sexual dimorphism, with semi-brachypterous females.

The main feature of the pattern is the wide, diffuse, gray-brown to purplish-brown subterminal band that may be present or absent on both wings, although better developed on the forewing. This may be a complete, wide, transverse band filling the space between the position of the (usually absent) postmedial line and the outer edge of the subterminal band across the entire wing, or, more commonly, it may be reduced to one or a few rounded spots or patches, or nearly missing. Poorly developed antemedial, medial, and postmedial bands are present or absent, but a medial band is more likely to be present than are the others. The hindwing is not quite as brightly colored as the forewing. The markings are locally, perhaps geographically, variable, with nearly immaculate individuals more common some places than others. Wing length: males, 14–17 mm; females, 15–18 mm.

Western populations of *Speranza ribearia* have adults that are somewhat different, showing a greater disparity between well-marked and poorly marked specimens than is apparent in the East. This is partly sexual. Western females tend to be much more heavily marked than males, whereas eastern females and males are nearly alike. This western form could be regarded as a subspecies, for which the name *fascioferaria* Hulst is available. In extreme examples the male is nearly immaculate (plate 3, figure 8), and the female has an almost complete, wide, purplish-brown band occupying the space between the postmedial and subterminal bands. The female lectotype of *fascioferaria* is especially well marked in this respect, with a wide, complete, dark band between the postmedial and subterminal lines, widest toward the inner margin. Occasional Colorado males are similarly marked. Unlike eastern *ribearia*, these moths generally have no dark markings on the underside. Specimens of the *fascioferaria* type occur in the region from Colorado to Saskatchewan and Alberta, and westward to eastern Oregon. Examples from McCreary, Manitoba (BMNH) seem intermediate.

Because western specimens may be confused with *helena* or *occiduaria*, it should be further emphasized that *ribearia* does not usually have distinct dark costal spots on the forewing, and that the females are not only as large as or larger than males but have the same rounded wing shape. The other species are sexually dimorphic

FIGURE 26: MALE GENITALIA OF *SPERANZA* SPECIES

a. S. ribearia, right valva; Montreal, Quebec (USNM 57416). *b. S. simplex*, genital capsule; Glacier National Park, Montana (USNM 57490). *c. S. ribearia*, aedeagus; Montreal, Quebec (USNM 57416). *d. S. simplex*, aedeagus; Glacier National Park, Montana (USNM 57490).

in wing size, shape, and color, with the wings of females reduced and the apex of the forewing acute or subfalcate.

Male genitalia of *Speranza ribearia* (text figure 26 *a, c*) are distinctive in several respects. Uncus produced and pointed, not apically truncated or notched; end of gnathos, normally pointed and toothlike in other species, is flattened, broadly spatulate, truncated, and upturned in *ribearia*; interlobular process of valve in form of two elevated ridges intersecting at 90°, each denticulate with a combined total of 3–4 sharp, sclerotized points; process near middle of ventral margin of saccular lobe also toothlike; aedeagus with long, nearly straight, tapered, sharp or somewhat flat-

tened subapical process that is attached to aedeagus externally and thus not a cornutus. Most features unique within *Speranza*. Eighth sternum shallowly notched only to about one-eighth of its length.

Female genitalia (text figure 25 *d*) characterized by unusually large sterigma, consisting of deep ostial funnel with a wide opening and a protruding, medially notched, flangelike dorsal side. Funnel arises from within very large, sclerotized ostial pouch bearing three or more transverse folds or pleats across its ventral surface. Ductus bursae, or combined bursa neck and ductus, relatively short.

The larva (plate 10, figure 13; also Wagner et

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al., 2001: 35) is about 25 mm long at maturity and aposematic in color and pattern, with a yellow or mixed yellow and white ground color and numerous black spots that are enlargements of the spots at the bases of the setae (pinacula). Head white with black spots; ground color of body white but with yellowish suffusion on dorsum (McGuffin, 1972), or "light, lively yellow" with cloudlike white patch laterally on each segment (Fitch, 1848). Setal bases forming conspicuous black spots, of which those of the subdorsal setae are largest, except for those of setae L3 and SV3, which are also large and sometimes fused into a single patch on each segment or into a stripe of irregular width; prothoracic plate and all legs unicolorous; anal plate black and white (McGuffin, 1956: 10; 1972: 48–49). First instar larvae are gray with black spots and a black head, but the ground color becomes yellowish or yellowish green, and the head paler and variably dark spotted in the second and third instars; and finally yellow and white with a black-spotted head in the fourth and fifth instars. Variation in larval markings of this species was discussed by McGuffin and Bolte (1971). The conspicuous last instar larva somewhat resembles that of the European *Abraxas grossulariata* Linnaeus, which is also a pest of cultivated *Ribes*.

The overwintered eggs hatch as the bushes are leafing out in the spring, and the larvae reach maturity in June at about the latitude of central New York and southern Ontario. They pupate at or near the surface of the soil and produce adults mainly in July, after a pupal period of about three weeks. Larvae may be collected by beating them from the bushes beginning about the last week of May in New York. *Speranza ribearia* is host specific on species of *Ribes* (Grossulariaceae) and commonly feeds on cultivated currants and gooseberries in gardens. It is one of the few species of *Speranza* regarded as a pest, but it seems much less common now than formerly, probably because cultivated currants and gooseberries are less commonly grown.

This species has a wide but seemingly discontinuous distribution, probably depending upon the availability of hosts, from Fredericton, New Brunswick to the District of Columbia, westward to southern Alberta, Montana, Idaho, eastern Oregon (Baker), and Colorado. In the intervening region I have seen specimens from southern Quebec, Ontario, Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jer-

sey, Pennsylvania, western Maryland, West Virginia, Ohio, Illinois, Michigan, Wisconsin, North Dakota, Manitoba, Saskatchewan, Iowa, Nebraska, Missouri, Kansas, and as far south as Oklahoma and Hemphill County, Texas. The species is univoltine, and the adults generally fly from late June to early August, although I saw records for as early as 10 June (Oswego, Labette County, Kansas) and 25 May (Stillwater, Oklahoma).

Because of its association with cultivated currant and gooseberry, and the distinctive appearance of both adults and larvae, this species became known early in the history of American entomology. It has a more informative literature than any other American species of *Speranza*, including colored illustrations in at least five previous works (Fitch, 1848; Holland, 1903; McGuffin, 1972; Covell, 1984; Wagner et al., 2001). Tietz (1972: 572–573) listed 36 references to earlier publications (1848–1950) giving life-history information.

Speranza simplex (Dyar), NEW COMBINATION

PL. 3, FIGS. 10, 11 (adult); TEXT FIG. 26 *b*, *d* (♂ gen.); TEXT FIG. 25 *e* (♀ gen.) (RWH 6281).

Pygmaena simplex Dyar, 1907, *Jour. New York Ent. Soc.*, **15**: 232.

Type locality: Laggan, Alberta. [USNM]

NOTE—Described from 10 male and one female syntypes. I designate as the lectotype a male labeled Laggan, Alberta; Aug. 8–15; Type No. 10442, U.S.N.M. (all of the syntypes have this same type number on a red label); and *Pygmaena simplex* Type, Dyar (probably in Dyar's handwriting). It also has a lectotype label. Another specimen of the type series is labeled Laggan, BC [sic]; Dyar & Caudell; and, as well as having the same type label described above, it has an extra label that says "Mt. Fairview, Aug. 17-06," which is a possible clue to the exact locality. Laggan, which is a type locality for many species of moths, was a scenic railway stop near the site of the present Lake Louise, Alberta, and it no longer exists as a community or named locality. On a trip to the region in 1991 I made local inquiries and was told by a resident that the present townsite of Lake Louise is part of what had been known as the Laggan railroad district, which included about 30 miles of track. The railway continued to operate until 1990. The only indication of the name to be seen now is "Laggan's Bakery Shop" in the community of Lake Louise.

This is an obscure, sooty-gray, alpine and probably subalpine species known only from the section of the Rocky Mountains extending from Wyoming to Alberta and British Columbia. In addition to dusky color and distinctive genitalia, it differs from *andersoni* and other plain gray-brown species in its more evenly rounded outer margin and unmarked fringe on the forewing; very small, probably flightless female; narrower male antennal shaft with visibly shorter, almost scaleless, blackish branches (relative lengths measureable but only with difficulty); the presence of a thin, dark postmedial line on the forewing of most specimens; and discal spots on both wings. Although *simplex* has the appearance of a high alpine moth, its eyes are not reduced as might be expected; indeed, the male eyes are slightly larger than those of *Speranza argillacearia*, suggesting that *simplex* is partly or largely nocturnal. The female is at least as well marked as the male and almost as dark, but it has the smallest wing measurements of any member of the tribe in North America except *Speranza lorquinaria*. Wing length: males, 12–15 mm (n = 34); females, 9 mm (n = 6).

The male genitalia (text figure 26 *b, d*) show a configuration of structures on the sacculus lobe of the valve so similar to those of *ribearia* and *flavicularia* that there would seem to be no doubt about the relationship. The aedeagus also is similar in shape, although it lacks the large spine. The female genitalia (text figure 25 *e*) also are of the same basic type, with a prominent and sclerotized ostial tube, and show nothing to dispel the idea that *simplex* is a specialized and simplified member of the *ribearia*-group adapted to a harsh alpine habitat.

The early stages and hosts are unknown; although if the species is related to the *ribearia*-group, as indicated above, the food plant may prove to be a species of *Ribes* (Grossulariaceae). At 7,500' in Highwood Pass, Alberta, adults were found flying among willows growing along swift-flowing alpine streams (McGuffin, 1972: 53).

Speranza simplex has been collected at about 45 sites between 5,000' and 10,300' in the Rocky Mountains of Alberta, British Columbia, Montana, and Wyoming. Many of the localities are in Jasper, Banff, Yoho, Kootenay, Glacier, and Yellowstone National Parks. The highest sites are on the east side of Beartooth Pass, Montana (10,300'), the Wind River Range, Sublette County, Wyoming (10,100') and the Bighorn Moun-

tains, Wyoming (9,900'); others are generally below 9,000'. Its southern limit appears to be in the Wind River Range, Sublette and Fremont counties, Wyoming. Surprisingly, this species has not been found in Colorado, or farther north in Canada or Alaska, where it should be well adapted to boreal conditions. Wyoming specimens are somewhat larger and better marked than those from Montana or the Canadian Rockies. I have seen 355 specimens, of which most (258) are in the American museum of Natural History.

The flight period is 16 July–27 August, except that four specimens from Maligne Lake, Alberta (CU) are dated 1–4 July. The latest were taken on Signal Mountain, Jasper, Alberta. Most specimens examined were collected between mid-July and the first week of August.

I looked for a possible relationship between *simplex* and the superficially similar north European *Pygmaena fusca* (Thunberg) but found them very different. *Pygmaena fusca* is even more highly adapted and simplified for life in a severe boreal habitat, with reduced eyes, hairy vestiture, and further wing reduction in the female. Its simplified male genitalia do have a well-developed valvula, typical of *Speranza*, and show nothing in this character system that would exclude *P. fusca* from the genus *Speranza*. However, it is not closely related to any species in the American fauna.

Unassociated species

The following four species have an obvious affinity to the foregoing groups in general but do not seem to fit well in any of them. Each is unique in appearance, and the genitalia, although not radically different, do not clearly relate them to any of the above or to one another. I place them together here rather than at the end of *Speranza* because they are less closely related to the *quadrilineararia*-group or to the southwestern species grouped toward the end of the genus.

Speranza lorquinaria (Guenée), NEW COMBINATION

PL. 3, FIGS. 12–15 (adult); PL. 10, FIGS. 14, 15 (larva); TEXT FIG. 27 *a, c* (♂ gen.); TEXT FIG. 27 *b* (♀ gen.) (RWH 6324).

Tephрина lorquinaria Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 101.

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Type locality: California ("Un ♂. Envoi de M. Lorquin."). [Lost]

NOTE—The Guenée types of some species collected in California by Lorquin have not been found (Hulst, 1894: 306, 1895: 11; Oberthür, 1923: 249), and the holotype of *lorquinaria* is one of them. However, the original description clearly fits the present species, which is the type species of *Elpiste* and was long known as *Elpiste lorquinaria*.

Halia tripunctaria Packard, 1873, *Proc. Boston Soc. Nat. Hist.*, **16**: 26.

Type locality: California. [MCZ]

NOTE—Described from one male and one female. No lectotype has been designated.

Speranza lorquinaria is a somewhat atypical species found commonly west of the Rocky Mountains. It has a special pupal character found elsewhere only in *Letispe*, new genus and *Digrammia* Gumpfenberg; namely, an elongate, vertical (dorsoventrally oriented) group of several closely parallel grooves and ridges (prespiracular furrows) situated subdorsally on the sloping anterior surface of the 5th abdominal segment. These may be concealed from view if the segments are closely fitted together, but if the segments are extended sufficiently they are conspicuous. There may be some justification for retaining the genus *Elpiste* for this one species, but inasmuch as it fits *Speranza* in other respects, including the genitalia of both sexes, I chose to leave it near the end of the more typical members of *Speranza*.

The wings are light yellowish to grayish brown, with two brown-bordered, yellow transverse lines on the slightly falcate forewing, and usually one or two small, dark, subapical spots and a single small but distinctive extramedial dot. Without the dark spots it might be mistaken for *Letispe metanemaria*, but it lacks the bold, black-lined subapical concavity on the forewing outer margin and the angular hindwing of *Letispe*. The present species is easily recognized by its color, pattern, wing shape, and unusually long palpi, unusually long pectinations of the male antennae. The larva feeds on species of alder, birch, and willow. Although typical of *Speranza* in most features, the position of *lorquinaria* within the genus is unclear. It has no close relative.

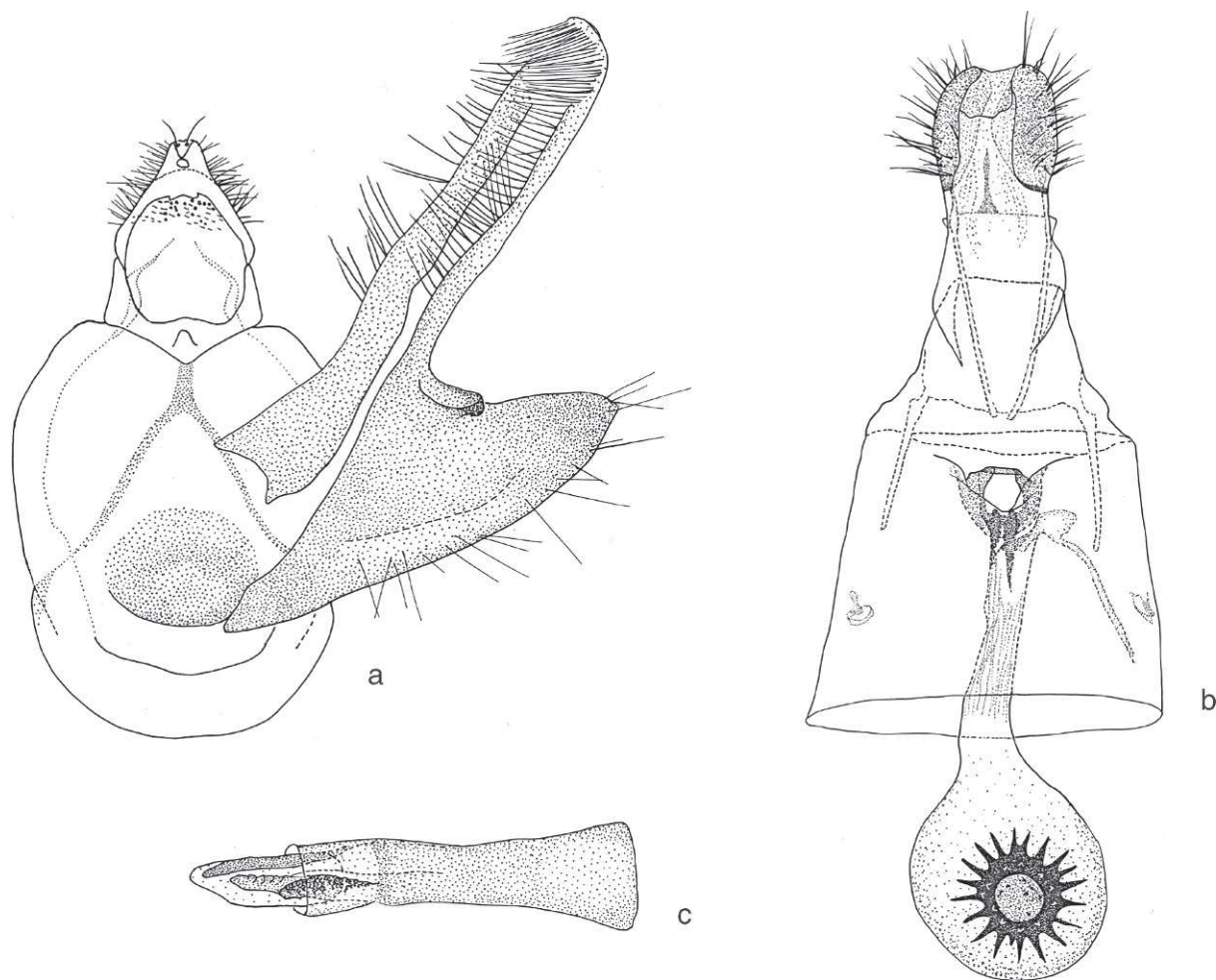
Palpi very long, protruding beyond eye a distance equal to three-fourths length of foretibia. Hindtibia of male not swollen. Sexes alike. Forewing yellowish to grayish brown, with median space and outer half of outer third contrastingly

paler relative to basal area and proximal half of outer third, which are clouded with darker brown; antemedial and postmedial bands yellow, thin, regular, the former nearly straight, and the latter usually slightly waved, neither band quite reaching costa; lines dividing inner margin and costa into three nearly equal sections; yellow antemedial band preceded by thin, brown border, and postmedial band followed by much wider brown band that occupies proximal half of outer third; usually two small subapical spots present, and also a single, small, black, extramedial dot on M_3 , which is unusual for *Speranza*. Discal spot small, brown, somewhat elongated tangentially to costa. Hindwing lighter, sometimes yellowish, powdery, with a faint, wide, dusky outer band, usually obsolescent; discal spot faint; fringes of both wings unicolorous, sometimes preceded by very thin, dark terminal line. Underside pale yellow, dusted with darker scales, sometimes heavily and sometimes with wide, diffuse, fragmentary, dark subterminal band on both wings; small discal spot present. Wing length: males, 13–19 mm; females, 13–18 mm.

Although there is little change in the Pacific Coast Region from British Columbia to southern California, some geographical variation is apparent in this species eastward. A few specimens from the Sierra Nevada (Placer, Nevada, and Mono counties) are darker brown, with more diffuse markings, and the black spots in the outer third of the forewing enlarged. Twenty-five specimens from the Wasatch Mountains toward the upper end of Ephraim Canyon (8,500'), Sanpete County, Utah (plate 3, figures 12, 13) are consistently of a more grayish color than the yellowish-brown specimens from most other places, and they also show a tendency toward larger, more intensely blackish spots.

The male genitalia (text figure 27 *a*, *c*) are simple and show nothing to indicate any particular relationship to other species. The sacculus is somewhat narrowed and bluntly pointed; the interlobular process well developed and about average in size and shape; similarly with the uncus, gnathos, and juxta. The aedeagus is hardly distinguishable from that of *Speranza occiduaria*, although more abruptly expanded at the proximal end. The incision in the eighth sternum is openly V-shaped, almost as widely as that of *amboflava*, and the lobes are more rounded.

The female genitalia (text figure 27 *b*) appear generalized also. More by chance than phylogeny

FIGURE 27: GENITALIA OF *SPERANZA LORQUINARIA*

a. Male genital capsule; Ephraim, Sanpete County, Arizona (USNM 57449). *b* Female genitalia; Mendocino County, California (USNM 57451). *c.* Aedeagus; Ephraim, Sanpete County, Utah (USNM 57449).

they happen to be remarkably similar to those of *S. amboflava*, which could not be considered closely related.

The larva occurs in two or more color forms, basically green and brown to grayish. Last-instar larvae collected from *Alnus sinuata* (Regel) Rydb. (Betulaceae) in Lane County, Oregon and from willow in Yakima County, Washington were green with a pale yellow lateral stripe that extended onto the side of the head, and numerous fine, faint, whitish or yellowish longitudinal lines in both the dorsal and ventral areas. The anal plate had a whitish margin, and a thin, pale line may run down the outer side of the anal proleg. The head and all legs were also clear green, without dark markings. The pale intersegmental folds of the integument in some larvae may give the appearance of thin, whitish, annular rings sepa-

rating the segments. A brown larva lacked the bold, yellowish lateral stripe, and the thin stripes also tended to be suppressed.

A dark form (plate 10, figure 15), collected from *Alnus rhombifolia* Nutt. in Mendocino County, California was dark pinkish or purplish gray, almost blackish in part, without an obvious lateral stripe, but with the usual numerous, closely spaced, sinuous, pale, longitudinal lines, varying from white to pinkish. Most pinacula stood out as small black spots; and the spiracles on A1–A5 were each situated within a black patch. The intersegmental folds formed pale rings around the body from about A1–A6. The legs were purplish, and the head was light gray to lavender, rather densely marbled with black.

Another form reared from a *Salix* species in Plumas County had a whitish to pinkish body,

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with a complex blotched, reticulate, and sinuously lined pattern of bluish gray. Only segment A2 had a conspicuous dark lateral patch; otherwise, segments A2–8 had a small, round, dark pinaculum surrounded by white just behind and below the level of the spiracle, as well as other dark pinacula variously situated on the body. The legs were concolorous with the ground color but variously marked with dark gray. The head was whitish, conspicuously banded, spotted, and marbled with black. Although the two dark forms described present a different aspect, certain common features of the pattern are easily traced and seen to correspond. The described larvae were collected, reared, and photographed by B. Scaccia, and the reared adults identified by me.

The larva was also described by McGuffin (1972: 61), who seems to have had an intermediate form with green ground color and dark markings, including the lateral patches surrounding the spiracles on A2–5 as described for the second form above, and the dark markings on the head. This species obviously has a highly polymorphic larva.

Speranza lorquinaria commonly feeds on alder, as indicated by the above records from *Alnus sinuata* and *A. rhombifolia* (Betulaceae), as well as others in the U. S. National Museum of Natural History reared from “alder” in British Columbia and Idaho. Adults were reared from larvae on *Alnus incana* (many), *A. sinuata* (3), and *Salix* species (8) in Oregon (J. C. Miller). It also feeds on willow (species unidentified) (Salicaceae). McGuffin (1972: 61) reported species of *Alnus*, *Betula*, and *Salix* as food plants in Canada.

This species occurs from southern British Columbia, including Vancouver Island, through Washington, Oregon, and California to Los Angeles and San Bernardino counties in the coastal region, and in the Sierra Nevada southward at least to Mono County. It has been collected in Idaho; Sweetgrass County, Montana; Carbon and Sublette counties, Wyoming; Routt County and Estes Park, Colorado; at Provo, Nebo Junction, and on the west slope of the Wasatch Range at 6,000'–8,500', Sanpete County, Utah. Available collection dates for British Columbia are 15 June–5 September; Washington and Oregon, 23 June–28 September; California, 16 May–30 October (earliest and latest from Lake and Mendocino counties respectively); Montana, 29 July–4 August; and Utah, 20 July–9 August. It apparently has two broods in the Pacific Coast region

and overwinters in the egg stage. Eggs that I obtained from late-season females did not hatch, thus behaving as though in diapause.

Speranza loricaria (Eversmann), NEW COMBINATION

PL. 3, FIGS. 16, 17 (adult) (RWH 6290).

Fidonia loricaria Eversmann, 1837, *Bull. Soc. Impériale des Naturalistes Moscou*, **10**: 59

Type locality: Kazan, Russia. [ZIN]

Idaea vinctaria Zeller, 1846, *Isis von Oken (Encyclopädische Zeitung von Oken)*, **30**: 203

Type locality: Lievland [Europe]

Sympherta julia Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 338

Type locality: Easton [Kittitat County], Washington. [USNM]

NOTE—Described from an unspecified number of specimens from Sudbury, Ontario (Evans); Washington (C. V. Riley); Calgary [Alberta]; Glenwood Springs, Colorado (Wm. Barnes); and Montana. In the USNM there are specimens with Hulst Type labels from Easton, Washington and Glenwood Springs, Colorado (2); a fourth is without locality. One of the two from Glenwood Springs is a female of *Speranza coloradensis*, and it must be a spurious type because no females were mentioned in the original description (This specimen was mistakenly illustrated as a female of *julia* by Barnes and McDunnough, 1912, pl. 15, fig. 5). Specimens in the AMNH with Hulst type labels include a second C. V. Riley specimen from Easton, Washington and one labeled only “N. M.” A specimen from Sudbury, Ontario has data as given in the original description but no type label. All of the valid syntypes are males. I hereby designate as the lectotype of *Sympherta julia* Hulst the specimen in the USNM from Washington. The more significant (of six) labels on this specimen read: “Easton Wash. K.,” “Through C. V. Riley,” Unknown Fo[r] Hulst,” and “*Sympherta julia* Type Hulst” (red-bordered and lined). A lectotype label has been added.

Thamnonoma nubilata Warren, 1904, *Nov. Zool.*, **11**: 563. NEW SYNONYMY

Type locality: South Park, Colorado (1 male, Osler). [BMNH]

Speranza loricaria is a northern or montane, holarctic species associated with trembling aspen, willow, and possibly other poplars. It is unique in being the only American member of the tribe

Macariini with a flightless female having extremely reduced wings, the forewings being the length of the antennae or less. The species is otherwise normal for the genus. The male has a bluish-gray forewing with brown transverse bands and usually some rust shading beyond the postmedial line. It somewhat resembles *S. coloradensis*, but the markings are more diffuse, and the male antennal branches are twice as long as those of *coloradensis*.

MALE. Head and body gray, legs brownish. Antennal branches long, equalling combined length of as many as four antennal segments. Forewing light bluish gray, sparsely sprinkled with blackish scales, and marked with the following gray-brown transverse lines or bands: a roundly convex antemedial line; a wider, diffuse, nearly straight medial band erect from inner margin, usually crossing basad of discal spot; a slightly S-shaped postmedial line that forms the inner boundary of a broad transverse band that is bounded outwardly by a crenulate subterminal line. This broad band varies through different shades of brown but is usually somewhat tinted with orange brown or rust. Outer half of outer third of wing variably shaded and darker than median space. Terminal row of black dots mark vein endings. Discal spot large, dusky, and, like most of the markings, tends to be diffuse. Costal spots not developed, although all transverse lines may widen and intensify slightly upon reaching costa. Hindwing pale yellowish brown, dusted with gray brown, and with a weak, roundly curved, gray-brown postmedial band; discal spot faint; terminal black dots as on forewing but not as distinct. Underside gray on forewing, becoming orange-yellow tinted toward costa, lighter on hindwing, powdery, with vague, dusky transverse bands and discal spots reflecting those on upper side. Fringes concolorous with wing above and beneath. Wing length: 13–17 mm, mostly 15–16 mm.

FEMALE. Brachypterous, with forewing extending only about as far as fourth abdominal segment. Head, body, and wings light bluish gray, lightly dusted with black scales. Forewing usually with distinct pattern of dark brown antemedial and postmedial bands, or with entire outer third dark brown; forewing discal spot may be present; fringe of forewing dark. Wing length: 4–7 mm.

Variation throughout the wide range of this

species is slight, although Alaskan specimens ($n = 42$) tend to have an especially diffuse, indistinct pattern and average small compared to American specimens from elsewhere. American populations differ more from place to place than most of them do from Palearctic *loricaria*. The latter cannot be distinguished except by locality label. The name *julia*, therefore, has no standing as a subspecies.

Male genitalia with saccular lobe quite broad, rounded, plain; valvula distinctive, in form of elevated, bladeliike ridge from costal lobe to middle of costal margin of saccular lobe, then turning basad at an acute angle toward basoventral corner, forming a ridge down middle of inner face of saccular lobe; this ridge tapers off and ends near middle of saccular lobe. Aedeagus with sharp, dentate, subapical process on right side, which may or may not be visible in profile depending on how specimen is mounted on slide. Otherwise, male genitalia generalized and typical for *Speranza*. Eighth sternum incised for one-fourth of its length, with diverging, V-shaped notch and extruded, flangelike, somewhat sclerotized apices, bluntly pointed at posterolateral angles.

Female genitalia also simple and generalized, showing nothing to reveal species relationships. Illustrations of both sexes were given by McGuffin (1972: fig. 232).

I have not seen the larva of this species, but it was described by McGuffin (1972: 58) as follows: Last instar—head pea green; body green; middorsal line green, flanked by white line; ad-dorsal a fine green line; subdorsal green with white line as its upper margin; lateral stripe greenish white; venter green with light midventral line. Ives and Wong (1988: 181, fig. 88G) reported that the larva has green and brown forms, and they illustrated the brown form in color. It is purplish brown with the meso- and metathorax largely blackish, and irregular, diffuse blackish rings around segments A2–5. All longitudinal lines are indistinct or broken, and the whitish lateral stripe appears only as disconnected patches on segments A1–4. No green coloring is apparent on the body. The head is reddish brown.

The major food plant in North America is trembling aspen, *Populus tremuloides* Michx. (Salicaceae), judging by the large number of collections (844) recorded by the Canadian Forest Insect Survey (Prentice et al., 1963: 429). I examined some of this material. They also reported

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many collections from willow, *Salix* sp. (176), including *S. discolor* Muhl., *humilis* Marsh., and *lucida* Muhl.; and balsam poplar, *Populus balsamifera* Linnaeus (43) (Salicaceae). Additional records from *Populus grandidentata* Michx. (5) and from white birch, *Betula papyrifera* Marsh. (16) (Betulaceae) may in part be correct, but the reared specimens that I examined from birch proved to be misidentified specimens of the northern form of *Speranza anataria*. However, one correctly identified one is labeled as reared from an *Alnus* sp. (Betulaceae) in British Columbia. McGuffin (1972: 59) listed *Populus* species, *Salix* species, and *Betula papyrifera*. Two earlier lepidopterists with whom I was acquainted, D. J. Lennox (New Hampshire) and P. F. Bruggemann (Alberta) reported in correspondence that they had reared *S. loricaria* from larvae found on "poplar" in the spring. Willow and birch are reported as food plants in Scandinavia (Skou, 1986: 221). In my experience in collecting this species in many places, I never saw it where aspen was not growing in the immediate vicinity. The overwintered eggs hatch when the trees leaf out in the spring, and the larval stage lasts from about mid-May to early July.

Speranza loricaria occurs from British Columbia and Alaska across Canada to Nova Scotia and Newfoundland. In the United States, I have seen it from Maine, New Hampshire, Vermont, New York (Catskill and Adirondack Mountains), Michigan, Wisconsin, Minnesota, North Dakota, South Dakota (Black Hills), Idaho, Wyoming, Montana, Alaska, Colorado, Utah, Nevada (Elko County), New Mexico (Sandoval, Santa Fe, Socorro, and Otero counties), Arizona (White Mountains, Apache County; Kaibab Plateau and near Flagstaff, Coconino County), Washington, and California (Modoc and Plumas counties). It occurs north to Norman Wells, Northwest Territory; Dawson, Yukon; and central Alaska. The species is Holarctic and occurs in all of the Scandinavian countries and eastward through Finland, the Baltic Region, Russia (but not Britain or western Europe) to eastern Siberia. The adults fly mainly between mid-June and early August, although most specimens from all regions were collected in July. They have been taken 7 July–21 August in the Yukon Territory.

Speranza plumosata (Barnes and McDunnough), NEW COMBINATION

PL. 3, FIGS. 18–21 (adult); PL. 11, FIG. 1

(larva); TEXT FIG. 28 *a, c* (♂ gen.) (RWH 6296).

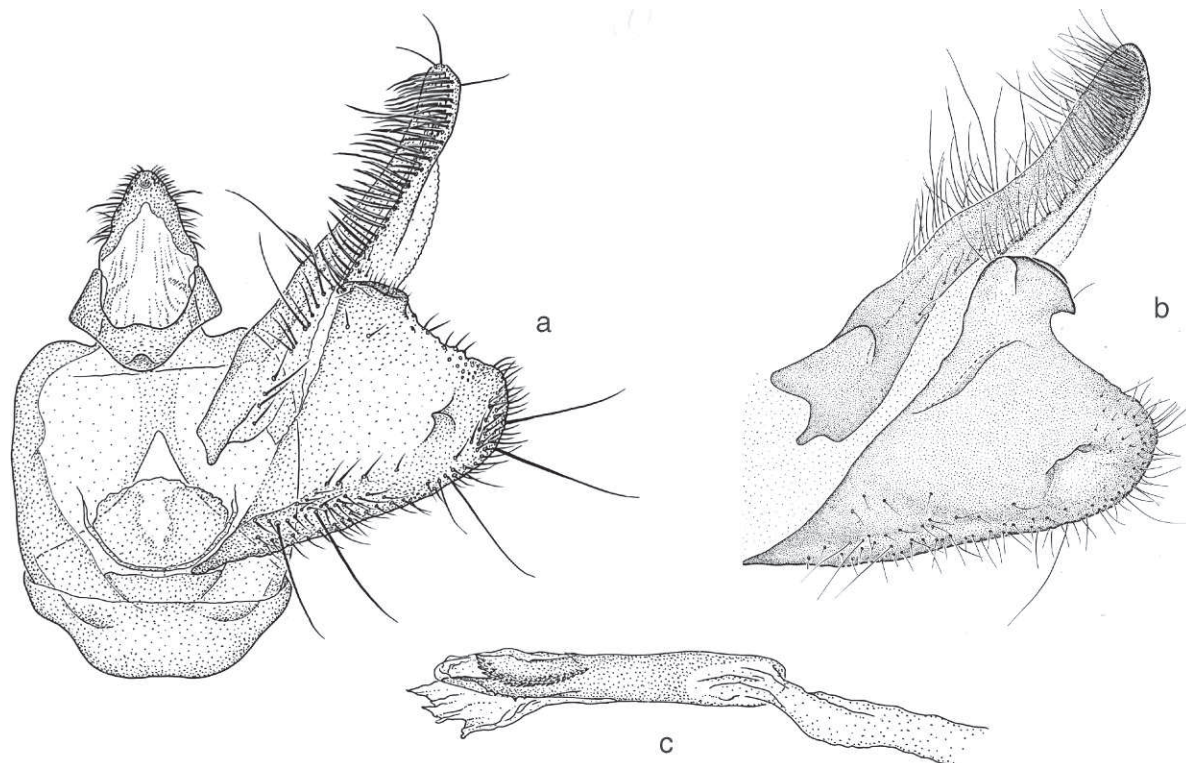
Itame plumosata Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, **3**: 237, pl. 24, figs. 7, 8.

Type locality: Huachuca Mountains, Arizona. [USNM]

NOTE—Described from eight males and five females from the Huachuca Mountains, White Mountains, Tucson, and Palmerlee, Arizona, and from Provo, and Stockton, Utah. I designate as lectotype of *Speranza plumosata* a male from the Huachuca Mountains, July 16–23, labeled by McDunnough as the Type male. It is a large specimen with a wing length of 14 mm.

This is a pale, yellowish-brown, maple-feeding, western species that occurs from British Columbia to Arizona. It has reddish-brown to darker brown forewing markings in the form of antemedial and postmedial lines, a weak medial line, a small, transversely elongated discal spot, and variable brown suffusion in the outer third, concentrated mainly as a dark patch opposite the discal cell and an irregular dark subapical patch near the costa. The hindwing is pale with a weak postmedial line. The outer margins are marked with an often incomplete terminal series of black dots between the veins, and the fringes are concolorous with the ground color or unmarked. The undersurfaces are yellowish with most of the markings repeated, but not as clearly. The species is so distinctive that the illustrations preclude the need for further description. Wing length: males, 12–15 mm; females, 13–15 mm. The size is usually about 13 mm for males and 14 mm for females. Colored illustrations of the adult, as well as line drawings of the genitalia, were also provided by McGuffin (1972: figs. 178, 179; p. 151, fig. 233a–f).

Speranza plumosata is subject to considerable geographic variation. Those from arid areas in Utah and Arizona may be unusually pale (plate 3, figures 20, 21), especially specimens from the vicinity of Flagstaff, Arizona; and those from farther north may be unusually dark (plate 3, figures 18, 19). Some specimens from southern Arizona are larger than any from elsewhere and include those in the type series of *plumosata* with a wing length of up to 15 mm. Also, the length of the branches of the bipectinate male antennae is geographically variable, the specimens from Arizona and Utah having noticeably longer and

FIGURE 28: MALE GENITALIA OF *SPERANZA* SPECIES

a. *S. plumosata*, genital capsule; Glacier National Park, Montana (USNM 56902). b. *S. pustularia*, right valva; Oxon Hill, Prince George's County, Maryland (USNM 56892). c. *S. plumosata*, aedeagus; Glacier National Park, Montana (USNM 56902).

more widely spaced branches than those from the Northwest or California. The few specimens seen from California have the shortest branches.

Both the male (text figure 28 a, c) and female genitalia are characteristic of the more conservative members of the genus but there is nothing about them to indicate any particular relationship. They seem about as close to those of *Speranza confederata* as anything, but that is probably coincidence.

A larva from Oregon (plate 11, figure 1), photographed and illustrated by J. C. Miller (1995), appears similar to that of *S. pustularia* (both feed on maple); green with white to light yellow stripes, consisting of a very regular, white dorsolateral, an obsolescent whitish spiracular, whitish addorsals, and faint yellowish or whitish stripes in the intervening dorsal, lateral, and ventral spaces. Head leaf green, unmarked. Thoracic legs green to brownish, translucent; prolegs green.

The larva was also described by McGuffin (1972: 510), based on material from British Columbia. The last instar larva was 22 mm long, light yellow green, with fine, green, geminate

middorsal, addorsal, and subdorsal lines. Fine white lines were mentioned for the fourth (penultimate) instar but not the last instar. The legs and plates were concolorous with the body ground color. The head was described as light green to light-russet green. The larvae described were collected from dwarf maple, *Acer glabrum* Torr. var. *douglasii* (Hook.) Dipp. between late May and early July. The Oregon larvae were reared on *Acer glabrum* and *A. circinatum* Pursh. (J. C. Miller). Specimens in the Franclemont Collection from Walnut Canyon, Coconino County, Arizona, were reared from larvae on boxelder, *Acer negundo* Linnaeus. I collected adults of this species at various times in Arizona, Utah, and British Columbia, always in the vicinity of maple.

Speranza plumosata occurs in the mountains of the West, from southern British Columbia to the Huachuca Mountains, Arizona. It occurs as far east as the middle of Montana (Sweetgrass County), Colorado (Larimer County), and southwestern New Mexico (Grant County), and as far west as Yale and Lillooet, British Columbia, central Washington and Oregon, and Plumas and Sierra counties, California. In California it is known

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only from the Sierra Nevada foothills to Mono County but in Arizona is widely distributed at medium elevations to within a few miles of the Mexican border (Ramsey and Carr Canyons, Huachuca Mountains).

Some recorded flight periods for different parts of the range are as follows: Arizona: late June–18 August; Colorado-Utah: 19 July–27 August; California-Oregon: 27 July–23 August; Montana: 9–15 August; British Columbia-Washington: 19 June–16 August, except for one from Lillooet, British Columbia dated 13 September 1930 (B. C. Provincial Museum).

Speranza pustularia (Guenée), NEW COMBINATION

PL. 3, FIGS. 22–27 (adult); PL. 11, FIG. 2 (larva); TEXT FIG. 28 *b* (♂ gen.); TEXT FIG. 29 (♀ gen.) (RWH 6273).

Stegania pustularia Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 49, pl. 17, fig. 9. Type locality: “Amérique septentrionale.” [USNM]

NOTE—Described from three males and two females, “Coll. Mus. et Gn.” The two females from the Guenée collection are in the collection of the USNM, and I hereby designate the better marked of the two as the lectotype; it is so labeled. This lectotype selection is contrary to the recommendation of the *International Code of Zoological Nomenclature* advising taxonomists to designate specimens that have been illustrated. However, the illustration of the male syntype published by Guenée is no longer recognizable as *Speranza pustularia* because the white pigment has changed to black, dark brown, or slate gray in the three copies of this work that I examined, imparting a very misleading aspect to the figure.

Speranza pustularia is the only species of the genus that is mostly pure white, and the only species treated in this work that is mainly white except species of *Protitame*, especially *virginalis*. However, *S. pustularia* is usually recognized easily by its distinctive brown markings and by chaetosemata that nearly meet in the middle behind the head in the characteristic macaraine manner; those of *Protitame* species are widely separated as in other Geometridae. The species is typical of *Speranza* in every way except for the unusual white color. It is a frequently abundant maple-feeding species from the Great Plains east-

ward, and from Canada to Florida and the Gulf States.

The wings are nearly pure white above and beneath, and the better marked specimens have three (rarely four) thin, sharply delineated, subparallel, cinnamon-brown transverse lines on the forewing that widen at the costa to form four brown costal spots. The costal spots are frequently of almost equal size, although that marking the costal terminus of the (usually missing or obsolete) subterminal band is the one most likely to be smaller than the others. The male forewing has a large fovea, and the female has a vestigial fovea. The hindwing, which is slightly angled near the middle of the outer margin, is usually marked only with a minute dark discal dot and a portion of the brown postmedial line that shows toward the inner margin. Better marked specimens also have a terminal series of dark brown spots that become obsolescent or lost in specimens with reduced markings. All brown wing markings may be reduced in any combination. On the underside some markings may be repeated in reduced intensity, although they are mostly lost. The front, collar, and body are white, but the palpi and a small patch behind the eye are bright orange brown. The antennae, and in part the forelegs and midlegs are light yellow brown, except that the shaft and branches of the antennae are white-scaled dorsally. The bipectinate male antennae have long branches nearly equal to the combined length of three antennal segments. The female antennae are simple and may have mixed brown and white scales. Wing length: males, 11–13 mm; females, 11–15 mm. Most specimens are near the middle of these size ranges.

The moths are highly variable everywhere with respect to reduction or even the occasional exaggeration of the brown markings; and a few have the markings so reduced that the wings are immaculate or nearly so. The variation also has a geographic component as indicated by unusual variants from near the southern limits of the distribution in Texas and Florida. These specimens (plate 3, figures 26, 27) have the three main transverse lines of the forewing, when present, indicated as continuous light yellowish- or reddish-brown lines, not as series of dots as is usual in more northern specimens, and, more conspicuously, the costal brown spots of the forewing are missing or nearly so. Males of these populations may be immaculate.

The genitalia are illustrated (text figures 28 *b*,

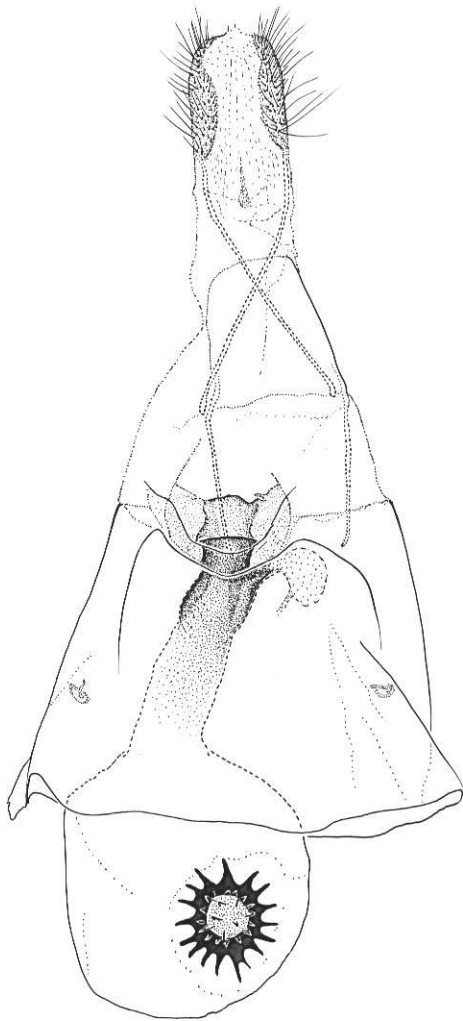


FIGURE 29: FEMALE GENITALIA OF *SPERANZA PUSTULARIA*

Enfield, Penobscot County, Maine (USNM 56457); Oxon Hill, Prince George's County, Maryland (56893).

29) and need not be described, inasmuch as the moths could hardly be confused with anything.

The larva has been described by several authors (Saunders, 1871: 225; Forbes, 1948: 39; McGuffin, 1972: 60; Allen, 1985: 191; Wagner et al., 2001). Body leaf green to pale blue green, a good match for the underside of the leaf of red maple; subdorsal band nearly white, prominent but not quite reaching the head or anal proleg; body otherwise with numerous thin, sinuous, often incomplete, whitish longitudinal lines, including an inconspicuous lateral (spiracular) and pair of addorsal stripes; head light green to ivory or light tan, without markings; all legs light green or yellowish green, essentially concolorous with body. Saunders, writing 131 years ago, described

the larva of *pustularia* accurately as follows (quoted by Packard, 1876: 311): "The head is green, and the body bluish green, with closely set whitish and yellowish longitudinal stripes. A double whitish dorsal line, with bordering lines of yellowish white, neither of which are unbroken, but are formed of a succession of short lines and dots. Below these, on each side, are two or three imperfect white lines, made up of short streaks, and much fainter than those bordering the dorsal line; spaces between the segments yellowish. The skin all over the body is much wrinkled and folded. The undersurface is green, with a tinge of yellowish between the segments; feet yellowish green, prolegs green faintly tipped with brown." The larvae change color from green to pink before pupating. The light-green eggs overwinter and hatch the following spring; the larvae are full grown about the middle of June in Ontario, earlier southward.

The larvae feed on maple, probably on various species, although most records are for red maple (*Acer rubrum* Linnaeus). Prentice et al. (1963: 421) listed red maple, sugar maple (*A. saccharum* Marsh), silver maple (*A. saccharinum* Linnaeus), and mountain maple (*A. spicatum* Lam.) in decreasing order of frequency relative to the number of collections (13 for red maple; 2 for mountain maple). Other hosts mentioned in the literature are questionable. This species has occasionally been reported in sufficient abundance to be injurious to trees; and in Connecticut in the mid-1960's I saw adults in such numbers that they resembled snowflakes falling from the trees.

Speranza pustularia occurs from western Newfoundland and Nova Scotia to southern Saskatchewan, southward at least to Putnam County, Florida, southern Louisiana, and Anderson County, Texas; and westward in the central United States at least to Iowa, Kansas, and Arkansas. It is not known to have more than one brood, and the adults fly mainly in mid to late summer in the North and late spring or early summer to mid summer in the South; for example, the available dates are 19 July–10 September for Nova Scotia; 20 June–13 September for Maine; 16 June–9 August for New York and Pennsylvania; 21 June–7 August for Virginia, West Virginia, and North Carolina; May–August for Missouri (J. R. Heitzman, in litt.); April 18–2 June for Florida and Texas; and it is recorded for June in Louisiana. Other localities at these latitudes have comparable flight times.

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The *quadrilinearia*-GROUP

This is a group of four western species that appear to represent two pairs of sister species, whose closest affinities, on the basis of genital structure, would seem to lie with the complex that includes *extemporata* and *coortaria*. The *quadrilinearia-trilinearia* pair have similar genitalia but are distinguishable by differences in color and markings. The second species pair, comprised of *guenearia* and *austriata* from California differ somewhat from each other in appearance and in male genitalia. Both pairs have mutually exclusive distributions. The species of the *quadrilinearia*-group have elongated male genitalia with an extended saccus, the same type of valvula, and similar pointed, sclerotic structures in the aedeagus. Those whose hosts are known feed on Rhamnaceae. *Speranza trilinearia*, once abundant in Arizona, is not known to have been collected since 1955.

Speranza quadrilinearia (Packard), NEW COMBINATION

PL. 3, FIGS. 28–31 (adult); PL. 11, FIGS. 3, 4 (larva); TEXT FIG. 30 *a* (♂ gen.); TEXT FIG. 31 *a* (♀ gen.) (RWH 6288, 6289 (part), 6307).

Halia quadrilinearia Packard, 1873, *Proc. Boston Soc. Nat. Hist.*, **16**: 26.

Type locality: Sierra Nevada, California. [MCZ]

NOTE—Described from two male syntypes, but I found only one in the MCZ, a good specimen labeled “Sierra Nev.” I designate this as the lectotype.

Semiothisa inquinaria Hulst, 1887, *Ent. Americana*, **2**: 189.

Type locality: California. [AMNH]

Tephрина disparata Warren, 1904, *Novitates Zoologicae*, **11**: 562. REVISED SYNONYMY.

Type locality: South Park, Colorado. [BMNH]

NOTE—Described from one male and two female syntypes. I hereby designate as lectotype the male, which is clearly a specimen of *Speranza quadrilinearia*.

Selidosema pallescens Grossbeck, 1907, *Ent. News*, **18**: 150. NEW SYNONYMY.

Type locality: California [one female]. [AMNH]

This is a widely distributed western *Ceanothus*-feeding species with a bluish-gray forewing,

which may have four transverse lines, as the species name suggests. However, the lines are more likely to be obsolescent, at least in part. Although this species may be confused with *extemporata* in California, the dark spots marking the points at which the transverse lines meet the costa are not the conspicuous and consistent feature of the pattern that they are in that species. The female is more heavily marked than the male, often with dark shading on the forewing near the inner margin just beyond the postmedial line. The male genitalia easily distinguish *quadrilinearia* from all others except *trilinearia*, which formerly seemed to replace *quadrilinearia* in southern Arizona but can no longer be found.

Male with forewing light blue gray, lightly sprinkled with darker scales; well-marked specimens with at least four nearly parallel, regular, transverse lines erect from inner margin, turning basad just before costa and thickening at that point to form narrowly wedge-shaped, dark brown markings at costa on medial, postmedial, and subterminal bands; any or all of these markings, as well as the transverse bands themselves, may be obsolescent; transverse bands may be diffuse; a diffuse fifth dark band or shade may be present between postmedial band and the incomplete, sinuous, brown subterminal band; discal spot present, blackish, sometimes incorporated into medial band and apparently absent; small, faint, dark spot frequently present on radial vein at base of wing. Hindwing pale brown, powdery, dusted with smoky gray toward inner margin, and with or without a faint, convex, grayish transverse band across middle; discal spot nearly absent. Fringes dusky on both wings, sometimes faintly checkered. Underside yellowish brown, diffusely and uniformly granulated on hindwing, sometimes with dusky suffusion in median area of forewing; faint postmedial bands and faint discal spots may be present on both wings.

Female similar to male but commonly differing in three respects: costal bars or wedge-shaped marks on forewing often larger, more boldly defined; diffuse dark shaded patch often present between postmedial and subterminal bands near inner margin; and outer third of forewing often highlighted with light reddish brown centrally and toward costa. Also, outer margin of hindwing more crenulate than that of male. Wing length: males, 11–16 mm (mostly 14–16 mm); females, 13–16 mm.

Specimens from a population in central Colo-

rado (plate 3, figures 28, 29) are an unusually uniform, powdery gray and lightly marked, including females, and at first I mistook them for *Speranza trilinearia*. Those from most of Colorado, Wyoming, Montana, Idaho, British Columbia, Utah and northern Arizona are all much alike. Specimens from Clark County, Nevada are unusually small and pale, with a reduction of markings in the females. Females from southern and central California may be very pale, with white ground color, and with or without a coarse sprinkling of dark scales. The type of *pallescent* is one of these.

The male genitalia (text figure 30 a) are characterized by a large, flat, truncated saccular lobe and emarginate saccus, in addition to the unusually developed triangular valvula and other features common to the group. The notch in the eighth sternum is deeper than that of *guenearia*. Neither the male nor female genitalia differ noticeably from those of *trilinearia*, but they are different from those of *guenearia*. The female has a larger sterigma than does *guenearia*, and the male a differently shaped valve.

I am aware of two radically different larval forms in this species (plate 11, figures 3, 4), which, for simplicity, may be termed green and brown. Last-instar larvae as follows:

GREEN FORM. Body light green, with a set of many fine, sinuous, lighter green longitudinal lines dorsally and subdorsally, less apparent ventrally. A large, bold, black, lateral patch in a subspiracular position in middle of each segment from T3 to A6 with trace on A7, semi-double on A1, and extending down base of leg on T3. Black patches partially bordered with white dorsally, which is all that remains of spiracular stripe except for a longer strip between 3 and A1. A small black spot preceding spiracle on T1, and additional black shading ventrally on T1. Head brown, paler laterally and toward mouthparts, and a dark brown vertical strip anteroventrally. Prothoracic shield tinted with brown. Thoracic legs brownish; prolegs green, tinted with pink distally.

BROWN FORM. Body rather slender, densely and uniformly mottled with dark purplish brown on a whitish or pale gray background; dorsally, subdorsally, and laterally the confused pattern elements resolve themselves into faint, full-length, geminate stripes; paired dorsal lines intensify intersegmentally to form dorsal series of small

black patches on abdomen, and some pinacula also stand out as small dark dots; other, more distinctive blackish markings adorn body as follows: 1) a small patch adjoining and in part surrounding spiracle on T1; 2) a large patch on T3, just anterior to third thoracic leg, extending from venter up side about to level of spiracles or higher; and 3) quite large, irregular, smudgy dark patches around spiracles on A1 and A2, that on A1 being the larger. A conspicuous white stripe originates behind base of third thoracic leg and becomes an irregular, waved, and broken subspiracular stripe that diminished in width on A1 and disappears on A6; this stripe bounded ventrally on each segment from A1–A5 by an irregular, fusiform dark streak situated beneath or mainly posterad of each spiracle. Head whitish, irregularly spotted and mottled with black that shades into purplish laterally and on clypeus; head darkest dorsally. Thoracic legs reddish brown to black; prolegs concolorous with body. Some markings, especially white lateral streak behind third thoracic leg, suggest those of *S. guenearia*. The description of the brown form is based on a photograph of a larva found and reared on *Ceanothus velutinus* Dougl. ex Hook. (Rhamnaceae) in Plumas County, California by B. Scaccia. The larva was described somewhat differently by McGuffin (1972: 54, fig. 228a–c), who also reported the hosts as *Ceanothus* species. I also saw adults that were reared from larvae on a *Ceanothus* species by C. Henne and from *Ceanothus cuneatus* (Hook.) Nutt., both in Los Angeles County, California (LACM); and others reared from *Ceanothus velutinus* Dougl. ex Hook. and *C. integerrimus* Hook. & Arn. in Oregon (J. C. Miller).

Speranza quadrilinearia occurs in suitable habitats from the southern interior of British Columbia, Washington, and northern Idaho through Oregon and all of California, including coastal counties and the Sierras, to Los Angeles and San Bernardino counties, the Laguna Mountains, San Diego County, and into Baja California (Santo Tomas, 8 July 1953). It also occurs in Nevada and Utah and extends as far east as Santa Fe County at 9,500', New Mexico; central Colorado; Sheridan, Wyoming; and Deadwood, Black Hills, South Dakota (20 August 1912, R. A. Leussler). I have not seen it from Montana or from Arizona, with the exception of one small but otherwise normal specimen that I took on the Kaibab Plateau, 8,300', near Jacob Lake, Coconino County, Arizona, and another taken at the same place by

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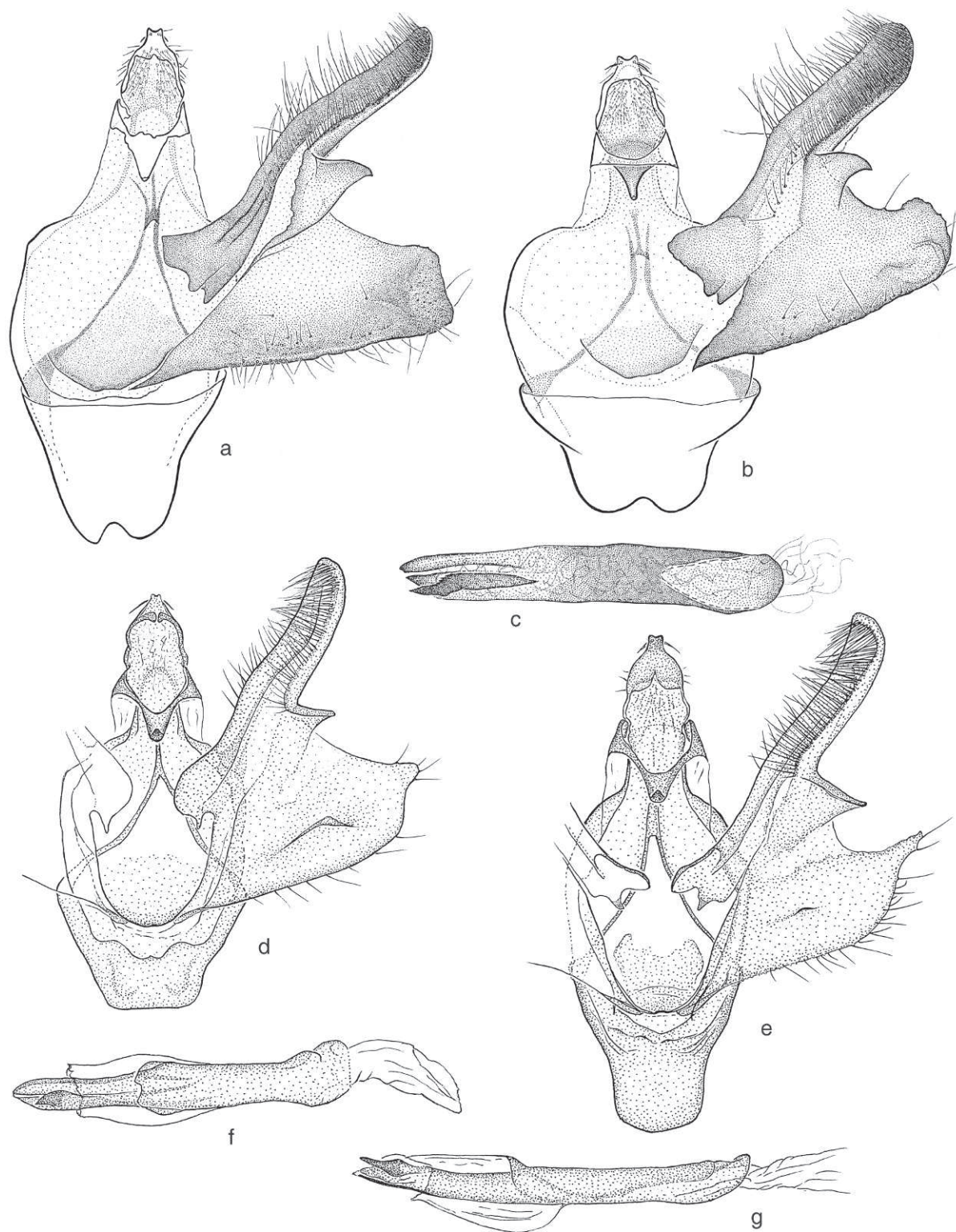
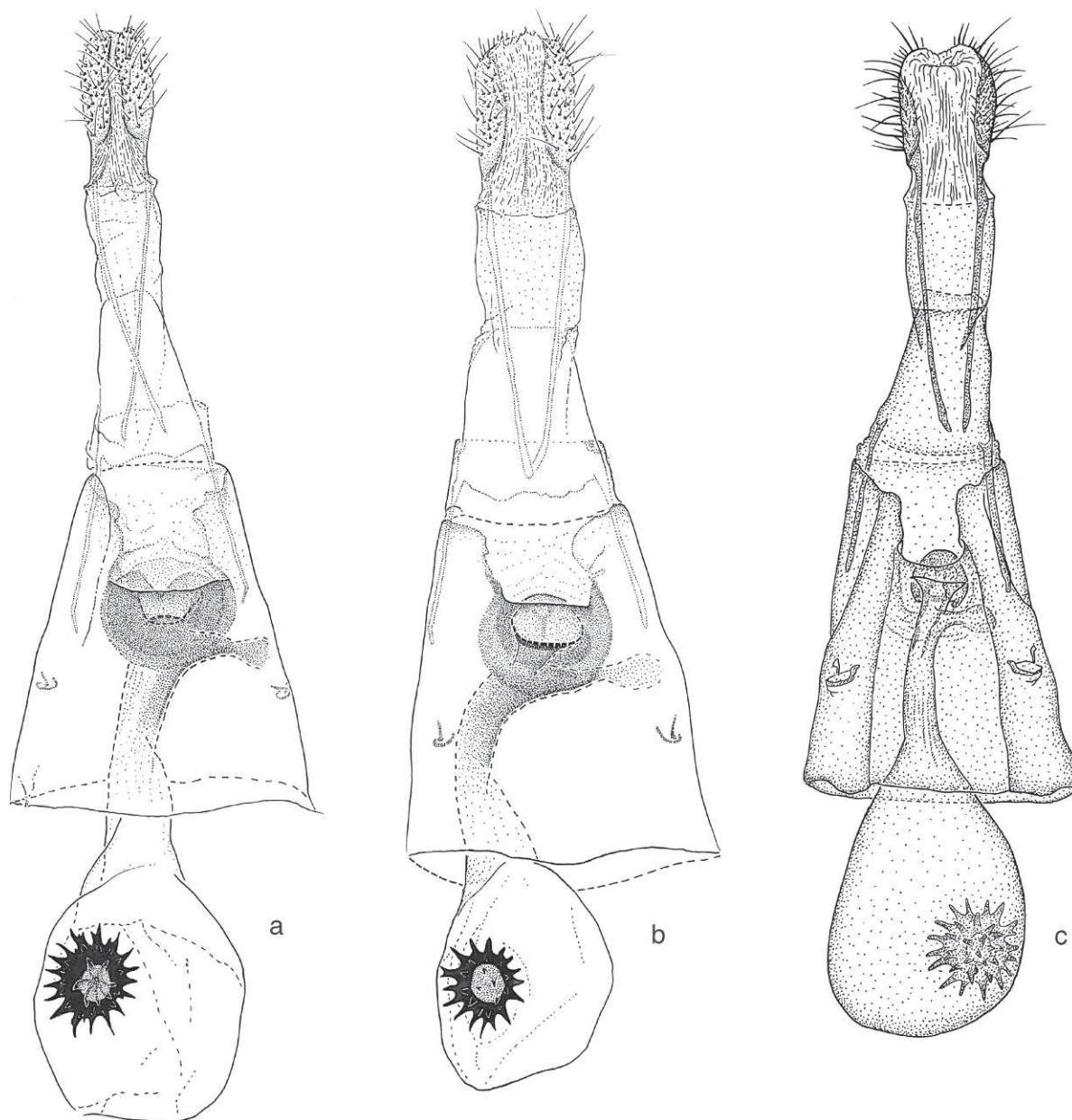


FIGURE 30: MALE GENITALIA OF *SPERANZA* SPECIES

a. S. quadrilinearia, genital capsule; Mono County, California (USNM 56916). *b. S. trilinearia*, genital capsule; Mohave County, Arizona (USNM 56908). *c. S. trilinearia*, aedeagus; Mohave County, Arizona (USNM 56908). *d. S. guenearia*, genital capsule; Kerby, Josephine County, Oregon (USNM 58201). *e. S. austrinata*, genital capsule; Ventura County, California (DCF 1596). *f. S. guenearia*, aedeagus; Kerby, Josephine County, Oregon (USNM 58201). *g. S. austrinata*, aedeagus; Ventura County, California (DCF 1596).

FIGURE 31: FEMALE GENITALIA OF *SPERANZA* SPECIES

a. S. quadrilinearia; Tulare County, California (USNM 56900). *b. S. trilinearia*; Mohave County, Arizona (USNM 56909). *c. S. guenearia*; Illinois River, nr. Kerby, Josephine County, Oregon (USNM 58022).

F. H. Rindge. The flight period is about 15 June–11 August over much of its range.

Speranza trilinearia (Grossbeck), NEW COMBINATION

PL. 3, FIGS. 32, 33 (adult); TEXT FIG. 30 *b*, *c* (♂ gen.); TEXT FIG. 31 *b* (♀ gen.) (RWH 6302).

Cymatophora trilinearia Grossbeck, 1910, *Jour. New York Ent. Soc.*, **18**: 205.

Type locality: Southern Arizona. [USNM]

NOTE—Described from six males and three females, of which four males and one female are in the USNM, including the specimen labeled “*Cymatophora trilinearia* type Grossbeck.” This is the specimen illustrated by Barnes and McDunnough (1912: pl. 15, fig. 6), and I hereby designate it as the lectotype.

Speranza trilinearia is a faintly marked Arizona species with pale, violaceous-gray forewings that

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usually have three thin, brownish, transverse lines. The postmedial line tends to be concave, making it appear slightly oblique. The forewing is much like that of *S. guenearia* but lacks the yellow postmedial band. The genitalia probably cannot be distinguished from those of *quadrilinearia*, to which *trilinearia* is most closely related. *Speranza trilinearia* and a plain, powdery-gray form of *quadrilinearia* that occurs in Colorado (plate 3, figures 28, 29) may be deceptively similar, but *quadrilinearia* has wide, squarish wings, not the narrower (or more elongated) wings of *trilinearia*, and the females of *quadrilinearia* are better marked than the males, unlike those of *trilinearia*. This species has a curious history of being at one time abundant and now unaccountably rare or no longer present, judging by the large numbers collected prior to 1918 and the absence of recent specimens in collections (see concluding paragraph).

Sexes nearly alike. Forewing light violaceous gray brown (“mauve” according to early authors, but all specimens available are old and probably faded); three thin, gray-brown transverse lines, any or all of which may be obsolescent; antemedial convex, medial straight or concave, Postmedial concave, bending basad just before costa; weak subterminal band sometimes present, indicated as a small, dark, reddish-brown spot (the only dark spot) at costa, otherwise as a diffuse, fragmentary, dusky or yellowish band; some diffuse, dusky shading sometimes present near outer margin; discal spot faint or absent; fringe gray, slightly darker than ground color. Hindwing very pale yellowish brown, almost unmarked; fringe gray, darker than wing. Underside pale, unmarked, tinted with yellow, which is brightest toward costa and apex of forewing. The upperside of the forewing of a few specimens has a suggestion of the yellow band of *guenearia*, but the species are distinct, with different male genitalia. The forewing shape of *trilinearia* is slightly different, being a little more elongated and produced at the apex than is normally so in either *guenearia* or *quadrilinearia*. Wing length: males, 12–16 mm; females, 12–16 mm.

Neither the male nor female genitalia of this species appear to be distinguishable from those of *S. quadrilinearia*.

The early stages of *Speranza trilinearia* are unknown. *Speranza quadrilinearia* and *guenearia*, the only two members of this species-group

whose hosts are known, feed on species of *Ceanothus* and *Rhamnus* respectively, and *trilinearia* might be expected also to feed on a species of Rhamnaceae.

This species is known only from Arizona, except for two specimens in the USNM from “So. Utah. July 1900,” and “Bellevue, Wash. Co., 2000 ft., Utah, VII.8.17.” The many Arizona specimens examined (USNM, AMNH, and other collections) nearly all bear the data labels of early collectors active between 1899 and 1917, mainly O. C. Poling, and the localities are as follows: Gila County; Mohave County; Hualapai Mountains, Mohave County; Maricopa County; Dewey; Flagstaff; [Santa] Catalina Mountains [Pima County], 7,500'; Redington; Huachuca Mountains; Palmerlee, Cochise County; Garces [Cochise County] (Biederman); Paradise, Cochise County; White Mountains, Apache County. A specimen in the Los Angeles County Museum of Natural History labeled Mt. Graham, 7,300', Pinalena Mts., Graham County, Arizona, 28 June 1955, is the most recent specimen seen. A few others were collected in Oak Creek Canyon, 14–17 June 1942 and 14 June 1946 by J. L. Sperry (AMNH, BMNH). The collection dates for Arizona are 23 May–24 June, except for one in August and one in October that may have been incorrectly labeled. Both Utah specimens were taken in July.

One hundred and ninety specimens of *trilinearia* in the U. S. National Museum, nearly all from the Barnes collection, were collected before 1918, with the exception of a single specimen from the White Mountains taken 24 June 1937 by Don Meadows. The most recent record (1955) is the one from Mt. Graham mentioned above (LACM). One hundred and forty nearly perfect but unspread specimens from the Barnes collection, taken in the Hualapai Mountains (year not given but obviously in the early 1900's), were apparently all collected around the same time, probably the same year, indicating that the species could be abundant. Indeed, I know of no other species of *Speranza* of which that many were collected in the same place at the same time. The present status of *trilinearia* is unknown. No specimens are known to have been collected during the past 45 years, despite intensive collecting in areas where it once occurred so commonly. It is not known from Mexico.

Speranza guenearia (Packard), NEW COMBINATION

PL. 3, FIGS. 34, 35 (adult); PL. 11, FIG. 5 (larva); TEXT FIG. 30 *d, f* (♂ gen.); TEXT FIG. 31 *c* (♀ *f* gen.) (RWH 6301).

Thamnonoma guenearia Packard, 1876, Monograph of the geometrid moths or Phalaenidae of the United States, in Hayden, F. V., *Rept. U. S. Geol. Surv. Terr.*, **10**: 252, pl. 9, fig. 70.

Type locality: "North California." [MCZ]

NOTE—Described from two males, both of which are in the MCZ. I designate the specimen labeled "Cloverd N. Cala" [Cloverdale, Sonoma County], as the lectotype.

It was a surprise to find that the Pacific Coast moth long familiar as *Itame guenearia* is in reality two species, one in southern California and extending into northern Baja California and the other in northern California and Oregon. The northern species is the true *guenearia*; the southern one is described below as *S. austrinata*. Nearly all specimens of both species are easily distinguished from *S. quadrilinearia* and *S. trilinearia*, and indeed from all other Macariini, by the presence of a conspicuous yellow transverse band in the outer part of the forewing near and parallel to the outer margin. Rare exceptions occur in Ventura County, where a few specimens lacking the yellow band have been collected, but the genitalia (text figure 30 *d, f*) show them to belong to the southern species.

Speranza guenearia differs from *S. austrinata* in the light violaceous-gray ground color of the forewing, more regular yellow transverse band that is usually nearly straight and of uniform width, and in having less or no dark gray shading associated with the transverse bands of the forewing. The yellow band of *austrinata* may be irregular, sometimes interrupted, and with a conspicuous amount of dark gray shading on both sides of it. In essence, *guenearia* has a plain, rather pale appearance, almost without markings except for the regular, nearly straight, yellow band, and also usually a yellowish costa that is not apparent in *austrinata*. The male genitalia of *guenearia* differ from those of its sibling in four obvious features (see description).

Body and forewing light violaceous gray, thinly sprinkled with darker scales; frons, palpi, most of legs, and most antennal scales yellow; center of frons with some gray or brown scales in some

specimens; collar gray dorsally, extensively yellow brown laterally; vertex yellow or with a mix of gray and brown scales. Forewing with faint, darker, gray or gray-brown antemedial and postmedial bands, erect from inner margin and nearly straight but bending basad near costa; bright-yellow band in postmedial position nearly straight, of uniform width, and nearly parallel to outer margin, but true postmedial is the thin, dark shade preceding it; discal spot faint or absent; subterminal band represented by series of minute dark dots; fringes unicolorous. Hindwing usually very pale, faintly yellowish, usually unmarked and finely flecked with gray toward inner margin only, but this is variable; medial band sometimes present, faint; discal spot weak, often absent; fringe pale violaceous gray. Underside of forewing like upperside but lighter, often more yellowish, especially in costal area; markings indistinct, transverse yellow band present but appearing faded, washed out. Underside of hindwing light ochreous yellow, less heavily flecked with gray than that of *austrinata*; small discal spot present. Length of forewing: males, 12–16 mm; females, 14–16 mm.

Male genitalia as illustrated (text figure 30 *d, f*). Differing from those of *austrinata* in the smaller valvula; wider saccular lobe of valve, which is less extended and less pointed apically; shorter, squarish saccus; and differently shaped sclerotic inclusion toward apical end of the slightly stouter aedeagus.

Female genitalia (text figure 31 *c*) differing from those of *quadrilinearia* and *trilinearia* in the reduced sterigma, more slender ductus bursae, and tendency for signum to be slightly larger. Differing little from those of *austrinata* except that end of ductus bursae near ostium is less sclerotized, including short lateral diverticulum leading to ductus seminalis; sterigma smaller, and sclerotized integument of seventh segment surrounding sterigma wider, more extensive.

Speranza guenearia was reared from larvae on *Rhamnus californica* Eschsch., 15 mi W of Winters, Napa County (B. Scaccia.). They were collected as larvae 2 June 1988, pupated 4 June, and emerged 21 June. The last-instar larva, based on those from Napa County, is purplish or vinaceous brown, finely and uniformly covered dorsally and laterally with a whitish, punctate to reticulate pattern arranged in vague, barely perceptible, longitudinal bands, and with a larger proportion of white evident ventrally. The somewhat wrinkled

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lateral fold has a large black spot on A1, preceded by a white dash that tapers off toward the base of the third thoracic leg; an irregular white lateral patch follows on A2. There are no other conspicuous markings on the body. The prolegs are concolorous with the body; the thoracic legs are blackish. The head is reddish brown with a fine, quite uniform, whitish reticulate pattern. The black and white lateral body markings are similar to those of *quadrilinearia* but not as extensively developed. However, they support the probability of a close relationship already suggested by similarities of genitalia and food plants. A comparison with *S. austrinata* cannot be made because information on the larva of that species is not available. It is to be expected that a green larval form also occurs.

Speranza guenearia occurs in California from northern Los Angeles and Ventura Counties to the vicinity of Mono Lake, Mono County, Truckee, Nevada County, and northward to the Warner Mountains, Modoc County (Fort Bidwell), northern Del Norte County, and in Oregon at least to the Siskiyou Mountains, Josephine County. A single specimen in the USNM is labeled "Nev." with no other information. A unique specimen (AMNH) from Trout Creek, Ibapah Mountains, [Juab County], Utah, 12 August (T. Spalding) resembles *guenearia* but has the yellow transverse band of the forewing quite broadly bordered with dark brown on both sides.

Collection dates for this species extend from about 2 April to 29 July, being generally later northward, earlier southward. Despite the extended flight period, there probably is only one generation, which is characteristic of the genus.

There is little geographic variation in this species, the only significant variant seen being the specimen from the Ibapah Mountains, Utah, mentioned above.

Speranza austrinata Ferguson, NEW SPECIES

PL. 3, FIGS. 36, 37 (adult); TEXT FIG. 30 *e*, *g* (♂ gen.).

Speranza austrinata Ferguson.

Type locality: Miramar [Naval Air Station], San Diego County, California, 20 May 1943, S. S. Nicolay. [USNM]

This taxon, first recognized here as a species distinct from *S. guenearia*, occupies southern California from southern Ventura and Los Angeles

counties to the Mexican border and into Baja California, apparently overlapping slightly with *guenearia* at its northern periphery. It resembles *guenearia* but is somewhat darker and has a less regular transverse yellow band on the forewing that may also be of irregular width or discontinuous. Also, there are differences in the genitalia of both sexes.

Male and female essentially alike. Body and forewing violaceous gray, lightly sprinkled with darker scales; collar gray with yellow-brown patch behind eye limited to a smaller area than seen in *guenearia*; vertex gray; antenna, frons and legs with mixture of gray and yellow scales; palpus with a few yellowish scales but mainly reddish brown on outer (lateral) sides. Forewing blue gray, darker than that of *guenearia*; antemedial and medial bands, if present, indicated in darker gray, closer together than those of *guenearia*, often somewhat irregular, and with medial band often widening to form dark spot at costa; yellow transverse band of forewing variable, often irregular compared to the consistently regular yellow band of *guenearia*; yellow band variable in width, commonly narrowing or with a gap between veins M_1 and M_3 ; dark gray to black shading often present on both sides of yellow band, variable, often mixed with reddish brown and commonly forming a dark point or wedge-shaped spot on outer side between M_3 and Cu_1 , not present in *guenearia*; discal spot present or absent; subterminal a series of small dark dots, a little larger than those of *guenearia*; fringes unicolorous. Hindwing lighter but not as pale as that of *guenearia*, and usually more heavily but finely sprinkled with darker gray; small discal spot often present; fringe violaceous gray like that of forewing. Underside of forewing gray, variegated with yellowish near costa and slightly so in outer part of wing beyond yellow transverse band, which may be distinct but never as bright as on upperside; fringes dusky. Underside of hindwing ochreous yellow, quite densely and evenly flecked with violaceous gray, much like that of *guenearia* but usually a deeper yellow and more heavily flecked; small discal spot present. Length of forewing: males, 11–15 mm ($n = 56$); females, 11–16 mm ($n = ?$) [not indicated, ed.].

In what is probably the zone of contact between *guenearia* and *austrinata* in Ventura County, specimens were collected in which the yellow transverse band of the forewing is missing, being replaced by a wide, diffuse, dark band evidently

derived from dusky shading sometimes present at the margins of the yellow band. These are labeled "Craven's Ranch, Casitas Pass, Ventura Co., California, 29 July 1960, C. W. Kirkwood" (AMNH). The male genital drawing illustrated was made from one of these specimens.

Male genitalia (text figure 30 *e, g*) similar to those of *guenearia* but differing in having all components slightly elongated except saccular lobe of valve, which is narrower but not elongated, although tapering distally to an extended, sharper apex. Valvula larger than that of *guenearia*, and saccus may be more extended as in specimen shown, although shape of saccus is not consistent. Sclerotized dentate structure near distal end of aedeagus longer and attenuate, not short and stout like that of *guenearia*.

Female genitalia (not shown) similar to those of *guenearia* but with a larger sterigma, about twice as wide as ductus bursae or nearly one and one-half times as wide as sterigma of *guenearia*. Also, ductus bursae a little more heavily sclerotized.

TYPES. Holotype ♂. Miramar [Naval Air Station], San Diego County, California; 20 May 1943; S. S. Nicolay. USNM. Paratypes (56 ♂, 15 ♀): California. Same locality and collector as for holotype; 1 May 1943 (1 ♀): NAS [Naval Air Station] Miramar, San Diego County; 10 February–27 July 1997; N. Bloomfield (32 ♂, 5 ♀). San Diego, San Diego County (ex Barnes coll.) (13 ♂). San Diego, San Diego County; 1–7 May; (ex Barnes coll.) (2 ♂). San Diego, San Diego County; 27 July 1907, 28 April 1908; W. S. Wright (1 ♂, 1 ♀); San Diego, San Diego County; 26 April, 6 June 1909; Geo. H. Field (1 ♂, 1 ♀). San Diego, San Diego County; 4, 8 June 1936, bred by C. M. Dammers (2 ♀). Loma Linda, San Bernardino County; May 16–23 (ex Barnes coll.) (1 ♀). Los Angeles (1 ♂). Burbank, Los Angeles County; 21 April 1961, F. P. Sala (1 ♀). San Diego, San Diego County; 3 March–2 June 1924, 16 May 1923 [E. Piazza] (6 ♂, 3 ♀). USNM. Some paratypes will be distributed to other collections.

Speranza austrinata was reared from larvae on *Rhamnus crocea* Nutt. (Rhamnaceae) at Riverside, California in early June 1935 (C. M. Dammers, LACM); and from the same plant species growing in the Mission Gorge area, San Diego, 18–28 May 1972 (C. Henne, LACM). The larva has not been described or illustrated.

This species is less widely distributed than *S. guenearia*, being limited to California from southern Ventura and Los Angeles counties to Baja California, where it was taken at Cañon las

Cruces, Distrito Norte (Don Meadows). Most specimens in collections are from San Diego County, where it is a very common species.

The *graphidaria*-GROUP

To this group I assign five somewhat unusual species of the arid regions of the Southwest, Texas, and Mexico. Like members of the *pallipennata*-group, they do not represent *Speranza* in the familiar northern or Holarctic sense but appear to be something different, possibly deserving generic or subgeneric recognition. They do differ from all the more typical species of *Speranza* in being multivoltine. Also, the larva is quite different, but otherwise I found no morphological features that would decisively set them apart from the foregoing *Speranza* species.

They mostly share similarities of antennal structure (short male antennal branches), wing color and shape, and general appearance, with all except *perornata* having a whitish ground color, even potentially so in the very dark *benigna*. The extramedial spot is all but absent, but may appear faintly in some *deceptrix* and *graphidaria*. The wings may be slightly angulate, and the outer margin of the forewing is slightly concave toward the apex.

The simple male genitalia have all the essential elements of *Speranza* except that the usual pair of spinelike setae (horns) of the uncus are absent, as is also true of the *pallipennata*-group; and the aedeagus of most species is unusual in having on the vesica a slender, elongated cluster of fine cornuti of a type not seen elsewhere in the genus.

The variable female genitalia also fall within limits that would be considered normal but have a special stellate signum characterized by a reduced central core or plate, from which radiate relatively long spines. Some of the spines are branched once (i.e., bifurcate). This type of signum contrasts especially with that of the *pallipennata*-group, in which the signum is spineless and much reduced or absent.

The only reported food plants are species of *Condalia* (Rhamnaceae) and *Bumelia* (Sapotaceae). Morphological variation within the group is such as to cast doubt on whether it is monophyletic, mainly because I have placed here two divergent species that fit no better elsewhere. These are *benigna* and *perornata*. The latter bears no resemblance in color or pattern but at least has the right male genitalia and antennae. I think that *benigna* is more likely to be misplaced.

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KEY TO SPECIES OF THE GRAPHIDARIA-GROUP

1. Ground color of forewing white 2
- Ground color of forewing not white, or so heavily obscured by dark shading that a pale ground color is not obvious 4
2. Forewing with all three blackish transverse bands about equally prominent, and postmedial band waved or sinuous; hindwing gray; W. Texas, New Mexico only *schatzeata*
p. 152
- Forewing with medial band less prominent than antemedial and postmedial bands; postmedial band regular or nearly so, although sharply angled near costa; hindwing brown or yellowish brown; Texas to Arizona 3
3. Transverse bands or lines regular or nearly so, subterminal band on underside without strong black shading or highlights; hindwing brown or gray brown; saccular lobe of valve of male genitalia rounded or pointed, not truncated; W. Texas to Arizona *deceptrix*
p. 148
- Transverse bands or lines of forewing often finely irregular; hindwing light yellowish brown; subterminal band on underside with strongly contrasting black filling or highlights; male genitalia with saccular lobe large and truncated; Texas only *graphidaria*
p. 149
4. Wings dark sooty gray brown with black discal spot forming part of medial band, which is apparent near costa only and is perpendicular to costa; usually few other markings; Arizona, S. California, S. Nevada *benigna*
p. 153
- Wings gray and faintly violaceous to ochreous orange yellow, darkening or intensifying distally in outer third of forewing; discal spot absent, but transverse bands showing as thin lines near costa, the medial one oblique; S. Arizona only (rare) *perornata*
p. 154

Speranza deceptrix (Dyar), NEW COMBINATION

PL. 3, FIGS. 38, 39 (adult); TEXT FIG. 32 *f*, *h* (♂ gen.); TEXT FIG. 33 *e* (♀ gen.) (RWH 6312).

Sciagraphia deceptrix Dyar, 1913, *Proc. U. S. Natl. Mus.*, **44**: 309.

Type locality: Tehuacán, Mexico. [USNM]

Itame (Diastictis) graphidaria sobriaria Barnes and McDunnough, 1917, *Contrib.*

Nat. Hist. Lep. N. Amer., **3**: 239, pl. 24, fig. 9. REVISED SYNONYMY.

Type locality: Redington, Arizona. [USNM]

NOTE—Described from seven males and two females from Redington, all of which are in the USNM collection. I hereby designate as lectotype the specimen illustrated by Barnes and McDunnough (1917: pl. 24, fig. 9) and labeled by them as “Type ♂.”

Although easily recognized by the genitalia in both sexes, this species may be deceptively similar to *graphidaria* in appearance. Males are more grayish, often heavily suffused with dark scales on the forewing, but females may be almost as pale as *graphidaria*, with a similarly white median space. The well-developed sexual dimorphism, especially in Texas populations, is one of the special features of *deceptrix*, inasmuch as the sexes of *graphidaria* and other members of the group are more nearly alike. The less yellowish hindwing, slightly more regular forewing postmedial, and substantial reduction or loss of the boldly contrasting black markings on the underside that typify *graphidaria* are other differences. Also, *deceptrix* in the United States is distributed from Texas to Arizona; *graphidaria* seems limited to Texas.

MALE. Forewing ground color whitish or light gray, irrorated with dark brown to blackish, often so heavily that very little pale ground color shows; basal and distal thirds commonly darker than median space; outer third with one or more longitudinally ovate, reddish-brown spots at or near usual position of extramedial spot; antemedial a thin, blackish line, convex in costal half, slightly concave in posterior half; postmedial similar, meeting costa at nearly 90°, abruptly angled at about M₁, concave between that point and costa, and regular, nearly straight or slightly concave between angle and inner margin; faint, diffuse basal and medial bands present or absent; fringe weakly checkered. Hindwing variable gray brown, sometimes slightly yellowish, traversed by three weak, convex bands parallel to outer margin, any or all of which may be obsolescent; fringe gray to yellowish, hardly checkered. Underside with forewing mostly gray, hindwing paler and dusted with dark scales; hindwing with or without wide, dark gray, subterminal band, which may rarely, when present, be well defined and blackish, although rarely if ever as boldly emphasized as that of *graphidaria*; forewing with

very little of subterminal band showing, and then only toward apex.

FEMALE. Similar to male but with upperside of forewing nearly always paler, brighter, with much whitish ground color showing, especially in median space, and transverse lines more distinct; ovate reddish-brown spots in outer third of forewing, characteristic of males, may be present in females when outer third is dark, but this part of wing in some specimens may be almost as pale as median space; in that case the reddish-brown markings may be absent and replaced by a more usual, dusky extradiscal spot or patch. Hindwing paler than or similar to that of male. Undersurfaces as in male.

Palpi of both sexes shorter than those of *graphidaria*, not much surpassing frontal crest. Male antennal branches also shorter, the longest hardly longer than the combined length of two antennal segments (more nearly equal to three segments in *graphidaria*). Wing length: males, 9–13 mm; females, 9–11 mm.

Texas females, especially those of the summer broods, tend to be paler than those from Arizona. The largest specimens everywhere are those found in spring (April) or fall (October, November). Summer specimens from June to September are small.

The male genitalia, although much less deviant from the norm than those of *graphidaria*, show enough similarities to suggest that they are sister species. In the aedeagus, the long, pinnate string of small cornuti, and the annular ribbing of the annellus (if not removed in dissection), are alike in the two species and not found elsewhere. The near absence of the interlobular process (valvula) is another common feature, one that might have been thought reason enough to remove both species from the genus *Speranza*; and the very wide excavation of the eighth sternum, although shaped somewhat differently, is nevertheless another unusual feature shared by the two species. However, there are just as many differences, such as the shape of the saccular lobe of the valve—short and pointed or narrowly rounded in *deceptrix*, elongated and curiously truncated in *graphidaria*; and the more narrow distal process of the gnathos, and presence of a slender apical process on the uncus.

The female genitalia are easily distinguished from those of *graphidaria* and all other species by the differently shaped, bilobed or trilobed os-

tial cavity. The bursa copulatrix is less ribbed and comprised of thinner integument. However, both species do have a large, distinctive ostial cavity unlike others of the group, and both have a special sclerotized plate in the ostial opening, triangularly shaped in *deceptrix*, more rounded in *graphidaria*.

The larva has not been described, but it was reported that the food plant in Arizona is *Condalia spathulata* Gray (Rhamnaceae) (R. Nagle, pers. comm.). This ties in well with what is known of *graphidaria* and supports the belief that they are closely related.

Speranza deceptrix is widespread in southern Texas and was collected in the following counties: Brewster, Presidio, Kimble, Kerr, Bexar, Starr, and LaSalle. I have seen it from Cochise, Pima, and Santa Cruz counties, Arizona. Records indicate that it flies from April to October in Texas, and March to September in Arizona. It apparently extends deep into Mexico, judging by the type locality, but I have not seen it from New Mexico. The species is often common where it occurs.

Speranza graphidaria (Hulst), NEW COMBINATION
PL. 3, FIGS. 40, 41 (adult); PL. 11, FIG. 6 (larva); TEXT FIG. 32 *a, c* (♂ gen.); TEXT FIG. 33 *a* (♀ gen.) (RWH 6311).

Semiothisa graphidaria Hulst, 1887, *Ent. Americana*, 2: 190.

Type locality: Texas. [AMNH]

NOTE—Described from two males and two females from Arizona and Texas. Barnes and McDunnough (1917: 239) restricted the type to a female from Texas in the Hulst collection, thus, in effect, selecting a lectotype. The other female, from Arizona, is in the USNM, and it is a specimen of *Speranza deceptrix* as would be expected, because *graphidaria* is not known from Arizona. Another female of *deceptrix* in the USNM has a Hulst type label, but it is probably a spurious type because only two females and two males were mentioned. The present location of the two male syntypes is unknown.

This species is distinguished from *Speranza deceptrix* mainly by the following differences: 1) the more contrasting, black-and-white pattern of the forewing; 2) the more decidedly yellowish-brown tint of the hindwing; 3) the very contrasting, blackish-marked subterminal band on the underside of the hindwing, also reappearing slightly toward the apex of the forewing; 4) the very dif-

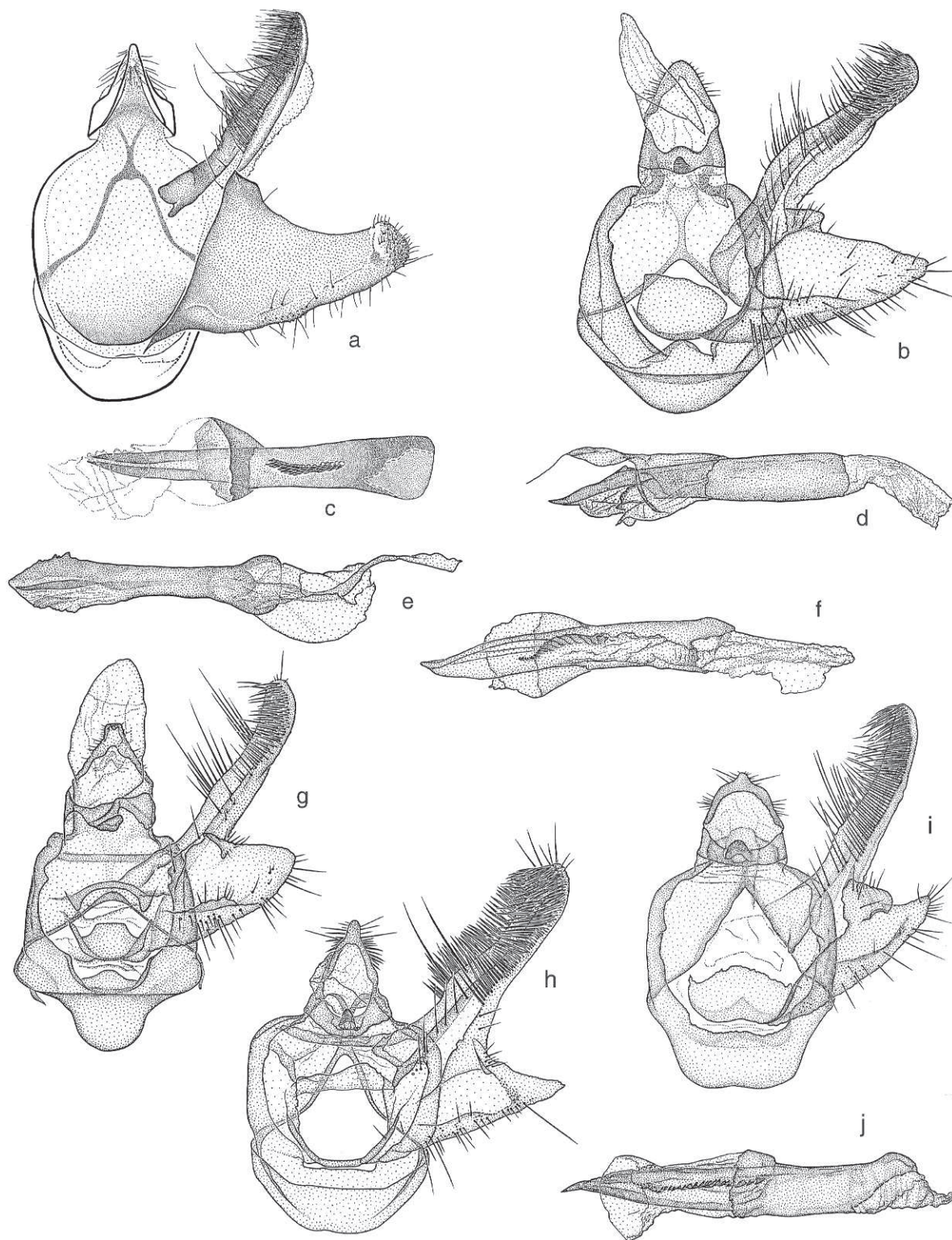


FIGURE 32: MALE GENITALIA OF *SPERANZA* SPECIES

a. S. graphidaria, genital capsule; LaSalle County, Texas (USNM 53966). *b. S. schatzeata*, genital capsule; Guadalupe Mountains, Culberson County, Texas (USNM 58241). *c. S. graphidaria*, aedeagus; LaSalle County, Texas (USNM 53966). *d. S. schatzeata*, aedeagus; Guadalupe Mountains, Culberson County, Texas (USNM 58241). *e. S. benigna*, aedeagus; Mohave County, Arizona (USNM 58243). *f. S. deceptrix*, aedeagus; Big Bend National Park, Brewster County, Texas (USNM 58240). *g. S. benigna*, genital

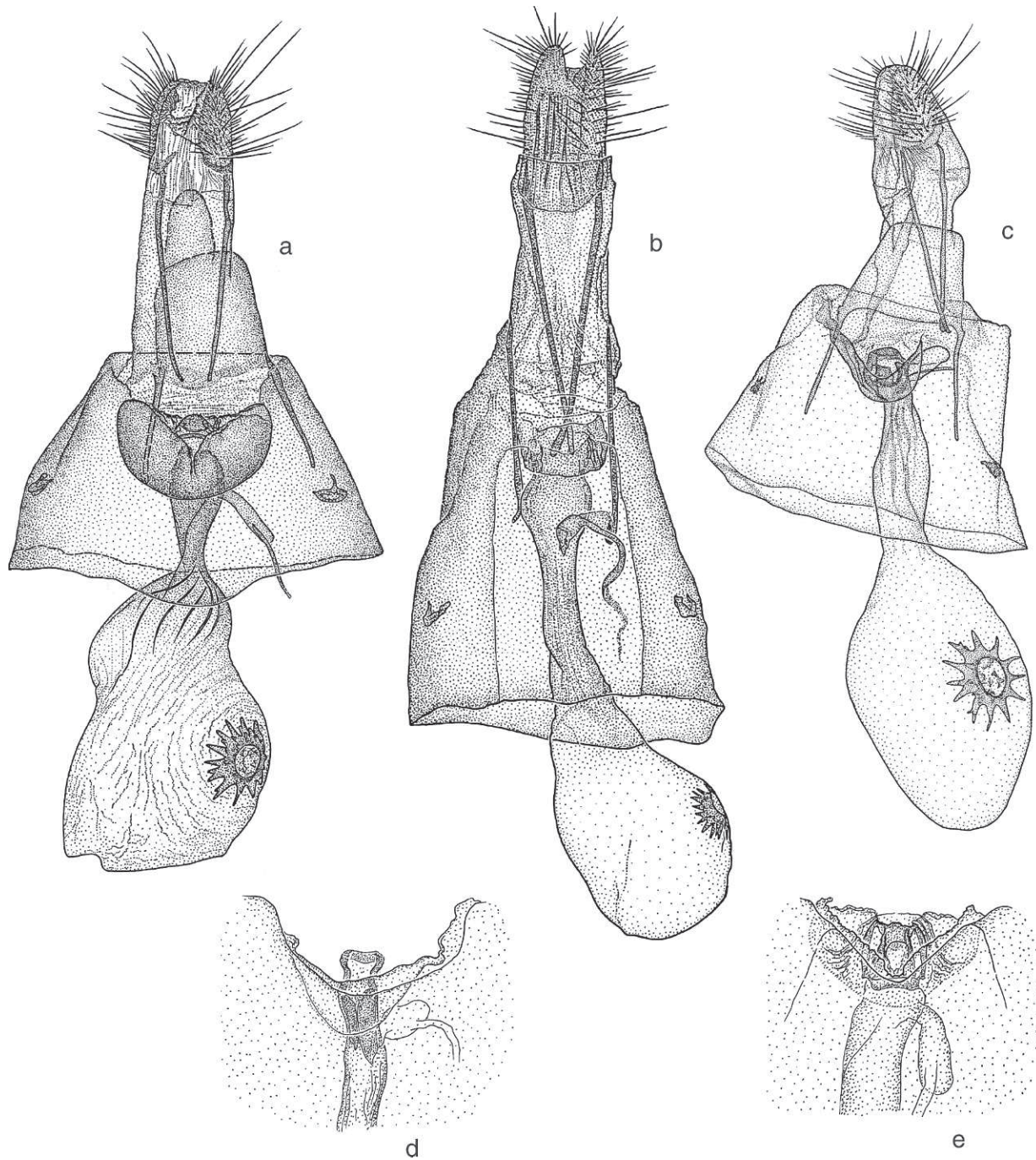


FIGURE 33: FEMALE GENITALIA OF *SPERANZA* SPECIES

a. S. graphidaria; Sinton, San Patricio County, Texas (USNM, 58237). *b. S. benigna*; Mohave County, Arizona (USNM 28244). *c. S. perornata*; Redington, Pima County, Arizona (USNM 58247). *d. S. schatzeata*, S8, ostium bursae and ductus bursae; Guadalupe Mountains, Culberson County, Texas (USNM 58032). *e. S. deceptrix*, S8, ostium bursae and ductus bursae; Chisos Mountains, Brewster County, Texas (USNM 58239).

←

capsule; Mohave County, Arizona (USNM 58243). *h. S. deceptrix*, genital capsule; Big Bend National Park, Brewster County, Texas (USNM 58240). *i. S. perornata*, genital capsule; Brown Canyon, Baboquivari Mountains, Pima County, Arizona (DCF 1595). *j. S. perornata*, aedeagus; Brown Canyon, Baboquivari Mountains, Pima County, Arizona (DCF 1595).

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ferent genitalia in both sexes; and 5) its occurrence only in Texas, whereas *deceptrix* occurs also in Arizona. See *Speranza deceptrix* for more detailed discussion of these and other differences.

Speranza graphidaria is distinguished from *S. schatzeata* by: 1) the much greater amount of white ground color showing on the forewing; 2) the more regular course of the postmedial line on the forewing as compared to the wavy postmedial line of *schatzeata*; 3) the light yellowish-brown hindwing as compared to the almost uniformly gray hindwing of *schatzeata*, which entirely lacks yellowish-brown tints; 4) the very bold, blackish subterminal band of the pale hindwing underside rather than the uniformly frosted gray, lightly marked underside of *schatzeata*; 5) the shorter male antennal branches; and 6) the very different genitalia in both sexes. See *Speranza schatzeata* for more detailed discussion of the differences.

Speranza graphidaria is a slightly larger and decidedly more boldly marked species than the others with which I compare it. Although males may have the median space somewhat more suffused with dark brown than do females, the sexual dimorphism is less than that of *deceptrix*. As is true of most species, including others of this group, winter and early spring specimens are larger than summer ones. Wing length: males, 10–13 mm; females, 11–13 mm.

Differences in the genitalia are discussed under *deceptrix* and *schatzeata*.

A mature larva from Cameron County, Texas (plate 11, figure 6), from which an adult was reared by D. L. Wagner, was moderately stout, brown above and light grayish mauve beneath, the two colors sharply separated by a distinct but incomplete whitish spiracular stripe. The usual set of fine, pale stripes present above and beneath but very faint, barely discernible. Spiracular stripe well developed, laterally on parietal lobe of head and on T1 and T2, fading out on T3 and again on A6, reappearing on A7 and A8 to anal proleg. Segmental series of small, irregular, black blotches, one per segment, in brown dorsal area at interface between dark dorsum and pale spiracular stripe; and a few corresponding dark spots, mostly weak and indistinct, in the pale purplish ventral area. Head brown, essentially concolorous with dorsum of thorax, except for lateral white extension of spiracular stripe. Thoracic legs brown; prolegs brown to purplish with black stripe down anterolateral side of A6 proleg. This larva was found on *Bumelia celastrina* H.B.K. La

Coma (Sapotaceae) in the Sabal Palm Audubon Refuge. Many adults were also reared from larvae on *Condalia hookeri* M. C. Johnst. (Rhamnaceae) near San Antonio, Texas by R. O. and C. A. Kendall, and voucher specimens were deposited in the USNM.

This species is known only from southern Texas, where specimens have been collected in at least 13 counties from Cameron and Hidalgo north to San Patricio, Bexar, Kimble, Kerr, and Uvalde, and farther west only in Brewster County (Big Bend National Park). It is characteristic of the thorn scrub (mesquite-acacia savanna) and mesquite-oak savanna toward the southern end of Texas, and it has been collected in every month of the year.

Speranza schatzeata (Cassino), NEW COMBINATION

PL. 3, FIGS. 42, 43 (adult); TEXT FIG. 32 *b*, *d* (♂ gen.); TEXT FIG. 33 *d* (♀ gen.) (RWH 6310, 6313).

Itame schatzeata Cassino, 1927, *The Lepidopterist*, 4: 70.

Type locality: Alpine [Jeff Davis County], Texas. [MCZ]

Itame schatzeata form *dimidiata* Cassino, 1927, *The Lepidopterist*, 4: 71.

Type locality: Alpine, Texas. [MCZ]

NOTE—No types were mentioned for *dimidiata* in the original description, although specimens were labeled as types. Two specimens labeled as paratypes are in the USNM, and the others should be in the MCZ. As Cassino mentioned, this name refers to the smaller specimens of the July brood. The name *schatzeata* is based on spring specimens (March–May). As it was clearly intended for an infrasubspecific form, the name has no standing in nomenclature.

Itame minata Cassino, 1928, *The Lepidopterist*, 5: 7. NEW SYNONYMY

Type locality: Davis Mountains, Texas. [MCZ]

NOTE—The holotype of *minata* is a worn male of *schatzeata*. The genitalia (Cassino slide 4516) confirm this determination.

This very distinct little species has a limited distribution only in West Texas and southeastern New Mexico, and although it may occur in adjacent Mexico, I have seen no specimens from there. It is uncommon in collections. The moths are distinguished by their overall gray aspect,

without any yellowish- or reddish-brown tints, and with black transverse lines and blackish irroration on the forewing; the presence on the forewing of a distinct medial line (usually); the markedly irregular or waved forewing postmedial; the frosted gray undersurfaces without strong markings; and the black-and-white alternately banded antenna. The last two features, however, would not distinguish *schatzeata* from the otherwise very different *S. benigna*.

Male antenna with long pectinations, the longest fully equal to combined length of three antennal segments (as in *graphidaria*, but longer than those of *deceptrix*, shorter than those of *benigna*); palpi shortest of the group, readily separating this species from *graphidaria* and *benigna*, but only slightly shorter than those of *deceptrix*. Sexes colored alike. Head, body, legs, and antenna clothed in mixture of black-and-white scales. Forewing with ground color white, heavily irrorated and striated with blackish or dark brown; three dark transverse lines or bands usually present—a roundly convex antemedial, a concave medial well basad of discal spot and bending basad before costa; and a decidedly waved or sinuous postmedial; some dusky shading basad of antemedial and distad of postmedial; terminal line thin, dark, interrupted; fringes black-and-white checkered; extramedial spot essentially absent. Hindwing dusky with only faint markings, but becoming whitish dusted with black toward inner margin, and with terminal line and fringes as on forewing. Underside of forewing gray, with mixture of white scales only toward apex and in fringe; of hindwing whitish, heavily irrorated with gray brown, with weak, dusky medial and postmedial lines and discal spot, and checkered fringe. Wing length: males, 8.5–12.0 mm; females, 10.0–11.0 mm. Moths largest March–April, smallest June–September. No other seasonal or geographic variation.

Male genitalia shaped quite like those of *deceptrix* but with several differences, as follows: saccular lobe of valve similarly pointed, but the elevated, flangelike rim incomplete, not forming continuous subapical bridge between outer (ventral) margin and interlobular process; interlobular process present as a discrete feature, not forming integral part of the elevated, flangelike, submarginal rim; tip of uncus rounded and blunt, not extended as a process as in *deceptrix*; toothlike process of gnathos short; aedeagus with no inclusions other than a single, small, dentate point, and

without the long, pinnate, connected string of cornuti of *deceptrix* and *graphidaria*; incision of eighth sternum deep and narrow, less than half as wide as aedeagus (as wide as aedeagus in *deceptrix* and *graphidaria*, and further widened at deepest extremity in *graphidaria*).

Female genitalia without the much enlarged, sclerotized ostial cavity or pouch of *deceptrix* and *graphidaria*, having only a shallow, membranous one.

The early stages and food plants of *schatzeata* are unknown.

I have seen *schatzeata* from Real, Pecos, Brewster, Jeff Davis, Presidio, and Culberson counties, Texas and from Eddy County (White City), New Mexico. All records are from west of the Pecos River except one from Rio Frio, Real County. Adults have been collected in every month from March to October with the exception of April.

Speranza benigna (Hulst), NEW COMBINATION

PL. 3, FIGS. 44, 45 (adult); TEXT FIG. 32 *e*, *g* (♂ gen.); TEXT FIG. 33 *b* (♀ gen.) (RWH 6309).

Diastictis benigna Hulst, 1898, *Can. Ent.*, **30**: 191.

Type locality: Los Angeles County, California. [USNM]

NOTE—Only one specimen was mentioned in the original description, and it is in the USNM. A specimen with a Hulst type label in the National Collection is therefore assumed to be the holotype. Hulst evidently thought that it was male, but it is a female, of which the genitalia were mounted on a slide in 1940 (JFGC No. 2929, now relabeled as USNM 58245).

This is another small southwestern species centered mainly in the Mohave Desert region. It is the only consistently dark colored member of the *graphidaria*-group, being without any conspicuous pale markings or reddish- or yellowish-brown tints. The color is predominantly dark sooty brown or charcoal, lightly and variably sprinkled with whitish scales on the forewing and near the inner margin of the hindwing. The head, body, and legs are also sooty brown frosted with pale gray or white. Most wing markings are obscured except the three main transverse lines of the forewing, which usually persist only as widened blackish lines or wedges where they meet the cos-

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ta. Complete, thin, dark antemedial and postmedial lines may be apparent or even distinct in some specimens, however. The dark discal spot of the forewing may be separate or merged with what remains of the medial line. Checkering of the fringes is apparent only in the palest specimens. The palpus is the longest in this group, with the end of the second segment clearly surpassing the frontal crest. The male antennal branches also are the longest, being as much as $3\frac{1}{2} \times$ the length of one antennal segment. The markings of *benigna* are so simple that this diagnostic description plus the keys and illustrations should serve all identification needs. Wing length: males, 9.5–12.0 mm; females, 8.0–11.0 mm.

The species shows little geographic variation except that Californian specimens tend to be more distinctly marked with transverse lines than do those from Arizona or Nevada.

The male genitalia are most similar to those of *schatzeata* in general form, although nearly every component differs in shape. The process of the uncus is somewhat extended and truncated, and of the gnathos wide and spoon shaped. The costal lobe of the valve is less bent, and the saccular lobe is wider and bluntly pointed or rounded apically, although the interlobular process and subventral raised rim of the saccular lobe are not very different in the two species. The saccus is unusual in being quite extended and constricted so as to appear almost knoblike rather than broadly and uniformly rounded as it more or less appears in *schatzeata*, *deceptrix*, and *graphidaria*. The aedeagus is without cornuti, but terminates distally in two elongate sclerites of equal length, one slender, slightly curved, and finely tapered to a sharp point, the other much thicker, more heavily sclerotized, and bearing a row of three or four short, sharp, dentate processes on its right side, which is continuous with the outer wall of the aedeagus. The incision of the eighth sternum is unusually shallow and V-shaped, its depth being equal to only one-eighth the length of the sternum. By comparison, that of *schatzeata* is equal to almost one-third the length of the eighth sternum.

The female genitalia have an elongated ovipositor and what appears to be an elongated, sclerotized ductus bursae that is swollen toward the middle. This structure is unique in having its surface densely and minutely denticulate. There is no or but slight indication of an ostial cavity,

pouch or deep sclerotized depression such as distinguishes *deceptrix* and *graphidaria*. The signum is characteristic of the group in having a rather small central core and many long, radiating points, some of them bifurcate.

The species has a limited distribution in southern California (San Bernardino, Riverside, Kern, Inyo, and Ventura counties), southern Nevada (Clark County and near Caliente, Lincoln County), and western Arizona (Mohave and Maricopa counties). I saw no specimens from Los Angeles County, although that was given as the type locality. Most Californian specimens examined are from San Bernardino County, where it was collected in many widely separated localities. The most from one place are the 62 specimens in the USNM from the Hualapai Mountains, Mohave County, Arizona. This is a species of arid regions in and adjoining the Mohave Desert, and it often occurs where creosote bush, *Larrea tridentata* (Sesse and Mocino ex DC.) (Zygophyllaceae) forms a dominant part of the vegetation. The food plant is unknown.

The collection dates are in May, June, and July. Some from the Barnes collection in the USNM are labeled August and September (Mohave County), which may be correct, but the dates on many specimens in the Barnes collection are unreliable.

Speranza perornata (Barnes and McDunnough), NEW COMBINATION
PL. 3, FIG. 46 (adult); TEXT FIG. 32 *i, j* (♂ gen.); TEXT FIG. 33 *c* (♀ gen.) (RWH 6300).

Itame perornata Barnes and McDunnough, 1916, *Contrib. Nat. Hist. Lep. N. Am.*, **3**: 26, pl. 2, fig. 16.

Type locality: Redington, Arizona. [USNM]

This is a curious little species known to me only from the male holotype and nine other specimens from southern Arizona, equally divided between two very different color forms. The forewing of the type is a light, very slightly violaceous gray brown, becoming darker and with a faint reddish-brown tint outwardly between the postmedial line and the outer margin; but the others, if indeed they are the same species, are light orange brown or orange ochreous. I cannot account for the difference in color and had not expected the gray-brown and ochreous specimens to belong to the same species. However, they have identical markings and genitalia. There can be no certainty that

the two forms are conspecific until more material is studied, but this treatment assumes that they are.

The ochreous or buff-colored specimens have the appearance of being discolored or bleached, as though left in a cyanide jar for much too long a time, although the coloring is so uniform as to appear natural. Also, the five specimens are from two or more collectors at different times and places, reducing the likelihood that they were similarly mishandled. I have seen no other specimens of any species of *Speranza* that were bleached or discolored in this way.

Speranza perornata has the outer margin of the forewing more concave between the apex and the end of M_2 than any other member of the group. The thin, delicate, sharply defined transverse lines are clear only near the costa of the forewing and are black in the gray specimen, rust colored to dark brown in the ochreous ones. A distinctive feature of *perornata* is that the medial line of the forewing is inclined outwardly from the costa in the direction of the outer margin more acutely than are either of the other lines (nearly parallel to inner margin of forewing between costa and fork of R_5 in most specimens, less acute in the others). The undersurfaces are gray brown, dusted with darker scales in the holotype, entirely bright yellow ochreous in the others. The palpus is of medium length, with the end of the second segment about even with the front, and the male antennal branches are short, the longest about equal to the combined length of one and one-half to two antennal segments. The scales of the head, body, and legs are mixed light and dark grayish brown in the holotype, light and dark ochreous in the other specimens. Wing length: holotype male, 11.0 mm; other males, 10.0–11.0 mm ($n = 5$); females, 9.5–11.0 mm ($n = 4$).

Male genitalia (text figure 32 *i, j*) most like those of *schatzeata* but with valvula twice as large; uncus more stout, about as wide as long and apically produced to form a short, knoblike tip; saccus wider than that of *schatzeata*, although not more produced; vesica with long, slender bundle of fine cornuti as in *deceptrix*, *graphidaria*, and *schatzeata*. Incision of eighth sternum distinctive in being wide, deep, and U-shaped, actually no deeper than that of *schatzeata*, but differing in having the sclerotized apices produced well beyond the posterior margin of the segment.

Female genitalia (text figure 33 *c*) also most comparable to those of *schatzeata*, with same sort

of ostium and wide, shallow, membranous ostial pouch, but with a very different ductus bursae, which, instead of being long and partly twisted or at least flexible, is relatively stout, nearly straight, and rigidly sclerotized for its full length.

The gray-brown holotype and an ochreous female in the USNM are labeled simply Redington, Ariz., without collection dates (Barnes collection). An ochreous male and female [LACM and AMNH] are labeled Brown's Canyon, Baboquivari Mountains, Pima County, Arizona, 5 and 6 September 1953, Lloyd M. Martin. Also in the AMNH are three gray males and one female, of which two are labeled Miami, Arizona, 25 March 1947 (L. H. Bridwell), and Redington; and an ochreous male and female labeled "Ariz." Little can be said about the flight period except that it flies in March and September.

The early stages are unknown.

Like *Speranza trilinearia*, *S. perornata* seems not to have been collected recently, those from 1947 and 1953 being the most recent seen. The others are all early 20th century specimens. Unlike *trilinearia*, it may never have occurred commonly since its discovery.

The *pallipennata*-GROUP

This is an unusual group of five mostly small, pale species of southern and western Texas, Arizona, and Mexico. Four of them occur in the United States. The outer wing margins are rounded, and the wings have a white, pale gray, or pale yellowish ground color and definitive gray to gray-brown markings, except that one species is almost without markings. Perhaps the most important anatomical difference is that the signum of the female genitalia is lost or greatly reduced. In all other members of the genus it is well developed and usually large.

The markings consist mainly of subparallel antemedial and postmedial bands on the forewing that are perpendicular to the inner margin, and of which one or both, but especially the antemedial, may be obsolescent. The postmedial band of the forewing, when well developed, is wide and outwardly diffuse, inwardly better defined and waved. The markings are so well developed in *pallipennata* as to make it appear ornate, but the new species that I describe is hardly marked at all. The extramedial spot is wanting in this group, but the forewing may have a short row of small, separate or confluent, subterminal black dots near

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the costa (*grossbecki*, *specifica*, *saphenata*). The subterminal dots are merged into one dark subapical costal spot in *pallipennata* and *simpliciata*. The outer wing margins are regular and rounded, the forewing apex and tornus often more rounded than usual, and the forewing slightly narrower and more elongated than is often the case in this genus. The branches of the bipectinate male antennae average longer than those of the *graphidaria*-group, the longest being equal to the length of three antennal segments. All species are alike in visible external features, except that *pallipennata* has slightly longer male antennal branches than do the others.

The male genitalia appear similar to those of most species of the *graphidaria*-group, but the interlobular process tends to be more exaggerated, being drawn out and compressed to a blade-like or chisel-like distal edge in all except *pallipennata*; the saccus is much abbreviated in some species but not all; and the inclusion apparent within the aedeagus is elongate-ovate and distally rounded or obtusely and bluntly pointed, altogether different from the long string of small cornuti in most members of the *graphidaria*-group.

The female genitalia are divergent in having the signum vestigial or lost, but only in *pallipennata* is it missing entirely. The bursa copulatrix of this species is further aberrant and unique among all Macariini examined in being much elongated, slender, and so delicately membranous as to be almost impossible to dissect, inflate, and mount satisfactorily. Indeed, the female genitalia of *pallipennata* proved to be about the most difficult of any geometrid that I ever dissected, judging from my preparations of four specimens from different sources. Other species of the *pallipennata*-group did not present this problem.

Four species belonging to this group occur in the United States and another is in Mexico. Two species were described from Mexico, namely *Cymatophora specifica* Dyar, 1916, *Proc. U. S. Natl. Mus.*, **51**: 24, from Tehuacán [Puebla]; and *Cymatophora evelis* Dyar, 1919, *Insec. Insc. Mens.*, **7**: 83, from Pachuca [Hidalgo] (holotypes in USNM). However, the two names evidently refer to one species [thus, *Cymatophora evelis* Dyar is a junior synonym of *Speranza specifica* Dyar, NEW SYNONYMY, NEW COMBINATION], whose genitalia are very close to those of *Speranza saphenata*. The early stages remain unknown for all species of the *pallipennata*-group.

KEY TO SPECIES OF THE *PALLIPENNATA*-GROUP

1. 1. Ground color of forewing and fringe pure white; wing usually well marked with gray or blackish bands; forewing discal spot ringlike with a pale filling or absent; Texas to Arizona 2
- Ground color of forewing pale yellowish or gray; if nearly white, then wing almost unmarked or fringe pale yellow or gray, not white; forewing discal spot small, dark, without pale filling; Texas, Mexico 3
2. Forewing with fringe checkered or spotted with dark gray, antemedial band clearly present, and discal spot ringlike with a pale filling; hindwing with postmedial band *pallipennata* p. 161
- Forewing with fringe unmarked, antemedial band obsolescent, and discal spot absent; hindwing with postmedial band essentially absent *simpliciata* p. 159
3. Forewing pale gray, whitish, or pale yellowish, with weak, thin, transverse bands or none; pale, poorly marked, nondescript moths: West Texas only *saphenata* p. 157
- Forewing gray with wide, dark, gray-brown postmedial band, the proximal edge of which is well defined, and the distal edge diffuse; relatively well-marked moths; southern Texas, Mexico 4
4. Forewing postmedial band with proximal margin slightly irregular or diffuse, not with sharply defined blackish edge from inner margin to costa; black subterminal dots toward costa small, separate or contiguous; southernmost Texas ... *grossbecki* p. 156
- Forewing postmedial band with a thin, sharply defined, blackish proximal edge from inner margin to costa; black subterminal dots larger, confluent, forming prominent black subapical spot; Mexico *specifica**

Speranza grossbecki (Barnes and McDunnough), NEW COMBINATION
PL. 3, FIGS. 47–49 (adult); TEXT FIG. 34 a (♂ gen.) (RWH 6315).

Diastictis grossbecki Barnes and McDunnough, 1913, *Contrib. Nat. Hist. Lep. N. Am.*, **2**: 128, pl. 7, figs. 10, 12.

Type locality: Brownsville, Texas. [USNM]
NOTE—Described from 10 males and nine females from Brownsville and San Benito [Cameron County], Texas. I designate as lectotype the specimen

originally labeled "Type ♂" and illustrated by Barnes and McDunnough (1913: pl. 7, fig. 10).

This is a faintly violaceous, light gray species with a wide, dark brown, postmedial band on the forewing and usually two to four blackish subterminal dots in a row toward the costa. *Speranza saphenata* may also have these dots, but it is otherwise an almost unmarked, pale yellowish moth limited to West Texas and southern New Mexico. *Speranza grossbecki* is known only from Cameron County, Texas, and although described from 19 specimens, few have since been collected.

Forewing light gray with wide, somewhat diffuse, postmedial band and black dots as mentioned in the diagnosis above, although both features are variable and may be reduced; also present is a diffuse, brown, antemedial band, almost parallel to postmedial band, and a brown discal spot in the otherwise clear median space. Hindwing slightly paler, bisected by a slightly concave, brown postmedial band just beyond middle; fringes concolorous with both wings, unmarked. Underside of forewing dusky, becoming yellowish and sprinkled with gray brown toward apex or apex and outer margin; of hindwing entirely yellowish and uniformly dusted with gray-brown scales; well defined, regular, gray-brown postmedial bands on both wings, and discal spot of same color on hindwing. Wing length: males, 10.0–11.5 mm (n = 8); females, 11.5–12.0 mm (n = 6).

Male genitalia about average for the group. Interlobular process (valvula) much longer and wider than that of *pallipennata* but not as long as that of *saphenata*, similar to that of *simpliciata*. Saccus much reduced, as in *pallipennata*. Like others of the group, however, *grossbecki* differs from *pallipennata* in its shorter, less produced saccular lobe and much shorter terminal process on the gnathos.

The female genitalia have the largest signum of the closely related species examined (female of *simpliciata* not available), but still it is only slightly larger in diameter than the spiracle of the seventh abdominal segment. That of *saphenata* is slightly smaller than the spiracle, and that of *pallipennata* is missing altogether.

The early stages are unknown.

Speranza grossbecki is known mainly from the type series collected at Brownsville and San Benito, Texas by George Dorner sometime prior to 1913. I have seen only two other specimens, a

male from Brownsville, 5 November 1928 (AMNH), and another collected in the Santa Ana National Wildlife Refuge, Hidalgo County, 20 October 1970 (Blanchard Coll., USNM). The type series is labeled with approximate dates in February, March, and April (e.g., March 16–23) but not the year; only one bears a specific handwritten date (II-22) [February 1922]. This species has either been overlooked by more recent collectors or has become rare and possibly endangered, as have other moths in the Lower Rio Grande Valley.

Speranza saphenata Ferguson, NEW SPECIES

PL. 3, FIGS. 50–52 (adult); TEXT FIG. 34 *d*, *f* (♂ gen.); TEXT FIG. 35 *a* (♀ gen.).

Speranza saphenata Ferguson.

Type locality: Government Spring, Big Bend National Park [Brewster County], Texas. [USNM]

This pale, nondescript, cream-colored to grayish species was first collected in Eddy County, New Mexico in 1964 by F. H. Rindge and at Big Bend in 1965 by A. Blanchard. Both considered it to be new. I subsequently confirmed this and found the species to be most closely related to the Mexican *S. specifica* (Dyar), although of different appearance, lacking the gray coloring and bolder markings of *specifica*. *Speranza saphenata* might be confused with *Taeniogramma mendicata*, especially worn specimens, but the male antennae of *saphenata* are bipectinate, whereas those of *mendicata* are heavily setose only. The new species is widespread in West Texas and southern New Mexico.

Ground color of forewing pale whitish gray, of hindwing cream. Forewing finely irrorated (dusted) with light yellowish to grayish brown, color not strongly contrasting with ground color; pattern varying from none to an almost full complement of markings that are, however, indicated only delicately or diffusely in shades of light gray brown, with little contrast. Forewing markings may consist of nearly parallel antemedial and postmedial bands, a small discal spot, and one to three small, dark dots arranged in a subterminal row near costa. Postmedial band may be followed distally by a wider shade in light brown or gray brown. Hindwing may have a weak, diffuse, postmedial line and faint discal spot. Fringes of both wings pale yellowish, unmarked. Underside of

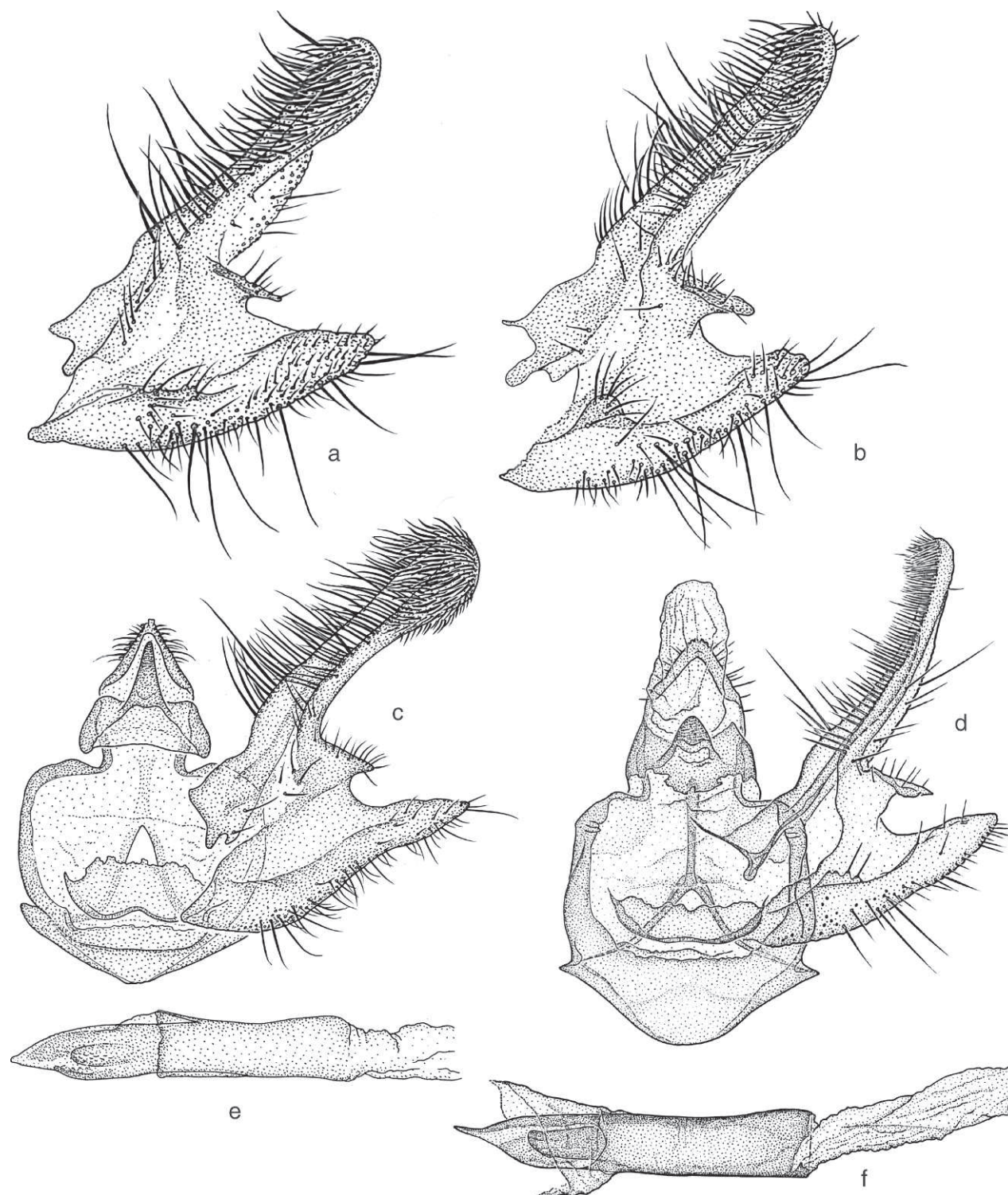


FIGURE 34: MALE GENITALIA OF *SPERANZA* SPECIES

a. S. grossbecki, right valva; Brownsville, Cameron County, Texas (USNM 53386). *b. S. simplicata*, right valva; Redington, Pima County, Arizona (USNM 53385). *c. S. pallipennata*, genital capsule; Big Bend National Park, Brewster County, Texas (USNM 57579). *d. S. saphenata*, genital capsule; Texas (USNM 58856). *e. S. pallipennata*, aedeagus; Big Bend National Park, Brewster County, Texas (USNM 57579). *f. S. saphenata*, aedeagus; Texas (USNM 58856).

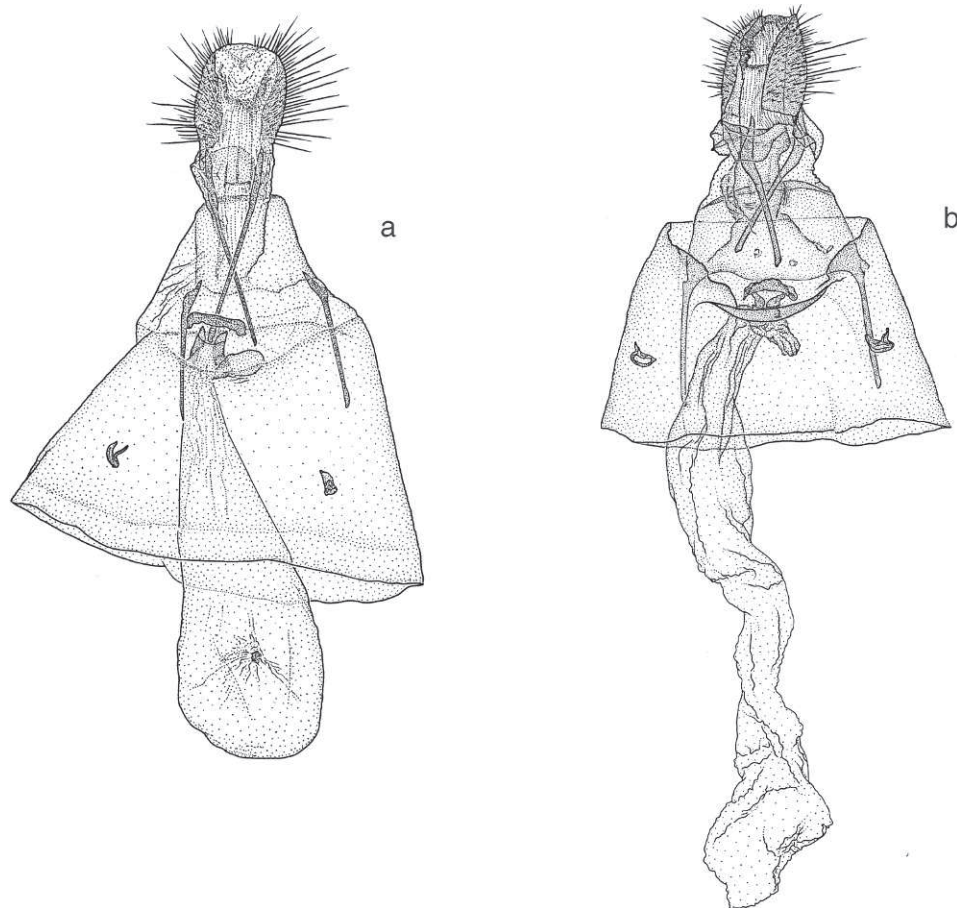


FIGURE 35: FEMALE GENITALIA OF *SPERANZA* SPECIES
a. S. saphenata; Big Bend National Park, Brewster County, Texas (USNM 58250). *b. S. pallipennata*; Big Bend National Park, Brewster County, Texas (USNM 58252).

forewing pale gray, becoming yellowish irrorated with gray brown toward costa and apex, of hindwing all pale yellow, irrorated with gray brown; both wings beneath with regular, gray-brown postmedial line, that of hindwing curved subparallel to outer margin. Head, body, and scales of antennae concolorous with ground color of wings. Structure of appendages as in *grossbecki*, *specifica*, and *simpliciata*. Wing length: holotype, 12.0 mm; other males, 9.0–12.5 mm; females, 11.0–13.0 mm.

Male genitalia almost indistinguishable from those of *specifica*, except that terminal process of gnathos is wider, almost spatulate (more conical in *specifica*, but only one specimen examined). As in most other species of the group, the interlobular process is flattened, sharp, and chisel-like toward its distal end, but this structure is more prominent than usual because it extends farther

out from the valve and has its flattened part curved or curled in the direction of the saccular lobe.

Female genitalia similar to those of *grossbecki* but with an even more reduced signum, which is smaller than the spiracle of the seventh segment.

The early stages are unknown.

TYPES. Holotype ♂. Government Spring, Big Bend National Park, Brewster County, Texas; 12 October 1969; A. and M. E. Blanchard. USNM. Paratypes: 52 ♂, 6 ♀. Texas. Same locality and collectors; 29 September 1965, 10 May 1972 (12 ♂, 3 ♀). Same locality; 12 September 1982; E. C. Knudson (1 ♂). Oak Spring, Big Bend National Park, Brewster County; 8 May 1972; A. and M. E. Blanchard (2 ♂, 1 ♀). Dugout Wells, Big Bend National Park, Brewster County; 4 June 1973, 12 May 1966; same collectors (2 ♂). Basin, Big Bend National Park, Brewster County; 29 June 1965; same collectors (1 ♂); Panther Pass, Chisos Mts., [Big Bend National Park], Brewster

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County; 2 June 1973; D. C. Ferguson (1 ♂). K-Bar Ranch, Chisos Mts., [Big Bend National Park], Brewster County; 16 September 1971, 4 May 1972; A. & M. E. Blanchard (2 ♂). Same locality; 1 June 1973; D. C. Ferguson (1 ♂). Green Gulch, Big Bend National Park, Brewster County; 11 September 1966; A. & M. E. Blanchard (1 ♂). Same locality; 29 May 1981; E. C. Knudson (1 ♂). Hot Springs, Big Bend National Park, Brewster County; 4 April 1984; E. C. Knudson (1 ♂). Park Headquarters, Big Bend National Park, 3,700', Brewster County; 6 August 1974; R. H. Leuschner (1 ♂). Sierra Diablo Wildlife Management Area, 6,000', [20 mi NNW Van Horn], Culberson County; 31 March 1970, 27, 28 May 1973, 1 September 1970; A. and M. E. Blanchard (6 ♂). Same locality; 27, 29, 30 May 1973; D. C. Ferguson (12 ♂). Nickel Creek, 5,000', Guadalupe Mts., Culberson County; 22 May 1973; A. and M. E. Blanchard (1 ♂). Bear Canyon, 5,700', Guadalupe Mts., Culberson County; 4 September 1969; same collectors (1 ♂). Cherry Canyon, 5,096', Guadalupe Mts., Culberson County; 24 May 1973; D. C. Ferguson (3 ♂). McKittrick Canyon, 5,000', Guadalupe Mts., Culberson County; 23 May 1973; D. C. Ferguson (2 ♂). Smith Canyon, 5,750', Guadalupe Mts., Culberson County; 22 May 1973; D. C. Ferguson (1 ♀). Tom Mays Park, El Paso County; 24 May 1981; E. C. Knudson (1 ♀). New Mexico. White's City, Eddy County; 27 March 1993; D. C. Ferguson (2 ♂). AMNH, ECK, RHL, USNM.

I saw but did not label as paratypes a large series from Sitting Bull Falls, 42 mi SW of Carlsbad, Eddy County, New Mexico, 4,800', 26–29 June 1964, F. P., and M. Rindge (55 specimens) (AMNH), as well as others from West Texas. The localities mentioned represent the entire known distribution of *Speranza saphenata*. The species has been collected in every month from March to October with the exception of July.

Speranza simplicciata (Barnes and McDunnough), NEW COMBINATION
PL. 3, FIGS. 53–55 (adult); TEXT FIG. 34 b (♂ gen.) (RWH 6316).

Itame simplicciata Barnes and McDunnough, 1918, *Contrib. Nat. Hist. Lep. N. Am.*, 4(2): 150, pl. 21, fig. 15.

Type locality: Paradise, Arizona. [USNM]

NOTE—Described from two males. I hereby designate as lectotype the specimen labeled by Barnes and McDunnough as the “Type ♂” and illustrated by them.

Although the white and gray coloring of this species might lead to confusion with *Speranza pallipennata*, many subtle differences distinguish

them. *Speranza simplicciata* is more plainly marked, lacks discal spots and checkered fringes, has nearly lost the antemedial band and the whitish subterminal band of the forewing as well as the postmedial of the hindwing, and has the dark subapical costal spot of the forewing reduced in intensity. It is rare in collections and is known only from a few specimens from southeastern Arizona, southeastern New Mexico, and West Texas.

Forewing white to light gray, with antemedial band obsolescent or lost, postmedial band with its course nearly straight but shallowly waved, and diffusely shaded with variable amounts of dark to light gray brown on outer (distal) side; also, postmedial band with two shallow curves, their convex sides facing basad, one before and one after M_3 and sometimes split into anterior and posterior segments by a gap at M_3 . The dark shading distad of postmedial is the most conspicuous feature of the pattern, and it may vary from negligible to almost fully occupying the space between the postmedial and the otherwise unapparent subterminal band. A weak, grayish subapical spot or bar lies immediately basad of the position of the subterminal line at the costa. Discal spots absent, and whitish fringes unchecked on both wings. Hindwing pale gray or brownish, variably infuscated and sometimes quite dark (as in holotype), unmarked or nearly so. Underside of forewing gray, of hindwing nearly white but dusted with gray, unmarked. Wing length: males, 11–13 mm; females, 12 mm.

The male genitalia are similar to those of *grossbecki* and *saphenata* but with a rounded, well-formed basoventral papilla on the saccular lobe of each valve, and a somewhat better developed interlobular process. The saccus is much better developed than that of *grossbecki*, but the apex of the gnathos, like that of *grossbecki*, is pointed and conical in outline, not wide as in *saphenata*. However, the male genitalia are much more like those of *grossbecki* and *saphenata* than like those of *pallipennata*, except that, as in the last species, the wide, longitudinal, membranous fold of the costal lobe is much reduced.

The female genitalia are not available for comparison at the time of writing.

The early stages and hosts of *Speranza simplicciata* are unknown.

I have seen this species only from the Chiricahua Mountains, Portal, and Bisbee, Cochise County, and Redington, Pima County (types), Ar-

izona, from Eddy and Lincoln counties, New Mexico, and from the Davis Mountains, Jeff Davis County, and the Sierra Diablo, Culberson County, Texas, from elevations up to 6,000'. Specimens were collected in every month from March to August, with the earliest (March 31) from the Sierra Diablo, and the latest (August 29) from the Chiricahua mountains and Bisbee, Cochise County. The largest collections examined were a series of 48 from the Chiricahua Mountains (J. G. Franclemont—CU) and a similar series from southeastern New Mexico (F. H. Rindge—AMNH).

Speranza pallipennata (Barnes and McDunnough), NEW COMBINATION

PL. 3, FIGS. 56–59 (adult); TEXT FIG. 34 *c*, *e* (♂ gen.); TEXT FIG. 35 *b* (♀ gen.) (RWH 6317).

Diastictis pallipennata Barnes and McDunnough, 1912, *Can. Ent.*, **44**: 126.

Type locality: Redington, Arizona. [USNM]

NOTE—Described from one male and four females, all but one female of which are in the USNM. I designate as lectotype the specimen labeled "Type ♀," because it is in better condition than the "Type ♂." Also, this female was illustrated (as *Diastictis pallipennis*, a misspelling) the same year that the original description was published, although in a different publication (Barnes and McDunnough, 1912, pl. 20, fig. 43).

Speranza pallipennata is the most often collected member of this group, and the only one that could be described as ornate because of its full complement of sinuous, boldly contrasting, transverse bands, checkered fringes, and small, ringlike forewing discal spot with a pale filling. The discal spot varies from distinct to obsolescent, but is readily discernible in most specimens. None of the closely related species has checkered fringes or a pale filled discal spot.

Inasmuch as I referred to the particular features of this species in the preceding three descriptions and in the key, a full description here would seem redundant. Wing length: males, 10.0–12.0 mm; females, 12.0–13.5 mm.

No geographic variation is apparent, but considerable individual variation occurs in the degree of gray versus white in the background color of both wings. In most specimens the ground color is conspicuously white, but infuscation of the white areas does occur, and rare individuals, as

one from Portal, Arizona have an almost melanic appearance.

The male genitalia are immediately recognizable among species of this group by the following differences: the greater elongation of the pointed apex of the saccular lobe of the valve and its attenuated shape, with a concave ventral margin; the reduced and subconical interlobular process as compared to the more protuberant, bladellike or chisellike shape seen in related species; the unusually long and slender apical process on the gnathos; and the distally flared costal lobe of the valve, which is thus considerably wider toward its apical end.

The female genitalia are peculiar in having an exceedingly elongated, membranous, delicate bursa copulatrix without a signum, so delicate that it can hardly be seen. It is slender and tubular in form, extending nearly the full length of the abdomen and containing a straight, almost equally long spermatophore that is difficult to remove without badly distorting and tearing the bursa copulatrix. I have not dissected the lectotype and would recommend that no one do so without practising on several other females of this species beforehand. Otherwise, destruction of the genitalia would be the likely outcome.

The early stages are unknown.

I have seen *pallipennata* from various localities in Brewster, Jeff Davis, and Culberson counties, Texas; Lincoln and Eddy counties, New Mexico; several localities in Cochise County, and from Oracle, Pinal County, Redington, Pima County, and Madera Canyon, Santa Cruz County, Arizona. They were collected at 3,400–5,300 feet, mostly in the Chisos Mountains (Big Bend National Park) and Davis Mountains, Texas; in the Guadalupe Mountains in both Texas and New Mexico; and in the Chiricahua Mountains, Arizona. It is obviously present in other ranges in southern Arizona, including the Huachuca mountains, although rarely collected. The recorded flight period is 2 April–23 September, with collection dates for every month within that time span.

GENUS

Epelis Hulst

Epelis Hulst, 1896, *Trans. American Ent. Soc.*, **23**: 322, 324.

Type species: *Fidonia truncataria* Walker, 1862, *List of the Specimens of lepidopterous*

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Insects in the Collection of the British Museum, **24**: 1,034. Original designation.

Epelis is a North American genus of a single day-flying species, which occurs almost coast to coast in northern peat bogs and western subalpine meadows. The genus is very closely related to *Speranza*, but I agree with McGuffin (1972: 15) that it should be kept separate because of two important differences. *Epelis truncataria* overwinters as a pupa, unlike species of *Speranza*, which overwinter in the egg stage; and the mature larva has the crochets on each proleg in two groups. All North American Macariini whose larvae are known, except *Heliomata* and *Fernaldella*, have the crochets in one group. Another feature in which *Epelis* differs from other Macariini, I believe also first noticed by McGuffin (1972: 13, key to pupae), is that the maxillae of the pupa extend posteriorly as far as the tips of the antennae. The adults have the brighter coloring and reduced eyes characteristic of diurnal moths. The antennae are bipectinate; the gena is unscaled; and the palpi are porrect and quite long, exceeding the front for nearly half their length. In the genitalia, the males have a normal valvula, and the females have a large stellate signum, in both cases resembling those of *Speranza* species.

In much of the earlier literature, *truncataria* was referred to the genus *Isturgia* Hübner [1823], but in the last check list (1983: 89) I restored the genus *Epelis* to accommodate it. The type species of *Isturgia* is a very different taxon, not at all congeneric with *Epelis truncataria*. In recent works *truncataria* has been included in *Macaria* (Scoble et al., 1999; Scoble and Krüger, 2002).

The European “*Macaria*” *carbonaria* (Clerck, 1759) is clearly related to *Epelis truncataria*, having much the same wing pattern but in black and white; a somewhat similar uncus; a valvula; a two-pronged aedeagus; and an incised eighth sternum, although with the incision much more shallow than that of *Epelis*. However, the tegumen of *carbonaria* is differently formed, and the valve is smaller and more simple. The food plant and habitat (heaths and moors) are similar to those of *truncataria*, and the pupa also overwinters. The generic name *Pseudoisturgia* Povolný and Moucha, 1957, was proposed for *carbonaria*, but European lepidopterists could transfer *carbonaria* to the much older genus *Epelis*, should it be thought appropriate. The character of the crochets in *Epelis*—their division into two

groups—is shared with the Palearctic *Narraga* (*fasciolaria*) and Nearctic *Heliomata*, *Fernaldella* (*georgiana*), *Protitame*, and *Taeniogramma* (*tenebrosata*) and presumably with all species of those genera; but I do not consider *Epelis* to be closely related to them. *Isturgia* has normal crochets arranged in one group and fully separated chaetosemata. Larvae of *Pseudoisturgia carbonaria* were not available for examination. The condition of the crochets may depend more on habitat adaptation than on phylogeny.

Epelis truncataria (Walker)

PL. 3, FIGS. 60–64 (adult); PL. 11, FIG. 7 (larva); TEXT FIG. 2 c (venation); TEXT FIG. 36 a, c (♂ gen.); TEXT FIG. 36 b (♀ gen.) (RWH 6321).

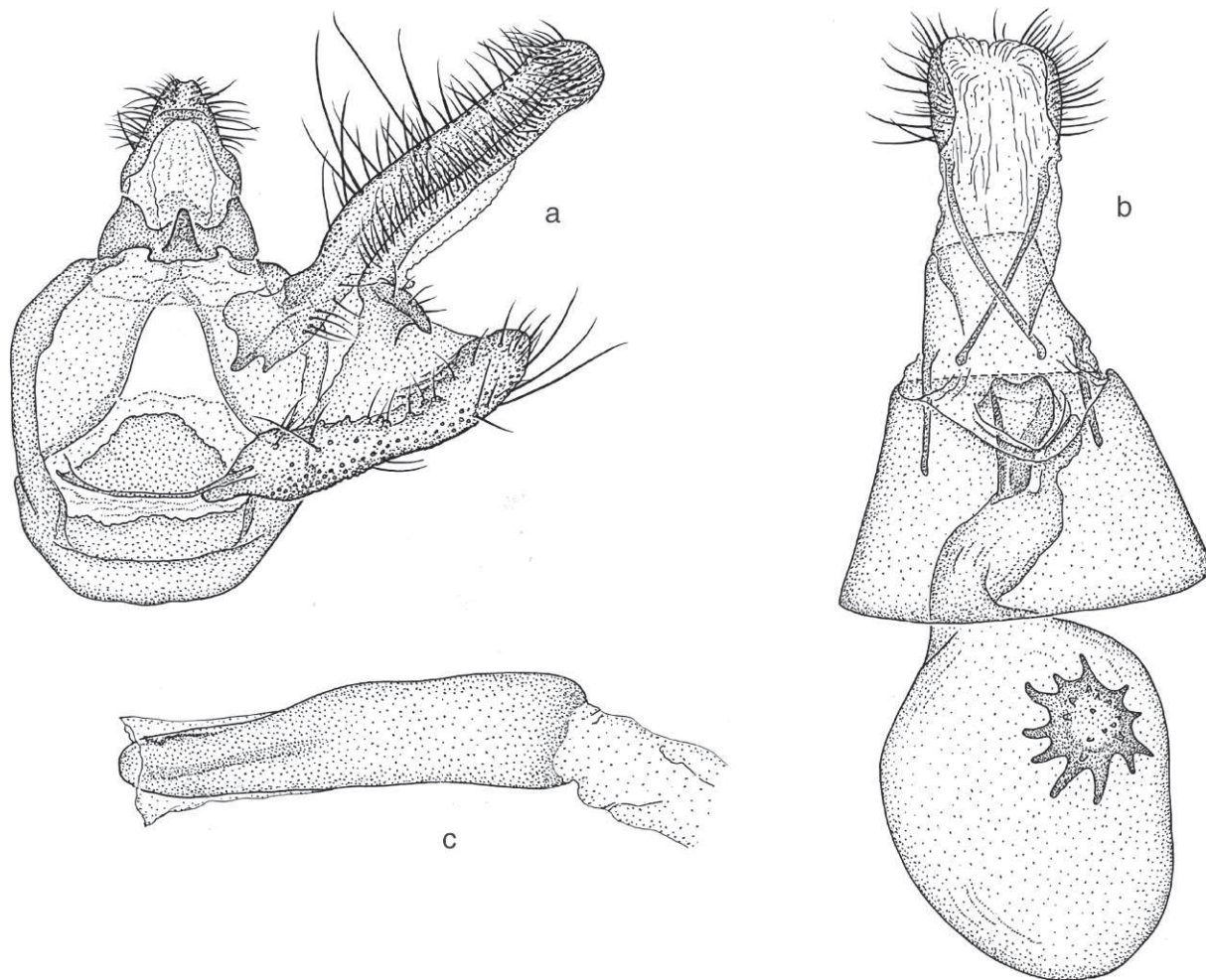
Fidonia truncataria Walker, 1862, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **24**: 1,034. [BMNH]

Type locality: St. Martin's Falls, Albany River, Hudson's Bay [Ontario].

NOTE—Described from three specimens. No lectotype has been designated.

The generic discussion touched upon the most important descriptive details except color and size. Ground color of wings varies from white to orange yellow, with hindwings somewhat brighter, but specimens in which white predominates over yellow (plate 3, figure 63) are relatively uncommon. Forewing with four transverse, dark brown bands, these being an antemedial, medial, postmedial, and submarginal, of which the postmedial and submarginal have a white distal border; antemedial may have a less distinct, whitish, proximal border; ground color showing between and beyond blackish bands is a mixture of white and orange yellow, or all orange yellow, variably and sometimes heavily dusted with dark brown.

Hindwing similar but with only three dark brown transverse lines, curved subparallel to outer margin, and with more of the orange-yellow color showing between and beyond them. Middle and outer bands with or without a white distal border. Fringes dark gray brown, often faintly checkered with yellow. Faint, dark discal spot on forewing. Undersurfaces paler, brighter, dominated by a rusty-orange shade, with transverse bands brown to reddish brown. Body dark gray brown with a few light yellowish scales dorsally, the abdomen becoming yellowish brown posteriorly

FIGURE 36: GENITALIA OF *EPILIS TRUNCATARIA*

a. Male genital capsule; Armdale, Halifax County, Nova Scotia (USNM 57578). b. Female; Halifax watershed area, Nova Scotia (USNM 58890). c. Aedeagus; Armdale, Halifax County, Nova Scotia (USNM 57578).

and beneath. Shaft of antenna in both sexes boldly marked with alternating white and blackish segments. Front, palpi, and legs yellowish, variably sprinkled with groups of dark brown scales. Wing length: males, 9–12 mm; females, 9–12 mm.

Some western specimens, especially from Colorado, are above average in size and tend to show more of the orange coloring. However, other western specimens from higher elevations in Colorado, Idaho, and elsewhere are as small as eastern specimens and may be darker, with wide blackish bands.

The genitalia of both sexes (text figure 36 a–c) are essentially similar to those of *Speranza* species and as illustrated.

The illustrated larvae of *Epelis truncataria* from Massachusetts (plate 11, figure 7; Wagner

et al., 2001: 37) were quite slender, purplish gray above and paler grayish to pinkish beneath, with the contrasting areas of color separated by a thin but distinct, white lateral stripe. Darker dorsal area marked with usual set of very thin, interrupted, pale longitudinal lines. Underside paler because of many wider white stripes, grayish to pinkish between. Lateral stripe runs from parietal lobe of head to outer side of anal proleg. Setae brown to black, often whitish tipped. Head brown; thoracic legs pinkish brown; prolegs light purplish gray. These larvae were reared on leatherleaf, *Chamaedaphne calyculata* (Linnaeus) Moench (Ericaceae), a common low shrub of sphagnum bogs northward.

The above may be just one form of a polymorphic larva, because it has been described somewhat differently by several authors.

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Dyar (1902) described the egg and first four instars of the larva "from a female taken on the summit of the foothills back of Golden, Colorado (Chimney Gulch)." In the fourth instar the head, body, and legs were green, with short, black setae; the longitudinal lines consisted of an addorsal, subdorsal, lateral ("substigmatal-subventral fold"), subventral, and adventral, all of which were described as geminate, pale, almost whitish filled, except the subventral fold, which was white. "Later the color pales and the lines look whitish with dark green edges." "A short, robust larva, uniform, the segments not elongate." The food plant was *Arctostaphylos uva-ursi* (Linnaeus) Spreng. McGuffin (1972: 15) described all instars, of which the fifth (last) was described as follows: Length: 15–16 mm, width 2.2–2.4 mm. Head russet to green, with or without fine brown markings in herring-bone pattern on parietal lobes; antennal pit scarcely emarginate. Body green with light green or white lines, margined in gray, i.e., geminate gray at middorsal, addorsal, subdorsal, subventral, adventral, and midventral; prominent white line in lateral region; plates yellowish green; thoracic legs russet; prolegs green, with crochets in two groups. McCabe (1991: 5, 22) described the mature larva as green, with a diffuse, pink, dorsal line. His illustration shows a larva that is slender, straight, and twig-like in resting posture, seemingly not in keeping with Dyar's description of the larva as short and robust. In addition to *Chamaedaphne*, the reported food plants are bearberry, *Arctostaphylos uva-ursi*, in Canada (McGuffin, 1972: 15) and Colorado (Dyar, 1902), and Canada blueberry, *Vaccinium myrtilloides* Michx. (both Ericaceae) in the Adirondack Mountains, New York (McCabe, 1991).

Epelis truncataria occurs across Canada from St. Johns, Newfoundland and Nova Scotia to the interior of British Columbia, and northward to southern Labrador; Hudson Bay, Ontario; Churchill, Manitoba; Northwest Territories; Yukon; and Alaska. In the United States it is known from suitable habitats southward through New England to Connecticut, Long Island, and the New Jersey pine barrens, and in central New York, Michigan, Wisconsin, South Dakota, Colorado, and Idaho. I have also seen it from the Magdalen Islands, Quebec (CMNH) and one labeled Victoria, B. C. (CMNH). The species is univoltine, with adults flying mostly in May and early June almost everywhere, even in Alaska. The earliest and latest

dates for a few specific regions are as follows: Nova Scotia, 17 May–13 July; Maine, 15 May–4 July; southern New England, New York, New Jersey, 2 May–June; Michigan, Wisconsin, 1 May–8 July; Colorado, 22 May–13 July; Alberta, 8 June–14 July; Idaho, British Columbia, 25 April–29 July (earliest and latest both from Cranbrook, B. C.); Alaska, 21 May–12 June. It was taken on 17 June at Lake LaBerge, Yukon and on 22 June at Fort Good Hope in the Northwest Territories. July records are usually worn stragglers or specimens from high mountain habitats.

The adults fly by day in sphagnum bogs or in heath or moorlike habitats in the Northeast and central regions, but may occur in relatively dry sites in the West, such as montane shrub barrens or wherever bearberry grows. Some Alaskan specimens were labeled as "flying over cranberry flowers" or "among willows." In Nova Scotia, *truncataria* flies together with *Ematurga amitaria* (Guenée) (Boarmiini) by day in the same bog habitats, and both display the rust-brown coloring characteristic of so many diurnal moths. They also share this habitat at about the same season with *Mesothea incertata* (Walker) (Geometrinae) and lycaenids of the genus or subgenus *Incisalia*.

GENUS

Psamatodes Guenée

Psamatodes Guenée, 1857 [1858], in Boisduval and Guenée, *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, **10**: 107.

Type species: *Psamatodes rimosata* Guenée, 1857 [1858], *ibidem* **10**: 110, designated by Fletcher, 1979. Brazil.

Xenoecista Warren, 1897, *Novitates Zoologicae*, **4**: 484, REVISED SYNONYMY.

Type species: *Xenoecista subdiversa* Warren, 1897, *ibidem* **4**: 498, by original designation.

The members of this mainly Neotropical group do not closely resemble the typical *Macaria* species as represented in temperate North America and Eurasia, but they have until now been included. The wing shape is typical of *Macaria*, with angulate hindwing and somewhat acute forewing, although the subapical cavity on the outer margin of the forewing is not strongly developed. Wings light yellowish brown, variably marked or suffused with darker brown, and characteristically with all transverse lines nearly parallel. Postme-

dial lines of both wings nearly straight for most of their length and often clearly followed distally by a dark shaded band that may be more prominent on underside. Dark costal spots, which mark ends of transverse lines conspicuously in so many species of *Macaria*, are missing, or, if any appears to be present, it is nearly always precostal in position, giving wings of this group a simplified, atypical aspect. Occasional specimens of *abydata* and other species have what amounts to a postmedial or subterminal costal spot, but in most it is lacking. A dark spot or patch is more likely to be present in usual place at or just distad of postmedial line opposite end of forewing discal cell. Head and thorax often with a dusky or rust-colored vertex and collar.

Antennae may be simple or bipectinate independently of variation in other characters. Although most species have simple antennae, a few (e.g., *trimaculata* in our fauna) have strongly bipectinate male antennae, which would be an anomalous situation within *Macaria* except that males of *M. aequiferaria* have bipectinate male antennae with short branches, and *aequiferaria* is a normal *Macaria* in other respects. Males have the hindtibia considerably enlarged, enclosing the usual hair pencil, and have a normal pecten on third abdominal sternum. Forewing is without a fovea.

Male genitalia (text figures 37 *a, b, g, h*; 38 *a, c*; 39 *a-f*) peculiar and consistent in having a valvula, seemingly homologous to that seen in all species of *Speranza*, although it could have developed independently. Saccular lobe has a longitudinal ridge running from near base to distal margin, close and subparallel to ventral margin. This ridge may be simple (*pallidata*) or variously adorned, often with a small, longitudinal (*everiata*, *errata*) or transverse (*atrimacularia*) flange-like process near middle, and with another subapically that may be in form of a setose hump or lobe (*abydata*, *everiata*). Tip of uncus truncated or slightly excavated, and bearing two strong, often widely set, modified setae, giving it characteristic aspect of well-developed "horned uncus." Aedeagus (text figures 37 *g, h*; 38 *c*; 39 *c, f*) remarkably uniform throughout group. Also, characteristic eighth sternum deeply incised and narrowly cleft in deepest part, then with sides of cleavage diverging caudally to form a process on each side that extends beyond end of segment, each ending in slightly expanded or inwardly or outwardly bent, sometimes hooklike tip. Form of

sternite is consistent except in a few variant South American species (*memor*, *ramparia*, *limbularia*) that may not belong here.

Female genitalia with transverse, flaplike or bridgelike structure surmounting ostial opening caudally; a longitudinally rugose neck region on bursa copulatrix; and a rather small but many-pointed stellate signum just before anterior end.

Those species that have been reared are all associated with woody-stemmed legumes, except that *abydata* has also been reared from soybean (herbaceous) and *errata* has been reared from a species of Sapindaceae as well as from Fabaceae.

Viewing *Psamatodes* as presently known, one can easily discern two groups, represented north of Mexico by *abydata*, *trientata*, *everiata*, and *errata* as one branch, and *pallidata*, *atrimacularia*, and *rectilineata* as the other. Species of the *abydata*-group are larger, with a simpler pattern (fewer lines), have a prominent, setose process on the saccular lobe of the male genitalia, and a larger, more lamellate, untilted, transverse ostial flap in the female genitalia. Members of the *pallidata*-group tend to be smaller, with multiple parallel lines in the wing pattern, lack a setose process in the male genitalia, and have a narrower, cross-braced, bridgelike, transverse structure rather than a flaplike one. Although it might not at first be apparent that species of the *abydata*- and *pallidata*-groups of *Psamatodes* are closely related, nothing in their structure, wing pattern, color, or larval habits effectively distinguishes them.

The *pallidata*-GROUP

This group includes *pallidata*, *atrimacularia*, and *rectilineata* as well as the following Neotropical species: *rimosata* Guenée, *rectilineata* (Warren), *subdiversa* (Warren), *pernicata* (Guenée), *nigropunctata* (Warren) (probable synonym of *pernicata*), *ramparia* (Schaus), *limbularia* (Hübner), *memor* (Dognin), *imitatrix* (Thierry-Mieg), and probably *doriteata* (Guenée), although the last few become increasingly different and, by themselves, would hardly be suspected of being part of the lineage that includes *abydata*. Unfortunately, the type species, *Psamatodes rimosata*, has simplified male genitalia that are not very easily associated with others that I include in *Psamatodes*, but I think they belong with it. All of these Neotropical species except *rimosata* are NEW COMBINATIONS with *Psamatodes*. [New text by Lafontaine, ed.]

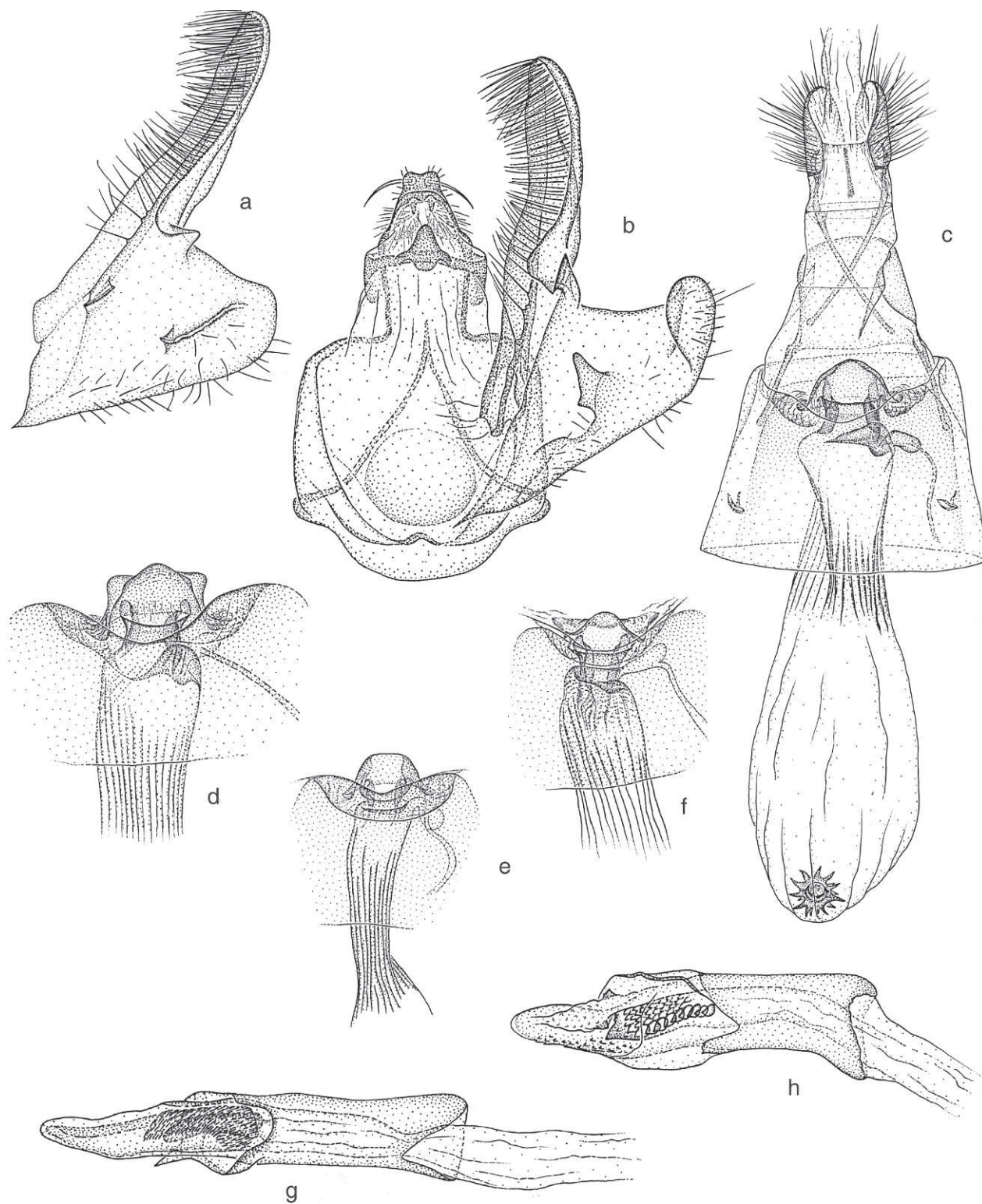


FIGURE 37: GENITALIA OF *PSAMATODES* SPECIES

a. P. pallidata, male right valva; Brownsville, Cameron County, Texas (USNM 52759). *b. P. atrimacularia*, male genital capsule; Brownsville, Cameron County, Texas (USNM 53190). *c. P. everiata errata*, female genitalia; Baboquivari Mountains, Pima County, Arizona (HWC 1532). *d. P. abydata*, female S8, ostium bursae and ductus bursae; Santa Ana Refuge, Hidalgo County, Texas (AB 5042). *e. P. atrimacularia*, female S8, ostium bursae, and ductus bursae; Brownsville, Cameron County, Texas (USNM 57514). *f. P.*

A possibility to be considered is that the *pallidata*-group is a primitive assemblage retaining features shared with *Speranza*, such as the valvula, the bipectinate male antenna in some species, and the similarly shaped uncus; and that the *abydata*-group is a sister-group that has come more to resemble the typical species of *Macaria* through convergence.

Psamatodes pallidata (Warren), NEW COMBINATION

PL. 3, FIGS. 65–67 (adult); TEXT FIG. 37 *a*, *h* (♂ gen.); TEXT FIG. 37 *f* (♀ gen.) (RWH 6354, part).

Xenoecista pallidata Warren, 1897, *Nov. Zool.*, **4**: 484.

Type locality: “Amazons” [Brazil]. [BMNH]

NOTE—In the last checklist (Hodges *et al.*, 1983: 89), when this and other genera were included in *Semiothisa*, the name *Semiothisa pallidata* (Warren) was a junior secondary homonym of *Semiothisa pallidata* (Packard, 1873) (now in *Digrammia*), and I used the next available name, *trimaculata* Warren, 1906, for this species. In *Psamatodes* there is no such homonymy, and the older name, *pallidata* Warren, 1897, becomes available.

Xenoecista trimaculata Warren, 1906, *Proc. U. S. Natl. Mus.*, **30**: 533.

Type locality: Cayenne, French Guiana. [USNM]

This species and *atrimacularia* are very similar, small, pale brown moths from Cameron and Hidalgo counties, Texas southward that have been confused in collections since *atrimacularia* was described in 1913, although *pallidata* is peculiar in having pectinate male antennae. The color and wing shape are close to those of *abydata*, although the wings may be slightly narrower as well as smaller. Both the medial and postmedial bands of the forewing are abruptly angled basad before the costa, and the hindwing has three or four discrete transverse lines or bands rather than two. The black spots on the forewing may be present or absent in both. The underside also is marked by three or four brown transverse lines

on a pale yellowish ground instead of the usual medial line and wide postmedial band. What usually accounts for the multiple-lined appearance, at least on the underside of the hindwing, is the presence of a pair of thin, parallel lines interposed between the antemedial and postmedial lines, although sometimes these are fused to appear as one. The space between the outermost of the double lines and the postmedial line may be partly occupied by a smudgy-brown suffusion representing the rudimentary beginnings of the wide, often solid, dark brown postmedial band of *abydata*. This is seen more often in *pallidata* than in *atrimacularia*. However, the male antennae provide the only external feature by which *pallidata* and *atrimacularia* are easily and reliably distinguished. The male antenna of *pallidata* is conspicuously bipectinate, with branches three to four × as long as the width of the antennal shaft, as in *Speranza*. *Psamatodes atrimacularia* agrees with most species of *Macaria* and *Digrammia* in having a simple, merely ciliate male antenna. Wing length: males, 10–12 mm; females, 11–13 mm.

Male genitalia (text figure 37 *a*, *h*) similar to those of *everiata* Guenée and *errata* McDunnough but without the heavily setose process on saccular lobe of the valve. Simpler than those of *atrimacularia* in lacking the thin, erect, blade-like, rectangular flange in middle of saccular lobe, and in having a less exaggerated flange in angle where outer margin of saccular lobe meets costal lobe, in latter character resembling *abydata* and *errata* rather than *atrimacularia*. Notch in eighth sternum much deeper than that of *atrimacularia*, reaching a point halfway between posterior and anterior margins of segment.

Female genitalia (text figure 37 *f*) with very short, necklike ductus bursae between the corpus bursae and ostium bursae that is slightly longer than wide, unlike the ductus bursae of *atrimacularia*, in which it is even shorter and not as long as wide. Also, “neck” adjoins corpus bursae subterminally, leaving a small, rounded overlap of the latter structure produced posterad beyond juncture (as in *abydata* and *errata*). In *atrimacularia*, the “neck” adjoins terminally and no

←

pallidata, female S8, ostium bursae, and ductus bursae; Brownsville, Cameron County, Texas (USNM 53191). *g*. *P. atrimacularia*, aedeagus; Brownsville, Cameron County, Texas (USNM 53190). *h*. *P. pallidata*, aedeagus; Brownsville, Cameron County, Texas (USNM 52759).

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overlapping at the posterior end of the corpus bursae is apparent.

The early stages have not been described, but many adults sent to me for identification from an Australian biocontrol of weeds field station in Mexico had been reared from larvae found on *Mimosa pigra* Linnaeus (Fabaceae) in Oaxaca, Veracruz, Tabasco, and Guerrero (some deposited in USNM).

Psamatodes pallidata has a wide Neotropical distribution, reaching its northernmost limit in southern Texas, where it has been collected at Brownsville and Santa Rosa, Cameron County, and at the Santa Ana National Wildlife Refuge, Hidalgo County, in March, October, November, and December. I have seen only 38 Texas specimens. The USNM collection contains 46 Neotropical specimens from Mexico, Guatemala, Panama, Colombia, Ecuador, Guyana, and Cayenne.

Psamatodes atrimacularia (Barnes and McDunnough), NEW COMBINATION, REVISED STATUS

PL. 4, FIGS. 1–3 (adult); TEXT FIG. 37 *b, g* (♂ gen.); TEXT FIG. 37 *e* (♀ gen.) (RWH 6354, part).

Macaria atrimacularia Barnes and McDunnough, 1913, *Contrib. Nat. Hist. Lep. N. Amer.*, 2: 127, pl. 6, figs. 16, 18.

Type locality: Brownsville, Texas. [USNM]

NOTE—Described from two male and two female syntypes. I hereby designate as lectotype the specimen labeled “Type ♂” and illustrated by Barnes and McDunnough, 1913: pl. 6, fig. 16. The legend for the figures published in 1913 gives San Benito, Texas as the locality, but the labels on these specimens, which are the lectotype and “Type ♀,” agree with the original description in giving it as Brownsville.

Psamatodes atrimacularia is a rare, possibly now endangered species known only from Cameron and Hidalgo counties, Texas. All similar Mexican and other Neotropical specimens examined proved to be *pallidata*. Although very different in male genitalia, *atrimacularia* and *pallidata* are of almost identical appearance, except that the male antennae are simple and merely ciliate in the former, clearly bipectinate in the latter. Other differences were discussed under *pallidata*. Wing length: males, 10–11 mm; females, 10–12 mm.

Male genitalia more elaborately modified than

those of *pallidata* and unlike any from north of the Mexican border, although similar to those of a few other Neotropical species, through which the relationship to *pallidata* becomes more apparent. Costal lobe of valve with a deep, rounded, foldlike hollow in ventral margin to accommodate the enlarged sclerotized flange in angle between this lobe and outer margin of saccular lobe. Saccular lobe with longitudinal ridge from base to apex, roughly parallel to ventral margin, and bearing raised, bladelike flanges in two places. These consist of a sharply quadrate, obliquely divergent flange near middle, and a more rounded one toward apex, the latter folded or inclined inward. Notch in eighth sternum relatively shallow compared to that of *pallidata*, reaching only one-third of way from posterior to anterior margin of segment.

Female genitalia with very short, necklike ductus bursae that is wider than long, and without a posterior extension or overlap of the neck of the corpus bursae beyond the juncture with the ductus bursae, as the latter adjoins terminally, not subterminally as in *pallidata*.

The immature stages are unknown.

Psamatodes atrimacularia is known only from Brownsville and the Sabal Palm Preserve, two miles north of Brownsville, Cameron County, and from Pharr, Mercedes, the Santa Ana National Wildlife Refuge, and Bentsen-Rio Grande State Park, all in Hidalgo County, Texas. It has been collected in every month of the year except January, and at least as recently as 1988. I have seen about 65 specimens in many collections, but mostly in the USNM and AMNH. Although it is an isolated entity within our fauna, *atrimacularia* has close relatives in South America with closely matching male genitalia that differ only in the most minor respects. These include *P. nigropunctata* (Warren, 1897: 480), described from Venezuela, and *P. pernicata* (Guenée, 1857 [1858]: 84), from Brazil. These species also agree with *atrimacularia* in having simple male antennae.

This species and *pallidata* have been confused since the original description, as many “*atrimacularia*” in collections are really *pallidata*. I incorrectly synonymized them in the 1983 check list, not noticing until later that two species are involved. McDunnough was also unaware of the second species when he described *atrimacularia*, and only through chance happened to have specimens of the more localized, unnamed one.

Psamatodes rectilineata (Warren), NEW COMBINATION

PL. 4, FIGS. 4, 5 (adult); TEXT FIG. 38 *a, c* (♂ gen.); TEXT FIG. 38 *b* (♀ gen.).

Tephrinopsis rectilineata Warren, 1900, *Nov. Zool.*, 7: 206.

Type locality: Paraná, Entre Rios, Argentina. [BMNH]

NOTE—Described from a series of syntypes, including both sexes. No lectotype has been designated. The USNM collection has 12 specimens from Argentina identified by Warren, but they are not types.

Tephrinopsis fragilis Warren, 1904, *Nov. Zool.* 11: 562. NEW SYNONYMY.

Type locality: Pisco, Peru. [BMNH]

NOTE—Described from one male and four female syntypes. No lectotype has been designated. Although it is not clear from the original description that *fragilis* is the same species as *rectilineata*, the description mentions the dark extramedial spot that is often present in *rectilineata*. Old specimens in the USNM appear to have been distinguished and labeled as *fragilis* only because of the presence of the dark spot on the forewing.

This is a small light brown to gray-brown tropical American species taken once in the Florida Keys. It is allied to *Psamatodes pallidata* (Warren), *atrimacularia* (Barnes and McDunnough), and to the Neotropical *rimosata* Guenée, type species of *Psamatodes*; but in southern Florida, where it may be established, it is likely to be confused only with *Macaria carpo* or *M. aequiferaria*. The gray-brown postmedial band of the forewing is nearly straight and subparallel to the outer margin, bending basad only slightly toward the costa; that of the hindwing straight to somewhat convex. The collar, vertex, frons and palpi are ochreous but not brightly so. The male antenna is simple, and the male hindtibia is swollen and encloses a large hair pencil. The chaetosema of both sexes, if not covered with scales or mutilated, may be seen to consist of little more than a single row of setae, shorter in the middle but apparently continuous from one side of the head to the other, the lateral extremity of the row on each side bending posteriorly for a short distance along the edge of the eye. The genitalia show *rectilineata* to belong to the *pallidata*-group.

Wing shape *Macaria*-like but with only a very slight preapical concavity on outer margin of forewing, without the subapically darkened fringe; hindwing not angulate. Fore- and hind-

wings colored alike; ground color pale yellowish brown, variably sprinkled with darker, gray-brown scales or clusters of scales. Forewing with antemedial a thin line, sometimes faint to nearly absent, almost straight and erect from inner margin to just before costa, where it may bend basad; medial band prominent to obsolescent, diffuse, nearly straight, subparallel to both antemedial and postmedial bands, traversing wing through discal spot or nearly so; postmedial band straight to slightly irregular, subparallel to other bands and to outer margin, thin or consisting of a series of disconnected dots, often closely paralleled outwardly by a wider brown band from inner margin to costa; postmedial often widening and intensifying toward inner margin to form a dark spot or bar, sometimes double, and a prominent feature of the pattern in well-marked specimens. Hindwing basically similar but lacking antemedial band and dark spots, and with postmedial band and its wide external border not parallel to the rounded outer margin but running nearly straight across from inner margin to just before distal end of costa. Discal spots of both wings small, often obscure; fringes light brown, preceded by rows of small, dark intervenular dots. Undersurfaces similar but usually a darker, orange-brown color, with markings simplified, diffuse or ill defined. Other features as given in first paragraph above (diagnosis). Wing length: males, 10–11 mm; females, 9–13 mm.

Male genitalia (text figure 38 *a, c*) with tip of uncus truncated, stoutly horned near tip, and valve with small but distinct valvula like other species of *Psamatodes*. Saccular lobe of valve without any other special structures but with a prominent fold or ridge along ventral margin that could easily give rise to or have absorbed such structures. Sclerotic inclusion in vesica is of the type seen in *abydata* and its relatives.

Female genitalia (text figure 38 *b*) hardly differing from those found in *Macaria* but with a strongly rugose neck region in the bursa copulatrix and with a small, radially irregular, stellate signum typical of *Psamatodes*.

This species was reared on 17 January 1976 from larvae on *Prosopis alba* Griseb. (Fabaceae) in the province of Boqueron, Paraguay, by C. A. DeLoach and H. A. Cordo, biocontrol entomologists with the U. S. Department of Agriculture. A voucher specimen is deposited in the USNM. Various possible food plants, including about six

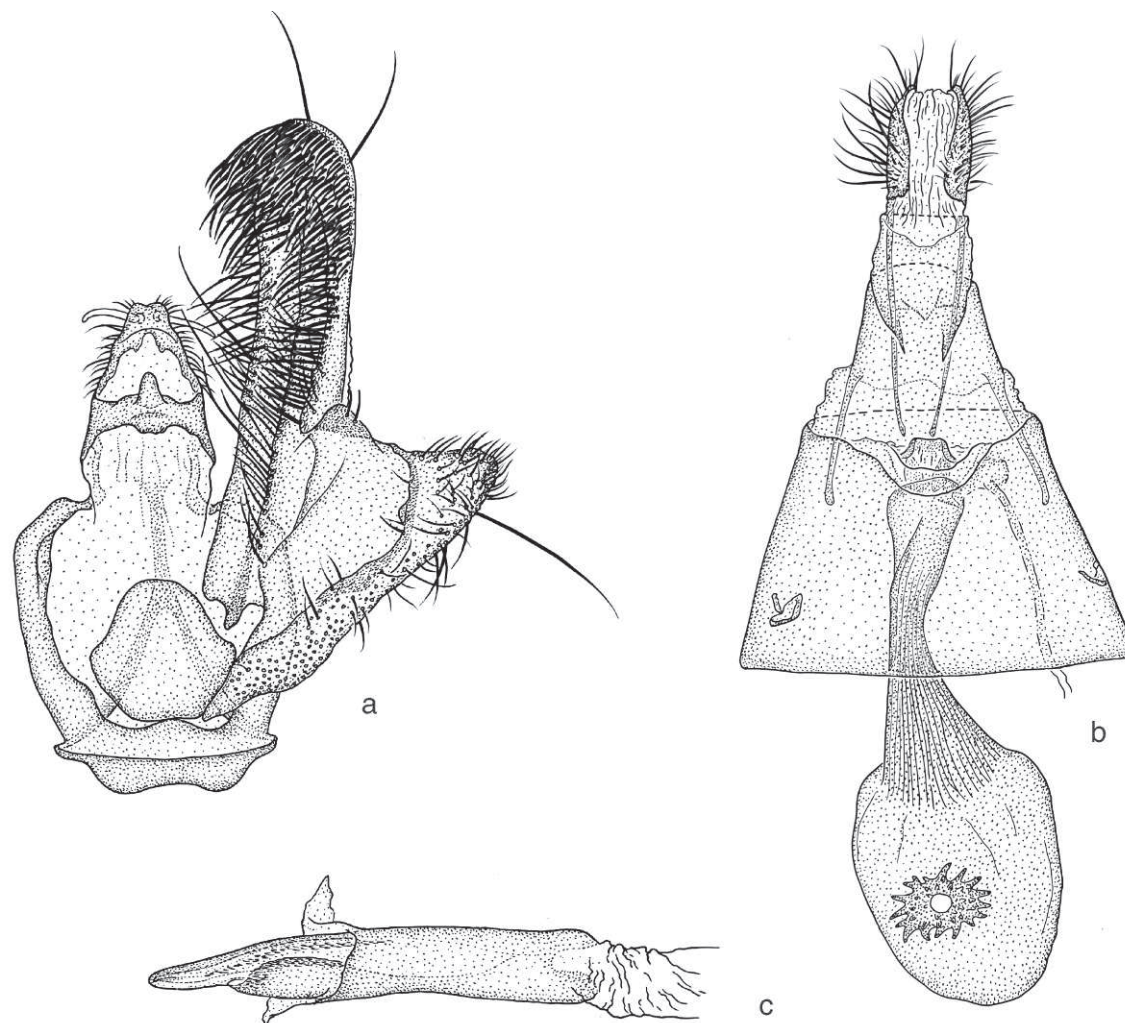


FIGURE 38: GENITALIA OF *PSAMATODES RECTILINEATA*

a. Male genital capsule; Warr. Prov., Boquerón, Paraguay (USNM 58029). *b.* Female genitalia; Loggerhead Key, Monroe County, Florida (USNM 57060). *c.* Aedeagus; Warr. Prov., Boquerón, Paraguay (USNM 58029).

species of *Acacia* Miller (but not *Prosopis* L.), occur in South Florida.

Psamatodes rectilineata occurs in Argentina, Paraguay, and probably other South American countries, but no further data are available. Similar moths occur in Peru but may not belong to the same species. The USNM has specimens from various localities in Argentina, and from Nuevo Asuncion and Boqueron, Paraguay. The few with dates were collected in late March, except for the reared one, which emerged in January.

The two Florida specimens, found among unidentified moths in the USNM, are labeled Loggerhead Key, 1.9 miles south of Cudjoe Key, 15–17 February 1973, R. Thorington, J. Layne, and P. Cone. How this species reached Florida is a

mystery. I thought it likely that the specimens were mislabeled and queried Richard Thorington, a Smithsonian mammalogist, about his recollections of the trip. He remembered that they collected a few insects on Loggerhead Key but did not know what they were or how there might have been a mixup in labeling. They were given to someone in the Entomology Department for the National Collection. I include this species because it may be or have been present in the Florida Keys.

The *abydata*-GROUP

This group includes *abydata*, *trientata*, *everiata*, and *errata*. It also includes *P. paleolata* (Guenée), from Hispaniola, although its distribution

may prove more extensive. *Psamatodes paleolata* is superficially similar to *abydata* but may be recognized by the presence of an elongate flange on the saccular lobe of the valve in the male genitalia, dorsal to the longitudinal ridge but converging with it subbasally; by the absence of the central process on the ridge (also absent in *everiata*); and by the nature of the setose lobe, which is slightly more elongate and slightly more basad than in the other two species. Several unstudied Neotropical taxa, such as *armigerata* (Guenée), *delauta* (Felder), *irrufata* (Guenée), and *pandaria* (Schaus), appear closely related and might help close the gap between the two groups. [New text by Lafontaine, ed.]

Psamatodes abydata (Guenée)

PL. 4, FIGS. 6–9 (adult); PL. 11, FIGS. 8, 9 (larva); TEXT FIG. 39 *a–c*, *e* (♂ gen.); TEXT FIG. 37 *d* (♀ gen.) (RWH 6332).

Macaria abydata Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, **10**: 80.

Type locality: Brazil. [BMNH]

NOTE—I designate one of the two male syntypes, BMNH geometrid slide 12,427, as the lectotype.

Macaria infusata Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, **10**: 81.

Type locality: Brazil. [BMNH]

NOTE—The abdomen of the male holotype is missing, and therefore the specimen cannot be identified with certainty. By its appearance and source, it is a synonym of either *abydata* or *everiata* Guenée and is placed here provisionally until some other means is found of distinguishing the species.

Macaria diffusata Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, **10**: 81.

Type locality: Brazil. [BMNH]

NOTE—The holotype of *diffusata* (BMNH geometrid slide 12,442) is a female, not a male as Guenée indicated, and the female genitalia do not show clearly whether it is *abydata* or *everiata*. The name is left here provisionally, as in the case of *infusata*.

Macaria lataria Walker, 1861, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **22**: 740.

Type locality: Santarem [Brazil]. [BMNH]

NOTE—Described from one male from Santarem and one female from Venezuela. The male, BMNH

geometrid slide 12,430, is hereby designated the lectotype.

Macaria santaremaria Walker, 1861, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **23**: 917.

Type locality: Santarem [Brazil]. [BMNH]

NOTE—Described from two males, of which the specimen labeled BMNH geometrid slide 12,422 is hereby designated the lectotype. The abdomen had been damaged and the genitalia were missing, but the specimen closely resembles the lectotype of *lataria* from the same locality (J. D. Holloway, in litt.).

Macaria punctolineata Packard, 1873, *Ann. Rept. Peabody Acad. Sci.*, **5**: 64, NEW SYNONYMY.

Type locality: Texas. [MCZ]

Macaria adrasata Snellen, 1874, *Tijds. voor Ent.*, **17**: 70, pl. 5, fig. 8.

Type locality: Kingston, Jamaica. [RMNH]

NOTE—Identity of this taxon was confirmed by J. D. Holloway (in litt.), who examined the type. Specimens from Jamaica in the USNM are a rich orange-brown color and look as though they may not be *abydata*.

Semiothisa simulata Hulst, 1887, *Ent. Americana*, **2**: 188, NEW SYNONYMY.

Type locality: Texas, by present lectotype designation. [USNM]

NOTE—Hulst described this species from “2 males coll. Graef, Hulst,” with no locality given. Hulst must have added what he thought were two matching females to the type series subsequent to the original description, as four specimens labeled as types have been found—two males and two females, the latter spurious if we accept that the original syntypes were males as described. Barnes and McDunnough (1916: 182), in referring to this species, wrote that “in the Hulst Coll. The “type” is a female from Arizona and in the Graef Coll. we found a male type from Texas; this latter being probably the true type.” They did not know of the other two “types,” which turned up later. The above female from Arizona is now in the AMNH (listed by Rindge, 1955: 153), and another female “type” from Arizona, without abdomen, is in the USNM. The two male syntypes, labeled as from Arizona and Texas, are also in the USNM, and slides have been made of them. The one from Arizona is the taxon that McDunnough later described as *errata*, and the one from Texas is *abydata*. In order to keep name changing to a minimum, I designate as lectotype of *simulata* Hulst the

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male syntype from Texas, thus adding this name to the synonymy of *abydata*. The lectotype is labeled: "Tex./Collection Brkln. Mus./*Semiothisa simulata* Type. Hulst/male genitalia on slide 25 Mar. 1942 H.W.C. 1523." A lectotype label has been added.

Semiothisa ochrata Warren, 1900, *Nov. Zool.*, **7**: 206.

Type locality: Dominica [Windward Islands], West Indies. [BMNH]

Chiasmia vagabunda Inoue, 1986, *Tinea*, **12**: 66.

Type locality: Nakijin, Okinawa. [BMNH]

NOTE—Synonymized by Holloway, 1993: 161.

Previously known in the North American literature as *Semiothisa punctolineata* (Packard), this taxon proved to be the same as the widespread, Neotropical, often migratory pest species variously identified as *Semiothisa* or *Macaria abydata*, *infusata*, or *santaremaria*, and which, apparently by introduction into the Pacific Region, has become the most widely distributed tropical member of the tribe Macariini. Its original range encompassed almost the entire region from Argentina and Uruguay to the southern and central United States, but it somehow reached Hawaii and has spread rapidly through the islands of the Western Pacific and Indo-Australian Region from western Samoa and New Caledonia to Borneo.

Within the continental United States it is easily recognized as the only light yellowish-brown species of Macariini from Texas (and occasionally Arizona) eastward with a wide, usually solid, dark-brown postmedial band crossing both wings on the underside (plate 4, figure 9), except for *P. trientata* in southern Texas and Florida. *Macaria aemulataria* and *M. promiscuata* may have similar markings, but their bands are less solid and complete and less contrasting, and they have a well-defined, rounded, subapical excavation on the outer margin of the forewing, a feature that is absent or nearly so in *abydata* and its various siblings. The male genitalia conveniently distinguish *abydata* from everything else in the United States except *trientata*. The species might easily be confused with *everiata* from Arizona and northwestern Mexico if they occurred together in the continental United States, but this does not happen except rarely in Arizona.

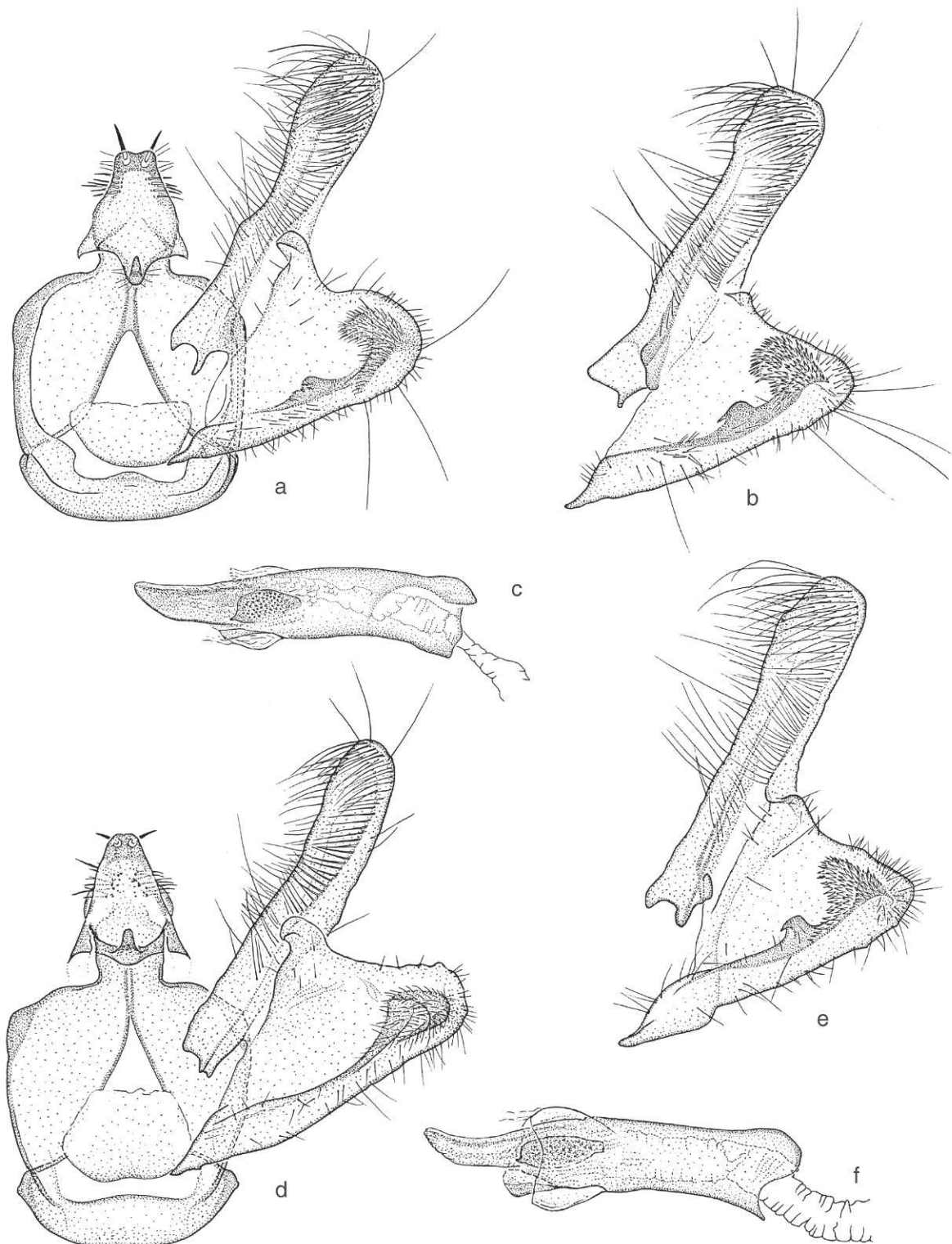
Wings pale yellowish brown, with three brown transverse lines on forewing and two on hindwing above and beneath. Upperside with antemedial line of forewing usually faint, curved or slightly

angled; medial of both wings a slightly thicker, more diffuse band, nearly straight but slightly waved or crenulate and deflected basad in a discrete curve to circumvent discal spot on hindwing; postmedial lines of both wings also usually somewhat waved or crenulate but following a nearly straight course overall, that of forewing nearly parallel to outer margin but curving slightly basad toward costa. Postmedial lines separate pale yellowish median space from extensively dark shaded outer third of both wings, above and beneath, the dark shading of underside forming a contrasting, dark brown band crossing both wings. Pale areas of upperside frequently flecked with darker scales, giving a granulated effect, and transverse lines may include a variable number of blackish vein dots. Discal spot of forewing a small brown bar, perpendicular to costa, darker on underside; that of hindwing a roundish black dot on both surfaces. Blackish patch between M_3 and CuA_1 immediately distad of postmedial line on upper surface of forewing may be present or absent but is never very well developed; subapical spot near costa may also be present but is poorly developed. Underside of wings in general very similar to uppersides except that medial band is weak, and outer third of both wings more conspicuously bisected between contrasting dark band adjoining postmedial line and paler, yellowish outer half toward outer margins. Wing length: males, 12–15 mm; females, 12–16 mm (U. S. specimens).

Male genitalia (text figure 39 *a–c, e*) easily recognized by presence of a thin, angular or hook-like flange arising centrally on the ridge that runs from subapical setose lobe toward base of sacculus (ventral) lobe of valve.

Female genitalia (text figure 37 *d*) of both *abydata* and *errata* have a low, transverse, rounded flange anterior to ostium, and a rounded, flange-like plate extending posterad immediately posterior to ostium. In *abydata* the posterior plate bears an accessory lateral flap on each side, making its overall outline appear somewhat squared or truncated. In *errata* the lateral flaps are rudimentary, making the overall shape of the postostial part of the genital plate appear rounded. This is variable and not altogether dependable.

The larva is typically macariine, having a leaf-green head and body with longitudinal white or pale yellowish stripes. Superficially, it resembles that of *Digrammia decorata*, *D. subminiata*, and many other members of the tribe. The pattern

FIGURE 39: MALE GENITALIA OF *PSAMATODES* SPECIES

a. P. abydata, genital capsule; Palo Duro Canyon, Randall County, Texas (AB 5038). *b. P. abydata* right valva; Miami, Miami-Dade County, Florida (HWC 1520). *c. P. abydata*, aedeagus; Palo Duro Canyon, Randall County, Texas (AB 5038). *d. P. everiata errata*, genital capsule; Baboquivari Mountains, Pima County, Arizona (HWC 1525). *e. P. abydata*, right valva; Holawa, Oahu, Hawaii ([unknown] 1453). *f. P. everiata errata*, aedeagus; Baboquivari Mountains, Pima County, Arizona (HWC 1525).

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consists of an unusually strong lateral stripe that incorporates the spiracles and continues forward onto the side of the head; a thinner subdorsal stripe; and a still thinner addorsal stripe. Faint, irregular, pale longitudinal lines or broken traces of such lines may occur between the subdorsal and addorsal stripes, and in the subventral area. The most distinctive larval feature is a small black spot on the side of the second abdominal segment between the spiracle and the subdorsal band, noteworthy because it appears homologous to similar spots in the larvae of *Digrammia ocellinata* and *Macaria aemulataria*. This description is based on a colored photograph by D. Preston of a Hawaiian larva feeding on *Leucaena* (plate 11, figure 8).

A larva that I think is *abydata* was collected by D. L. Wagner from *Prosopis glandulosa* near Brownsville, Texas (plate 11, figure 9). It was green with a wide, pale yellow lateral stripe, a much thinner yellowish dorsolateral stripe, and four still thinner, less conspicuous whitish stripes in the dorsal space. The lateral stripe continues onto the head to the base of the mandible. Head otherwise yellowish green. This larva is further adorned with large, purplish-red, lateral, segmental patches, one straddling the lateral stripe on each segment of both thorax and abdomen. The black lateral spot over the lateral stripe on segment A2 in the Hawaiian larva described above is embedded within the lateral segmental patch. The presence or absence of dark segmental patches is commonplace in many species of macariine larvae.

Adults in the U.S. National Museum from the continental United States were reared from larvae on *Acacia smallii* Isely (formerly regarded as *A. farnesiana* (Linnaeus) Willd. See Isely, 1973) in Kinney County, Texas (C. J. DeLoach); *Sesbania drummondii* (Rydb.) Cory at Brazoria, Texas (A. Blanchard); *Sesbania* sp. at Missouri City, Texas (P. T. Rihard); *Cassia* sp. at Victoria, Texas (J. D. Mitchell); and *Parkinsonia aculeata* Linnaeus at Temple City, Bell County, Texas. I also identified reared specimens from *P. aculeata* in Sinaloa, Mexico (J. García B.) and from soybean, *Glycine max* (Linnaeus) Merrill at São Paulo, Brazil (Lourencão et al., 1980). In the Pacific islands it is commonly associated with *Leucaena leucocephala* (Lam.) DeWit, a shrub introduced from tropical America, with *Mimosa invisa* Mart. (from Brazil), and with *Acacia koa* Hildebr. (all Fabaceae), and on flowers of *Nephelium litchi*

Cambess. (Sapindaceae). Except for the last, the reported food plants are nearly all woody-stemmed species of Fabaceae (=Leguminosae).

Psamatodes abydata is indigenous to most of tropical and subtropical America from southern Florida and southern Texas to Uruguay and Argentina, but it is migratory, appearing occasionally as a seasonal immigrant in the central United States as far north as Boulder, Colorado; Nebraska; Chicago and in Putnam County, Illinois; Madison and Milwaukee, Wisconsin; and it has been taken as far east as Ithaca, New York and Scranton, Pennsylvania. The species has also been collected in Louisiana, Arkansas, Oklahoma, Missouri, Kansas, western Kentucky (McCracken County), Iowa, and Indiana, and with some regularity as far north as Missouri and Kansas. It is uncommon in Arizona, where it seems to be replaced almost entirely by *Psamatodes everiata errata*, but one specimen in the USNM was collected at Pueblo del Sol, Huachuca Mountains, 22 September 1986 (R. Wielgus), (USNM slide 57,496) and two more by me in Ash Canyon, Huachuca Mountains, 9 August 1991. It seems to be rare in Florida, but I collected one at Homestead on 14 May 1978. The species that I have identified as *P. trientata* is much more common in southern Florida than is *abydata* but apparently never strays north of the southernmost counties of Florida and Texas.

Psamatodes abydata has been collected every month of the year in Texas, during the summer months at least from June onward in Oklahoma, Kansas, Missouri, and Arkansas, and 2 August–18 October in the more northern states.

In 1970 *abydata* appeared in Hawaii and soon spread to every major island in the group. Hawaiian specimens were originally identified by me as *Semiothisa santaremaria*, a name now recognized as a junior synonym of *abydata*. In the mid 1970's it was collected in the western Pacific on Yap, Saipan, and the Bonin Islands, south of Japan, and during the 1980's was recorded from Guam, Okinawa, Taiwan, Luzon, Sabah (Borneo), Sulawesi (Celebes), western Samoa, Tonga, and New Caledonia (J. D. Holloway, pers. comm.). The USNM has specimens collected in Fiji in 1986. The source of the Pacific and Indo-Australian introduction has not been determined.

Psamatodes abydata shows some geographical variation between North America and the Neotropics; those from Central and South America have a paler, less yellowish ground color and ten-

dency to have more dark shading in the subterminal area of both wings. Those that I have seen from Hawaii seem to be of the latter form. Within the vast Neotropical range of this species there is further variation in size and in the extent and intensity of the dark subterminal banding. Specimens from the Caribbean and Florida are smaller and usually darker, more uniformly brown and less variegated than those from Texas and Mexico. All migrant examples from the northern states clearly resemble Texas specimens. This observation, coupled with the midwestern distribution pattern and apparent absence of records from east of the Appalachians, suggests that populations of Texas or Mexico give rise to the long-range migrants that are often carried far northward by southwesterly summer winds, and that those of their close relatives, *trientata* in Florida, Cuba, and southern Texas, and other species in the West Indies, are relatively sedentary, never moving up the Atlantic Coast in summer as do many migrants. Only the most minor differences in genital characters are apparent (see *trientata*).

Although *abydata* and *everiata* are clearly distinct species, the data suggest that they have almost mutually exclusive distributions over large areas. *Psamatodes abydata* has been identified from the south-central, central, and middle Atlantic United States, Arizona (uncommonly northward), Cuba (one specimen), the Leeward and Windward Islands, Mexico, and very widely in Central and South America. *Psamatodes trientata* (Herrich-Schäffer), which occurs in Cuba, Florida, and southern Texas, is similar but smaller and non migratory. It is treated subsequently. *Psamatodes everiata* Guenée is known from Hispaniola, Brazil, Peru, Costa Rica, and as subspecies *errata* (McDunnough) from northern Mexico and Arizona; *P. paleolata* Guenée, with clearly different genitalia, occurs on Hispaniola.

Psamatodes trientata (Herrich-Schäffer)
PL. 4, FIGS. 10–12 (adult); PL. 11, FIG. 10 (larva).

Macaria trientata Herrich-Schäffer, 1870, *Correspondenz-Blatt des Zool.-Miner. Ver. Regensburg*, **24**: 184, REVISED STATUS, NEW COMBINATION.
Type locality: Cuba. [Gundlach collection, Havana]

NOTE—The one male type, examined by V. O. Becker (2002: 416), listed as No. 479 in Gundlach's

book (1881), is in very poor condition, being faded, and with the wings partially eaten. Despite this, Becker considered it recognizable and matched it with a specimen that he collected in Cuba. Nearly all 36 specimens of the *abydata* complex from Cuba in the USNM apparently represent *trientata* (only one being *abydata*) and agree more closely with their counterparts from southern Florida and Texas than any of them do with *abydata*.

Psamatodes trientata is similar to *P. abydata* but is nearly always smaller by an average of about 1.5 mm of wing length, is usually a deeper yellow (Cuba) or more brownish (Florida and Texas) in overall wing coloring, and usually has less contrast between the lighter basal and medial thirds and darker distal third of the forewing. The series of dark dots marking the postmedial line, which are usually distinct in *abydata*, are obsolescent in *trientata*. Dark granulation and blackish flecks or spots on the wing surfaces, common in *abydata*, are reduced; and the black extramedial spot, commonly present in *abydata*, is decidedly reduced in females and usually lost in males of *trientata*. In *abydata* (Texas specimens), the extramedial spot is present in about 6.0% of males (n = 35) and 90% of females (n = 50); in *trientata* (U. S. specimens), it is present in 0% of males (n = 38) and 28% of females (n = 14); and, if present, generally smaller sex for sex than those of *abydata*. The undersurfaces are variable but in general similar. A small proportion of the moths, 5% or less, cannot be distinguished from *abydata* with certainty. An important behavioral difference is that *trientata* is a sedentary species, apparently never straying northward; whereas *abydata* is highly migratory, dispersing northward from Texas into the Midwest as an annual immigrant and less commonly as far as Pennsylvania and New York, more than a thousand miles beyond the range of its known host plants. Wing length: table 1.

Male genitalia very similar to those of *abydata*, but posterior processes of eighth sternum are more likely to be widened toward tips; in *abydata* they most often taper to pointed tips without widening. In general, the smaller process on the inner face of the saccular lobe, basad of the larger, heavily setose subapical one, is smaller (more constricted), and the large setose subapical one is larger in *abydata* than in *trientata*, although this is variable in both, and it does not show in the illustrations because I did not realize the significance of the differences until long after the

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Table 1.
Relative wing lengths in mm of *Psamatodes trientata* and *P. abydata*.

	<i>P. trientata</i> : FL	<i>P. trientata</i> : TX	<i>P. trientata</i> : Cuban	<i>P. abydata</i> : TX
males	11–13 (n = 24)	12–14 (n = 6)	10–14 (n = 15)	12–15 (n = 47)
females	11–14 (n = 5)	11–13 (n = 8)	10–15 (n = 24)	12–16 (n = 43)
male average	12.2	12.8	11.7	13.6
female average	12.4	12.1	12.1	13.8

drawings were made. The female genitalia show no obvious differences.

Floridian and Texan specimens of *trientata* are similar, except that the Texas ones are often slightly larger. Both differ noticeably from Cuban specimens, which are more deeply yellowish above and beneath, and often have the transverse postmedial band or shade that crosses both wings beneath more narrowed, lighter in color, sometimes mixed with orange, and fading out on the distal side. These differences would seem to suggest that the Cuban population, only 90 miles from Florida, has been effectively isolated for a long time, longer than the Texas and Florida ones have been isolated from each other. This supports my idea that *trientata* is a sedentary species, and that *abydata* is a long-range migrant with frequent exchange of genetic material over long distances that inhibits the process of geographic variation as in other migrants. *Psamatodes abydata*, although individually variable everywhere, shows only minor geographic changes through its entire latitudinal range from Illinois to Paraguay.

Most major Caribbean islands and some lesser ones have their own slightly different version of a *trientata*-like *Psamatodes*, and some of these are distinct species with different genitalia, although they may be almost inseparable superficially. Most specimens collected on Hispaniola are *P. paleolata* (Guenée), in which the second process on the saccular lobe of the male, basad of the large setose preapical one, is missing, and the middle of the saccular lobe is marked by a low, longitudinal ridge with a knifelike edge. The male genitalia of the widely distributed *P. everiata* (Guenée), which occurs on this and other islands, in South and Central America, Mexico, and Arizona, differ as shown (text figure 39 d, f). Related but slightly different *Psamatodes* populations in Jamaica, Grenada, and perhaps Barbados and elsewhere remain to be studied.

The following description is of a larva (plate

11, figure 10) collected in the Audubon Sabal Palm Sanctuary, Cameron County, Texas in December 2001, by D. L. Wagner, and from which an adult *trientata* was reared. The host was *Ebonopsis ebano* (Berl.) Barneby and Grimes. Body leaf green with a thin, slightly irregular but sharply defined, bright yellow lateral stripe, ending on anterior edge of A8, and bright yellow intersegmental rings on the posterior margins of A1–A5. Entire dorsal area between lateral stripes occupied by numerous thin, delicate, fragmented, whitish lines, interspersed with a few blackish maculae, most of which are pinacula. Head green with extension of yellow lateral stripe running down its side, and with reddish mouth parts. Thoracic legs greenish, tinted with brown or red, each bearing a diffuse dark spot laterally near base. Prolegs green, tinted with red distally. Lateral stripe, essentially ending on A8, does continue faintly on next segment to form a very thin, pale margin on supraanal plate.

In the Caribbean islands *P. trientata* is known with certainty only from Cuba. It may be more widespread but unrecognized. In the United States I have seen it only from Monroe, Miami-Dade, Broward, Collier, and Indian River counties, Florida, and from Cameron, Hidalgo, Kleberg, Kerr, Brazos, and Presidio counties, Texas. Many in collections are labeled Florida City, taken in the 1950's. The northernmost record that I saw from Florida is one taken in October 1941 at Vero Beach, but a male figured by Kimball (1965: pl. 22, fig.7) from Siesta Key, Sarasota County, also appears to be *trientata*. This species is probably overlooked by collectors, especially in Texas, because of confusion with the more abundant *abydata*. Nothing is known about its distribution in Mexico. Adults have been collected in every month in Florida within the period 15 February–15 December, with the earliest being from Florida City and latest from Key Largo; and the available dates for Texas are 24 February (La-

guna Atascosa, Cameron County)—18 November (Santa Ana Wildlife Refuge), with collections in February, April, May, June, September, October and November only.

Psamatodes everiata (Guenée)

PL. 4, FIGS. 13–17 (adult); TEXT FIG. 39 *d*, *f* (♂ gen.); TEXT FIG. 37 *c* (♀ gen.) (RWH 6333).

Macaria everiata Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, **10**: 80.

Type locality: Haiti. [BMNH, genitalia on geometrid slide 12,433]

Apicia? rithrusaria Walker, 1860, *Catalogue of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **20**: 102.

Type locality: Santo Domingo [Hispaniola]. [BMNH]

NOTE—Doubtfully identified. Not only is the holotype a female, which makes identification difficult, but the hindwings and abdomen are missing. The forewings so closely match those of the types of *everiata* and *tegularia* that it would appear to be the same species (J. D. Holloway, in litt.).

Pyrinia tegularia Walker, 1860, *ibidem*, **20**: 228.

Type locality: Santo Domingo [Hispaniola]. [BMNH, genitalia on geometrid slide 12,434]

Semiothisa errata McDunnough, 1939, *Can. Ent.*, **71**: 252, SUBSPECIES.

Type locality: Gila-Pinal County line, Arizona. [CNC]

Psamatodes everiata in the Neotropics resembles *abydata* so closely that it can be distinguished reliably only by the absence of the small angular or slightly hooked structure near the middle of the ridge that parallels the ventral margin of the saccular lobe of the valve in the male genitalia. Consequently, *everiata* has been identified from only a few widely separated localities between Rio de Janeiro and Arizona, and in the West Indies. It is likely to be more generally distributed than these records suggest but will remain confused with the more prevalent *abydata* in collections until every specimen has been dissected. Fortunately for an understanding of the U. S. fauna, the remote, seemingly disconnected population of *everiata* found in Arizona and northern

Mexico is so clearly distinct from *abydata* that almost every specimen may be recognized without dissection. I considered that it might be a species without structural differences but chose to concur with J. D. Holloway (in litt.), who dissected and studied the types in the BMNH and regarded it as a geographic variant of *everiata*.

Psamatodes everiata errata (McDunnough), NEW COMBINATION, NEW STATUS

PL. 4, FIGS. 13–17 (adult); TEXT FIG. 39 *d*, *f* (♂ gen.); TEXT FIG. 37 *c* (♀ gen.) (RWH 6333).

Semiothisa errata McDunnough, 1939.

Type locality: Gila-Pinal County line, Arizona. [CNC]

This subspecies may be distinguished from nominate *everiata* and from *Psamatodes abydata* by its clear, light yellowish-brown coloring, usually devoid of scattered dark flecks and of medial lines or bands; by its regular, nearly straight, sharply defined but thin, dark, postmedial lines on both wings, above and beneath; and by a tendency for the outer third of both wings on the upperside to be almost uniformly a darker shade of brown than the remaining two-thirds and to average slightly wider than that of *abydata*. Many are not or hardly dark shaded in the outer third but uniformly pale. *Psamatodes abydata* and tropical *everiata* may also have the outer third of the wings darker, but in such specimens this sector of the wings is usually split between darker proximal and paler distal halves, not uniformly or gradually shaded from dark to lighter as in *errata*. The medial submarginal dark spot or patch of the forewing may be present but is usually not well developed.

This taxon, like most others, is variable, and a few specimens show features likely to lead to confusion with *abydata*. Some are more brown than yellowish, being finely dusted with dark brown scales which, however, give a less peppered or flecked appearance than those of *abydata*, partly because of their fineness but mainly because the transverse lines of *errata* do not incorporate or consist of series of blackish spots as do those of *abydata*. The darkest specimens (e.g., plate 4, figures 16, 17) represent a mainly cool-season form that flies in the lower canyons of the Huachuca Mountains, Cochise County in October and March and possibly all winter. They are so

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distinctive that at first I thought they might be another species. The size of *errata* and *abydata* is about the same. Wing length: males, 13–16 mm; females, 12–16 mm.

The male genitalia (text figure 39 *d, f*) essentially resemble those of *abydata* except for the complete absence of the angulate, usually slightly hooked (rarely rounded) process near the middle of the longitudinal ridge on the ventral (saccular) lobe of the valve that is characteristic of that species. The ridge itself is present, running close and parallel to the ventral margin of the saccular lobe from near its base to the heavily setose, subapical prominence. The setose prominence is also similar in the two species, although often smaller in *everiata*.

The female genitalia (text figure 37 *c*) are less reliable. Both species have a rounded, flangelike, transverse plate immediately posterior to the ostium, but in *abydata* this structure nearly always bears on each side a smaller, rounded accessory flap or lobe that makes its overall form appear more squared off or transversely rectangular. The accessory lobes tend to be less apparent or even absent in *everiata* or *errata*, enabling the postostial flange or protrusion to retain its shallowly rounded shape. Variation in both *everiata* and *abydata* allows for some overlap, so that the perceived distinction is not wholly dependable.

The early stages of *everiata* and subspecies *errata* have not been described, but adults were reared in 1990 from larvae feeding on *Acacia smallii* Isely (Fabaceae) at Tucson, Arizona (R. Wielgus). Also, a preserved larva and two pupal shells identified as this species by R. Nagle of Tucson had been reared from *Dodonaea viscosa* (Linnaeus) Jacq. (Sapindaceae), which is not native in Arizona. Note that *P. abydata* was also reported to feed on a species of Sapindaceae as a substitute host.

Psamatodes everiata errata is known mainly from southern Arizona, although it has been collected farther north near Flagsaff, Coconino County. Most specimens in collections are from the Huachuca and Chiricahua Mountains, Cochise County; the Santa Rita Mountains, Santa Cruz County; and the Baboquivari Mountains, Pima County, and, judging from the hundreds collected, it must at times be common. Specimens in the USNM from Cumpas, Sonora belong to subspecies *errata*, and others from Baja California were mentioned by Rindge (1969: 31). The habitat as I have seen it at around 5,000–6,000

feet in the Huachuca Mountains is primarily mixed oak, manzanita, and grassland.

Specimens have been collected in every month from March to October.

GENUS

Macaria Curtis

Macaria Curtis, 1826 (Sept. 1), *British Entomology*, **3**: 132.

Type species: [*Phalaena*] *liturata* Clerck, 1759, *Icon. Insect. rariorum*, **1**: pl. 6, fig. 6. Original designation, but incorrectly cited as *liturata* Linnaeus.

Eutropa Hübner, 1825 [1831], *Zuträge Samml. exot. Schmett.*, **3**: 39.

Type species: *Eutropa distribuaria* Hübner, 1825 [1831], *ibidem*, **3**: 39, pl. [102], figs 585, 586. Monotypy

Philobia Duponchel, 1829, in Godart and Duponchel, *Hist. nat. Lépid. Papillons France*, **7** (2): 105, 195.

Type species: *Phalaena notata* Linnaeus, 1758, *Systema Naturae* (edition 10), **1**: 523. Original designation (but see Fletcher, 1979: 163).

Sciagraphia Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 321, 329.

Type species: *Macaria granitata* Guenée, 1857 [1858], in Boisduval and Guenée, *Hist. nat. des Insectes, Spec. gén. Lépid.*, **10**: 85. Original designation.

Species of *Macaria*, like various other genera in this tribe, have a somewhat angulate wing shape. The wings of *Speranza* and *Digrammia* are generally less angulate, often quite rounded. *Macaria* is better distinguished by the following combination of features: male antenna nearly always simple as in *Digrammia*, only rarely bipectinate and then with very short branches; genitalia of both sexes exceptionally uniform from species to species, showing hardly any perceptible differences among 22 of our species (*minorata*, *sexmaculata*, and *carpo* are slightly divergent); valve simple, plain, without any dentate or spinelike processes and without the valvula of *Speranza* and *Psamatodes*, but with one or more small, setose, knoblike papillae on inner surface of valve, usually toward base of saccular lobe (reduced in a few species); uncus narrowly conical, not broad and truncated as in *Psamatodes*, and moderately

“horned,” i.e., bearing a pair of enlarged setae dorsoapically as in most other Macariini; aedeagus usually slender, without the scobinate or imbricated, platelike inclusion characteristic of *Psamatodes* species; female genitalia always with a large, radially symmetrical, stellate signum (signum absent in *Digrammia* and *Letispe*), and a simple sterigma, unlike the enlarged or elaborate sterigma common in *Digrammia* and in many *Speranza* species; fovea present or absent, even between closely related species-groups; foretibia never with an apical spine or claw; accessory cell (areole) of forewing present or absent; third anal vein of hindwing present as in *Speranza* and *Digrammia* (absent in *Psamatodes*); pecten on the third abdominal sternum present except in *notata*-group; hindtibia usually enlarged but not so in *aemulataria*; preapical furrows of segment A2 of pupa absent (present in *Digrammia* and most or all *Speranza*); diapause in pupal stage (egg stage in *Speranza*).

Twenty-one of the 25 species are conifer feeders, mostly on Pinaceae, but with one on Taxodiaceae and two, including the extinct Bermuda species, on Cupressaceae. Of the remainder, *aemulataria* feeds on maple, *notata* on birch and poplar, and *promiscuata* and *carpo* on Fabaceae. Those on Pinaceae evidently speciated relatively recently in North America as many are very closely related and not present in the Palearctic Region. However, *signaria* and *notata*, plus the common ancestor of *liturata* and *adonis*, evidently invaded the Palearctic Region from North America across the Bering Land Bridge. I can see virtually no difference between Nearctic and Palearctic specimens of *signaria* and *notata* even at the subspecific level, and *liturata* and *adonis*, although probably distinct, are very closely related.

Nearly all of the North American *Macaria* species fall within two main groups—the conifer-feeding group and, on deciduous trees, the *notata*-group. The conifer feeders are easily divided into two subgroups mainly on the basis of color, the gray species of the *signaria*-group and the brown species of the *bicolorata*-group; but also, the gray species have a fovea, and the brown species do not. A few conifer feeders stand out if examined carefully. *Macaria sexmaculata* has much the appearance of the gray species, and *minorata* of the brown species, but they are among the very few that can be recognized by slightly different genitalia; and *sexmaculata* differs from those it most resembles in lacking a fovea. *Ma-*

caria aequiferaria would appear to be a brown species, but it has a conspicuous fovea, a strange host (bald cypress), and a distinctive larva. *Macaria multilineata* and *M. ochreatea* are divergent brown species on Cupressaceae whose nearest relatives appear to be a small Caribbean group. *Macaria notata* has look-alike counterparts in the Neotropics, although a close relationship is not necessarily supported by the genitalia. *Macaria promiscuata* has a close sister-species on the same host (redbud) in northeastern Mexico described herein as *M. solisata*. *Macaria carpo* belongs to a small Neotropical group with genitalia similar to all of those discussed above, but it is not very closely related to any of them. The South American *Macaria infimata* Guenée, once reported in error from Florida (Kimball, 1965: 178), is a close relative of *M. carpo*.

This concept of *Macaria* is greatly restricted relative to what was formerly regarded as *Semiothisa* or *Macaria* worldwide. I should emphasize again that the name *Semiothisa* is not applicable to North American or probably any Old World species because the male genitalia of the type species, *Semiothisa gambaria* Hübner, 1818, from Surinam, are peculiar in having a spinelike or sickle-shaped costal lobe similar to that of the Cassymini. *Semiothisa gambaria* belongs to a Neotropical group characterized by genitalia of this type, although they otherwise resemble *Macaria* species, having, for example, the transversely elongated chaetosemata. They are not Cassymini. The genera *Speranza*, *Digrammia*, and *Letispe* are easily distinguished from *Macaria*. Most of the species formerly included in *Macaria* (as *Semiothisa*) in North American literature proved to belong to *Digrammia*. My recognition of *Psamatodes* as a genus separate from *Macaria* is more tenuous, but it seemed that these mainly yellow-brown, legume-feeding, Neotropical species with consistent differences in the male genitalia form a natural group that warrants generic rank. It remains for future research on the Neotropical fauna to determine whether this is supportable.

The *notata*-GROUP

This is a group of several pale, whitish to yellowish-brown species, of which *notata* (*ulsterata*) and *aemulataria* are well-known examples. The genitalia of the species treated are typical of *Macaria* in hardly differing from one species to an-

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other, regardless of the outward appearances of the moths. Two members of the group, *promiscuata* and *solisata*, have a decidedly swollen hindtibia (plus the attendant pecten on the third abdominal sternum), but in the remaining species, *M. notata*, *aemulataria*, and *juglandata*, these features are lost. It is normal in *Macaria* for the hindtibia to be enlarged and a pecten on the third abdominal sternum present.

The green or brown larvae have an unusually glossy, translucent integument, unless they are dark, in which case the integument may be glossy but opaque. The usual white stripes tend to be reduced or lost.

The Palearctic *notata* and Nearctic *ulsterata* have always been considered different species, but I found no differences and regard them as synonymous. The distribution is quite similar to those of other Holarctic Macariini; namely *Macaria signaria*, *Speranza brunneata*, and *Digrammia rippertaria*.

Following a paper on this group by Pearsall (1913), lepidopterists were misled for nearly a century in trying to treat *aemulataria* as the complex of four species as treated by Pearsall; namely *aemulataria*, *perplexata*, *versitata*, and *aspirata*. Pearsall proposed the last three names for supposed species occurring in Utah, Colorado, and Arizona respectively, but his types all represent the same very pale taxon, which I think is probably one species. If so, the name *perplexata* has page priority. One can hardly say that four species were recognized because they were never revised; no one understood what the western ones were; and names, if assigned in collections, were purely speculative. Even as recently as McGuffin (1972: 24), for example, it was thought that the populations of far-western Canada should be regarded as *perplexata*, not *aemulataria*. I recognize three species in this closely knit complex, and another form in Arizona may prove to be a species, although I do not describe it.

Macaria notata (Linnaeus)

PL. 4, FIGS. 18–23 (adult); PL. 11, FIGS. 11, 12 (larva) (RWH 6330).

Phalaena notata Linnaeus, 1758, *Systema Naturae* (edit. 10), 1: 523.

Type locality: Europe [Sweden?].

Geometra notataria [Denis and Schiffermüller], 1775, *Ankündigung syst. Werkes*

Schmett. Wienergegend: 104 (unjustified emendation).

Macaria notaria Morris, 1861, *A Natural History of British Moths*, 1: 177 (unjustified emendation).

Philobia ulsterata Pearsall, 1913, *Jour. New York Ent. Soc.*, 21: 188. NEW SYNONYMY. Type locality: Big Indian Valley, Catskill Mountains, New York. [AMNH]

NOTE—Described from a type male and type female and eight male and eight female “cotypes.” I hereby designate as the lectotype the type male, collected 28 June 1907, and it is so labeled.

Macaria notata kirina Wehrli, 1940, *Die Gross-Schmetterlinge der Erde*, 4, Suppl.: 386, pl. 30k. EXTRALIMITAL SUBSPECIES. Type locality: Not specified. Described “aus dem Ussuri-Gebiet, der Mandschurei (Maunsham, Gouv. Kirin, Juli) und Korea (Poktusan, 2,500 m).”

Macaria notata appalachiata Ferguson, NEW SUBSPECIES.

Type locality: Waterrock Knob, 5,800', Jackson County, North Carolina. [USNM]

Macaria notata is almost the only species of the genus in the continental United States or Canada with the following combination of features: an unswollen male hindtibia; absence of the pecten on the third abdominal sternum; a yellow to rust-brown head; angulate outer wing margins with a strongly emphasized subapical crescent (the black-lined concavity just posterior to the apex of the forewing); and a nearly white ground color (the only exceptions are a few unusually pale specimens of *aemulataria*). *Macaria notata* is also fairly large, nearly always with a wing length of 14 mm or more, and occurs only north of the 40th parallel except for populations in the mountains of Colorado and down the Appalachians to extreme northern Georgia. *Macaria aemulataria* is similar but has an overall yellow-brown rather than black-and-white appearance, averages smaller, and extends much farther southward to the Gulf Coast and the Mexican border. *Macaria promiscuata* is similar in size and upperside markings but has a strongly brown-banded underside (plate 4, figure 32), is yellowish, has a swollen male hindtibia (text figure 3 d), and is more southern. Both in Europe and North America, *notata* shows local irregularities of distribu-

tion, probably linked to availability of the northern birches and alders that are its preferred hosts.

I found no way to distinguish most North American *Macaria ulsterata* from the Eurasian *M. notata* and had to conclude that they are the same species. For the most part they could not even be separated as subspecies, although all North American populations seem to be univoltine, and European ones are reported to be bivoltine. A distinctive, boldly and contrastingly marked form is found in the southern Appalachians, and I describe this as a new subspecies because it is the only really different geographical segregate that I know to occur in the entire holarctic distribution of *notata*. It could be a species but at present there is insufficient evidence to support this.

Wings of *Macaria notata* strongly angulate; ground color nearly white, only lightly sprinkled with grayish brown, with usual transverse lines or bands yellowish brown to grayish brown, subparallel, mostly weak or diffuse except toward costa of forewing where they may be prominent, slightly irregular; forewing with preapical spot well defined, subrectangular, dark reddish brown to nearly black; and the dark extramedial spot at intersection of postmedial with M_3 and Cu_1 often nearly the same size, blackish, clearly dissected into four or five parts by white lines at postmedial and on veins; discal spot missing on forewing, present on hindwing. Terminal line blackish, very thin, incomplete; fringes pale yellow in fresh specimens, with or without weak dark rays opposite veins, and solidly dark in outer-marginal concavity just behind apex of forewing. Under-side whitish, and lined, sprinkled, or variegated much as on upperside but with yellowish to reddish brown in nominate subspecies, with dark grayish brown in Appalachian subspecies; and postmedial and subterminal together usually forming wide reddish-brown to grayish-brown band on both wings; otherwise much like upperside. Male antenna laminate, quite heavily setose; male hindtibia not or only slightly swollen; scales of head, palpi, patagia yellowish to reddish brown, sometimes suffused with gray; body otherwise nearly concolorous with ground color of wings; abdomen with addorsal and sometimes lateral dark spots on all but last one or two segments. Wing length: males, 13.0–16.0 mm; females, 13.0–16.5 mm; western specimens averaging slightly larger than eastern ones.

It is doubtful whether the male genitalia could

be distinguished from those of *M. aemulataria* except by their larger size. The ventral lobe of the valve and all other components are almost exactly the same shape in the two species, although some members of the *aemulataria* complex from the Southwest have a more rounded, less produced ventral lobe. The somewhat similar *S. promiscuata* also has a more rounded lobe, which, in addition, has a more prominent subterminal ridge. The female of *notata* has a very large signum, often twice the size of the signum of *aemulataria* or *promiscuata*. The genitalia of the subspecies are indistinguishable.

I reared this species from females collected in the Priest River Experimental Forest, Bonner County, Idaho, in June 1979, and Granville Ferry, Annapolis County, Nova Scotia, in July 1994. Last-instar larvae about 25 mm long, light to dark brown or greenish, with the same glossy, thin, translucent body integument as *aemulataria* and *promiscuata*; marked with 10 thin, closely set, finely sinuous, longitudinal dark brown lines on dorsum, a similar set of lines repeated less distinctly on venter, and with wide, upright, brown bars laterally on segments A2–A5 that incline obliquely forward slightly; fragments of such bars also present on segments A1 and A6. Longitudinal lines may be obscured in dark brown specimens. Head transversely and irregularly barred with bands of chestnut brown dorsally, which also extends but fades somewhat down the fronts of the parietal lobes; frons and sides, behind stemmata, much paler; thoracic legs ringed with black, the first pair less so than the others; body gray brown laterally toward base of third thoracic leg; base of first abdominal leg with dark pigmented lateral plate, and second abdominal leg with two dark, upright bands on sides; prothorax with dark pigmented patches on each side of dorsal line; supraanal plate finely spotted with brown. Larvae variable in amount of dark coloring, with lines on dorsum heavy and dark in some, much lighter and incomplete in others. Those from Nova Scotia (two lots) were darker brown than the larvae from Idaho. The larvae were reared in Maryland on *Betula populifolia* Marsh. Common food plants are species of birch, alder, and willow, judging from many specimens examined that had been reared by the Canadian Forest Insect Survey in western Canada. *Betula papyrifera* Marsh., *Populus tremuloides* Michx., and *Alnus* species were given as hosts by McGuffin (1972: 24), and white birch, yellow birch,

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red alder, mountain alder, sitka alder, and others by Prentice (1963: 401). Many European authors cite only birch and willow as food plants in the Palearctic Region. Although this species is widely reported as double brooded in Europe, it seems always to be single brooded in North America.

Macaria notata occurs in northern and central Europe and locally across cool-temperate Eurasia to eastern Siberia and North Korea; and in North America from the Canadian Northwest Territories and British Columbia to Oregon, thence to the Atlantic coast from Newfoundland to New England, extending southward to Colorado in the Rockies and to extreme northern Georgia [Brass-town Bald, Towns County].

Within our region I recognize the following two subspecies.

Macaria notata notata (Linnaeus)

PL. 4, FIGS. 18–20 (adult); PL. 11, FIGS. 11, 12 (larva) (RWH 6330).

Phalaena notata Linnaeus, 1758.

Type locality: Europe.

Geometra notataria [Denis and Schiffermüller], 1775.

Macaria notaria Morris, 1861.

Philobia ulsterata Pearsall, 1913.

Type locality: Big Indian Valley, Catskill Mountains, New York. [AMNH]

I treat *M. notata* from most of North America as the nominate subspecies because I can see no differences that would separate them from European specimens. Although the ground color of the moths is nearly white, they have a faintly yellowish or cream-colored overall appearance because of their light brown or yellow-brown markings, both above and beneath; the group of spots around the intersection of the postmedial line and veins M_3 and CuA_1 (extramedial spot) is usually at least as large as the subapical spot and more nearly black than the other dark markings on the forewing. The markings of the underside are usually tinted with light reddish brown or yellowish brown and could only rarely be described as gray brown; the head and patagia are ochre yellow to reddish brown.

The genitalia and larva were discussed under the species heading.

The distribution of nominate *notata* in North America extends from Vancouver Island, British

Columbia to Nova Scotia and Newfoundland. Northward it reaches Fort Simpson, Northwest Territories; Gillam, Manitoba; the Albany River, northern Ontario; and Lake Mistassini, Quebec. Its known limits southward are in Marion, Clatsop, and Baker counties, Oregon; Klamath, California; Larimer County, Colorado; near sea level to New Haven County, Connecticut, but in the Appalachian Mountains to western Maryland. A few specimens seen from higher elevations in West Virginia appear to belong to the Southern Appalachian subspecies. The distribution of *notata* in the northern Midwest and Great Plains states is uncertain. I personally have not encountered it anywhere in the West south of the Selkirk Mountains in northern Idaho and the Crazy Mountains in central Montana. Intensive collecting at the right season at Fort Niobrara, Nebraska, in a likely habitat with white birch, alder, and willow, also failed to yield this species.

Macaria notata seems always to be univoltine in North America, with adults flying mostly in June and July. Toward its southern limits the moths may appear earlier (17 May in Maine and Connecticut). Some dates for specific regions: 6 June–1 August for Nova Scotia; 13 July–6 August for southwestern Newfoundland; 27 May–11 August for Maine and New Hampshire; 12 July at Gillam, Manitoba; 14 June–20 July in British Columbia; 16 June–13 July in Idaho and Oregon; 17 July–5 August in Colorado.

A uniformly dark grayish-brown male of this subspecies was collected at Farmington, Maine, on 17 May 1965 (USNM) and is the only melanic example seen from North America. All markings are obliterated except the two largest groups of spots on the forewing, and it would hardly be recognizable were it not for the unswollen hind-tibia.

Macaria notata appalachiata Ferguson,
NEW SUBSPECIES
PL. 4, FIGS. 21–23 (adult).

Macaria notata appalachiata Ferguson.

Type locality: Waterrock Knob, 5,800 ft., Jackson Co., North Carolina. [USNM]

This isolated taxon occurs between 3,200 and 6,000 feet in the Southern Appalachian Mountains. It has a heavily marked, black and white appearance, without the usual yellow-brown coloring on the upperside. Although the dark markings of the upperside of the forewing are mostly

better developed, the extramedial cluster of spots at the intersection of the postmedial with M_3 and Cu_1 tends to be reduced and less sharply defined relative to the rectangular subapical costal spot than in the nominate subspecies. This is a distinctive subspecies, perhaps really a species; I have seen no specimens that are intermediate.

Ground color of wings white, heavily irrorated with gray; usual transverse lines gray instead of yellowish brown, and large spots of forewing black or nearly so; dark costal markings exaggerated in size as well as coloring, and black bar marking costal end of postmedial line commonly touching or confluent with squarish subapical spot, nearly always clearly separated in nominate *notata*; cluster of black extramedial spots at intersections of postmedial line with M_3 and Cu_1 most often smaller than subapical costal spot (same size or larger in subspecies *notata*). Underside usually heavily dusted with dark scales and with transverse bands deep reddish brown to gray brown rather than light reddish brown and thus appearing more boldly defined. Head and patagia not bright ochreous but variably infuscated, appearing dusky, although some yellowish scales remain. Wing length: holotype male, 15.0 mm; other males, 13.0–15.5 mm; females, 14–16 mm.

Genitalia apparently not differing from those of nominate subspecies.

Early stages unknown, but yellow birch, *Betula alleghaniensis* Britt., always seems to be present where this subspecies is most common.

TYPES. Holotype ♂. Waterrock Knob, 5,800', Jackson County, North Carolina; 16 July 1974; D. C. Ferguson. USNM. Paratypes: 45 ♂, 30 ♀. North Carolina. Same data as holotype; 22 June, 16, 17 July 1974 (26 ♂, 19 ♀). Balsam, 3,200', Jackson County; 20–22 June 1974; D. C. Ferguson (8 ♂, 3 ♀). Mt. Mitchell, ca. 6,000', Yancey Co.; 28 June 1967; D. C. Ferguson (1 ♀). Richland Balsam Mountain, 6,000', Jackson-Haywood County line; 30 June, 2, 3 July 1967; D. C. Ferguson (9 ♂, 6 ♀). Grandfather Mountain, 5,280', Avery County; 14 July 1974; D. C. Ferguson (2 ♂, 1 ♀). USNM; some paratypes distributed to other collections.

The type locality is 500–600 feet southwest of the Blue Ridge Parkway, opposite the trail to Waterrock Knob, which is on the other side of the road, and a short distance northwest of the small community of Balsam. The light trap had been placed in a small “bald” adjoining a mature stand of yellow birch and Fraser fir. The same road passes near the summit of Richland Balsam a few

miles southeast of the village of Balsam, and that collecting site was in Fraser fir and red spruce several hundred feet down the slope from the Richland Balsam overlook parking area. I have also seen specimens from Spruce Knob and Black Mountain, Pocahontas County, West Virginia; from the Mt. Rogers area, Washington County, and the Grindstone Recreation Area, Smyth County, Virginia; and from several sites at about 5,000' and above in Great Smoky Mountains National Park, in Tennessee and North Carolina. Also, it has been collected on the east slope of Brasstown Bald (4,200'), Towns County, Georgia. Specimens from the Appalachian Plateau of western Maryland are *Macaria notata notata*.

Macaria aemulataria Walker

PL. 4, FIGS. 24–26 (adult); PL. 11, FIGS. 13, 14 (larva); TEXT FIG. 3 c (leg) (RWH 6326, 6327, 6328, 6329).

Macaria aemulataria Walker, 1861, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, **23**: 884.

Type locality: New York. [BMNH]

NOTE—Described from male and female syntypes from New York and East Florida, of which a male from New York has been regarded as the equivalent of a lectotype. “Walker’s name was limited to the male from New York” (Pearsall, 1913: 190). All of the types were from the Doubleday collection, and the type locality is probably Trenton Falls, the main site of Doubleday’s New York collecting.

Macaria sectomaculata Morrison, 1874, *Proc. Boston Soc. Nat. Hist.*, **16**: 198.

Type locality: “Mass., New York.”

NOTE—I did not find the types of *sectomaculata*, and no lectotype has been designated.

Philobia perplexata Pearsall, 1913, *Jour. New York. Ent. Soc.*, **21**: 190, NEW SYNONYMY.

Type locality: Provo, Utah. [AMNH]

NOTE—Although two or three color forms that were previously thought to be species occur in the Southwest, Pearsall’s type material of *perplexata*, *aspirata*, and *versitata* consists mainly or entirely of the same form, the very pale one illustrated (plate 4, figure 26). I designate as lectotype the large, pale, female syntype.

Philobia versitata Pearsall, 1913, *ibid.*, **21**: 191, NEW SYNONYMY.

Type locality: Clear Creek, Co[lorado]. [AMNH]

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NOTE—Of the two syntypes in the AMNH, one is a damaged male and the other a female in good condition labeled Rico [Dolores County, Colorado]. This specimen would make the better lectotype, but the locality is not as given in the original description. I did not record the label data for the male.

Philobia aspirata Pearsall, 1913, *ibid.*, **21**: 191. NEW SYNONYMY.

Type locality: Prescott, Arizona. [AMNH]

NOTE—The types are a male taken 16 August 1909 and a female taken 22 August 1909. The latter, in better condition and bearing F. H. Rindge's slide label #1700, is hereby designated as the lectotype.

This common species, which has the appearance of a small, brownish version of *M. notata*, occurs almost throughout the temperate United States and southern Canada, wherever species of maple occur, and it is probably the most widely distributed macariine in North America. It was formerly much confused with *M. promiscuata* and *M. aequiferaria*, from both of which it differs in wing pattern, food plant, and the lack of a swollen male hindtibia. In the West it is likely to be confused with *M. perplexata*, but that is another story, which I will recount later.

Typical eastern *aemulataria* with ground color whitish to cream colored or very pale brown, usually so heavily peppered or suffused with gray-brown to yellow-brown scales as to make the wings appear darker; pale ground color often predominates only in median and basal areas, especially of hindwing. Forewing markings similar to those of *notata* and *promiscuata*; with subparallel antemedial, medial, and postmedial bands present but not boldly marked; with large, roundish, extramedial spot between R_5 and M_1 that is dissected by fine, pale lines into a somewhat reticulate pattern of about six sections; and with smaller, quadrate, chestnut-brown postmedial spot at costa. Hindwing without dark markings, but with a nearly straight or slightly sinuous brown medial band, a usually weak, more sinuous, convex postmedial band that may consist of a single or multiple lines; outer third more solidly brownish than basal and middle thirds. Undersurfaces of both wings often paler but highly variable from almost white to heavily dusted with brown scales, essentially without postmedial spots but with transverse bands more prominent than above and often in part bright reddish brown. Medial and postmedial bands of underside often multiple, incorporating 2–3 separate lines,

especially the postmedial, but may be incomplete (postmedial band on undersurface of *promiscuata* always well developed and complete). Wing length: males, 10–13 mm ($n = 78$); females, 11–14 mm ($n = 84$). Some western specimens differ, mainly in color (geographical variation discussed below).

Male genitalia typical of the *Macaria notata*-group, with only subtle differences. Relative to *notata*, aedeagus slightly shorter and stouter, and saccular lobe more tapered apically. *Macaria promiscuata* and *M. solisata* have the saccular lobe wider and more broadly rounded at apex; ventral margin of juxta straight or only slightly concave, not so clearly emarginate as in *aemulataria*; process of gnathos and two spinose setae of uncus slightly longer; and sclerotized band on vesica about twice as large as that of *aemulataria*.

Female genitalia essentially indistinguishable from those of other members of the *notata*-group, although smaller than those of *notata*. However, the female genitalia of *promiscuata* and *solisata*, as well as being larger, differ slightly in having the structures associated with the ostium enlarged and more heavily sclerotized.

Although several variants that might be considered subspecies do occur in the West, Pearsall's types all represent essentially the same form, which is larger and consistently paler than eastern *aemulataria*, in some areas with a nearly white ground color (plate 4, figure 26). When I encountered these whitish specimens in Utah, I too concluded that they were distinct and perhaps they are, but more material now available suggests that the various western forms in different regions or mountain ranges may grade into one another or nearly so in a confused pattern of variation. Although the very pale form occurs locally in Utah, Colorado, and Arizona, more "normal" specimens of several degrees of brownishness also occur in those states. The population occupying Frijoles Canyon, Bandelier National Monument, New Mexico has moths with a rich, reddish-brown coloring, darker than any eastern specimens. Some specimens from the Southwest are almost exactly like eastern ones, although usually a little larger. I reared a brood from such a specimen taken in Bear Canyon, Santa Catalina Mountains, and found that the larvae lack the dark markings common in eastern larvae.

The most distinctive geographic variant of *aemulataria* occurs in southern California. All of the material seen is from Los Angeles and Bur-

bank, Los Angeles County, and Wheeler Hot Springs, Ventura County. This form is yellowish brown to gray brown, moderately dark for the species, has the extramedial spot reduced or nearly absent, and all transverse lines well defined on both wings above and beneath. I considered that it might be a species but found no morphological differences. The larva of this form is undescribed and the host unreported.

To summarize, all regions east of the Rocky Mountains and much of the Pacific Northwest in British Columbia, Washington, and Oregon are occupied by the nominate form, *aemulataria* (plate 4, figures 24, 25); the southern Rocky Mountains and probably the Great Basin Region by a somewhat larger, brighter form (plate 4, fig. 26) that may have a nearly white ground color and possibly a slightly different larva (the names *perplexata*, *aspirata*, and *versitata* are available for this if it should in future be given specific or subspecific rank); and southern California has a different, smaller, yellowish- to grayish-brown form with reduced black spots and well-defined lines as described above (48 examined from Los Angeles and Ventura counties). In the Pacific Northwest and northern Rockies, *aemulataria* and *perplexata* appear to intergrade and differ from eastern *aemulataria* only in minor ways.

The larva has the smooth, glossy, translucent integument seen also in *notata* and *promiscuata*, but it most commonly has few if any dark markings. The body is predominantly green and marked with thin, whitish to pale yellow addorsal, subdorsal, dorsolateral, and lateral lines. The addorsal and lateral (spiracular) lines are widest; the other lines may be interrupted and indistinct. When blackish or dark purplish markings are present they may be of two kinds: a distinct, round, black spot that may be present in the middle of A2 between the dorsolateral and lateral lines; or this same space may be variably filled with blackish suffusion from just a trace or none to an almost complete, wide band extending almost the whole length of the body and dorsolaterally onto the parietal lobes of the otherwise yellowish-green head to a degree proportional to the intensity of its dark coloring. The same dark band may also be interrupted periodically to form a series of about five blackish, supraspiracular streaks from about A1 to A5. Lateral surfaces of thoracic legs and first proleg may be tinged with dark purple to black. Larvae of both spring and summer generations that I reared in Maryland

had variable dark markings, although many were nearly all green. A brood that I reared from the Santa Catalina Mountains, Arizona, had unusually distinct longitudinal yellow lines but no dark markings at all. Length at maturity: 20 mm.

The larvae feed on species of maple (*Acer*) (Aceraceae), and I could not induce them to eat anything else. Upon trying to test Forbes's (1948: 44) assertion, "Larva on locust," I found it untrue. The larvae refused black locust and starved. McGuffin (1972: 24), curiously, gave no host information. Two broods that I reared in Maryland chose *Acer rubrum* Linnaeus and were easily reared on it. At two sites in the West where I found *aemulataria* particularly common, Fort Niobrara National Wildlife Refuge, Nebraska, and Frijoles Canyon, New Mexico, the only maple present was boxelder, *Acer negundo* Linnaeus, and I reared the Arizona brood on this species. At Arizona sites where I collected this species, however, the maples present were *Acer grandidentatum* Nutt. or *A. glabrum* Torr.

This species has a coast-to-coast distribution in the temperate zone. Southwest Newfoundland to British Columbia, north at least to central Alberta, and southward to Georgia, the Gulf States, East Texas, the Guadalupe Mountains, Texas, New Mexico, the mountains of southern Arizona, and on the Pacific Coast to Los Angeles County, California.

Some flight periods for different geographic areas are as follows: Nova Scotia, 3 June–9 August (probably one brood); Quebec, about 20 May–9 August (Handfield, 1999); New York/Pennsylvania, 9 May–26 August (two broods in more southern areas); Maryland, 10 April–16 September, with such an intermingling of emergences that the broods cannot be differentiated except for the first; East Texas, 10 March–20 November; Utah, 6 June–27 August; Arizona, 21 March–21 August; California, 14 April–26 October.

Macaria juglandata Ferguson, NEW SPECIES
PL. 4, FIGS. 27–29 (adult).

Macaria juglandata Ferguson.
Type locality: Los Angeles, California.
[USNM]

This species of coastal southern California is closely related to *aemulataria* but differs in coloring, in the transverse bands of the wings, reduction of the extramedial spot of the forewing,

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in the near absence of the usual double row of black dorsal dots on the abdomen, and in being seasonally dimorphic, unlike its close relatives. It has an unusual host, walnut, from which it has been reared many times, but by very few collectors. Nearly all specimens in collections were reared or collected by F. P. Sala (Los Angeles) and N. McFarland (Santa Monica Mountains). It seems likely that the habitat of this species is effectively isolated from that of its nearest relatives.

Differs from *aemulataria* in more saturated reddish- or yellowish-brown coloring of wings, always darker in early spring specimens; wings marked with a more complete, thin, well-defined set of transverse bands on both wings, above and beneath, and with the more regular and roundly convex hindwing postmedial being especially noticeable. Whitish ground color characteristic of other species reduced, and dark extramedial spot or patch of forewing reduced or absent. Very worn females may appear whitish. Especially significant is the almost complete loss of the double row of black dorsal spots on the abdomen. Wing length: holotype, 11 mm; other males, 10–12 mm; females, 11.5–13.0 mm.

There are no structural differences in the genitalia or otherwise that would distinguish *M. juglandata* from other members of the *aemulataria* complex, but that is not unusual in the Macariini.

TYPES. Holotype ♂. Carnavon Way, Los Angeles 90027 [postal code], California; 29 March 1981; F. P. Sala. USNM. Paratypes: 18 ♂, 18 ♀. California. Same locality and collector; 29 March, 16 July, 2, 11, 27 August, 4–9 September, 9 October (9 ♂, 7 ♀). Burbank, Los Angeles County; 18 August, 6 September 1966; F. P. Sala (1 ♂, 1 ♀). Roscoe [Sun Valley district], Los Angeles; 24 March 1947; [collector not given] (1 ♂). Benedict Canyon, 5 mi N Beverly Hills, Los Angeles County; 2, 26, 27 July, 2–26 August; N. McFarland (3 ♂, 8 ♀). Oak Pass Road, Santa Monica Mountains, 1,100' (elevation given on one label only), 5 mi N Beverly Hills, Los Angeles County; 16 March 1956, 4, 25 June 1957; N. McFarland (1 ♂, 2 ♀). Wheeler Hot Springs, Ventura County; 27 July 1943; D. Meadows (3 ♂). CAS, CNC, LACM, UCB, USNM.

The description plus the illustrations should cover most details adequately, as the species is distinctive within the area where it occurs. Spring specimens (plate 4, figure 27) are often marked with a much darker shade of brown than are those that fly later in the season, and summer ones, especially those from the Santa Monica Mountains, are more likely to be a pale, reddish-brown shade.

No seasonal dimorphism of this nature occurs in *Macaria aemulataria*.

The early stages have not been described, but the larva is reported to feed on California walnut, *Juglans californica* S. Watson (N. McFarland, F. P. Sala, pers. comm.), which is the only native walnut whose limited distribution coincides with that of the moth.

The localities given for the types represent the entire known distribution for this species.

Macaria promiscuata (Ferguson)

PL. 4, FIGS. 30–32 (adult); PL. 11, FIG. 15 (larva); text fig. 3 *d* (leg) (RWH 6331).

Semiothisa promiscuata Ferguson, 1974, *Jour. Lep. Soc.*, **28**: 297.

Type locality: Devil's Den State Park, Washington Co., Arkansas. [USNM]

This species superficially resembles *Macaria aemulataria*, and the two were confused prior to 1974. However, *promiscuata* is much more distinct than it may appear and is easily distinguished from both *aemulataria* and *notata* by the regular, boldly defined, intensely reddish-brown postmedial bands on the undersides of both wings (plate 4, figure 32), the much enlarged male hindtibia, and the presence of a transverse comb of long bristles (pecten) on the underside of the third abdominal segment of the male. It is generally larger than *aemulataria*, about the same size as *notata*, and it is mostly confined to the southeastern quarter of the continental United States.

Wing shape, general coloring, and pattern of upperside almost exactly like those of *aemulataria*, but ground color in basal and medial spaces often paler, nearly white, and slightly more lustrous and translucent. Forewing with usual pattern of three brownish transverse lines, nearly perpendicular to inner margin, slightly waved, with postmedial line darkest, and with medial line usually situated closer to antemedial than to postmedial line; cluster of blackish spots opposite cell well developed and approaching chestnut-brown subapical costal spot so closely that the two groups form an almost continuous band. Hindwing whitish or pale yellowish brown basad of postmedial, usually light brown beyond it. Underside sparsely but coarsely speckled with deep reddish brown and distinctively marked with well defined, bright reddish-brown postmedial bands on both wings, that of forewing straight and directed toward tornus, that of hindwing evenly

curved; bands closely preceded on both wings by a thin, very irregular line of the same color that follows a roughly parallel course. Male antenna with setae about as long as thickness of shaft; male with usual transverse comb of bristles on third abdominal sternum (lacking in *aemulataria* and *notata*) and very enlarged hindtibia, bearing a long hair pencil concealed within a full-length groove down posterior side of tibia. Head and patagia reddish brown to yellowish brown, contrasting with ivory-colored thorax; abdomen marked with paired dorsal black spots for almost its full length. No seasonal or geographic variation apparent. Wing length: males, 12–13 mm; females, 12–15 mm.

Male genitalia close to those of *aemulataria* but differ as follows: ventral (saccular) lobe of valve very broad and distally rounded; elevated, bladelikey ridge near outer end of this lobe consisting mainly of a single component in *promiscuata*, of two components in *aemulataria*; ventral margin of juxta straight or hardly concave in *promiscuata*, clearly emarginate in *aemulataria*; sclerotized structure in vesica almost twice as large in *promiscuata*. Female genitalia doubtfully distinguishable; larger, and with sclerotized structures associated with ostium slightly enlarged.

I reared *promiscuata* from a female taken in my garden (Montgomery County, Maryland) on 1 August 1986, and this is the first published account of the early stages. Last instar larva 25 mm long at maturity, distinctively colored, mostly dark purplish to black dorsally above level of spiracles, as well as laterally on thorax and abdominal segments six and seven, and yellowish green ventrolaterally and ventrally. In live larva, purplish integument almost black, cut by many longitudinal, thin, geminate, finely irregular magenta or lavender lines. Purplish area also variable in extent, commonly covering entire dorsum, leaving some greenish dorsal integument only on thorax and last three abdominal segments; however, dark dorsal area may be variably reduced to point of leaving only an incomplete subdorsal band. Patch of dark coloring always remains on sides of thorax and abdominal segments six and seven; prothoracic leg yellowish green, mesothoracic leg partly dark, metathoracic leg all black, at least laterally; proleg of sixth abdominal segment also black laterally; head yellowish green, without dark markings. The green and purplish coloring was a good match for some of the dark red petioles of the food plant, but the larvae rested on

the undersides of the leaves rather than on the petioles.

The young larvae, when offered leaves of nearly all the kinds of trees and shrubs that grew in the vicinity, showed a clear preference for redbud, *Cercis canadensis* Linnaeus [= *Cercis occidentalis* Torrey ex Gray] (Fabaceae), and thrived on it. They did some preliminary nibbling also on red maple, *Acer rubrum* Linnaeus (Aceraceae), but it became clear that maple was unsuitable as a food plant. They ate nothing else. The overall distribution corresponds so well to that of redbud that this plant seems certain to be the natural host, especially inasmuch as the sister species, *M. solisata*, from the mountains of Tamaulipas, Mexico, was also reared from *Cercis canadensis*.

The apparent northern and western limits of distribution for *promiscuata* approximate a line drawn from Baltimore, Maryland to Madison, Wisconsin, thence to southeastern Kansas, and south to the vicinity of Houston, Texas. It has been taken at many places within this area, including several counties of Maryland (probably throughout); Arlington, Virginia; Morgan County, West Virginia; Ohio; at Elkhart and Decatur, Illinois; Kentucky; Tennessee; Washington County, Arkansas; Labette County, Kansas; Sequoyah County, Oklahoma, and Montgomery County, Texas. I saw one specimen labeled Bedford, New York, 21 July 1944 (Florida State Coll.). Although there are many records for the South, including the Gulf States, *promiscuata* has not been collected in Florida south of Alachua, Jackson, Levy, Liberty, and Volusia counties, or in Texas south of Montgomery County.

Collection dates for most states do not show discrete broods, although at least two broods obviously occur even at the northern edge of its range. For Maryland there is sufficient information to reveal two clear broods and perhaps a partial third, 9 May–6 July and 22 July–9 September. Data available for other areas seem to show the same pattern; e.g., April–September for Missouri, Arkansas, Kansas and Oklahoma; March to August for Louisiana; and March, April, May, August, and September for eastern Texas.

This species has a locally irregular or discontinuous distribution and is never very common. The habitats in Maryland include the mainly deciduous forests of oaks, hickories, tulip tree, and Virginia pine near the eastern edge of the Piedmont, as well as floodplain forest of the Potomac

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River and coastal plain of the Delmarva Peninsula, where the vegetation is different. The essential element is the presence of redbud.

Macaria solisata Ferguson, NEW SPECIES
PL. 4, FIGS. 33, 34 (adult).

Macaria solisata Ferguson.

Type locality: Rancho del Cielo, 3,500' [1,057 m], 6 km NNW of Gomez Farias, Tamaulipas, Mexico [USNM]

NOTE—It is a pleasure to name this new species after its collector, Dr. Maria Alma Solis, Research Entomologist and pyralid specialist of the Systematic Entomology Laboratory, Agricultural Research Service, U. S. Department of Agriculture, located at the National Museum of Natural History. Rather than the usual Latin feminine genitive-case ending (*solisae*), I have taken the liberty of adding a traditional geometrid suffix, *ata*, for the sake of euphony.

In 1974, I described *Semiothisa promiscuata* from the eastern United States. Although widespread from Maryland to Kansas and southward to Florida and Texas, *promiscuata* had been overlooked earlier because of its superficial resemblance to *M. aemulataria* (Walker), a more common species that is not as closely related to *promiscuata* as it appears. It seemed unlikely at the time that *M. promiscuata* or anything really close to it would occur south of the U. S./Mexico border, especially another species on the same food plant. Although members of a Neotropical species complex to which the names *regulata* Fabricius, *notata* Stoll, *enotata* Guenée, and *centrosignata* Herrich-Schäffer refer are quite similar superficially, these moths are clearly distinct from the more northern Nearctic ones in wing pattern and genitalia. Nevertheless, in 1982, a species very closely related to *promiscuata* was found in the mountains of northeastern Mexico by Alma Solis, who collected and reared the material that now becomes the type series of a new species named for her.

After considerable effort in collecting females and trying different plants, I identified the food plant of *promiscuata* in Maryland in 1986, only to learn that Dr. Solis had reared a closely related, undescribed Mexican species on the same plant, *Cercis canadensis* Linnaeus (Fabaceae), four years earlier. Her data are based on larvae found feeding on this plant in nature, the more reliable method; my larvae were from eggs laid by a captive female and then offered a choice of many

plants, from which they chose redbud. However, the two events verify each other, leaving little doubt that redbud is the natural host of both species. No other Macariini are known to feed on a species of *Cercis*, although several diverse complexes of this tribe, probably including the *regulata*-complex mentioned above, feed on other woody-stemmed Fabaceae.

Macaria solisata is closely similar to *M. promiscuata* of the eastern U. S. but differs in being of a darker brown color, with generally heavier markings, and, on the underside, lacking the regular, sharply defined, contrasting, bright reddish-brown bands just distad of the postmedial lines on both wings. Some dark shading is present at this position, but it is darker, more diffuse, often interrupted, and may mimic the dark, parallel line preceding it to form a double band. The angle near the middle of the outer margin of the hindwing is usually more produced and attenuate, at least in females, rather than being a right angle or slightly acute as in *promiscuata*. Darker, more irrorated wing surfaces, above and beneath, and convex, double postmedial bands of the underside provide the most convenient recognition features for this species.

Body, antennae, palpi, and legs like those of *promiscuata*, dusted or spotted with brown, but with ground color less yellowish, and markings less reddish; collar and front brown, not bright reddish brown as in *promiscuata*; male antenna setose, with setae slightly longer than thickness of shaft; female antenna simple; hindtibia of male enormously developed, containing a large hair pencil. In wing characters, sexes nearly alike, with male slightly paler and having a less sharply angled hindwing. Both wings above heavily irrorated and in part suffused with gray brown, largely obscuring dull-white ground; transverse lines dull gray brown, somewhat diffuse, not contrasting. Forewing with convex antemedial band, almost erect but slightly waved medial band, and a pair of similar postmedial bands, compressing a thin whitish line between them and straddled opposite cell by cluster of usually five nearly black spots; space between these spots and costa, just distad of line, filled by dark-brown subapical patch. Except for dark fringe in preapical concavity, characteristic of group, fringes of both wings dull yellow with gray-brown rays opposite veins. Hindwing generally similar but lacking all dark postmedial spots, with nearly straight but slightly waved antemedial band, a double but not

strongly developed, convex, postmedial band, and a small, dark discal spot. Ground color of underside brighter and more yellowish, heavily and coarsely irrorated with chocolate brown. Forewing with single antemedial and medial lines and double postmedial lines nearly straight but slightly irregular, chocolate brown, subparallel. Undersurface of hindwing like uppersurface but with markings darker, more contrasting. Length of forewing: holotype, 13 mm; other males, 13 mm; females, 14–15 mm.

Male genitalia similar to those of *promiscuata* but with tip of uncus appearing more broadly truncated, distal process on gnathos slightly wider, with two almost equally developed ridges near outer margin of ventral lobe of valve instead of one being large and the other obsolescent as in *promiscuata*, and a shorter aedeagus, less produced apically; distance from attachment of anellus (near middle of aedeagus) to apex of aedeagus of *solisata* related to that of *promiscuata* as the ratio 28:35, based on specimens of about equal size. Eighth sternum deeply cleft almost to middle as in *promiscuata*.

Female genitalia similar to those of *promiscuata* but with slightly narrower ductus bursae and differences in shape of other sclerotized structures associated with ostium.

TYPES. Holotype ♂. Rancho del Cielo, 3,500' [1,057.5 m], 6 km NNW of Gomez Farias, Tamaulipas, Mexico; reared 6 Aug. 1982 from larva found feeding on *Cercis canadensis* [= *Cercis occidentalis*]; M. A. Solis. USNM. Paratypes: 15 ♂, 4 ♀. Same data as for holotype; 30 July–6 August 1982. The larvae had pupated 18–31 July 1982. Most paratypes in USNM.

Apart from the food plant, redbud (*Cercis canadensis* Linnaeus), and collection dates (see introductory remarks), nothing is known of the life history. No description or photo of the larva is available.

Unassociated species

I assign two species to this category because they do not fit conveniently elsewhere. *Macaria carpo* is a small tropical legume feeder established in southern Florida. It is typical of *Macaria* in every way but has a somewhat different combination of adult features. The next most closely related species of which I am aware is the South American *M. infimata* Guenée whose male genitalia differ from those of *carpo* only in minor respects.

Macaria carpo (Druce)

PL. 4, FIGS. 35–38 (adult); text fig. 40 *a, b* (♂ gen.); TEXT FIG. 40 *c* (♀ gen.).

Semiothisa carpo Druce, 1893, *Biologia Centrali-Americana*, 2: 130, pl. 53 fig.13.

Type locality: Not established pending designation of lectotype.

NOTE—An unstated number of syntypes was listed from: “Mexico, La Venta 300 feet, Rio Papagaio 1,200 feet, all in Guerrero (H. H. Smith), Paso de San Juan in Vera Cruz (coll. Schaus); Guatemala, Volcan de Santa Maria Pacific Slope (Richardson); Costa Rica, Volcan de Irazu 6,000 feet (Rogers); Panama, Chiriqui (Ribbe, in Mus. Staudinger).” A lectotype has not been designated.

NOTE—*Macaria infimata* Guenée (1857 [1858]: 81), from Cayenne, is similar to *carpo*, and I had thought that they might be the same species. However, the male holotype of *infimata* in the BMNH has genitalia that are slightly different from those of *carpo*. I believe that *infimata* is a closely related but different Neotropical species, and that the name *carpo* is applicable to the species of southern Florida. Records of *infimata* from Florida reported by Kimball (1965: 178) remained until now an unresolved issue, but a specimen so identified in the Kimball collection in the MCZ proved to be nothing other than a worn *Digrammia gnophosaria* (Guenée). It thus appears that *M. infimata* can be dismissed from consideration as part of the U. S. fauna.

Macaria fidelis Warren, 1897, *Nov. Zool.*, 1897: 429.

Type locality: Costa Rica. [BMNH]

Semiothisa punctistriata Warren, 1906, *Proc. U. S. Natl. Mus.*, 30: 530, NEW SYNONYMY. Type locality: Orizaba, Mexico. [USNM]

NOTE—The holotype is a female that is almost an exact match for specimens from Florida.

NOTE—*Semiothisa pandaria* Schaus, 1913, *Ann. Mag. Nat. Hist.*, 11: 342 (type locality: Guapiles, Costa Rica, 850 ft. alt.), also appears to be closely related to *carpo*, but the female holotype and two other female specimens in the U. S. National Museum of Natural History are slightly larger and darker than most *carpo*.

This is the first report of *Macaria carpo* from the United States, where it has been collected mainly in Miami-Dade County, Florida. It is a small brown to yellow-brown species, slightly smaller than *M. aequiferaria*, which it may superficially resemble, even having similarly bipectinate male antennae. However, *carpo* does not have the head and collar a contrastingly different color from the

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rest of the body, a conspicuous fovea in the male forewing, an enlarged male hindtibia, or a pecten on the third abdominal sternum of the male. Also, the bands on the undersides of the wings in *carpo* are more sharply delineated, with the inner edges of the outermost dark bands of both wings nearly straight and directed more nearly toward the anal angles. The genitalia, although not differing greatly from those of *aequiferaria* or the various pine feeders, are different enough to be recognized (text figure *a-c*).

Upperside dull gray brown to reddish brown, fairly uniform; markings often reduced; faint discal spots on both wings; lines subparallel, not very distinct and only occasionally thickened to form dark spots at costa; one or two dark spots may be present in outer third of forewing, one subapically and the other opposite discal cell; outer third of both wings may be somewhat darker than rest of wing, and with subterminal band wanting except for two dark spots mentioned; terminal line obsolescent; fringes concolorous with wing. Underside pale brown, dusted with dark scales, with variable but often distinct transverse lines, and a contrasting dark brown subterminal band on both wings, often wide enough to reach outer margin. This dark outer band evidently delimited proximally by subterminal rather than postmedial line, because latter may be present separately immediately preceding it. Inconspicuous discal spots usually present on both wings beneath. Scales of head and patagia concolorous with those of thorax, abdomen, and wings, or nearly so. Abdomen of male unmarked, of female with small paired black dots on dorsum of first two or three segments.

Male forewing with small, fully scaled depression near base on underside but without a fully developed fovea. Male antenna nearly bipectinate, with branches shorter than thickness of shaft, heavily setose; female antenna simple. Front and palpi about like those of *aequiferaria*, except that nearly all of third palpal segment is contrastingly paler than second segment; in *aequiferaria*, no more than tip of third segment is pale, and it is often all brown. Male of this species also lacks swollen hindtibia, the sclerotic process protruding into opening of tympanic cavity, and the pecten on third abdominal sternum, all of which are present in *aequiferaria*. Wing length: males, 10.0–12.0 mm; females, 10.0–12.5 mm.

Forty-one specimens that I collected at the

University of Florida Tropical Plant Research Station at Homestead in November 1976 are fairly uniform in appearance and agree well with most of the 40 specimens from Mexico and Central America in the U. S. National Museum of Natural History. Females collected by T. S. Dickel in Fuch's Hammock, near Homestead, are much more heavily marked. As all specimens were collected in the autumn, nothing can be said about seasonal variation of *carpo* in Florida.

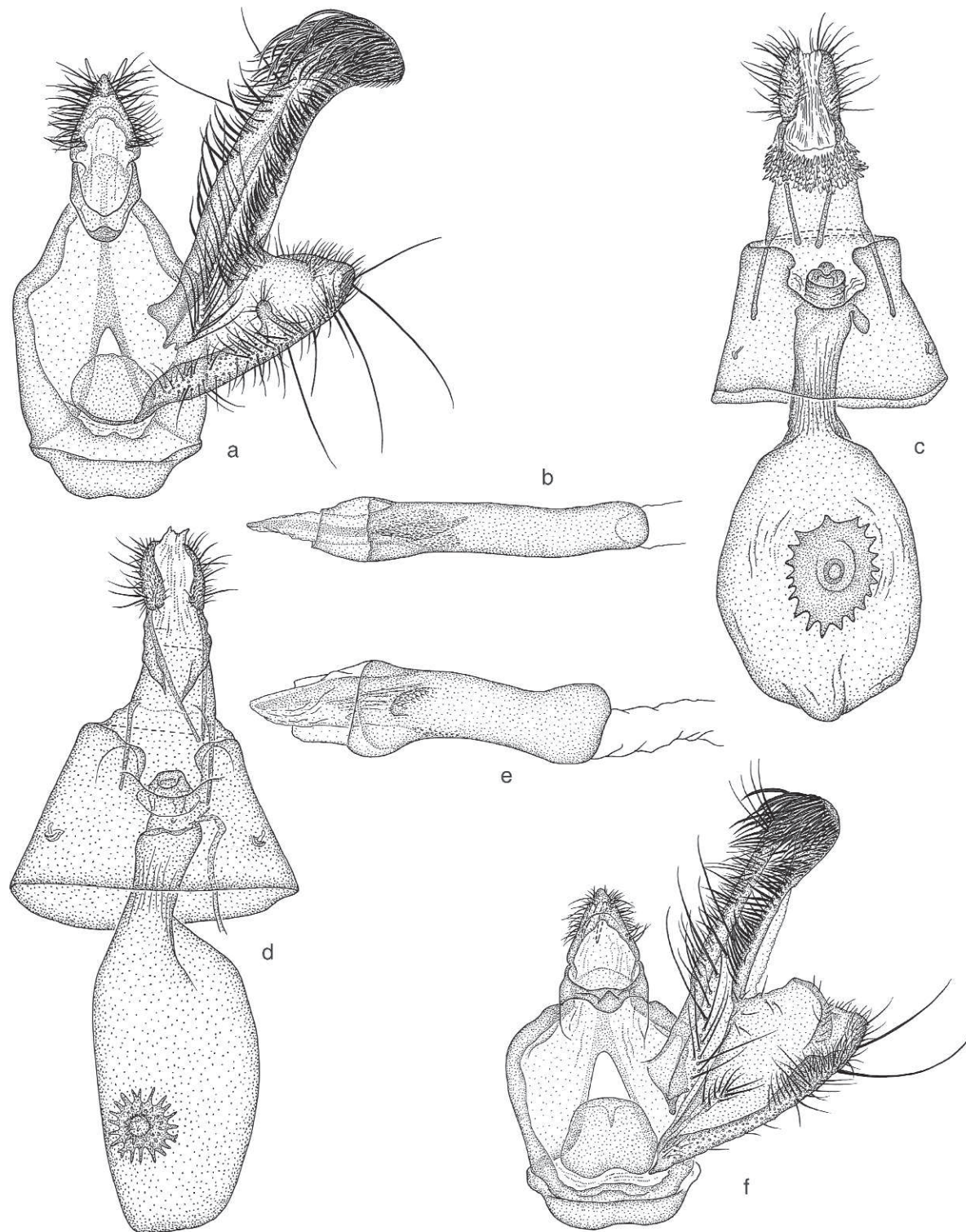
The male genitalia are distinctive in many ways but perhaps best compared to those of *aequiferaria* (text figure 40 *e, f*). Uncus of *carpo* more slender and pointed; costal process of valve more bent toward tip, and tip more heavily setose; ventral lobe smaller relative to costal lobe, hardly more than half size of ventral lobe of *aequiferaria*; a process arises from inner face of ventral lobe about halfway out in *carpo*, much nearer base in *aequiferaria*, and it is larger, twice as long as wide, in *carpo*; aedeagus with prominent, spinelike sclerite; and eighth sternum cleft only for one-third of its length in *carpo*, one-half its length in *aequiferaria*.

Female genitalia with large stellate signum much wider than ductus bursae, and with short points; signum of *aequiferaria* about as wide as ductus bursae and with long points (text figure 40 *d*). Ductus bursae of *carpo* only half as wide as that of *aequiferaria*, hardly wider than sclerotized structures (sterigma) associated with ostium bursae, which also are somewhat differently shaped.

Macaria carpo was reared from earpod tree, or guanacaste, *Enterolobium cyclocarpum* (Jacq.) Griseb. (Fabaceae) in Costa Rica (D. Janzen); also from "*Schwartzia cubensis*," a plant name that I have not been able to verify. [Possibly a species of *Solandra*, Solanaceae—ed.]

Within our region, *carpo* is known only from Miami-Dade County, Florida, with the exception of one record from Winter Park, Orange County, taken 12 October 1942 (LACM). Elsewhere, it occurs widely in several states of southern Mexico, and in Guatemala, Costa Rica, Panama, and at Havana, Cuba. The U. S. National Museum of Natural History collection contains specimens from all of those places. The Florida material was collected 12 October 1942, 31 October 1985, 14–21 November 1976, 24 November 1985, and 21, 22 December, 1955. I am aware of no other U. S. records.

I compared *carpo* with *aequiferaria* only because they are superficially similar, not because

FIGURE 40: GENITALIA OF *MACARIA* SPECIES

a. M. carpo, male genital capsule; Homestead, Miami-Dade County, Florida (USNM 58013). *b.* Aedeagus; Homestead, Miami-Dade County, Florida (USNM 58013). *c.* Female genitalia; Homestead, Miami-Dade County, Florida (USNM 56979). *d. M. aequiferaria*, female; McClellanville, Charleston County, South Carolina (USNM 58026). *e. M. aequiferaria*, aedeagus; McClellanville, Charleston County, South Carolina (USNM 58025). *f. M. aequiferaria*, genital capsule; McClellanville, Charleston County, South Carolina (USNM 58025).

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they are closely related. *Macaria carpo* is especially likely to be confused with small, summer-brood specimens of *aequiferaria*, and may occur in the same general areas in southern Florida. *Macaria carpo* is one of the many Neotropical legume feeders, not closely related to anything in the North American fauna, but, as indicated earlier, very close to the South American *M. infimata* Guenée.

The *bicolorata*-GROUP

The following species (*aequiferaria*, *bisignata*, *masquerata*, *bicolorata*, *adonis*, *ponderosae*, *transitaria*, *distribuaria*, *sanfordi*, and *minorata*) are closely related to members of the *signaria*-group, all except *aequiferaria* feeding on Pinaceae, and having mostly similar or indistinguishable genitalia. However, they are brown instead of gray, have no apparent fovea, feed exclusively on pine, and mostly have a more southerly distribution. The largest species, *M. distribuaria*, extends well into the northern Neotropics. If a vestigial fovea is present, it is concealed by a covering of scales. The larvae tend to be associated with one species of pine or a few related species, but most are easily reared on other pines with which they would not be associated in nature.

The Palearctic type species of *Macaria*, *M. liturata* (Hübner), is a member of this group but does not occur in North America, being replaced in our fauna by the very closely related *M. adonis* Barnes and McDunnough.

Macaria aequiferaria Walker

PL. 4, FIGS. 39–45 (adult); PL. 12, FIG. 1 (larva); TEXT FIG. 3 g (wing bases); TEXT FIG. 40 e, f (♂ gen.); TEXT FIG. 40 d (♀ gen.) (RWH 6335).

Macaria aequiferaria Walker, 1861, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **23**: 886.

Type locality: East Florida. [BMNH]

Macaria postrema Walker, 1861, *ibidem*, **23**: 887.

Type locality: East Florida. [BMNH]

Macaria subpunctaria Walker, 1861, *ibidem*, **23**: 918.

Type locality: Honduras. [BMNH]

Macaria morosaria Walker, 1861, *ibidem*, **23**: 942.

Type locality: Not given. [BMNH]

NOTE—All four Walker names were based on individual male specimens, which are therefore holotypes. The types of *aequiferaria* and *postrema* are specimens of the late spring brood, probably collected by Doubleday at St. Johns Bluff, Duval County, Florida in 1838. This brood would be expected to fly there in March and April. When I saw the type of *morosaria*, I had no doubt that it represents the same species as *aequiferaria* although the source of the holotype is not known. The type locality for *subpunctaria* (Honduras) may well be correct because the range of Montezuma bald cypress, *Taxodium mucronatum* Ten. (Taxodiaceae) extends to that region.

Macaria aequiferaria is a common species from the northernmost cypress swamps in Maryland and Delaware to Florida, the Gulf States, Texas, and far into Mexico or beyond. Although it is the only species in the Macariini known to feed on a member of the Taxodiaceae, it represents hardly more than a subgroup of the large species complex on Pinaceae and has similar genitalia. In wing shape and pattern, it suggests a small, brown version of *M. fissinotata*, and indeed has a fovea in the male forewing characteristic of the northern conifer-feeding Macariini. However, the fovea (text figure 3 g) is unusually large and complex, and it simplifies identification of *aequiferaria* because no other brown species of *Macaria* in the Southeast has this structure. *M. aequiferaria* is seasonally dimorphic, with a dark early spring form and a lighter, yellowish-brown, often slightly smaller summer form. The larva is unusually distinctive for a macariine.

The summer form, which may continue into the fall as a fourth brood, has often been confused with *M. aemulataria*. Males are easily distinguished because *aequiferaria* has a conspicuously swollen hindtibia, a pecten on the third sternum, and the large fovea mentioned above. Females are not as easy to separate, but in *aequiferaria* the dark extramedial spot or cluster of spots near the intersection of M_3 and CuA_1 on the forewing is less clearly dissected by yellow veins, the brown postmedial band on the underside of the forewing (plate 4, figure 45) is nearly parallel to the outer margin, and the corresponding band on the hindwing is likely to be curved, also more nearly parallel to the outer margin.

Upperside grayish brown to yellowish brown, finely mottled; forewing with antemedial, medial, and postmedial lines distinct or indistinct, brown,

nearly straight, parallel, the postmedial, which may be most distinct and blackish, bending inward somewhat toward costa; all three lines, plus subterminal band, widened and darkened to form dark spots at costa; postmedial and subterminal also thickened and interrupted to form two to four dark spots opposite cell; forewing without discal spot. Hindwing with two or three transverse lines that may be straight or convex; discal spot present. Both wings, especially in females, may be paler basad of postmedial and darker beyond it; terminal line thin, weak, usually broken into series of dots or crescents between veins; fringes concolorous with wings but often dark in outer-marginal concavity behind apex of forewing. Underside pale yellowish, variably dusted with brown and with two reddish-brown transverse bands on each wing; outer band consisting of two lines with complete or incomplete brown filling between them; outer band of forewing thickened and shading to brighter reddish brown toward costa; small blackish discal spots on both wings. Head yellowish to reddish brown; collar darker brown. Body otherwise concolorous with upper surfaces of wings; abdomen with usual paired, black, segmental spots on dorsum. Male forewing with large, complex fovea not found in any other species with which it is likely to be confused. Male antenna bipectinate with short branches about as long as thickness of shaft; female antenna simple. Palpi of sexes nearly equal, with end of second segment barely surpassing front, and short third segment decumbent. Male hindtibia enlarged and longitudinally grooved on inner side, although without a hair pencil in any specimen examined.

Although fairly consistent in size, this species shows some seasonal and geographic variation in peripheral areas of its distribution. Wing length throughout most of range: males, 10.5–13.0 mm, with average of 12.14 mm ($n = 57$); females, 10.5–13.5 mm with average of 11.56 mm ($n = 64$). Summer specimens are usually slightly smaller than spring ones. However, a sample of nine male and 11 female specimens of the early spring form from the Big Cypress Swamp, Collier County, Florida, 24 February 1985, are the southernmost that I have seen from the United States and also the smallest, averaging about one mm less in wing length than those from farther north. Five males and seven females of the late spring (second) brood from Pedernales Falls, Blanco County, Texas, 4 May 1973, average 11.6 mm for

males and 13.0 mm for females, considerably larger than normal.

Spring and summer generations of *aequiferaria* differ in appearance as follows: **Early spring form** (plate 4, figures 39, 40)—This is the darkest of the forms and is predominantly grayish to dark-reddish brown, without yellowish-brown tints characteristic of later forms; markings relatively distinct. Underside dull white or at least not strongly yellowish and tending to have wide, somewhat diffuse, dark reddish-brown transverse bands. First spring brood is of this form wherever *aequiferaria* occurs. **Late spring form** (plate 4, figures 41, 42)—This form has a more yellowish-brown color, with reduced markings in the male. It hardly differs from the later summer broods in most of its range, although it may be slightly larger. In Texas, however, this form may be more distinctive and colored a pale, dull brown or yellowish beige, with reduced markings above and narrowed brown bands beneath. Also, the branches of the pectinate male antennae of this form are longer than the thickness of the shaft, being about $1.5 \times$ as long as those of all other forms or broods examined, but I found no other reason for suspecting this to be another species. **Summer form** (plate 4, figures 43, 44)—This form, representing the third and fourth generations, is fairly uniform throughout the range of *aequiferaria* and is distinguished from the first spring generation by its more yellowish-brown coloring and reduced markings, especially in the male. It tends also to be slightly smaller. The underside is nearly always decidedly yellow, with the transverse brown bands boldly contrasting and highly variable in width.

The male genitalia are of the simple type typical of the *Macaria* species that feed on Pinaceae and are virtually indistinguishable from those of *signaria*, *granitata*, *bisignata*, *distribuararia*, and their close relatives, except possibly for a more slender costal lobe on the valve and stouter, less elongated uncus. *Macaria carpo* of southern Florida, which might be mistaken for *aequiferaria*, has a different valve with the costal lobe elongated and downcurved at the end and an uncus that is also exaggerated in length. The female genitalia likewise are probably not distinguishable from those of the pine, spruce, fir, and hemlock feeders, agreeing in every detail, for example, with those of *granitata*.

I reared this species from a female taken at Welaka, Putnam County, Florida, in March 1987.

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The larva has green and brown forms, and both are distinctive; indeed, unlike those of any other species. General form rather long and slender; green form matching foliage, brown form matching twigs, upon which they rest, stretched out and appressed against the bark. **Green form**—Leaf green, with most of the usual longitudinal stripes present but weak; these include faint, pale, sinuous, addorsal, supraspiracular, and adventral stripes; midventral stripe (marking dorsal vessel) blue gray, becoming tinted with reddish brown on thoracic segments; subdorsal stripe unusually developed and conspicuous, pure white, being a series of elongate-fusiform segmental sections of the white subdorsal stripe, constricted intersegmentally but wide in the middle of each segment; subdorsal bounded ventrally by a wide, blackish stripe occupying about the dorsal half of the supraspiracular space, and bounded dorsally by a series of black dashes, one in posterior half of each body segment. Within the dark half of the supraspiracular space (which may not always be completely dark), there is usually a faint, pale sinuous, white or brownish supraspiracular stripe. Lateral stripe white or yellowish, fairly distinct but irregular, interrupted, occupying lateral fold and slightly subspiracular in position; another segmental series of black dashes present immediately ventrad of lateral stripe, essentially a repeat of the dorsolateral ones but centered on each segment, not in posterior half. Green larva may have some light brown tinting in subventral area. Head green with a lateral, black, longitudinal streak on side of each epicranial lobe. Thoracic legs dark purplish; prolegs mostly green. **Brown form**—Markings of body similar to those of green form but with all green coloring replaced by light pinkish or purplish brown; blackish markings in general more extensive or with exaggerated intensity. Head drab greenish yellow with the same black lateral streaks on epicranial lobes and a few much smaller streaks or blotches dorsally or frontally on the lobes, and with black shading on frons and both sides of epicranial suture. The whitish lateral stripe also extends onto side of head beneath the black streak. Thoracic legs blackish; prolegs with irregular brown and blackish markings laterally. Length at maturity: 22–24 mm.

These small but elegant larvae have a counterpart in the two forms of another cypress-feeding geometrid, *Anacamptodes pergracilis* (Hulst), in which the colors and longitudinal orientation of

the pattern elements are remarkably similar (but not the details of the pattern).

A few earlier records confirm the host specificity. One male in the USNM from Cape Henry, Virginia was reared “on cypress.” 8 May 1927; another, from the same host, at Pinecrest, Monroe County, Florida, was reared 2 October 1980 (A. T. Drooz); and a female reared from bald cypress at Laurel, Sussex County, Delaware, 22 July 1982, was sent for identification by the Pennsylvania Department of Agriculture.

Macaria aequiferaria is known to occur from Maryland and Delaware to southern Florida, and westward to Eagletown [McCurain County], Oklahoma, and Blanco County, Texas. I would guess that it is present in river swamps along the Mississippi to Kentucky and the southern tip of Illinois. Specimens were collected by V. O. Becker at El Encino, 250 m, Tamaulipas, Mexico, 21–31 May 1997, at a site where *Taxodium* was growing along the river. This tree was probably Montezuma bald cypress, *Taxodium mucronatum* Ten. These are similar to U. S. specimens, but the males are lightly marked, and the females have heavier, dark, transverse lines on the forewing. *Macaria aequiferaria* is not to be expected outside the range of *Taxodium*.

At the latitude of the Gulf States this species has at least three generations, the first commonly flying in March and April, the second in May and June, and the third in July and August. Specimens collected in September or October may represent fourth generation emergences, and the few seen from October appear to have reverted to the more grayish-brown coloring of the early spring brood. In Florida the moths appear as early as February and have been collected as late as December, and in Louisiana were collected by V. A. Brou in every month from January to October. For more northern states there are few data, but specimens of the spring brood were taken in North Carolina in May, and in Virginia at the beginning of June; a second brood would be expected in July and August, and I did collect one male of this brood on 24 July 1986 at Grasonville, Queen Anne’s County, Maryland, possibly the most northerly record for the species and about 35 miles from the nearest known cypress.

Macaria bisignata Walker

PL. 4, FIGS. 46–50 (adult); PL. 12, FIGS. 2, 3 (larva) (RWH 6335 part, 6341 part, 6342).

Macaria bisignata Walker, 1866, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **35**: 1,655. Type locality: North America. [BMNH]

Macaria consimilata Zeller, 1872, *Verh. zool.-bot. Ges. Wien*, **22**: 483. REVISED SYNONYMY.

Type locality: Massachusetts. [BMNH]

NOTE—The name *consimilata* was based on two specimens, a male and female. The male is either *bicolorata* or a dark specimen of *bisignata*, I am inclined to think the latter. The female is not *bicolorata* and is either a dark *bisignata* or the species that I describe as *masquerata*, which is not known to occur that far south. Both types resemble the dark southern form of *bisignata* found from Maryland southward. As the identity of the type is thus difficult to determine, I designate the male as the lectotype and assign *consimilata* to the synonymy of *bisignata*.

Macaria galbineata Zeller, 1872, *Verh. zool.-bot. Ges. Wien*, **22**: 484.

Type locality: Massachusetts. [BMNH]

Diastictis festa Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 335. REVISED SYNONYMY.

Type locality: Colorado (false locality). [AMNH]

NOTE—Based on one female type, which I examined and found to represent *M. bisignata*, not *aequiferaria* as listed in earlier check lists. Colorado is a false type locality because neither *aequiferaria* nor *bisignata* is known to occur there. There is no locality label on the specimen.

This common, pale brownish-white species closely resembles *M. masquerata* and might also be confused with worn *M. bicolorata*, but the pale coloring, above and beneath, and the usually larger, chestnut-brown, subapical costal spot on the forewing will usually distinguish it. This species is widespread in the Northeast, the Great Lakes Region, and Appalachians and is mainly associated with white pine, *Pinus strobus* Linnaeus

Upperside dull white, variably but most often sparsely dusted or shaded with pale grayish brown. Forewing marked by three dark brown spots where antemedial, medial and postmedial lines meet costa, and by a larger, subrectangular spot where subterminal band meets costa; another segment of subterminal band usually persists as a smaller dark spot between M_3 and CuA_1 , and this is more often missing in *bicolorata* and *masquerata*. Any of the three main transverse lines

of forewing may be present or absent but are commonly faint or incomplete. Similarly weak medial and postmedial lines may continue across the hindwing. Position of medial band on forewing varies but is usually near middle of median space; in *bicolorata* it tends to lie before the middle, and in *masquerata* beyond the middle. Underside has pale, weakly marked, faded appearance, in contrast to bright yellow-brown, strongly marked underside of *bicolorata*; postmedial band of underside of hindwing usually appears curved toward inner margin in *bisignata* and *masquerata*, straight or closely followed by a straight band or line that is produced toward anal angle in *bicolorata*. Yellow-brown vestiture of head and patagium fairly prominent and contrasting sharply with pale thorax. Male antenna closely laminate, appearing simple like that of female, but thicker; those of *bicolorata* and *masquerata* have segments (flagellomeres) more separated and distinct. Wing length: males, 13–15 mm; females, 14–16 mm.

Genitalia differ little from those of *bicolorata* or others in this species-group, although, in female, signum tends to be very slightly smaller than that of *bicolorata*, and there may also be slight differences in form of sclerotized ductus bursae. Such differences too vague to be of much help for identification.

The distribution of *bisignata* northward corresponds almost exactly to that of its main food plant, *Pinus strobus*, from Nova Scotia to western Ontario and Minnesota, north of Lake Superior to Lake Nipigon and almost to the Manitoba border, and southward in the Appalachian region to the Carolinas. It has been reported from Newfoundland (Prentice, 1963), where *Pinus strobus* and *P. resinosa* occur sparingly, but I have not seen the specimens. In the Midwest it reaches eastern Missouri, and the southernmost records that I have seen are from Greenville, South Carolina. I collected it as high as 5,800 feet in the mountains of North Carolina. The species also occurs locally on the coastal plain or piedmont somewhat farther south than the natural distribution of white pine, as in the suburbs of Washington, D.C. and Annapolis, Maryland, and this is probably because the host is so widely planted as an ornamental that *M. bisignata* has been able to extend its range. However, it must be able to feed on other pines because southern specimens have been taken where white pine is absent.

From about the latitude of Massachusetts

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northward *bisignata* is univoltine, with records for 22 May–19 August in Nova Scotia (Ferguson, 1954), 11 May–9 August in Maine (Brower, 1974), and 7 June–5 August in Wisconsin (H. M. Bower coll., LACM); from Connecticut southward it is bivoltine, with records for 8 May–16 July and 2 August–20 September. Curiously, the earliest and latest available dates, 8 May and 20 September, are from near the northern limit of the bivoltine population in Connecticut. In Maryland it flies from 20 May through most of June and appears again from about mid-August to early September. The South Carolina records were taken 6 and 12 June.

The green and white striped larva was described by McGuffin (1972: 26), who also gave setal maps and an illustration of the head. The usual food plant of this species is white pine, *Pinus strobus* Linnaeus, and it has been reared many times. As it always seemed to occur in the presence of white pine in the Northeast, I had thought for many years that it is host-specific on this tree. However, it not only occurs southward where white pine is present only as an ornamental but in areas where it is seemingly absent, evidently switching to *Pinus virginiana* or possibly *P. rigida*. The moths associated with these hard pines southward are often darker in color (plate 4, figures 46, 47), as described below. Other conifers, such as *Pinus resinosa*, spruce, and larch, have been reported as hosts (e.g., by Prentice, 1963) but need to be verified.

This species shows slight variation geographically and seasonally. Southern specimens of both broods average larger and darker than Canadian ones, and second brood specimens are more boldly marked than spring specimens, with darker transverse lines and often with a broad, dusky, submarginal border above and beneath. Adults of the northern, single-brooded populations closely resemble southern spring-brood specimens. Southern specimens may closely resemble *masquerata*.

Macaria masquerata Ferguson, NEW SPECIES

PL. 4, FIGS. 51–53 (adult).

Macaria masquerata Ferguson.

Type locality: Purcell's Cove, Halifax County, Nova Scotia. [CNC]

Semiothisa bicolorata, Ferguson, 1954: 301; McGuffin, 1972: 26; Brower, 1974: 101; not Fabricius, 1798.

This is a northern species apparently associated with jack pine, *Pinus banksiana* Lamb., from Maine and Nova Scotia across Canada and the northern Great Lakes states to eastern Alberta. Its brown coloring on the upperside is intermediate between that of *bisignata* and *bicolorata*, and it has often been misidentified as *bicolorata*. However, the underside is more nearly white than yellow, with weak or diffuse yellowish-brown to pale reddish-brown markings, similar to that of *bisignata*. It should be noted also that the medial band of the forewing is often relatively prominent and tends to be closer to the postmedial than to the antemedial, the opposite of *bicolorata*. This also provides a useful character on the underside, where the discal spot of the forewing usually lies directly in the path of the medial band in *masquerata*, but somewhat distad of the medial band in *bicolorata*. *M. bisignata* seems less consistent in this respect, and its discal spot underneath can be either in the medial band or beyond it, and on the upperside its medial band is almost exactly in the middle of the median space. It occurs together with *bisignata* wherever their respective hosts occur in proximity.

Upperside of wings whitish, densely infuscated with grayish brown to dull reddish brown so that only in basal half of hindwing and median space of forewing is much pale ground color apparent. Forewing usually quite uniformly brown, but hindwing often conspicuously paler between base and postmedial line; usually with four dark spots on forewing costa marking costal ends of transverse line, but these clearly dark brown rather than black, especially subapical patch; antemedial, medial, and postmedial bands present, nearly parallel, but weak; medial band usually most conspicuous of the three and positioned closer to postmedial than to antemedial, two features in which this species differs from both *bisignata* and *bicolorata*. Hindwing with usual diffuse, nearly straight, medial band and thinner, convex, slightly irregular postmedial band, beyond which there is often a faint reddish-brown flush between postmedial and the almost invisible subterminal. Underside with ground color whitish, sometimes yellowish-tinted in part but never as brightly or uniformly so as in *bicolorata*, generally more like that of *bisignata*; markings with very faded appearance relative to those of *bicolorata* and often considerably reduced, also as in *bisignata*; brown postmedial band of hindwing tending to follow convergent course with medial band toward inner

margin in *masquerata*, appearing to be directed more nearly parallel to medial band and thus toward anal angle in both *bicolorata* and *bisignata*; discal spot on underside of forewing directly in path of medial band in *masquerata*, usually somewhat distad of it in *bicolorata*, and either way in *bisignata*. Male antenna nearly simple. Head yellowish brown, patagia reddish brown; upperside of thorax violaceous gray brown as in *bicolorata* but slightly paler. Wing length: holotype, 14.0 mm; other males, 14.0–16.0 mm; females, 15.0 mm.

Genitalia do not seem to differ in any way from those of closely related species.

The larva was described briefly by McGuffin (1972: 27, fig. 203g) and illustrated in color as the jack pine looper by Ives and Wong (1988: 22–23, fig. 10I) (both as *Semiothisa bicolorata*). The last instar is about 20 mm long, green, with a whitish or gray middorsal stripe, a yellow-green subdorsal stripe, and light, yellow-green, lateral and midventral lines; head chestnut brown with light line posterior to stemmata, and another light line over parietal lobe. The figure by Ives and Wong shows a wide, bold, yellow-green lateral stripe; thoracic legs brown, prolegs green. The Canadian Forest Insect Survey reared 325 specimens (as *bicolorata*) from larvae on *Pinus banksiana*, five from *P. sylvestris*, two from *P. contorta*, two from *P. resinosa*, and two from *P. strobus* (Prentice, 1963: 405). I saw many of their specimens reared from *P. banksiana* and can confirm that they are *masquerata*. Allowing for the possibility of sampling or identification errors, one is left with the conclusion that *Pinus banksiana* is the major if not the only food plant; and my experience in collecting adults at light only in stands of jack pine confirms this.

TYPES. Holotype ♂. Purcell's Cove, Halifax County, Nova Scotia; 12 July 1962; D. C. Ferguson. CNC. Paratypes: 32 ♂, 41 ♀. Nova Scotia. Same locality and collector as for holotype, 8 July 1956 (3 ♂). Glenville, Cumberland County; 12 July 1949; D. C. Ferguson (1 ♂). Debert, [Colchester Co.]; 18 July, 1967; W. Harrington (1 ♀). New Brunswick. Dorchester, [Westmorland County]; 7 August 1951; D. C. Ferguson (1 ♀). Kouchibouguac National Park; 13 July 1977; J. D. Lafontaine (1 ♀). Caraquet, [Gloucester County]; 10 July 1950; D. C. Ferguson (2 ♀). Quebec. Kazubazua (McGuffin, 1972, fig. 71) (1 ♂). Same locality; 16 July 1935; G. S. Whalley (1 ♀). Same locality; 16 July 1935; T. N. Freeman (1 ♀). Same locality, reared 17 March 1944 from jack pine (1 ♀). Same locality; 11 June 1935; G. S. Whalley (1 ♀).

Wright; 11 June 1935; F. A. Urquhart (McGuffin, 1972, fig. 72) (1 ♀). Norway Bay; 8 July 1937; E. G. Lester (1 ♀). Maine. Sebec Lake; 24–30 June; [A. E. Brower] (1 ♂). Bar Harbor; 11 July 1937; A. E. Brower (1 ♀). Southwest Harbor; 9 July 1938; [A. E. Brower] (1 ♀). Kingfield; 14 July; [A. E. Brower] (1 ♀). New York. Raybrook, Essex County; 8 July 1952; F. H. Rindge (2 ♂). Ontario. Foleyet; emerged 12 April 1948, reared from jack pine, No. S47-4943A, F[orest] I[nsect] S[urvey] (1 ♂). Skead, reared from jack pine, 24 January 1949, 22, 24 February 1944 (2 ♂, 1 ♀). Nakina; reared from *Pinus banksiana*; 16 February 1962 (1 ♂). Willard Lake; reared from jack pine, 2 March 1939 (1 ♀). Capetol Twp.; reared from jack pine, 23 February 1946 (1 ♀). Fort William; reared from *Pinus banksiana*; 19 October, 8 November 1966 (1 ♂, 1 ♀). Minaki; 7 July 1928; J. McDunnough (1 ♂). Kerr Lake, Lanark; 22 June 1975; S. D. Hicks (1 ♂). Constance Bay; 10, 17 July 1984; K. Bolte & P. Macdonald (2 ♂, 3 ♀). Sudbury; 3 June 1959, 12 July 1958; J. C. E. Riotte (2 ♀). Larsson's Camp, One-sided Lake; 25 July 1960; M. R. MacKay (1 ♂). Black Sturgeon Lake; 29 June 1963 (1 ♀). Michigan. Hulbert, Chippewa County; 28 July 1960; Kelton & Whitney (1 ♀). Shaw Lake, Barry County; 13 July 1985, G. Balogh (3 ♀). T38N R1W S35, Cheboygan County; 2 August 1985; G. Balogh (1 ♀). T2N R16W S18, Allean County; 5 July 1984; G. Balogh (2 ♀). Illinois. Pine Campground, Sand Ridge State Forest, Mason County; 23 May 1985, G. Balogh (1 ♂, 1 ♀). Wisconsin. Lake Katherine, Oneida County; 7 June–26 July 1958–62; H. M. Bower (3 ♂, 8 ♀). Near Presque Isle, W side Carlin Lake, Vilas County; 29 June 1985, 6 July 1981, 3, 7 July 1983; G. Balogh (6 ♂). N of Eagle Junct. on GN and N, Waukesha County; 11 July 1983; G. Balogh (1 ♂, 1 ♀). Nr Manitowish Waters, Powell Marsh, Vilas County; 7 July 1981; G. Balogh (2 ♀). Hahn Rd. near Minoqua, Oneida County; 28 May 1977; G. Balogh (1 ♂). Manitoba. Sandilands; 11–12 July 1928; N. & E. Criddle (1 ♂). Alberta. Smoky Lake; reared from jack pine, 31 January 1955 (1 ♂). Bonnyville; reared from jack pine; 31 January 1955 (1 ♀). CNC, LACM, USNM, and others. Reared specimens all from the Canadian Forest Insect Survey and deposited in the Canadian National Collection.

The type locality is in an area of rocky, granitic hills, interspersed with bogs and small lakes, behind the coastal village of Purcell's Cove, south of the entrance to Halifax Harbor. The habitat is locally unique in being largely covered for several square miles with scrubby jack pine, the only jack pine within 40–50 miles, but the species appears to be present wherever this tree grows.

Macaria masquerata is known from Nova Scotia, New Brunswick, northern Maine, Quebec, northern New York, Ontario, Michigan, Wisconsin, Manitoba, central Saskatchewan, and east-

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central Alberta, always in association with jack pine, except for several Canadian Forest Insect Survey records from red pine, lodgepole pine, Scotch pine, and white pine. McGuffin's distribution map for *bicolorata* (1972, fig. 11) applies to *masquerata*. The distributions of the two species do not overlap or meet as far as I am aware, but *bisignata* is broadly sympatric with both. *Macaria masquerata* probably has one generation per year, and the adults mostly fly from June until the first week of August. The dates for Ontario are 31 May–21 July; for the Great Lakes states, 23 May–2 August. All Canadian specimens identified as *bicolorata* are probably *masquerata*. I found no evidence that the true *bicolorata* occurs as far north as Canada, although, like *M. granitata*, it might be found where there is pitch pine in southern Quebec or Ontario. As they seem not to occur together, *masquerata* and *bicolorata* need not be confused, but distinguishing pale specimens of *masquerata* from unusually dark specimens of *bisignata* is often difficult.

When I first collected this species I had no difficulty in recognizing it as something different from the familiar *bisignata* and thought that it was *bicolorata* (1954: 309). This determination was consistent with that of McDunnough and the Canadian National Collection and was subsequently followed also by Prentice (1963) and McGuffin (1972). Having now lived for many years within the range of the true *bicolorata*, I can easily see that the Canadian species is different and indeed more closely related to *bisignata*.

Macaria bicolorata (Fabricius)
PL. 4, FIGS. 54–56 (adult) (RWH 6341).

Phalaena Geometra bicolorata Fabricius, 1798, *Ent. Syst.* 1: 454.
Type locality: Virginia.

Phalaena Geometra praeatomata Haworth, 1809, *Lep. Brit.*, p. 345
Type locality: Not known

NOTE—Originally described as from the British fauna, *praeatomata* was later identified (Guenée, 1857 [1858]: 76) as North American. The two specimens that Guenée referred to *praeatomata* are now in the USNM. A colored figure in Wood's *Index Entomologicus* (1839, pl. 26, fig. 746) may represent the type of *praeatomata*. Wood, in a later edition (1854), changed its status to that of a form of *liturata*, although his original figure does show a moth that closely resembles *bicolorata* (the figure in the 1854 edition is poor). The type had come from the

well-known London dealer, John Françillon, who is believed to have received and distributed specimens collected by John Abbot in Georgia. It is likely that *praeatomata* was based on an American specimen with misleading or no locality data, which puts it in a category similar to that of *Nematocampa limbata* (Haworth) (Ferguson, 1993: 67) or *Hypagyrtis unipunctata* (Haworth).

Macaria consepta Walker, 1861, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, 23: 941.
Type locality: Not given. [BMNH]

NOTE—Based on two syntypes.

Macaria grassata Hulst, 1881, *Bull. Brooklyn Ent. Soc.*, 4: 33.

Type locality: Florida, as labeled (not Colorado, as given in the original description). [AMNH]

NOTE—Hulst described *grassata* from one specimen from "Colorado," but the specimen labeled as the type from the Hulst collection is a female from Florida (Rindge, 1955: 144; also Barnes and McDunnough, 1916: 182, who identified it as the present species and mentioned another, "identical" specimen labeled "Colo.," that may have been the intended type). In either case the locality given by Hulst is false because *bicolorata* is not known from Colorado, and the specimen bearing Hulst's type label is clearly labeled Florida. When I saw this "small, dark female type from Florida" in the American Museum of Natural History, I had no difficulty in recognizing it as *bicolorata*.

This commonly collected eastern species is grayish brown with reduced dark markings on the upperside, and pale to bright ochre yellow, with well-developed reddish-brown or purplish-brown markings on the underside. Some specimens are darkest beyond the postmedial line, giving the uppersides of both wings a somewhat bicolored, dark bordered appearance that probably suggested the name. However, the species is bicolored also with respect to the brown upperside and contrasting yellow underside. *Macaria bicolorata* is closely related to *bisignata* and *masquerata* but is darker above and beneath. The undersides of *bisignata* and *masquerata* are mostly whitish with yellow-brown instead of deep reddish-brown markings. These differences, as well as the features that distinguish *bicolorata* from the still darker *transitaria* and *distributaria*, will be best appreciated by referring to the colored illustrations. *Macaria bicolorata* occurs from Florida and the Gulf coast, including eastern Texas, to

Massachusetts and Ohio, and possibly farther in suitable habitats. It is a hard-pine feeder on *Pinus virginiana*, probably *P. rigida* and others. Canadian records for *bicolorata* as given by me (1954: 309), and by Prentice (1963: 405) and McGuffin (1972: 26, figs. 71, 72) refer to the northern, jack-pine feeding form that I describe as a new species, *M. masquerata*.

Ground color light yellowish brown, heavily infuscated or shaded with violaceous gray brown, often solidly so in outer third beyond postmedial line; all four transverse lines or bands marked by dark-brown spot at costa, the medial and subterminal most prominently, but lines otherwise obsolescent; medial band often complete on both wings but weak, diffuse, irregular. Underside bright yellowish, with prominent reddish-brown or purplish-brown medial and postmedial bands, the latter usually double, with one component nearly straight, and the other irregular; yellow areas dusted with reddish-brown scales, often heavily concentrated beyond postmedial, resulting in wide, reddish-brown outer borders on undersides of both wings. Discal spots weak or wanting above, small but distinct beneath. Head and patagia bright ochre yellow to bright reddish brown, contrasting sharply with violaceous gray-brown thorax. Male antenna shortly fasciculate, nearly simple. Wing length: males, 12–16 mm; females, 14–17 mm.

Genitalia of both sexes like those of other members of the group.

This species has a white-striped green larva typical of this section of the genus, but it has not been described in detail. I inadvertently illustrated a larva of *bicolorata* as *granitata* in my revision of the *signaria*-group (1974, fig. 19). The description of *granitata* in the text of that paper is correct, but the particular larva figured, which was beaten from *Pinus virginiana* near Beltsville, Maryland, subsequently yielded an adult female of *bicolorata*. Because of long-standing confusion of this species with *bisignata*, *masquerata*, and others, hardly any previously published host or distribution data can be said to refer to any one of them without question. As its range extends far beyond that of Virginia pine, *bicolorata* must feed on other hard pines such as *P. rigida*, *P. echinata*, and perhaps *P. taeda*.

Macaria bicolorata occurs in pine woods throughout the eastern states from Cape Cod and Martha's Vineyard, Massachusetts, central New York (Ithaca), Ohio, and Missouri to the Gulf

Coast, down the Florida peninsula to Hernando and Highlands counties, and to Walker, Montgomery, and Harris counties, Texas. Brower (1974) reported it from Maine, but his specimens, now in the U. S. National Museum of Natural History, are mostly *masquerata*, mixed with a few unusually dark *bisignata*. *M. bicolorata* seems especially common in the Atlantic Coast region from southern New Jersey to the Carolinas. It is double brooded in the northern part of its range, flying in May and June and again from mid-July to early September in New Jersey and Maryland. Farther south the flight periods become more extended and the individual generations unclear. In coastal South Carolina it was taken in every month from March to October, except June, and in Louisiana in every month from March to November. Available records for Florida and Texas are less complete but would seem to agree with those from Louisiana.

This species is always variable in the amount of gray-brown shading on the upperside and reddish-brown shading on the underside but shows no particular geographical trends in coloring, except that northern specimens from New England are slightly paler than usual. In size it varies slightly. Texas specimens are the largest, Florida specimens seem the smallest, and those seen from elsewhere are about average and uniform. No seasonal variation is apparent, and the sexes are nearly alike.

Macaria adonis Barnes and McDunnough
PL. 4, FIGS. 57–61 (adult); PL. 12, FIG. 4
(larva) (RWH 6338).

Macaria adonis Barnes and McDunnough,
1918, *Contrib. Nat. Hist. Lep. N. Am.*, 4:
148, pl. 21, fig. 12.

Type locality: Monache Meadows, Tulare
Co., California. [USNM]

NOTE—The original description did not specify a holotype but indicated only that it was based on 5 males, 9 females, which are therefore syntypes. I hereby designate as the lectotype the specimen that McDunnough labeled as the type male.

Macaria adonis is a large western member of this species-group in which the basal two-thirds of the forewing are a light, violaceous mouse gray with a dusting of darker scales, and the outer third predominantly light reddish brown or orange brown. The only taxon with which *adonis* is likely to be confused is *M. ponderosae* as they may occur to-

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gether in stands of ponderosa pine in the central Rocky Mountain region and outlying ranges to the east. However, *M. adonis* has a much greater range west of the continental divide, reaching the Sierra Nevada, the Cascades, and southern British Columbia. It is larger than *ponderosae* by an average of about 5 mm in wing expanse, and is fully as large as the southeastern *distribuaria*. It is generally lighter in color than *ponderosae*, more extensively suffused with reddish brown between the postmedial line and outer margin of both wings, and does not have the contrastingly darker border toward the outer margin; the two are similar on the underside, but *adonis* is more coarsely lined and infuscated. It should be noted especially that *adonis* has nearly simple male antennae like those of *bicolorata* and *bisignata*; *ponderosae* has nearly bipectinate antennae with rudimentary, fasciculate branches as long as the width of the antennal shaft.

Forewing with three dark, nearly straight, subparallel, transverse lines, often incomplete, most heavily emphasized at costa; basal and median spaces light violaceous gray, or dull white heavily infuscated with gray and a sprinkling of blackish scales; outer third, beyond postmedial, mostly reddish brown but with a gray area subapically. Hindwing coloring like that of forewing but slightly paler, less intense. Underside light yellowish to reddish, strongly lined and coarsely sprinkled with brown, but relatively uniform, usually with a diffuse or obscure, reddish to yellowish band rather than a clear, boldly defined one between postmedial and subterminal lines of hindwing. Head and patagia light yellow brown with some darker, red-brown scales; darker in Rocky Mountains than in California. Wing length: males, 15.0–18.0 mm; females, 16.0–19.0 mm.

Differences in the genitalia between this and most other species that feed on Pinaceae are negligible in both sexes.

I reared this species in 1987 from a female collected at South Lake Tahoe, California, where the host must have been *Pinus jeffreyi*. Otherwise I have seen reared material only from the Canadian Forest Insect Survey, and they were reared from larvae beaten from *Pinus ponderosa* Laws. and *P. contorta* Dougl. in British Columbia. The larva was described by McGuffin (1972: 27).

Macaria adonis is widespread in western North America from British Columbia (as far north as Terrace, near Prince Rupert, according to Pren-

tice, 1963: 406) to the mountains of San Bernardino and Riverside counties, California, westward in California to Lake County and within sight of the Pacific in the mountains behind Smith River, Del Norte County, and in Oregon to the Rogue River National Forest. It is present in central Utah, Alamosa County, Colorado, and even follows ponderosa pine locally to the east of the main Rocky Mountain system, occurring where this tree grows in Sweetgrass County, Montana, and in the Black Hills, South Dakota. In the southern parts of its range, *adonis* is recorded from elevations of 6,700 to 8,000 feet, and in the Sangre de Cristo Mountains, Colorado, I collected it at around 9,000 feet.

This species is mostly univoltine, flying from mid-June to the end of July or early August in the Rocky Mountain region. Toward the Pacific Coast, however, the flight period as determined from museum specimens becomes so extended that it is hard to determine whether the species is bivoltine or simply responding to local differences in elevation and climate. For example, the dates for Washington and Oregon are 3 May–16 August, although most are in July. In California, especially the southern part, many records for June and August, and as late as 9 September, indicate at least two broods. Those that I reared from California mostly emerged later the same year, but a few diapaused until the following spring.

The species shows some geographical variation in size and color, but not enough to warrant the recognition of subspecies. Specimens from California, particularly those of the type series, are the largest and palest. Specimens from Utah are also pale, but smaller, and those from Colorado and elsewhere in the Rocky Mountains, and from Oregon to British Columbia are somewhat darker. A series of nine from the Selkirk Mountains in Idaho are the darkest, and nine reared specimens from British Columbia are the smallest, hardly larger than *transitaria*.

Macaria adonis is the closest American counterpart of the Palearctic *M. liturata* (Clerck); indeed, they are almost the same species, although the exaggerated size and color of most *adonis* generally mask the relationship. Their affinity is best appreciated by a comparison between *liturata* and small specimens of *adonis* from the Northwest, such as those from British Columbia mentioned above. Some of these northwestern specimens could be overlooked in a series of *li-*

turata were it not for the locality labels. Their closely similar genitalia varies as much between different individuals of *adonis* as between *adonis* and *liturata*. However, *liturata* has a darker subapical spot on the forewing where the subterminal band approaches the costa, a more convex and regular postmedial band on the hindwing, and a lighter sprinkling of dark scales, above and beneath.

Macaria ponderosae Ferguson, NEW SPECIES

PL. 5, FIGS. 1–3 (adult); PL. 12, FIGS. 5, 6 (larva).

Macaria ponderosae Ferguson.

Type locality: Fort Niobrara [National Wildlife Refuge], Cherry County, Nebraska. [USNM]

This is a close but easily recognized relative of *M. transitaria* found in association with ponderosa pine. Its appearance is constant, and no intermediate populations are known. The most conspicuous feature is the brightly contrasting, pale brown to red-brown color on both sides of the postmedial line of the forewing, encroaching upon the medial space and occupying the proximal half of the outer third, forming a broad transverse band on the forewing and between the postmedial and the subterminal area of the hindwing. In a few specimens, usually females, the bands may remain reddish, and such examples resemble females of *M. transitaria resinosae*. However, there are other differences, described below. Brighter specimens are more likely to be confused with *M. adonis* than with nominate *transitaria*. This species occurs on pine-covered hills and ridges in Nebraska, South Dakota, and Wyoming and in the Rocky Mountain region from Montana to northern Arizona.

Ground color pale yellowish to violaceous gray, the latter (darker) shade variably encroaching outwardly from the base so that one or the other may predominate in different specimens; sparsely dusted with blackish scales in basal and medial areas. Forewing with three subparallel, dark brown lines, slightly sinuous, at right-angles to inner margin, but often partly fading out, especially postmedial line. Hindwing with matching but more convex medial and postmedial; space between postmedial and subterminal of forewing occupied by a bright, usually bicolored band, pale brown basal and outer margin darker

brown on both wings, except for subquadrate, bluish-gray, apical patch on forewing. Underside pale yellowish, with most of upperside pattern repeated brightly and distinctly, unlike *t. resinosae*. Especially noteworthy on underside of hindwing is the space between postmedial and subterminal lines, which forms a well-delineated, mostly pale yellowish band in *ponderosae*, a more often ill-defined, brick-red band in nominate *transitaria* (obsolete in *t. resinosae*). Head and patagia bright ochre yellow to red brown, contrasting sharply with violaceous gray-brown thorax. Wing length: holotype, 14.0 mm; other males, 14.0–15.0 mm; females, 13.0–16.0 mm.

Genitalia of both sexes like those of *transitaria* and other members of the group.

Macaria ponderosae has the usual white-striped green larva typical of all Macariini on Pinaceae. The lateral stripe is wider and better defined than that of *transitaria*, in which it is very irregularly defined, somewhat fragmented, and centered on the wider, dull greenish-yellow lateral fold, which provides minimal contrast. The space between the two longitudinal stripes may be green or purplish. Both the dorsolateral and lateral white stripes extend more prominently onto the head than they do in *transitaria*, and the dorsolateral one, upon reaching the “face,” almost encloses the triangular, dark green clypeus. The conspicuous brown area of each parietal lobe is more intensely colored, with little of the lighter reticulate pattern seen in *transitaria*. The larva of *ponderosae* is perhaps more similar to that of *adonis*, another western species on the same host, although the longitudinal stripes in *adonis* are very pale yellowish or cream colored, not pure white. The larval description of *ponderosae* is based on one brood of larvae that I reared from a female collected on a pine ridge in the Nebraska National Forest just south of Chadron. Before maturing, the larvae were successfully transferred to *Pinus virginiana*. At the Nebraska site, and where the species occurs in the Black Hills, South Dakota, *P. ponderosa* is the only pine present.

TYPES. Holotype ♂. USNM. Fort Niobrara [National Wildlife Refuge], Cherry County, Nebraska; 21 June 1983; D. C. Ferguson. Paratypes: 67 ♂, 27 ♀. Nebraska. Same data but collected 14–29 June 1983 (30 ♂, 3 ♀). Hackberry Lake, Valentine National Wildlife Refuge, Cherry County; 7, 9, 21 June 1983; D. C. Ferguson (1 ♂, 2 ♀). South Dakota. Hill City, Pennington County; 20 July 1964; D. C. Ferguson (3 ♂, 2 ♀). Joe Dollar Gulch,

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Hill City, Pennington County; 10–30 July 1964; D. C. Ferguson (3 ♂, 13 ♀). Wyoming. 6 mi NW Newcastle; 25 June, 3, 13 July 1965; R. W. Hodges (3 ♂, 1 ♀). Colorado. Boulder, 5,500'; June 17, 18, 1961; M. R. MacKay (2 ♂). New Mexico. McGaffey, Zuni Mts., 7,500', McKinley Co.; July 21, 25, 1962; E. & I. Munroe (2 ♂). Arizona. Fort Valley, 7,350', 7½ mi. NW Flagstaff, Coconino Co.; 28 June–29 July 1961, 1964, 1965, J. G. Franclemont (19 ♂, 4 ♀). Walnut Canyon, 6,500', 6½ mi ESE of Flagstaff, Coconino Co.; 5 July, 5, 19 Aug. 1965; J. G. Franclemont (3 ♂). Hart Prairie, 8,500', 10 mi NNW Flagstaff, Coconino Co.; 1 July 1961; J. G. Franclemont (1 ♀). Vail Lake Road, 6,500', 9½ mi SE Flagstaff, Coconino Co.; 18 July 1961; J. G. Franclemont (1 ♂). USNM, some paratypes deposited in other collections.

In addition to the localities given above, I have seen this species from several other widely separated places in the Rocky Mountain region, as follows: NE side of Howie Rd., ¼ mi from Gibson Road, 4,500', Sweetgrass County, Montana, 19, 21 Aug. 1969 (worn), J. G. Franclemont (several in JGF coll., Cornell University); Crook County, Wyoming; Rock Creek Park, near Colorado Springs, Colorado, May, June, July, August (large series in AMNH); Rock Creek Canyon, Colorado Springs, Colorado, 13 May–28 July (LACM, MCZ, NSM); Mt. Evans, Clear Creek County, Colorado, 24 Aug. (LACM); Logan Canyon, Cache County, Utah, 4 July (LACM); Jemez Springs, New Mexico (MCZ); Frijoles Canyon, New Mexico, 1 Aug. 1942, C. A. Thomas; Dog Canyon, 6,500', Guadalupe Mountains National Park, Texas, 20 Aug. 1990, E. C. Knudson; Hannagan Meadows, Greenlee County, Arizona; Mormon Lake, Arizona, 7,000' (MCZ); Tonto Creek Campground, Gila County, Arizona, 1 July 1956 (LACM).

The distribution of *ponderosae* appears to be completely isolated from that of the eastern *transitaria* by the intervening Great Plains, except for a single specimen in the United States National Museum from Georgia that appears to be *ponderosae*. Although far out of range, it may have been a vagrant, or possibly a variant of *transitaria*.

The flight period is from late June into August, by which time the moths are mostly worn. The species is probably univoltine.

The moths are especially variable in the width and intensity of the pale yellowish to reddish-brown banding in the postmedial area of the wings, but this variation seems unrelated to geography. Those seen from the Rocky mountains

appear no different from Nebraska specimens, and nearly all would immediately be distinguishable from eastern *transitaria*; darker ones could be confused with some *transitaria resinosae*, but these taxa are widely separated geographically as far as is known. In Montana and the Black Hills, *M. ponderosae* is sympatric with the larger, still brighter *M. adonis*, which it would seem to mimic, flying in the same places at the same times, and undoubtedly associated with the same host.

Macaria transitaria (Walker)

PL. 5, FIGS. 4–9 (adult); PL. 12, FIGS. 7, 8 (larva) (RWH 6339).

Macaria transitaria Walker, 1861, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, 23: 886.

Type locality: East Florida. [BMNH]

NOTE—The name *transitaria* was based on one specimen, and the type locality is probably St. Johns Bluff, Duval County, the source of most or all of the species that Walker described from East Florida. I examined the type and have no doubt that it represents the present species. It seems uncommon to rare in Florida, but its presence is confirmed by a specimen in the USNM from Suwannee County.

Macaria transitaria resinosae Ferguson, SUBSPECIES.

Type locality: Lake Kejimikujik National Park, Queens County, Nova Scotia. [CNC]

This widespread polytypic species appears to be absent in peninsular Florida but occurs at least from northernmost Florida to Nova Scotia and westward in suitable habitats to the Rocky Mountains. It is smaller (average wing length about 14 mm) and usually darker than *distributaria*, with the wing markings less clearly defined. Some have hardly any dark markings except the usual three spots along the costa of the forewing as in the much smaller *M. minorata*. The median space of the forewing rarely stands out as conspicuously paler than the rest of the wing. In the northern subspecies and in *M. ponderosae* the wide reddish-brown transverse band beyond the postmedial usually stands out as the palest part of the forewing. I could find no structural differences in either sex that would distinguish *transitaria* from *distributaria* or any other closely related species, but consistent differences in size, color, distribution, and host preferences would seem to leave no doubt that they are distinct.

They overlap broadly with no indication of in-

terbreeding, except that in some places (e.g., Arkansas), some *transitaria* may approach *distribuaria* in color and pattern, but not in size. The two subspecies of *transitaria* are on different hosts and allopatric, and they may be species. I would have been inclined to treat it as such were it not for a confusing zone of intermingling between the southern *transitaria* and northern *resinosae* in Massachusetts. Differences in habitat strongly suggest that the nominate subspecies is primarily on *Pinus rigida* Mill., *P. taeda* Linnaeus, and perhaps *P. serotina* Michx., and that the northern one is on *P. resinosa* Ait.

It is of interest to note that the more northern or western members of the immediate *transitaria* complex, namely *ponderosae* and *adonis*, have the large, rust-red or red-brown patch on the forewing.

Semiothisa transitaria transitaria (Walker)
(er)

PL. 5, FIGS. 4–6 (adult) (RWH 6339).

Macaria transitaria Walker, 1861.

Type locality: East Florida. [BMNH]

Wings dark, overall coloring appearing more chocolate brown than bright reddish brown, although reddish band beyond postmedial prominent in some specimens; highly variable. Fore- and hindwing commonly with full complement of dark, sinuous, transverse lines as in *distribuaria*, but one or more of these, especially forewing postmedial, may be obsolescent; basal and medial areas of forewing sometimes blue gray in manner of *distribuaria*, but not as bright or boldly contrasting as in that species. Underside relatively plain, purplish gray to purplish brown, sometimes pale yellowish brown, dusted with brown scales; with or without dark, convex antemedial or postmedial lines on both wings and wide, parallel, reddish-brown band beyond postmedial; dark discal spot on hindwing. Head and patagia reddish to yellowish brown. Wing length: males, 13.0–15.0 mm; females, 12.5–16.0 mm.

Male and female genitalia like those of closely related species such as *distribuaria*, *adonis*, and *ponderosae* but slightly different from those of *minorata* (see description under latter species).

The nominate subspecies is known to occur from Cape Cod, Massachusetts, Ithaca, New York, Scioto County, Ohio, and Quincy, Illinois, to northern Florida, the Gulf Coast, and to Texas as far west as Bastrop County. From the latitude

of New Jersey to the northern edge of its range in Massachusetts and central New York, subspecies *transitaria* seems to have two broods, flying from May to early July and again from late July to the beginning of September. From Maryland and Virginia southward emergences become increasingly spread out and the overlapping broods hard to distinguish. Sample flight periods are as follows: coastal Maryland, Virginia, North Carolina, Kentucky, Illinois, northern South Carolina, 20 April–7 October; coastal South Carolina and Georgia, 16 March–19 May, 7 July–26 August, and 29 September–23 October; East Texas, 2 March–30 April, 1 June–31 August, and 21 September–24 November, with one isolated capture on 25 January at Houston. For Louisiana, records are reported for every month except January and February (V. A. Brou, pers. comm.).

The natural food plants of this subspecies are still in doubt, but some good guesses can be made. Occurrence of adults in the field from Maryland northward points consistently to an association with pitch pine, *Pinus rigida* Mill., not with *P. virginiana* Mill., *P. strobus* Linnaeus, or *P. banksiana* Lamb. (although it is easily reared on *P. banksiana* and *P. virginiana*). I collected it in a small stand of pitch pine near Ithaca, New York, where no other pines were present. Host relationships southward are not so clear, but I would suspect these to include pond pine, *Pinus serotina* Michx. and loblolly pine, *P. taeda* Linnaeus. The southward distribution corresponds well with that of *P. taeda*. From a female collected on 28 April 1962 at Mt. Pleasant, South Carolina, I reared a large brood of this species that yielded 136 full-sized adults in late June and early July of the same season. Upon returning to Nova Scotia following that trip, I fed them *Pinus banksiana*, which proved to be an acceptable food. However, the northern subspecies, *M. transitaria resinosa*, does not seem to occur in association with *P. banksiana*, but with *P. resinosa*. I reared *transitaria* again from a female taken at the edge of the Okefenokee Swamp, Charlton County, Georgia, this time on *P. virginiana*, although the dominant pines at the source were *P. taeda* and *P. palustris* Mill.

Macaria transitaria resinosa Ferguson,
NEW SUBSPECIES

PL. 5, FIGS. 7–9 (adult); PL. 12, FIGS. 7, 8 (larva).

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Macaria transitaria resinosae Ferguson.

Type locality: Lake Kejimikujik National Park, Queens County, Nova Scotia. [USNM]

This northern subspecies differs from nominate *transitaria* in being generally paler, more reddish, with reduced markings, and with a more noticeable difference between males and females. The males may hardly differ from southern *transitaria*, but the females are almost unmarked above or beneath, and have a large, diffuse area of light rust or bright reddish brown between the medial and subterminal areas of the forewing that obliterates other markings. This is repeated to a lesser extent on the hindwing. Scales of the head and patagia are ochre yellow to bright reddish brown in the usual way. Specimens illustrated in color by McGuffin (1972, figs. 69, 70, as *transitaria*) from Ontario also show the sexual difference distinctly. I mistakenly listed and illustrated this subspecies from Nova Scotia as *distribuarua* (1954, pl. 15, fig. 13). Wing length: holotype, 13.5 mm; other males, 13.0–14.0 mm; females, 13.0–15.0 mm.

Genitalia of both sexes indistinguishable from those of nominate *transitaria* and of all the brown pine feeders (except *minorata*).

TYPES. Holotype ♂. CNC. Lake Kejimikujik [National Park], Queens Co., Nova Scotia, 20 June 1960, D. C. Ferguson. Paratypes: 5 ♂, 28 ♀. Nova Scotia. Same locality and collector, 18 June 1957 (1 ♀). Armdale [Halifax], 9 July 1945, D. C. Ferguson (1 ♀). Maine. Rockwood, Somerset County, 11 July (1 ♀). Kingfield, Franklin County, 14 July (1 ♀). Bar Harbor, Hancock County, 1 July 1938, 9 July 1937, 4 August 1936, A. E. Brower (3 ♀). Michigan. Kingsford, Dickinson Co., 8 July 1983, George Balogh (1 ♀). T2N R14W S18, Allegan Co., 5 July 1984, George Balogh (1 ♀). Wisconsin. W side Carlin Lake, near Presque Isle, Vilas Co., 4, 5 July 1985, G. Balogh (2 ♂). Same data but collected 7 July 1981 (1 ♀). T39N R5E S24, Oneida Co., 5 July 1981, G. Balogh (1 ♀). Minoqua, Oneida Co., 6 July 1976 (1 ♀). Juneau Co., 23 August 1981 (1 ♀). Lake Katherine, Oneida County, 10 June–19 July 1947–63, H. M. Bower (3 ♂, 15 ♀). CNC, GJB. LACM, USNM.

Little is known of the early stages of this subspecies. Neither *transitaria* nor *distribuarua* was listed by the Canadian Forest Insect Survey (Prentice, 1963). This taxon probably had been collected but not recognized as distinct from *minorata* or some other species. McGuffin (1972: 26) identified it as *transitaria* but did not have enough information for a larval description. He

listed *Pinus banksiana* Lamb. and *P. resinosa* Ait. as food plants and illustrated a reared adult. My limited field experience with this subspecies would seem to confirm the association with *P. resinosa*, as I have not known it to be present in the absence of this tree. I never found it in stands of jack pine or white pine. The type locality has abundant white and red pine but probably no jack pine within a radius of 40 miles.

Subspecies *resinosae* is known from Maine and Nova Scotia, from various localities in Ontario west to Lake of the Woods, and from Michigan and Wisconsin, but it is relatively rare in collections. It is univoltine with a recorded flight period of 18 June–4 August, except for one unusually late Wisconsin record for 23 August.

This subspecies and the western *M. ponderosae* both have conspicuous reddish coloring that distinguishes them from nominate *transitaria*, but *ponderosae* is much brighter, almost like *M. adonis* and with its sexes colored alike.

Macaria distribuarua (Hübner)

PL. 5, FIGS. 10–12 (adult); PL. 12, FIG. 9 (larva) (RWH 6336).

Eutropa distribuarua Hübner, 1825 [1831], *Zuträge Samml. Eur. Schmett.*, 3: 39, pl. [101], figs. 585, 586.

Type locality: Pennsylvania.

NOTE—Hübner's figures clearly represent this species, but it has never again been found as far north as Pennsylvania. It is much more likely that the specimens had been sent from Georgia by John Abbot, who was about the only source of moths from the southern United States before that time, and that Hübner gave the wrong locality.

Macaria oppositaria Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 76, pl. 4, fig. 6.

Type locality: North America (Coll. Boissduval).

NOTE—In the check list (1983: 86) I mentioned *oppositaria* as a name first published in synonymy and hence unavailable. After reviewing the matter again, I find that two interpretations are possible. Guenée's figure 6 is a colored illustration of *distribuarua* with the explanation, *Macaria oppositaria* male, printed at the bottom of the plate. This is the equivalent of a valid description. However, in the accompanying text (p. 76), supposedly issued simultaneously, Guenée used the name *distribuarua* Hübner and cited *oppositaria* as a synonym, saying that he had concluded that his *oppositaria* was nothing other than

the male of *distribuaria*. Future authors should be aware that *oppositaria* can thus be regarded as an available name, as listed by Rindge (1958b: 4). The present location of the two syntypes is not known.

Macaria proxanthata Walker, 1863, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **26**: 1,642.

Type locality: East Florida. [BMNH]

Aspilates? antaurata Walker, 1863, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **26**: 1,686.

Type locality: Not given. [BMNH]

NOTE—I saw the types of *proxanthata* and *antaurata* in the British Museum and considered that there was no doubt about their identity. Both may have come from the same place, where the species is common. Walker said that the type of *proxanthata* came from the Doubleday collection, and Doubleday collected his “East Florida” material while staying at St. Johns Bluff, then a small ship-building settlement on the St. Johns River near Jacksonville, in March and April 1838. This was in the vicinity of the present Ft. Caroline National Monument, Duval County.

This large southern species may be recognized by its exaggerated coloring and size, combined with a feature of the forewing pattern—constriction of the median space in the postcubital (vannal) fold, which is easily seen in the specimens illustrated. Although *distribuaria* and *sanfordi* are nearly identical in color and pattern and occur together in Florida, *distribuaria* is unusual in being the largest species of *Macaria* in the eastern United States. Its average wing length of about 17 mm nearly equals that of the western *M. adonis*; *M. sanfordi* is one of the smallest species. Occasional bright, well-marked southern specimens of *transitaria* may approach *distribuaria* in appearance, but the gray medial and basal areas of the forewing are never as pale, the underside is less boldly marked, and the moths are nearly always smaller. In the absence of measurable characters (other than overall size), subjective criteria are hard to avoid. Reference must be made to the illustrations and to what is known of distributions and hosts.

Forewing with antemedial and postmedial lines thin, black, sinuous, dividing wing into nearly equal thirds as measured at inner margin, and with postmedial or both lines tending to protrude into medial space in postcubital fold, thus con-

stricting medial space at that point; basal and medial areas mostly pale bluish gray, flecked or striated with darker gray or dark brown; basal area often partly shaded with rust; medial space bisected by a diffuse, dark brown medial band; space between postmedial and subterminal lines rust brown, forming broad transverse band; space between subterminal and outer margin light gray, variably shaded with dark brown, but usually with a clearer gray apical patch. Hindwing divided near middle by dark, convex, somewhat sinuous postmedial line that forms the boundary between a lighter, grayish basal half and a predominantly brown or rust-colored outer half; basal half may be subdivided by diffuse antemedial band, and distal half by a diffuse brown subterminal band curved parallel to the postmedial. Both wings with discal spots absent or indistinct; terminal line thin, black, incomplete; fringes mostly dark gray brown, sometimes paler between vein endings, somewhat crenulate, especially on hindwing. Underside pale gray to pale yellowish, fairly uniformly irrorated with dark brown; most markings of upperside repeated, but more diffusely; wide, brown or rust-colored band beyond postmedial often weak and fading out on forewing but well defined and prominent on hindwing, its inner and outer margins almost parallel. Male antenna as in *transitaria* and *sanfordi*, intermediate between laminate and bipectinate, with short, setose branches nearly equal in length to width of shaft. Head and patagia bright reddish brown, contrasting with blue-gray thorax and abdomen, which are concolorous with gray areas of wings. Wing length: males, 15.0–18.0 mm; females, 15.0–19.0 mm.

Male genitalia indistinguishable from those of *sanfordi*, *transitaria*, and most other members of the group, except for their larger size in proportion to size of moth. Female genitalia also are without distinguishing features.

I reared a large brood of *distribuaria* from Welaka, Florida in 1962, but kept no notes or colored photographs. Larvae were preserved in alcohol; thus, any distinctive markings they might have had have long since faded. They reached 30 mm in length. The larvae were fed longleaf pine, *Pinus palustris* Mill., until about half grown, and then they were successfully switched to jack pine, *Pinus banksiana*, a northern tree that could not be their host in nature. My guess is that *Pinus palustris* is the major host except in Florida and the Greater Antilles, where it probably also feeds

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on slash pine, *Pinus elliottii* Engelm. I found *distribuaria* occurring in abundance at Homestead, Miami-Dade County, where only *P. elliottii* was present. Although loblolly pine, *Pinus taeda* Linnaeus, is another possible food plant, *distribuaria* does not follow its range northward but seems to drop out at or before the northern limit of *P. palustris*.

This species occurs at least from Niagara, Moore County, and Southern Pines, North Carolina, to Miami-Dade County, Florida, and westward across the Gulf States to Harris and Tyler counties, Texas. It also occurs in the Dominican Republic and would be expected elsewhere in the Caribbean. Although there are specimens in the collection of the U. S. National Museum of Natural History from Texas, Guatemala, and the Dominican Republic, I have seen none from Cuba or Mexico.

Adults of this species have been collected in every month of the year in Florida, but peak emergence times for any given area are not clear from the available data. It appears at least as early as April in North Carolina, at Thomasville, Georgia, and Houston, Texas, and was taken in every month except January and February in Louisiana (V. A. Brou Coll.). I found it common in May and November on two trips to Homestead, Florida, and the specimens from the Dominican Republic were also collected in May. The brood that I reared from a female taken in March 1962 in Putnam County, Florida all emerged in June, except two that did not emerge until September and October.

The material at hand (160 specimens) shows what appear to be three stages of geographical variation, which would probably become a continuum if more specimens were available from intervening areas. More northern specimens, from the Carolinas, the Gulf States, and northern Florida are the largest, with brown areas of the wings more often chocolate brown than rust. A series of 212 from Louisiana (Florida State College) are especially large. Thirty from Homestead, Miami-Dade County, Florida, are distinctly brighter, above and beneath, with very prominent, lighter brown to rust-colored bands on both wings. A few from St. Petersburg and Lake Placid, Florida, seem closest to those from Miami-Dade County. Eleven specimens from the Dominican Republic are paler and still brighter than those from southern Florida and are further distinguished by the reddish band beyond the post-

medial line of the forewing tending to be much narrower toward the costa than toward the inner margin. I could see no differences in the genitalia among these populations.

Although this species was named four times in the nineteenth century from specimens probably all collected before 1840, it remained unaccountably rare in collections until recently. For example, the collection of the U. S. National Museum of Natural History contains only eight specimens, mostly from the Barnes Collection, collected before 1950, but about 125 collected after 1950. Kimball (1965: 176) listed many records under the name *distribuaria*, but until then and for some time thereafter *distribuaria*, *transitaria*, and *sanfordi* were commonly confused in collections, and those records need to be reexamined. Most authors (e.g., McDunnough, 1938; Forbes, 1948; Kimball, 1965) did not recognize *distribuaria* and *transitaria* as different species. Identity of the two species became known in the 1970's (McGuffin, 1972; Ferguson, 1975, 1983).

Macaria sanfordi (Rindge)

PL. 5, FIGS. 13–15 (adult); PL. 12, FIG. 10 (larva) (RWH 6337).

Semiothisa sanfordi Rindge, 1958, *Amer. Mus. Nov.*, **1,910**: 5.

Type locality: Port Sewall, Martin County, Florida. [AMNH]

Macaria sanfordi almost exactly resembles *M. distribuaria* in miniature, although in fresh specimens the pattern may be more strongly emphasized and the colors brighter. Its wing expanse averages about eight mm less than that of *distribuaria* in both sexes. The medial space of the forewing is similarly constricted in the two species, a character that helps distinguish them from *transitaria*. The reason that the wing pattern stands out more clearly in *sanfordi* is that its ground color is nearly white rather than gray, and the reddish-brown forewing band bounded on one side by the pale median space and on the other by a nearly white subterminal often stands out in bold contrast. This is variable, however, because the white subterminal may be well defined and complete, or obsolescent. *M. sanfordi* occurs in peninsular Florida and feeds on sand pine, *Pinus clausa* (Chapman) Vasey.

Pattern of both wings like that of *distribuaria* except that median space of forewing often seems narrower and distal third wider; e.g., median

space in postcubital fold often only half as wide as at inner margin in *sanfordi*, usually more than half as wide in *distributaria*. Another trend is for antemedial line to be almost evenly and roundly convex in *sanfordi*, waved in *distributaria*. Ground color almost pure white, showing mainly in pale median space, in subterminal line or band, and to lesser extent toward base and inner margin of hindwing. Red-brown band distad of postmedial line on forewing strongly emphasized and conspicuous, usually more so than in *distributaria*, varying from deep mahogany brown in southern Florida to light rust brown in northern Florida. Hindwing with colors of forewing repeated but much less intensely, about as in *distributaria*. Underside as in *distributaria* but with more intense coloring; red-brown areas exaggerated to bright rust in light-colored specimens, or heavily infuscated with dark scales in darker ones. Head and patagia ocher yellow to deep reddish brown, contrasting sharply with violaceous-gray thorax. Wing length: males and females, 11.0–14.0 mm.

Genitalia show no significant differences from *distributaria* or *transitaria* in either sex.

I reared this species from a female of the dark southern form taken at the Archbold Biological Station, Highlands County, Florida on 23 February 1985. The white-striped green larva (plate 12, figure 10) is typical of those that feed on Pinaceae. In the last instar it is almost exactly the same shade of green as the needles of the food plant, with white subdorsal and lateral (spiracular) stripes. The stripes are straight, slightly irregular at the edges but of uniform width, about one-third as wide as the green space between them, and continue onto the head. The front of the head, between the extended subdorsals, is mainly greenish, but the side, between the extended lateral and subdorsal, is light chestnut brown. Length at maturity: 25.0 mm. Two species of pine, *Pinus elliottii* and *P. clausa*, grew in the immediate vicinity, and of these the young larvae would eat only the sand pine, *P. clausa*. Last instar larvae were again offered foliage of both pines, as well as *Pinus virginiana* from Maryland. They then fed freely on both *clausa* and *virginiana* but continued to ignore *P. elliottii*, which showed slight signs of nibbling on one needle only. I believe that the natural host of *sanfordi* is *Pinus clausa*.

Macaria sanfordi seems to have a very limited distribution entirely within the Florida peninsula,

from about the latitude of Lake Okeechobee to the St. Johns River. A specimen that I collected at Welaka, Putnam County, is the northernmost record that I have seen. The species has been collected in January, February, March, April, June, August, November, and December, but mostly in March and April.

Up to this point I have treated *sanfordi* as a single species without question, but for a species with so restricted a distribution, it shows some surprisingly abrupt north-south variation that does not seem to be seasonal. Toward southern Florida the moths are small and dark, with a sharply delineated pattern (plate 5, figures 13, 14); farther north, as in Volusia and Putnam counties, they tend to be larger, lighter, with the reddish-brown shades tending more toward bright rust than mahogany, and with the markings in general slightly less regular and more diffuse (plate 5, figure 15). With respect to color, this trend is the opposite of what one finds in *distributaria*, which has a heavily reddish, somewhat diffuse form in Miami-Dade County, and a more contrastingly marked, gray and brown form in northern Florida. With regard to size, however, the two species agree in becoming larger toward their northern limits. More material is needed from more localities to determine the significance of the variation.

Macaria minorata Packard

PL. 5, FIGS. 16–18 (adult); PL. 12, FIG. 11 (larva); TEXT FIG. 41 *a*, *c* (♂ gen.); TEXT FIG. 41 *b* (♀ gen.) (RWH 6340).

Macaria minorata Packard, 1873, *Peabody Acad. Sci. Ann. Rept.*, 5: 66.

Type locality: Natick, Massachusetts. [MCZ]

NOTE—The specimen labeled type, which is probably a holotype, is a male without abdomen. It has no locality label.

This is a small, brown, northeastern species about the size of *sexmaculata*, with hardly any markings. It could be described as resembling a small, faded *transitaria*, but with the hindwing usually much paler than the forewing. It seems to be present wherever white pine grows or is extensively planted from eastern Canada and the Great Lakes region to Maryland, and to northern Georgia in the mountains. Among all the species of *Macaria* that feed on Pinaceae, *M. minorata* is unique in having male genitalia that are easily recognized as different, with a patch of persistent, bristlelike

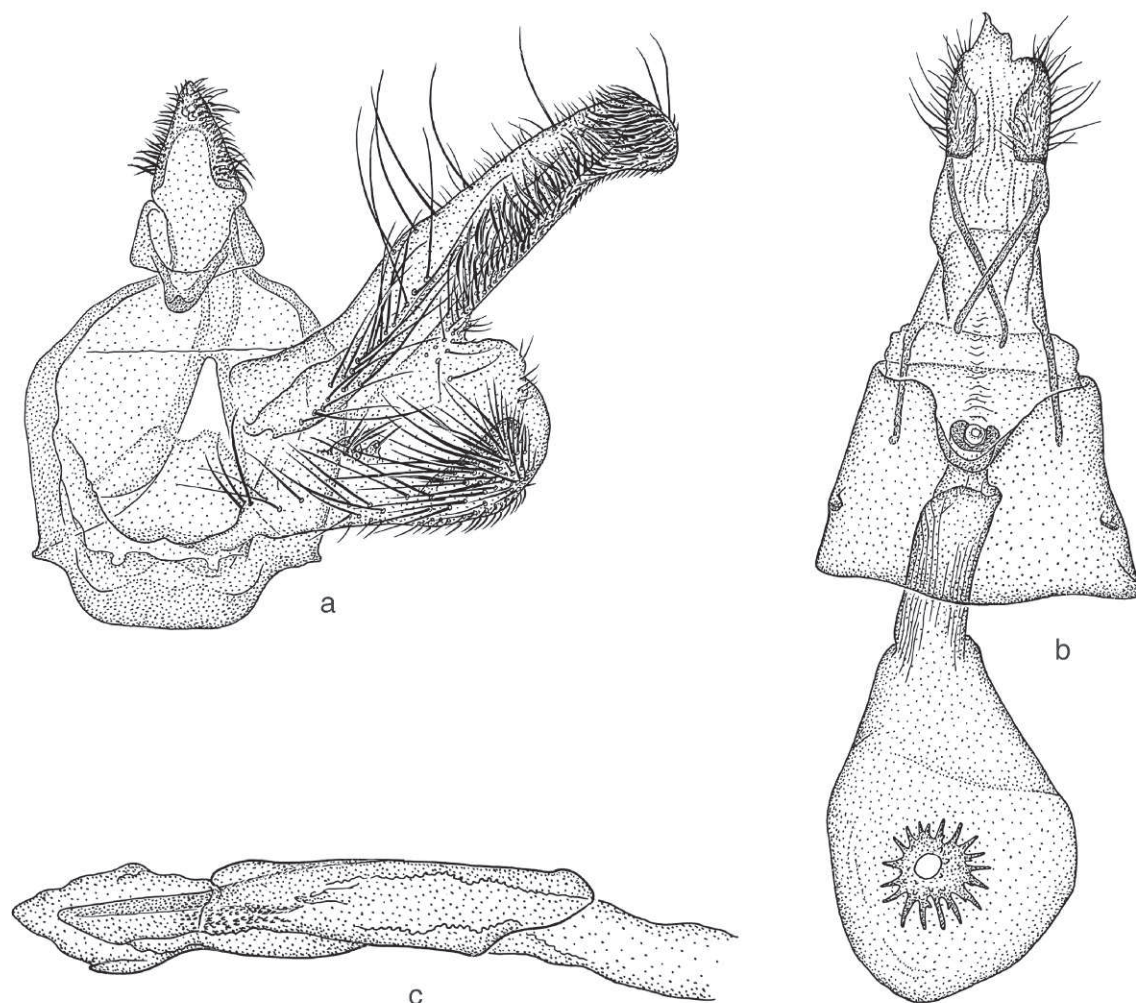


FIGURE 41: GENITALIA OF *MACARIA MINORATA*

a. Male genital capsule; Ithaca, Tompkins County, New York (USNM 56941). *b.* Aedeagus; Ithaca, Tompkins County, New York (USNM 56941). *c.* Female; Bar Harbor, Hancock County, Maine (USNM 56942).

setae on the saccular lobe of the valve and a distally curved costal lobe.

Forewing almost evenly colored, grayish brown to reddish brown with a faintly violaceous tint, and diffuse, reddish-brown, submarginal shading distad of postmedial line; three dark brown spots at costa marking positions of antemedial, medial, and postmedial lines, which are otherwise obsolescent except in occasional well-marked variants; no discal spot. Hindwing distinctly paler than forewing, and variable; sometimes with all three main transverse lines, but these usually weak; sometimes also with weak continuation of reddish submarginal shade from forewing and weak discal dot. Underside very pale, almost unmarked except for a weak, yellow-

ish-brown subapical costal spot on forewing and an evenly convex submarginal band of same color on hindwing. Male antenna with paired, setose, conical processes on each segment; i.e., nearly bipectinate. Scales of head and patagia bright ochre yellow, contrasting with gray-brown thorax and wings. Wing length: males, 10.0–12.0 mm; females, 12.0–13.0 mm.

Male genitalia differ from those of all other members of this conifer-feeding group in three noticeable features: costal lobe of valve abruptly curved downward near tip (outward as usually mounted on slide); saccular (ventral) lobe of valve, toward its outer corner and on inner face, has a raised area covered with many coarse, almost spinelike setae; and uncus slender, being

narrower than costal lobe of valve near its middle (wider in related species). Another apparent difference that may prove to be consistent is that the posterior extremities of the bifid sternum are bluntly pointed in *minorata*, more rounded in related species. Coarse setae on saccular lobe of valve are particularly distinctive. Female genitalia show no distinguishing features.

The larva of *M. minorata* resembles those of the *signaria* complex and is very similar to that of *signaria* but more slender. When at rest stretched out full length on a pine needle it is an exceptionally good match for the white pine foliage. It is multiple-lined dorsally, with a pair of thin, white, irregularly waved, addorsal lines bordering the dark green to purplish dorsal vessel; and laterad of these a pair of white dorsolateral bands about twice as boldly marked as the addorsals and separated from them by a band of light green ground color about equal in width to the dorsolaterals; dorsolateral and addorsal bands blend together to form diffusely whitish dorsum on last two segments. Longitudinal lateral fold mostly white, forming lateral band, although in part tinted with yellowish green, especially on thoracic segments. Space between lateral and dorsolateral bands mostly dark purplish or purplish gray as in many *signaria* and other members of the group, although not as contrastingly so as in *oweni* and some *signaria*. Unlike *signaria*, *pinistrobata*, and others, *minorata* has the purplish dorsolateral band nearly filling entire space between the white bands, not just its upper half. Venter green with faint white stripes. Head green with the usual white extensions of the dorsolateral and lateral bands, these separated by a strongly contrasting zone of dark brown, almost black, on side of the head. Thoracic legs brownish. *Macaria pinistrobata*, another white pine feeder, also differs in having more yellowish green mixed with the pure green between the white bands. The larvae described were reared on white pine from a female collected in Montgomery County, Maryland in 1989.

The larva was also described by McGuffin (1972: 25). The distribution of this species, including its local pattern of occurrence wherever encountered, suggests that its preferred and possibly exclusive food plant is white pine, *Pinus strobus* Linnaeus. Other reported hosts, namely jack pine and red pine, may be correct but need verification.

Macaria minorata occurs from Nova Scotia to

the Great Lakes region of Ontario, as far north as Trois Rivières, Quebec and the north shore of Lake Superior, westward to Minnesota, and southward to the vicinity of Washington, D. C. near the coast; but following the distribution of its host down the Appalachians to North Carolina, northern South Carolina (Oconee County), and to northern Georgia (widespread). No geographical variation is apparent.

This species is univoltine in Canada, flying from late May or early June to early August, with most records for June. In New England and other northern states it may appear both earlier and later, indicating more than one brood; for example, 16 May–1 September in Maine (Brower, 1974); 15 May–3 September at East Wareham, Massachusetts; as early as 18 April at Hamden, Connecticut; and as late as 7 September at East River, Connecticut, the latest dates surely representing partial second generation emergences. The dates for Maryland are 18 May and 8, 25 August, and it was taken in the southern Appalachians in June, July, August, and September.

The *signaria*-GROUP

This is a compact and difficult group of ten closely related, mainly gray to gray-brown, conifer-feeding species (*sexmaculata*, *submarmorata*, *marmorata*, *signaria*, *unipunctaria*, *pinistrobata*, *fissinotata*, *oweni*, and *granitata*), most of which may occur together across much of Canada and the northeastern United States. I revised these in an earlier paper (Ferguson, 1974b), which may be consulted for additional detail. One species, *M. unipunctaria* (W. S. Wright), is exclusively western. Another, *M. signaria* (Hübner), has an almost complete Holarctic distribution from Scandinavia and the Alps to far eastern Siberia, and from the Pacific Northwest to Newfoundland and New England, ranging far southward in both the eastern and western mountain systems. The speciation process within *signaria* is more advanced in the Nearctic part of its distribution, where it has three or four visibly different geographic and presumably subspecific variants, not counting the seven other siblings that I treat as species.

The *signaria*-group is most closely related to the *bicolorata*-group of predominantly brown pine feeders. A remarkable feature of both groups, together with a few other Nearctic species of *Macaria*, is that they constitute a complex of more than 20 obviously different species with in-

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distinguishable genitalia. Nearly all may be recognized in other ways, usually by a combination of wing pattern, color, size, foodplants, relative emergence times, and distribution or habitat. Two exceptions, which stand out because they do have slightly different male genitalia, are *M. sexmaculata*, generally associated with the *signaria*-group, and *M. minorata*, associated with the *bicolorata*-group. Except for *sexmaculata*, all members of the *signaria*-group have a fovea in the male forewing; those of the *bicolorata*-group do not have the fovea.

The extremely similar members of the *signaria*-group have evolved diverse host associations, with species that have become host specific on larch, hemlock, Douglas-fir, white pine, and a group of hard pines that include pitch, Virginia, and loblolly pine; and the most widely distributed species, *signaria*, on all genera of Pinaceae but with a special preference for spruce (*Picea*), fir (*Abies*), and Douglas-fir (*Pseudotsuga*). *Macaria signaria* is our only species of *Macaria* that regularly feeds on and prefers spruce and fir in nature. Larvae of some may be induced to feed on the “wrong” host in captivity or if starved. For example, *M. granitata* may be reared on white pine, although there is no evidence of it having anything to do with white pine in the wild; and larvae of *M. submarmorata* may be successfully transferred from larch to jack pine. The Pacific slope subspecies of *M. sexmaculata* will sometimes feed on Douglas-fir in nature, although the usual food would be expected to be larch. Species of the *bicolorata*-group have also divided up the host resources but among the various species of pine only. *Macaria signaria* is exceptional, not only because of its vast distribution and broad host range, but also because it is the most commonly collected member of the group where it occurs, except perhaps in the southern Appalachians, where *M. pinistrobata* and *fissinotata* predominate at low to mid-elevations.

The larch-feeding *Macaria sexmaculata*, although included because of its appearance and host, is not a member of the *signaria*-group in the strictest sense, being slightly divergent in genitalia, absence of the fovea, more coarsely serrate or fasciculate male antenna (at least in subspecies *incolorata*), sexual dimorphism, size and appearance, and in features of the larva. It might be considered a member of the *bicolorata*-group, but does not agree well with them either. It is a widespread, northern species with a slightly larger

subspecies from the Rocky Mountains westward that is distinguished by different male antennae, and apparently by the ability to feed on both larch and Douglas-fir. *Macaria sexmaculata* has a close larch-feeding counterpart in Japan, *M. fuscaria* (Leech), which very closely resembles nominate *sexmaculata*. Arbitrarily placed in the *bicolorata*-group, *Macaria minorata* is similarly divergent, with distinguishable male genitalia. It has no very close relatives.

Macaria sexmaculata Packard

PL. 5, FIGS. 19–24 (adult); PL. 12, FIGS. 12, 13 (larva) (RWH 6320, 6343).

Macaria sex-maculata Packard, 1867, *Proc. Boston. Soc. Nat. Hist.*, **11**: 44.

Type locality: Square Island, Labrador. [MCZ]

NOTE—Described from an undisclosed number of specimens, including both sexes. No lectotype has been designated.

Macaria unimodaria Morrison, 1874, *Proc. Boston Soc. Nat. Hist.*, **16**: 196.

Type locality: Massachusetts. [BMNH]

Semiothisa labradoriata Möschler, 1883, *Ent. Zeitung, Ent. Ver. Stettin*, **44**: 118.

Type locality: Southern Labrador. [ZMHB]

Cymatophora deleta Hulst, 1900, *Jour. New York Ent. Soc.*, **8**: 218. NEW SYNONYMY.

Type locality: Webster, New Hampshire. [AMNH]

NOTE—Described from one female holotype, which I had no hesitation in identifying as this species.

Macaria minorata var. *incolorata* Dyar, 1904, *Proc. U. S. Natl. Mus.*, **27**: 906, SUBSPECIES

Type locality: Kaslo, British Columbia. [USNM]

NOTE—Described from an unspecified number of males, of which I designated one as the lectotype (Ferguson, 1974b: 604).

Sciagraphia purcellata Taylor, 1908, *Can. Ent.* **40**: 98.

Type locality: Kaslo, British Columbia. [USNM]

NOTE—Described from three syntypes, of which I designated as lectotype a female taken on 7 July 1907 (Ferguson, 1974: 604).

This small, northern, transcontinental species resembles and is often confused with *Macaria sub-*

marmorata, and both are larch feeders. However, the lack of a fovea in the male forewing and other differences suggest that it is really a member of the *bicolorata*-group. Sexual dimorphism is more apparent than in the *signaria*-group, the genitalia are slightly different, the male antennae, although slender, are more heavily setose, and the larva is distinctive, with very different green and dark brown forms. Despite its undistinguished appearance, *sexmaculata* is a taxonomically isolated species, with no close relatives except the Japanese *Macaria fuscaria* (Leech), which hardly differs and also feeds on larch (H. Inoue, pers. comm.). *Macaria sexmaculata* occurs as two different kinds of populations, separated by the northern Rocky Mountains. These differ somewhat in appearance, hosts, and antennal structure, I treat them as subspecies, although they may be species.

Macaria sexmaculata sexmaculata Packard

PL. 5, FIGS. 19–21 (adult); PL. 12, FIGS. 12, 13 (larva) (RWH 6320, 6343).

Macaria sex-maculata Packard, 1867.

Type locality: Square Island, Labrador. [MCZ]

Macaria unimodaria Morrison, 1874.

Type locality: Massachusetts. [BMNH]

Semiothisa labradoriata Möschler, 1883.

Type locality: Southern Labrador. [ZMHB]

Cymatophora deleta Hulst, 1900.

Type locality: Webster, New Hampshire. [AMNH]

This is the eastern subspecies, which seems to occur wherever eastern larch (*Larix laricina* (Du Roi) K. Koch) is present. Male. Fovea at base of forewing wanting or at most vestigial, fully scaled; color variable but most often uniformly brownish, more so than in species of the *signaria*-group, much less distinctly marked than female; occasional males contrastingly colored, resembling females. Normal males evenly dusted with brown, leaving little of the whitish ground to impart the usual gray aspect to the wings. Fore- and hindwing almost alike. All three transverse bands of forewing may be present, but normally weak and in part obsolescent; postmedial commonly strongest, almost erect, regular, bending inward to meet costa at 90°. Lines of hindwing also var-

iable; usually distinct only toward inner margin, sometimes well defined, sometimes almost wanting. Subapical costal and extramedial spots much reduced in male, not normally conspicuous. Discal spots vague or wanting. Underside marked with brown much as in similar species. Female. Usually lighter colored than male, with more whitish ground color showing, giving a decidedly more grayish aspect to wings, and thus a closer resemblance to some of the other species, especially *submarmorata*. Hindwing usually somewhat browner than forewing. Markings as in male but more complete, darker, more contrasting; subapical costal and extramedial spots tending to be much better developed, the latter most often large, rounded, blackish, conspicuous. Underside as in male but with markings darker. Occasional females more brownish, unicolorous, resembling males. Length of forewing: males, 10.5–12.0 mm; females, 10–13 mm. Mean wing length (eastern Canada): males, 11.33 mm (n = 60); females, 10.83 mm (n = 24).

Male genitalia differing from those of *signaria*-group in the stouter, longer tooth on gnathos, smaller size of the two subapical spines on dorsum of hoodlike uncus, and in the narrower, less rounded ventral lobe of valve. Also, uncus acuminate and rather pointed, not tapered evenly to a truncated or shallowly notched tip as in species of *signaria*-group.

Female genitalia with corpus bursae less elongate, more globular in shape, resembling that of the closely related Japanese species, *fuscaria*, rather than *signaria*; and detached, sclerotized element of sterigma lacks the usual evenly contoured, rounded or squarish shape, having a somewhat aborted form, depressed on distal side.

The larva of *sexmaculata* (plate 12, figures 12, 13) was described by McGuffin (1947: 113–115; 1972: 28) and illustrated in color by Ives and Wong (1988: 22, figs. J, K), and Wagner et al. (2001: 45). Ives and Wong did not give localities, and it is unclear whether their figures show *sexmaculata* or its subspecies, *incolorata*. This species is peculiar in having two sharply differing forms in the last instar, one green, the other brown to blackish. Up to the penultimate instar all larvae are green or gray green. After the last molt there is a transition period of about two days during which some of the larvae acquire the dark coloring. No other species of *Macariini* is known to undergo such an extreme color change. It seems unlikely that the dark color in this case is

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induced by the stress of overcrowding, as has been suggested for other species, because both forms may be field collected by beating larch. The green form, although resembling that of *signaria*, may be distinguished by its smaller size, only 15 mm as opposed to 21 mm, by the head and thoracic legs being entirely green, and by the absence of dark subventral stripes. In *signaria* and related species the head has contrasting lateral, or dorsolateral, blackish-brown markings. The superficially similar *Macaria submarmorata*, also on *Larix*, may be heavily colored with purplish, has dark head markings and, according to two broods that I reared from Nova Scotia, is marked by conspicuous purplish-brown spiracular spots. Although these lateral spots may also occur in *signaria*, they apparently never do in *sexmaculata*.

The only food plant recorded in eastern North America is *Larix laricina*, although *sexmaculata* was collected commonly at a site in central New York where European larch, *Larix decidua* Mill., was the only possible host (L. R. Rupert, pers. comm.).

The nominate subspecies of *sexmaculata* occurs from Newfoundland, Labrador, and the Maritime Provinces to Alberta, and south to Massachusetts, Connecticut, New York, Maryland, Michigan, and North Dakota and is to be expected wherever larch grows or is planted within this range. The southernmost records are of two specimens from Cunningham Swamp and Cranesville Swamp, both in Garrett County, Maryland (J. Glaser), where a few relictual larches may still be found.

Sample flight periods are, for Newfoundland, 29 June–6 August; Nova Scotia and New Brunswick, 17 May–27 July and 10 August–6 September, indicating two broods; Maine, 26 June–5 July, 10 August; southern New England, 21 June–20 August; New York, 22 May–14 June, 13 August; Maryland, 17, 28 August; Manitoba–Alberta, 25 May–28 June.

Macaria sexmaculata incolorata Dyar
PL. 5, FIGS. 22–24 (adult) (RWH 6343a).

Macaria minorata var. *incolorata* Dyar, 1904.

Type locality: Kaslo, British Columbia. [USNM]

Sciagraphia purcellata Taylor, 1908.

Type locality: Kaslo, British Columbia. [USNM]

The western region, mainly beyond the Continental Divide, in British Columbia, Idaho, Washington, and Oregon, is occupied by subspecies *incolorata*, which differs in its larger size, more heavily serrate and fasciculate male antennae, and more brownish wing color, with the markings more diffuse and less distinct. It also has the ability to feed on both larch and Douglas-fir, but of course we do not know whether nominate *sexmaculata* would eat Douglas-fir because it may not occur, or at least has not been studied, within the range of that tree.

As well as being larger and more brownish, males of *incolorata* differ from those of eastern *sexmaculata* in a further reduction of the dark brown wing markings; three transverse lines and subapical costal spot of forewing, commonly distinct in subspecies *sexmaculata*, usually obsolescent in *incolorata*; small discal spot of hindwing usually absent. Some males very nearly immaculate, resembling worn specimens of *M. minorata*, which may explain why Dyar described it as a variety of *minorata*. Females also usually larger and browner than eastern specimens and show reduction of the dark markings as in males. Wing pattern in general gives effect of being simplified, although transverse lines of forewing, especially postmedial, may remain distinct. Extramedial spots less developed and more likely to be diffuse or wanting. In darker, well-marked specimens, these spots may be present but subdued by incorporation into a dark brown band just beyond and parallel to postmedial. Such a band rarely present in females of nominate *sexmaculata*, which in general have a grayer, more crisply marked appearance. There is considerable variation. Length of forewing: lectotype male of *incolorata*, 12 mm; other males, 10.5–13.5 mm (n = 56); lectotype female of *purcellata*, 12 mm; other females, 11.0–13.5 mm (n = 30).

The genitalia appear to be indistinguishable from those of subspecies *sexmaculata*.

Larvae from British Columbia were briefly described by Ross and Evans (1958), who mentioned the two color forms, similar to those of nominate *sexmaculata*. The host in the southern interior of British Columbia was western larch, *Larix occidentalis* Nutt., but there is probably no host separation between the two subspecies. Specimens from Nordegg, Alberta, on the eastern

slope of the Rockies, where the host was probably eastern larch, have the more heavily fasciculate antennae of *incolorata*. The gap between eastern and western larch is partly filled by subalpine larch, *Larix lyallii* Parl., and eastern larch extends into the intermountain region in north-eastern British Columbia. About 10 adults, most of which I saw, were reared from Douglas-fir by the Canadian Forest Insect Survey in British Columbia, as well as many more from western larch. It is interesting to note that this is not the only record of *Pseudotsuga* serving as an alternate host for a larch-feeding moth. Voûte (1952) reported an occurrence of the larch casebearer, *Coleophora laricella* (Hübner) (Coleophoridae), on this tree.

Subspecies *incolorata* occurs from just east of the main Rocky Mountain system in Alberta (Nordegg) to the intermountain region of southern British Columbia, in northern Idaho (and probably western Montana), Washington, and Oregon. Its range in the Pacific Northwest would be expected to coincide with that of western larch, but if it can subsist on Douglas-fir it could range more widely.

The recorded flight period is 19 May–15 August, which probably includes a partial second generation in mid to late summer.

Macaria submarmorata Walker

PL. 5, FIGS. 25–27 (adult); PL. 12, FIG. 14 (larva) (RWH 6350).

Macaria? submarmorata Walker, 1861, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, 23: 887.

Type locality: St. Martin's Falls, Albany River, Hudson Bay [northern Ontario]. [BMNH]

This is a northern, larch-feeding species closely resembling *M. marmorata* but much smaller, almost as small as *M. sexmaculata*, with which it has often been confused. The size of the moths is intermediate between that of *pinistrobata* or *oweni* and *sexmaculata*. Males are easily distinguished from *sexmaculata* by the presence of a well-developed fovea, and also by a difference in the antennal segments, which, when viewed ventrally, have a less exaggerated triangular shape. Pale, well-marked specimens, especially females, may also be confused with *pinistrobata* or with poorly marked or worn specimens of *oweni*. The genitalia are not useful for identifying this species

except that they do differ slightly from those of *sexmaculata*. The range is transcontinental within the distribution of larch (*Larix*).

Male basically resembling the commonest form of *M. signaria* but smaller, darker, the forewing having a more bluish-gray aspect that contrasts with a quite brownish hindwing, and with usual three lines and other markings of forewing tending to be darker and more complete. The almost pure white ground color of forewing largely obscured by dense overlay of gray-brown scales, giving the gray effect. Extramedial spot as in *signaria*; subapical costal spot blackish brown but usually weak, not prominent. Hindwing commonly variegated with white along inner margin, otherwise almost plain. Underside much browner, with hindwing and costa of forewing yellowish, the markings weak and diffuse; postmedial band across hindwing light brown. Forewing beneath often with patch of pure white scales just before apex, these comprising a portion of subterminal band or shade, and repeating a similar but less obvious marking on upperside. Other species, including *signaria*, also have this white patch but with less contrast. Female like male but with transverse bands heavier and darker, and usually with more white ground color showing, resulting in generally paler, more contrasting aspect. Hindwing of female also with more white and with transverse bands more evident, at least near inner margin. Wing length: males, 11–14 mm; females, 10.5–13.0 mm. Mean wing length: males, 12.4 mm (n = 75); females, 12.0 mm. (n = 54).

Geographic variation is slight, although specimens from Newfoundland average slightly larger and show more of the white ground color than those from elsewhere. Most Newfoundland specimens cannot be distinguished from mainland specimens easily or at all, but a few, especially females, are so pale that they might be confused with *oweni* or very pale females of *pinistrobata*.

Genitalia like those of *signaria* and most others of the group in both sexes.

I reared two broods of this species from females collected at Debert in June 1960 and Upper Economy in July 1994, both localities in Colchester County, Nova Scotia. Larvae from the earlier rearing, which were illustrated in black and white (Ferguson, 1974: 609, fig. 15), show variation in the presence or absence of a row of dark lateral spots interrupting the spiracular stripe segmentally. This spotted form was not present among larvae of the 1994 rearing. As a larva,

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submarmorata is one of the more colorful species of the group, with wide, bold stripes. Ground color varying from green to pink or purplish, and I describe them separately. **Green form**—Middorsal stripe green with a diffuse white addorsal stripe on each side; subdorsal stripe white, quite wide, regular, well defined; space between addorsal and subdorsal about equal in width to subdorsal stripe and pale green; spiracular stripe white, about same width as subdorsal but its edges irregular to sinuous; space between subdorsal and spiracular occupied by two stripes of subequal width, the upper one deep purplish, almost black, and the lower one bright green; ventral area green except for whitish adventrals enclosing a deep purplish middorsal stripe. Head dull green with a large extension of the the purplish-black dorsolateral stripe onto the parietal lobe, and an irregular, lesser extension of the white subdorsal stripe adjacent to it; head yellowish green laterally. Thoracic legs light purplish brown; prolegs partly green, partly deep purplish or black. **Dark form**—Similar except that green areas are variably tinted with pink or purplish, and dark dorsolateral stripe is wider, encroaching into green area that separates it from spiracular stripe; green space between white spiracular and white adventral stripes with or without a longitudinally fusiform, pink, subventral patch on each segment, which in occasional larvae intensifies and expands dorsad into the spiracular stripe to form large, dark, purple segmental spots of the kind seen in some *signaria* larvae (Ferguson, 1974b: 609, figs. 11, 15). Head with dark lateral area larger and diffusing its purplish coloring into paler adjoining areas. Thoracic legs and prolegs nearly black. The dark larval forms are thought to arise under stressful conditions such as overcrowding. These larvae (1994 rearing) were not especially crowded, but as I almost ran out of fresh larch foliage, they may have had to complete development on poor quality food.

There is no evidence that this species feeds in nature on anything other than larch, *Larix laricina* (Du Roi) K. Koch, and perhaps *L. occidentalis* Nutt., unless by accident. All that I reared were fed on eastern larch except for a group of 17 that I transferred experimentally to jack pine, *Pinus banksiana* Lamb., in the penultimate instar. They fed readily upon the pine, and all matured quickly and pupated. It did not alter the size or appearance of the larvae in any way, but all of my pupae of this species died during hibernation.

Of 29 adults reared by the Canadian Forest Insect Survey, 27 were from larch, one from spruce and one from Douglas-fir. Two others from Douglas-fir in British Columbia might be this species, but I could not be sure of their identity. My familiarity with habitats in the Northeast where I collected this species almost annually for many years also point conclusively to an association with larch.

Macaria submarmorata occurs in all Canadian Provinces and the Yukon, but in the United States I know of records only for Maine, New Hampshire, Connecticut (Beckley Bog, near Norfolk, Litchfield County), and Wisconsin.

Undoubtedly it is present in other northern states where larch swamps and sphagnum bogs are present. The Beckley Bog site is an isolated relict plant community that includes larch, and it is the southernmost locality for *M. submarmorata*. When I was taken there by the late Sidney Hessel (a short canoe trip) on 21 June 1965, this was one of the most common moths at our lights.

The recorded flight period for Newfoundland is 30 June–6 August; and for Nova Scotia, New Brunswick and Maine, 17 June–1 August. More westerly records are based on few specimens, most of them reared from collected larvae, but the flight period seems about the same as in the Northeast. The Yukon record, from Burwash Creek, Kluane District, was taken 8 August.

Macaria marmorata (Ferguson)

PL. 5, FIGS. 28–30 (adult) (RWH 6349).

Semiothisa marmorata Ferguson, 1972, *Can. Ent.*, **104**: 564.

Type locality: Dorchester, Westmorland County, New Brunswick. [USNM]

Semiothisa banksianae Ferguson, 1974b, *Can. Ent.*, **106**: 591.

Type locality: Same as for *M. marmorata* above, and based on the same type material.

NOTE—The name that I proposed for this species in 1972 proved to be a junior secondary homonym of *Macaria marmorata* (Warren) from Kwa Zulu-Natal, South Africa. The African species had been described as *Chiasmia marmorata* Warren (1897: 114) but was transferred to the genus *Semiothisa* by Janse in his *Moths of South Africa* (1932: 216). Because of this homonymy, I published the replacement name, *banksianae*. More recently, however, *marmorata* Warren was reassigned to the genus *Chiasmia* Hübner, “1816” [1823] (See Scoble et al., 1999: 132), thus allowing *marmorata* Ferguson to

be reinstated as the oldest available name for the present species. I do not indicate new combination, revised status, or new synonymy above because those changes were already made in Scoble's *Catalogue of the Geometridae of the World* (1999: 569), in which, however, such taxonomic changes are not indicated.

This is a large, bluish-gray, northern species similar in appearance to *submarmorata* but not usually as heavily marked, and it is much larger, being nearly equal in size to northern *unipunctaria*. The forewing can be rather dark in the male, lighter in the female and it has a full complement of three transverse bands; the hindwing, like that of *submarmorata*, is decidedly brownish. The known distribution of *marmorata* lies within a mostly narrow belt across Canada and a few northern states from Nova Scotia to British Columbia, the Yukon, and Washington, following the distribution of the food plants, jack pine (*Pinus banksiana* Lamb.) in the East and lodgepole pine (*Pinus contorta* Dougl.) in the Northwest. The only records that I have seen from the United States are from Maine, Michigan, and Washington.

Macaria marmorata is so similar in color and markings to *M. submarmorata* that a detailed description would seem redundant. The dark forewing markings of *marmorata* are slightly more diffuse and may show less contrast with the bluish-gray background color; and the hindwing, like that of *submarmorata*, is brownish, more so than that of related species. Wing length (eastern specimens): males, 14–16 mm; mean wing length of males, 14.8 mm (n = 27); females, 14–16 mm; mean wing length of females, 14.8 mm (n = 8).

The male genitalia may not be distinguishable from those of related species, but in the few examined the costal lobe of the valve appeared slightly longer and more nearly straight than in other species of the group. This may not be consistent. The genitalia are larger, of course, in proportion to the size of the moth.

The female genitalia also may be no different, but the corpus bursae appears to have a longer shape than that of the most closely similar species, *submarmorata*.

There is relatively little variation in this species. Western specimens associated with lodgepole pine are darker, with more of a bluish or purplish tint to the gray coloring, but since the western specimens available to me were nearly all reared and the eastern ones collected at light,

this may not be a valid comparison. Size varies little between east and west.

I reared *M. marmorata* from a female taken at the type locality in 1950 but have no colored photograph of the larva. However, I kept a detailed description, which was published in my earlier revision (1974: 592–593) and is reproduced below. Apart from above-average size, the larva is characterized by a purplish ground color, with green showing only as part of the spiracular stripe; by the dark ventral border of the subdorsal stripe consisting of two or three very fine lines rather than one wider, solid line; and by the head being almost wholly blackish or dark brown. A green form of the larva might occur, like those that predominate in most species of the group, but those that I reared were all of the purplish form described below.

Ground color of body light pinkish purple; dorsum occupied by four narrow, sinuous, irregular, longitudinal violet lines, the mesial pair, or ad-dorsals, enclosing a purplish middorsal stripe only slightly darker than ground color; subdorsal area with 2–3 separate, thin, closely parallel lines of dark violet with a white border dorsally, and this again followed dorsally by a faint, irregular, violet edging; spiracular stripe pale greenish yellow, wide and distinct but diffusely defined, and shaded both dorsally and ventrally with equally wide borders of green; spiracles pale brown, situated near upper margin of greenish-yellow part of spiracular stripe; subventral stripe represented by a pair of irregular, violaceous lines, slightly paler than ground, bordered on both sides with dark purple; ventral area with a pair of irregularly defined, dull whitish adventral lines enclosing a midventral stripe of a similar or very pale purplish shade; adventrals shaded laterally with darker violet; thoracic legs dark purplish brown; prolegs pale violet shading into green. Head almost entirely blackish as in *M. oweni* but slightly darker; setae and stemmata shining black. Maximum length: 25 mm.

I identified more than 200 adults reared from larvae beaten from jack pine and lodgepole pine by the Canadian Forest Insect Survey. These data, plus the exclusive association of the adults with these trees when they are found in nature, leave no doubt about the food plants.

Macaria marmorata is known in Canada from Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, and the Yukon, and in the United States from

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Maine, Michigan, and Washington. Four specimens in the USNM from Newport and Astoria, Oregon, 8–26 July, appear to be this species but have unusually dark gray-brown rather than light brown hindwings (plate 5, figure 29). The recorded flight period, which probably does not vary much across the continent, is 11 June–1 August, indicating one generation.

Macaria signaria (Hübner)

PL. 5, FIGS. 31–36 (adult); PL. 12, FIG. 15, PL. 13, FIG. 1 (larva); TEXT FIG. 2 *a* (venation) (RWH 6344, 6345).

Geometra signaria (Hübner), [1809], *Sammlung Europäischer Schmetterlinge*, 5: pl. 61, fig. 313.

Type locality: Europe [Bavaria?]

NOTE—Identification of *signaria* is based on Hübner's illustration, fig. 313, which is easily recognized as the present species.

Tephrosia dispuncta Walker, 1860, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, 21: 405. REVISED SYNONYMY.

Type locality: St. Martin's Falls, Albany River, Hudson Bay [northern Ontario]. [BMNH]

NOTE—My revision of this species complex (1974b) contains photographs of the types of all the Walker names listed as synonyms of *M. signaria*.

Boarmia inordinaria Walker, 1860, *ibidem*, 21: 488.

Type locality: Township of Montcalm [Quebec]. [CNC]

Macaria? subapicaria Walker, 1861, in W. S. M. D'Urban, *Can. Nat. Geol.*, 6: 40.

Type locality: Canada ("Valley of the River Rouge"). [CNC]

NOTE—The River Rouge is in southern Quebec, flowing southward to enter the Ottawa River about 15 miles upstream from the easternmost end of Ontario.

Macaria haliata Walker, 1861, *List of the Specimens of lepidopterous Insects in the Collection of the British Museum*, 23: 885.

Type locality: Nova Scotia, by previous lectotype designation (Ferguson, 1974b: 578).

NOTE—A possible homonym or senior synonym, *Tephrosia haliata* Guenée (1857 [1858]: 97) was described from two males collected in California by Lorquin, and it has been listed by some authors as a possible member of the *signaria*-group (e.g.,

McDunnough, 1938: 158) or as a species of "*Semiothisa*" (Scoble *et al.*, 1999: 884). Species of this group do occur in California (*signaria*, *unipunctaria*), but Guenée included species of many genera in *Tephrosia*. We may never know the identity of *haliata* Guenée because the types are apparently lost (Oberthür, 1923: 247; Ferguson, 1974: 574).

Macaria irregulata Walker, 1861, *ibidem*, 23: 890.

Type locality: New York. [BMNH]

Larentia? exnotata Walker, 1862, *ibidem*, 24: 1,186.

Type locality: Nova Scotia. [BMNH]

Macaria quadrisignata Walker, 1866, *ibidem*, 35: 1,655.

Type locality: North America. [BMNH]

Semiothisa fraserata Ferguson, 1974b, *Can. Ent.*, 106: 581. NEW SYNONYMY.

Type locality: Richland Balsam Mountain, 6,000', Jackson-Haywood County line, North Carolina.

NOTE—This name was based on 176 specimens collected at sheets with 15 watt ultraviolet fluorescent tubes on 30 June–3 July 1967. The site was on the 6,000-foot crest of Richland Balsam Mountain just far enough down the slope from the summit parking lot to be out of sight of the road (the Blue Ridge Parkway). The dominant tree in the vicinity at that time was Fraser fir (*Abies fraseri* Poir.).

Macaria signaria is the most abundant and widely distributed member of the *signaria*-group, being associated with the northern coniferous forest and with mixed forest of the Canadian Zone and the northern fringe of the Transition Zone across the whole of North America and Eurasia. It extends far southward in the Appalachians and in the mountain systems of the American West, as well as in the Alps and other mountain ranges in Europe and Russia. It is also the least specialized with respect to foodplant choices, feeding on all genera of pinaceous conifers within its range; whereas others of the group are restricted to one genus or even one species of tree. *Macaria signaria* is the most widely distributed member of the *signaria*-group and the most abundant where it occurs. It is also geographically the most variable member of the group.

Distinguishing features of the most widespread and common form are subtle and variable; but in general appearance *signaria* tends to be the most lightly marked, uniformly brownish or gray-

brown species of the group, without strong contrasts in shade between the fore- and hindwing, as with the bluish-gray forewing and brown hindwing of *marmorata* and *submarmorata*; also it is generally without the bolder contrasts and conspicuous white ground color of *submarmorata*, *pinistrobata*, *granitata*, or the pale ground and straight-lined pattern of *fissinotata*. Most Nearctic specimens from east of the Rocky Mountains and those from Europe are extremely similar, whereas those from the Pacific Northwest to northern California and the northern Rocky Mountains are conspicuously larger. These are further discussed as part of the main description, which follows.

Across much of Canada and the northern states east of the Rocky Mountains, ground color of wings whitish, with a heavy overlay or suffusion of light gray brown in the male, less so in the female; forewing of male mostly gray brown, usually with only vestiges of the whitish ground color; female with much more of the whitish ground color showing on both wings and with a more complete set of markings; gray-brown shading, as well as usual blackish bands and spots of both sexes presenting a diffuse, subdued aspect, without the bolder contrasts and more intense grays or blacks of the markings in related species. Postmedial band irregular and similar to that of *pinistrobata*. Hindwing, although brownish, remaining pale, and with its transverse bands little emphasized or obsolescent. Fringes mostly light brownish, essentially concolorous with wings. Otherwise variable, in males often heavily variegated with brown to reddish brown, especially on forewing where subapical spot may be reddish brown; underside with more whitish in females than in males, and with some reddish-brown tints in many but not all specimens of both sexes; diffuse brown to reddish-brown postmedial band (sometimes double) more likely to be present in females, evenly curved, subparallel to outer margin. Appendages and head and body coloring not differing from that of closely related species. Wing length: northeastern males, 12.5–15.0 mm (mean length, 13.4 mm) ($n = 84$); northeastern females, 11.5–14.5 mm (mean length, 12.9 mm) ($n = 73$). Southern Appalachian males, 14–16 mm (mean length: 15.4 mm) ($n = 24$); females, 13–15 mm (mean length: 14.4 mm) ($n = 14$). Rocky Mountains westward, males, 14.0–17.7 mm (mean length: 15.4 mm) ($n = 41$); females, 14.0–17.5 mm (mean length: 15.8 mm) ($n = 44$).

The genitalia are indistinguishable from all others of the *signaria*-group in both sexes. Those of *M. sexmaculata* are slightly different, but this species is not in the strict sense a member of the group.

Although the nominate European form and predominant North American form of *signaria* described above are very similar, they do differ somewhat. The overall coloring of European specimens is slightly more brownish, not as gray as the American subspecies. Also, the European form is more distinctly banded on the hindwings, above and beneath. Most have a full complement of three brown transverse bands on the hindwing, of which the postmedial is best developed. On the underside of the hindwing the medial band may be missing and the antemedial weak, but the postmedial is usually distinct. In American specimens of *signaria* all of the transverse bands on the hindwing are most commonly weak or absent, both above and beneath, and the wing is more suffused with gray. This does not apply to Pacific Coast populations of *signaria*, which are different again, being large and often more boldly marked than either of the above geographic variants and often difficult to distinguish from northern *Macaria unipunctaria*. In other American species of the *signaria*-group the transverse bands are as well or better developed than in European *signaria*, at least on the undersides. *Macaria signaria* is regarded as uncommon in Europe, in contrast to its abundance in the Canadian and Hudsonian forests of North America.

Macaria signaria is represented in North America by at least three visibly different entities, which I do not name because their status is uncertain. One of them occurs together with normal *signaria* in Nova Scotia but is uncommon and confined to larch swamps. It is an abnormally pale, whitish form of normal size and markings that could be some kind of environmentally induced variant or still another species. It occurs together with normal *signaria*, but only very locally in apparent association with larch, although evidence for larch being the host is circumstantial only. I attempted to rear it but obtained no offspring and made no color photographs. Ordinary *signaria* can feed on larch without this affecting its appearance. This pale form is probably more widespread but unnoticed.

The second form is one that replaces eastern *signaria* west of the Rocky Mountains from southern Alaska to northern California and is it-

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self geographically variable within that region. It is large (wing length: males, 14–17 mm; females, 13.5–16.0 mm), with the females often pale and well marked, and seems to reach its best development on Vancouver Island and around Puget Sound (plate 5, figure 34). It is easily confused with *Macaria unipunctaria* in that area, and the relationship between the two is uncertain. *Macaria unipunctaria* of the mountains in Alberta, Montana, and British Columbia is large and dark, however, darker than is usual for *signaria* and much darker than *unipunctaria* of the Southwest. The Pacific Coast form of *signaria* bears more of a resemblance to the southern Appalachian taxon discussed below, being fully as large, although not as bright and clearly marked.

The third form (plate 5, figures 35, 36) that stands out as different is the one that I named *fraserata* (1974b: 581) but now place in the synonymy. The taxonomic status of *fraserata* has become increasingly doubtful because I described it as a species, in view of the possibility that it may be only an environmentally induced form of the high, cool, moist habitat on the highest summits of the Southern Appalachians. Although this form was exceedingly abundant when originally collected, it is uncertain whether the real thing has since been recovered, probably because the presumed host, Fraser fir (*Abies fraseri* Poir.) (Pinaceae), has since been drastically reduced by the introduced adelgid *Adelges piceae* (Ratzeburg). The few recent specimens that I have seen were borderline in appearance and may have been large individuals of *M. signaria*. The form matching the types of *fraserata* has not been reared as far as I know. It occurred in the zone of Fraser fir at a time when the trees were large and healthy, still not noticeably affected by the invasive balsam woolly adelgid that later destroyed them. The moth was abundant. Although recognition of this large, bright form as a species did not seem a problem to me at the time, material from other sites in the Southern Appalachians later appeared to be intermediate, casting doubt on the validity of *fraserata* as a species. Perhaps *fraserata* had best be regarded as an ecological or environmentally induced form related to some common factor in these widely separated habitats.

The larva of *signaria* was described by Dyar (1904), Ross and Evans (1958), McGuffin (1972), Ferguson (1974), Ives and Wong (1988: 23, fig. 10F), and Wagner et al. (2001: 47). I have reared this species several times from Nova Scotia

(spruce, fir, larch), Great Smoky Mountains National Park (spruce, fir), and from Quilcene, on the east side of the Olympic Peninsula, Washington (Douglas-fir). All of these larvae were essentially alike in color and pattern, although the brood from Washington was of the large Pacific Slope form discussed above, and the larvae were correspondingly large. The Canadian Forest Insect Survey (Prentice et al., 1963: 408) reported rearings from about six species of pine, but as that was before the moths of this group were differentiated, the eastern host records could refer to other species, such as *M. pinistrobata*. However, their western records from pine (from areas where related *Macaria* species are absent, except *unipunctaria* on Douglas-fir) probably do mostly refer to *signaria*, and I examined much of this reared material, including 10 adults each from *Pinus monticola* and *P. contorta latifolia*. The small numbers reared from pine relative to other trees indicate that pines are not the usual hosts of *signaria*. The Canadian Forest Insect Survey reared 3,382 adults from balsam fir; 3,111 from Douglas-fir; 2,675 from white spruce; and 1,655 from western hemlock. Hemlock is a very likely food plant in the East, because adults have often been collected at sites where the only suitable hosts present were eastern hemlock or white pine, as in central New York, Massachusetts, and Connecticut. In Europe *signaria* has been reared from spruce and Scotch pine, but its full range of hosts there may not be known or recorded.

The following descriptions were originally based on Nova Scotian larvae reared from eggs but have been confirmed by more recent rearings from other places. The larvae occur in two very different color forms that are frequently present among offspring of the same female. **Green form** (plate 12, figure 15)—Ground color bright green; subdorsal line pure white, bordered ventrally by a green stripe darker than the ground or a black to dark purplish stripe and then a green stripe; position of middorsal stripe marked by a dark green stripe bordered by a pair of addorsals of a somewhat paler green than the ground color; lateral line (i.e., spiracular or stigmatal line) white, tinted with greenish or yellowish, sometimes varying to pale lemon yellow; pale stripes tend not to be as wide as those of *pinistrobata* and *fissinotata*; minute brown spiracular openings lie within lateral line near its dorsal edge; venter marked by pair of dark green adventrals, bordered with whitish varying to pale green or yellow; ad-

ventrals separated by a narrow, green, midventral space, slightly paler than ground color; thoracic legs light brown to black, prolegs unicolorous with green ground color. Head pale green; epicranium marked laterally, or dorsolaterally, by a conspicuous, shiny, blackish-brown patch that extends to the antennae and is present in all larvae of the group except *sexmaculata*. It serves as an extension onto the head of the dark body stripe that runs just beneath the subventral stripe; this dark head patch variable in color (between black and brown) and extent. Setae and stemmata shining black. The green larvae turn pinkish before pupation. Note that the larva of *unipunctaria* (plate 13, figure 2) is different. **Brown form** (plate 13, figure 1)—Usual green ground color obscured to a variable extent by dark purplish-brown pigmentation; entire dorsal area may appear purplish, with thin, sinuous, greenish or yellowish addorsals; green dorsolateral stripe replaced by a wide, dark, purplish stripe, bordered above by a reduced white subdorsal that may be segmentally interrupted, or even vestigial; lateral stripe pure white to yellowish, commonly interrupted by a prominent, dark purplish blotch in middle of each segment, just posterad of spiracle; venter marked by pair of dark, purplish subventral stripes, almost as wide as dorsolaterals, sometimes with a thin white lateral margin. Thoracic legs with sclerotized parts reddish brown, dark purplish basally; prolegs green to purplish. Head mostly dark, with a whitish area dorsally and frontally, this being an epicranial extension of pale dorsal area of body; head with the usual dark brown area dorsolaterally, appearing as a continuation of the dark dorsolateral stripe, and laterad of this again a diffuse paler shade, opposite the white lateral stripe of the body; pale frontal and lateral areas of head tending to be marked by irregular spots of dark brown. Maximum length of both forms: 21 mm.

The brown or purplish larvae are rarely collected by beating or sweeping but are common in reared broods, and it is thought that they are induced by the stress of overcrowding. Many Geometridae do have different larval color forms, usually green and brown, that seem to be natural, and this is very common. For example, *Macaria sexmaculata* has two very different forms, green and variegated dark gray brown to blackish, which, for later instars at least, may be obtained in about equal numbers by beating the food plant.

Ives and Wong (1988, fig. 10 E, F) show as

forms of *M. signaria dispuncta* two excellent photos that may not be of the same species. Figure F is probably correct, but figure E from Douglas-fir appears to be a stouter larva with simpler markings, and they acknowledge (p. 23) that larvae from this host "are generally lighter in color than those on spruce or balsam fir." The larva shown in this figure might be expected to be that of *unipunctaria*, but it does not match larvae of *unipunctaria* that I reared from Utah. Western larvae from Washington that I reared on Douglas-fir are normal for *signaria*.

Macaria signaria occurs in North America across Canada from Newfoundland and southern Labrador to the Yukon and southern Alaska, and southward into the United States to Connecticut; central New York (Ithaca); the Catskill Mountains, New York; Pennsylvania; Michigan; Wisconsin; down the Appalachians to North Carolina and Tennessee, and reportedly to northern Georgia and Alabama (although I have not seen those specimens); and in the West southward to the Black Hills, South Dakota; Crook County, Wyoming; through the Cascades and Olympic Mountains; and as far south as Lake, Placer, Sonoma, Napa, and Plumas counties, California.

Across Canada generally there is only one protracted generation, the adults flying from about the beginning of June to the end of July, with a few early records in May for more southerly areas, and late stragglers in early August. From the latitude of southern New England southward there is at least a partial second generation, with a scattering of late adults from mid-August to mid-October.

Macaria unipunctaria (W. S. Wright)

PL. 5, FIGS. 37–42 (adult); PL. 13, FIG. 2 (larva) (RWH 6346).

Melanolophia unipunctaria W. S. Wright, 1916, *Ent. News*, 27: 458.

Type locality: Glen Alpine Creek, Tahoe, Calif. [SDNHM]

Macaria perplexa McDunnough, 1927, *Can. Ent.*, 59: 244.

Type locality: Nicola, B. C. [CNC]

Macaria unipunctaria is about the largest species of the *signaria*-group (a few *signaria* from isolated eastern and western populations are equally large), and it is the only one that is exclusively western. It occurs in association with Douglas-fir

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throughout much of the West, usually in mountainous regions, from Alberta and British Columbia to Arizona but is much confused and misunderstood because the adults gradually change in appearance from the Southwest to the Northwest. Southwestern specimens are pale, bright, lightly marked, and uniform, with a distinctive, light brown, subapical costal patch. Beginning in the White Mountains, Arizona, however, and thence northward to Alberta and British Columbia, and also in the northern Sierra Nevada, the specimens are darker, with the wings more granulated or suffused with dark scales, and the subapical patch more inclined to blackish. This darkening trend culminates in the dark gray northern form that McDunnough described as a species, *Macaria perplexa*, and which at its most extreme is the antithesis of what makes the bright southwestern form of *unipunctaria* so distinctive.

I reconsidered the question of whether *perplexa* and *unipunctaria* may be two species but found no reason to think so. The entity described as *perplexa* is a northern or high-elevation series of populations of *unipunctaria* characterized by a gradual darkening of the wings in clinal fashion over a long distance. Thus it seems futile to recognize *perplexa* as a named subspecies as I did earlier (1974b). Indeed, the population of the type locality of *unipunctaria* at Lake Tahoe, California is intermediate.

Northwestern specimens of *Macaria signaria* may also be dark and are sometimes impossible to distinguish from *unipunctaria* of the same region. I have retained them as separate species mainly for three reasons: 1) *M. unipunctaria* feeds only on Douglas-fir as far as we know, whereas *signaria* feeds on various conifers; 2) the larvae are different; and 3), adults of southwestern *unipunctaria*, devoid of all dark suffusion, are distinctive and easily distinguished from *signaria*.

Southern form—Sexes essentially alike except that female may be paler (plate 5, figures 40–42). General aspect similar to that of *signaria*, with the light gray wing color resulting from an even dusting of dark brown or blackish scales on a whitish ground; usual three transverse bands crossing forewing dark brown, erect from inner margin, waved, subparallel, commonly weak and indistinct except near costa (but see discussion of geographical variation); subapical costal spot subrectangular, commonly pale yellowish brown proximally, darkening to deep reddish brown distally, but varying from all dark to obsolescent;

extramedial spot dark brown or blackish, varying from well developed to absent or diffuse, but commonly about half size of subapical costal spot. Hindwing about same color as forewing, faintly marked with only traces of one to three bands at inner margin, and with a small discal spot. Underside with markings indistinct, diffuse, but with subapical costal spot of forewing expanded, diffuse, prominently light yellowish brown to reddish brown. Wing length: males, 15.0–17.5; female, 15.0–17.5. Mean wing length: male, 16.4 mm (n = 18); female, 16.5 mm (n = 18). **Northern form** (*Macaria perplexa* McDunnough)—Not altogether northern because the range begins in Apache County, Arizona and in the central Sierra Nevada (plate 5, figures 37–39). Apex of forewing in both sexes becoming less produced. Pale coloring that is characteristic of specimens from Arizona, New Mexico, Utah, and southern California gradually darkening northward, tending to be obscured with dark gray-brown suffusion, more so in males than in females; both extramedial and subapical costal spots often reduced, but with at least a trace of yellow-brown coloring as seen in subapical costal spot of southern *unipunctaria* still present in about one-third of the reared British Columbian specimens, but seems to be lost in those from Montana. Underside more yellowish than upper-side and marked with diffuse bands and patches of reddish brown. Length of forewing: males, 14.0–16.5 mm; females, 14–17 mm. Mean forewing length: British Columbia males, 15.3 mm (n = 13); British Columbia females, 15.6 mm (n = 19); Montana males, 14.6 mm (n = 10); Montana females, 15.1 (n = 7).

Genitalia similar to those of *signaria* and related species except that those of female are slightly larger, with tapering neck region of bursa copulatrix longer, and sterigma tending to be slightly truncated on its posterior margin.

Variation mostly covered in descriptions of southern and northern forms given above. Specimens from New Mexico, Arizona, the eastern rim of the Great Basin in Utah, southern Nevada, and southern California, including the southern Sierras, are pale, except that those I have seen from the White Mountains, Apache County, Arizona show the beginnings of the darkening trend. This darkening continues northward through the pine-Douglas-fir zone in the mountains of Colorado, Wyoming, eastern and central Utah, and in the Sierra Nevada, although pale to intermediate

specimens continue to occur in central and northern California in Sonoma, Lake, Napa, Amador, Tulare, Modoc, Mendocino, Humboldt, and Siskiyou counties. The darkest specimens are from British Columbia, Alberta, Idaho, and Washington, but those from Oregon also can be very dark. Specimens from Montana are a little paler. The transition between the pale and dark forms is not an abrupt boundary but a gradient that occupies a large part of the total distribution. Darkening of the wings may be related in part to climatic differences, because the palest specimens of *unipunctaria* usually seem to be associated with semi-arid conditions.

Another problem in recognizing *perplexa* as a subspecies is that the population at the type locality of *unipunctaria* is intermediate. A series of 118 specimens in the USNM from Ward Creek, near Tahoe City is quite uniform, a little closer to the pale southern form than to the dark northern form but still part way between, and with almost complete loss of the light brown color from the subapical costal spot, which is mostly blackish. These topotypical moths are very similar to specimens from the White Mountains, Arizona and Colorado. The main identification problem with *M. unipunctaria*, and one that I have not solved, is the difficulty of distinguishing it from the large North Pacific Coast form of *signaria* in Oregon, Washington, and western Canada, although I examined about 800 specimens of this species.

Larvae (plate 13, figure 2) that I reared from a female of the pale, southwestern form collected in the Wasatch Mountains near Ephraim, Sanpete County, Utah differed markedly from those of *signaria* and all other species of the *signaria*-group. The pale dorsolateral stripe, present and well developed in other species, is absent, and the only conspicuous longitudinal stripe is the wide, light yellow spiracular. Almost the entire dorsal and ventral area of the body between spiracular stripes is filled in with numerous fine, sinuous or geminate, charcoal-colored longitudinal lines on a light bluish- or greenish-gray background. This pattern is interrupted only by a thin, gray, blackish-edged middorsal stripe, a wider yellow mid-ventral stripe, and a limited, irregular encroachment of leaf green immediately above and below the irregular but quite wide spiracular stripe. Head light green with the usual sublateral brown "cheeks," which are straight, clearly defined, and run from a dorsolateral position at back of head

to mandibles, keeping clear and anterad of stemmata. Brown patches on head of *signaria* are commonly more extensive and diffuse. Thoracic legs light brown; prolegs green and blackish. None of the larvae that I reared was marked with dark brown or purplish as is common in *signaria*. I have not seen northern larvae of the "*perplexa*" form and cannot say whether they agree.

The overall distribution is mainly as already indicated, from Montana, Alberta, and British Columbia through the Rocky Mountain system to New Mexico and Arizona, in the Great Basin, Cascades, and Sierra Nevada to the southern end of the Sierras.

This species flies in June and July in most of its range, including Arizona, Utah, Colorado, Montana, Idaho, and Alberta, with no evidence of a second generation. The flight period is longer in the Pacific Coast region, suggesting a second or partial second generation. The available dates are 23 May–17 August for California; 18 May–13 September for Oregon; and 18 May–5 August for British Columbia.

Macaria pinistrobata (Ferguson)

PL. 5, FIGS. 43–46 (adult); PL. 13, FIG. 3 (larva) (RWH 6347).

Semiothisa pinistrobata Ferguson, 1972, *Can. Ent.*, **104**: 563.

Type locality: Lake Kejimikujik, Queens County, Nova Scotia. [USNM]

NOTE—The type locality is now in Kejimikujik National Park, close to the northeast shore of Lake Kejimikujik and near the Grafton Lake Fish Hatchery. The site has since been developed into a public beach area.

Although very close to *M. signaria* in size and wing pattern, this species presents a more black-and-white appearance because of the contrasts between its intensified dark shading and markings against the more extensive whitish ground color. Females are especially variable and may be very pale. Normally the features of *pinistrobata* are subtle, but they are readily apparent in fresh, bright material. The moths may seem intermediate between *signaria* and *oweni* and have been mistaken for *oweni*; although they are more often mistaken for *granitata*. Many more melanic specimens of *pinistrobata* have been collected than of any other species in the tribe. *Macaria pinistrobata* is mainly a species of the Northeast and Great Lakes Region, and its range coincides with

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that of its food plant, eastern white pine, *Pinus strobus* Linnaeus, and follows the distribution of this tree far down the Appalachian system.

Male. Ground color of forewing whitish, variably dusted or shaded with gray to blackish scales, space between medial and postmedial bands usually palest; three lines commonly present, irregularly waved, blackish, expanded at costa, tending to fade out toward inner margin; medial band often weakest; dark preapical costal spot variable but normally strong, subquadrate, usually very dark, almost blackish, occasionally brownish suggesting that of *granitata*; extramedial spot blackish, variable, sometimes obsolete, averaging about same size as preapical costal spot. Hindwing gray brown, usually much less marbled with white than forewing, especially toward costa; markings obsolescent except toward inner margin, where the ends of the three bands become visible. Underside whitish, extensively shaded with light yellowish brown, often forming two ill-defined bands across hindwing but no discrete markings on forewing; preapical costal spot replaced beneath by area of light brown; costa, immediately before and after postmedial, often marked by areas of light buff yellow. Underside more decidedly brownish than that of *M. signaria*, without the stronger contrasts of *granitata* or *oweni*, but similar to that of *submarmorata*.

Female. Like male but generally much paler, with white ground color more extensively apparent both above and beneath; upperside of hindwing variable, either like that of male or uniformly variegated with white from inner margin to costa.

Melanic specimens of both sexes show all degrees of darkening, although about 95% are extremely dark. Rare individuals are just slightly darker than normal. In the darkest specimens the usual markings are all but obliterated, except for a contrasting whitish subterminal present on the forewing in females but not males. The hindwing is paler than the forewing, and the underside, especially along veins, postmedial bands, and costa, is shaded with rusty red brown. Wing length: males, 12–15 mm; females, 12.0–14.5 mm. Mean forewing length: males, 13.45 mm; females, 12.0–14.5 mm.

Genitalia probably not distinguishable from those of *signaria*, although in female ductus bursae seems slightly more stout.

Except for well-established industrial mela-

nism in the vicinity of Halifax, Nova Scotia (Ferguson, 1974: 587–588), this species varies little throughout its range. Specimens from eastern Canada, New England, New York, Michigan, Maryland, and North Carolina are all essentially alike, except for 14 males that I collected in a white pine grove near Concord, New Hampshire that are more uniformly grayish and not as heavily marked as usual.

Larva (plate 13, figure 3) almost exactly like that of *signaria*, but in those I reared from Nova Scotia the pale subdorsal and lateral stripes were wider and the addorsals were yellow. If these features were consistent, which is unlikely, the larvae could be distinguished. The head is green and the dark extension onto the lobe of the head is a little less extensive but black and clearly defined, with few dark spots surrounding it. *Macaria pinistrobata* does not seem to have a dark form or one with lateral segmental brown blotches as found in *signaria*. The larvae of *pinistrobata* and *fissinotata* are so similar that it may not be possible to tell them apart, although in a brood of the latter that I reared from Tennessee, the white subdorsals were again narrower and relatively weak, more as in *signaria*. Ample evidence shows that *pinistrobata* is host specific on eastern white pine (Ferguson, 1974b; Wagner et al., 2001: 48).

Macaria pinistrobata occurs from Nova Scotia and Maine to Quebec, Ontario, Michigan, Wisconsin and southward to the latitude of New Jersey and Maryland from near sea level to the mountains, thence down the Appalachians to North Carolina, Kentucky, Tennessee and probably northernmost Georgia and adjacent South Carolina, wherever white pine grows. In the suburbs of Washington, D. C., where white pine is probably not native but commonly planted as an ornamental, this species has come in, as doubtless it has elsewhere beyond the fringe of its original range. However, it is much less common in such areas than *M. fissinotata*.

This species has one main flight period, about 15 May–15 July (beginning in June northward). Occasional individuals may continue to appear through late summer, with the latest recorded being from Maine on 22 September. Late records are too rare to indicate a full second brood and must be partial or accidental second-brood emergences.

Macaria fissinotata (Walker)

PL. 5, FIGS. 47–50 (adult); PL. 13, FIG. 4 (larva) (RWH 6348).

Acidalia? fissinotata Walker, 1862 [1863], *List of the lepidopterous Insects in the Collection of the British Museum*, **26**: 1,595.

Type locality: Trenton Falls, New York. [BMNH]

Macaria retinotata Walker, 1862 [1863], *ibidem*, **26**: 1,642.

Type locality: Nova Scotia. [BMNH]

NOTE—Lectotypes for both of the above names were designated and illustrated by me (1974: 589; 620, figs. 230, 231).

This is a pale, often lightly marked, hemlock-feeding eastern species with a reduced forewing pattern, at least in spring specimens. The postmedial band of the forewing is unusual in being nearly straight for most of its length, the medial line indistinct or wanting, and the fringes of both wings pale yellow in fresh specimens. The transverse bands of the hindwing, although rather a light gray brown and diffuse, are more completely indicated than in either of the foregoing species. The species is also unusual in being the first member of the *M. signaria* complex to emerge in the spring, up to two weeks earlier than other species, and in having a large second brood, even in the northern parts of its range. Also, it is seasonally dimorphic, with moths of the summer generation being more heavily and brightly marked than spring ones.

Both wings with whitish ground color variably but often quite uniformly dusted with gray-brown scales, except in palest specimens that have a predominantly white ground. Forewing with usual markings reduced or simplified, dark brown to blackish. Antemedial and postmedial bands of forewing dark, but weak, often interrupted, occasionally obsolescent, the latter more nearly straight than in other species of group except where it angles basad near costa. Medial band wanting or only faintly indicated in light gray brown, but becoming a dark brown or blackish spot at costa; extramedial and preapical costal spots variable but tending to be much reduced, sometimes almost wanting; discal spot absent. Hindwing with upper surface variegated with gray brown or fuscous, the darker coloring usually arranged as three transverse bands, of which the antemedial or medial, or both, may be re-

duced or absent; postmedial usually best developed and may be partly merged with medial band, thus appearing as one especially wide band. Hindwing discal spot usually present, faint, diffuse. Fringes of both wings yellowish, often very lightly checkered. Underside as pale or paler, with markings of upperside repeated indistinctly, and costa shaded with yellow brown, especially beyond postmedial in position of preapical costal spot. Female differs from male in being slightly broader winged, with usual dark bands and spots somewhat more boldly emphasized, including a more frequent or complete median band on forewing; greater contrast between whitish ground and gray-brown bands or shading gives wings a more variegated appearance than those of male. Wing length: males, 12–14 mm; females, 11.5–14.0 mm. Mean length: male, 13.1 mm (n = 38); female, 12.7 mm. (n = 38).

Summer-brood adults are a little darker and more boldly marked than spring ones, and reared specimens of both generations tend to be better marked and brighter than field-collected ones. Between eastern Canada and the southern Appalachians geographic variation is slight but noticeable. From Maryland southward the moths tend to be a little brighter than northern ones in both broods; that is, they show greater contrast between light and dark shades in their wing coloring; and specimens from the Great Smoky Mountains, where the species is common, seem especially large and bright.

Larvae (plate 13, figure 4) of several broods that I reared differed slightly from those of both *M. signaria* and *M. pinistrobata*, but these differences may prove not to be consistent. Markings of *fissinotata* seem less bright than those of the other species, probably because the pale stripes, most notably the subdorsal and lateral stripe, are narrower than those of *signaria*, and much narrower than those of *pinistrobata*. Mid-dorsal stripe dark green, flanked by a very weak pair of whitish addorsals, these being separated from the thin white subdorsal by a green space, which is often replaced or partly so with dark purplish or black and may be termed the supra-spiracular stripe. Lateral (spiracular) stripe weak, diffuse, ill defined, yellow green but often broken, unlike those of other species. Subventral stripe weak, purplish, faintly edged with white. Head with lateral lobes heavily marked with dark chestnut brown, otherwise green to pale brown mesially and frontally, the paler area being a di-

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rect continuation of the pale dorsal part of the body pattern. Thoracic legs pale to dark brown, prolegs mostly green. Larvae of *fissinotata* entirely lack the conspicuous purplish lateral spots or blotches characteristic of the dark, more heavily marked examples of *dispuncta*, and commonly present in all larvae that I reared of *M. submarmorata*. A fine illustration of the larva was published by Wagner et al. (1997: 84).

It has long been apparent from field observations and many rearings, including those of the Canadian Insect Survey, that this species is exclusively associated with hemlock in nature, and its range follows the distribution of eastern hemlock (*Tsuga canadensis* (Linnaeus) Carr.) almost exactly. However, it can be reared on other conifers in captivity. I found that later instars of larvae reared from eggs could be switched to white pine, larch, Douglas-fir, balsam fir, and white and red spruce with little difficulty, but did not try this with newly hatched larvae. The switched larvae produced normal adults of *fissinotata*.

Macaria fissinotata occurs from Nova Scotia, including Cape Breton Island, to southern Quebec, Ontario, through the Great Lakes Region to Wisconsin, and southward in the East through New England, New York, northern New Jersey, Pennsylvania, western and central Maryland, and the mountains of Virginia, West Virginia, Kentucky, Tennessee, North and South Carolina, and northern Georgia. It has been common in the suburbs of Washington, D.C., where hemlock is extensively planted as an ornamental, but in the late 1980's and into the 1990's the trees suffered severely from the depredations of an introduced woolly adelgid, and the moth is in decline.

The following flight periods are given for states or provinces where large samples of specimens have been collected. Nova Scotia, 28 May–23 June (July 3 on Cape Breton Island), and 2–21 July; Quebec and Ontario, 27 May–16 June, and 2–21 July; New England, 4 May–2 July, and 6 July–4 September; New York, New Jersey, Pennsylvania, 19 April–28 June, and 10 July–17 September, but probably with some of the late June records representing second-generation emergences; Maryland, 17 April–20 June, and 30 July–8 September; Kentucky, 14 April–7 July, and 15 July–26 August; the Carolinas, Tennessee, and northern Georgia, 16 May–11 June, and 30 June–5 September. Some dates relevant to broods, especially in the Appalachians, may be

confused because of the effects of elevation on emergence times.

For all of the more northern areas, most collection dates are for May and June, suggesting that the second generation is partial. This is supported by several of my laboratory rearings in which a fraction of the offspring, varying up to about 50%, emerged later the same season, the remainder diapausing for emergence the following spring.

Macaria oweni (Swett)

PL. 5, FIGS. 51–53 (adult); PL. 13, FIG. 5 (larva) (RWH 6351).

Sciagraphia granitata var. *oweni* Swett, 1907, *Jour. New York Ent. Soc.*, **15**: 128–129.

Type locality: Grand Lake, Newfoundland. [USNM]

NOTE—The lectotype was designated earlier (Ferguson, 1974b: 596).

Macaria oweni is easily recognized by its boldly marked, contrasting, black-and-white appearance. In fresh specimens the ground color of the forewing is cream, later fading to white; that of the hindwing is always whitish. The three main transverse bands of the forewing are usually all present and complete; those of the hindwing are broken and incomplete but form one or more irregular dark bands above and beneath. The range is northern, from Newfoundland to Alberta, following that of the food plant, eastern larch or tamarack (*Larix laricina* (Du Roi) K. Koch), although its range does not seem to extend either as far north or south as does that of the food plant.

Similar in size and basic pattern to several related species, as for example *signaria*, *pinistrobata*, and *granitata*, but ground color paler and blackish markings heavier, giving a very boldly marked and contrasting appearance. Sexes almost alike, the female only slightly paler and more brightly marked. Wing shape slightly more acute than that of *signaria*; i.e., apex a little more produced and hindwing more angulate. Ground color of forewing cream colored in fresh specimens, later fading almost to white; of hindwing, white; fringes cream colored to whitish, lightly marked with dark rays opposite vein endings. All markings of forewing, including preapical costal spot, blackish rather than brown; of hindwing, lighter but gray rather than brown; antemedial and postmedial bands of forewing usually complete; me-

dial band, variable in strength and position, could be described as complete in 40% of specimens, usually females; when incomplete, represented by spots at costa, inner margin, and at fork of CuA₁ and CuA₂. Antemedial and medial bands often contiguous or even confluent in whole or in part. Median subterminal and preapical costal spots variable in size, about as in other species but always blackish, occasionally so expanded as to be almost united. Postmedial third of forewing variably shaded with gray; when dark, leaving a vague, irregular, whitish subterminal line that curves outward toward apex and tornus. Hindwing variably mottled or striated with dark grayish, commonly forming a nearly complete postmedial band, and incomplete medial and antemedial bands. Underside white, heavily and contrastingly marked with dark gray brown, with at least a trace of the usual yellow-brown shading at costa. Length of forewing: males, 12.0–14.5 mm; females, 11.5–15.0 mm. Mean wing length: males, 13.4 mm; females, 14.5 mm.

Genitalia similar to those of *signaria* in both sexes, except that in the male the valves appear slightly longer.

There is little geographic variation. Specimens from Newfoundland and most mainland sources agree in being somewhat suffused with dark scales, whereas Nova Scotian examples are unusually bright and contrasting. However, Nova Scotian and other mainland specimens agree in size although Newfoundland specimens average about 1 mm larger in forewing length.

Macaria oweni normally feeds only on eastern larch, *Larix laricina* (Du Roi) K. Koch. I collected many larvae by beating or sweeping branches of larch and reared one brood of larvae from eggs on this host. In the Atlantic Provinces, where I had the opportunity to see and collect *S. oweni* almost annually for about 25 years, it became obvious that adults occurred only in the presence of this tree.

Mature larva green with a wide, conspicuous, purplish-brown, dorsolateral stripe, bordered above with a pale subdorsal stripe, usually narrow and greenish white, occasionally pure white. Dorsum marked only by a middorsal stripe of a darker green than the ground. Spiracular stripe white but not especially contrasting, being broken at intervals by encroachments of the green ground color. Ventral area marked by a pair of purplish-brown subventral stripes, each bordered on both sides with white, the more ventrad of the white

stripes is possibly an adventral stripe. These are separated midventrally by a narrow strip of green. Thoracic legs dark purple, prolegs pale violet. Dark purplish-brown dorsolateral stripe extends onto parietal lobe of head as far as the antennal socket, forming the usual blackish head patch. Markings of the same shade occur behind the head dorsally, separated from the dark lateral areas by pale brown. Maximum length: 20 mm.

Macaria oweni occurs across Canada from Newfoundland to Alberta and in suitable habitats in Maine, New Hampshire, New York, Michigan, Wisconsin, and probably other northern states. There is no evidence that it follows the mountains southward. Larch survives in a few small bogs in western Maryland, but *oweni* has not been found there.

Macaria granitata Guenée

PL. 5, FIGS. 54–57 (adult); PL. 13, FIGS. 6, 7 (larva) (RWH 6352).

Macaria granitata Guenée, 1857 [1858], *Histoire naturelle des Insectes, Species Général des Lépidoptères*, 10: 85.

Type locality: Pennsylvania. [lost] (Ferguson, 1974b: 598).

Macaria succosata Zeller, 1872, *Verh. zool.-bot. Ges. Wien*, 22: 485.

Type locality: Massachusetts. [BMNH]

NOTE—I designated and illustrated the lectotype of *succosata* in my revision of this group (Ferguson, 1974b: 598; 620, fig. 233).

This is an easily recognized, midtemperate-zone eastern species, in which the forewing is variegated in multiple shades of gray brown except for a pale area in the outer half of the median space, between the medial and postmedial bands. This constrained pale area may be light gray to white or even faintly yellowish in fresh specimens. The subapical costal spot is nearly always rust colored rather than blackish as in most species of the group. The underside is variable but is most often boldly patterned in dark reddish brown on a pale background. The moths show almost no sexual dimorphism except that the pale patch on the forewing tends to be brighter in females. *Macaria granitata* occurs from southern Maine, New Hampshire, southern Quebec, and Ohio to the mountains and foothills of the Carolinas and northern Georgia in association with pitch pine and other hard pines. It is most often confused in

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collections with *M. pinistrobata*. Adults were shown in color by Holland (1903 and later editions, pl. 43, fig. 37); Covell (1984, pl. 49, fig. 21); Handfield (1999, figs. 6352-1-4); and Wagner et al. (2001: 49).

The most useful distinguishing features of this species are in the wing coloring, and reference to the illustrations should make more detailed description unnecessary. The general impression is one of contrast between the sharply defined dark markings and whitish ground color, with the two main features of the forewing being the pale patch in the median area and the rust-colored subapical costal spot. The latter may be obscure, but even so it nearly always appears as the only reddish-brown spot on the upperside of the forewing. Wing length: males, 12.0–14.5 mm; females, 13–15 mm. Mean wing length: males, 13.8 mm (n = 30); females, 13.7 mm (n = 19).

Differences in the genitalia are nebulous, but in the males examined the sacculus lobe of the valve is slightly wider and more rounded than that of *M. signaria*. The female genitalia also are hardly distinguishable from those of allied species, but the neck of the bursa copulatrix seems longer than most, and the postostial sclerite is unusually wide, with an almost truncated posterior margin. This sclerite, about all there is of the sterigma, is more produced and rounded posteriorly in *signaria* and in most other species of the *signaria*-group.

My reared broods of this species, from Lakehurst, New Jersey and Beltsville, Maryland, included the usual green larvae and a dark (deep purplish) form; but it should be remembered that an hypothesis exists that the common pink or purplish forms in geometrid larvae are induced by overcrowding, as might occur when they are reared but only rarely in nature. **Green form** (plate 13, figure 6)—Dorsum green with darker green to bluish middorsal stripe, almost as wide as space separating it from subdorsal stripe; ad-dorsal stripes obsolescent, almost absent, may be apparent as faint, very diffuse, light bluish or pale-green lines; subdorsal stripe whitish to pale yellow, about half as wide as spiracular stripe, which is a brighter yellow; dorsolateral space between subdorsal and spiracular stripes divided into an upper blackish half and lower green half, as in green forms of *signaria*, *fissinotata*, *submarmorata*, and *oweni*; yellow spiracular stripe wide and conspicuous; space beneath spiracular stripe green, but ventral area variably dark pur-

plish, almost black, and marked with at least two fine, sinuous, whitish lines, which are probably an adventral and subventral. Head with the usual continuations of the pale body stripes and between them the wide, lateral, blackish band extending down the side of the epicranial lobe as far as the antenna; head mostly green otherwise, including frontal triangle, but with some light brown markings and dark spots dorsomesially. Thoracic legs purplish brown; anterior prolegs partly dark purplish, partly green; posterior prolegs green. In the New Jersey larvae the subdorsal stripe was white and variable in width; in the Maryland larvae it was consistently pale yellow and much narrower than the spiracular. **Dark form** (plate 13, figure 7)—Markings mostly similar but with green areas variably masked with purplish to purplish-brown suffusion, so that entire dorsal, dorsolateral, and ventral areas may be this color. Subdorsal and spiracular stripes in dark forms more inclined to be white rather than yellow. Subdorsal stripe often further narrowed, although spiracular stripe remains wide. Markings of head that are normally light brown or green are also darkened. Any degree of darkening between the green form and the especially dark form described here may occur. I did not see any *granitata* larvae with the large, dark, lateral abdominal blotches such as those seen in some individuals of *signaria* (plate 13, figure 1), *submarmorata* (Ferguson, 1974b: fig. 15), or *oweni* (Ives and Wong, 1988: 22, fig. 10G).

Macaria granitata is a mid-latitude species, occurring from the southernmost parts of Maine, New Hampshire, Vermont, Quebec, and central New York to Ohio, thence southward to northern South Carolina, Georgia, and Alabama (foothills or mountains only). It is abundant in the pine woods of New Jersey, Maryland, Virginia, and Kentucky, perhaps less so northward and southward. There is only one known location for it in Canada, in the vicinity of a pitch pine ecological reserve in southern Quebec (Franklin, St. Malachie-d'Ormstown) (Handfield, 1999: 283, 936; fig. 6352). I collected several in a small, isolated stand of pitch pine near Ithaca, New York.

Pitch pine, *Pinus rigida* Mill., is, I believe, the only pine with which this species has positively been associated, although it would be expected to feed on other hard pines. Larvae reared from eggs in the laboratory will freely feed on *Pinus banksiana*, *P. virginiana*, and even on *P. strobus*, but the only pine with which the distribution of *gran-*

itata coincides almost exactly is pitch pine. Larvae that I collected by beating Virginia pine where *granitata* was abundant near Beltsville, Maryland, yielded only *M. bicolorata*; but pitch pine grew nearby.

The *multilineata*-GROUP

This is a small group of three species: *Macaria multilineata* Packard from the eastern United States, *M. ochrifascia* (Warren), NEW COMBINATION, from Bermuda, and *M. angulata* (Warren), NEW COMBINATION, from Jamaica. The last, described as *Thamnonoma angulata* Warren (1897: 484 (Type locality: Newcastle, Jamaica), is the only one of the three not treated and illustrated in the present work. *Macaria ochrifascia* apparently is extinct. Although all may not be closely related, they do have almost indistinguishable genitalia, share certain similarities or trends in wing shape, color, and male antennal structure, and all probably feed on Cupressaceae, especially juniper. Elements of their pattern and color add up to a *Gestalt* that would seem to relate them. They have no evident kinship with other juniper-feeding species but seem closer to the pine-feeding complex that includes *bicolorata*, *distributaria*, *sanfordi*, *transitaria*, and *minorata*. The genital morphology conforms to the basic, simplified configuration repeated with almost no change throughout all of the species of *Macaria* that feed on Pinaceae, as well as some others. The wings are angulate, a fovea is present in the male forewing, and areas of light violaceous gray brown and rust are an important part of the color scheme. These are the same colors characteristic of the pine-feeding *bicolorata*-group and are commonplace among other pine-feeding Geometridae, but not usually other juniper feeders.

A special peculiarity of the group is that they have in part reverted to bipectinate male antennae, which are only slightly developed in the mainland North American species, but are fully bipectinate with long branches in the insular, tropical ones. This led to their earlier misplacement in meaningless, catch-all genera. The subtropical, Floridian *Macaria sanfordi* also has what I would describe as bipectinate male antennae with short branches, although longer than those of any other pine feeder or of *multilineata*. The Bermudian species is also peculiar in having lost the pecten on the third sternum of the male; the other two species retain it (I found it missing

in one dissected specimen of *multilineata*, which suggests its presence or absence in a single species or a possible sibling species). The Jamaican species has male antennal branches only about half the length of those of *ochrifascia* and is unusual in having a transverse dorsal bar of white scales conspicuously situated along the posterior edge of the mesothorax; it also has the outer wing margins slightly more crenulated than usual.

The Bermuda endemic, *Macaria ochrifascia*, is included in this treatment because the indigenous terrestrial biota of Bermuda is mainly North American or at least derived from the same sources, with few Caribbean elements that are not also present in the southeastern United States (Ferguson, Hilburn and Wright, 1991), is unlikely to be considered in any other revisionary context, and deserves to have the unfortunate circumstances of its extinction brought to the attention of readers.

Macaria multilineata Packard

PL. 5, FIGS. 58–62 (adult); PL. 13, FIG. 8 (larva); FIG. 42 *a, b* (♂ genitalia); FIG. 42 *c* (♀ genitalia) (RWH 6353).

Macaria multilineata Packard, 1873, *Fifth Rept. Peabody Acad. Sci.*, [for 1872]: 65.

Type locality: not given. [MCZ]

NOTE—The one surviving type, possibly the holotype, is a damaged male with hindwings glued, head and abdomen missing, and without a locality label. What remains still clearly represents the present species. Packard later (1876: 288) mentioned having three specimens from Massachusetts, Philadelphia, Pa., and New Jersey.

Semiothisa patriciata Grote, 1883, *Can. Ent.*, **15**: 129.

Type locality: North Carolina. [Type not found]

NOTE—Described from the Neumögen collection, which was deposited in the Museum of the Brooklyn Institute and later transferred to the U. S. National Museum of Natural History. I have not found the type, and a manuscript list of North American Lepidoptera types in the U. S. National Museum of Natural History, prepared by C. Heinrich and H. W. Capps in the 1950's or earlier, does not include it. However, the National Collection contains a Connecticut specimen of *multilineata* labeled by J. H. McDunnough as having been compared with the type of *patriciata* in the collection of the Brooklyn Institute.

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This brown, eastern, juniper-feeding species does indeed have a multilineate appearance, with at least the postmedial lines appearing double or even triple, and most lines distinct, oblique, nearly parallel, and nearly straight. The undersurfaces are boldly striped transversely with bands of speckled white, dark brown, and bright reddish brown, and frequently the postmedials beneath appear double. Also, the dark spots of the costa and subterminal area of the upperside of the forewing are brown to reddish brown, varying in contrast to blackish brown. The unusual male antennae are subpectinate; i.e., pectinate with very short, heavily setose, fasciculate branches. This species probably cannot be distinguished from its closest allies by means of the genitalia, but its general appearance, especially of the underside, is so distinctive that it need not be confused with anything.

Male antenna with shaft about as thick as haustellum, almost pectinate, with rudimentary branches of which the longest are about equal in length to thickness of antennal shaft; branches tapered, prominently setose, dorsally with brown scales. Palpi, eyes, and legs normal, although male hindtibia much enlarged, about three times as long as hindtarsus. Abdomen gray brown with some blackish spots laterally and sometimes groups of dark scales dorsally and ventrally; thorax and tegulae violaceous gray; patagia light brown, tipped with dark brown; vertex and front light yellowish brown, the latter usually with transverse band of dark brown across middle; legs light yellowish brown, speckled with dark brown. Wings with dull whitish ground, usually mostly suffused or irrorated with violaceous grayish brown; forewing with thin, usually continuous, distinct, regular, blackish antemedial and postmedial lines, often nearly straight and nearly parallel to outer margin; a more diffuse medial line may be present between them; either antemedial, postmedial, or both may be closely paralleled by lesser lines that make them appear double or even triple, and medial line may be faintly doubled or tripled, or may not be present at all; antemedial and medial lines often expand to form dark spots at costa; subterminal area usually with a wide, regular, continuous, light reddish-brown band, encompassing at its costal end a chestnut-brown, subquadrate, subapical spot; a faint pale line marks interface between reddish-brown band and grayish-brown space between it and thin, black, broken or continuous terminal line; fringe

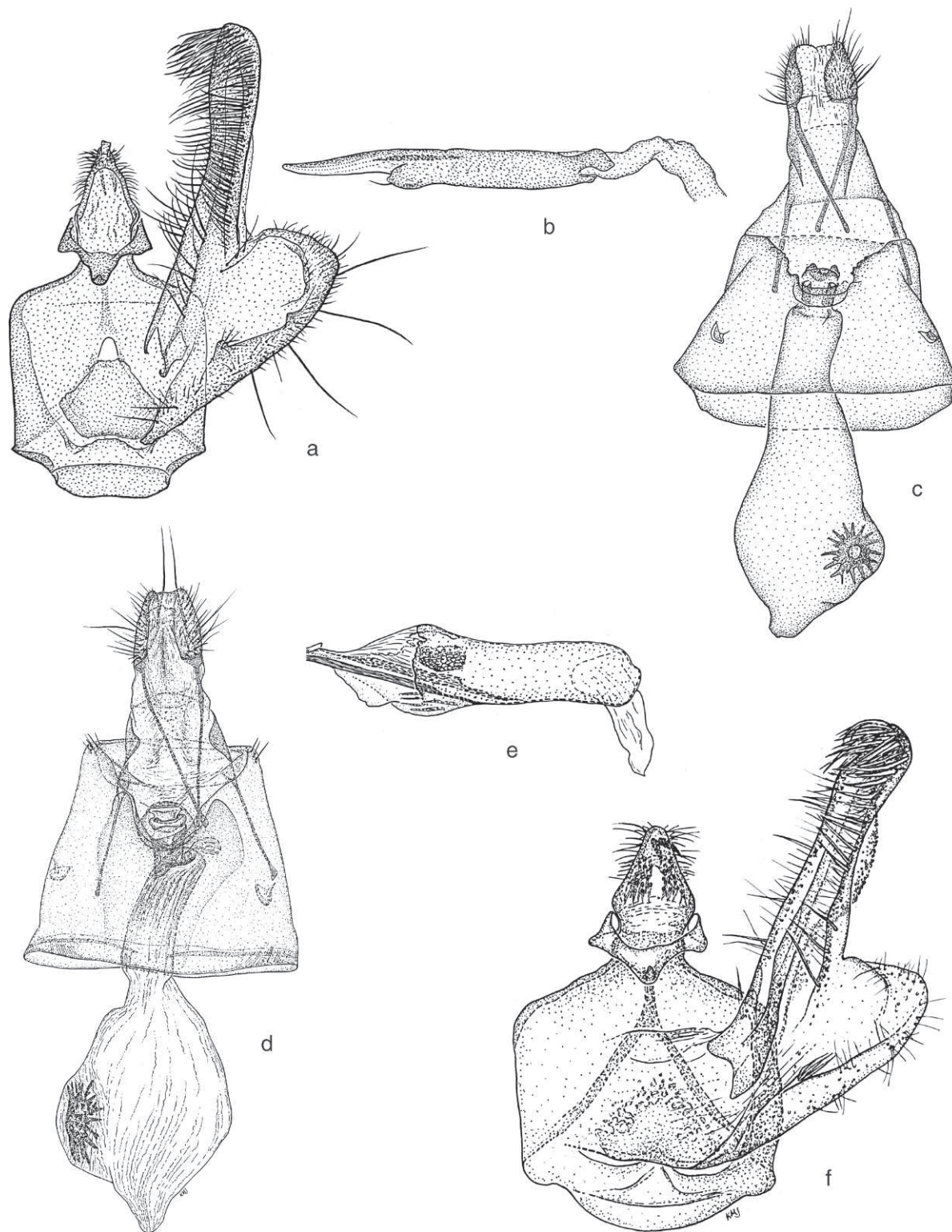
gray brown, only faintly checkered. Hindwing similar to forewing but with basal half paler, and without antemedial line but with noticeable discal spot. Underside comparable but more coarsely marked, with lines transformed into mostly wider, more intensely colored, subparallel bands of dark granulated white, dark brown, and rust brown. Wing length: males, 12–14 mm; females, 12–14 mm.

Male genitalia almost exactly like those of *M. transitaria* except for tendency for ventral lobe of valve to be slightly more produced at the end; and the excavation of the eighth sternum has a strong tendency to narrow and then widen again to a rounded opening at its anterior extremity.

Female genitalia hardly differing, if at all, from others of the present group or from those of the many pine-feeding species.

I reared this species three times from eggs, using various cultivated junipers as well as the common eastern redcedar, *Juniperus virginiana* Linnaeus, which is the only possible host over large areas where the species occurs. On the coastal plain from New Jersey southward it quite possibly feeds also on Atlantic white cedar, *Chamycyparis thyoides* (Linnaeus) B. S. P., and from South Carolina to Florida and westward to East Texas, the only likely host is southern redcedar, *Juniperus silicicola* (Small) Bailey. Last instar larva with an interrupted, white-striped pattern typical of juniper-feeding species, but not as extreme as that of the *Digrammia continuata*-group; body bright leaf green, with conspicuous, subdorsal and lateral white stripes, irregular in outline and broken or nearly so intersegmentally; lateral stripe tinged with yellow at the edges in some specimens; dorsum with darker green mid-dorsal stripe marking position of dorsal vessel, flanked by pair of thin, faint, whitish addorsal lines; ventrolateral stripe thinner than lateral stripe and more interrupted, light yellow. Head green, matching body, but with widely spaced pair of diffuse, blackish bands running down front, and marked lateroventrally with yellow or white where lateral body stripe continues onto head. Thoracic legs faintly brownish; prolegs mostly green but with extension of white lateral stripe continuing down lateral flank of anal proleg. Spiracles yellowish brown and situated within lateral stripe near its irregular dorsal edge. Length: 21 mm.

Macaria multilineata occurs from Massachusetts and Connecticut to coastal South Carolina

FIGURE 42: GENITALIA OF *MACARIA* SPECIES

a. M. multilineata, genital capsule; Montgomery County, Maryland (USNM 53006); *b. Aedeagus*; Montgomery County, Maryland (USNM 53006). *c. Female*; East River, Litchfield County, Connecticut (USNM 53185). *d. M. ochrifascia*, female; Bermuda (USNM 57331). *e. M. ochrifascia*, aedeagus; Bermuda (USNM 57238). *f. M. ochrifascia*, genital capsule; Bermuda (USNM 57238).

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and evidently farther, because there are isolated Florida records from Cass County, Cassadaga, Volusia County, and Quincy, Gadsden County; it extends westward at least to Illinois, Missouri, Arkansas, and to Sequoyah County, Oklahoma and Anderson, Harrison, and Cass counties, Texas. I saw specimens that verify these distributional limits, including three from Florida. Normal specimens of this species were collected several times at The Wedge Plantation, near McClellanville, South Carolina, along with the unnamed form or species described below. The collection dates for Connecticut and New Jersey are 13 June–23 August, with most records for August; for Maryland and Virginia, 12 April–14 September, with most records for May and August; for Missouri, April–September, almost continuously; for Texas, 4 April–28 June and 18 August. As the species is generally uncommon, and the data discontinuous, the number of generations is uncertain, although there are at least two in most of its range and three or four southward.

In an earlier draft of this manuscript I described a form of *multilineata* as a new species (plate 5, figure 60), later abandoning it as a named entity because of uncertainty as to whether it is consistently distinguishable. This form was first noticed at The Wedge Plantation, McClellanville, South Carolina, but has also been collected in Louisiana (V. A. Brou); and I have seen somewhat similar specimens from Worcester County, Maryland. I reared it in Maryland but found no differences in the larva and fewer differences in the adult than were apparent in the South. I describe, illustrate, and record what is known of this form so that others may recognize it and perhaps succeed in determining its status. It resembles *multilineata* but lacks the additional transverse lines and characteristic obliqueness of the forewing lines that give that species its unique appearance. Even the antemedial and postmedial lines are not always distinct, but the undersurfaces of the wings are boldly marked as in *multilineata* or more so, except that the postmedial line on both wings is single, not double as is commonly so in *multilineata*. The specimens seen from the South indicate an unusual degree of seasonal variation. Three spring examples of this form have an appearance that might suggest that they were hybrids between *multilineata* and *transitaria*, but some later ones, with their more whitish ground color, could almost be mistaken for

very dark specimens of *bisignata*, until one looks at the underside. Further description follows.

All structural features, including genitalia of both sexes, as in typical *multilineata*. Transverse lines on upperside of forewing not unusually oblique and not parallel to outer margin as are those of *multilineata*, but more nearly erect from inner margin; antemedial a single, weak, dark line, widening and turning basad toward costa; medial line an indistinct, straight, dusky shade, also widening and forming a dark spot at costa; postmedial line a single, nearly straight, discontinuous, blackish line, turning basad and strengthening somewhat toward costa, but obsolescent in summer and fall specimens; wide reddish-brown band just beyond postmedial, which is obvious in typical *multilineata*, hardly noticeable and nearly concolorous with rest of subterminal area, except that it includes a dark spot opposite discal cell and a relatively large and distinct, dark chestnut-brown, subquadrate, preapical spot at costa; also, space between preapical spot and apex partly shaded with white. Dark spots of forewing decidedly more prominent than those of normal *multilineata*. Hindwing with reddish-brown band distad of postmedial line more prominent than that on forewing, and with overall pattern more simplified and less oblique than that of *multilineata*; i.e., postmedial line, or band, does not give appearance of being double, and whitish subterminal line obsolescent. Black terminal line on both wings discontinuous, nearly wanting; fringes essentially concolorous with outer third of wing, hardly checkered, and in a very fresh specimen, tipped with pale yellow. Undersurfaces of wings as in normal *multilineata* or with even greater contrasts between light and dark areas, and with postmedial band appearing single in specimens examined, not double. Wing length: male, 14 mm; female, 15 mm (spring specimens); male, 13 mm; female, 13 mm (summer, fall specimens).

The three spring specimens have a larger, more brownish aspect than those taken later in the season, with less of the whitish ground color showing and that in the basal half of the hindwing only. The summer and fall specimens show about as much white ground color in the median space of the forewing as on the hindwing, and also nearly lack the paired, black dorsal abdominal spots that are fairly prominent in spring specimens. However, these differences need to be verified with more material than is now available. Capture dates: 29 March, 1 May, 24 June, 8 Oc-

tober (South Carolina); March, April, August–October (Louisiana, V. A. Brou, pers. comm.).

Macaria ochrifascia (Warren), NEW COMBINATION

PL. 5, FIGS. 63, 64 (adult); FIG. 42 *d* (♀ genitalia); FIG. 42 *e* (♂ genitalia).

Thamnonoma ochrifascia Warren, 1897, *Nov. Zool.*, 4: 484.

Type locality: “One male from the Bermudas,” labeled “4.90” [April 1890]. [BMNH]

Alcis verrilliata Dyar, 1902, in Verrill, A. E., *Trans. Connecticut Acad. Sci.*, 11: 890.

Type locality: Bermuda. [USNM]

NOTE—This name was synonymized with *M. ochrifascia* (as *Semiothisa ochrifascia*) by Ferguson, Hilburn, and Wright (1991: 45).

This island endemic presents no identification problems because it is known only from Bermuda and appears to be extinct. The last specimens known to have been collected were taken by L. Ogilvie in 1924 (one in the Bermuda Natural History Museum and four in The Natural History Museum, London). The oldest specimens that I saw are three in the latter museum, collected in “Bermuda, Apr. [18]73.” It fed on the endemic juniper, or Bermuda cedar, *Juniperus bermudiana* Linnaeus (Cupressaceae), and was reported to be abundant in the first decade of the 20th century (Jones, 1910). The moths are highly variable, brown, tending toward melanism, with or without dark, transverse bands associated with the somewhat irregular antemedial and postmedial lines of the forewing and postmedial line of the hindwing, and the usual rusty-brown band in the subterminal area of both wings. The transverse bands are not abnormally oblique like those of *multilineata*, although the postmedial in some specimens appears double both above and beneath as it does in *multilineata*. The terminal line is a series of dark dots; the fringes are light brown, generally concolorous with the wing, and not checkered. Because of the suffused, melanistic appearance that evidently prevail, the normal markings tend to be obscured in most specimens. The color and pattern are repeated on the undersurfaces, usually with reduced intensity or further suffusion.

Male antenna bipectinate, with very long, slender, setose branches four times as long as thickness of antennal shaft; shaft and branches with glossy, mottled, gray-brown scales dorsally; fe-

male antenna simple, similarly scaled; eyes and front as in *multilineata*, but front with less distinct dark-brown band across middle; palpi short, hardly exceeding front, bluntly pointed, brown, first segment paler; haustellum normal; legs normal, although hindtarsus longer relative to tibia than that of *multilineata*, about half as long as hindtibia in male, three-fourths as long in female; male hindtibia moderately swollen. Patagia yellowish brown or dark brown but usually not strongly contrasting with thorax; body brown, unmarked. This species is peculiar not only in having such well-developed bipectinate male antennae but in lacking the pecten on the third sternum of the male, being one of the very few species of *Macaria* seen in which the pecten is missing. Wing length: males, 12–16 mm; females, 13–14 mm.

Male genitalia resembling those of *multilineata* in almost every detail, although the notch in the eighth sternum is not as deep, occupying less than half the segment, and somewhat differently shaped from that of *multilineata*, more nearly like that of the Jamaican *angulata*, but again not as deep.

Female genitalia not clearly differing from those of *multilineata*.

Virtually all that we know of the habits and life history of this species was recorded by F. M. Jones (1910) who wrote: “Abundant; bred; also at light and sugar. This variable insect is supposed to be exclusively Bermudian. Its larvae are abundant in the winter and spring, doubtless throughout the year, on the Bermuda cedar, *Juniperus bermudiana*, but their protective coloration is so perfect that search for them except by beating is almost hopeless. They are of almost uniform diameter without prominent protuberances; smooth, green in color of the same shades as the younger leaves of the cedar; a light line on the head, following the groove of the clypeus; a light subdorsal line, curved outwardly on the segments; an interrupted pale stigmatal line. Pupation in a thick earthen cocoon; the pupa green, translucent, the abdominal segments brown; in January and February the pupal period lasted eighteen to twenty-two days.” These observations were made by Jones during a stay in Bermuda from December 1908 to May 1909, and eight of his specimens in the U. S. National Museum of Natural History are labeled December and February. Fourteen of A. E. Verrill’s specimens collected in May 1901, including the holotype of *Alcis verrilliata* Dyar,

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are also in the U. S. National Museum of Natural History. Thirty-eight specimens were examined, including 16 in The Natural History Museum, London.

Two weeks of moth collecting in Bermuda by the author in October 1987, and again in March 1988, plus additional light collecting and beating of cedar foliage by D. J. Hilburn, formerly of the Bermuda Department of Agriculture and Fisheries, failed to show any sign of *M. ochrifascia*. The host plant was all but exterminated by an introduced scale insect, *Lepidosaphes pallida* Maskell (Coccoidea: Diaspididae) in the 1940's and 1950's, and the trees seen in Bermuda today are nearly all descended from a few protected survivors. This setback, combined with severely disturbed and fragmented habitat throughout the densely populated islands, appears to have eliminated *Macaria ochrifascia*.

GENUS

Letispe Ferguson, NEW GENUS

Gender: feminine

Type species: *Semiothisa metanemaria* Hulst, 1887

NOTE—*Letispe* is an anagram of *Elpiste*.

Letispe contains a single peculiar species that does not fit any previously established genus. Following my transfer of *lorquinaria* Guenée and *marcescaria* Guenée to the genus *Speranza*, only *metanemaria* remained of the three species previously included in *Elpiste* Gumpfenberg. I could not retain *Elpiste* or either of its synonyms (*Sympherta* Hulst or *Gladela* Grossbeck) for *metanemaria* because *lorquinaria* is the type species for all three names, which thus become junior synonyms of *Speranza*. *Sympherta* also happens to be a junior homonym. Therefore, I propose *Letispe* to accommodate this one unplaced species.

This genus is distinguished mainly by its unusual male genitalia, which are elongated much in the manner of the *Speranza quadrilinearia*-group, with both the saccus and uncus produced. However, the most reliable feature of *Speranza*, the interlobular process or valvula, is lacking. Instead, the otherwise simple saccular lobe bears a unique, elongate, scooplike, apical process and a triangular, sclerotized, basoventral process toward its proximal end, and the vesica has a cluster of eight to nine small cornuti, which are not usually this clearly differentiated in the Macariini. The

eighth sternum is deeply notched in the usual way, and the pecten on the third abdominal sternum is absent, as in *Speranza*.

The female differs from those of most genera, including *Speranza*, in having lost the signum. Also as in *Speranza*, the male antennae are bipectinate, and the hindtibiae are not enlarged. The wing margins are strongly angulate like those of the *Macaria notata*-group and unlike species of *Speranza*. From the early spring collection dates for larvae, and the early and late dates for adults, I suspect that *metanemaria* does not have a pupal diapause. This is difficult to determine for species that occur where relatively mild winters may preclude the need for a diapause.

Letispe metanemaria (Hulst), NEW COMBINATION

PL. 6, FIGS. 1–3 (adult); PL. 13, FIG. 9 (larva); TEXT FIG. 43 *a, c* (♂ gen.); TEXT FIG. 43 *b* (♀ gen.) (RWH 6325).

Semiothisa metanemaria Hulst, 1887, *Ent. Americana*, 2: 188.

Type locality: Arizona. [AMNH]

NOTE—Described from four males and four females from Arizona in the collections of Graef, Holland, and Hulst. The “Type male” in the AMNH mentioned by Rindge (1955: 148) is hereby designated the lectotype. A female syntype in the USNM from the Graef collection is questionably eligible because it has a label that says “Sonora,” not Arizona.

Semiothisa castalia Druce, 1893, *Biologia Centrali-Americana. Insecta. Lepidoptera-Heterocera*, 2: 133, pl. 53, fig. 18.

Type locality: Northern Sonora, Mexico. [BMNH]

Letispe metanemaria is a light yellow-brown (females) to largely gray-brown (males), southwestern species with simple markings consisting of two regular, well-defined, brown to reddish-brown transverse lines on the forewing and one on the hindwing, and small discal spots. The outer margins of both wings are angulate, the forewing with a pronounced, blackish-lined concavity near the apex, and the hindwing with an almost 90° angle near the middle of the outer margin. The species somewhat resembles *Psamatodes everiata errata* of Arizona, but the wings of that species usually have a more extensively darkened, contrasting outer third, the forewing lacks the blackish-lined concavity near the apex that is conspicuous in both sexes of *metanemaria*, and

the male antennae of *errata* are simple, not bipectinate. The dark extramedial spot, commonly present in *errata* and many other species, is rarely present in *metanemaria* and then only as a vestige.

Male antennal branches moderate, not exceeding one and one-half times length of one antennal segment; chaetosemata well developed, nearly meeting in middle behind head; palpi of medium length in both sexes, surpassing front for less than half their length, and with third segment usually decumbent. Head, body, and antennal shaft clothed in a mixture of pale-yellowish and light brown scales. Wings pale yellowish, dusted with light brown scales, especially on forewing, leaving hindwing paler. Rare individuals may be so heavily dusted as to appear dark. Forewing with antemedial band convex to nearly straight; postmedial band clear yellowish on proximal side, shaded with reddish brown on distal side, nearly straight, subparallel to outer margin; outer margin with strong, dark, crescent-shaped mark posterior to apex, as mentioned earlier; a faint, brown vestige of an extramedial spot occasionally present. Hindwing with convex or somewhat angled postmedial line only. Both wings with faint discal dots and weak, incomplete series of dark terminal dots or dashes. Fringes pale yellowish except in concavity of forewing as noted. Underside pale yellowish, lightly dusted with brown scales, and with postmedial lines repeated less distinctly. Wing length: males, 13–16 mm; females, 13–16 mm.

Although some individual variation occurs, it is not as noticeable as in most species of other genera. No geographic or seasonal effects are apparent.

The genitalia are described under the generic heading.

This species has been reared several times, but few details on the early stages have been available until now. The description below of the last instar is from live larvae reared from eggs laid by a female that I collected in Carr Canyon, 5,600', east side of the Huachuca Mountains, Arizona in mid-August 1999. They fed rapidly through late August and early September, and produced adults in late September and early October. They fed well on the slender, resinous, almost leafless stems of desert broom, *Baccharis sarothroides* Gray (Asteraceae), which the larvae resembled. Larval ground color green to slightly bluish green, marked with a complex longitudinal

pattern of numerous lines or stripes. Dorsolateral and lateral (spiracular) stripes prominent, pale yellowish to nearly white, 0.5–1.0 mm wide; lateral stripe generally the wider and more yellowish. Dorsum green, with darker green to purplish-gray middorsal stripe flanked by 2–3 very fine, slightly sinuous, parallel whitish lines. Space between dorsolateral and lateral stripes green to dark purplish gray, also with 2–3 very thin, sinuous, whitish lines, which may be fragmentary. Lateral stripe, which may be pale yellow or greenish rather than white, is situated on the lateral fold, and its margins appear very sinuous under magnification. Ventral area of abdomen between A1 and first prolegs with a wide, pale-greenish, midventral band, divided by a fine, whitish midventral line and with a fine whitish line forming a border on each side. Ventral band flanked laterally by a slightly narrower, dark green to grayish, longitudinal subventral band in line with lateral sides of both thoracic legs and prolegs, and between this and the lateral stripe by a green ventrolateral space. The darker subventral and lighter ventrolateral bands thus formed are each subdivided by a thin, sinuous, whitish line and separated from each other by a similar line. Legs greenish, but anal proleg with blackish vertical band on anterior side. Head mostly light yellow brown, darker brown mesially and frontally; dark, dorsolateral body stripe extending onto side of parietal lobe of head in a herring-bone pattern. Length: 24–27 mm at maturity. Larva surprisingly similar superficially to some *Macaria* species, for example members of the *M. signaria*-group, but distinguished by the more numerous fine lines.

Adults were reared by R. Wielgus in November 1984 from a larva on camphor weed [*Heterotheca* sp. (Asteraceae)] at Tombstone, Arizona (AMNH) and in April 1990 from larvae on an unspecified *Baccharis* at Tucson, Arizona (USNM). The species was also reared at Tucson by W. A. Palmer in 1987, from larvae on *Baccharis sarothroides* (USNM). Larvae field collected in March and early April produced adults later in April, and those collected in the fall emerged as late as November.

Pupa dark brown, almost black, moderately glossy, with prominent antennae and a small, erect protuberance (*callus* of Crumb, 1929: *callosity* of Forbes (1948) and McGuffin (1972), which is rounded (domelike) on top, finely, densely setose, and situated on anterior margin of

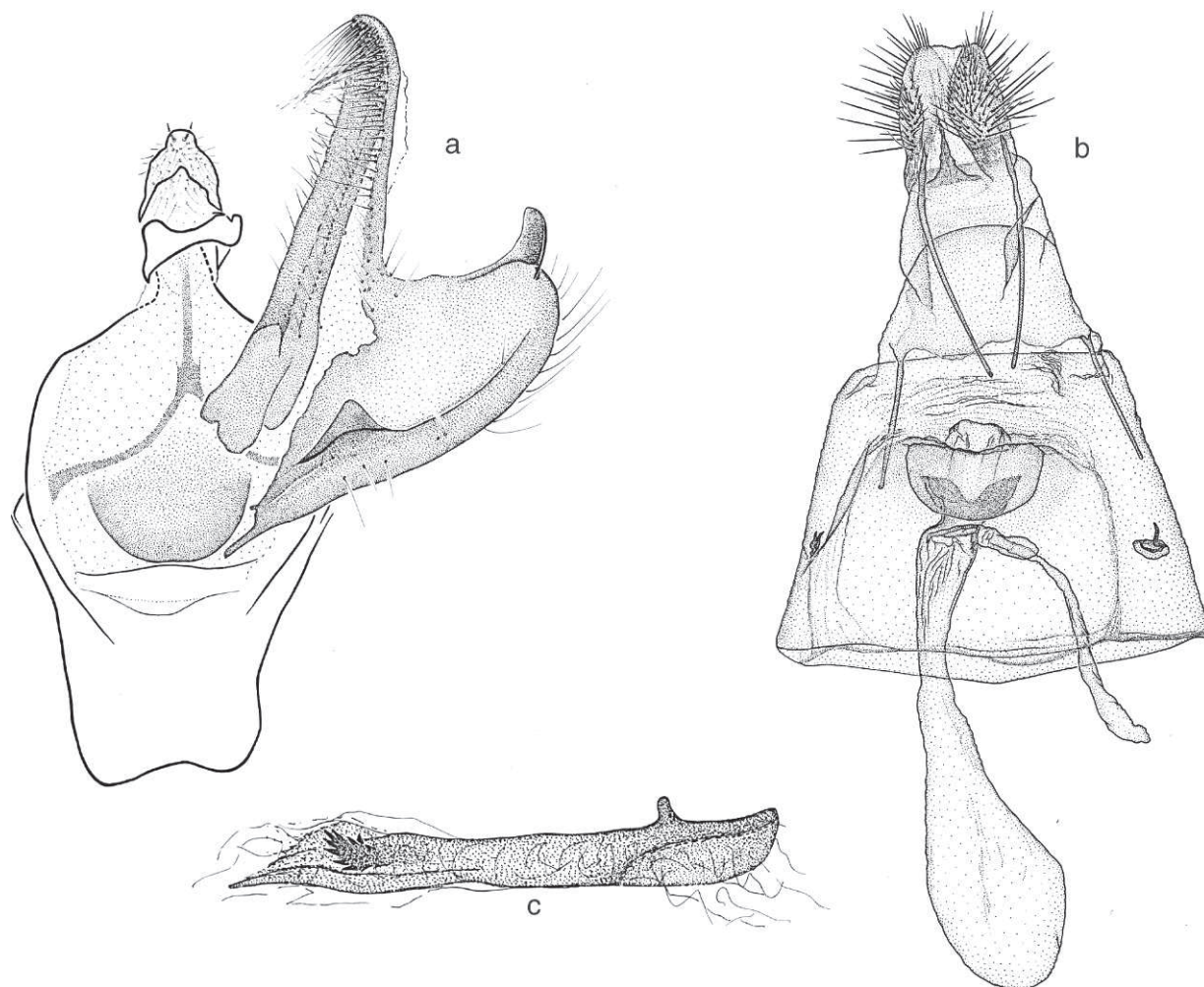


FIGURE 43: GENITALIA OF *LETISPE METANEMARIA*
 a. Male genital capsule; Mohave County, Arizona (USNM 57445). b. Female; Mohave County, Arizona (USNM 57446).
 c. Aedeagus; Mohave County, Arizona (USNM 57445).

mesothorax above the spiracle. Many geometrid pupae have a mesothoracic callosity, which is usually just a thickened pad of cuticle dorsolaterally at the anterior margin of the mesothorax. It appears hollowed beneath and open anteriorly, this forming an apparent spiracular hood, which may be densely covered with very fine setae on its anterior margin. However, in some Macariini and Cassymini it is developed as a more elevated and conspicuous process.

This species occurs widely in Arizona, where it may at times be common; also in Clark County, Nevada; in the Panamint Mountains, Inyo County, and in San Bernardino, Riverside, and San Diego counties, California. In Mexico it was taken in Sonora (type of *castalia*) and in Baja California at least as far south as Cedros Island. In Ar-

izona it has been collected at light in every month from April to September inclusive, and in California from March to May. The few Nevada specimens are labeled April and May, and one from Baja California was taken 28 May.

GENUS

Digrammia Gumpfenberg

Digrammia Gumpfenberg, 1887, *Nova Acta Acad. Caesar. Leop. Carol.*, **49**: 325. Nomenclaturally available but without included species until Gumpfenberg, 1896, *ibidem*, **65**: 291.

Type species: *Phasiane mellistrigata* Grote, 1873, *Bull. Buffalo Soc. Nat. Sci.*, **1**: 12, pl. 1, fig. 11. Designated by Fletcher, 1979, in

I. W. B. Nye, *Generic Names of Moths of the World*, **3** (Geometridae): 61.

Asmate Gumpfenberg, 1887, *Nova Acta Acad. Caesar. Leop. Carol.*, **49**: 335 (key). Nomenclaturally available but without included species until Gumpfenberg, 1896, *ibidem*, **65**: 232.

Type species: *Phasiane rippertaria* Duponchel, 1830, in Godart and Duponchel, *Hist. nat. Lépid. Papillons France*, **8**(1): 159, pl. 180, fig. 5, by subsequent monotypy.

Spinuncina Wehrli, 1937 (June 22), *Ent. Zeit. Frankfurt am Main*, **51**: 119.

Type species: *Phasiane rippertaria* Duponchel, 1830, *ibidem*, by original designation. *Spinuncina* was again proposed by Wehrli, 1937 (Sept. 8), *Ent. Rundschau*, **54**: 563.

Species of *Digrammia* differ from all members of the tribe except *Letispe* and *Rindgea* in the absence of a signum in the female genitalia. They further differ from *Macaria* (with which they were formerly combined under the name *Semiothisa*) in their less angulate wing shape, more diverse and complex genitalia in both sexes, usually including sharp processes or lobes on the valve unlike any in *Macaria*, a digitiform process on the aedeagus in three of the species-groups but not elsewhere in the Macariini, and, in most females, a characteristically bilobed or “winged” sterigma of a type not seen in other genera; also in the presence of prespiracular furrows in the pupae of all species examined (a character shared with *Speranza* and *Letispe* but not with *Macaria* or *Psamatodes*). Male antenna always simple; male forewing without a fovea; pecten on the third abdominal sternum present; hindtibia enlarged; horned uncus well developed and often with additional enlarged setae, commonly two to four pairs unlike *Macaria*; valvula absent or very weakly developed; and long, sharp foretibial claw present in *spinata*, *indeterminata*, and sometimes in *decorata*.

I recognize nine species-groups based on features of the genitalia and general aspect of the moths, and give an introduction to each group. These are also food-plant groups with few exceptions. Usually all members of a species-group are host specific on one genus or family of trees and shrubs, but not always. In two or three groups almost every species has a different host, as in the *californiaria*-group; or, within a group there

may be just one or two nonconformists that fit the group morphologically but feed on some completely unrelated plant. Hosts of *Digrammia* species are diverse and include Cupressaceae, Salicaceae, Fabaceae, Asteraceae, Polygonaceae, Rosaceae, and Zygophyllaceae. The largest taxonomic and food-plant group is comprised of those on Salicaceae (15 species), which feed on many species of willow but only rarely on poplars. The willow-group includes one known host exception—*D. yavapai*, which feeds on *Robinia*. *Digrammia californiaria*, *D. yavapai*, and members of the *eremiata*-group appear to be the only species to feed on Fabaceae, feeding on *Lotus*, *Vicia*, *Robinia*, *Amorpha*, and a few related plants but not on the same hosts as *Rindgea*. Those on Cupressaceae (11 species) are mostly on *Juniperus*, but some feed on *Cupressus*, *Thuja*, *Calocedrus*, and *Chamaecyparissus*. It is not known whether any feed exclusively on these other genera.

Digrammia, with 49 species, is the second largest macariine genus in North America (*Speranza* has 51 species). Additional species occur in Mexico, Central America, the West Indies, and in Eurasia, but it seems more than likely that the genus is best represented in the Nearctic Region. *Digrammia rippertaria* (Duponchel), a widespread boreal and montane species, is Holarctic and one of the few members of the genus in the Old World. It was formerly known as *hebetata* (Hulst) on this continent because no one recognized European and American specimens as the same species, and also because the type of *hebetata* was misidentified until now.

Most species of *Digrammia* have genitalia that are quite simple to only moderately complex, but *Rindgea*, which is associated with mesquite, mimosa, and related Fabaceae with pinnately compound leaves in the Southwest and Mexico, has evolved extraordinarily divergent and bizarre genitalia in both sexes. It is likely that these moths were derived from more prosaic *Digrammia*-like ancestors in the same semi-arid habitats between the Mexican border states and Central America where they mostly live now, and that *Rindgea* is the sister group of *Digrammia*. *Rindgea* has split into two groups, as is apparent from the genitalia.

The *californiaria*-GROUP

The four western species of this group may not really be that closely related, but their genitalia

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show similarities in both sexes, especially the absence of the digitiform process of the aedeagus, which is nearly always present in the several related species-groups that follow. The adults are among the more nondescript species and may be difficult to distinguish by superficial appearance. The known hosts are unusually diverse for closely related macariines: *californiaria* on various legumes (Fabaceae), *colorata* on creosotebush (Zygophyllaceae), and *pervolata* on mountain mahogany (Rosaceae).

Digrammia californiaria (Packard)

PL. 6, FIGS. 4–8 (adult); PL. 13, FIG. 10 (larva); TEXT FIG. 44 *a, b, d* (♂ gen.); TEXT FIG. 45 *a* (♀ gen.) (RWH 6380).

Macaria californiaria Packard, 1871, *Proc. Boston Soc. Nat. Hist.*, 13: 392.

Type locality: California. [MCZ]

NOTE—Packard described *californiaria* three times (1871, 1873, and 1876), expanding his concept each time. The original description was based on both sexes but probably only one specimen of each, collected by Henry Edwards or by J. Behrens, but without the specific locality given. In 1873 Packard described two females from Goose Creek, Siskiyou County that he considered to be variants of the same species, but I have not seen them. In his monograph of 1876 Packard mistakenly synonymized *pallidata* Packard, from Texas, and included *ordinata* Walker (as *maculifascia* Hulst) from Kansas under *californiaria*. One of the two surviving specimens in the MCZ labeled as a type of *californiaria* is a female of *ordinata* (labeled “Ks. [Kansas], Snow”). The other is a female representing the present species, but it is uncertain whether this is the female of the original description; the similarly labeled example of *ordinata* is a spurious type. The female representing the present species is without an abdomen; and since it was illustrated in color by McGuffin (1972, fig. 96), the head has been lost. Comparison of McGuffin’s figures of the genitalia (1972, figs 208 g–k) with mine (text figures 44 *a, b, d*, 45 *a*) shows that we agree on the identification of *californiaria*. He referred to the surviving type as a holotype, but as Packard (1871) mentioned two specimens, it is a syntype. I hereby designate this specimen, illustrated by McGuffin, as the lectotype of *Macaria californiaria* Packard, 1871, trusting that it is the female of the original description.

This widespread western species is common and easily identified only in California. Elsewhere it is known from widely scattered localities, is more variable, and hard to recognize except by the gen-

italia. I would not have guessed, for example, that the decidedly darker or grayer specimens from Oregon or Washington, or the Black Hills, South Dakota, belonged to *californiaria* without dissecting them. The shape of the valve (text figure 44 *a, b*), with its single spine, and absence or obsolescence of the digitiform process of the aedeagus serve to distinguish males of this species; more subtle features in the shape of parts of the sterigma (text figure 45 *a*) usually make possible the identification of females.

Californian specimens light grayish brown and finely granulated, especially on the slightly paler hindwings. Three main transverse lines of forewing indistinct except where they meet costa to form the usual three black spots. Specimens from California characteristically have double dark patch straddling postmedial line opposite end of cell, this consisting of 1) a black bar on postmedial line between M_1 and CuA_1 , often about equal in length to subapical costal spot or bar, to which it may be joined, and 2), a diffuse dark patch of similar length appearing as shadow of black bar on outer side of postmedial line. Shadow is part of subterminal band, which otherwise is little developed. Although a common feature of many species of *Digrammia*, this double dark patch is helpful in this group owing to its near absence in *pervolata* and *delectata* and its absence, near absence, or presence in modified form in *colorata* and other species that may appear similar. Unfortunately, it also tends to disappear in *californiaria* from the Pacific Northwest and South Dakota. Outer third of both wings usually somewhat darker than proximal two-thirds in specimens from California and Arizona, but not elsewhere. Two external structural features of the male are helpful in identification of *californiaria*. The longest male antennal setae, like those of most *Digrammia* species, are short, hardly longer than the thickness of the antennal shaft. *Digrammia pervolata*, with which *californiaria* is easily confused in the Southwest, has decidedly longer antennal setae, often more nearly twice as long as the thickness of the antennal shaft. Males of *californiaria* (and the sometimes similar *Rindgea maricopa*) may have an unusually long hindtibia, slightly more than twice the length of the hindtarsus. Other species with which *californiaria* may be confused have the hindtibia equal to or less than twice the length of the hindtarsus. Unfortunately, the long hindtibia seems consistent only in California. Arizona specimens are mixed,

and in those from elsewhere the hindtibia is reduced to twice the length of the hindtarsus. Length of forewing: males, 12–15 mm; females, 12–16 mm. The size is about average for the genus.

To summarize the geographical variation, Californian specimens are more brownish than gray and marked as described above; those from Arizona, Utah, and Colorado are similar but often not as well marked; and specimens from Elko County, Nevada, Oregon, Washington, and southwestern Canada, as well as three from near Hill City, South Dakota, are darker, grayer, less granulated, frequently lack the double dark spot on the postmedial line of the forewing, and may closely resemble *delectata*. The variation seems geographically inconsistent. The male hindtibia is slightly longer than twice the length of the hindtarsus in specimens from California but not necessarily in those from elsewhere. The genitalia do not vary appreciably.

The male genitalia (text figure 44 *a, b, d*) should be recognized easily. They are most similar to those of *nubiculata* or *pictipennata* but lack the digitiform process on the aedeagus.

The female genitalia (text figure 45 *a*) may be recognized by the characteristic shape of the two winglike lobes of the sterigma, which extend posteriorly nearly parallel well beyond the ostium.

Larva green, rather plain, with numerous fine, whitish or faintly yellowish longitudinal stripes, most of them irregular and interrupted except for a slightly stronger subdorsal (dorsolateral) and a much more distinct, pale subspiracular. The subspiracular, as usual, relatively conspicuous because of its greater width, but irregularly defined. Intersegmental folds show as thin yellowish rings. One pair of setae, probably SV2, especially well developed, stiff, straight, white basally, black tipped. Head leaf green, not shiny, with a reticulate pattern of very fine whitish lines and the usual lateral extension of the whitish subspiracular stripe beneath the level of the stemmata. Thoracic legs pale pink; and prolegs lightly or partly tinted with the same color. Larvae of *californiaria* may have both green and brown forms so frequent in *Macariini*, but I have no information on this. The above description is from a photograph provided by B. Scaccia, who reared a brood from eggs obtained from a female taken in Lane County, Oregon (photograph and reared specimens in USNM).

Digrammia californiaria feeds on various low-

growing legumes. The larvae reared by Brian Scaccia ate alfalfa (*Medicago sativa* L.), lupine (*Lupinus* sp.), and vetch (*Vicia* sp.). It was reared from larvae on *Amorpha californica* Nutt. and *Lotus purshianus* Clem & Clem. in the San Gabriel Mountains, Los Angeles County (C. Henne, in LACM); and a species believed to be *californiaria* was reared on "*Lotus scoparius*" (= *Lotus crassifolius*) but no adults were obtained (McFarland, 1965: 62, and notes in LACM). All reported hosts are Fabaceae.

Digrammia californiaria occurs throughout most of California, including Santa Catalina Island, northward through Oregon and Washington to western Canada, where it is present in the southern parts of Saskatchewan, Alberta, and British Columbia. Eastward, it occurs widely and sometimes commonly in Arizona and has been taken, but more rarely, in Nevada, New Mexico, Utah, Colorado, Wyoming, and in the Black Hills, South Dakota. In Colorado it has been found as far east as the Pawnee National Grassland, Weld County. Eighty-five percent of the nearly 500 specimens examined are from California. The species is common in southern California, where it may fly every month of the year, although with few records for the period between October and January. Even in western Canada there are two broods, with flight period of 30 May–17 July and 31 July–28 August. It was collected 28 April–27 May in Lincoln County, New Mexico; mainly in June and July in more northern localities.

Digrammia colorata (Grote)

PL. 6, FIGS. 9–12 (adult); PL. 13, FIGS. 11, 12 (larva); TEXT FIG. 44 *e, g* (♂ gen.); TEXT FIG. 45 *b* (♀ gen.) (RWH 6381).

Semiothisa colorata Grote, 1883, *Can. Ent.*, **15**: 7.

Type locality: Arizona. [USNM]

NOTE—Described from several specimens from the B. Neumögen collection, now in the USNM. I designate as lectotype a male labeled simply "Arizona," and H. W. Capps slide No. 1174, USNM slide No. 57,308, and USNM Type No. 34,212.

Cleora godmani Druce, 1892, *Biologia Centrali Americana. Insecta. Lepidoptera-Heterocera*, **2**: 72, pl. 48, fig. 9. NEW SYNONYMY.

Type locality: El Paso, Texas. [BMNH]

NOTE—Described from an unspecified number of

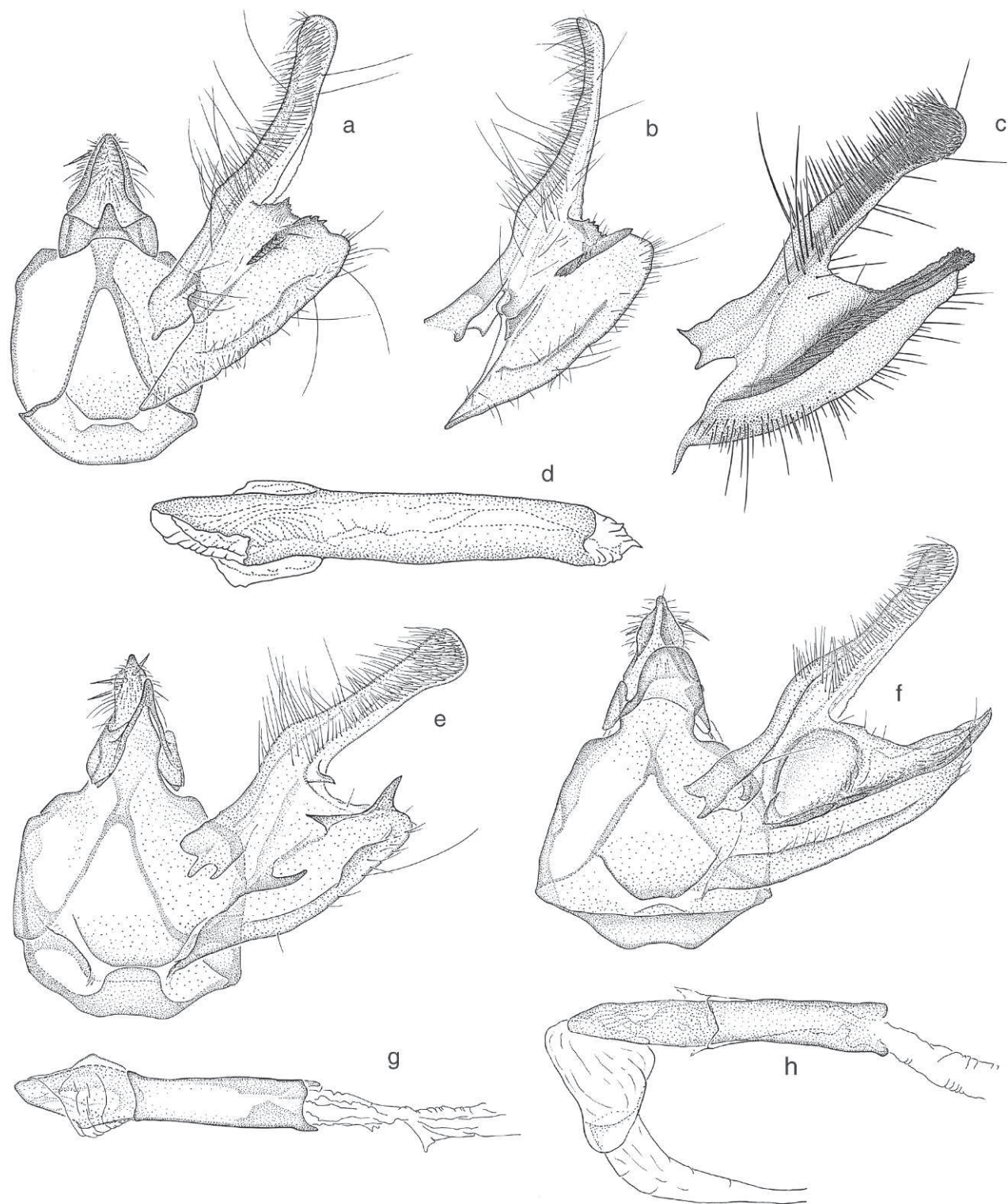
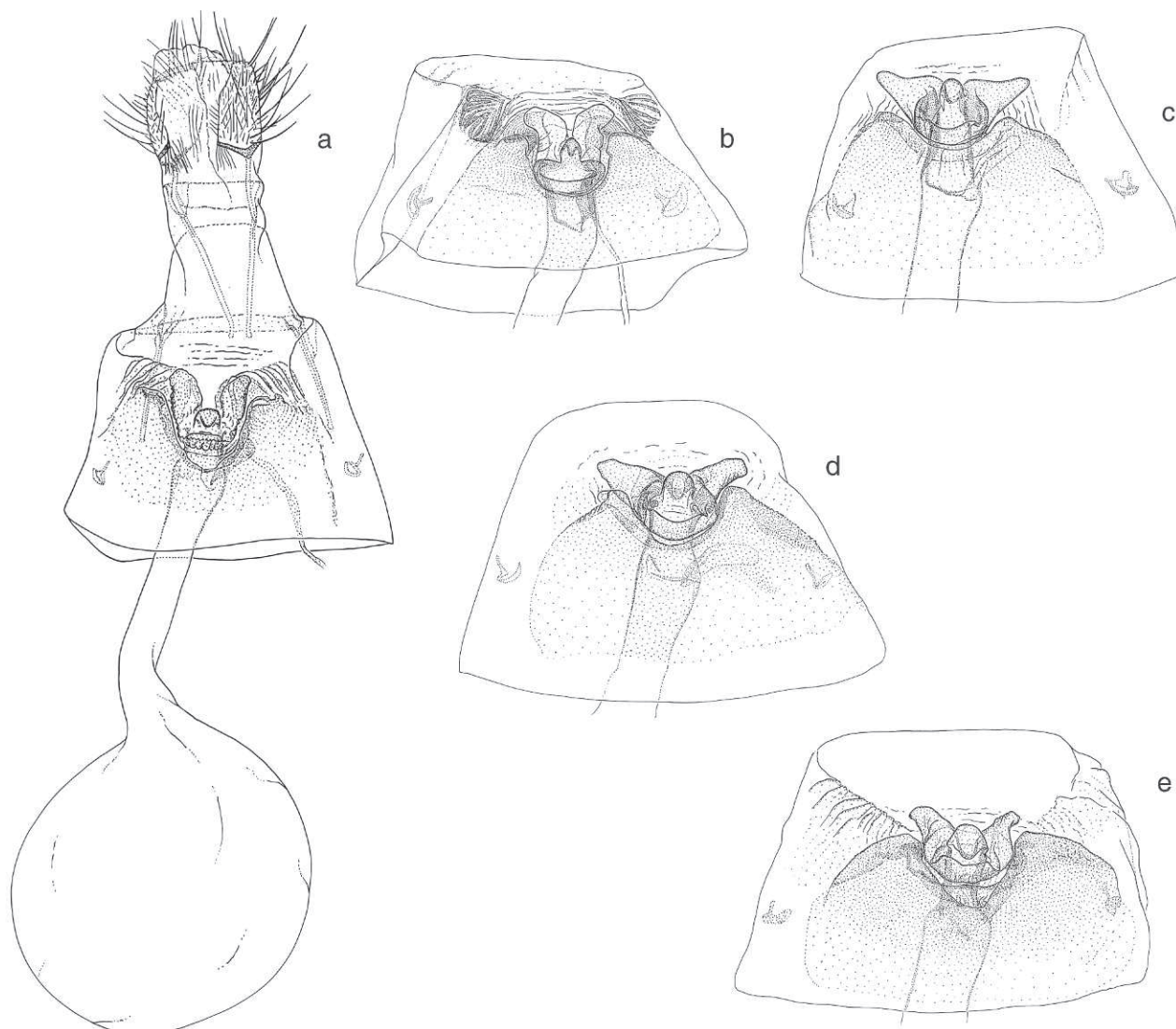


FIGURE 44: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. californiaria, genital capsule; Mineral King, Tulare County, California (USNM 53023). *b. D. californiaria*, right valva—variant; Hill City, Pennington County, South Dakota (USNM 53060). *c. D. aliciata*, right valva; Washington County, Utah (USNM 57023). *d. D. californiaria*, aedeagus; Mineral King, Tulare County, California (USNM 53023). *e. D. colorata*, genital capsule; Panther Pass, Big Bend National Park, Brewster County, Texas (USNM 53042). *f. D. pervolata*, genital capsule; Grand Canyon, Coconino County, Arizona (USNM 53050). *g. D. colorata*, aedeagus; Panther Pass, Big Bend National Park, Brewster County, Texas (USNM 53042). *h. D. pervolata*, aedeagus; Grand Canyon, Coconino County, Arizona (USNM 53050).

FIGURE 45: FEMALE GENITALIA OF *DIGRAMMIA* SPECIES

a. *D. californiaria*; Walnut Canyon, Coconino County, Arizona (USNM 53356). b. *D. colorata*, S8, ostium bursae and ductus bursae; Avra Valley, Pima County, Arizona (USNM 53212). c. *D. pervolata*, S8, ostium bursae and ductus bursae; Major's Flat, Ephraim Canyon, Sanpete County, Utah (USNM 57015). d. *D. pervolata*, S8, ostium bursae and ductus bursae; Smith Canyon, Culberson County, Texas (USNM 57053). e. *D. aliciata*, S8, ostium bursae and ductus bursae; Washington County, Utah (USNM 57287).

syntypes from El Paso, Texas and northern Sonora, Mexico. Druce commented that "the description and figure are taken from specimens obtained by Mr. Godman at El Paso, those from Sonora being in poor condition." I hereby designate as lectotype a male in good condition in the British Museum, bearing my green slide label No. 1548. When I examined this specimen I believed it to be the one illustrated by Druce, although the abdomen as drawn by the artist resembles that of a female.

Sciagraphia conarata Grossbeck, 1908, *Jour. New York Ent. Soc.*, **16**: 26.

Type locality: Yavapai County, Arizona. [AMNH]

NOTE—Described from three females in the Grossbeck collection, now in the AMNH. I designate as lectotype one of those labeled Yavapai Co., Arizona, V-29, *Sciagraphia conarata*, female Type, Gross., and female genitalia slide No. 2056 (by F. H. Rindge).

Digrammia colorata is generally the most abundant species of the genus in the Southwest, from southern California to West Texas, wherever its

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host, creosotebush, is present. It resembles the well-marked forms of *pervolata* or *pallidata* but differs in commonly having a light reddish-brown tint, especially noticeable in the median area of the forewing. This ruddy tint may fade to a cream-colored shade in old or weathered specimens, and they may then be hard to recognize. Like *pervolata*, it has long male antennal setae, some of which exceed in length the thickness of the antennal shaft. Small, poorly marked *colorata* may be hard to distinguish from *Rindgea parcata*, except that they rarely have the wide, dark, outer marginal border on the underside typical of *parcata* (plate 8, figure 31). Winter or early spring specimens (plate 6, figures 11, 12) are often so much larger and more heavily marked than those that fly in summer and fall that they might easily be mistaken for some other species. The distinctive male genitalia have four pointed, thornlike processes on each valve, and the female has the two winglike lobes of the sterigma turned outward preapically in a characteristic manner.

Although little geographical variation is apparent, the species is dimorphic sexually and seasonally with respect to wing markings and size. Males relatively coarsely irrorated with dark scales or patches of dark scales against a slightly reddish-tinted, pale brown ground color; usual transverse lines of forewing irregular, mostly obsolescent, terminating in the usual three or four blackish spots at costa and one to three lesser dark patches at inner margin; discal spot of forewing often prominent; outer third of forewing often heavily shaded, complex, variegated gray and brown; terminal line thin, black, interrupted at veins. Hindwing also may be heavily irrorated on a dull whitish ground, with two transverse lines showing only as dark patches toward inner margin. Both wings sometimes with outer third darker, reflected more prominently beneath as a gray-brown outer border as in *Rindgea parcata*, but usually not so. Females averaging larger, lighter, much less heavily marked than males. Wing length: males, 9–16 mm; females, 10–15 mm.

Seasonal variation mainly affects size, although cool season (December–April) specimens from some areas such as the Mojave Desert, California, may be heavily suffused with gray, largely replacing the usual light reddish-brown coloring. Winter to early spring specimens also may be much larger than the summer ones flying from May to September or October, as the following measurements reveal, and those from the transi-

tional periods in April–May or October–November are commonly intermediate, depending on local conditions of elevation and climate. Wing length of cool-season specimens (December–April): males, 12.0–16.0 mm.; average male, 13.8 mm (n = 65); females, 11.0–15.0 mm; average female, 13.8 mm (n = 41). Wing length of warm-season specimens (May–September): males, 10.0–13.0 mm; average male, 11.3 mm (n = 42); females, 11.0–13.0 mm; average female, 12.1 mm (n = 20). This is based on combined measurements of specimens from California, Arizona, and Texas.

Male genitalia (text figure 44 *e, g*) unique in having four sharp, thornlike processes on valve, arranged as illustrated. Incision in eighth sternum simple, varying from V-shaped to U-shaped at its extremity, and does not quite reach midpoint of sternite. Aedeagus with rudimentary digitiform process.

Female genitalia (text figure 45 *b*) similar to those of *californiaria*, *pervolata*, *delectata*, and others but may be distinguished by characteristic shape of winglike lobes of sterigma. These lobes long, apically rounded, and directed posteriorly except where turned outwardly one-half to two-thirds of way from base.

Digrammia colorata occurs in southern California, including Santa Catalina Island, and northward in suitable desert areas to Darwin; Lone Pine; the Panamint Mountains; Death Valley National Monument, Inyo County, Inyokern, Kern County; Clark County, Nevada; throughout Arizona north at least to Flagstaff; in New Mexico; at Florissant Colorado (one record); and in West Texas. In Texas it occurs abundantly west of the Pecos River but is also present much farther eastward as indicated by specimens in the U. S. National Museum of Natural History from Kerrville, Kerr County, and Lake Brownwood, Brown County. This species also occurs in Mexico; I have seen it from Valle de Santo Domingo, Baja California Sur (USNM), and from Sonora and Chihuahua (UCB). It flies in every month from February to November, but probably not in the cooler areas.

I reared a large brood of this species from a female taken in thorn scrub (mesquite) on the bank of the Rio Grande, 6 mi. west of Lajitas, Brewster County, Texas in 1993. Last instar larva with ground color yellowish green, matching the foliage of the host, creosotebush, *Larrea tridentata* (DC.) Coville (= ?*Larrea divaricata* of au-

thors, not Cav.) (Zygophyllaceae), but also with complex markings. It has 11 fine, closely set, equally spaced, white to light brown longitudinal stripes, more than the usual complement of such lines. These may be partly fragmented or indistinct and are not strongly contrasting. Subspiracular stripe white to light yellow, wide, prominent but irregularly defined, and interrupted on each segment by a variable, dark, black to purplish blotch that usually encompasses the spiracle. This varies from one or two small, irregular, dark streaks or patches in vicinity of spiracle, and often touching it, to a large blotch occupying half of the lateral side of the segment, and extending (in reduced form) across the dorsal area to connect with the lateral blotch on the other side. The large, dark, lateral markings are most extensive on T1, T2, and A6 in heavily marked larvae, and the dark purplish color extends down the outer sides of the legs on those segments. Additional small, dark purplish dots and streaks may occur on the thoracic and posterior abdominal segments. Setae black, unusually large and prominent, many with black bases. Head pale yellow brown, spotted and barred with darker brown, in part in a herringbone pattern. Whitish subspiracular extends forward from thorax onto side of head below stemmata. Length at maturity: 22–25 mm. These larvae are obviously adapted to live and feed on the excessively sticky, resinous, curiously scented foliage of the foodplant, upon which I reared them without difficulty.

The foodplant was confirmed by other reared lots that I examined, as follows: 1) reared from eggs at Tucson, Arizona, 1982 (R. Nagle); 2) reared from larvae “on 3rd and 4th leaf pairs of *Larrea divaricata*,” Avra Valley, W of Tucson, 1973 (R. G. Cates & M. L. Paulson); 3) from larvae beaten from *Larrea* near Bisbee, Cochise County, Arizona, 1985 (N. McFarland); 4) from larvae, same host, Sevilleta Natl. Wildlife Refuge, Socorro County, New Mexico, 1983, (N. Cobb); 5) from larvae, same host, near Bakersfield, Pecos County, Texas, 1976, (C. J. DeLoach); 6) from larvae, same host, Inyo County, California, 1988 (B. Scaccia). Voucher specimens from these rearings are in the USNM.

Digrammia pervolata (Hulst)

PL. 6, FIGS. 13–16 (adult); TEXT FIG. 44 *f*, *h* (♂ gen.); TEXT FIG. 45 *c*, *d* (♀ gen.) (RWH 6382, 6383).

Thamnonoma pervolata Hulst, 1880, *Bull. Brooklyn Ent. Soc.*, 3: 42.

Type locality: Colorado. [AMNH]

Phasiane davisata Cassino, 1928, *The Lepidopterist*, 5: 1, NEW SYNONYMY.

Type locality: Davis Mountains, Texas. [MCZ]

NOTE—The genitalia of the holotype show clearly that this is the same species as *pervolata*.

Digrammia pervolata is often the most common of the nondescript gray to gray-brown species in the Southwest, although its known distribution seems to encompass only parts of Arizona, New Mexico, West Texas, Utah, Colorado, and Wyoming. It is replaced in southern California by the closely related *D. aliciata*, and in most of Texas and elsewhere in the Great Plains Region by the superficially similar *D. pallidata*. It overlaps broadly with *Digrammia californiaria*, *delectata*, *yavapai*, and *Rindgea maricopa* and may be difficult to distinguish except by genitalia. *Digrammia pervolata* is also highly variable (plate 6, figures 13–16), and specimens occur that may be confused with any of the above. It has been universally misidentified since the time of the original description, and all literature references in the interval must be disregarded. A full description would be more confusing than helpful, and I will call attention only to those features that make identification of *pervolata* possible.

The wings may be evenly gray, with few markings, to highly variegated. The blackish costal spots of the forewing and three main transverse lines may be present or absent in any combination, although the latter are usually present but weak. Variable amounts of dark subterminal shading may also be present or absent. The dark thickening of the postmedial line opposite the end of the discal cell of the forewing and dark shading associated with it distad of the postmedial line are reduced or wanting in *pervolata*. This species also has a fairly well-developed subterminal dark border on the underside of the hindwing beneath, and *californiaria* usually does not.

Seasonal and geographic variation in this species adds further confusion. Cool-season specimens in March–May (plate 6, figures 15, 16) have a tendency to be large and diffusely marked; warm season specimens (plate 6, figures 13, 14) throughout the summer are smaller and more boldly marked. Those from Coconino County,

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Arizona are somewhat different and especially difficult to distinguish from *D. californiaria*.

The length of the male antennal setae, although also somewhat variable, usually helps to distinguish *pervolata* from all others except *aliciata*. The antennal shaft is thin, and the setae relatively long, the longest equal in length to nearly twice the thickness of the antennal shaft at that point. In most others the setal length barely exceeds the width of the shaft. *Rindgea maricopa* and *Digrammia pallidata* also have long setae, but the antennal shaft in those species is also thicker. The male antennal setae are a subtle and not very satisfactory character, but nothing else is consistent enough to be useful apart from the genitalia. Wing length: males, 12–15 mm; females, 12–15 mm.

The male genitalia of *pervolata* are distinctive and almost unique in having the inner face of the ventral lobe of the valve bisected lengthwise from base to apex by a prominent, nearly straight ridge, and in having a small, acutely pointed spine arising from the basal end of this ridge. A large, oval depression lies between the dorsal (costal) and ventral lobe, as in *D. ubiquitata*. Only *aliciata* has a similar longitudinal ridge, but it differs in being coarsely serrated and in lacking the spine at the base. The oval depression is less prominent in *aliciata*. Males of *pervolata* often may be identified without dissection by brushing away some scales, if the end of the ventral lobe of the valve happens to extrude sufficiently beyond the tip of the abdomen.

The female genitalia (text figure 45 *c, d*) may be recognized by the general configuration of the elongated, tapered, outwardly directed, winglike lobes of the sterigma. A sterigma with winglike lobes is common to all members of the group but the shape varies. Those of *D. ubiquitata* and *D. denticulata* are also similar but each lobe is more angulate. The most closely related species, *aliciata*, differs in having the ductus bursae abruptly constricted near the ostium, having less pointed lobes, and a heavier sclerotized fold on the posterior margin of the seventh sternum, just before the sterigma.

Several adults of this species were reared by B. Scaccia from larvae beaten from birchleaf mountain mahogany, *Cercocarpus betuloides* Nutt. (Rosaceae) near Montrose, Colorado and near LaSal, San Juan County, Utah, but no larval description or photograph is available (voucher specimens in USNM identified by genitalia).

Digrammia pervolata occurs widely in Arizona, eastward to the the Davis and Chisos Mountains, Texas, and northward at least to Sanpete County, Utah, Larimer County, Colorado, and Platte County, Wyoming, where I found it abundant in Guernsey State Park, on the North Platte River. Otherwise I have seen it only from Chihuahua, Mexico. It seems to be entirely replaced in southern California by *aliciata*. Available collection dates are March–October in Arizona and New Mexico; March, May, June, July, August, and October in West Texas; early July–mid-August in Utah; July 1–31 for Colorado, and 12 July in Wyoming. It occurs generally at elevations of 5,000–8,000 feet, but I collected it as high as 8,850' in Utah and 8,500' in Colorado.

Digrammia aliciata (Cassino)

PL. 6, FIGS. 17, 18 (adult); TEXT FIG. 44 *c* (♂ gen.); TEXT FIG. 45 *e* (♀ gen.) (RWH 6387).

Phasiane aliciata Cassino, 1928, *The Lepidopterist*, 5: 3.

Type locality: Mt. Wilson, California. [MCZ]

NOTE—I examined the holotype and six paratypes. The holotype has lost its right forewing.

This species and the more widespread *D. pervolata* are closely related and often nearly indistinguishable in appearance. However, *aliciata* is known only from southern California and Washington County, Utah; averages slightly larger; has a paler gray ground color in part (pale brownish or cream colored in some specimens), and may have heavier black markings; has a strongly serrated longitudinal ridge on the ventral lobe of the valve (usually unserrated in *pervolata*); and at least three diagnostic features in the female genitalia, as described later. More heavily marked variants, such as the holotype and the few examples from Utah, are so distinctive that they need not be confused with any other species of *Digrammia*.

General habitus and variation much like those of *pervolata*, but with trend toward heavier markings that culminates in the unusual, dark-spotted appearance of extreme examples. Such markings on forewing may consist of the usual three costal black spots and sometimes a fourth subapically, if position of subterminal band happens to be marked at costa; a discal spot; three lesser spots where main transverse lines meet inner margin; antemedial and medial spots on cubital vein,

sometimes connected to form a streak; complete series of black vein dots on postmedial line; complete series of small, dark, intervenular, terminal dots or wedges; and a large, rounded, subterminal patch just beyond postmedial line and between M_2 and CuA_1 . Hindwing has one or two dark spots marking transverse lines at inner margin, and a series of terminal dots. Underside like that of *pervolata* except for frequent presence of more prominent, mesial, subterminal, dark patch on forewing. Male antenna with setae distinctly longer than thickness of shaft, as in *pervolata*. Wing length: males, 13–16 mm; females, 16 mm.

Male genitalia easily recognized by heavily developed, sclerotized, longitudinal ridge or flap on ventral face of valve that is serrated or sculptured in manner much more exaggerated than that of *pervolata*; also, small spine arising from basal end of this ridge in *pervolata* is missing in *aliciata*, and oval depression between costal and ventral lobes less prominent in *aliciata*.

Female genitalia with ductus bursae abruptly and strongly constricted just anterad of ostium, a more heavily developed, sclerotized fold in integument on posterior margin of seventh sternum as compared to that of *pervolata*, and lobes of stergma less pointed.

The early stages are unknown, but, like the closely related *D. pervolata*, it might feed on *Cercocarpus*.

I have seen *aliciata* from Mt. Wilson, Mt. Lowe, Angeles Crest, Mint Canyon, San Gabriel Canyon, Buckhorn Flat, and Clear Creek Camp, in Los Angeles County; Wrightwood, 6,100', San Bernardino County; Pinyon Crest, 4,400', Riverside County; Summerland, Santa Barbara County; and Hunter's Flats, Inyo County, all in California; and from Leeds, Washington County, Utah. It has been taken in every month from May to October in California, and in June in Utah. *Digammia alicata* is uncommon in collections, and this account is based on only 27 specimens.

The *denticulata*-GROUP

This is a group of four mainly western species [*sempunctata*, *delectata*, *ubiquitata* and *denticulata*, ed.], including a new one and another recovered from synonymy. Adults have two or more sharp processes on the ventral lobe of the valve and a digitiform process on the aedeagus. The genitalia are extremely similar to those of the *nubiculata*-group, but the moths are more robust

and of decidedly different appearance. All except *delectata* are gray with black markings, and *denticulata* usually has distinctive white areas; *delectata* varies geographically from brownish to gray and is the most nearly immaculate of the four species. The known hosts are species of *Purshia* (Rosaceae), *Eriogonum* (Polygonaceae), and *Ceanothus* (Rhamnaceae). Two species are wide ranging northward to the Yukon or Alaska, and one of these, *denticulata*, extends eastward to northern New York.

Digammia sempunctata (Bates), REVISED STATUS, NEW COMBINATION
PL. 6, FIGS. 19, 20 (adult); PL. 13, FIGS. 13, 14 (larva); TEXT FIG. 46 a, c (σ gen.); TEXT FIG. 47 a (ρ gen.) (RWH 6373, part).

Semiothisa sempunctata Bates, 1886, *Can. Ent.*, 18: 75.

Type locality: Elko, Nevada, 10,000'. [AMNH]

NOTE—Described from one female that survives intact and, although faded, appears to be an excellent match for specimens that I collected in the East Humboldt Mountains, 40 mi ENE of Elko. According to the elevation given, the type must have been collected somewhere in the Ruby or East Humboldt Mountains, because the elevation of Elko is only about 5,200'. The name *sempunctata* was relegated to the synonymy by Hulst in 1887 and remained a synonym or subspecies of *denticulata* for the next century. I might have overlooked it too had I not collected fresh material from near the type locality.

This species is so close to *ubiquitata* in appearance that some specimens may be distinguished with certainty by reference to the genitalia. The wings are slightly darker and more uniformly gray, less mottled or variegated with gray and white, and the half of the postmedial band toward the costa tends to be a more nearly continuous black bar, only slightly bent or curved, not strongly angled at M_1 . The male genitalia lack the large, rounded depression seen in the valve of *denticulata* and *ubiquitata* and resemble those of *delectata*. *Digammia sempunctata* is known mainly from the Great Basin Ranges.

Wings almost uniformly gray but sometimes with slight whitish shading in median and subterminal areas of forewing. Forewing with antemedial band regular, usually somewhat convex, weak, boldly emphasized with black only near costa; medial line usually faint, nearly straight, becoming strongly marked with black only near

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costa; postmedial line heavily outlined with black for about half its length from costa to midpoint and followed immediately beyond by a black smudgy spot or twin spots at M_3 ; black part of postmedial band constricted or slightly interrupted near middle, or continuous; discal spot absent; terminal line faint, gray brown, interrupted; fringe light gray with diffuse, darker rays opposite veins. Hindwing fairly evenly grayish, slightly mottled with lighter and darker shades, with a faint, dark, convex postmedial band showing toward inner margin, and a faint discal spot; terminal line and fringe as on forewing. Underside of forewing dusky, sometimes becoming slightly luteous toward apex, with regular, diffuse, slightly darker antemedial and postmedial bands and diffuse discal spot; underside of hindwing paler, with relatively wide but diffuse postmedial band, without much contrast, and a discal spot smaller and more sharply defined than that of forewing. Color of body and structure of head and appendages like those of *ubiquitata*. Wing length: males, 13–15 mm ($n = 12$); females, 14–15 mm ($n = 9$); holotype female, 15 mm.

Male genitalia (text figure 46 *a*, *c*) with valve much like that of *delectata*, lacking the large concavity between costal and ventral lobe characteristic of *ubiquitata*, *denticulata*, and *pervoluta*, and with ventral lobe less produced distally; also, valve with one large, basally directed dentate process, longer than narrowest width of costal lobe of valve (not longer in *delectata*). Aedeagus easily distinguished from that of *delectata* by shorter digitiform process, the length of which is less than thickness of aedeagus.

Female genitalia (text figure 47 *a*) with wing-like, sclerotized plates of sterigma small, expanding less than width of anterior margin of seventh sternum (exceeding that width in *ubiquitata* and *denticulata*), about same size as those of *delectata*; median nipplelike process surmounting ostium of similar size but simpler structure than those of the other species; ductus bursae swollen near ostium, unlike that of *delectata* but agreeing with those of *ubiquitata* and *denticulata*.

This species was reared from larvae on *Purshia tridentata* DC. at Boise, Idaho in July 1961 by M. M. Furniss. I verified the determination by dissection of a male from this rearing. Nothing else is known about the early stages.

I have seen *sexpunctata* from Larimer County, Colorado; Elko County, Verdi, and Franktown, Nevada; Mono County, California; Richfield,

Utah; Boise, Idaho; Joseph, Wallowa County, Metolius River, and McMinnville, Oregon; and from near Mazama, Okanogan County and Wenatchee, Washington. Most collection dates are from early to mid-July, but records for May, June, late July, and early August in Colorado, Washington and Oregon, and for 15 May in Utah, indicate two broods in areas with a longer growing season. In mountainous areas the species occurs in the middle elevations to 7,000'–8,000'.

Digrammia delectata (Hulst)

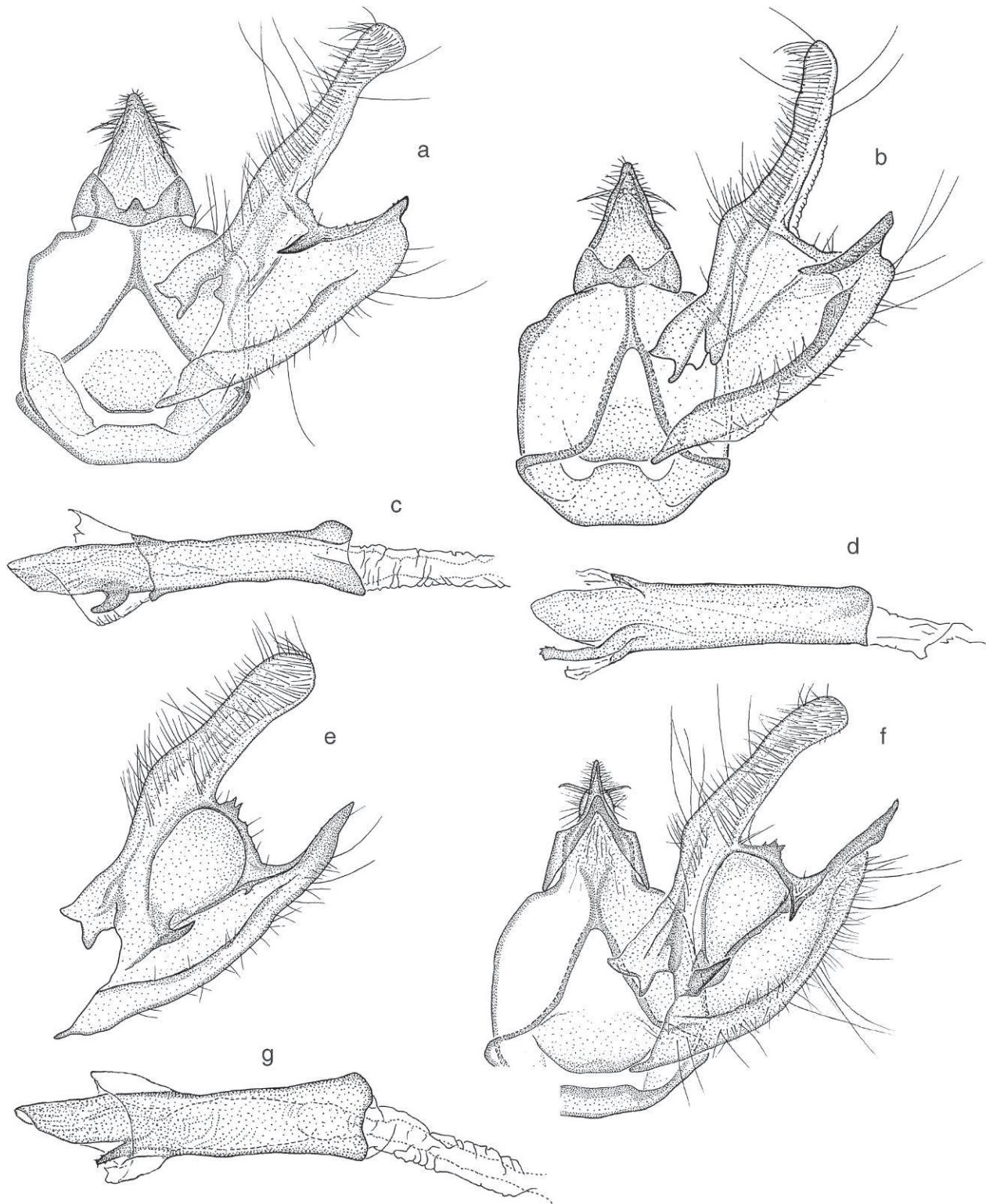
PL. 6, FIGS. 21–23 (adult); PL. 13, FIG. 15 (larva); TEXT FIG. 46 *b*, *d* (δ gen.); TEXT FIG. 47 *b* (φ gen.) (RWH 6374).

Semiothisa delectata Hulst, 1887, *Ent. Americana*, 2: 190.

Type locality: Col[orado]. [USNM]

NOTE—Described from one male specimen, in poor condition but recognizable. A genital slide of the type was made by F. H. Benjamin in 1934, and text figure 46 *d* was drawn from this preparation (FHB 949). A female in the American Museum of Natural History from Arizona is also labeled “Type,” but, as noted by Rindge (1955: 141), it is a spurious type because the original description specified a male from Colorado. The holotype agrees with the description in sex and locality (given only as “Col.” on the specimen label) and bears Hulst’s type label. It was in the collection of the Brooklyn Institute, later acquired by the USNM.

Digrammia delectata is a plain, gray to gray-brown species with the transverse lines usually appearing as little more than black spots or wedges at the costa of the forewing; the postmedial and antemedial lines may be thinly outlined with black for part or all of their length, widening only toward the costa, but such transverse lines are more often obsolescent. The species is variable with respect to such lines, as well as wing color (whether gray or brownish), texture (coarseness in mixture of light and dark scales), and size, and this variation is partly geographical as might be expected of such a wide-ranging species. It occurs from British Columbia to the Mexican border, and from Missouri to the Pacific, but is usually uncommon. *Digrammia delectata* may be confused with *triviata*, which is a more smoothly textured gray and more likely to have a broad, diffuse, dark brownish, subterminal shade on both wings, or with *sexpunctata*, which has a more extensive black band on the postmedial line. Confusion might also arise with *californi-*

FIGURE 46: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. sexpunctata, genital capsule; Franktown, Washoe County, Nevada (USNM 52992). *b. D. delectata*, genital capsule; Departure Bay, British Columbia (USNM 53067). *c. D. sexpunctata*, aedeagus; Franktown, Washoe County, Nevada; (USNM 52991). *d. D. delectata*, holotype, aedeagus; Colorado (FHB 949). *e. D. ubiquitata*, right valva; Major's Flat, Ephraim Canyon, Sanpete County, Utah (USNM 57030). *f. D. denticulata*, genital capsule; Cherry County, Nebraska (USNM 57026). *g. D. denticulata*, aedeagus; Cherry County, Nebraska (USNM 57026).

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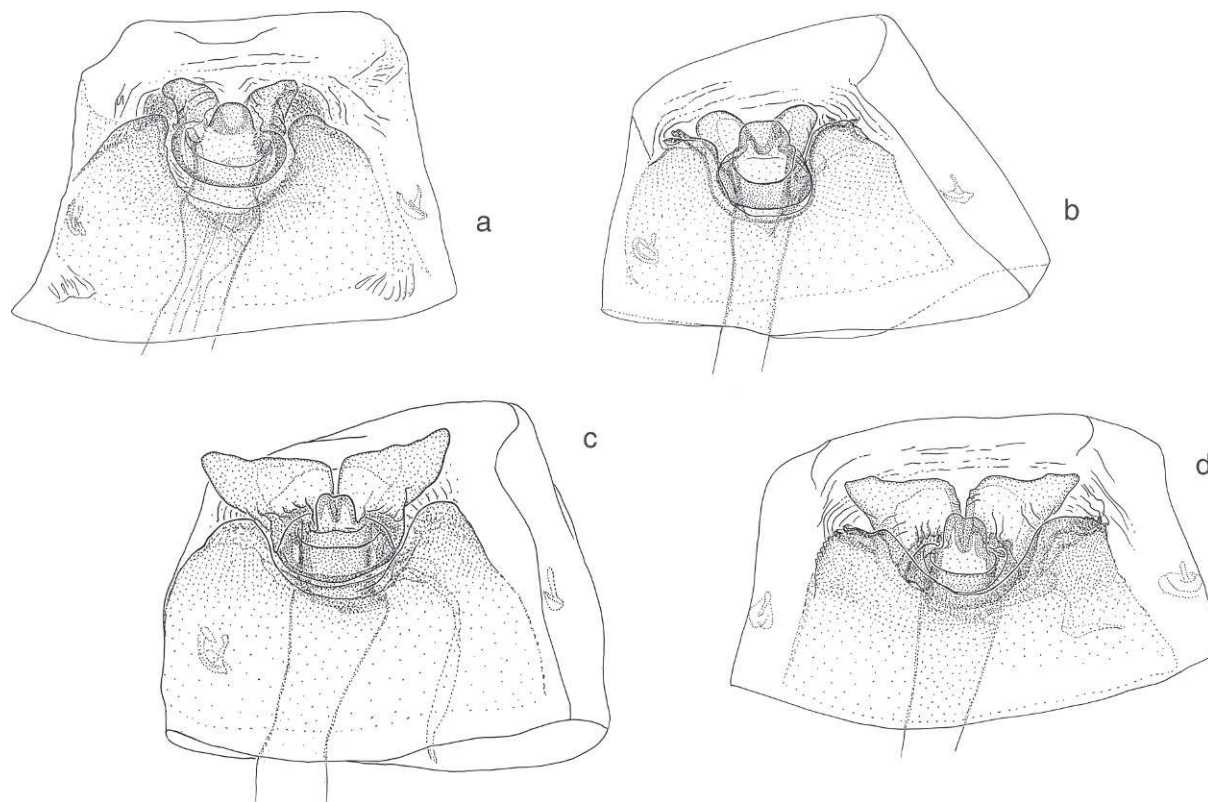


FIGURE 47: FEMALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. sexpunctata, S8, ostium bursae and ductus bursae; Elko County, Nevada (USNM 57290). *b. D. delectata*, S8, ostium bursae and ductus bursae; Denver, Denver County, Colorado (USNM 53363). *c. D. ubiquitata*, S8, ostium bursae and ductus bursae; Ephraim Canyon, Sanpete County, Utah (USNM 57032). *d. D. denticulata*, S8, ostium bursae and ductus bursae; Florence, Douglas County, Nebraska (USNM 53292).

aria in the West, *pervolata* in the Southwest, and with both *pervolata* and spring-brood *pallidata* in Texas, where separation of these species becomes particularly difficult. A difference that I have found helpful is that *delectata* has short, nearly straight male antennal setae, no longer than the thickness of the antennal shaft, whereas *pervolata* and *pallidata* have setae longer than the width of the shaft and more likely to be bent or curled toward the ends. Genital dissections, especially of females, may be necessary where *delectata* overlaps with any of them, but once the local limits of variation are understood and the subtle differences appreciated, the species usually may be recognized.

Additional, more detailed description probably would not be helpful, although it might be noted that *delectata*, *pervolata*, *pallidata*, and *triviata* all have a dark subterminal band or diffuse, dark outer border on the underside of the hindwing, whereas *californiaria* lacks such markings or shows only vestiges of them. All of these species

have small, poorly developed discal spots; a small, dark spot or patch where the otherwise almost invisible postmedial line meets the costa of the forewing; and a somewhat luteous tint toward the apex on the underside of the forewing. Wing length: males, 11–15 mm; holotype male, 12 mm; females, 12–15 mm.

Male genitalia (text figure 46 *b, d*) resemble those of *sexpunctata* except that the basally directed dentate process that arises near outer margin of ventral lobe of valve is shorter, its length not exceeding narrowest width of costal lobe; and the digitiform process of aedeagus is longer than thickness of aedeagus.

Female genitalia (text figure 47 *b*) usually with winglike plates of sterigma expanding less than width of anterior margin of seventh sternum, like those of *sexpunctata* (although in Texas specimens they may be longer); median nipplelike process surmounting ostium of usual form as seen in *ubiquitata* and *denticulata*, appearing more com-

plex internally than that of *sexpunctata*; and ductus bursae unswollen toward ostium.

Although seasonal variation in *S. delectata* is minimal, unlike that of *pallidata* and *colorata*, it shows some geographic variation in size, color, pattern, granular texture of wing coloring, and female genitalia. Before seeing the genitalia of these various populations of *delectata*, I did not recognize them as belonging to the same species. Specimens from the Pacific Northwest tend to be small, gray, and well marked; those from California are of average to large size and sometimes well marked, but are especially unusual in having the light gray background variegated with diffuse, irregular, smudgy, light brown shading following the general course of the transverse lines on the forewing, and coarsely dusted with brown scales on both wings; specimens from the Great Basin and Arizona tend to have a pale gray, fine-textured background, with clear, finely delineated black markings; those from the central to northern plains and Rocky Mountains often have a brownish cast, reduced black markings, and are uniformly a little below average size; 30 specimens from Texas are highly variable in markings and size but average larger, and they are mostly clear gray rather than brown. Atypical local populations evidently can occur within these areas, because a few specimens from Denver and from Weld County, Colorado, are gray and more heavily irrorated than others from the Rocky Mountains and central plains. Again, I did not initially recognize them before dissecting the genitalia.

Several specimens of *delectata* were reared from larvae on *Eriogonum effusum* Nutt. (Polygonaceae) at the Central Plains Experimental Range, 8 km N of Nunn, Weld County, Colorado (J. A. Scott), and sent to me for identification. They emerged in late June 1976. Brian Scaccia reared it on *Ceanothus cuneatus* (Hook.) Nutt. From an unknown locality.

Digrammia delectata occurs from Big Bend National Park, Texas, Oklahoma, Kansas, western Missouri and the Dakotas to southern British Columbia, Washington, Oregon, and throughout California at least to Riverside County, and including Santa Cruz Island and in Arizona as far south as the Huachuca, Santa Rita, and Baboquivari Mountains. It seems most common in Arizona and southern California and has been collected in Baja California (J. Powell). The dates indicate two or more broods in Texas (March–May, July, September–October); Arizona (April–

June, August–September); southern California, (January–June, August–October); and the Pacific Coast even as far north as British Columbia (April–September). It is probably univoltine throughout most of the remaining area, flying in June and July.

Digrammia ubiquitata Ferguson, NEW SPECIES

PL. 6, FIGS. 24–26 (adult); TEXT FIG. 46 *e* (♂ gen.); TEXT FIG. 47 *c* (♀ gen.).

Digrammia ubiquitata Ferguson.

Type locality: Telluride, 8,745', San Miguel County, Colorado. [USNM]

This species and the extremely similar *D. sexpunctata* were formerly confused with *denticulata*, and specimens of the three species were mixed in collections. However, consistent differences in wing coloring, genitalia, and distribution show that they are different species. *Digrammia ubiquitata* can usually be distinguished from *denticulata* by its appearance, because the wings are quite uniformly darker, almost mouse gray, with little or no clear whitish ground color showing. The male genitalia are similar except that only one of the two large dentate processes on the inner face of the valve is present in *ubiquitata*, the one near the base of the valve. In the female, the sterigma is slightly smaller. Separating *ubiquitata* from *sexpunctata* is more difficult because many specimens are superficially indistinguishable or nearly so. The forewing of *ubiquitata* is more likely to have an abrupt angle or outward bulge in the black-marked portion of its postmedial band near the costa, and to be less uniformly gray. The genitalia are obviously different from those of *sexpunctata* in both sexes, as illustrated. *Digrammia ubiquitata* has the widest distribution of the three species, ranging from Alaska and northern Manitoba to West Texas and Arizona, and it is generally the most common in collections.

Wings gray, with or without some variable whitish suffusion, but never with more white than gray or with the contrasting gray to gray-brown transverse bands on a nearly white background that distinguish *denticulata*. Forewing with usual three main transverse lines marked at costa by strong, wedge-shaped black spots; lines otherwise weak to obsolete except that outermost costal spot may be produced along postmedial line about halfway to inner margin, either as a contin-

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uous black band or a bar followed by one to three small spots; this black-banded or spotted portion of postmedial line nearly always distinctly angled or curved between R_5 and M_1 , distinguishing this species from the very similar *D. sexpunctata*, in which this band only slightly bent, sometimes nearly straight. Hindwing paler than forewing, mottled gray and whitish, with the two transverse lines usually present but weak, spaced about as in *denticulata* but not prominent, hardly denticulate. Fringes of both wings gray, with faint, diffuse, darker rays opposite veins; terminal line or shade negligible. Underside nearly white, heavily irrorated or suffused with brown, and ochreous tinted toward apex of forewing; forewing usually without contrasting dark shadow beyond postmedial and with postmedial angled as on upper-side; hindwing usually with three transverse lines like those of *denticulata* (commonly only one in *sexpunctata*). Head, body, and appendages about like those of *denticulata* and *sexpunctata* but light gray as in latter species, not nearly white as in *denticulata*. Wing length: holotype: 15.0 mm; other males: 13.0–16.0 mm; females: 12.5–15.0 mm.

Male genitalia (text figure 46 *e*) like those of *denticulata*, having the same large concavity between the costal and ventral lobes of the valve, but they appear to differ consistently in the absence of one of the two opposing dentate processes on the inner side of the valve. The basal one is present, but the outer one that arises near the base of the distal prolongation of the ventral lobe in *denticulata* is wanting in *ubiquitata*.

Female genitalia (text figure 47 *c*) much like those of *denticulata* but with the sterigma somewhat smaller in all dimensions; winglike lateral plates of sterigma noticeably less massive. Differences difficult to describe and best understood by reference to the figures. Sterigma of *sexpunctata* still further reduced.

Although this is a widespread and fairly common species, it apparently has never been reared, and the food plant is unknown.

TYPES. Holotype: ♂. Telluride, 8,745', San Miguel Co., Colorado; 27 June 1977; D. C. Ferguson. USNM. Paratypes: 47 ♂, 18 ♀. Colorado. Same locality and collector; 27 June–12 July 1977 (20 ♂, 10 ♀). 6 mi W of Telluride, 8,000', San Miguel County; 15 July 1977; D. C. Ferguson (5 ♂). Lizard Head Pass, 10,250', San Miguel County; 2 July 1977; D. C. Ferguson (2 ♂). Great Sand Dunes National Monument, 8,200', Alamosa County; 17 June, 22

June 1982; D. C. Ferguson (2 ♂). Zapata Ranch [near Great Sand Dunes Natl. Mon.], 7,900', Alamosa County; in [zone of] ponderosa pine-pinyon-juniper-cottonwood-aspen, 26 June 1982, and 8,200', in ponderosa pine-pinyon-juniper-Douglas-fir-willow, 23 June 1982; D. C. Ferguson (2 ♂). The Castles, 8,800', 8 mi E of Buena Vista, Chaffee County; in ponderosa pine-pinyon-juniper-cottonwood-aspen, 4 July 1982; D. C. Ferguson (1 ♂). Sangre de Cristo Mts., Custer County; [no date]; J. H. Baker (1 ♂). Estes Park, 7,800', Larimer County; 31 July 1967; A. & M. E. Blanchard (1 ♂). Utah. Major's Flat, 7,100', near Ephraim, Sanpete County; 8, 10 July 1980; 22 July, 3 August 1981; D. C. Ferguson (2 ♂, 3 ♀). Great Basin Experiment Station [U. S. Forest Service], 8,850', near Ephraim, Sanpete County; 10 July 1980; D. C. Ferguson (1 ♂). Ephraim Canyon, 6,000', Sanpete County; 23, 25 July 1981; D. C. Ferguson (3 ♀). Willow Cr. Rd., 7,500', nr Ephraim, Sanpete County; 6 July 1980; D. C. Ferguson (1 ♀). Nevada. Angel Creek, 7,000', E Humboldt Mts., SSW of Wells, Elko County; 18, 25 July 1971; D. C. Ferguson (1 ♂, 1 ♀). Oregon. Spring Creek, Baker [Blue Mts., ca. 4,000'], Baker County; 7 May–11 June 1959–70; J. H. Baker (9 ♂). USNM; a few paratypes will be distributed to other museums.

Digrammia ubiquitata occurs from northern Manitoba (Nelson River; Piquitenay River; Gillingham) and Alaska (Fort Yukon; Ramparts; Ketchikan), southward through British Columbia, Washington, Oregon, Idaho, Nevada, Colorado, Utah, to Inyo County, California, and the vicinity of Flagstaff and the White Mountains, Arizona. In Colorado, Utah, and Nevada this species occurs in the middle elevations between about 6,000' and 10,000'. In Utah it was collected in the oak-pinyon-juniper zone and also higher in the zone of aspen, fir, Douglas-fir, and spruce. In Colorado I found it in association with these same tree species and also with ponderosa pine and cottonwood. Its range spans the Transition and Canadian Zones and extends somewhat into the upper Sonoran Zone at lower levels and the Hudsonian Zone at upper levels. Its flight period is from mid-June to early August in the Rocky Mountain Region but begins much earlier and ends later in Washington and Oregon, where there may be two broods. Available dates for the Pacific Northwest: 15 April (Brewster, Washington)–5 September (Wenatchee, Washington). Of 45 specimens from Oregon and Washington, 24 were collected in May and June, four in April, and the rest in July and August except for the one record in September. *Digrammia ubiquitata* evidently flies in June and July in Canada, southern Alaska, in the Sierra Nevada, California, and northern Arizona.

Digrammia denticulata (Grote)

PL. 6, FIGS. 27–29 (adult); TEXT FIG. 46 *f, g* (♂ gen.); TEXT FIG. 47 *d* (♀ gen.) (RWH 6373, part).

Semiothisa denticulata Grote, 1883, *Can. Ent.*, **15**: 133.

Type locality: California. [USNM]

NOTE—Described from one female specimen, which is clearly this northern species with extensive white ground color and gray bands. It matches specimens from western Canada and the northern prairie regions of the United States, and there remains some doubt about the type locality. Authentic Californian records are few, but I did find a specimen in the Canadian National Collection labeled Greenville [Plumas County].

Digrammia denticulata stands out among members of this group because it is the palest, with an almost pure white ground color. It has the usual dark transverse lines, three on the forewing and two on the hindwing, often weakly developed, those on the forewing usually forming three blackish spots at the costa. Shading beyond the postmedial of the forewing forms a gray band most of the way across the wing, and this is repeated more narrowly as a gray or gray-brown outer-marginal band on both wings. A thin, black, terminal line combines with dark rays in the fringe to give the illusion of a finely scalloped outer margin, especially on the hindwing, which probably inspired the name *denticulata*. When well developed in the usual way, the gray shading beyond the postmedial of the forewing is diagnostic.

Most specimens of this species should be recognized easily by their appearance, and little additional description is needed. A few of the palest examples of *ubiquitata* may be hard to separate from *denticulata*, and in such cases the genitalia should be examined. Denticulate terminal line and fringe markings on hindwing or both wings of *denticulata* better developed than in related species and characteristic. Underside heavily irrorated with brown scales and becoming ochraceous toward costa on both wings and toward apex of forewing. Hindwing with three transverse lines instead of two on undersurface, these being medial, postmedial, and subterminal instead of antemedial, medial, and postmedial as on upper-surface. Body, collar, vertex, and front pale gray; palpi, lateral edge of front, and scales immediately behind eye reddish brown, a pattern found also

in the *eremiata*-group and elsewhere in *Digrammia*; legs pale yellowish brown, variably speckled with darker brown. Male antenna ciliate, with length of setae slightly less than thickness of shaft; female antenna filiform with very short setae. Front not raised but with usual crest of scales on lower margin. Palpi of both sexes surpassing front slightly. In male, pecten on the third abdominal sternum well developed, and hindtibia swollen in usual way. Wing length: males, 12.0–15.0 mm (n = 70); females, 13.0–14.5 mm (n = 21).

Male genitalia (text figure 46 *f, g*) like those of *ubiquitata*, with similar, large, ovate depression on inner face of valve in zone between costal and ventral lobe; however, *denticulata* differs in having two sharp, dentate processes, one near base of ventral lobe and the other arising near base of distal process on same lobe. *Digrammia ubiquitata* has only the basal process well developed, with distal one vestigial or obsolete.

Female genitalia hardly differing from those of *ubiquitata*, with similarly shaped winglike flanges on sterigma. However, the mesial papilla surmounting ostial opening is usually about twice as large as that of *ubiquitata*.

The food plant of *denticulata* is not known. McGuffin (1972: 34) briefly described the egg and first instar larva but did not rear it, presumably because he did not find the food plant.

This species has a wide distribution from Ontario, northern New York, and the northern Midwest almost to the Pacific Coast. It has been collected as far east as Chaumont (3-mile Creek Road), Jefferson County, New York and Thunder Bay, Ontario, and as far north as Smoky Falls, Mattagami River, Ontario; Gillam, Manitoba; Yellowknife (on Great Slave Lake), and Fort Simpson, Northwest Territories; and Whitehorse and Dawson, Yukon. In the United States there are scattered midwestern records from Indiana Dunes State Park, Indiana; the vicinity of Chicago and in Putnam County, Illinois; and Atchison County, Missouri. Westward it extends across the Great Plains to Alberta; Montana; the vicinity of Denver, and Washington and Yuma counties, Colorado; and as far south as Pottawatomie County, Kansas. Although not seen from the intervening regions, it reappears in Washington, Oregon, and in Plumas County, California (CNC), judging from collections examined.

Published records without illustrations or supporting specimens are of little value because of past confusion of *ubiquitata* with *sempunctata*,

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both of which were included in *denticulata* by previous authors. For example, of those figured by McGuffin (1972, fig. 93), from British Columbia, is almost certainly a specimen of *ubiquitata*, but figure 94, from Alberta, represents *denticulata*. *Digrammia denticulata* may overlap with *ubiquitata* throughout most of its range from Colorado to Manitoba and the Yukon, but less so with *sexpunctata*, which is known only from the intermountain region.

Records for *denticulata* show a wide range of dates from May to August, even in the Canadian Prairie Provinces, and this probably represents two broods. Many scattered records for June, July, and well into late August suggest that each brood may have a wide emergence latitude, varying with local weather conditions and making the separate flight periods difficult to distinguish. Records by region fit the following extended periods: New York, 18 June, 6 August; Ontario, 11 May–21 August; Manitoba, 22 May–11 August (mostly in June); Saskatchewan, Alberta, 12 May–28 August; Northwest Territories, Yukon records for June, July, August; Indiana, Illinois, Iowa, 29 April–20 September, with a possible division into generations of 29 April–13 July (last specimen worn) and 29 June (fresh)–20 September (worn); Great Plains from North Dakota to Kansas, 27 May–9 July; California, 22 August. I examined 240 specimens, mostly from the Prairie Provinces, the Dakotas, and Nebraska.

The *nubiculata*-GROUP

The species of this western assemblage [*pictipennata*, *terramalata*, *nubiculata*, *palodurata*, and *curvata*, ed.] are somewhat smaller than most and of less robust build. The moths are diverse in appearance but so uniform structurally that I illustrate the male genitalia of only one species. The male genitalia closely resemble those of *D. californiaria* except for the presence of a digitiform process on the aedeagus. One species, *curvata*, has bold black transverse bands of the forewing and is often mistaken for a member of the *continuata*-group. Two of the five species are new. The known hosts are *Chrysothamnus* and *Stenotopsis*, both Asteraceae.

Digrammia pictipennata (Hulst)

PL. 6, FIGS. 30–32 (adult); TEXT FIG. 48 f (♀ gen.) (RWH 6372).

Macaria pictipennata Hulst, 1898, *Can. Ent.*, **30**: 162.

Type locality: Prescott, Arizona. [USNM]

NOTE—Described from an unspecified number of syntypes from “Prescott and Senator, Ariz.; from Dr. Kunze. Taken July 1st, and Sept. 1st to Sept. 9th, 1896.” Of three specimens found that bear the usual red-bordered Hulst type labels, one female from Senator is in the AMNH, and one male from Prescott, Sept. 1, and one female from Senator, July 13, are in the USNM. I designate as lectotype the male from Prescott in the USNM, as its collection date, Sept. 1, is one of the dates indicated in the original description. Hulst is known sometimes to have affixed type labels to specimens not included in the type series (Rindge, 1955: 96), and the female labeled July 13 may be one of them. Although not well spread, the lectotype is in good condition and clearly recognizable as the present species.

This is a light gray southwestern species with whitish ground color, variably dusted with dark gray-brown scales and, on the forewing, a faint antemedial line, obsolete medial line, and relatively prominent postmedial line that is strongly emphasized by diffuse dark shading on both sides for all or much of its length. Blackish wedges mark the points at which the principal lines meet the costa, and the postmedial is only slightly angled toward the costa. The gray coloring of this species is characterized by a faintly bluish or purplish tint, most evident in fresh specimens and especially in reared ones. This characteristically variegated, somewhat spotted bluish-gray appearance, with the gently curved to nearly straight postmedial line and its associated, often conspicuous, transverse band of diffuse, irregular, dark shading usually provide the clues needed for recognition of this species. The genitalia hardly differ from those of other species in the group, although there are tendencies toward differently shaped components in the sterigma of the female.

Antennae, palpi, and legs as in closely related species. Forewing whitish to pale bluish gray, dusted with darker scales; antemedial line weak, convex or at least turning in near costa; medial line fragmentary or wanting; postmedial line usually fragmented but emphasized by usual black thickening opposite discal cell; all three lines marked by black, wedge-shaped spots where they meet costa; postmedial line thinly edged with white distally and shaded with black on both sides, especially on distal side where blackish shading forms a variable, diffuse, dark band in

proximal half of subterminal space. This dark band may intensify to form a still darker patch distad of discal cell and again on approaching costa, where it may form a subapical patch. Hindwing mottled gray, almost unmarked. Underside finely mottled gray brown, sometimes slightly darker beyond position of postmedial lines, almost unmarked. Wing length: males, 12–14 mm; females, 11–15 mm. Moths average small in the warm months, larger in November–March.

Male genitalia probably not distinguishable from those of *nubiculata*, having the small dentate process in the middle of the valve near its base, which is obsolescent in *curvata*.

Female genitalia as shown (text figure 48 f), but it should be noted that the sterigma is unusually variable, showing range of differences that would be considered characteristic of different species in other groups. The winglike posterolateral processes especially variable in size, from about one-fourth to at least one-half the length of the anterior apophyses. Sclerotized knob or papilla surmounting ostial opening also varies proportionately in size and shape from small and bluntly conical to large and broadly rounded. All degrees of variation may be seen in material from one region, such as Arizona (6 dissections examined).

This species was reared from larvae on *Stenotopsis linearifolius* (DC.) Rydb. (Asteraceae) at Riverside, California on 2 April 1948, by C. Henne (LACM). No description of the larva is available.

Digrammia pictipennata has a more southern distribution than its widespread relatives, *curvata* and *nubiculata*, occurring in arid regions from Big Bend National Park, the Guadalupe Mountains, and El Paso, Texas to San Diego, California, and northward to Sanpete County, Utah, Clark and Elko counties, Nevada, and Marin, Solano, Mariposa, Stanislaus, Tulare, Mono, and Inyo counties, California. It is widespread in New Mexico, but there is only one Colorado record, an old specimen from Glenwood Springs. It extends southward into Baja California. Most material in collections is from Arizona and California.

The collection dates for Arizona include every month of the year except December and January, but in southern California it has been taken throughout the winter months and may breed continuously. Toward the northern periphery of its

range in Utah and Nevada, dates in May, June, and August indicate two broods. I have seen few specimens from West Texas, but those records are for March and May.

Digrammia terramalata Ferguson, NEW SPECIES

PL. 6, FIGS. 33, 34 (adult); TEXT FIG. 48 e (♀ gen.).

Type locality: Big Buffalo Creek [White River Badlands], N of Cedar Pass, Jackson County, South Dakota. [USNM]

This is an elusive, easily overlooked species known from only nine specimens from the South Dakota Badlands, the vicinity of Fort Collins, Colorado, and the Chisos Mountains, Texas. What may be seen of the obscure pattern suggests a relationship to *pictipennata*, although the mottled pale brown coloring of *terramalata* is very different. Not much can be expected of the genitalia, which are remarkably similar in all five species of this group, but the male of *terramalata* has an especially prominent ridge on the valve toward the distal end of the outer margin of the ventral lobe; and the female has the winglike processes of the sterigma unusually extended. Although the genitalia are unlike those of any of the willow feeders, the moths could be confused with those of *indeterminata*, except that they lack the foretibial spine.

Antennae, eyes, palpi, and legs as in other members of the group, except that male antennal setae are about equal in length to thickness of antennal shaft, shorter than those of *pictipennata*, which are distinctly longer than thickness of shaft. Ground color of wings light yellowish brown, dusted and marked with somewhat darker, gray-brown scales. Forewing of holotype marked like that of *pictipennata* but with little contrast; antemedial, medial, and postmedial lines present, along with reduced, dark brown, wedge-shaped spots marking their intersections with costa, but all such markings obsolescent in other specimens; rounded, dark brown spot in subterminal area opposite discal cell also present in holotype and faintly so in two other specimens; terminal line a series of thin, dark dashes, each thinly bordered distally with yellowish white; fringes pale grayish white, diffusely checkered with brown. Hindwing similarly colored but almost unmarked, except for traces of postmedial line where it meets inner margin. Underside light, finely mottled gray

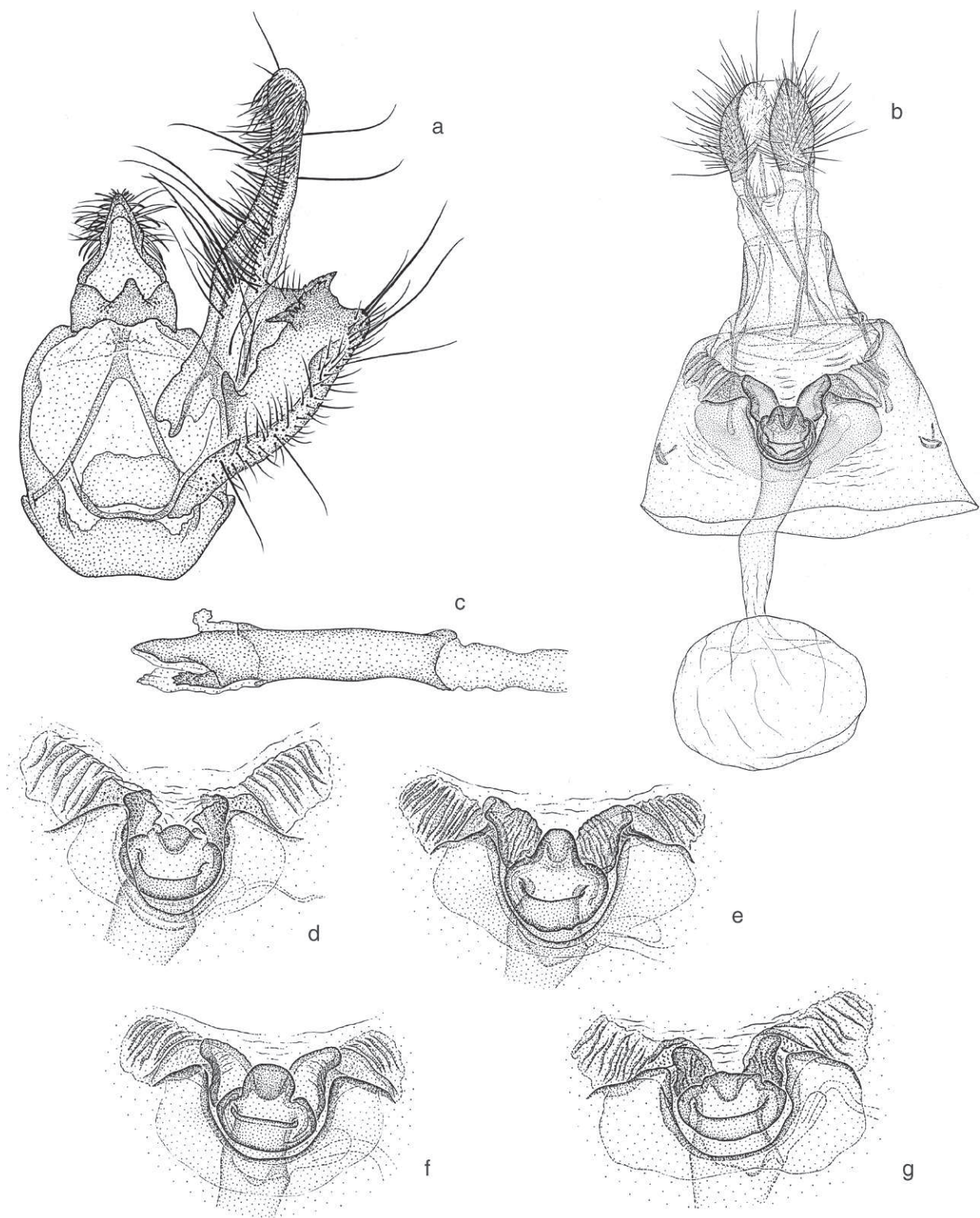


FIGURE 48: GENITALIA OF *DIGRAMMIA* SPECIES

a. D. curvata, male genital capsule; Cave Creek Canyon, Cochise County, Arizona (DCF 1598). *b. D. nubiculata*, female; Alamosa County, Colorado (USNM 57325). *c. D. curvata*, aedeagus; Cave Creek Canyon, Cochise County, Arizona (DCF 1598). *d. D. palodurata*, S8, ostium bursae and ductus bursae; Palo Duro Canyon, Randall County, Texas (USNM 57310). *e. D. terramalata*, S8, ostium bursae and ductus bursae; Jackson County, South Dakota (USNM 53427). *f. D. pictipennata*, S8, ostium bursae and ductus bursae; Walnut Canyon, Coconino County, Arizona (USNM 53279). *g. D. curvata*, S8, ostium bursae and ductus bursae; Walla Walla, Walla Walla County, Washington (USNM 53266).

brown; inner two-thirds of hindwing paler, with white ground color; small discal spot present on each wing. Wing length: holotype, 12.0 mm; other males, 12.0 mm; females, 11.5–13.0 mm.

Male genitalia probably indistinguishable from those of *pictipennata*, except that thickened ventral rim of ventral lobe of valve has, toward its outer end, an obtusely triangular, raised, flange-like prominence. This may be rudimentary but is not as well developed in any other species. A similar prominence may be present in reduced form in *palodurata*, however.

Female genitalia (text figure 48 *e*) also like those of *pictipennata* but with posterolateral, winglike lobes of sterigma better developed, longer, and more prominently recurved apically.

The early stages and foodplant are unknown.

TYPES. Holotype: ♂. USNM. Big Buffalo Creek, N of Cedar Pass, Jackson County, South Dakota; 8 July 1964; D. C. Ferguson. Paratypes (4 ♂, 4 ♀). South Dakota. Same data as for holotype (1 ♂, 3 ♀). Colorado. 5100 Greenwood Crescent, Fort Collins, Larimer County; 8 May 1989; P. A. Opler (1 ♂). Mail Creek, Fort Collins, Larimer County; 1 September 1989; P. A. Opler (1 ♂, 1 ♀). Texas. Panther Pass, Chisos Mountains, 6,000', Brewster County; 4 June 1973; D. C. Ferguson (1 ♂). CSUC, USNM.

The type locality was in open, rough, eroded, badlands prairie, with some grass, forbs, and shrubbery but without trees, at a place where natural pits and embankments provided my collecting lights and sheets with shelter from the wind. This was on a secondary, then unpaved road, a few miles north of the park headquarters at Cedar Pass and probably just outside the boundary of Badlands National Monument. The Texas locality was near the highest point on the well-traveled road from the Big Bend National Park Headquarters to the Chisos Mountains Basin, just before it descends into the Basin, and up and over the ridge off to the right side of the road where the collecting lights could not be seen from the road. This site is at or near the head of Green Gulch.

Digrammia nubiculata (Packard)

PL. 6, FIGS. 35–37 (adult); TEXT FIG. 48 *b* (♀ gen.) (RWH 6371).

Phasiane nubiculata Packard, 1876, Monograph of the Geometrid Moths or Phalaeni-

dae of the U. S., in F.V. Hayden, *Rept. Geol. Surv. Terr.*, **10**: 267, pl. 13, fig. 45.

Type locality: “Bridger, Wyoming, July 20 (Packard, Hayden’s Survey).” [MCZ]

NOTE—Described from two females, one of which, without locality label, survives intact in the MCZ, and the other, a female from Colorado labeled as a type, in the USNM. The latter specimen, although undoubtedly the same species and labeled Colorado, does not agree well with Packard’s description or illustration and may be a spurious type. It came to the USNM by way of the Brooklyn Museum, and bears a handwritten and a red, printed USNM type label. As with many early specimens, the handwritten label may have been added subsequent to the description. I hereby designate the female in the MCZ as the lectotype because it is more likely to be authentic. Should it be that the USNM specimen is a true type, then the lectotype would be the one from Bridger, Wyoming.

This is a slightly smaller than average, gray, western species in which the wings appear as though heavily dusted with darker scales and the forewing has three or four regular, subparallel, transverse lines. The lines are not boldly defined with black like those of *curvata*, but are obvious enough to be a distinctive feature of most specimens and of the species. The absence of conspicuous, dark, forewing bands or patches aids in separating *nubiculata* from *curvata*, *pictipennata*, and from the vaguely similar *excurvata*, and its gray, multilined aspect distinguishes it from the two other members of the present group, namely the light brown, obscurely marked and more localized *palodurata* and *terramalata*. It is a species of dry mountain slopes and canyons from the Rockies to the eastern slopes of the Sierras and Cascades and is often abundant where found.

Structure of antennae, palpi, legs., etc. as in other members of this species group. Forewing whitish, dusted with darker scales so as to appear gray, except for whitish band in outer half of subterminal space; forewing crossed by thin, dark, faintly whitish-bordered antemedial, medial, and postmedial lines that may be diffuse or interrupted but never wide like those of *curvata*, and an apparent subterminal line that is the interface between the darker proximal half and pale distal half of subterminal space; lines subparallel, almost equally spaced, straight to gently curved; postmedial not or hardly incurved toward costa, unlike that of *curvata*; usually without black, wedge-shaped spots where forewing lines meet

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costa, although weak, blackish thickening of postmedial may be present at its usual position opposite discal cell, reflected distally by another small, dark patch in subterminal area; dark band of subterminal area also intensified toward costa in some specimens. Hindwing brownish, diffuse, hardly marked except for a very reduced repetition of black-and-white forewing coloring toward inner margin. Underside of both wings gray brown, with some whitish scaling and a suggestion of banding and faint discal spots but almost unmarked. Wing length: males, 12–14 mm; females, 10–14 mm. Females average smaller than males.

Male genitalia hardly differing from those of the four other members of this species-group. Bidentate, fusiform armature transversely attached to outer margin of ventral lobe of valve well developed but not noticeably serrated as in *curvata* and *palodurata*. Small dentate process arising near middle of valve toward base clearly present, as in *pictipennata* and *terramalata*, and raised ridge near ventral margin of ventral lobe nearly as well developed as in *terramalata* (obsolescent in other species of group).

Female genitalia (text figure 48 *b*) with posterolateral winglike processes of sterigma, as well as their associated integumental folds and sclerites, tending to be well developed for the group, but it should be noted that these are variable in all species. Lip or collar encircling ostium better sclerotized than in all others of the group except *curvata*.

This species was reared from larvae on rabbit-brush, *Chrysothamnus* sp. (Asteraceae), by B. Scaccia and voucher specimens deposited in the USNM.

Digrammia nubiculata is primarily a Great Basin and Rocky Mountain species but occurs from southern British Columbia (Arrowhead Lake), Idaho, and Montana to Mono County, California, Nevada, Wyoming, Colorado, Utah, northern Arizona, and Frijoles Canyon, New Mexico. It extends at least as far west as Yakima, Washington and Klamath Falls, Oregon and is present in Modoc, Lassen, and Siskiyou counties, California but apparently not west of the Cascades nor the crest of the Sierras; and it does not occur anywhere east of the eastern Rocky Mountains foothills. I have seen it from Albany and Platte counties, Wyoming. It may be double or triple brooded, with records for every month from April to late September as far north as Washington, and

28 April–11 August in Colorado and Wyoming. I found it commonly at various localities between 7,000 and 9,600 feet in central Colorado in late June and early July, and between 7,000 and 8,200 feet in Elko County, Nevada in July, and thought at the time that it might have only one generation at those elevations. However, it has been collected at similar elevations in Lander County, Nevada as early as 31 May; in Mono County, California as early as 10 May, and in Sweetgrass County, Montana as late as 17 August; elsewhere to 30 August.

Digrammia palodurata Ferguson, NEW SPECIES

PL. 6, FIG. 38 (adult); TEXT FIG. 48 *d* (♀ gen.).

Digrammia palodurata Ferguson.

Type locality: Palo Duro Canyon, Randall County, Texas. [USNM]

This species appears most closely related to *nubiculata*, but its uniform, light brown coloring and loss of nearly all markings result in a very different appearance. It is known from only a few specimens collected at the type locality by E. C. Knudson.

Male antenna, like that of *nubiculata*, with long setae that may be nearly twice as long as thickness of shaft; similarly also, palpi short in both sexes, not or hardly exceeding front, and male hindtibia less than twice length of hindtarsus. Forewing brown, uniformly colored, although finely mottled or variegated, showing only faint, dark, discal spot and traces of postmedial line; faint traces of all three main forewing lines may be visible near inner margin and costa, but otherwise mostly obscured; terminal line a series of brown dashes bordered with white distally, and fringes pale gray brown checkered with darker brown. Hindwing somewhat paler than forewing, especially toward costa, almost unmarked. Undersurfaces of wings colored like uppersurfaces but slightly paler, almost devoid of markings. Wing length: holotype, 13.0 mm; other males (*n* = 2), 12.5–13.0 mm; females (*n* = 2), 12.0–12.5 mm.

Male genitalia not differing from those of *nubiculata* except for possible tendency for ventral rim of ventral lobe of valve to form a slightly more elevated ridge toward its distal end.

Female genitalia (text figure 48 *d*) similar to those of *curvata* in reduced, almost aborted wings

of sterigma and reduced integumental folds, but resembling those of *pictipennata* and *terramalata* in more lightly sclerotized lip encircling ostium.

The early stages and food plant are unknown.

TYPES. Holotype: ♂. USNM. Palo Duro Canyon, Randall County; 9 May 1981; E. C. Knudson. Paratypes: 2 ♂, 2 ♀. Same data as for holotype. ECK, USNM.

Digrammia curvata (Grote)

PL. 6, FIGS. 39–41 (adult); TEXT FIG. 48 *a*, *c* (♂ gen.); TEXT FIG. 48 *g* (♀ gen.) (RWH 6370).

Phasiane curvata Grote, 1880, *Bull. Brooklyn Ent. Soc.*, 3: 47.

Type locality: “Nevada and Colorado. Dr. Bailey and Mr. Neumögen.” [USNM]

NOTE—The syntype from the Neumögen collection is a male in very good condition in the collection of the USNM. It bears a Grote type label but is without locality information. I designate this specimen as the lectotype, and it is so labeled.

Phasiane cruciata Grote, 1883, *Ann. Mag. Nat. Hist.*, ser. 5, 11: 55.

Type locality: New Mexico. [Type not located]

Digrammia curvata closely resembles species of the *D. continuata*-group and has often been confused with them. However, the larva feeds on rabbit-brush, not juniper, and by both host association and anatomical structure, the species is clearly allied to the group that includes *nubiculata* and *pictipennata*. It is most easily distinguished from similarly black-banded juniper-feeding species by the nature of the antemedial band of the forewing, which nearly always ends abruptly well before reaching the costa. It is widespread west of the Great Plains from British Columbia to the Mexican border.

Antennae, palpi, legs, and body as in the most closely related species except that male front is less protuberant than that of some other species, such as *nubiculata*, being almost flush with eyes in profile. Wings whitish to gray, finely sprinkled with darker gray. Forewing with antemedial and postmedial lines in part heavily outlined with black bands, beginning at inner margin but ending or weakening toward costa. Antemedial band a short black bar, inclined outward from inner margin and nearly always abruptly ending about one-third of its length short of costa; postmedial evenly concave and boldly defined for most of its

length, bending basad and weakening toward costa, thus feebly S-shaped in form; both black bands thinly bordered with white or yellow on side facing away from median space; incomplete dark median band present or absent, strongest at inner margin, often convergent with antemedial band near middle of wing; outer third of wing beyond postmedial divided between dark gray to gray-brown proximal half and light gray distal half. Hindwing with whitish ground color mostly obscured by heavy gray-brown irroration; fragments of medial or postmedial bands often present at inner margins. Both wings with thin, broken, black terminal line and faintly dark checkered fringes. Underside heavily dusted with darker scales and with dark subterminal band and concave postmedial band of forewing showing through with much reduced intensity, and with dark or dark and light shaded subterminal band following curve of outer margin on hindwing. Wing length: males, 12.5–15.0 mm; females, 11.0–15.5 mm.

Male genitalia (text figure 48 *a*, *c*) nearly indistinguishable from those of the other four species in this closely knit group.

Female genitalia (text figure 48 *g*) may be recognized by the weakly sclerotized, divergent, winglike posterolateral process of sterigma. These are quite large and have same basic form as those of *pictipennata* and *terramalata*, but have appearance of being only about half sclerotized. Also, ductus bursae is longest of the five species, extending for about two-thirds of its length cephalad of anterior margin of seventh segment, as opposed to hardly more than half its length in the other species.

This species varies locally in size and degree of brownish coloring but with no obvious geographical trends in those features. Specimens from southern California are light gray and have the black markings unusually bold and contrasting. Many specimens from Colorado and northern Arizona have a slight brownish tint; whereas those from Montana, Wyoming, and Utah have the normal grayer coloring typical of the Pacific Coast region. The most distinctive form occurs in Cochise and Santa Cruz counties, southern Arizona, where the wings are somewhat darkened and granulated, and all blackish markings are reduced, often lost entirely. I had thought that this might be a species but can see no structural differences.

The food plant was first reported by Mc-

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Dunnough (1927: 245), who reared one female adult from a "pale green larva found feeding on rabbit-brush (*Chrysothamnus* [Asteraceae])" in British Columbia. Several were reared in Oregon from larvae on *Chrysothamnus nauseosus* (Pall. ex Pursh) Britton (J. C. Miller, Oregon State Univ.); in Los Angeles and San Bernardino counties, California from larvae on *Chrysothamnus nauseosus mojavensis* (Greene) H. M. Hall & Clem. (C. Henne coll., LACM); from *Chrysothamnus* in Los Angeles County, California (B. Scaccia); from *Chrysothamnus* sp. near Sierra Vista, Cochise County, Arizona (N. McFarland); from *C. nauseosus hololeucus* (Gray) H. M. Hall & Clem. near Flagstaff, Arizona (G.W. Fernandez, Dept. Biol. Sci., N. Ariz. Univ.); and from a "desert composite" (CUIC Coll.).

The rearing by McFarland represents the southern Arizona form with reduced markings. The site was about 16 miles south of Sierra Vista at 4,900 feet. Larvae of all sizes were beaten from the rabbit-brush on 20 August 1984, and those that were mature yielded adults in early September.

Digrammia curvata occurs from southern British Columbia and Montana to southern California and northern Baja California, Arizona, and New Mexico, and at least as far east as Denver, Colorado and the Wyoming side of the Black Hills (Weston County). I have not seen it from Texas. It is often locally common when found. As with so many species, the dates indicate one brood northward and at least two southward. Mostly the flight period is in June and July northward, although there are records for as early as 18 May in Oregon, 29 May in Inyo County, California and as late as 27 August in Montana, which suggest more than one brood in those regions. In southern California it flies in February and March and at intervals later in the season. In the Arizona-New Mexico region it has been collected in April, June, July, August, September, and October.

The *pallidata*-GROUP

This is a group of two western juniper-feeding species, *pallidata* and *triviata*. They are gray with reduced black markings, mainly lacking the conspicuous black transverse bands associated with the antemedial and postmedial lines of the forewing, except in *triviata*, where they are spots at the costa. The male genitalia are characterized by a large, elevated, subtriangular, sclerotic ridge

longitudinally on the inner face of the saccular lobe. This rises to a point near the middle, but is not serrated or only slightly so. Also, they lack the digitiform process on the aedeagus characteristic of the *continuata*-group. These two species could have been considered members of the *continuata*-group were it not for the absence of the digitiform process.

Digrammia pallidata (Packard)

PL. 6, FIGS. 42–45 (adult); TEXT FIG. 49 *a* (♂ gen.) (RWH 6384, 6410).

Macaria pallidata Packard, 1873, *Ann. Rept. Peabody Acad. Sci.*, 5: 64.

Type locality: Texas. [MCZ]

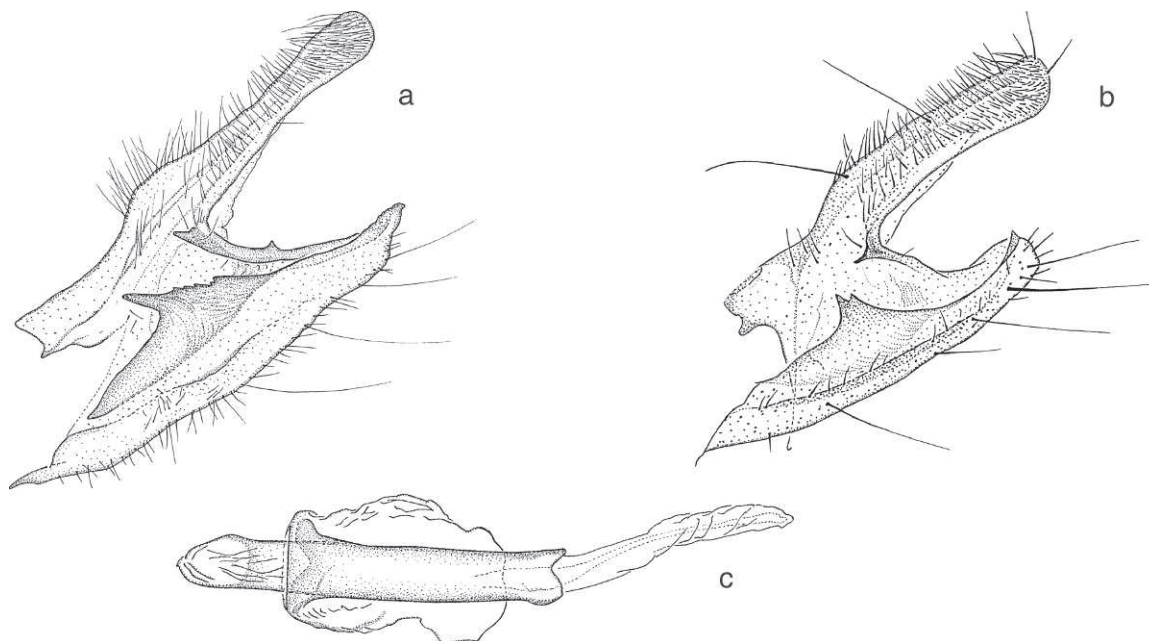
NOTE—Described from what Packard said was one male collected by Belfrage. It is probably from Bosque County, but this is uncertain because Belfrage also collected elsewhere in Texas (Geiser, 1933). The specimen labeled as the type in what appears to be Packard's handwriting is a female, not a male, and has lost both forewings. The female genitalia (Slide DCF 1541) clearly identify it as the present species. Either Packard mistook it for a male, or it is a pseudotype. I refrain from designating this specimen as the lectotype in case a male type is found.

Macaria azureata Cassino, 1928, *The Lepidopterist*, 5: 4, NEW SYNONYMY.

Type locality: Jemez Springs, New Mexico. [MCZ]

NOTE—The holotype of *azureata* represents one of the several nondescript gray species that cannot be identified with certainty except by the genitalia, and Cassino's slide #3346 of the holotype cannot now be found. However, McDunnough (1945: 66) wrote of having seen the specimen and the slide and remarked that "the harpe [is] a large, triangular projection in the center of the clasper [valve]." This could fit either *Digrammia pallidata* or *D. triviata*, but *azureata* lacks the characteristic dark costal spots of *triviata* and almost certainly is the same species as *pallidata*. *Digrammia pallidata* has not recently been reported from New Mexico but could well occur there. I agree with McDunnough that the wings of *azureata* are of the usual gray color, certainly not "light blue or azure" as specified in the original description (McDunnough concluded that Cassino was color blind).

Digrammia pallidata has been misunderstood since the time of Packard, with the name being applied almost randomly in collections to any species of this nondescript appearance, often to

FIGURE 49: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. *D. pallidata*, right valva; Laguna Park, Bosque County, Texas (AB 5017). b. *D. triviata*, right valva; Elko County, Nevada (USNM 52953). c. *D. triviata*, aedeagus; Walnut Canyon, Coconino County, Arizona (USNM 52954).

Rindgea parcata or *R. disparcata*. When I dissected the holotype it became clear that *pallidata* is the gray, seasonably variable, juniper-feeding species that is locally common in East Texas and Oklahoma, less common northward in the Midwest as far as southwestern Wisconsin. This species was usually mistaken for *D. pervolata* or *D. californiaria*, or *R. parcata*, and indeed many specimens superficially can hardly be separated from *pervolata*. However, *pallidata* may not be sympatric with either *pervolata* or *californiaria*, being more eastern. Its affinity is more with the juniper feeders of the *continuata*-group, and it is most closely related to *D. triviata*, as revealed by the similar genitalia.

Digrammia pallidata is not unlike *triviata* but is often larger and more variable, from plain, pale gray with a few small dark spots to well marked with the transverse lines apparent and a heavy sprinkling of dark scales.

The spring form (March–May; plate 6, figures 43–45) is almost uniformly, finely mottled gray on both wings, with the usual three black costal spots marking the ends of the otherwise indistinct or fragmented transverse lines of the forewing. A dark smudge or trio of dark dots around the junction of M_1 and the postmedial line may be present or absent. The outer third of the wings in this

form is not or only slightly darker than the other two-thirds. The underside usually has no markings other than the discal spots. Wing length of spring form: males, 12–14 mm; females, 13–16 mm.

The summer form (June–October; plate 6, figure 42) is usually smaller and more heavily sprinkled or mottled with dark scales, often has distinct dark transverse lines on both wings, and may have the outer third of both wings darker, especially on the underside. Wing length of summer form: males, 10–11 mm; females, 12–13 mm.

The male genitalia (text figure 49 a) hardly differ from those of *D. triviata*. The only apparent difference is in the nature of the bladelike, partly serrate, mesial ridge that runs from base to apex on the inner face of the saccular lobe of the valve. In *D. pallidata* this is more consistently complete distally, where it continues in a much reduced form all the way to the apex. In *D. triviata* this ridge more often becomes obsolescent before reaching the apex. However, both species may show either condition. The female genitalia do not differ from those of *triviata*.

Digrammia pallidata apparently has never been reared, and the food plant is not known. However, its close relationship to *triviata* sug-

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gests that it should be a juniper feeder; and its larva would be expected to resemble that of *triviata*.

This species occurs in central East Texas, apparently not much south of the latitude of San Antonio, and west to Uvalde, Kerr, Kimble, San Saba, Lampasas, and Brown counties. It occurs northward through Oklahoma (Sequoyah, Murray, and Comanche counties) (D. R. Davis); Arkansas (Eureka Springs, Carroll County); Missouri (Roaring River State Park, Barry County) (J. R. Heitzman); Cedar Point Biol. Sta., 8 mi N of Ogallala, Keith County, Nebraska (E. Quinter); and several were taken in Nelson Dewey State Park, Grant County, Wisconsin (G. Balogh), about 20 miles up the Mississippi from Dubuque, Iowa.

Digrammia pallidata flies continuously from March to October in Texas. Although most specimens seen were collected in the spring months, this may only reflect greater collecting activity at that season. In Oklahoma, Arkansas, Missouri, and Nebraska it was collected in May, June, July, and August. A series of 37 collected in Keith County, Nebraska in mid-July appear to be of the smaller, summer generation. The Wisconsin specimens were collected in late June.

Digrammia triviata (Barnes and McDunnough)

PL. 6, FIGS. 46–49 (adult); PL. 14, FIGS. 1–3 (larva); TEXT FIG. 49 *b, c* (♂ gen.) (RWH 6385, 6388).

Phasiane triviata Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, **3**: 233; pl. 23, fig. 1.

Type locality: Chiricahua Mountains, Arizona. [USNM]

NOTE—Described from seven syntypes from the Chiricahua Mountains, Huachuca Mountains, and Paradise, Arizona. I designate as lectotype the specimen labeled by McDunnough as the Type male.

Phasiane woodgateata Cassino, 1928, *The Lepidopterist*, **5**: 2. NEW SYNONYMY.

Type locality: Jemez Springs, New Mexico. [MCZ]

NOTE—Cassino described *woodgateata* from one male, which is clearly a small specimen of *Digrammia triviata*. However, the male genitalia on Cassino slide No. 4243, the number corresponding to that on the specimen label, are those of *Macaria minorata* (Packard). The body of the holotype of *woodgateata*

is covered with dried glue, which suggests that it may have been repaired with the wrong abdomen before the slide was made.

Digrammia triviata is a widely distributed, western, juniper-feeding gray species with three black spots or bars marking the transverse lines at the costa of the forewing. Otherwise the transverse lines are weak, although often apparent, and the outer third of the forewing is usually somewhat darker than the remainder of the wing. However, it is geographically and seasonally variable, and southern spring specimens, especially in West Texas, may have a uniformly gray forewing with three costal spots but no lines. The species is closely related and quite similar to *D. pallidata*, although their distributions do not overlap broadly. *Digrammia pallidata* usually has a more granulated background color and often has a more complete pattern, and it has at least a remnant of the usual dark forewing patch around the intersection of the postmedial line and vein M_1 typical of so many species of Macariini but lacking in *triviata*. *Digrammia triviata* is more likely to be confused with the superficially similar but not closely related *D. delectata*. The latter is a uniformly lighter gray, with obsolescent transverse lines and a light rust border of scales behind the eye that is dark chocolate brown or speckled with dark brown in *triviata*.

Throughout the Rocky Mountain region, from British Columbia and Montana to Arizona and New Mexico, the moths are mostly quite uniform in appearance, medium to small, fairly dark and well marked, and with the outer third of the forewing usually a darker shade of gray. Several specimens from the East Humboldt Mountains, Elko County, Nevada are an exception, being unusually pale and uniformly gray. Many from southern Arizona and the Davis Mountains, Texas are large, uniformly gray and almost immaculate except for the black costal markings. These moths are spring specimens collected in March and April where the species is bivoltine. As far as I could determine, second brood specimens collected in July and August in Texas and southern Arizona are smaller and darker, like northern ones; and it is likely that this seasonal variation occurs wherever *triviata* is bivoltine. The sexes are alike. Wing length throughout most of the range: males, 11–14 mm; females, 12–15 mm; spring brood in Arizona, Texas: males, 13–16 mm; females, 15–16 mm.

The male genitalia (text figure 49 *b, c*) hardly differ from those of *D. pallidata*. The only feature that approaches consistency is in the nature of the bladelike, centrally raised and serrated ridge on the inner face of the saccular lobe of the valve. In *triviata* this ridge is most often short, not extended to the apex, except sometimes as a fine, threadlike line. In *pallidata* the ridge is more likely to extend from the base of the valve to the apex of the saccular lobe, and the apex is more likely to be extended and pointed, although anything from a blunt, rounded apex to a pointed one can occur in either species. There seem to be no consistent differences in the female genitalia. The ostium bursae lies between two opposing, stout, valvelike sclerites that are outwardly rounded, inwardly concave.

Last instar larva with ground color green or brown (most brown), with the usual series of oblique white, brown, and black lateral segmental markings, each marking of the series becoming pale brown or tan ventrolaterally. Brown shading on A4–6 more extensive than on other segments and extending well up each side into lateral area or beyond, but obvious only in green larvae. Both color forms with a brown head, unusual for green forms in species of this group. Frontal triangle black bordered with whitish in both forms. Larva lacking pair of light brown dorsal spots straddling middorsal line on A5, characteristic of *D. cinereola* and most *pallorata*. Larva of *triviata* especially brightly and boldly marked, one of the more handsome members of group.

My larvae were reared from eggs laid by a female collected in the Davis Mountains, Texas, in March 1993, mainly on alligator juniper, *Juniperus deppeana* Steud. (Cupressaceae), although they readily accepted other *Juniperus* species growing in the area. Another was reared from a larva found on *J. deppeana* in Madera Canyon, Arizona, and a series reared from eggs on an unspecified *Juniperus* sp. in Walnut Canyon, near Flagstaff, Arizona (J. G. Franclemont). Larvae were collected and reared on Rocky Mountain juniper, *Juniperus scopulorum* Sarg., by the Canadian Forest Insect Survey in British Columbia (Prentice et al., 1963: 413). The species appears to occur in association with juniper throughout its range and undoubtedly feeds on other species besides those mentioned.

Digrammia triviata occurs from south-central and southeastern British Columbia through Idaho, Montana and all of the Rocky Mountain states to

southern Arizona, New Mexico, and the Guadalupe and Davis Mountains, Texas. It was common where I collected moths in Elko County, Nevada; Platte County, Wyoming; Cherry County, Nebraska; and several times at high elevations, even up to 11,250 feet near Telluride, Colorado. It is to be expected throughout these regions wherever juniper is present.

Although this species may be univoltine northward or at high elevations, flying in June and July, it clearly has two or more broods throughout most of its range. For example, near Big Timber in south-central Montana, several were taken 7–21 August 1969, suggesting a second brood. In Colorado, it has been taken every month from 19 April–1 September; in Arizona, March–September (based on over 400 Arizona specimens); in Texas, every month from February–September.

The *continuata*-GROUP

The 11 closely related species of *Digrammia* in this group [*continuata*, *pertinata*, *setonana*, *nampensis*, *imparilata*, *excurvata*, *pallorata*, *cinereola*, *burneyata*, *atrofasciata*, and *modocata*, ed.] are the most difficult members of the tribe Macariini taxonomically. Initially I had expected that the number of species would be reduced through synonymy, but long-term and detailed investigation, including the rearing of most species, showed otherwise. I did synonymize *orillata* and *nigroalbana* and reduced *septemberata* to a subspecies of *cinereola* but had to resurrect *cinereola* from the synonymy and describe three new species, raising the total from 10 to 11. All are western except *continuata*.

Members of the *continuata*-group appear to be closely related to those of the *pallidata*-group except that they have a digitiform process on the aedeagus, a character found elsewhere in the *denticulata*-, *eremiata*-, and *muscaria*-groups. There are no consistent anatomical differences in the genitalia by which these very similar species may be distinguished, with the exception of *atrofasciata* (text figure 50 *d*) and possibly *modocata*. It is unusual for species of *Digrammia* to have indistinguishable genitalia, although commonplace among the North American species of *Macaria*.

The larvae are typical of almost all juniper-feeding geometrids in having a green and white pattern interrupted and modified in such a way as to match the foliage of the host almost exactly.

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However, I found enough differences to construct a key to most of them, omitting four that were unavailable. This key is meant to cover species of Macariini on Cupressaceae and includes *Digrammia triviata*, which, together with its sister-species, *D. pallidata*, are here treated as belonging to a separate group, although closely related to the *continuata*-group. For convenience, the key also includes *Macaria multilineata*.

The 23 structurally similar species of *Macaria*, however similar and confusing they may be, usually have clear differences in host specificity. This is not true for the *continuata*-group, in which most species will feed on almost any *Juniperus* and, at least as a secondary choice, on *Thuja*, *Chamaecypar*, and *Cupressus*. *Digrammia burneyata* favors *Calocedrus* but has been found on *Thuja*. *Digrammia imparilata* has been reared only from species of *Cupressus*. Species that I reared all fed freely on exotic junipers grown as ornamentals except *burneyata*, which was reared on *Calocedrus* without being offered a choice.

I still have difficulties in recognizing some of these moths, especially individuals of *setonana*, *napensis*, *imparilata*, and *excurvata* that are not definitively marked or colored, and of course *pertinata*, the most nondescript of all; and I had recurrent doubts about their validity as species. They might be considered geographic variants or subspecies, but of what species? *D. imparilata* could be a southwestern subspecies of *excurvata* except that they occur together and maintain separate identities. I tried to relate *napensis* to them or to *setonana* but found no intergradation, and *napensis* just seemed too different. Earlier, I had decided to treat *pertinata* as a western extension of *continuata* but, after seeing more material, concluded that there is no better reason to associate it with *continuata* than with any other species. It still stands as a distinct entity. There remain one or two morphs in the Southwest that could be additional species, but insufficient material and information make it seem unwise to recognize them as such.

It was easy to rule out seasonal variation in all cases except for *D. atrofasciata*, which I reared and found to have minor spring and summer forms, treated until now as two species, *nigroalbana* and *atrofasciata* respectively. Although most species seem able to feed on more than one genus of Cupressaceae, there is no evidence that a change of hosts affects the appearance of the

adult in any way, so this is not likely to be a cause of intraspecific variation. Despite the difficulties of identifying them, I believe that the 11 taxa in this group are real, especially in consideration of larval differences that may sometimes be better developed than the characters available for identifying adults.

The usefulness of larval differences is limited, however, because they are features of color only and will mostly fade in alcohol-preserved specimens. For the early stages to be taxonomically useful at the species level, it is essential to keep high-quality photographic images of live last-instar larvae of these moths, as of most Geometridae, to supplement collections of larvae in alcohol. Live and alcohol-preserved larvae and color transparencies were used in constructing the following key.

KEY TO LARVAE OF THE *DIGRAMMIA* *CONTINUATA*-GROUP THAT FEED ON JUNIPERS, CEDARS, AND WESTERN CYPRESSES (CUPRESSACEAE)

NOTE—This key is based on live, last-instar larvae, color photographs, and to a lesser extent on larvae in alcohol, although it is not likely to work for fluid-preserved specimens because their colors inevitably change. Many Macariini, like other Geometridae, have dimorphic larvae with green and brown forms, and it would be expected of this species group also. However, I have not seen many brown or dark larvae, and the key mainly treats green ones. Four species are missing from the key, namely *Digrammia pallidata*, *pertinata*, *excurvata*, and *imparilata*. They remain unavailable and may never have been reared. Another disadvantage of the key is that many geometrid larvae of other genera and even subfamilies that feed on trees of this family also mimic the foliage so closely that they may not easily be distinguished from macariine larvae, for example, *Glena plumosaria* (Packard), *Carphoides incopriaria* (Hulst), and *Stannoctenis morrisata* (Hulst). A key to encompass such larvae probably could be devised, but I have not done so. Too many are still unknown.

1. With pattern of oblique white, brown and often blackish lateral segmental markings; these usually associated with ventrolateral or subventral brown shading that may vary from bright reddish brown to pale tan 2
- With or without pattern of oblique lateral segmental markings; but, if present, such markings without associated reddish-brown or tan shades subventrally 6
2. Head brown; ground color of body green or brown (plate 14, figures 1–3). Western and Tex-

GEOMETROIDEA

- an; on juniper (the related *D. pallidata* might have a similar larva, but it is unknown) *D. triviata*
p. 258
- Head green; ground color of body nearly always green (may be purplish gray if larva is nearing pupation) 3
3. Segments T2 and T3 with reddish-brown lateral markings that are almost as conspicuous as those on A3–5, although somewhat smaller; if this distinction is unclear, then A5 should have brown dorsal markings; western 4
- Segments T2 and T3 without reddish-brown lateral markings, or, if such coloring is present, it appears faded and much less conspicuous than that on A3–5; segment A5 without brown dorsal markings; eastern and western 5
4. Segment A5 apparently always with small brown or pinkish-brown patch or paired spots on dorsum; brown lateral or subventral coloring on T2, T3, and A3–5 not exceeding area of combined white and blackish lateral markings on those segments (plate 14, figures 10, 11); western Nebraska to Great Basin and southward; on juniper *D. cinereola*
p. 272
- Segment A5 nearly always without brown dorsal markings; conspicuous brown lateral or subventral shading associated with lateral markings on T2, T3, and A3–5 exceeding area of combined white and blackish markings on those segments (plate 14, figures 8, 9); central Texas to Colorado, west to Great Basin and California; on juniper *D. pallorata*
p. 270
5. Ground color bright pea green; white lateral patches on T2 and T3 prominent; pale brown shading laterally on A3–5 or A4 and A5 only (plate 14, figure 4); East and Midwest, Canada to Florida and Texas; on juniper *D. continuata*
p. 261
- Ground color gray green; white lateral patches lost or obsolescent on T2 and T3; pale brown shading laterally on most body segments, but at least on A1–5 (plate 14, figure 13); Texas to southern California; on juniper *D. atrofasciata*
p. 276
6. With pattern of somewhat oblique lateral markings, but these not as well developed as in foregoing species 7
- With pattern of interrupted stripes and sometimes complex markings, but generally without oblique, lateral, segmental markings 8
7. White lateral markings a prominent series of roughly diamond-shaped white patches on T2, T3, and A1–8, each black bordered toward posterior apex but comprised of more white than black (plate 14, figure 5). British Columbia, SW Alberta; on western red cedar and Rocky Mountain juniper *D. setonana*
p. 265
- White lateral markings present but smaller; much reduced or lost on thoracic segments and on A6–8; those on abdominal segments with as much black or dark green as white (plate 14, figures 6, 7). Central California; on western juniper, Arizona cypress, and various cultivated junipers *D. napensis*
p. 266
8. Ground color bright pea green; subdorsal and lateral stripes wide, white, conspicuous, intersegmentally constricted or interrupted, appearing irregular but without oblique or black components (plate 13, figure 8). Eastern U.S.; on eastern and southern redcedar and Atlantic white cedar *Macaria multilineata*
p. 227
- Ground color more likely to be gray green or dull green; subdorsal and lateral stripes thin, hardly wider than subdorsals, or apparently absent; stripes pale yellow or greenish white. Mostly in N California, Oregon, or northward; on various species of cedar, cypress, or juniper 9
9. Pattern plain green with thin, sinuous or interrupted white or greenish-white subdorsal stripe and similar but more fragmented lateral stripe that forms slightly oblique patch below each spiracle; dark middorsal and faint, pale addorsals; head green, whitish laterally (plate 14, figure 12). Washington and Oregon, southward through the Sierra Nevada and other ranges to southern California and Hualapai Mountains, Arizona; known from incense cedar and redcedars *D. burneyata*
p. 274
- Pattern a complex mix of intermingled gray green, yellowish, white, and blackish markings, with an irregular, fragmented, yellowish spiracular stripe on lateral fold; fragments of a white subdorsal fold on thoracic and last few abdominal segments; faint white addorsals present on the first few anterior segments; head green with fine herringbone pattern that is white laterally, black subdorsally (plate 14, figure 14). Oregon and northern California; on McNab's cypress and western juniper *D. modocata*
p. 277

Digrammia continuata (Walker)

PL. 6, FIGS. 50–52 (adult); PL. 14, FIG. 4 (larva); TEXT FIG. 50 a–c (♂ gen.); TEXT FIG. 50 e (♀ gen.) (RWH 6361, 6362).

Anaitis continuata Walker, 1862, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, 25: 1,445.

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Type locality: East Florida. [BMNH]

Aspilates strigularia Walker, "1862" [1863], *ibidem*, **26**: 1,675.

Type locality: East Florida. [BMNH]

Anaitis orillata Walker, "1862" [1863], *ibidem*, **26**: 1,740. NEW SYNONYMY.

Type locality: Orilla, West Canada [Orillia, Ontario]. [BMNH]

This widely distributed species is the only member of its juniper-feeding complex present in the eastern, southeastern, and most of the midwestern U. S. and eastern Canada, although it also extends westward across the Great Plains and probably farther. I suspect that it is present in the West but has gone unrecognized, being difficult to distinguish from the closely related species that occur there. *Digrammia pertinata* (McDunnough) and *D. setonana* (McDunnough) may be no more than western populations or subspecies of *continuata*, with essentially the same wing pattern. *Digrammia continuata* has a relatively uniform forewing pattern with the black bands standing upright from the inner margin and curving toward each other on either side of the often contrastingly paler gray median space. In other words, the antemedial is convex and the postmedial for most of its length is concave, and the ground color of the basal and distal thirds is often darker than the median third.

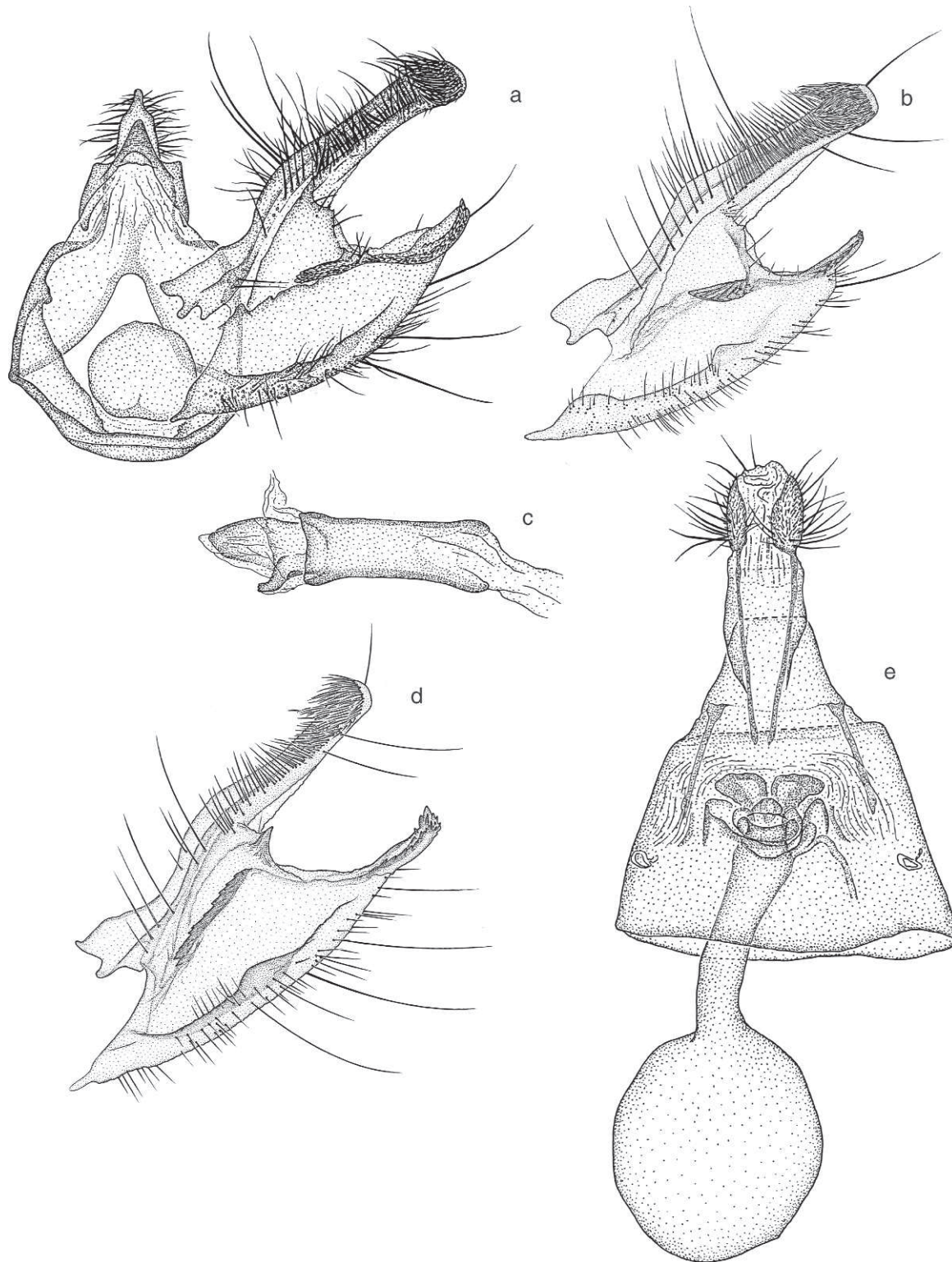
Wings gray brown with dark, often smooth-textured appearance southward (*continuata*), but with paler, coarsely strigose ground color and thick, diffuse black bands in northern and some northwestern specimens (*orillata*). The pale, light gray ground color, if it shows at all, usually limited to median space of forewing and then only faintly variegated or strigated. Antemedial line nearly perpendicular from inner margin and slightly convex, resembling that of *D. setonana*. Antemedial and postmedial lines of forewing often nearly parallel to outer margin, and a weak, diffuse medial band, when present, also subparallel to other bands. Moths average slightly smaller than those of most closely related species, although those from extremities of range in the West and in Florida tend to be both larger and paler than from elsewhere. Much variation occurs even among offspring from one female. Wing length for most of eastern United States: males, 10–14 mm (n = 120); females, 12–15 mm (n =

80); for Canada, Nebraska: males, 12–15 mm (n = 31); females, 13–16 mm (n = 12).

Male and female genitalia probably not distinguishable from those of other members of group with exception of *D. atrofasciata* (Packard), which differs from all in having longer serrated ridge that almost bisects saccular lobe of valve.

In the East the larvae feed on *Juniperus virginiana* Linnaeus and presumably *J. silicicola* (Small) Bailey where either tree is present, except that in Canada and nearby northern states they also feed on eastern white cedar, *Thuja occidentalis* Linnaeus (Prentice et al., 1963: 414 (69 records); and Connecticut Agricultural Experiment Station collection). The *Thuja*-feeding population was formerly thought to be a different species, *D. orillata*. In the southernmost parts of its range, *D. continuata* must feed on *Juniperus silicicola* where that tree replaces *J. virginiana*, and in the southern Plains States it may feed on *J. ashei* Buchholz and on *J. scopulorum* Sargent northward, as these are the only suitable native hosts present where adults have been collected. In the mid-Atlantic Coast region it is likely that *continuata* also feeds on Atlantic white cedar, *Chamaecyparis thyoides* (Linnaeus) B.S.P. I reared this species on a mixture of *Juniperus virginiana* and on various unidentified ornamental species in 1974, 1976, and 1993. The larva is typical of the group, with the longitudinal white lines interrupted, and the lateral white stripe broken into segmental, subspiracular patches that are slightly oblique.

Digrammia continuata occurs in Canada from New Brunswick to southern Manitoba and southward in the United States to Brevard and Sarasota counties in peninsular Florida. It occurs thence westward with little alteration in general appearance at least as far as the Dakotas, central Nebraska (Cherry County); Kansas; Oklahoma City and Comanche County, Oklahoma; and Fort Worth and Kerrville, Kerr County, Texas. Initially I had expected that *continuata* would occur but be unrecognized in the West, but have not positively identified it from anywhere west of the limits outlined above. *Digrammia pertinata* and other western specimens of that type could conceivably be western *continuata*. Many specimens from large series collected in Nebraska and southern Arizona have the more shaded or variegated ground color of *pertinata* and appear intermediate to that taxon. However, I kept *pertinata* separate because of large gaps in distribution.

FIGURE 50: GENITALIA OF *DIGRAMMIA* SPECIES

a. D. continuata, male genital capsule; Bathurst, New Brunswick (USNM 52998). *b. D. continuata*, right valva; The Wedge, McClellanville, Charleston County, South Carolina (USNM 53000). *c. D. continuata*, aedeagus; Bathurst, New Brunswick (USNM 52998). *d. D. atrofasciata*, right valva; Cochise County, Arizona (USNM 57016). *e. D. continuata*, female; Siesta Key, Sarasota County, Florida (USNM 53243).

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Digrammia continuata has at least two broods and possibly at least a partial third brood from about the latitude of Connecticut to Maryland or Virginia; one brood toward its northern limit; and more than three broods in the South. It flies in June and July in Canada, northern New England, and central New York. In New Jersey and Maryland it flies from late April to early September with possible gaps in the first half of July and again through part of August. The reared progeny of a Maryland female collected 30 April mostly emerged between mid-July and early August, but with a few stragglers in October and December that might have diapaused overwinter had they been outdoors. The dates for South Carolina include February, April, May, August, September, October, and November, showing either a prolonged midsummer hiatus or inadequate collecting. Flight data for other states are as follows: Missouri, late March–early October; Florida, every month of the year; Louisiana, collected every month except December and February; Texas, January–June, August–December; Nebraska, 2–29 June (although collecting was only within that period); Arizona, May, August–October. The generations become so seasonally confused in the Southeast that adults may be encountered at almost any time.

Digrammia pertinata (McDunnough)
PL. 6, FIGS. 53–56 (adult) (RWH 6365).

Semiothisa pertinata McDunnough, 1939,
Can Ent., 71: 253.

Type locality: Jefferson County, Montana.
[CNC]

This species is almost a nonentity, and I had expected the name to be a synonym. However, in the northern Great Plains and Rocky Mountain foothills where it occurs, *pertinata* is a recognizable taxon, however nebulous, because it does not seem to fit or be a part of any other species. In the absence of structural differences (normal for the group), it is best characterized by its nondescript appearance, almost without bold or distinctive markings but with exceptional variability that had best be appreciated by reference to the illustrations.

Forewing with the usual three dark transverse bands much as in other species, with the medial band usually weak, diffuse, or obsolescent. Bands neither strongly oblique nor straight as usual in *excurvata*, but almost erect from inner margin

and roughly parallel to outer margin; antemedial slightly convex, medial often nearly straight, postmedial slightly excurved (concave) between inner margin and M_1 , where it bends toward costa and then, just before costa, bends outward again. Bands usually indicated as thin, regular, blackish lines with extra brown to dark brown shading in about half the specimens, although not usually appearing double. Bands sometimes wide and very diffuse. Basic wing color varying greatly from uniformly gray to highly variegated or dappled gray or gray brown on a pale grayish ground. Median third may be paler (or rarely darker) than basal and distal thirds. Pale, diffuse subterminal band sometimes showing and preceded by a dark preapical patch toward costal end. Discal spot faint or wanting; fringe concolorous with wing or diffusely checkered with gray brown. Hindwing light gray brown, variegated with some whitish ground color showing through and with remnants of dark medial and postmedial bands toward inner margin. Discal spot and fringe as on forewing. Underside paler, faintly marked, outer third often darker on both wings. Wing length: males, 13–15 mm; females, 13–15 mm.

Neither the male nor female genitalia differ from those of *D. continuata* or most other members of the juniper-feeding group.

The immature stages are unknown, but the larvae most likely feed on juniper.

Digrammia pertinata is common where it occurs but has a curiously restricted range in the northern shortgrass prairie region. It is known from Jefferson and Sweetgrass counties, Montana; Billings and Jackson counties, North Dakota; Platte County, Wyoming; and Prowers County, Colorado. I have seen somewhat similar specimens from southern Arizona but question whether they could be the same species. The collection sites in the northern plains are in the region of rolling shortgrass prairie, but presumably require the presence of juniper. I collected it in Guernsey State Park near the South Platte River, Wyoming, in a sheltered, wooded hollow with ponderosa pine and Rocky Mountain juniper, *Juniperus scopulorum* Sarg.

Collection dates extend from 6 July (Wyoming) to 21 August (Montana), with records for almost every week within that period. A specimen from Medora, North Dakota was taken 27 May, suggesting that there may be two generations.

Digrammia setonana (McDunnough)

PL. 6, FIGS. 57–59 (adult); PL. 14, FIG. 5 (larva) (RWH 6364).

Phasiane setonana McDunnough, 1927, *Can. Ent.*, **59**: 245.

Type locality: Seton Lake, Lillooet, British Columbia. [CNC]

This species is distinguished by its consistent pattern and the arrangement of different shades of gray on the forewing. The antemedial band is always convex and rounded, and the postmedial band is decidedly concave for more than half its length. The medial third of the forewing is usually somewhat paler than the basal and distal thirds, and the postmedial band often has a thin white border on the side next to the median space. These are all features that may be seen in various combinations in other species, but together they impart a characteristic appearance to *setonana*. It is very similar to and may be a northwestern subspecies of *continuata*, which also tends to have the paler median space, although the larvae seem to be different; or, when more material is available, it may prove to blend into *pertinata* southward. As these problems cannot at present be solved, I leave *setonana* as a distinct species. However, one would not expect a species to occur exclusively in southern British Columbia or Alberta, as most members of this group are widespread. The apparent host, Rocky Mountain juniper, is much more widespread than *setonana*.

Forewing ground color light gray, more or less clouded or dusted with darker gray-brown scales, especially in basal space and just beyond postmedial band, often leaving median space appearing paler than rest of wing; median space often becoming whitish or with a thin whitish border separating it from the postmedial band; discal spot faint; antemedial band thin, black, roundly convex, farther out at costa than at inner margin, sometimes appearing double because of a closely parallel shadow line proximally; postmedial line regularly S-shaped in the usual way, being convex opposite discal cell and concave, often rather deeply so, from there to inner margin; postmedial also appears double because of a closely parallel, deep chestnut-brown shadow line on distal side; diffuse, dark brown medial band present or absent; outer third of forewing with diffuse, dark brown, wedge-shaped patch at costa, and otherwise divided down the middle by a variable, diffuse, usually faint, light gray subterminal band;

terminal line very thin, faint, usually broken into series of blackish dashes; fringes concolorous with forewing, faintly checkered. Hindwing nearly as dark as forewing, plain, marked only with a remnant of postmedial toward inner margin. Underside almost unmarked, sometimes with outer thirds of both wings slightly darker than medial and basal thirds. Wing length: males, 13–15 mm ($n = 27$); females, 13–16 mm ($n = 17$).

Most specimens that I have seen have a slightly brownish tint, but others are as gray as most *excurvata* and *cinereola*. Those shown by McGuffin (1972, figs. 107–108) are gray, as is a male that I collected at Lillooet in 1991.

The genitalia do not differ appreciably from those of *continuata* or most other species of the group in either sex.

Many were reared by the Canadian Forest Insect Survey from larvae on *Juniperus scopulorum* Sarg., although two were reported to have been reared from *Thuja plicata* Donn. (Prentice et al., 1963: 415). The dual hosts are not surprising because *Digrammia continuata* switches between *Juniperus* and *Thuja* in the East. McGuffin (1972: 37) described the last (6th) instar larva as follows (slightly modified): Length 17–21 mm. Head light green with dark gray or black herringbone pattern on parietal lobes; clypeus gray green, with gray spot on each basal angle. Antenna brown. Body gray green to green; middorsal a geminate gray line; subdorsal marked by a white, broken stripe, bordered ventrally with a geminate black or dark-gray line; abdominal segments marked laterally with oblique black line passing through spiracle from anterior and above spiracle to posterior and below; anterior to each oblique line is a white, yellow, or light green patch. Venter yellow green with broken geminate, gray, midventral line. Plates unicolorous; legs green. I have not seen the larva of *setonana*, but a colored illustration of a larva identified as this species and apparently agreeing with McGuffin's description was published by Ives and Wong (1988: fig. 10D). It differs in lacking the reddish-brown to tan shading present ventrolaterally beneath the lateral markings in my reared larvae of *continuata*.

Digrammia setonana occurs in the southern interior of British Columbia between the Columbia and Kootenay rivers (Windermere, Canal Flats) and the Fraser River, from near the U. S. border (Greenwood) to Williams Lake, Macalister, Marguerite, and Alexandria, well up the Fraser River.

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McGuffin (1972, map, p. 83) shows it from southern Vancouver Island, but I have not seen the specimens. Ives and Wong (1988: 23) mention it from southwestern Alberta. The species has not been found in the western U. S. The adults fly in June and early July and apparently represent a single generation.

Digrammia napensis (McDunnough)

PL. 6, FIGS. 60–62 (adult); PL. 14, FIGS. 6, 7 (larva) (RWH 6366).

Semiothisa napensis McDunnough, 1939, *Can. Ent.*, **71**: 254.

Type locality: Napa, Napa County, California. [CNC]

This species is the darkest and most northerly of a triad of similar species occurring mainly in the coastal regions of central and southern California. Large, brownish, boldly marked, black-banded spring-brood specimens are distinctive; but smaller, more grayish, less distinctively marked, late-season specimens are not always easily distinguished from those of the generally more southern *D. imparilata*. The antemedial band is variable from erect and slightly convex to decidedly oblique and straight, but the bands are rarely double as they are in both of the other species. The moths may be subdivided into gray and brown forms, and the gray ones further deviate toward obsolescence of the black transverse bands. However, I cannot be certain that the nearly immaculate gray specimens do not represent still another species. Further description follows.

Best marked specimens, with unusually dark brownish or gray wings and single black, straight to slightly convex antemedial and straight to somewhat sinuous postmedial on the forewing, stand out as different and need not be confused with those of other species. Bands rarely double, and medial bands usually absent or faint, as is the discal spot on both wings. Course of antemedial band inconsistent, either straight and oblique, meeting costa twice as far out as it does the inner margin, or straight and slightly convex, meeting inner margin at right angles. Postmedial band also variable from straight or slightly but evenly convex to somewhat sinuous; if sinuous, convex between R_5 and M_3 in the usual way and thence either straight or convex to inner margin, although about 12% ($n = 69$) show a small point or convexity in postmedial at first anal fold, a feature common in and otherwise unique to *im-*

parilata (in which it occurs with a frequency of 37% ($n = 91$)). Hindwing brown to gray, almost as dark as forewing, slightly marbled or dappled with whitish and marked only with vestigial discal spot and, near inner margin, with short remnants of medial and postmedial, or only the postmedial. Undersurfaces correspondingly dark and almost unmarked. Wing length: males, 13–19 mm; females, 13–19 mm. The species is quite a large one, and most specimens are within range of 15–17 mm in both sexes ($n = 84$).

As indicated earlier, *napensis* has an almost immaculate form, which, judging from only about 15 specimens, occurs almost entirely as gray rather than brownish specimens. A problem in assessing this kind of color change, however, is that moths that were gray when fresh have commonly faded to a more brownish hue in older collections. I decided against subdividing the species until the significance of the color variation has been determined.

The genitalia cannot reliably be distinguished from those of closely related species, all members of the *continuata*-group having indistinguishable genitalia except males of *atrofasciata* and *modocata*.

Digrammia napensis was reared by B. Scaccia from larvae beaten from foliage of *Juniperus occidentalis* Hook. in Yolo County, California. All of the several reared adults sent to me are of the gray, poorly marked or immaculate form. Another specimen that I believed to be *napensis* was reared from Arizona cypress, *Cupressus arizonica* Greene, presumably planted, in Chico Canyon, Butte County, California. Several were reared from larvae found on McNab's cypress, *Cupressus macnabiana* A. Murr. at Megalia, 2,400', Butte County by L. L. Crabtree. They were found in early to mid-July, and the adults emerged in late July–early August 1999. I reared this species from eggs sent to me by J. A. Powell from Berkeley, California, where the female was collected on 11 October 1993. The species is apparently established at Berkeley on ornamental junipers and cypresses. The larvae were easily reared on unidentified garden junipers, and the following description is based on them.

The last instar larva of *napensis* is distinctive and polymorphic, with green and brown forms, and some with the ground color intermediate. The head is brown in brown larvae and green in green ones, except that the clypeus may be brown in otherwise green larvae. The species thus differs

from the somewhat similar (but allopatric) *D. triviata*, which has a brown head in both forms. The brown form (plate 14, figure 7), which has a dark, purplish, gray-brown body background color, is boldly and contrastingly marked with black and white in a complex pattern, and the lateral markings are especially prominent on segments A1–5, having a strongly oblique aspect. Both green and brown larvae have blackish or grayish midventral patches on most abdominal segments. The green larvae (plate 14, figure 6), which may also have well-developed black and white oblique lateral markings, occur otherwise in a simpler form with the markings reduced and dull greenish white, entirely without the contrasting black and white highlights of the brown and better marked green larvae. Most of the described larval forms were present in the brood that I reared. Length at maturity: 26–28 mm.

Digrammia napensis is known from the following counties of California: Sierra, Butte, Lake, Napa, Sonoma, Marin, Solano, Yolo, Contra Costa, Alameda, Sacramento, Stanislaus, San Joaquin, Santa Clara, Santa Cruz, Kern, and Los Angeles. Most material in collections is from the San Francisco Bay region, although I saw single specimens that I was sure belonged to *napensis* from as far north and east as Chico Canyon, Butte County and Gold Lake, Sierra County. The southward limits are indicated by single specimens from Inyokern, 2,442', Kern County and Los Angeles County. The record from Los Angeles (USNM) may represent a labeling error, although the date (16 March) seems right for the spring generation of this double-brooded species. The most specimens seen (50) from one area are from Berkeley and nearby places in Alameda and Contra Costa counties, where the species is thought to feed on cultivated Cupressaceae.

Two well-separated flight periods are indicated in the San Francisco Bay area, 10 April–29 June and 9 September–26 October. Dates for Sonoma County are 8 April–25 June and 10 August–1 October, and two early specimens from Napa are labeled 23, 25 March. It was taken 5 July in Sierra County, 29 May in Lake County, 10 August at Stockton, San Joaquin County, in July, August, and September at Sacramento, 18 May in Kern County, and 16 March in Los Angeles County.

This concept of *napensis* is somewhat compromised by the existence of large, distinctive but anomalous specimens that resemble it from much more northern localities. I have seen a male from

Vancouver Island, British Columbia, 25 June 1990, T. M. Neal (R. Belmont Coll.), and one from Ketchikan, Alaska, June (MCZ). The existence of disjunct populations of *napensis* or of another species that happens to resemble *napensis* is possible. The only likely hosts in the north Pacific Coast Region would be species of *Thuja* and *Chamaecyparis*.

Digrammia imparilata Ferguson, NEW SPECIES

PL. 6, FIGS. 63–65 (adult).

Digrammia imparilata Ferguson.

Type locality: Phoenix, Maricopa County, Arizona. [USNM]

This species from southern California and southern Arizona has been variously misidentified as *orillata* [= *continuata*], *excurvata*, or *napensis*, but it is distinct from all of them. It averages large, like *napensis* and *excurvata*, is decidedly gray rather than brownish when fresh, and in overall color and pattern is intermediate between those species. However, the transverse bands of the forewing are often boldly outlined with black and appear double, although not as strongly so as those of *excurvata*, and they are frequently waved or sinuous, unlike the more regular bands of *napensis* and *excurvata*. The postmedial of *imparilata* is especially irregular, showing in more than one-third the specimens a small, outwardly convex, obtusely pointed bend in the postmedial band at CuA₂. This feature is unusual and would be diagnostic for *imparilata* except that it occasionally occurs in *napensis*.

Forewing with antemedial band thin or bold, erect from inner margin or oblique (leaning outward), straight or slightly sinuous, preceded by a slight shadow but hardly double. Postmedial line usually bold, gently curved to unusually irregular or sinuous, often with characteristic, obtuse point on distal side at CuA₂; shadow line often well developed, making postmedial appear double; medial band usually faint, regular to slightly waved; discal spot weak; trace of blackish subterminal band apparent near costa. Hindwing gray, almost as dark as forewing, only slightly mottled with paler shades, almost unmarked except for weak discal spot and small remnant of one or two transverse bands at inner margin. Moths average quite large, approaching size range of *napensis* and *excurvata*. Wing length:

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holotype, 16 mm; other males, 14–17 mm; females, 15–18 mm.

The genitalia appear to be indistinguishable from those of all species of the *continuata*-group except *atrifasciata* and possibly *modocata*.

This species was first reared by C. M. Dammers in 1934, and the larva was described by Comstock and Dammers (1935: 224–25, pl. 65, figs A–D) under the name *Phasiane orillata* Walker. I found the original reared specimens from Riverside in the LACM and identified them as the present species. The following is a modified condensation of their larval description (if I have interpreted it correctly).

Length 29 mm when mature. Ground color dark green to blue green. Middorsal line “lemon white,” paralleled by a similar line on each side; subdorsal stripe lemon white, broken in the middle of each segment and expanding to a subquadrate patch toward anterior margin of each segment; spiracles pale brown, rimmed with black; a raised brown lobular protrusion (lateral fold) beneath each spiracle, and inferior to that a lemon-white area. Thoracic legs pale green with pale brown points; prolegs pale green. Head pale green, blotched with irregular pale brown markings, and sparsely covered with pale brown setae. Mouthparts pink; stemmata black. Each body segment bears 12 brown setae arising from small, brown pinacula. Larvae of all instars collected from Guadalupe cypress [*Cupressus guadalupensis* S. Wats.] 23 December yielded adults in February and March. Comstock and Dammers also mentioned that adults were collected in the spring and fall months, and that the natural food plant in the area is probably a species of *Juniperus*. A problem with this description is that most of the features mentioned are common to all members of the group.

This species was also reared in the Los Angeles area in 1942 by C. Henne (LACM), who found the larvae on Arizona cypress, *Cupressus arizonica* Greene.

TYPES. Holotype ♂. Phoenix, Maricopa Co., Arizona (on house wall); 20 March 1976; R. Wielgus. USNM. Paratypes: 47 ♂, 30 ♀. Arizona. Phoenix, Maricopa County; 18 January–23 March, 4, 21 April, 16, 21 October 1975–76; R. Wielgus (18 ♂, 10 ♀). 1535 N. Camino Real, Tucson, Pima County; 13 January 1983, 21 April 1976, 4, 12 May 1980; R. Nagle (3 ♂, 1 ♀). California. Riverside, Riverside County; reared 13 May 1929, 4 March 1935, 12 March 1932; C. M. Dammers (1 ♂, 2 ♀). Riv-

erside, Riverside County; 18 May 1968; M. W. Stone (1 ♂). Riverside, Riverside County; 5 March–21 May 1933–38, G. H. and J. L. Sperry (5 ♂, 4 ♀). Gavilan Hills, Riverside County; 1 April 1951 (1 ♂). S Pasadena, Los Angeles County; reared on Arizona cypress, “6-2-42,” “6-9-42,” 6-12-42,” C. Henne (3 ♀). Los Angeles; May 1–15, 1929; J. A. Comstock (1 ♂). Cajon Summit, San Bernardino County; 6 February 1979; Sala (1 ♂, ♀). Rabbit Dry Lake, Granite Mts., San Bernardino County; 3 May 1979; F. P. Sala (1 ♂, 1 ♀). Burbank, Los Angeles County; 9 January, 7 April, 7, 30 May, 9 June 1959, 22 June 1962; [F. P. Sala] (8 ♂, 3 ♀); Claremont, Los Angeles County; (Metz) (1 ♂, 1 ♀). Carnation Way, Los Angeles Co., California, 1 January, 3, 6 April, 9 May, 7 September, 21 December 1968–73; [F. P. Sala] (5 ♂, 1 ♀). Los Angeles County; emg’d. May 1958; C. Hogue (1 ♀); Loma Linda, San Bernardino County; June 16–23, September 24–30 (1 ♂, 2 ♀). LACM, RN, USNM.

This species occurs from southern California to south-central Arizona, and nearly all of the known localities are as listed for the types. Its flight period in California is primarily in spring, from March to May or early June, and secondarily in the fall in September and October, with stragglers appearing irregularly in December, January, and February. The flight period in Arizona insofar as known also is in winter and spring, from January to May, with one record for October.

Digrammia excurvata (Packard)

PL. 7, FIGS. 1–4 (adult) (RWH 6363, part).

Phasiane excurvata Packard, 1874, *Rept. Peabody Acad. Sci.*, 6: 47.

Type locality: “Rocky Mountains.” [MCZ]

Sciagraphia spodoptera Hulst, 1898, *Can. Ent.*, 30: 162.

Type locality: “Colo., Cala.” [USNM]

NOTE—“The specimens are all females” [number not specified]. Two of them are in the USNM. I select as lectotype the specimen bearing the following labels: “Los Angeles/Co., CAL”; “May”; “Type No. 3923 U.S.N.M.”; “*Sciagraphia spodoptera* Type Hulst”; “♀ genitalia on slide Jan. 20, 1938 J.F.G.C. #1472”.

Typically this is a large species with a light gray forewing boldly marked with black transverse bands, which are often decidedly oblique; i.e., meeting the costa at points much farther out than where they intersect the inner margin. The antemedial and postmedial bands tend to be nearly straight, although the postmedial may be some-

what concave ("excurved") on the distal side for most of its length; and they are usually double; i.e., closely shadowed by parallel dark brown bands in their inner and outer sides respectively. A dark medial band is also usually present or partly so. The transverse bands of *excurvata* are surpassed in boldness only by those of *atrofasciata*, although matched in this respect by some specimens of *imparilata* and a very few *cinereola*. The species is highly variable, however, with a few small, poorly or differently marked variants that make it difficult to characterize *excurvata* concisely. It has a wide range from the Rocky Mountains and West Texas to the Pacific, and rarely to Oregon and Washington (but not seen from northern California). It seems to be absent or missed by collectors in many areas.

Male and female nearly alike but both are variable; difficult to describe. Forewing with apex slightly produced, giving it a more elongate aspect than in most other well-marked members of the group except *atrofasciata* and *pallorata*; ground color whitish, finely dusted or variegated with gray, but still about as pale as that of *pallorata*; three roughly parallel transverse bands, although medial one may be weak and is not double; antemedial band varying from slightly convex and nearly erect from inner margin to straight and strongly oblique (subparallel to outer margin), closely preceded by a chocolate-brown to blackish band, although this may or may not be well developed; medial band straight or excurved (concave on outer side); postmedial band quite bold, black, varying from nearly straight to decidedly excurved for all or most of its length, with the usual outward bulge near costa present or absent; postmedial distinctly double in nearly all specimens, with brown shadow band following postmedial on outer side from inner margin nearly to costa; between postmedial band and outer margin a black or brown subapical costal bar represents the costal end of the otherwise vague, whitish submarginal band. Discal spot usually incorporated into medial band and appearing absent. Terminal line a delicate series of dark, intervenular dashes. Fringe very light gray, checkered with darker gray brown. Hindwing light gray brown, variegated with whitish, mostly plain but with remnants of medial and postmedial bands toward inner margin. Inner margin narrowly edged with white. Terminal line and fringe as on forewing. Discal spot usually absent. Under-side of forewing pale gray with some of the up-

perside markings showing faintly; of hindwing, pale gray to whitish, essentially unmarked. Length of forewing: males, 14–17 mm; females, 15–20 mm.

Digrammia excurvata may resemble at least four other species that occur within its range. It has been confused with *pallorata*, but that species is smaller, generally paler, and its transverse bands are neither as oblique nor as boldly marked. Some *cinereola* in the region from West Texas to Colorado may be as boldly marked, but the bands are less oblique and only rarely appear double. *Digrammia imparilata* is a similarly large species whose bands may also be bold and double, but the wings are darker with little of the whitish ground color showing, the transverse bands are much less inclined to be straight or oblique and the postmedial band is usually sinuous. *Digrammiaatrofasciata* shares most of the features described for *excurvata*, including the slightly elongated forewing, the very bold, oblique, double, transverse bands, and a pale ground color, but it is smaller, with more exaggerated dark transverse bands, and it is distinguishable by the male genitalia.

Both the male and female genitalia are similar to those of all other members of the *continuata*-group except *atrofasciata*, the male of which is easily distinguished by the longer sclerotized dentate process in the middle of the ventral lobe of the valve. Although the male genitalia especially are highly variable, I found nothing consistently different about *excurvata*.

The early stages of *excurvata* have not been described, and I was unable to include it in the larval key. A large female was reared from a larva found on *Juniperus californica* Carriere in Del Puerto Canyon, Stanislaus County, California by J. Powell (UCB) on 8 April 1972, emerging on 9 May. Four others were reared from the same species of tree at Vincent and Lower Mint Canyon, Los Angeles County by C. Henne (LACM), emerging 25 March 1947 (Mint Canyon) and 6–8 June 1948 (Vincent). Another specimen, from San Jose, Santa Clara County, was reared from Italian Cypress by Powell on 12 June 1977 (UCB). It would be expected to feed on other junipers in the Rocky Mountain Region.

Digrammia excurvata is known from the following states and counties, which I list because of its apparently discontinuous distribution. CALIFORNIA: Contra Costa, Inyo, Kern, Los Angeles, Riverside, San Bernardino, San Diego, San

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Mateo, Santa Clara, Stanislaus; ARIZONA: Cochise, Coconino, Maricopa, Yavapai; NEW MEXICO: Bernalillo, Fremont, Lincoln, Los Alamos; TEXAS: Armstrong (Palo Duro Canyon), Brewster (Big Bend Natl. Park); NEVADA: Clark, Douglas [Holbrook]; UTAH: Beaver, Sanpete, Tooele, Washington; COLORADO: Alamosa, Chaffee, Fremont, Garfield, Grand, Mesa, Moffatt; OREGON: Baker; WASHINGTON: Kittitas [Easton].

The dates of occurrence for California are mainly 10 March–29 May, but with a few southern emergences as early as 8 February, and a scattering of others in June, July, August, September, and October, possibly indicative of a partial second brood. Arizona, New Mexico, and Texas have a similar pattern but beginning later (31 March); taken 20 April in the Charleston Mountains, Nevada. For the rest of the range northward the dates are 10 May–26 July, with a very few records for August and September. The main flight in Colorado and Utah occurs in June and July.

Digrammia pallorata Ferguson, NEW SPECIES

PL. 7, FIGS. 5–7 (adult); PL. 14, FIGS. 8, 9 (larva).

Digrammia pallorata Ferguson.

Type locality: Ephraim Canyon, 6,000', Sanpete County, Utah. [USNM]

This is a widespread, sometimes common species of the Southwest, most easily distinguished by its almost white ground color, relatively small size of the males, and distinct but thin and lightly marked antemedial and postmedial bands that may appear to be double. The pale wing coloring resembles that of *D. excurvata*, but the moths are smaller, with the transverse bands less boldly marked and lacking the strongly oblique aspect of the wing markings of *excurvata*. Large females may resemble pale females of *cinereola*, but the latter have a simplified wing pattern with the bands single, not double. Nothing in the genitalia distinguishes *pallorata*, but the larva has differences and may be recognized (see key).

Structure and color of body, head and its appendages, and legs as in related species. Forewing pale, ground color almost white but variably darkened by a scattering of transversely strigose clusters of gray-brown scales. Transverse bands tending to be more nearly erect from inner margin

than in some of the related species, most notably in *excurvata*. Antemedial band thin, black, straight to slightly convex, erect or leaning outwardly, subparallel to medial band; medial band usually weak, grayish, or obsolescent; postmedial band black, slightly S-shaped, i.e., straight or somewhat concave from inner margin, convex near costa, but straightening out subcostally to meet costal margin obliquely at about same angle as that of antemedial band. Antemedial and postmedial bands usually preceded and followed respectively by a closely parallel brown band, making them appear double; discal spot faint; space between postmedial and outer margin often heavily variegated with gray shading so that little of the pale ground color shows; in middle of this zone (outer third of wing), a small blackish or dusky preapical patch or dash may be present at costa; terminal line thin, dark, interrupted at veins; fringe slightly checkered, gray and whitish. Hindwing variegated or mottled gray brown and whitish, markings diffuse and consisting of remnants of medial and postmedial bands toward inner margin and occasionally a diffuse subterminal band near and subparallel to outer margin; discal spot small, weak; fringe of inner margin broadly white in pale specimens, narrowed in darker ones; fringe of outer margin like that of forewing. Undersurfaces finely and quite uniformly and diffusely variegated with light gray on a pale ground, hardly marked, but discal spots a little more prominent on both wings than they are above; fringes similar to those of upper surfaces. Wing length: males, 11–14 mm; females, 14–16 mm.

Spring (first generation) specimens tend to be larger than summer ones; the smallest specimens seen are second-brood moths taken in Kimble County, Texas in June. The largest spring specimens or those from farther north, as in Colorado, average about 2 mm larger in wing length. Otherwise there is little variation.

The genitalia of all members of the juniper-feeding complex are highly variable, but I found no features in either sex that would reliably distinguish *pallorata* from any of the others except *atrofasciata* and possibly *modocata*, both of which are nearly always easily identified by their appearance.

I reared *pallorata* from a female collected at White's City, New Mexico in March 1993. The larva is most similar to that of *D. cinereola*, and the larval description given for that species would

largely apply to *pallorata* except that the white and brown components of the oblique lateral pattern are much larger. The brown lateral or subventral shading associated with the lateral markings on T2, T3, and A3 to A5 exceeds in area the combined white and blackish markings on those segments in *pallorata* but not in *cinereola* (see key). Also, the brown lateral markings are connected across the dorsum of A5 in *cinereola*, or at least represented dorsally by a pair of brown spots; whereas the dorsum of A5 is more likely to be green in *pallorata*. The larvae fed on *Juniperus monosperma* (Engelm.) Sarg. and *J. pinchotii* Sudw.

TYPES. Holotype ♂. Ephraim Canyon, 6,000' [Great Basin side of Wasatch Mountains] Sanpete County, Utah; 22 July 1981; D. C. Ferguson. USNM. Paratypes: 79 ♂, 66 ♀. Utah. Same data as for holotype; 23, 25, 30 July 1981 (15 ♂, 4 ♀). Lower Ephraim Canyon, 6,300', Sanpete Co., 6, 13 August 1981; D. C. Ferguson (2 ♂, 2 ♀). Mouth of Ephraim Canyon, 5,800', Sanpete County; 27 July 1981; D. C. Ferguson (1 ♂, 1 ♀). Major's Flat, 7,100', near Ephraim, Sanpete County; 20, 22, 26, 31 July and 3, 12 August 1981; D. C. Ferguson (20 ♂, 5 ♀). Stockton, Tooele County; 7 May 1913, 12 July 1913; Tom Spalding (2 ♀). Beaver Creek Hills, Beaver County; June (1 ♂). Colorado. Great Sand Dunes National Monument, 8,200', Alamosa County; 25 June 1982, D. C. Ferguson (1 ♀). Glenwood Springs, Garfield County; "May 16–23," "July 16–23," "Aug. 16–23," "Sept. 8–15," "Sept. 16–23;" [W. Barnes] (1 ♂, 7 ♀). Texas. Cleburne, Johnson County; 6 May 1964; A. & M. E. Blanchard (1 ♂). Paducah, Cottle County; 17 April 1968; A. & M. E. Blanchard (1 ♀). Garner State Park, Uvalde County 30 September 1964; A. & M. E. Blanchard (1 ♂). Palo Duro Canyon State Park, Randall County; 3 May 1965; A. & M. E. Blanchard (2 ♂). Kerr Wildlife M[ana]g[emen]t Area, Kerr County; 23 March 1965; A. & M. E. Blanchard (1 ♂). Junction, Kimble County; 19 March 1964, 3 April 1968; A. & M. E. Blanchard (2 ♂). Sheffield, Pecos County; 31 March 1967; A. & M. E. Blanchard (2 ♂). Mt. Locke, 6,700', Davis Mountains, Jeff Davis County; 26 March 1968; A. & M. E. Blanchard (1 ♂). Sierra Diablo Wildlife Mgt. Area, 6,000', Culberson County; 20 May 1968; A. & M. E. Blanchard (1 ♀). Green Gulch, Big Bend National Park, Brewster County; 1 July 1965; A. & M. E. Blanchard (1 ♀). McKittrick Canyon, Guadalupe Mountains, 28 March 1968; A. & M. E. Blanchard (1 ♂). Bend, San Saba County; 11 March 1982; R. W. Poole (1 ♂). 6½ mi E Lampasas, Lampasas County; [date?]; R. W. Poole (1 ♂). Junction, Kimble County; 16, 18 June 1972; D. C. Ferguson (6 ♂). Alpine, Brewster County; "V-15;" F. Lemmer (1 ♂). Smith Canyon, 5,750', Guadalupe Mountains, Culberson County; 22 May 1973; D. C. Ferguson (3 ♂). Cherry Canyon, 5,097',

Guadalupe Mountains, Culberson County; 24 May 1973; D. C. Ferguson (1 ♀). McKittrick Canyon, 5,000', Guadalupe Mountains, Culberson County; 23 May 1973; D. C. Ferguson (2 ♀). New Mexico. Cimarron Canyon, 6,600', Colfax County; 26 July 1989, D. C. Ferguson (1 ♂). Frijoles Canyon, 6,066', Bandelier National Monument, Sandoval County; 8 August 1989; D. C. Ferguson (1 ♂). White Rock, ca. 6,700', Los Alamos County; 7 August 1989; D. C. Ferguson (1 ♀). 1 mi E Arizona State line, Guadalupe Canyon, Hidalgo County; 30 August 1971; J. Doyen (1 ♀). Carlsbad, Eddy County; 1 October 1995; J. Glaser (1 ♂). White's City, Eddy County; 26 March 1993; D. C. Ferguson (3 ♀). Jemez Springs, Sandoval County; 26 June 1916, 8 July 1924, [one with locality only]; J. Woolgate (3 ♀). Arizona. SW Research Station, 5 mi W of Portal, 5,400', Cochise County; 26 July–3 August 1959; A. B. Klots (1 ♀). Paradise, Cochise Co., various dates in March, April, May (2 ♂, 10 ♀). Peloncillo Mountains, Cochise County; 8 November 1975; F. & S. Werner (1 ♀). Cave Creek Ranch, Cochise County; 20 August 1974; E. G. & J. M. Linsley (1 ♀). Cave Creek Canyon, 5,400', Chiricahua Mountains, Cochise County; 11 April 1966 and at 4,880', 15 August 1967; J. G. Franclemont (2 ♂). Same data but 4,880'; 5, 23 August 1967 and at 5,400'; 7 May 1966; J. G. Franclemont (3 ♀). Silver Creek Wash, 0.7 mi W of Portal, Cochise County; 24 August 1966; J. G. Franclemont (1 ♂). Madera Canyon, 4,880', Santa Rita Mountains, Santa Cruz County; 19, 23 May 1963, 4 September, 10 October 1959; J. G. Franclemont (4 ♂). White Mountains, no date (1 ♀). North rim, Grand Canyon, Coconino County; 16, 17 July, D. Meadows (3 ♀). Madera Canyon, Santa Rita Mountains, southern Arizona, 17 July 1947; J. A. Comstock & L. M. Martin (1 ♀). Walnut Canyon, 6,500', 6½ mi ESE Flagstaff, Coconino County; 6–18 August 1964, 2–26 August 1965; R.W. Poole (2 ♂, 6 ♀). Molino Basin, 4,000', Santa Catalina Mountains, Pima County; 12 June 1958; J. M. & S. M. Burns (1 ♂). California. Pinyon Flat, San Jacinto Mountains, Riverside County; 14 July 1977; J. W. Johnson (1 ♂, 1 ♀). Same data but taken 11 July 1978 (1 ♀). Westguard Pass, White Mountains, Inyo County; 19 July 1968; P. Opler, J. Powell, J. A. Scott (1 ♀). AMNH, CU, JDG, LACM, UCB, USNM.

Digrammia pallorata occurs at least from Johnson, Lampasas, and LaSalle counties, Texas, across West Texas, New Mexico, and Arizona to Riverside and Inyo counties, California; and it has been collected northward in Alamosa and Garfield counties, Colorado; central Utah, where it was common in the oak-pinyon-juniper zone between 5,800 and 7,100 feet in Ephraim Canyon, Manti-La Sal National Forest; and in White Pine and Lander counties, Nevada.

This species occurs across so many isolated montane habitats and climatic zones that the

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flight times for individual generations are not easily determined, although it appears to be double or triple brooded everywhere. Flight times for Texas: 11 March–17 April, 6 May–1 July, and 30 September; for New Mexico: 26 March, 26 June, 8 July, 26 July–30 August, 1 October; for Arizona: 11 April–12 June, 5 July–30 August, 4 September–10 October; for California, 14–19 July; for Utah, 7 May, “June,” 12 July–13 August; for Colorado, May–September.

Digrammia cinereola (Hulst)

PL. 7, FIGS. 8–11 (adult); PL. 14, FIGS. 10, 11 (larva) (RWH 6363, part, 6375).

Diastictis cinereola Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 335, REVISED STATUS, NEW COMBINATION.

Type locality: Colorado. [AMNH]

NOTE—The holotype is a female labeled Glenwood Springs, Colo., 8-1892, W. Barnes. It is very worn and in poor condition, but I think recognizable as the species treated here.

Phasiane septemberata Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N. Amer.*, **3**: 235, pl. 23, fig. 4, SUBSPECIES, NEW SYNONYMY.

Type locality: Paradise, Cochise County, Arizona. [USNM]

NOTE—Described from four male and four female syntypes in the Barnes collection. Seven of them are in the USNM. I hereby designate as the lectotype the specimen that McDunnough labeled as the type male. It is the one illustrated in the *Contributions*, pl. 23, fig. 4.

This species is distinguished by its plain, uniformly gray or gray-brown coloring and simple, smoothly curved black transverse bands, which, however, may be absent or nearly so in the Arizona subspecies *septemberata*. The black transverse bands, when present, are nearly erect from the inner margin, less likely to be oblique and/or double as in *excurvata* and *imparilata* and not as sinuous as in *setonana*. The medial band is nearly absent; and the black antemedial and postmedial bands of the forewing may be almost exactly like those of *napensis* or *imparilata*, although better defined in nominate *cinereola* than in the latter species. The ground color, when it shows through the gray scaling, is nearly white, and specimens from the eastern side of the Sierras in California are very pale, strongly banded, and distinctive; most specimens from the southern Rocky Moun-

tain region are entirely gray except for the black transverse lines of the forewing. The moths are relatively consistent in size, pattern, and wing shape, and differ from those of most related species in that the males and females are more nearly the same size. The nominate subspecies has long been considered only part of the variation of *excurvata*, and its name treated as a synonym of that species. However, I am convinced that *cinereola* and *septemberata* are geographic variants of the same species. Although mainly separate geographically, there is ample evidence of intergradation where they meet.

Neither the male nor female genitalia appear to differ in any consistent way from those of other members of the *continuata*-group except *atrofasciata*, which has a difference in the male valve (text figure 50 d).

Digrammia cinereola cinereola (Hulst, 1896)

PL. 7, FIGS. 8, 9; PL. 14, FIGS. 10, 11 (larva) (RWH 6363, part).

Diastictis cinereola Hulst, 1896.

Type locality: Colorado. [AMNH]

Forewing pale to dark gray; antemedial band straight or slightly convex; postmedial band regular and of uniform width, slightly excurved opposite the discal spot in the usual way and slightly concave between that point and inner margin; medial band nearly absent. Transverse bands vary little except in width; antemedial and postmedial bands well separated, more so in females than males; and postmedial may have little or no dark shading associated with it. Wings long and of ample area, and forewing often has a rounded rather than produced shape at the apex. Hindwing uniformly gray, marked only by traces of two dark transverse bands near inner margin. Discal spots absent or nearly so on both wings. Undersurfaces uniformly gray, almost without a pattern. All of the subtle differences mentioned above together give this subspecies a special character by which it may nearly always be distinguished, not only from subspecies *septemberata*, but from other species. Wing length: males, 13–16 mm; females, 13–16 mm. Most specimens about 15 mm in both sexes (n = 63).

Noticeable geographic differences within this subspecies seem limited to variation in the shade of gray. Specimens from West Texas to Colorado have a tendency to be darkest, with the whitish

ground color almost completely obscured; and those from California lightest, being a very pale whitish gray; others are intermediate.

I reared three broods of this species from females taken in Ephraim Canyon, Sanpete County, Utah; at Fort Davis and at a roadside picnic area in Madera Canyon, Davis Mountains, Jeff Davis County, Texas, where *cinereola* was common in late March 1993. The Utah female resembled the Arizona subspecies, *septemberata*, but the resulting larvae were no different from those of nominate *cinereola*. I provide only one description, as follows, based on larvae reared from a female taken 25 March 1993 in Madera Canyon, Texas. Head green with some white shading laterally, including base of antenna and subdorsally in area of the herring-bone pattern that marks the parietal lobes in black dorsally, changing to white ventrally; lower edge of labrum white; mouthparts otherwise reddish brown; clypeus brownish. Body green with strong, somewhat sinuous, interrupted, white subdorsal stripe; a weak, interrupted white subventral stripe; and still less distinct, obsolescent, whitish addorsal and adventral lines; second and third thoracic segments with purplish-brown lateral spot, edged with white ventrally; abdominal segments one to six each with a U-, V-, or J-shaped, dark chocolate to blackish lateral mark filled with white or greenish white, with the open side facing cephalad and the dark brown upper arm enclosing the spiracle and inclining upward anteriorly, giving the lateral pattern of each segment its oblique aspect; this lateral segmental pattern continues much diminished on A7 and A8. Segments A2–5 each with a large, ventral, purplish-brown patch; pinacula blackish and mostly large enough to be conspicuous. Thoracic legs green; abdominal legs green with whitish lateral shading. A special and possibly diagnostic feature of this species, present in most but not all specimens, is a pink to light brown or purplish-brown dorsal spot on A5, or straddling the line between A5 and A6, in which case it may be somewhat hourglass shaped. This may be small or rudimentary, or often divided bilaterally at the middorsal line into two smaller spots. This marking is not present in *pallorata* or *atrofasciata* of the same area nor in any other species whose larva I have seen; and the extensive yellow-brown shading conspicuous ventrad of the white lateral abdominal markings in *pallorata* is not present in *cinereola*.

The Utah female, which resembled subspecies

septemberata, produced larvae with much smaller white lateral markings than those from Texas. It would require more rearings to determine whether this difference is consistent. Meanwhile, it can be explained only as part of the normal intraspecific variation. Larvae of both broods had the characteristic brown dorsal markings on A5, otherwise seen only sometimes in *D. pallorata*. Although larvae of *cinereola* and *pallorata* key out closely, *pallorata* has larger white and brown lateral markings.

Juniperus monosperma (Engelm.) Sarg., *J. pinchotii* Sudw., and *J. deppeana* Steud. (= *pachyphloea* Torr.) (Cupressaceae) were present where moths were collected in Texas, and all were accepted by the newly hatched larvae. The Utah larvae fed on *J. monosperma*, which was present at the collecting site. I offered foliage of various unidentified, ornamental junipers to the later instar larvae and they readily transferred their attention to these, often abandoning the native junipers but possibly only to choose the fresher foliage.

The nominate subspecies of *cinereola* occurs in the Davis Mountains, Sierra Diablo, and Guadalupe Mountains of West Texas, where some specimens appear transitional to subspecies *septemberata*, and in neighboring New Mexico, thence northward to Colorado (Montezuma, Alamosa, Chaffee, Fremont, and Garfield counties) and Wyoming (Platte County); in Sevier County, Utah; in Elko County and Verdi, near Reno, Nevada; and westward in Mono County, and in Yosemite National Park, California. I have not seen it from California west of the Sierras, or from Arizona where it is replaced by subspecies *septemberata*, although some intermediate specimens occur in Arizona.

The California records are few, but four specimens that I took on Lee Vining Creek, Mono County (plate 7, figure 9) were so pale and distinctive that I did not recognize them at the time as *cinereola*. In March 1993, I found this to be one of the commoner moths of the Davis Mountains, and at White's City, Eddy County, New Mexico it was surpassed in abundance only by *Rindgea prolificata*.

Flight period data for *cinereola* is sparse because few specimens have been collected in most of its range. It is likely that at least two generations occur widely. The known flight times for Texas and adjacent New Mexico are 21 March–23 May and 25–27 August; for Colorado, 27

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May–13 July; Wyoming, 6 July; Utah, 28 May–early August; Nevada, 15–22 July; California, 27 June–1 July. Specimens were collected at 4,000–8,200 feet, and it would be expected that at higher elevations a univoltine life cycle would prevail.

Digrammia cinereola septemberata
(Barnes and McDunnough)
PL. 7, FIGS. 10–11 (adult) (RWH 6375).

Phasiane septemberata Barnes and McDunnough, 1917.

This is a plain, mouse-gray subspecies, with the black transverse lines of the forewing reduced, fragmentary, or absent. Many specimens, including the lectotype, have complete but very thin, black antemedial and postmedial lines. In southern Arizona, however, where subspecies *septemberata* is especially prevalent, the moths may have fragmentary markings or none. It resembles an almost immaculate form of *D. napensis* that occurs in central California, and bears some resemblance to *D. burneyata* but averages smaller and is a true gray, not grayish brown like *burneyata*. The genitalia are not helpful for identifying either subspecies of *D. cinereola*.

The gray wings of *septemberata* most often uniformly colored, although some may be faintly mottled or variegated with paler shade, especially in median space. Blackish antemedial line inclined outward slightly, being up to twice as far from base at costa than at inner margin; it may be somewhat rounded or nearly straight, thin, usually faint, obsolescent, or missing entirely. Postmedial line also very faint, regular, curved outward around end of discal cell, usually meeting costa obliquely, often obsolescent. Faint, diffuse medial band sometimes present, subparallel to antemedial and postmedial lines. Hindwing only slightly paler than forewing, usually without markings except for trace of postmedial band near inner margin. Inner margin whitish in some specimens. Faint, diffuse discal spots may be present on both wings in some specimens but more often absent. Thin, dark, slightly crenulate terminal line with whitish outer edging present on both wings; fringes concolorous with gray wing coloring and only sometimes show faint, dark checkering. Undersurfaces gray, hindwing paler than forewing and finely variegated with whitish. Outer third of hindwing may be slightly darker, forming broad distal band, occasionally noticeable also on forewing. Fringes beneath may be

paler than above. Wing length: males, 13–16 mm; females, 13–17 mm. As usual in this genus and many other Geometridae, winter, fall, and early spring specimens average larger than summer or early fall ones.

Genitalia not differing from those of nominate subspecies or from other species of the juniper-feeding complex except *D. atrofasciata*, as described under that species and illustrated.

I have not reared *septemberata* from Arizona and have no information on the larva. It is probably similar to that of nominate *cinereola* and would be expected to feed on species of *Juniperus* or *Cupressus* (Cupressaceae).

Subspecies *septemberata* occurs across southern Arizona from the Chiricahua to the Baboquivari Mountains and in the Peloncillo Mountains, Hidalgo County, New Mexico. Specimens that appear intermediate between this and subspecies *cinereola* occur in the mountains of West Texas and less commonly in Arizona. In Arizona it has been collected in every month from April to October.

As indicated earlier, dark or poorly marked unicolorous specimens of a few other species, such as *napensis*, may resemble *septemberata* closely, but within its range there is usually nothing with which *septemberata* need be confused.

Digrammia burneyata (McDunnough),
NEW COMBINATION
PL. 7, FIGS. 12, 13 (adult); PL. 14, FIG. 12
(larva) (RWH 6376).

Semiothisa burneyata McDunnough, 1939,
Can. Ent., **71**: 253.

Type locality: Burney Mt., Shasta County,
California. [CNC]

This is a relatively distinctive, large, plain, uniformly gray-brown species, often with hardly any markings other than the thin, regular, black postmedial band that tends to be only slightly curved and nearly parallel to the outer margin; the pattern most resembles that of *D. modocata*. It also somewhat resembles that of lightly marked *D. cinereola* in the near absence of markings, but the distribution of *burneyata* is not known to overlap with that of *cinereola*. *Digrammia burneyata* is confined to the mountains of Oregon, California, and northwestern Arizona. It seems to be associated primarily with incense cedar, *Calocedrus decurrens* Torr., but will also feed on *Thuja* (both Cupressaceae). I discuss the life history and dis-

tribution in more than the usual detail because this species was little known until now and usually misidentified.

Fresh specimens of *burneyata* are mouse gray, although many older specimens in collections have faded to a light gray brown or light brown. The antemedial line of the forewing is weak, often barely apparent, and slightly convex. The postmedial is usually better developed, thin, black, sharply defined, regular, slightly convex toward costa and concave toward the inner margin, but the postmedial also may be incomplete or obsolescent. A faint, diffuse, nearly straight median band may be present, as well as a faint discal spot. The hindwing is plain gray brown, becoming slightly paler toward the costa, with a fragment of the postmedial showing at the inner margin. The fringes are concolorous with the wings, sometimes faintly checkered. The underside is lighter gray, unmarked except sometimes for a faint discal spot. Wing length: males, 15–17 mm; females, 15–17, most commonly in the range of 16–17 mm.

Genitalia of both sexes probably indistinguishable from those of most other members of group. However, there is tendency for digitiform process of aedeagus in male genitalia to be small and slender, although arising from large base. In size this process intermediate between those of most related species and that of *modocata*, in which it is further reduced. Female with ostium seemingly narrower than usual, and winglike plates of sternum large and wide, but these features variable and inconsistent.

This species was first reared by Brian Scaccia from larvae collected by beating *Calocedrus decurrens* and *Thuja plicata* D. Don. in southwestern Oregon in 1989. When offered a choice, the larvae accepted the foliage of both trees. The next year I reared *burneyata* from eggs laid by a female collected in the Siskiyou Mountains, Josephine County, Oregon in July, and these larvae were fed entirely on *Calocedrus*. The adults emerged the following spring. The larvae found by Scaccia were collected when midsized to almost mature on 17 July near Grants Pass and 26 August in Lane County, suggesting either two broods or an extended period of development.

Larva, including head and legs, a shade of green matching foliage. Body marked with slightly irregular longitudinal white stripes or lines; middorsal stripe darker green, flanked by pair of weak, interrupted, pale addorsals; subdorsal

stripes more distinct, nearly continuous, but unevenly delineated and irregular in width; lateral stripe wider, even more indefinite in outline, and discontinuous, being reduced mainly to a diffuse, slightly oblique patch beneath each spiracle, and continuing down side of last proleg. Underside is green with weak, irregular, white subventral stripes. Head with yellowish-white lateral patch or band, which is continuation of lateral body stripe. Spiracles light yellowish, thinly ringed with dark brown; those on A2–A5 also surrounded by slight outer ring of dark purplish-brown pigmentation. Like many juniper feeders, *D. burneyata* has modified its cryptic pattern by disruption of longitudinal lines, which tend to be broken into segments and in part offset or inclined obliquely in manner that blends with peculiar foliage of the Cupressaceae. However, disrupted pattern not highly developed in *burneyata*, being about midway between that of species on Pinaceae and those on *Juniperus*.

Digraemia burneyata is known from Chang-copush Hot Springs, Rainier National Park, Washington (one specimen, AMNH), and from Jefferson, Lane, Josephine, and Klamath counties, Oregon; Siskiyou, Shasta, Lassen, Trinity, Plumas, El Dorado, Calaveras, Mariposa, Fresno, Tulare, Kern, San Bernardino, Los Angeles, Riverside, and San Diego counties, California; and from the Hualapai Mountains, 6,100', Mohave County, Arizona. More specifically, some of the Oregon collection sites are as follows: Warm Springs [Jefferson County], Andrews Experimental Forest, Lane County, Bly Mountain [Klamath County], and Siskiyou National Forest near Kerby, Josephine County, Oregon; and some of those in California are: McArthur-Burney Falls Park, Shasta County; McBride Springs Campground, Mt. Shasta; Castle Crags State Park, Shasta County; North Bridge Campground, Lassen National Forest; Riverton and Blodgett State Forest, El Dorado County; Greenhorn Mountains, Kern County; Camp 4 area, 4,000', Yosemite National Park; Grant Grove, Sequoia National Park, Fresno County; Mineral King, Tulare County; San Bernardino Mountains; Pine Cove, San Jacinto Mountains, Riverside County; and Mt. Palomar, San Diego County. I found a specimen labeled Huachuca Mountains, Arizona, probably in error, although those from the Hualapai Mountains were collected recently by my colleague, John Brown, and are considered authentic.

The label data on adults generally indicate one

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brood in Oregon and California, flying mainly in June and July; but there are exceptional records for as early as 19 May (Warm Springs, Oregon) and 31 May (Bly Mountain, Oregon). There may be an early season brood otherwise overlooked. It was taken 11 April in the Hualapai Mountains. The larvae that I reared from a female taken 18 July grew slowly, pupated in September, and produced no emergences until the following spring.

Digrammia atrofasciata (Packard), NEW COMBINATION

PL. 7, FIGS. 14–17 (adult); PL. 14, FIG. 13 (larva); TEXT FIG. 50 *d* (♂ gen.) (RWH 6367, 6368).

Phasiane atrofasciata Packard, 1876, in Hayden, *Geol. Surv. Terr.*, p. 264, pl. 9, fig. 74.

Type locality: Waco, Texas. [MCZ]

NOTE—Described from at least three syntypes. I designate as lectotype a female bearing the large, red-bordered Packard type label and the number “39” pinned beneath the specimen on a separate small slip of yellow paper. The lectotype is intact, with abdomen.

Phasiane nigroalbana Cassino, 1928, *The Lepidopterist*, 4: 94, NEW SYNONYMY.

Type locality: Alpine, Texas. [MCZ]

NOTE—The holotype, allotype, and a large series of paratypes in the MCZ, plus two in the USNM, are all in good condition and represent the large spring form of this species. The types of *atrofasciata* are of the smaller summer form, which was thought until now to be a distinct species.

This southwestern species, with its oblique, boldly dark shaded black and brown transverse bands on the forewing, and more distinctly mottled or variegated hindwing, is more easily recognized than most members of the juniper-feeding group. It is also the only member of the group that is easily recognized by a feature of the male genitalia; namely, the unusually increased length of the serrated medial ridge on the inner face of the sacculus of the valve. It is found in suitable habitats from Oklahoma and East Texas to California.

Forewing ground color pale gray, almost white, but more or less suffused with dark brown, almost entirely so in some, especially summer specimens; antemedial band wide, black, straight or slightly convex, always oblique, about twice as far from wing base at costa as at inner margin,

and often appearing double (i.e., as two closely parallel bands, the proximal one usually dark brown rather than black); postmedial band straight or slightly concave, but often with a slight convexity opposite the small, indistinct discal spot; postmedial band subparallel to antemedial, and also commonly double, with black proximal and dark brown distal components; a much less boldly defined, dark medial band, parallel to postmedial, may also be present, running through or slightly basad of discal spot; median space paler than the more brownish basal and distal thirds, although distal third may be pale in its outer half, with ground color showing through as a pale gray, diffuse, subterminal band; a short, dark streak, parallel to postmedial, marks position of subterminal band or line at costa. Hindwing pale gray to pale brownish in light colored specimens, dusky in darker ones, variably marbled or mottled with white and blackish scaling toward inner margin and there resolving into diffuse remnants of the transverse lines, of which the postmedial is most distinct. Wing margin with the usual thin, interrupted terminal line, and unicolorous fringes that may be faintly checkered in paler specimens and solidly brown in darker ones. Underside paler, dull gray brown, vaguely marked, but with paler median space showing on forewing and usually a wide, darker, subterminal band on the otherwise pale brownish dusted hindwing; weak discal spots on undersides of both wings. Body gray brown; abdomen frequently marked transversely with thin, black or dark segmental bands that may have pale posterior margins. Palpi and legs gray brown, the latter with a mixture of lighter scales, and the hindlegs more whitish than brown. Front brown with a white ventral margin. Wing length: spring males (Feb.–Apr.), 13–16 mm; spring females, 13–16 mm; summer males (May–Oct.), 11–14 mm.; summer females, 11–14 mm (n = 200+).

This species shows both geographic and seasonal variation of the same feature, namely the degree of brown suffusion of the ground color. Eastern specimens from Texas and Oklahoma tend to be darker than those from farther west; and 10 summer specimens from the Arbuckle Mountains, Murray County, Oklahoma are the darkest seen. Eastern (Texas) summer specimens are not only smaller but decidedly darker than spring ones. Specimens from New Mexico, Arizona, and California tend to be paler and less brownish than the palest Texas specimens and

show relatively little difference between spring and summer broods. These may be difficult to distinguish from similar species such as *excursata* and *pallorata*. Intergradation between the darker eastern and paler western specimens occurs in Brewster, Randall, Hudspeth, and Culberson counties, West Texas. Although most specimens from the Davis Mountains are typical of those from central Texas, representing essentially the same geographic form, the names *atrofasciata* and *nigroalbana* from these areas refer to the somewhat different summer and spring forms respectively, giving rise to the notion that two species are present. I verified that early and later season specimens are forms of the same species by rearing summer adults from females collected in Kimble County in June and Jeff Davis County in March.

Digrammia atrofasciata is easily recognized by the male genitalia (text figure 50 *d*), in which the large, pointed, inwardly directed process arising from the distal margin of the saccular lobe of the valve is lengthened and fused to the saccular lobe, forming a serrated ridge down its inner face, almost reaching the base. This structure is close and parallel to the edge of the costal lobe. The serrated ridge thus formed is about twice the length of the corresponding structure in related species, although the genitalia hardly differ otherwise. No differences are apparent in the female genitalia.

Last instar larva with head green, not shiny; clypeus mostly dark brown; labrum dark green; parietal lobes white where bordering clypeus, but with thin herringbone pattern on sides and top, mostly patterned in blackish but partly white. Body green, color of juniper foliage, with thin, faint, broken cream-colored middorsal and ad-dorsal; a wider, interrupted, irregular white sub-dorsal apparent in most specimens; segments A2–A5 with irregular white blotch laterally, bordered with dark purplish brown posteriorly and dorso-posteriorly, incorporating the pinacula of the SD1 and L1 setae and the spiracle, and inclined forward in such a way as to make the lateral markings appear oblique. Both the white shading and brown diffuse edging may extend below the lateral fold and into the subventral area. Underside dull green with dark pinacula, which are otherwise not developed, conspicuous toward midventral area. The lateral markings are indicated much less clearly on the thoracic and remaining abdominal segments. Thoracic and abdominal legs

greenish with traces of white shading on lateral surfaces. Setae on body black and rather long. Length of largest larvae at maturity: 23 mm.

I found *Digrammia atrofasciata* in association with Ashe's juniper, *Juniperus ashei* Buchholz, in Kimble County, Texas, and one-seeded juniper, *J. monosperma* (Engelm.) Sarg. in Jeff Davis County, Texas. The larvae were reared on these as well as on alligator juniper, *J. deppeana*, from the Davis Mountains, and on various unidentified ornamental junipers.

This species occurs widely but discontinuously from Bosque, McLennan, Bell, Travis, and Bastrop counties, Texas to southern California. Its southern limits as far as known are Uvalde and Brewster counties, Texas; Cochise and Santa Cruz counties, Arizona; and Los Angeles County, California; and the northern limits are Murray County, Oklahoma (Arbuckle Mountains); Randall County, Texas (Palo Duro Canyon); Baca, Boulder, Fremont, Garfield, and Las Animas counties, Colorado; Sanpete County, Utah; White Pine County, Nevada; and San Bernardino County, California (several localities). As relatively few have been identified from outside of Texas or southeastern Arizona, I should add that I have also seen it from Socorro, Los Alamos, Hidalgo, and Grant counties, New Mexico; Zion National Park, Washington County, Utah; Coconino and Gila counties and the Chiricahua and White Mountains, Arizona. It is common in Cave Creek Canyon, Chiricahua Mountains, judging by a series of 66 collected there by J. G. Franclemont in July and August. The distribution in California seems especially limited, and few are known to have been collected. The habitats range from near sea level in Texas to over 7,000 feet in Colorado.

The flight period for Texas falls into three periods, 25 February–15 April, 3 May–4 July, and 11 September–15 October. The dates for Oklahoma are 19–30 July; for New Mexico and Arizona, 10 May–30 August; and for Colorado and Utah: 10 July–27 August. The California dates are 11 March–1 May and 25 August.

Digrammia modocata Ferguson, NEW SPECIES

PL. 7, FIGS. 18–20 (adult); PL. 14, FIG. 14 (larva).

Digrammia modocata Ferguson.

Type locality: Two miles NE of Timbered

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Crater, 3,600', Siskiyou County, California.
[USNM]

This quite easily recognized species of Oregon and northern California has a variably shaded, bluish-gray forewing and brown, almost unmarked hindwing. The slightly curved, subparallel antemedial and postmedial bands are widely spaced, and the postmedial is often much more distinct than the antemedial. The moths average large, about the same size as *burneyata*, to which *modocata* may be most closely related. It is the only member of the group with the digitiform process of the aedeagus so reduced that it does not protrude outside of the aedeagal shell. Otherwise the genitalia of both sexes are exactly like those of *burneyata*.

Forewing gray with faint violaceous tint when fresh, sometimes dusted with dark scales that may be arranged in a transversely strigose pattern of numerous very fine, parallel dashes; antemedial band brown to blackish, nearly erect from inner margin, straight or slightly curved, and weak or obsolescent; postmedial band blackish, more distinct than antemedial but also sometimes weak or obsolescent, its course convex to M_2 , then curving slightly toward costa, which it meets obliquely. A faint, diffuse, brown medial band or shade may be present, and postmedial band usually shaded outwardly with dark brown, which may be slightly rust tinted. Hindwing dusky, unmarked except for a faintly variegated inner margin. Hindwing, more so than forewing, with very thin, dark terminal line, bordered outwardly, between terminal line and the gray fringe, with whitish. Undersurfaces gray, unmarked. Antennae of most males with unusually wide antennal shaft and proportionately long setae. Wing length: holotype, (15 mm); other males, 14–16 mm; females, 14–16 mm.

Male genitalia with digitiform process of aedeagus much reduced, not projecting outside of aedeagus; may appear absent in some preparations (one of four examined), depending on quality of staining and position of aedeagus on slide. Digitiform process of what I assume to be the most closely related species, *burneyata*, is better developed. In all other respects, the male genitalia resemble those of *burneyata* and most others of the *continuata*-group.

Female genitalia as in other species of the group, although the “wings” (lateral processes) of the sterigma tend to be unusually large and wide, a trend also apparent in *burneyata*.

TYPES. Holotype ♂. USNM. 2 mi NE of Timbered Crater, 3,600', Siskiyou County, California; reared 3 August 1999 from larva on *Cupressus bakerii* (larva collected 10 July 1999, pupated 19 July 1999); L. L. Crabtree (USNM). Paratypes: 47 ♂, 28 ♀. California. Same data as for holotype; reared 3 August, 30 July 1999 (2 ♂); reared 28 July 1999 (1 ♀). Timbered Crater, 17 mi N of Fall River Mills, Siskiyou County; larva coll. from Modoc cypress 10 July 1999, pupated 23 July 1999, emerged 10 February 2000 (1 ♂). Hat Creek Ranger Station, Shasta County; 14, 19 July 1947; F. H. Rindge (3 ♂). Buck Creek Ranger Station, 5,150', Modoc County; 5–10 June 1970; P. A. Opler (13 ♂, 8 ♀). Cedar Pass, 6,000', Warner Mountains, Modoc County; 9 August 1965; E. & I. Munroe (1 ♂). Cedar Pass Campground, 5,900', Modoc County; 23 July 1968; J. Scott (1 ♂). Juanita Lake, 5,100', 9 km W McDoel, Siskiyou County; 24/25 June 1980; J. Powell & J. DeBenedictis (1 ♂). Blodgett State Forest, 18 mi E of Georgetown, El Dorado County; at light, 28 June, 15 July 1967; J. Powell (2 ♂). Oregon. Madras, Jefferson County; 5 May 1960; F. H. Rindge (2 ♀). Warm Springs, Jefferson County; 6, 29 April 1960; S. G. Jewett, Jr. (1 ♂, 1 ♀). Palisades State Park, Jefferson County; 14 June 1963; S. G. Jewett, Jr. (1 ♂). John Day, Grant County; 3 July 1964; Kenneth Goeden (1 ♂). Bend, Deschutes County; 29 May, 7 August 1964; Kenneth Goeden (2 ♂). Hwy. 20, 10 mi E of Bend, Deschutes County; 24 July 1993, reared from larva on *Juniperus occidentalis*, 93-33; [J. C. Miller] (1 ♂). Vic. Firwood Rd., 4 mi W Oregon City, Clackamas County; 1 July 1978; S. G. Jewett, Jr. (1 ♂, 1 ♀). Stinkingwater Mountain, Harney County; 24 June 1961; J. H. Baker (3 ♂, 5 ♀). Frenchglen, Harney County; 21 May 1950; J. H. Baker (1 ♀). Prineville, Crook County; 8 June 1958; J. H. Baker (1 ♂, 1 ♀). Prineville, Ochoco Wayside Overlook, Crook County; reared 24 June 1993 from larva on *Juniperus occidentalis* (93-39b,c, 93-38, 93-60, 93-64, 93-71, 93-77, 93-82) [J. C. Miller] (4 ♂, 4 ♀). 10 mi NW of Prineville, 3,500', Crook County; 21 July 1962; W. C. Cook (1 ♂). 7 mi E of Sisters, Dechutes County; reared 15 July 1993 from larva on *Juniperus occidentalis* (1 ♂). 13 mi SE of Sisters, Deschutes County; 29 May, 1964; J. H. Baker (2 ♂). Kahneetah Hot Springs, 1,600', Deschutes River, Jefferson County; 20 June 1968; Wm. Nelson (1 ♂, 1 ♀); Crater area, Christmas Valley, Lake County; 15 June 1970; J. H. Baker (1 ♂). Monument Peak, Linn County; 3 May 1969; C. Wm. Nelson (1 ♀). Black Butte, Jefferson County; reared 1 July 1986 from larva on *Juniperus occidentalis* Hook.; J. C. Miller (1 ♂). 5 mi NE of Kimberly, 2,200', Grant County; 5 September 1962; W. C. Cook (1 ♂, 2 ♀). AMNH, CNC, LACM, LLC, OSUO, UCB, USNM.

Five *Digrammia modocata* adults, including the holotype, were reared from larvae found on Modoc (Baker's) cypress, *Cupressus bakeri* Jeps., by Laurence L. Crabtree. Others were reared in

Oregon from western juniper, *Juniperus occidentalis* Hook., and the larva illustrated as that of an undescribed species (Miller, 1995: 32), based on reared adults that had been sent to me for identification. I have not seen the larva, but as figured by Miller from a colored photograph, it is a superb match for the juniper foliage on which it is resting. The coloring is the usual green, white, and gray or blackish arranged in a complex, broken mix of longitudinal, transverse, and oblique elements, but arranged in what appears to be an atypical pattern. The larva stands out as darker than most I have reared because of a predominance of gray to blackish in the color scheme. Other species, such as *napensis*, have dark larval color forms, and the Oregon larva just discussed may have been such an individual.

All of the known localities for *Digrammia modocata* are as listed for the types. The largest sample seen from one place was collected in the Warner Mountains, Modoc County, by P. A. Opler and others. The species has one of the most limited distributions of the *continuata*-group. Although it might prove to extend into Washington, British Columbia, or Idaho, I have seen no specimens from those regions. It is clearly distinct from *setonana* (British Columbia) and *pertinata* (Montana and southward). The flight period, from May to early August and, at least occasionally, in September, suggests two main generations and a partial third. This is supported by the presence of mature larvae in early July that proceed mostly without diapause to produce a summer generation of adults in late July and early August.

The *muscaria*-GROUP

Plain, brown moths [*muscaria* and *extenuata*, ed.] with outer margin of wings rounded, not angulate; forewing crossed by three regular, narrow, often evenly spaced, dark brown lines roughly perpendicular to inner margin; hindwing with two incomplete transverse lines. Antennae, palpi, and legs about as in most species of genus; male antennal setae slightly longer than thickness of antennal shaft; male hindtibiae enlarged, deeply grooved, containing a light reddish-brown hair pencil. Pecten well developed. Male genitalia with saccular lobe longitudinally divided by prominent, dentate ridge somewhat like those of *denticulata*, *pallidata*, *triviata*, or, most of all, *ordinata*. Female genitalia of the widely prevalent *californiaria-pallidata* type, but recognizable as

belonging to *muscaria*-group by minor differences, as may be seen in the illustrations. Genitalia showing no appreciable differences between the two included species in either sex.

The genitalia and wing pattern of these moths are surprisingly similar to those of the *eremiata*-group, but the cryptic brown larva and the hosts, which for *muscaria* are various western oaks, would seem to belie any close relationship to a group of legume feeders.

The male genitalia clearly resemble those of *D. ordinata* and to a lesser extent *eremiata*. The wing pattern most nearly matches that of *equivocata*, although that species has aberrant male genitalia that make it difficult to place. Species of the *muscaria*-group include the only American macariine known to be an oak feeder.

Digrammia muscaria (Guenée)

PL. 7, FIGS. 21–24 (adult); PL. 14, FIG. 15 (larva); TEXT FIG. 51 *a*, *c* (♂ gen.); TEXT FIG. 51 *b* (♀ gen.) (RWH 6377, 6378, 6379).

Tephрина muscaria Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 98.

Type locality: California. [USNM]

NOTE—Described from a male and a female. The male, now in the USNM, is hereby designated the lectotype. The location of the female syntype has not been determined.

Macaria respersata Hulst, 1880, *Bull. Brooklyn Ent. Soc.*, 3: 42, NEW SYNONYMY, SUBSPECIES.

Type locality: Colorado. [USNM]

NOTE—Described from 10 syntypes from Colorado. I hereby designate as lectotype a male in the USNM labeled: “Col.,” “Collection/Brklyn Mus;” “Type No./34216/U.S.N.M.,” “*Macaria respersata* Hulst Type; and male “gen. 953/20 Apr 34 FHB[enjamin].” A lectotype label has been added. Except for the loss of the right hindwing, the specimen is in almost perfect condition.

Diastictis subacuta Hulst, 1896, *Trans. American Ent. Soc.*, 23: 335, NEW SYNONYMY.

Type locality: Colorado. [AMNH]

NOTE—Described from an unspecified number of syntypes (probably 2) from Colorado and Nevada. A female from Colorado from the Hulst collection was selected as the lectotype by Barnes and McDunnough (1916: 180). Another type, from the Neumögen collection (USNM), is a small female of *Drepanulatrix falcataria* (Packard) labeled Nevada.

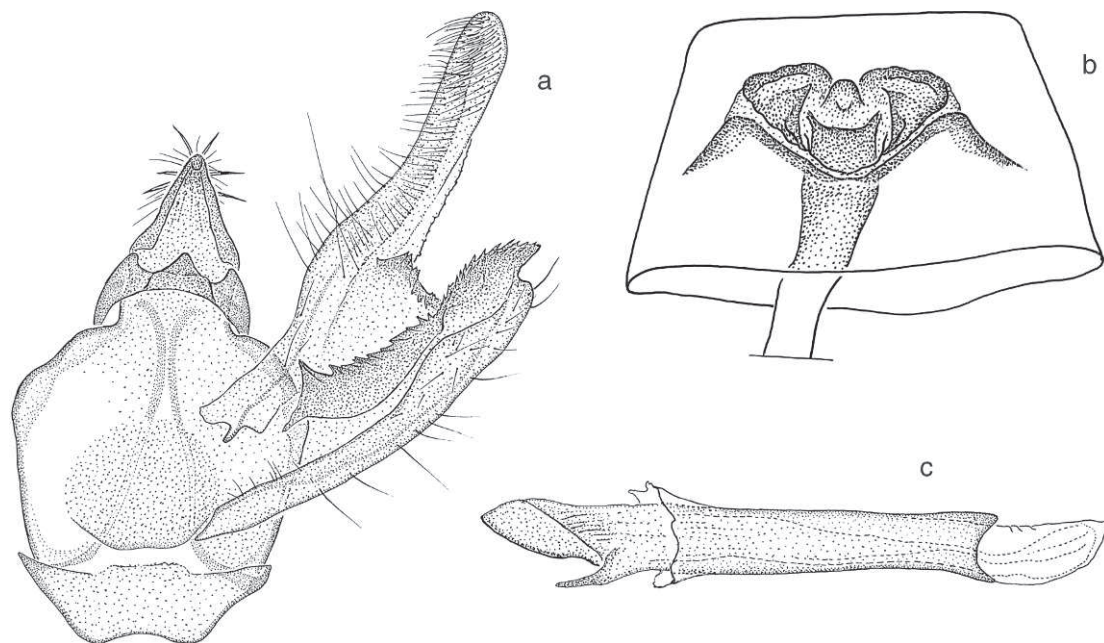


FIGURE 51: GENITALIA OF *DIGRAMMIA MUSCARIATA RESPERSATA*

a. Male genital capsule; Walnut Canyon, Coconino County, Arizona (USNM 52977). *b.* S8, ostium bursae and ductus bursae; Shasta Retreat, Siskiyou County, California (USNM 53325). *c.* Aedeagus; Walnut Canyon, Coconino County, Arizona (USNM 52977).

Macaria teucaria Strecker, 1899, *Lep. Rhop. Heter.*, Suppl. 2: 8, NEW SYNONYMY, SUBSPECIES.

Type locality: Seattle, Washington. [FMNH]

This is a widespread, western, oak-feeding species, with light brown wings, three thin, regular, almost parallel, darker brown, transverse lines on the forewing, and two similar but incomplete lines on the hindwing. The wings are dusted with dark brown scales. The moth is distinctive and likely to be confused only with the similar but darker, less distinctly marked *D. extenuata*. Forewing light brown with a fine, even, granulated aspect because of a dusting of dark scales; antemedial, medial, and postmedial lines almost equally developed, thin, regular, almost perpendicular to inner margin, subparallel but diverging slightly toward costa, and usually slightly curved basad before meeting costa; small black spot often present near middle of postmedial line, usually repeated as a second or second and third black spot just beyond postmedial line; these spots, which are vestiges of the extramedial spot, are most prevalent in nominate subspecies, usually obsolescent or missing in *respersata* and *teucaria*; discal spot a blackish dash, aligned at 90° to costa, and usually lying in path of medial line; terminal margin with row of minute blackish

dots; fringes concolorous with wing, unmarked. Hindwing similar, slightly paler, with small brown discal spot, and incomplete medial and postmedial lines, strongest at inner margin, fading out in middle of wing or toward costa. Under-surfaces with markings faint. Body, legs, and palpi uniformly colored, unmarked. Wing length: 14–16 mm for both sexes, although females average slightly larger than males. Male genitalia of this species (text figure 51 *a*, *c*) and *extenuata* characterized by a high, bladelike, serrated ridge on concave inner face of valve, running longitudinally through middle of ventral lobe. This may have one or usually two very prominent dentate processes and be with or without a series of smaller ones. Aedeagus with distinctive, slender, pointed, preapical process, different enough from those found in many other species to cast doubt on whether it is homologous. Serrate ridge of valve is reminiscent of those seen in other species such as *pallidata*, *triviata*, and *ordinata*, but again I think independently derived. Male genitalia of *muscariata* do not seem to differ from those of *extenuata*. Female genitalia (text figure 51 *b*) are of type found in *pervolata*, *californiaria*, and *colorata*, differing mainly in shape of winglike lateral sclerites of sterigma. Structural resemblance to the *californiaria*-group is surpris-

ing, considering that the appearance of the moths is so different and the hosts unrelated.

Digrammia muscariata is found from southern Vancouver Island to the Laguna Mountains, San Diego County, California, and eastward in Arizona, New Mexico, Utah and to the Front Range of Colorado and Big Bend National Park, Texas, probably wherever oak is present. With respect to wing color, pattern, and to a lesser extent size and male genitalia, this species breaks up into three main geographical entities that may be treated as subspecies. All have been named, and *teucaria*, at least, has been regarded as a distinct species since 1899. They have been known variously as *respersata* and *teucaria*, with the name *muscariata* misidentified or never associated with a recognized taxon. The subspecies are as follows.

Digrammia muscariata muscariata (Guenée)

PL. 7, FIG. 21 (adult); PL. 14, FIG. 15 (larva); TEXT FIG. (♂ gen.); TEXT FIG. (♀ gen.) (RWH 7377).

Tephrina muscariata Guenée, 1857 [1858].

Type locality: California. [USNM]

Characterized by a uniform gray-brown coloring, without such a coarse dusting of dark scales as is typical of the others, and usually with one to three small black spots straddling the postmedial line opposite the cell on the forewing. Such spotted specimens are unusual elsewhere, except in southwestern Colorado, where they may occur at a high frequency. Until now, this form has been lumped with *teucaria* in collections, although it is no closer to *teucaria* than to the Rocky Mountain *respersata*. The nominate subspecies occurs from the Laguna Mountains, San Diego County, at least to southwestern Oregon, west of the Sierras and Cascades from June to September.

Nominate *Digrammia muscariata* was reared from larvae on *Quercus dumosa* Nutt. in Siskiyou County, 1989, and from *Quercus douglasii* Hook. & Arn. in Yolo County, California, 1988 (B. Scaccia) (USNM). I reared it on *Quercus garryana* Dougl. ex Hook. from a female collected in 1990 on the eastern side of the Siskiyou Mountains near Cave Junction, Josephine County, Oregon; and it was reared from larvae collected from Garry oak in Oregon by J. C. Miller.

Digrammia muscariata respersata (Hulst)

PL. 7, FIGS. 22, 23 (adult); TEXT FIG. 51 *a*, *c* (♂ gen.); TEXT FIG. 51 *b* (♀ gen.) (RWH 6378).

Macaria respersata Hulst, 1880.

Type locality: Colorado. [USNM]

Diastictis subacuta Hulst, 1896.

Type locality: Colorado. [AMNH]

This is the widespread Rocky Mountain and intermountain form that is light brown, noticeably dusted with a sprinkling of darker brown scales, clearly marked with the three transverse lines, and usually without remnants of the extramedial spots. It occurs in oak woods from Yakima County (or east of the Cascades), Washington to Arizona and Big Bend National Park, Texas. It appears to have two broods except at higher elevation habitats of 7,000–8,700 feet, where it may be found in the central to southern Rocky Mountains. The available dates for Colorado, Utah, New Mexico, and Arizona are 2 June–25 August, and for West Texas, 28 March–1 July and 14 September. It was taken in Grant County, New Mexico on 30 April.

I reared this subspecies from a female collected in Ephraim Canyon, Sanpete County, Utah, and the foodplant there was Gambel oak, *Quercus gambelii* Nutt., the only oak present in the area. Some years earlier it had been reared from the same species of oak in Arizona by J. G. Franclemont (reared adults in Cornell University insect collection).

Digrammia muscariata teucaria (Strecker)

PL. 7, FIG. 24 (adult) (RWH 6379).

Macaria teucaria Strecker, 1899.

Type locality: Seattle, Washington. [FMNH]

This is a northwestern population associated with *Quercus garryana* Dougl. ex Hook. west of the Cascades in northwestern Oregon, Washington, vicinity of Vancouver, and southeastern Vancouver Island, British Columbia. Specimens of *teucaria* are slightly larger than *muscariata* from elsewhere, often a distinctive yellowish-brown color, and more heavily sprinkled with dark scales. In the male genitalia, the inner face of the ventral lobe of the valve tends to have a slightly different configuration of ridges, but this is inconsistent, being best developed in specimens from the northern extremity of the range. Sub-

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species *teucaria* from British Columbia and northern Washington has the appearance of a separate species, but I believe that it blends into *muscaria* farther south. The flight period for British Columbia and Washington, based on label data from field-collected specimens, is 13 May–17 June and 19 July–23 August. The emergence dates for a reared brood mentioned below fit the time frame for the second generation. The early stages of *teucaria* were described from Vancouver Island by Ross and Evans (1958) and Hardy (1959), and those accounts were quoted by McGuffin (1972: 35). The fifth (last) instar larvae were described as follows: Length, 23 mm. Head milky green, mottled and feathered with light brown. Body gray green with a tinge of cinnamon on intersegmental rings; dorsum and sides with closely spaced pale brown lines; venter with black dots on segments. Some larvae with black or yellow marks laterally. Ross and Evans noted crimson markings on the prolegs that were not mentioned by Hardy. Larvae were said to resemble oak twigs. Eggs laid by a captive female on 24 July hatched 3 August, and the larvae pupated 12 September. The food plant was *Quercus garryana* (Hardy, 1959; Prentice, 1963).

Digrammia extenuata Ferguson, NEW SPECIES
PL. 7, FIGS. 25, 26 (adult).

Digrammia extenuata Ferguson.
Type locality: Mohawk, Plumas County, California. [USNM]

This is a western species closely related to *Digrammia muscaria* and with indistinguishable genitalia. However, it has a darker, faintly violaceous ground color, hardly any dusting of darker scales but usually some dusky shading distad of the postmedial line, making the outer third of the forewing appear darker than the medial and basal areas, and usually with no sign of the small black spots (remnants of the extramedial spots of most Macariini) near the intersection of the postmedial line and M_3 of the forewing that are characteristic of nominate *muscaria*. *Digrammia extenuata* is broadly sympatric with *muscaria*, but it may not be an oak feeder because oak is absent in most of the places where it has been collected. Size, shape, and structure, including genitalia of both sexes, similar to those of *muscaria muscaria* and *muscaria respersata*, although wing length averages about one mm less in the

specimens examined. Forewing ground color gray brown with slight violaceous tint; diffuse, variable, darker shading distad of postmedial line in nearly all specimens, although rarely present in *muscaria*. Sprinkling of darker scales that is usually a feature of all subspecies of *muscaria* is much reduced in *extenuata* and further de-emphasized by darker ground color; antemedial and postmedial lines usually complete, very thin, the postmedial more inclined to widen and be black toward costa; medial line diffuse, indistinct, more often obsolete than in *muscaria*; discal spot transversely elongate, blackish, tending to be better developed than in *muscaria*. Hindwing a faintly violaceous gray brown, paler toward costa, marked only by small brown discal spot and a usually obsolescent segment of postmedial line near inner margin (*muscaria* often has part of medial line also); outer marginal fringes of both wings concolorous with wings, unmarked; inner margin of hindwing and its fringe whitish, similar to but more contrasting than those of *muscaria*. Undersurfaces almost uniformly light gray brown, finely but more noticeably irrorated with darker scales than uppersurfaces, often slightly darker distad of postmedial line on both wings; postmedial line on forewing and discal spots on hindwing present but weak. Wing length: holotype, 14 mm; other males, 14–15 mm; females, 13–15 mm.

The genitalia are similar to those of nominate *muscaria* and its subspecies *respersata* but may differ slightly from those of *Digrammia muscaria teucaria*.

The immature stages are unknown.

TYPES. Holotype ♂. USNM. Mohawk, Plumas County, California; 14 June 1946; W. R. Bauer. Paratypes: 14 ♂, 6 ♀. Same data but collected 7, 8, 15, 17, 19, 20, 26 June, and 7, 8 July 1946 (9 ♂). Nevada. Angel Creek, 7,000', E Humboldt Mountains, SSW of Wells, Elko County; 18 July 1971, D. C. Ferguson (1 ♂). Angel Lake Road above Wells, ca. 7,000', Elko County; 13 July 1971, D. C. Ferguson (1 ♂, 3 ♀). Same data; 15 July 1971 (2 ♀). Same data; 17 July 1971 (1 ♀). Lamoille Canyon, Ruby Mountains, Elko County; 5–12 July 1958 (2 ♂). Washington. Kamiak Butte, Whitman County; 4 August 1930; J. F. G. Clarke (1 ♂). AMNH, LACM, USNM.

In addition to localities given for the type series, the range of *D. extenuata* reaches the southern interior of British Columbia. Specimens reported by McGuffin (1972: 36, fig. 103) from Peachland, Keremeos, Kamloops, and Seton

Lake, where no oak is present, may refer to *extenuata*. His figure 103, although appearing too gray, probably represents this species, and figure 104 is a typical Californian *muscaria*. However, plotting distribution by availability of known hosts may be risky, because a few *muscaria* are also reported to have been collected where oak was not in evidence. Perhaps the moths have greater dispersal mobility than expected. The early stages are unknown. Although one would expect *extenuata* to be an oak feeder like *muscaria*, my specimens from Nevada were taken in open, shrubby, semi-arid Great Basin prairie, high on the northeastern slopes of the East Humboldt Range, with aspen nearby but no oak. Published plant distribution information confirms the absence of oak in those mountains. The habitat may be similar in most respects to that of the inland British Columbia localities mentioned above.

The type material in the USNM from California was received by me through an exchange with William L. Bauer in the 1950's and had been labeled by him as *respersata*. The Californian populations of *muscaria* at that time were recognized as different from *respersata* but were thought to be *teucaria*; and the unnamed *extenuata* was evidently misidentified as *respersata*. Although *muscaria* was proposed for a species from California, is the oldest name in the group, and was continuously carried in check lists, earlier lepidopterists failed to connect it with any recognized taxon.

The *eremiata*-GROUP

These [*ocellinata*, *ordinata*, *sublacteolata*, and *eremiata*, ed.] are gray-brown to dull-whitish moths of undistinguished appearance, having rounded or only slightly angulate wings, usually dusted with gray scales on a lighter ground and with three relatively regular, dusky, transverse lines or chains of dark dots on the forewing and two on the hindwing, or with remnants of such lines. A gray subterminal band may be present. Males have a swollen male hindtibia, a pecten on the third abdominal sternum, and a normal set of *Digrammia* characters in every other respect. Although most specimens in this group may be identified by color and pattern, occasional variants, or specimens in poor condition, may be recognized only with difficulty. The genitalia of all four species are distinctive, especially those of *ocellinata*. Species of the group have either one

or two pairs of spines on the dorsal side of the uncus that stand out as being stout and conspicuous, although there may be as many as 12 other long spines that are more slender. The group is endemic to the eastern half of North America, occurring from southern Canada to the Gulf of Mexico and westward to Colorado, but it is best represented in the Midwest and eastern to central Great Plains. The distributions of all but *ocellinata* seem unusually localized and are probably linked to the presence of locally occurring hosts. Although all were discovered and named more than a century ago, three of the four species continue to elude collectors and remain poorly known. The one common species, *D. ocellinata*, is a locust feeder on *Robinia pseudoacacia*, and known foodplants for other members of the group include species of *Tephrosia*, *Amorpha*, and *As-tragalus* (all Fabaceae).

Digrammia ocellinata (Guenée), NEW COMBINATION

PL. 7, FIGS. 27–29 (adult); PL. 15, FIGS. 1, 2 (larva); TEXT FIG. 52 *a, c* (♂ gen.); TEXT FIG. 53 *b* (♀ gen.) (RWH 6386).

Macaria ocellinata Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 85.

Type locality: North America. [USNM]

NOTE—*Digrammia ocellinata* was described from one male and one female, both of which are in the collection of the U. S. National Museum of Natural History. They are in worn condition, but intact (except for broken antennae), and are clearly recognizable. I hereby designate the male as the lectotype. A specimen from the Graef collection in the MCZ bears a Packard type label for *ocellinata* and is obviously a spurious type.

Macaria duplicata Packard, 1873, *Ann. Rept Peabody Acad. Sci.*, 5: 65.

Type locality: See note. [MCZ]

NOTE—*Macaria duplicata* was described from an unspecified number of specimens from "Maine (Packard); Mass. (Sanborn); West Farms, N.Y. (Angus); Illinois (Clemens); Alabama (Grote)." No lectotype has been designated.

Digrammia ocellinata is a mottled, gray to gray-brown species with a dull whitish ground color, and with the outer margins of the wings slightly angulate; i.e., concave behind the apex of the forewing and angled at end of M_3 on hindwing, unlike other members of this group. The usual

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transverse lines of both wings are discernible but often vague; a wide, irregular, brownish to dark gray subterminal band is characteristic and rarely absent; this closely follows the postmedial line, which may be represented in some specimens only by a series of dark vein dots like those of *ordinata*. The underside (plate 7, figure 29) is distinctive, with an orange-brown band enclosed between the thin, dark postmedial line and much wider subterminal band. Rare individuals in which this complex band of the underside and the subterminal band of the upperside are both obsolescent may be hard to distinguish from *ordinata*. However, the genitalia of both sexes (text figures 52 *a*, *c*, 53 *b*) should be recognized easily. In the male, the coarsely dentate, undulating, longitudinal ridge on the ventral lobe of the valve is diagnostic. *D. ocellinata* is the only common member of this group, and it occurs almost everywhere in the eastern United States or southern Canada where black locust, *Robinia pseudoacacia* Linnaeus, is native or planted. It may feed on other species of *Robinia* and honey locust, *Gleditsia triacanthos* Linnaeus. Older published records of *Rindgea nigricomma* (Warren) for the northern or eastern states probably refer to *ocellinata*.

Ground color of wings dull grayish white, with extensive overlay of gray-brown to bluish-gray scales and variably flecked with gray-brown scales, resulting in more coarsely mottled effect than in other members of group. Transverse lines gray brown, varying in intensity, in part indistinct but darker at costa. Forewing with antemedial regular, convex, medial band sinuous, diffuse; postmedial somewhat sinuous, angled toward costa at M_1 , sometimes represented by little other than series of black dots; proximal half of space between postmedial and outer margin occupied by wide, dark, subterminal band, usually gray or gray brown, but often including spots or patches of blackish brown; terminal line dark, thin, usually a series of dashes; fringe gray, separated from termen by thin whitish line; discal spot oblong, hollow, often indistinct. Hindwing mainly a repetition of forewing, except that darkest shades are less emphasized. Underside with paler ground, heavier sprinkling of dark scales, and bolder pattern, having as its most distinctive and diagnostic feature a complex postmedial band consisting of a thin, dark, postmedial line, a thicker subterminal band of the same color, and an orange-brown or ochreous band sandwiched

between them. This distinctively colored band is more than 90 percent consistent, but sometimes it fades out, is heavily suffused with black, or becomes predominantly orange brown through expansion of its ochreous component. Male antenna with setae slightly shorter than width of shaft, with alternating transverse bands of light and dark scales dorsally; female antenna slender, minutely setose, with scale pattern as in male. Head and body mostly matching grayish shade of wings, abdomen paler beneath. Palpi of both sexes exceeding front by length of third segment plus tip of second, usually light reddish brown with pale third segment; same reddish-brown color repeated in patch behind eye, as is characteristic of group. Legs pale yellowish brown, speckled with brown scales; enlarged hindtibia of male three \times length of tarsus. Wing length: males, 10–13 mm ($n = 124$); females, 11–14 mm ($n = 100$). The most noticeable variation in *ocellinata* is that of the subterminal band, which ranges from dark and contrasting to obsolescence (plate 7, figures 27, 28). This does not seem to have much geographical or seasonal significance, although 40 specimens from Cherry County, Nebraska, are unusually uniform in their lack of strong contrasts, on both upper- and undersurfaces. As all were taken in early June, it might be a seasonal difference, although material from elsewhere shows no definite seasonal variation. Very fresh specimens of *ocellinata* appear gray, and older, more faded ones are more brownish.

Male genitalia (text figure 52 *a*, *c*) unique and easily recognized, their most obvious feature being the coarsely dentate, elongate prominence near middle of inner face of ventral lobe of valve. Uncus with two pairs of conspicuously enlarged spines dorsally. Aedeagus stout, without a digitiform process, and resembling that of *equivocata* more than of any other within group. Eighth sternum essentially like that of all closely related species except *equivocata*. Female genitalia (text figure 53 *b*) with uniformly wide ductus bursae like that of *equivocata* but not longitudinally ribbed. Sterigma relatively large and complex but with homology to those of closely related species seemingly apparent; best understood by reference to illustrations; sterigma surrounded anteriorly by a wide, crenulated, preostial fold, unlike any other within group.

This species feeds on *Robinia pseudoacacia* Linnaeus, and possibly *Gleditsia triacanthos* Linnaeus (Prentice, 1963: 416). I reared it from eggs

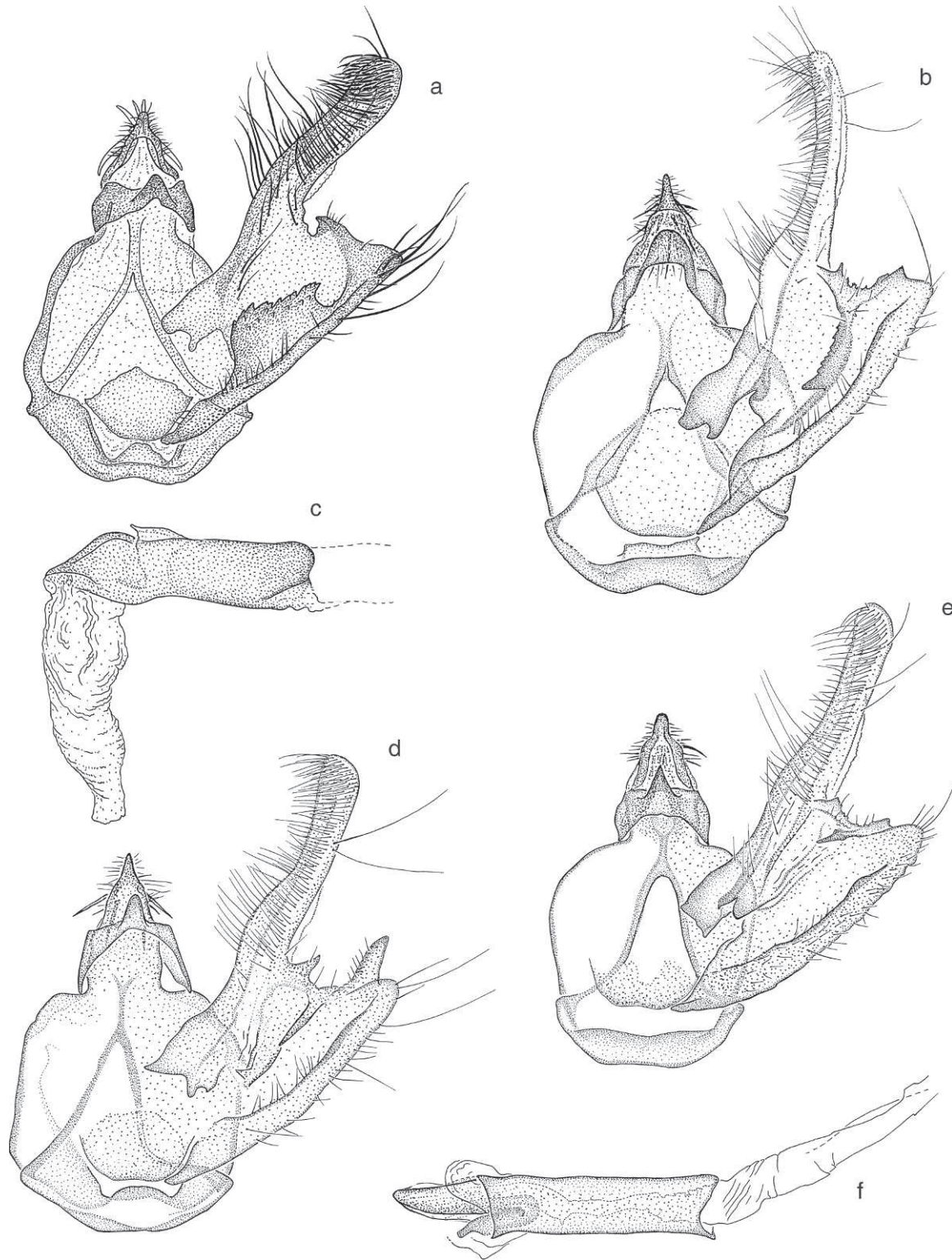


FIGURE 52: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. *D. ocellinata*, genital capsule; Dunrobin, Ontario (DCF 1547). b. *D. ordinata*, genital capsule; Elgin, Kane County, Illinois (USNM 52963). c. *D. ocellinata*, aedeagus; Dunrobin, Ontario (DCF 1547). d. *D. eremiata*, genital capsule; Moore County, North Carolina (USNM 52960). e. *D. sublacteolata*, genital capsule; Texas (HWC 1437). f. *D. sublacteolata*, aedeagus; Texas (HWC 1437).

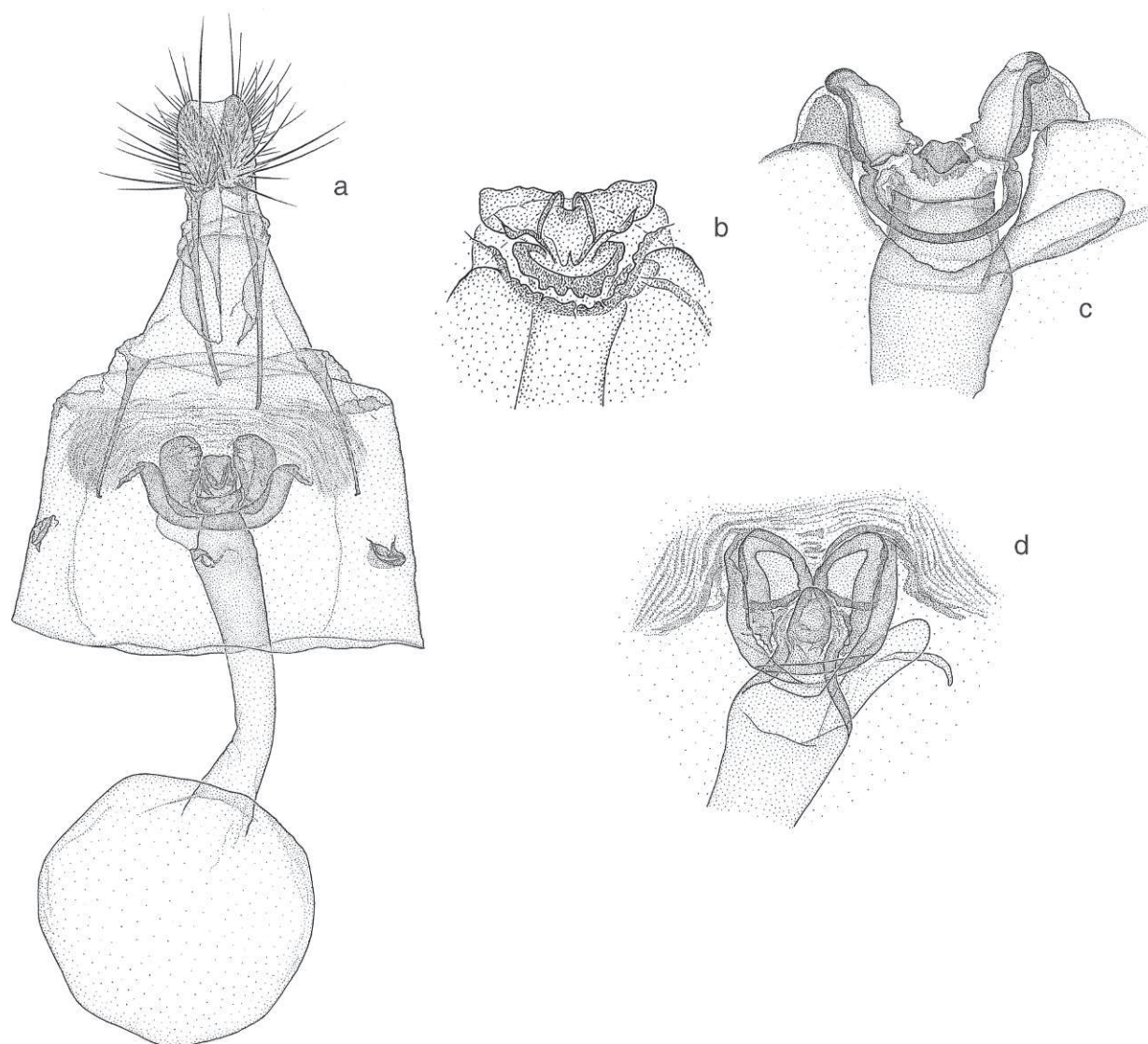


FIGURE 53: FEMALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. ordinata; New York (USNM 53423). *b. D. ocellinata*, S8, ostium bursae and ductus bursae; Colesville, Montgomery County, Maryland (USNM 58028). *c. D. sublacteolata*, S8, ostium bursae and ductus bursae; Cherry County, Nebraska (USNM 56973). *d. D. eremiata*, S8, ostium bursae and ductus bursae; Southern Pines, Moore County, North Carolina (USNM 53422).

on *Robinia pseudoacacia* in 1986 to obtain specimens and photographs of larvae and to verify the earlier descriptions by Dyar (1901) and McGuffin (1972: 39). Last instar larva green, with pair of broad, cream-colored or greenish-white dorsal stripes, separated by a middorsal green band about half the width of one dorsal stripe; white filling of dorsal stripes fades out on meso- and prothorax, as well as on posterior abdominal segments, leaving only their sinuous, dorsal and subdorsal, white margins; space between spiracles and lower edge of dorsal band occupied by weak, interrupted, purplish shade and thin, irregular, dis-

continuous, geminate white lines; venter green; second abdominal segment with prominent, dark purplish-brown spot above spiracle; all legs and basal integument immediately adjoining them dark purplish brown, except anal prolegs, which are only slightly tinged with this color; head green, shading to dark purplish brown laterally and with a reticulate white pattern covering the parietal lobes and clypeus; antennae and labrum light brown or pinkish. In live larvae, integument forms narrow, intersegmental folds of a pale, yellowish color, giving body a yellow-ringed appearance. McGuffin described larvae of two color

forms, green and gray, but mine from Maryland were all green. However, their ground color was a dull-yellowish to grayish shade of green. The dark spot above the spiracle on the second abdominal segment would be a useful key character for this species, although it must be noted that similar spots turn up elsewhere, as in last instar larvae of *Macaria aemulataria*.

Digrammia ocellinata occurs from Nova Scotia, Montreal, Quebec, Ottawa, Ontario, and Wisconsin to northern Florida, and westward to central Nebraska, eastern Oklahoma, and northeastern Texas. Although often a common species in the eastern and midwestern states, records for Florida and most of the Gulf States are relatively few. Black locust and other species of *Robinia* were originally confined to the Appalachian Mountains from Pennsylvania to Georgia, and to some areas of the Midwest such as the hills of southern Illinois and the Ozarks, and that must represent the original range of *ocellinata*. If it also feeds on honey locust or water locust, its distribution could have been more extensive southward and westward. However, its extension into the northern states and Canada must have followed the widespread planting of these trees, especially species of *Robinia*, as shade trees and ornamentals. The species has two broods northward, flying in May and early June, and again in July and August in most of New England, New York, Quebec, and Ontario. In Maryland, it is found in every month from April to September, but most records are for periods on April–May, July, and August–September, suggesting three broods. Louisiana records (V. A. Brou collection) extend from March to September.

Digrammia ordinata (Walker)

PL. 7, FIGS. 30–33 (adult); PL. 15, FIG. 3 (larva); TEXT FIG. 52 *b* (♂ gen.); TEXT FIG. 53 *a* (♀ gen.) (RWH 6356, 6358).

Fidonia ordinata Walker, 1862, *List of Specimens of lepidopterous Insects in the Collection of the British Museum*, 24: 1,038.

Type locality: not given. [BMNH]

NOTE—I examined the type in 1993 and found it to be the same species as *Sciagraphia maculifascia* Hulst, 1896. The name *ordinata* has long been incorrectly used for the species that I describe as *equivocata*. Although the type locality is unknown, it can be said that Walker had ample material available to him from the collections of Edward Doubleday (northern Florida) and John Abbot (Georgia), and

virtually nothing from the Midwest. The type appears to represent the pale form that occurs in the more eastern parts of the Midwest and in the Southeast, being similar to the type of the synonymic name *aucillaria* Strecker, reputedly from Florida.

Sciagraphia maculifascia Hulst, 1896, *Trans. American Ent. Soc.*, 23: 329, NEW SYNONYMY.

Type locality: South Dakota. [USNM]

NOTE—Described from an undisclosed number of syntypes, of which there are a male and female in the AMNH and a female in the USNM. I designate as the lectotype the female in the U. S. National Museum of Natural History, labeled: “S. Dak.,” “Collection/ Brkln. Mus.,” “Type No./34211/ U.S.N.M.,” and “*Sciagraphia/maculifascia*/Type Hulst.” It is in fair condition, lacking antennae and most of its legs, but is clearly recognizable as the present species.

Macaria aucillaria Strecker, 1899, *Lepidoptera, Rhopaloceres and Heteroceres, Indigenus and Exotic*, Suppl. 2: 8.

Type locality: Florida. [FMNH]

NOTE—Described from one female specimen, which I have not seen. However, a photograph and a drawing in the collection of the U. S. National Museum of Natural History, purportedly of the holotype, shows a specimen that certainly appears to be the same as *ordinata*. The type locality seems questionable because the most southerly specimens that I found during this research are from Myrtle Beach, South Carolina.

Digrammia ordinata usually is recognizable by its powdery gray-brown coloring, with the whitish ground color showing through slightly, mostly on the hindwing, and with the postmedial of the forewing being the most prominent of the three lines and commonly represented by a chain of small dark dots. The markings are similar to those of *sublacteolata*, and occasional specimens are almost indistinguishable from *sublacteolata* or *eremiata*. Unusually poorly marked individuals of *ocellinata* may also be confused with *ordinata*. In such cases, the genitalia will provide the only sure means of identification. The male genitalia have a truncated, bladelike, longitudinal ridge on the ventral lobe of the valve and have the extremity of the gnathos broad and rounded. Neither *ordinata* nor *eremiata* have a digitiform process on the aedeagus like that of *sublacteolata*. In the female genitalia, the shapes of structures associated with the ostium are diagnostic, and these differences are best understood by reference to the il-

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illustrations. This is a species of the Midwest and eastern Great Plains, except for seemingly disjunct populations in the Carolinas and possibly southward.

Further description of external features would hardly be helpful because *ordinata* resembles *sublacteolata* and *eremiata* in almost every visible detail except as noted above. Wing length: males, 11.0–14.0 mm (n = 50); females, 11.0–13.5 mm (n = 36).

This species varies in a way that led me to wonder whether two species are involved. Thirty-one examples from Cherry County, Nebraska (plate 7, figures 32, 33), are of a darker form than most of those from Illinois, Iowa, Kansas, Oklahoma, and North Carolina. (plate 7, figure 31), although both forms are represented in material from Iowa, South Dakota, and Illinois. The holotype of *ordinata* and image of *aucillaria* appear to be of the light form, and the lectotype of *maculifascia* represents the dark form. The light form is less densely irrorated with dark, gray-brown scales, showing more of the yellowish-white ground color, has more of a tendency for the postmedial to be a continuous, irregular line than a series of sharply defined dots, and appears to be slightly larger. No consistent differences can be seen in the genitalia. It should be noted that specimens of *sublacteolata* from Cherry County, Nebraska, are also unusually dark, but such dark specimens of that species have not turned up elsewhere.

The male genitalia (text figure 52 *b*) differ from those of other members of the group mainly in the presence of a bladelike, proximally truncated, usually serrated ridge running about halfway down the middle of the ventral lobe of the valve, shorter than and differently positioned from that of *ocellinata*. This replaces the dentate sclerite on the valves of *eremiata* and *sublacteolata*. The uncus has the usual pair of large dorsal spines, but these are preceded by a cluster of 10–12 others almost as large. The broadly rounded apical process on the gnathos is characteristic, and the aedeagus lacks a digitiform process. The eighth sternum resembles that of *eremiata*, being longer than that of *sublacteolata*, and its medial incision is much less than half the length of the sternum. The female genitalia (text figure 53 *a*) may be recognized by characteristic differences in the shape of structures associated with the ostium. Also, the ductus bursae is not abruptly narrowed at the ostium as in *eremiata*; and the scler-

otized collar that partly encircles the ostium in *sublacteolata* is missing in both *ordinata* and *eremiata*.

This species has been reared from larvae on false indigo, *Amorpha fruticosa* Linnaeus (Fabaceae), in Putnam County, Illinois, (M. O. Glenn) and Green Swamp, Big Island, Brunswick County, North Carolina (J. B. Sullivan), and from *Amorpha canescens* Pursh. (Fabaceae) at Elgin, Kane County, Illinois (A. K. Wyatt). The following description is based on colored photographs by D. L. Wagner of the material from North Carolina. Similar to the green form of *D. eremiata* but with the pale stripes thickened and diffuse, almost blending together, milk white except lateral stripe, which is partly yellow. Head yellowish green with prominent pale bluish reticulation. Extension of lateral stripe on side of head narrow, yellowish. Mouthparts in part reddish brown; antenna green basally, reddish distally. All legs pinkish red. A brown form corresponding to that of *eremiata* might occur but is not known.

Digrammia ordinata is mainly a hill-prairie or grassland species of the central Midwest and the Great Plains, occurring in Illinois, Wisconsin, Iowa, Missouri, Arkansas, North and South Dakota, Nebraska, Kansas, Oklahoma, and even as far west as Rock Creek Canyon, Colorado, evidently in localized habitats as it is not commonly collected. An apparently disjunct population of the light form occurs in the Southeast, where specimens were collected at Leland and Big Island, North Carolina, and near Myrtle Beach, Horry County, South Carolina, which are within the range of *Amorpha fruticosa*. The species appears to have at least two broods, the first flying from May to early July, the second appearing in mid- to late July and flying to early September. The earliest records noted are for 3 May at Sioux City, Iowa, although I found that fresh specimens of what was presumed to be the first brood continued to appear through most of June in Cherry County, Nebraska.

Digrammia sublacteolata (Hulst)

PL. 7, FIGS. 34–36 (adult); TEXT FIG. 52 *e*, *f* (♂ gen.); TEXT FIG. 53 *c* (♀ gen.) (RWH 6355).

Semiothisa sublacteolata Hulst, 1887, *Ent. Americana*, 2: 189.

Type locality: Ohio. [USNM]

NOTE—Described from two male and four female syntypes from Ohio. Of three specimens in the collection of the USNM bearing Hulst type labels, only one, a female, is labeled “Ohio.” The collection of the AMNH has a male syntype from Dayton, Ohio (Pilate), and it is likely that all the syntypes are from the same source. I designate as lectotype the Ohio female in the USNM, which measures about 24 mm in expanse, as Hulst said, and is labeled Type No. 3890 U.S.N.M., and H.W.C. [Hahn W. Capps] slide 1438. It has been renumbered as an USNM Slide (green label).

Macaria lapitaria Strecker, 1899, *Lepidoptera, Rhopaloceres and Heteroceres, Suppl. 2*: 8.

Type locality: Waco, Texas. [FMNH]

NOTE—Described from two specimens from Waco (coll. Belfrage); one from Dallas, Texas (coll. Boll); and three from Chihuahua, Mexico. I hereby designate as the lectotype one of the specimens from Waco, Texas, and it is so labeled. Strecker's type lot included at least two species; but the present designation preserves the generally accepted synonymy that dates from Dyar (1906: 93).

Tephrinopsis humillima Bastelberger, 1908, *Jahrbücher des Nassauischen Vereins für Naturkunde*, **61**: 79, NEW SYNONYMY.

Type locality: Texas. [SMFD]

NOTE—Described from one male specimen, which I identified from a colored photograph kindly sent to me by Manfred Sommerer.

This species is the palest member of the *eremiata*-group, typically with an almost milk-white ground color, lightly irrorated with gray-brown scales, and with the transverse lines weak or obsolescent. Well-marked specimens have the forewing postmedial represented by a complete row of dots that may be joined to form a continuous line, and they sometimes have a wide, gray-brown subterminal band in the space between the postmedial and outer margin of both wings. Small discal spots are present and less likely to be incorporated into the medial band than in other species of the group. Specimens from the Nebraska Sand Hills are darker gray and easily confused with *ordinata*; those from Montana are almost uniformly gray but not especially dark. The male genitalia of *sublacteolata* (text figure 52 e, f) are most like those of *ordinata* but differ in having a digitiform process on the aedeagus, an apically narrower gnathos, and in lacking the serrated, bladelike ridge on the inner face of the ventral lobe of the valve. The female genitalia have

a different sterigma (text figure 53 c). *Digrammia sublacteolata* occurs from southern Manitoba and Montana to Texas, and apparently eastward to Ohio (types only), but it is rare in collections from everywhere except Texas.

Little is needed to supplement the diagnostic description with respect to the simple wing pattern. The postmedial line of the forewing is sometimes ochreous tinged; the antemedial line is often indicated only by three or four dots and the medial line by one to four indistinct dots or none; the terminal line consists of dark dots between the vein endings; the fringes are the same shade as the ground color. The underside is less marked, sometimes more brownish or ochreous, and more coarsely irrorated with dark scales. The antenna of the male is simple, ciliate, with setae as long as the thickness of the shaft; of the female, filiform, hardly ciliate. The front is slightly protruding but flat, not convex. The palpi of both sexes hardly surpass the front, and are pale brown with the third segment whitish. The vestiture of the body, head, and antennae is whitish with a scattering of brown scales; the legs are often yellow brown; and there is no brown collar behind the head. Wing length: males, 11–13 mm; females, 10–13 mm (lectotype female, 12 mm).

No seasonal variation is apparent, but geographical variation could lead to confusion. Eleven specimens from Cherry County, Nebraska (plate 7, figure 35) are unusually dark; some are not easily distinguished from *ordinata* from the same locality (also unusually dark), although the genitalia of three examples confirmed that they are *sublacteolata*. Three specimens from Montana are different again, being medium gray and lightly marked. The lectotype matches specimens from Texas, and three in the Canadian National Collection from Manitoba also are more like those from Texas, although poorly marked and with the sprinkling of dusky scales, above and beneath, clumped to form a more strigose pattern.

The male genitalia are unique among species of the *eremiata*-group in having a digitiform process on the aedeagus, although it is usually shorter than in the example illustrated (text figure 52 f); otherwise the genitalia are similar to those of *ordinata* except that the only special structure on the inner face of the valve is a small spine or protuberance rather than an elongated, medial, bladelike ridge, and the gnathos tapers more narrowly toward its extremity. The uncus has one pair of dorsal spines conspicuously larger than

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others. The eighth sternum is shorter than those of *eremiata* or *ordinata*, with the medial incision almost extending to the middle; that of *equivocata* is uncleft and thus obviously different.

The female genitalia have the ostium partly encircled by a definite, sclerotized collar, and the valvelike flap at the opening of the ostium consists of a small, papillalike structure instead of the larger, ovoid plate of *ordinata*; the paired lateral plates of the sterigma are winglike, flared outwardly rather than rolled inwardly.

The early stages and food plants of *sublacteolata* are unrecorded.

Digrammia sublacteolata is known to have been collected only in the vicinity of Dayton, Ohio (types), Iowa, Manitoba, Nebraska, Montana, Wyoming, Kansas, Oklahoma, and Texas, and those in the several major collections studied added up to only 47 specimens. As this species is uncommon in collections, I give some specific localities and dates as follows: Bald Head Hills, 13 mi N of Glenboro, Manitoba, 8 August (3); Dayton, Ohio (1); Sioux City, Iowa, 17 August (1); Valentine National Wildlife Refuge and Fort Niobrara, Cherry County, Nebraska, 4–22 June (11); 7¼ mi N of Big Timber, Montana, 2, 7 July, 27 August (3); Guernsey State Park, Platte County, Wyoming, 6 July (3); Ottawa and Garden City, Kansas, 18 August, 23 September (2); Sulphur, Oklahoma, 14 July (1); Canadian, Hemphill County (2), Laguna Park, Bosque County (2), Fort Davis (1), Alpine (1), Palo Duro Canyon (2), Plano (1), and San Antonio, Texas, 17 March–27 May and “Aug.”–24 September. The apparent flight periods, about 4 June–7 July and 8–27 August northward, and 17 March–22 May and 14 July–24 September southward, indicate at least two generations.

Digrammia eremiata (Guenée)

PL. 7, FIGS. 37–39 (adult); PL. 15, FIGS. 4, 5 (larva); TEXT FIG. 52 *d* (♂ gen.); TEXT FIG. 53 *d* (♀ gen.) (RWH 6357).

Psamatodes eremiata Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, **10**: 109.

Type locality: North America. [USNM]

NOTE—Described from one male and four female syntypes, of which two are in the USNM and still in good condition. I hereby designate the male as the lectotype. As this species is most common in the Southeast, and there were few sources of specimens

from that region prior to 1858, I think it likely that the types were collected in Georgia by John Abbot.

Tephrina retectata Walker, 1861, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, **23**: 959.

Type locality: Georgia (Milne collection). [BMNH]

NOTE—This and the following two names were based on single specimens, which are therefore holotypes. That of *retectata* is a male with abdomen missing; *retentata* is a female to which the abdomen has been glued; and *gradata* is an intact female.

Tephrina retentata Walker, 1861, *ibidem*, **23**: 968.

Type locality: Not given. [BMNH]

Tephrina gradata Walker, 1861, *ibidem*, **23**: 968.

Type locality: Not given. [BMNH]

Macaria?? subcinctaria Walker, “1862” [1863], *ibidem*, **26**: 1,655.

Type locality: Not given. [BMNH]

NOTE—Described from two syntypes. I designate as lectotype an intact female in good condition bearing, in addition to the usual red-circled type label, another round label with the notation: 39/b. 19/1262, and another label saying: Photographed/B.M. negative/No. C. 15. The types of the four Walker names, as well as the Guenée types, are all much alike and probably from the same source—Georgia. Abbot evidently was able to supply many specimens of this uncommon species.

This is an eastern and central, gray-brown species with the rounded wings characteristic of the group, and with three similar, subparallel, almost equally spaced, transverse brown lines on the forewing and two on the hindwing. The transverse lines are more likely to be complete, equally developed, and continuous, rather than appearing as series of dots as in *ordinata* or *sublacteolata*. Occasionally, the transverse lines are indistinct. The subterminal bands are barely indicated above, present but not contrasting beneath; they are never wide and conspicuous as in *ocellinata*. The male genitalia may be recognized within the group by the presence of a prominent distal process on the ventral lobe of the valve, and a long, appressed, basally directed, dentate process on the inner face of the same lobe. The female genitalia are less distinctive but recognizable. *Digrammia eremiata* is almost as widespread as *ocellinata*, occurring from New Hampshire to

Florida and westward to Texas and the Great Plains.

The gray-brown coloring of both wings is the result of a dense powdering of gray-brown scales on a paler, light yellowish background, almost obscuring the pale ground basad of the postmedial line and often fully obscuring it distad of the postmedial on both wings; that is, the subterminal space is likely to be solidly grayish brown; faint, dusky, subterminal band may be present in the middle of the subterminal space; discal spots are usually not apparent; the terminal line is a connected series of thin, dark crescents, thinly pale edged outwardly; the fringes are gray, with very diffuse dark rays opposite the veins. The underside is similarly marked but more ochreous and paler, with more of a pale ground color showing on both wings basad of the subterminal band. The male antenna is ciliate, with setae about equal in length to the thickness of the shaft; the female antenna is filiform, very slender. The front is gray brown but bright reddish brown at the sides, and is not protuberant. The palpi of the male hardly surpass the front; of the female, a little longer, reddish brown, pale tipped. There is no brown collar behind the head dorsally as in many species. The scales of the head, body, and antennae are otherwise grayish brown with a few scattered, darker scales. The legs are pale brown. Wing length: males, 9.5–12.0 mm ($n = 18$); females, 10.0–12.5 mm ($n = 23$).

The male genitalia (text figure 52 *d*) have two distal, outwardly directed, dentate processes on the ventral lobe of the valve, the more nearly apical one large and slightly serrated on one side; the other, arising close to costal lobe, is less than one fourth the size of the serrated one and acuminate, sharp pointed; a third dentate process, as long as serrated one, is directed basad on the inner face of the valve, extending about to the middle of the ventral lobe. This process has a similar counterpart in *D. californiaria* and *D. sexpunctata*, but its homologue in *sublacteolata* is only about one-third the size, and in *ordinata* takes the form of an even longer, usually serrated, bladelikey ridge. The valve of *D. equivocata* (text figure 54 *a*) has no comparable process. The uncus has one pair of large dorsal spines, and also six or seven others almost as large. The end of the gnathos is intermediate between the much narrowed form typical of *sublacteolata* and the broadly rounded form seen in *ordinata*. The aedeagus does not have the digitiform process characteristic of *sub-*

lacteolata, or at most only a rudimentary one. The medial incision of the eighth sternum is clearly less than half the total length of the sternum, as in *ordinata*.

The female genitalia (text figure 53 *d*) are best understood by reference to the illustrations. The ostium is distinctly constricted, lacking the sclerotized collar of *sublacteolata*, and with the sclerotized papilla near its opening intermediate in size between those of *sublacteolata* and *ordinata*. The paired plates of the sterigma are like those of *sublacteolata* but more rounded. An area of rugose integument adjoining the sterigma is unusually well developed and extensive. The genitalia of *equivocata*, which resemble those of the *eremiata*-group, are nevertheless so different that distinguishing that species from *eremiata* by dissection presents no difficulties.

Digrammia eremiata has been reared from larvae on two genera of Fabaceae. Fifty-two adults were reared by R. O. Kendall from larvae on *Astragalus nuttallianus* DC. in Bastrop State Park, Bastrop County, Texas, emerging in May, June, August, and September 1962. Twenty-one of them that I examined in the AMNH are labeled "Foodplant: Vetch sp.," but Kendall (in litt., 1993), in response to my inquiry, corrected the determination of the foodplant to *A. nuttallianus*. A reared adult in the USNM, without locality data, is labeled: "5897/ on *Tephrosia*/ Iss[ued] [emerged] / 5 May [18]94." The larvae on which the following description is based were collected from a *Tephrosia* species in the Weymouth Woods Natural Area, Moore County, North Carolina by J. B. Sullivan.

Like most macariine larvae, *D. eremiata* has two color forms—green and brown. **Green form** (plate 15, figure 3)—A slightly bluish green with numerous longitudinal whitish stripes, and with the body ringed intersegmentally with yellowish folds from A1 to A6. Lateral stripe widest, with sinuous margins, white, with a green spot within stripe just ventrad and anterad of yellow-brown spiracle. Subdorsal stripe white, about half thickness of lateral stripe, also with its edges sinuous. Between lateral and subdorsal stripes are two very thin, irregular, broken white lines; and dorsal area between subdorsals with three more pairs of irregular, longitudinal lines, including a pair of thin addorsals, which may be yellowish. Outermost stripe in dorsal area, next to subdorsals, is also pale yellow. Ventral area with similar pattern of stripes, although very thin and discontinuous.

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Head green with a pale blue reticulate pattern and a continuation of white lateral stripe onto side of head as far as antenna. Thoracic and abdominal legs pink. **Brown form** (plate 15, figure 4)—Similar but green ground color entirely replaced by deep reddish brown, which is more red than brown; stripes all white or tinted with pink, none yellowish. Head mostly dull yellow brown, without reticulate markings; continuation of white subdorsal stripe onto side of head becoming mostly reddish. All legs reddish.

Digrammia eremiata occurs widely but locally throughout most of the eastern half of the United States from Massachusetts and New Hampshire (Forbes, 1948) to Sarasota County, Florida, all of the Gulf States, and westward at least to Aweme and Cartwright, Manitoba (the only Canadian records), South Dakota, Missouri, Arkansas, Kansas, Oklahoma, and Anderson and Bastrop counties, Texas. One from the C. V. Riley collection (USNM) is labeled "Colorado." Most that I have seen are from the New Jersey pine barrens, the Carolinas, Georgia, and Texas. It is uncommon in Florida and I have seen it only from Liberty, Okaloosa, Gadsden, and Sarasota counties. Although *eremiata* is present in southern New Jersey, I have not seen it from Maryland or Virginia. A month of midsummer collecting in the Nebraska sand hills (Cherry County) yielded *ordinata*, *equivocata*, and *sublacteolata* but not *eremiata*. *Digrammia eremiata* flies mainly in June and July toward its northern limits (once on 26 May in South Dakota), but appears as early as April from North Carolina southward. In Charleston County, South Carolina, specimens were collected in April, June, July, and August, indicating at least three broods in the South.

The *equivocata*-GROUP

This group consists of a single anomalous species, which is widespread in the East and Midwest, but always rare. The superficial appearance of the adult would place it in the *eremiata*-group, but the genitalia are peculiar, showing more similarity to those of the willow feeders (*rippertaria*-group) in both sexes, including the stout aedeagus and wide, partly rugose, bursa copulatrix. The host is unknown.

Digrammia equivocata Ferguson, NEW SPECIES

PL. 7, FIGS. 40, 41 (adult); TEXT FIG. 54 *a*, *c* (♂ gen.); TEXT FIG. 54 *b* (♀ gen.).

Digrammia equivocata Ferguson.

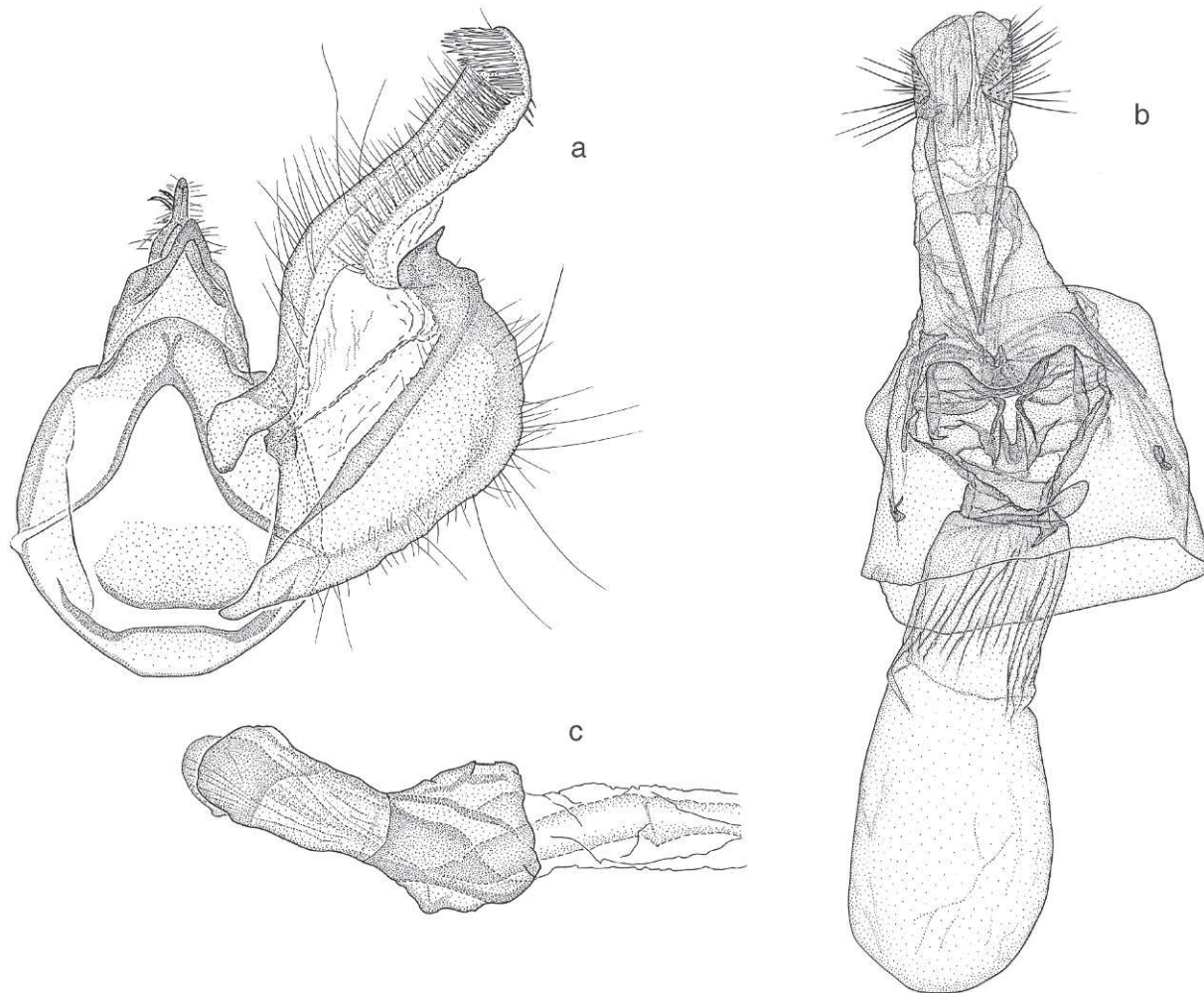
Type locality: Martha's Vineyard [Island], Massachusetts. [USNM]

Semiothisa ordinata of authors, not *Fidonia ordinata* Walker, 1862, *List of Specimens of Lepidopterous Insects in the Collection of the British Museum*, 24: 1,038.

NOTE—The name *ordinata* Walker proved to be a senior synonym of *maculifascia* Hulst, leaving the species widely misidentified in collections as *ordinata* without a name.

This curious species superficially resembles *D. eremiata* and *D. ordinata* and has been placed with them in the past. However, its genitalia could be interpreted as indicating relationship to the willow-feeding group that includes *D. rippertaria* and *hebetata*, despite the appearance of the moth. Males of *Digrammia equivocata* are almost unique within the genus in having an uncleft eighth sternum [but have a shallow excavation, ed.], and this may be seen and the moths readily identified without dissection by brushing a few scales from the posterior margin of this segment. The moths have three especially definite and regular transverse lines on the forewing and two on the hindwing, the latter fully as distinct as those on the forewing. The clarity and even course of these lines usually provide the clues needed to separate *equivocata* from the very similar *eremiata* and from other members of that group. However, occasional *equivocata* have lines that are not so definite, and a few *eremiata* have lines almost like those of *equivocata*. In such cases it may be necessary to refer to the genitalia, which are exceptionally distinct. This is another localized, rarely collected species and seems confined to a narrow, east-west band from southern New England and New York to the Midwest.

Wings finely variegated in shades of gray, resulting from dense and even irroration of gray-brown scales on a lighter ground. Upperside of forewing with three thin, nearly parallel, evenly spaced, usually distinct brown lines, almost erect from inner margin, in part curving inward slightly toward costa, although postmedial line may be straight; somewhat elongated brown discal spot just basad of medial line; faint subterminal shade sometimes apparent; terminal line a series of very small black dashes or crescents; fringes gray, hardly marked. Upperside of hindwing similar, about as dark as forewing, but with distinct medial and postmedial lines only, the former nearly

FIGURE 54: GENITALIA OF *DIGRAMMIA EQUIVOCATA*

a. Male genital capsule; Iowa City, Johnson County, Iowa (USNM 56975). *b.* Female; New York (USNM 53423). *c.* Aedeagus; Iowa City, Johnson County, Iowa (USNM 56975).

straight and usually running through discal spot, the latter convex but not quite enough to be parallel to outer margin. Underside like upperside, but with more of the pale ground color showing, and sometimes more yellowish or brownish than upperside. Color and structure of head and its appendages, body, and legs like those of *eremiata* and *ordinata*, although head and body generally paler and grayer, less brownish. Sexes colored alike. Wing length: holotype, 11.5 mm; other males, 11.0–12.0 mm ($n = 6$); females, 11.0–12.5 mm ($n = 8$).

Male genitalia (text figure 54 *a*, *c*) unusual, large, about $1.5 \times$ as large as those of *eremiata*, *ordinata*, and *sublacteolata*, and slightly larger than those of *ocellinata*. Valve with costal lobe curved in a more pronounced S shape; ventral

lobe with a much expanded, rounded, outer margin that is also sclerotized and sharply separated longitudinally from less sclerotized half of ventral lobe, this straight longitudinal edge being homologous to dentate ridge of *ocellinata*; distal margin of ventral lobe bearing a large sclerite armed with a sharp, thornlike point and situated closely adjacent to costal lobe or overlapping it slightly; this sclerite probably homologous to more mesial, outer, dentate nodule of *ocellinata*, but has migrated to point much closer to edge of costal lobe; probably also homologous to similarly situated processes in other related species, but resemblances not so clear. Saccus rounded, entire, not emarginate. Gnathos bluntly pointed, its stout apex thrust backward in same general direction as uncus. Tip of uncus with three or four

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pairs of spines of progressively diminishing size. Aedeagus of the stout type as in the willow feeders, without a digitiform process. Eighth sternum unique within this and most other groups of *Digrammia* in having no sign of the usual deep incision but only a shallow concavity.

Female genitalia (text figure 54 *b*) with “wings” of sterigma very large and folded or turned under distally; entire sterigma outlined by a surrounding fold of integument; ductus bursae very wide, like that of *ocellinata*, but lightly sclerotized and ribbed, and with more definite constriction toward ostium.

The early stages of *equivocata* remain unknown.

TYPES. Holotype ♂. West Tisbury, Martha's Vineyard, Dukes County Massachusetts; 15 July 1947; D. C. Ferguson. USNM. Paratypes: 16 ♂, 7 ♀. Same data as for holotype; collected by L. R. Rupert (1 ♂). Martha's Vineyard, Dukes County; 8 July; F. M. Jones (1 ♂). Barnstable, Barnstable County; 1 August 1952; C. P. Kimball (1 ♂). Wellesley, Norfolk County; 28 May 1904; L. W. Swett Coll. (1 ♂). New York. “N.Y.” Coll. Edw. L. Graef (1 ♀). Ohio. Holland, Lucas County; 15 July 1937; G. W. Rawson (1 ♀). Indiana. Hessville, Lake County; 17 June 1922; Emil Beer (1 ♂). Hessville, Lake County; O. Buchholz coll. (1 ♂). Clarke, Lake County; 21 May 1905 (1 ♀). Illinois. Chicago, Cook County; “7-6-01;” Holland Coll., “*Psamatodes eremiata*,” *The Moth Book* pl. XLIII, fig. 48 (1 ♂). Chicago, Cook County; “7-6-01;” S. E. Cassino Coll. (1 ♂). Chicago, Cook County; 14 July 1900 (1 ♂). Iowa. Iowa City, Johnson County; 23 May 1917, Barnes Coll.; 4 July 1918; A. W. Lindsey (2 ♂). Kentucky. “Kentucky, Sanborn,” “A. S. Packard Type,” “*Psamatodes eremiata* Guen.” (1 ♂). Manitoba. Aweme; 19 June 1904; Criddle (Taylor Coll.) (1 ♂). Aweme; 18 June 1903; J. Fletcher, genit. Slide GEO 559 (1 ♀). Cartwright; Barnes Coll. (2 ♀). [No locality]; “2-7-11” (1 ♀). Missouri. “C. Mo.” [Columbia, Missouri]; May; Coll. C. V. Riley (1 ♂). Nebraska. Hackberry Lake, Valentine Natl. Wildlife Refuge, Cherry County; 9, 15, 22 June 1983; D. C. Ferguson (3 ♂). CMNH, CNC, CU, MCZ, USNM. Another specimen in the USNM labeled “Senator, Ariz.,” almost certainly is mislabeled. It is not included in the type series.

This species occurs from coastal Massachusetts (Martha's Vineyard) and New York through Ohio, Illinois, Missouri, and Iowa to Kansas and Nebraska, and northward to Aweme and Cartwright, Manitoba. I would distrust literature records without seeing or, preferably, checking the genitalia of the specimens. The flight period mostly falls within the period 15 June–26 July, with earlier

records for 17 May in Johnson County, Kansas and 23 May at Iowa City, Iowa (USNM, dissected—text figure 54 *a–c*).

It is hard to judge geographical variation with so few specimens, but eastern specimens seem paler and brighter, with the transverse lines showing more boldly than in some western examples. The eastern ones are easily recognized, but a few from Iowa and Nebraska would be almost impossible to distinguish superficially from poorly marked specimens of *eremiata*.

The *rippertaria*-GROUP

This is the largest species-group in *Digrammia*, with 16 members [*rippertaria*, *hebetata*, *decorata*, *plemmelata*, *spinata*, *indeterminata*, *yavapai*, *mellistrigata*, *gilletteata*, *subminiata*, *neptaria*, *irrorata*, *fieldi*, *puertata*, *minuta*, and *gnophosaria*, ed.]. All may be willow feeders except *yavapai*, which feeds on New Mexico locust, *Robinia neomexicana* (Fabaceae). Genitalia of most agree in the following features: valves of generally similar shape and usually with pointed or lobate-conical process on outer margin of saccular lobe; aedeagus simple but unusually stout, without digitiform process; female with sterigma moderately complex and bearing the earlike processes common in *Digrammia*; bursa copulatrix wide for entire length, having essentially no neck region, and longitudinally rugose toward posterior end. Process on distal margin of saccular lobe in male, commonly near middle between corner adjoining costal lobe and outer (distal) corner of saccular lobe, has in some species migrated almost to outer corner (*subminiata*), or to position on inner face of saccular lobe (*puertata*, *neptaria*), or may be lost (*irrorata*, *gnophosaria*). This process in *puertata* is unusual in being flexible, sometimes pointing outward, and in some specimens folded basad as in example illustrated (text figure 57 *e*).

Many species also may be recognized as members of the group by subtle similarities of appearance, best appreciated, of course, once one has gained some familiarity with the genus. Most species, including *decorata*, *subminiata*, *spinata*, *plemmelata*, *hebetata*, *rippertaria*, *fieldi*, *puertata*, and (more rarely) *yavapai* and *gnophosaria*, show the characteristic dimorphism in presence or absence of the black transverse bands that may closely approximate the antemedial and postmedial lines in most other species-groups of this genus. In contrast to the uniformity of most species

in this group, some are notably divergent in different ways with respect to their genitalia and in appearance. These include *mellistrigata*, *neptaria*, *irrorata*, *minuta*, and *gnophosaria*. Two uncommon Great Plains species, *spinata* and *indeterminata*, are unique within the genus *Digrammia* in having a well-developed foretibial claw, except that a few *decorata* may have a similar or vestigial claw. The few larvae that are known are mostly of the common white-striped green type. But a few are slender brown twig or peteole mimics (e.g., *mellistrigata*, *neptaria*).

The *rippertaria*-group is mainly western and southwestern with different species occurring from Mexico to the Yukon and Hudson Bay. Only four of the 16 species reach the Atlantic coastal states or provinces, and *D. rippertaria* is boreal and Holarctic, indeed, having one of the most northerly distributions of any macariine.

Willow feeders, like their hosts, are essentially limited to riparian sites—vegetated stream valleys, gallery forest in the plains region, lake shores, river banks, floodplains, swamps, swales, and moist meadows. Some of the least common southwestern species are undoubtedly already in decline because of the suppression of native riparian vegetation by the introduced tamarisk or saltcedar, mostly *Tamarix chinensis* Lour. (Tamaricaceae).

Unexpected similarities in genitalia between *D. equivocata* and members of the *rippertaria*-group are discussed under the *equivocata*-group, which I established for that one species.

Digrammia rippertaria (Duponchel)

PL. 7, FIGS. 42, 43 (adult); PL. 15, FIG. 6 (larva); TEXT FIG. 55 *b, d* (♂ gen.) (RWH 6394, part).

Phasiane rippertaria Duponchel, 1830, in Godart and Duponchel, *Hist. nat. Lépid. Papillons France*, **8**(1): 159, pl. 180, fig. 5.

Type locality: Digne, France

Phasiane rippertaria flavularia Püngeler, 1902, *Deutsche ent. Zeitschrift Iris*, **15** (1): 158, pl. 6, fig. 6, SUBSPECIES.

Type locality: South Aksu [Uzbekistan].

NOTE—*Digrammia rippertaria flavularia* (Püngeler) is an extralimital subspecies.

Phasiane ponderosa Barnes and McDunnough, 1917, *Contrib. Nat. Hist. Lep. N.*

Amer., **3**: 234, pl. 23, figs. 7, 8, NEW SYNONYMY.

Type locality: Cartwright, Manitoba. [USNM]

NOTE—Described from two males from Cartwright, Manitoba, and two females from Aweme, Manitoba, and Calgary, Alberta. I designate as lectotype the specimen labeled: Cartwright, Man./ Type male/ pl. 23, fig. 7, in the *Contributions*. This is the form with two heavy black bands on the forewing.

Phasiane ponderosa form *demaculata* Barnes and McDunnough, 1917, *ibidem*, **3**: 235, pl. 23, fig. 9, NEW SYNONYMY.

Type locality: Calgary, Alberta. [USNM]

NOTE—Described from three males from Calgary and three females from Calgary and Banff, Alberta, and Field, British Columbia. I designate as lectotype the example labeled: Head of Pine Creek/11-V-06 (light)/Calgary, Alta./F. H. Wolley Dod, and Type male (the specimen figured by Barnes and McDunnough). This is the form with the two black bands much reduced or obsolescent. McDunnough (1917: 234) recognized that this northern species was not the same as *hebetata* (Hulst) and proposed the name *ponderosa* for it, being unaware that he was naming a previously described Palearctic species. However, *ponderosa* was subsequently synonymized to *hebetata* by McDunnough himself, and they continued to be regarded as one species until now.

Digrammia rippertaria is a northern or montane, Holarctic, gray to gray-brown, willow-feeding species, which, like *hebetata*, *decorata*, *subminiata*, and others, may occur with or without boldly defined black bars on the antemedial and postmedial lines. It overlaps broadly with *decorata* and *subminiata* in parts of the Midwest and Northwest but may be distinguished by its lack of any reddish-brown tints, the more coarsely mottled hindwing, and wider black forewing bars when they are present. The valve of the male genitalia lacks the basocostal dentate process of *decorata* and has the distal process of the ventral lobe much reduced relative to that of *subminiata*. *Digrammia rippertaria* and *D. hebetata* are very closely related, with corresponding black-banded and unbanded forms, and problems of identification may arise should they be found to occur together. However, *hebetata* is often very large, more reddish brown than gray, more suffused with dark scales, usually with a more definite dark spot where the postmedial of the forewing meets the costa, and with other subtle differences

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hard to describe but which should be apparent from the illustrations. North American *rippertaria* are much more similar to specimens of that species from Europe than to *hebetata*. These two species differ slightly but consistently in the shape of the thornlike process on the ventral lobe of the valve in the male genitalia (text figure 55 *b, d*). *Digrammia rippertaria* occurs in North America from Labrador to Alaska but southward only to the Dakotas and Montana.

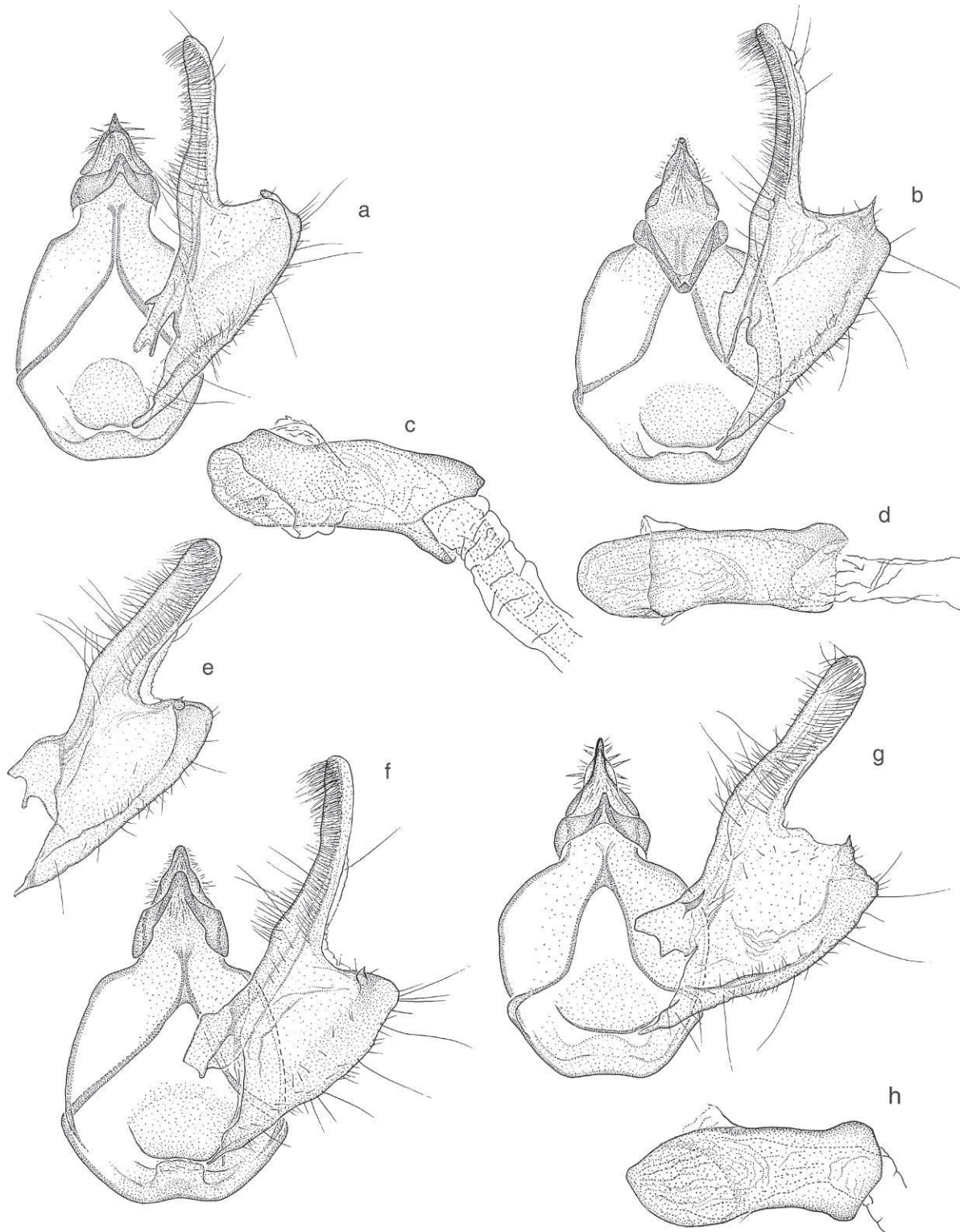
BANDED FORM. Moths light gray when fresh, becoming light gray brown with age (i.e., old specimens in collections). Wings usually more or less granulated with gray or dusky scales on a whitish background, forewing less so than hindwing. Forewing with strong black bar on antemedial line for two-thirds of its length from inner margin, abruptly disappearing toward costa; and a similar or wider black band on postmedial, forming a slightly S-shaped curve and terminating or abruptly weakening toward costa; both black bands with or without thin, white (rarely yellow) edging on one or both sides; postmedial may be closely shadowed outwardly by diffuse gray shade; a vague, pale subterminal shade usually present about midway between postmedial and outer margin; faint traces of terminal line in form of a few dusky spots or crescents; fringes weakly checkered in two shades of gray; discal spot small but usually distinct, in form of transversely elongated ring, gray in middle. Hindwing more mottled, with more of whitish ground color showing, without strong lines except usually some darkening of postmedial line toward inner margin, and a diffuse gray subterminal band with paler shading before and beyond it; discal spot as on forewing but smaller. Underside more coarsely granulate, slightly ochreous toward apex of forewing, with markings of upperside showing but not strongly so. Head and body light gray, unmarked, legs dull brownish; antennae, palpi, legs structurally similar to those of related species.

UNBANDED FORM. Similar to banded form but without bold black bands on forewing. Gray-brown antemedial and postmedial lines without much contrast may be present, but these are thin, diffuse, or obsolescent (as in lectotype of *dema-culata*). Wing length: in Canada and Alaska—males, 12–15 mm ($n = 29$); females, 11–15 mm ($n = 27$); in South Dakota—males, 14–17 mm ($n = 17$); females, 14–16 mm ($n = 6$). Although the

male genitalia of both *rippertaria* and *hebetata* have a sharp thornlike distal process on the ventral lobe of the valve, that of *rippertaria* is directed more nearly straight outward from the end of the valve and is plainly visible in profile, including its broad base. In *hebetata*, the pointed process is directed more nearly toward the viewer, assuming that the dissection is mounted with valves spread apart and lying nearly flat in the usual way, and neither the thornlike process nor its base may be apparent in profile view. Although this difference is subtle and requires good preparations for accurate appraisal, it proved consistent in all *rippertaria* and *hebetata* slides examined (about 10 of each). The valves of *D. rippertaria* are quite similar to those of *decorata* and *plemmelata* but recognizable. The female genitalia are perhaps not reliably distinguishable.

Three kinds of geographical variation are apparent in American *D. rippertaria*: 1) Specimens from the Black Hills, South Dakota, average noticeably larger than specimens from farther north, and the difference is apparent from the figures given above for wing length. 2) The proportions of black-banded to unbanded moths seem to vary in concordance with the geographic size difference; e.g., in Canada and Alaska, black-banded moths are in the minority by a ratio of about three to four in the material examined; in South Dakota they are in the majority by about six to one. Black banding appears unrelated to sex. 3) Convergence with respect to large size and some degree of reddish-brown coloring occurs between *rippertaria* and *hebetata* where both might be present, and such specimens may be hard to distinguish except by the male genitalia. Fortunately, the difference in the thornlike process on the valve remains constant.

The larva is a willow feeder and was described (as *hebetata*) by McGuffin (1972: 42). It has two color forms (last instar). **Green form**—Head yellow green with gray-green herring-bone markings; yellow line on lower lobe to base of yellow-green antenna; body yellow green with gray-green, geminate, middorsal, addorsal, subdorsal, subventral, and midventral lines; spiracular line yellow; legs and plates concolorous with body. **Brown form**—Head yellow, heavily marked with reddish brown in herring-bone pattern; yellow line from spiracular line on thorax to base of brown antenna; body yellow with geminate, brown, middorsal, addorsal, subdorsal, subventral, adventral, and midventral lines, of which the

FIGURE 55: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. yavapai, genital capsule; Coconino County, Arizona (USNM 53071). *b. D. rippertaria*, genital capsule; Gillam, Manitoba (USNM 52983). *c. D. yavapai*, aedeagus; Coconino County, Arizona (USNM 53071). *d. D. rippertaria*, aedeagus; Gillam, Manitoba (USNM 52983). *e. D. hebetata* (holotype of *innotata*), right valva; Tulare County, California (USNM 53085). *f. D. hebetata*, genital capsule; Ephraim Canyon, 8,500', Sanpete County, Utah (USNM 56039). *g. D. decorata*, paratype, genital capsule; Kamloops, British Columbia (HWC 817). *h. D. decorata*, paratype, aedeagus; Kamloops, British Columbia (HWC 817).

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subventral is darkest; midventral line solid toward middle of segment on abdominal segments 2–5; a dark-brown patch on each of abdominal segments 2–4 encloses spiracle and setae L2 and L3, with smaller but similar spot on abdominal segment 5; thoracic legs brown; prolegs and plates reddish brown. Length: 18–24 mm.

Digrammia rippertaria occurs from Labrador and the vicinity of James Bay, through northern Ontario, Churchill, Manitoba, to Rampart and Fort Yukon, Alaska, and Vancouver, British Columbia. It was taken in large numbers at km 234 and km 416 on the James Bay Highway, Quebec, 11–15 June 1982, by K. Bolte and R. Smith (CNC). Other northern records include Fort Simpson, Yellowknife, Hay River, and Fort McPherson, Northwest Territories, and Dawson, Whitehorse, Swim Lakes, 133° N, 63°3' W, 3,200', and Rampart House, Yukon. It extends southward in the East barely to the north shore of Lake Superior, but is present toward the southern borders of all the Prairie Provinces and British Columbia, and in the United States extends through the Dakotas and Montana. Two specimens in the USNM are labeled "Spanish Peaks/Col.—June 15, [18]75", "Wheeler Survey," but "Col." at that time meant Colorado Territory. The Spanish Peaks now are in Gallatin County, Montana, and I found no authentic records of *rippertaria* from as far south as Colorado. In the Palearctic Region it occurs in the Alps, including the French and Italian Alps, in European Russia and across Asia to far northeastern Siberia. The species has one brood, flying mostly from about mid-June to mid-July throughout its range, but taken as early as 24 May in Saskatchewan. I examined about 400 specimens of *rippertaria*, mostly in the Canadian National Collection.

Digrammia hebetata (Hulst), REVISED STATUS

PL. 7, FIGS. 44–46 (adult); TEXT FIG. 55 *e*, *f* (♂ gen.) (RWH 6394, part).

Phasiane hebetata Hulst, 1881, *Bull. Brooklyn Ent. Soc.*, 4: 34.

Type locality: Colorado. [AMNH]

NOTE—Described from two syntypes, one of which is in the AMNH. Two specimens in the USNM are also labeled types. One of the three must be a spurious type, probably one of those in the USNM, as Hulst surely would have kept one of the two originals in his own collection, now in the AMNH. I designate as lectotype the male in the American Mu-

seum of Natural History bearing the usual red-bordered Hulst type label and my lectotype label. It is a large specimen of the unbanded form, very worn and faded to a light brownish hue. The genitalia are damaged.

NOTE—The name *hebetata* was formerly applied to the more northern species that I now recognize as *rippertaria*, and *tulareata* was used for the larger species of Colorado, Utah, and the Sierra Nevada. However, I also concluded that the type material of *hebetata* from Colorado represents the same species as *tulareata*, which thereby becomes a junior synonym. Thus the former *hebetata* is really *rippertaria*, and what we have known as *tulareata* is the true *hebetata*.

Phasiane tulareata Cassino and Swett, 1923, *The Lepidopterist*, 4: 22, REVISED SYNONYMY. Type locality: Davis Creek, Modoc County, California. [MCZ]

NOTE—Although the original description gives "Monachee Meadows [Tulare County], Cal.," as the type locality, the holotype is a male labeled Davis Creek, Modoc County, California, which is at a much lower elevation than other localities for the species. The paratypes include specimens from both places.

Phasiane tulareata form *innotata* Cassino and Swett, 1923, *ibidem*, 4: 23, REVISED SYNONYMY.

Type locality: Monachee Meadows [Tulare County], 8,000', California. [USNM]

Digrammia hebetata has the appearance of a large, darker and more brownish form of *rippertaria* and, like that species, occurs with or without contrasting black bands superimposed upon the antemedial and postmedial lines of the forewing. It usually differs from *rippertaria* in having somewhat more of a reddish-brown tint, a more coarsely granulated or mottled wing pattern, and in having more dark brown shading immediately distad of the postmedial band. This dark shade may fill nearly half the space between the postmedial and the outer margin and is darker and more contrasting in black-banded than in unbanded moths. Nearly all specimens of both forms of *hebetata* have a dark spot where the postmedial line meets the costa; although sometimes present in *rippertaria*, this spot tends to be less developed or reduced to a thin line continuous with the postmedial in that species. The male genitalia of *hebetata* and *rippertaria* appear to differ consistently in the form and position of a thornlike process on the ventral lobe of the valve. This species

is known from the Sierra Nevada and Warner Mountains of California and the mountains of Utah and Colorado, mostly between 7,500 and 11,600 feet (although the Modoc County, California locality is lower in elevation), in places where willow thickets grow along mountain streams or in moist, grassy, subalpine meadows.

Digrammia hebetata and *rippertaria* are essentially alike in other respects, and little additional description is needed. Head, body, and legs light brown, variably dusted with darker brown scales, and at least with body and front appearing darker than the pale gray of *rippertaria*. Wing length: males, 15–18 mm ($n = 44$); females, 15–17 mm ($n = 17$).

Only 33% of the sample of 61 specimens in the collection of the U. S. National Museum of Natural History are of the banded form, a different proportion from that of *rippertaria*. However, this might vary geographically. Six of 10 examples from Colorado are banded, but only 11 of 44 Utah specimens, or 25%, are of the black-banded form. The dimorphism occurs in both sexes. The material from California, Utah, and Colorado otherwise shows little variation except for the very large size of some specimens from well up on the eastern side of the Sierras near Bishop and Lee Vining, California. These are coarsely and heavily irrorated with dark scales and without reddish-brown tints.

Male genitalia with thornlike process at distal margin of ventral lobe of valve short, without a wide, prominent base, and directed inward (upward, as mounted on slide) at about 90° relative to plane of valve. That of *rippertaria* appears large because of its expanded base, and it is directed more nearly outward, deviating by 45° or less from the plane of the valve. With practice, this difference may be seen without dissection in specimens in which the genitalia are sufficiently extruded simply by brushing a few scales from the tip of the abdomen. It was consistent in all specimens examined (about 10 of each species). I could not be sure of any differences in the female genitalia.

The early stages and hosts of *hebetata* are unknown, but its habitat and taxonomic affinities strongly suggest that it is a willow feeder.

This species is known from suitable montane habitats in the Rocky Mountains, Sierra Nevada, and Warner Mountains in the following counties: Chaffee, Grand, Summit, Gunnison, Pitkin, and San Miguel counties, Colorado; Sanpete County

(Wasatch Mts.), Utah; Fresno, Mono, Inyo, Tulare, Tuolumne, and Modoc counties, California. The only place where I collected this species commonly was at the old Great Basin Experiment Station of the U. S. Forest Service, at 8,850 feet on the Ephraim Canyon road, Sanpete County, Utah, where it came to light in a small, grassy, subalpine meadow with a small stream and many willow thickets, all sheltered by surrounding woods of aspen, white fir, and Engelmann spruce. It occurred between 7,500 and 10,000 feet in that area. The collection dates fall between 12 June and 22 August, with most records for all states being from early to mid-July. Five unusually large specimens from near Bishop and Lee Vining, on the east side of the Sierra Nevada, California, at 9,500 and 9,600 feet, were taken 6–13 August, which, with other late dates, is assumed to indicate an extended flight period in cooler habitats rather than a second brood. I took fresh specimens in a light trap hidden among shrubby willows in Tioga Pass on 4 July.

Digrammia decorata (Grossbeck), NEW COMBINATION, REVISED STATUS
PL. 7, FIGS. 47–49 (adult); PL. 15, FIG. 7 (larva); TEXT FIG. 55 g, h (♂ gen.); TEXT FIG. 59 b (♀ gen.) (RWH 6389).

Lozogamma sinuata Warren, 1904, *Novit. Zool.*, **11**: 561.

Type locality: San Juan Mts., Colorado [BMNH]

NOTE—*Lozogamma sinuata* Warren, 1904 is a junior secondary homonym of *Phasiane sinuata* Packard, 1874.

Sicagrapliia [sic] *decorata* Grossbeck, 1907, *Ent. News*, **18**: 253.

Type locality: Stockton, Utah. [AMNH]

NOTE—The name *decorata* Grossbeck was based on two female syntypes, one in the collection at Rutgers University (now in the AMNH), and the other at the Academy of Natural Sciences, Philadelphia. The syntype in the AMNH, F. H. Rindge genitalia slide No. 2330, is in very good condition, and I hereby designate it as the lectotype.

NOTE—At the time of the last check list (Hodges et al., 1983), I followed earlier authors and left all species of *Digrammia* in *Semiothisa*, a result of which was that *Semiothisa decorata* (Grossbeck), had to be regarded as a junior secondary homonym of *Semiothisa decorata* Warren, 1906, *Proc. U. S. Natl. Mus.*, **30**: 527, from St. Jean, Maroni River, French Guiana [USNM]. With its present reassignment to a

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different genus, the name *decorata* (Grossbeck) can be reinstated. Prior authors such as Grossbeck and McDunnough were unaware of the homonymy problem.

Semiothisa decorata arubrescens McDunnough, 1939, *Can. Ent.*, **71**: 255, REVISED STATUS.

Type locality: Kamloops, British Columbia. [CNC]

Semiothisa decorata arubrescens form *suffusata* McDunnough, 1939, *Can. Ent.*, **71**: 255.

Type locality: Kamloops, British Columbia. [CNC]

NOTE—This infrasubspecific name, which has no standing under the *International Code of Zoological Nomenclature*, refers to the color form without heavy black lines or shading on the antemedial and postmedial lines.

Digrammia decorata is a western species that resembles *subminiata* in pattern but is easily distinguished by its color, which is predominantly gray rather than reddish brown. Its closest relative is *plemmelata*, from which it differs in its more regular and wider postmedial band and the presence of a thornlike basocostal spine on the valve. It could be confused with *Digrammia fieldi* in the Southwest, although *fieldi* is generally smaller and has a less curved postmedial band, which is weakly S-shaped in *decorata*. *Digrammia spinata* of the central and southern Great Plains can also resemble *decorata*, and both can have the unusual character of a foretibial spine; but their ranges may not overlap. All of these species have corresponding plain and black-banded forms, but all have clear differences in the genitalia. Dissections may sometimes be necessary for identification. Because the pattern is so similar to those of related species, a complete description would be redundant and add nothing to what may be seen from the illustrations. As indicated above, distinguishing *decorata* from *fieldi* by superficial appearances is most likely to lead to confusion. However, *decorata* is mainly a more northern and montane species, and *fieldi* is a desert species. Although their distributions may interdigitate or nearly overlap in Mono and Inyo counties, California, and in the mountains and deserts of Utah and Arizona, it is doubtful whether they ever occur together in the same habitat. Some specimens from Alberta, Montana, Washington, and Colorado are peculiar in having a foretibial spine al-

most as well developed as that of *spinata*, although such a spine in *decorata* is more commonly lacking or not long enough to be visible beyond the terminal scales of the tibia. When the foretibial spine is present, it will distinguish those specimens of *decorata* from specimens of all other members of the willow-feeding group except *spinata*. Some Utah specimens have a slightly pinkish tint, which gave McDunnough (1939) a reason for proposing a subspecific name to distinguish specimens from elsewhere that do not have the pinkish color. The color is caused by reddish scales on the antemedial and postmedial bands (occupying space that would be black if the black bands were wider), and sometimes scattered in the median space. The pinkish coloring is only one aspect of many forms of variation that occur in this species and, by itself, hardly warrants a subspecific name. The species is of about average size for the genus and about the same size as *subminiata*, larger than most *fieldi*. Wing length: males, 12–14 mm; females, 12–15 mm.

The male genitalia (text figure 55 g, h) very closely resemble those of *plemmelata* and somewhat resemble those of *rippertaria* and *spinata* with respect to the shape of the valve, but *decorata* differs from those and most other species in having a small spine at the costa of the valve near its base. The excavation of the eighth sternum is in the form of a deep, widely diverging V-shaped notch, without the basal constriction characteristic of *subminiata* and *gilletteata*, and in this respect most resembles *plemmelata* and *rippertaria*.

The female genitalia (text figure 59 b) are characterized by unusually large, broad, winglike sterigmatal processes and by the particular shape of the central thickening where the “wings” adjoin. The differences will be best appreciated by reference to the illustrations.

I reared *decorata* from a female collected at light on 4 July 1987 among willow thickets on the shore of Mono Lake, California. At least two species of willow were present, but I did not identify them or determine which was the preferred host. The larvae were reared to maturity on *Salix babylonica* Linnaeus (a useful substitute food for nearly all willow feeders) and, in August, yielded 17 adults, about equally divided between the black-banded and unbanded forms. The mature larva was green, whitish ventrally, had an indistinct yellow subdorsal stripe, and a very distinct yellow lateral stripe about three wider than the subdorsal stripe. Two faint, fine, irregular white,

longitudinal lines occupied the lateral space between the yellow stripes, and four such lines were present in the dorsal area. The thoracic legs were green; the abdominal legs were faintly tinged laterally with pink. The head was green like the body, with a yellow to white extension of the spiracular stripe laterally, and reticulated encroachment of the thin white body lines dorsally; a small brown patch was present in fork of epicranial and lateral adfrontal sutures; stemmata two and three were blackish, others were pale brown. McGuffin (1972: 43) described the larva briefly, and also reported the food plants as species of *Salix*.

Digrammia decorata occurs across western Canada from southern Manitoba to Alberta and the interior of British Columbia, and southward to Lake, Kern (Greenhorn Mountains), Mono, and Inyo counties, California, but evidently not to the coast. In the Great Basin and Rocky Mountains it extends from Montana and Idaho through Nevada, Utah, Wyoming, Colorado, and to near the Mexican border in Santa Cruz County, Arizona. It is not known from the Great Plains region in the United States. The dates on most specimens are within the period 20 June–10 August, but earlier specimens were collected at many places; e.g., 10 May at Lundy Creek, Mono County, California; 8 June in Provo Canyon, Utah; as early as 24 April in Washington; 29 April in Oregon; 14 May in Saskatchewan; 12 May in British Columbia. Later records on 12, 15, 21 August were collected in western Canada. My second generation reared brood from Mono Lake kept emerging until 18 August. This species is obviously multivoltine almost throughout its range.

Digrammia plemmelata Ferguson, NEW SPECIES

PL. 7, FIGS. 50–52 (adult); TEXT FIG. 56 *a* (♂ gen.).

Digrammia plemmelata Ferguson.

Type locality: Anderson Springs, Lake County, California. [USNM]

This species most closely resembles *Digrammia decorata*, but the wing coloring is a more uniform, drab grayish brown, without strong dark shading in the outer third of the forewing; and the especially characteristic postmedial band of the forewing is thin, black, more irregular and with its curves more inclined to be angulate than

evenly curved as in *decorata*. Occasional worn examples of *Rindgea cyda* may look like this, but species of that group are not known to overlap in range with *plemmelata*. The valve of the male genitalia lacks the thornlike basocostal spine of *decorata*, and the saccular lobe is somewhat differently shaped at the outer extremity. The species is known from Oregon to central California.

Body and structure of appendages not differing from those of *decorata*. Wings uniformly light gray brown, the forewing typically without contrast between the basal, medial, and distal thirds, mainly because of the almost complete absence of blackish shading beyond the postmedial band. Antemedial band of forewing regular, convex, black, developed at inner margin but becoming thinner and usually disappearing before costa; postmedial band thin, black, with very little dark shading along its distal margin, concave between inner margin and CuA_2 , convex or somewhat angled at M_3 , abruptly angled at M_1 , then concave and usually interrupted between M_1 and costa; diffuse discal spot with light center. Fragments of dusky medial band present at inner margin and between discal spot and costa (only rarely complete). Pale, very faint, sinuous subterminal band may be present in otherwise almost uniformly colored outer third. Hindwing with faint traces of a dark postmedial band, a very diffuse, dusky, subterminal band apparent near inner margin, and a very faint discal spot. Wing margin with thin, dark, gray-brown, somewhat crenulate terminal line with whitish margin outwardly; fringes gray, weakly and diffusely checkered. Underside light gray, variably dusted with darker gray, and with faint discal spots. Wing length: holotype, 13 mm; other males, 12–14 mm; females, 13 mm.

The male genitalia differ from those of *decorata* mainly in the following two ways: 1) the prominent, sharp spine near the base of the costa of the valve is lost or nearly so in *plemmelata* (a minute, vestige of a point may be present but is difficult to see); and 2), the saccular lobe of the valve differs obviously in shape because the subapical prominence, which bears a short apical spicule and is inclined conspicuously distad in *decorata*, is smaller and more conical in *plemmelata*, and it is neatly folded in line with the straight, semimembranous, outer margin of the saccular lobe between its apex and juncture with the costal lobe. Other similar species, such as *D. fieldi* (text figure 57 *f*) and *D. puertata* (text figure 57 *e*), clearly differ in features of the valve, as

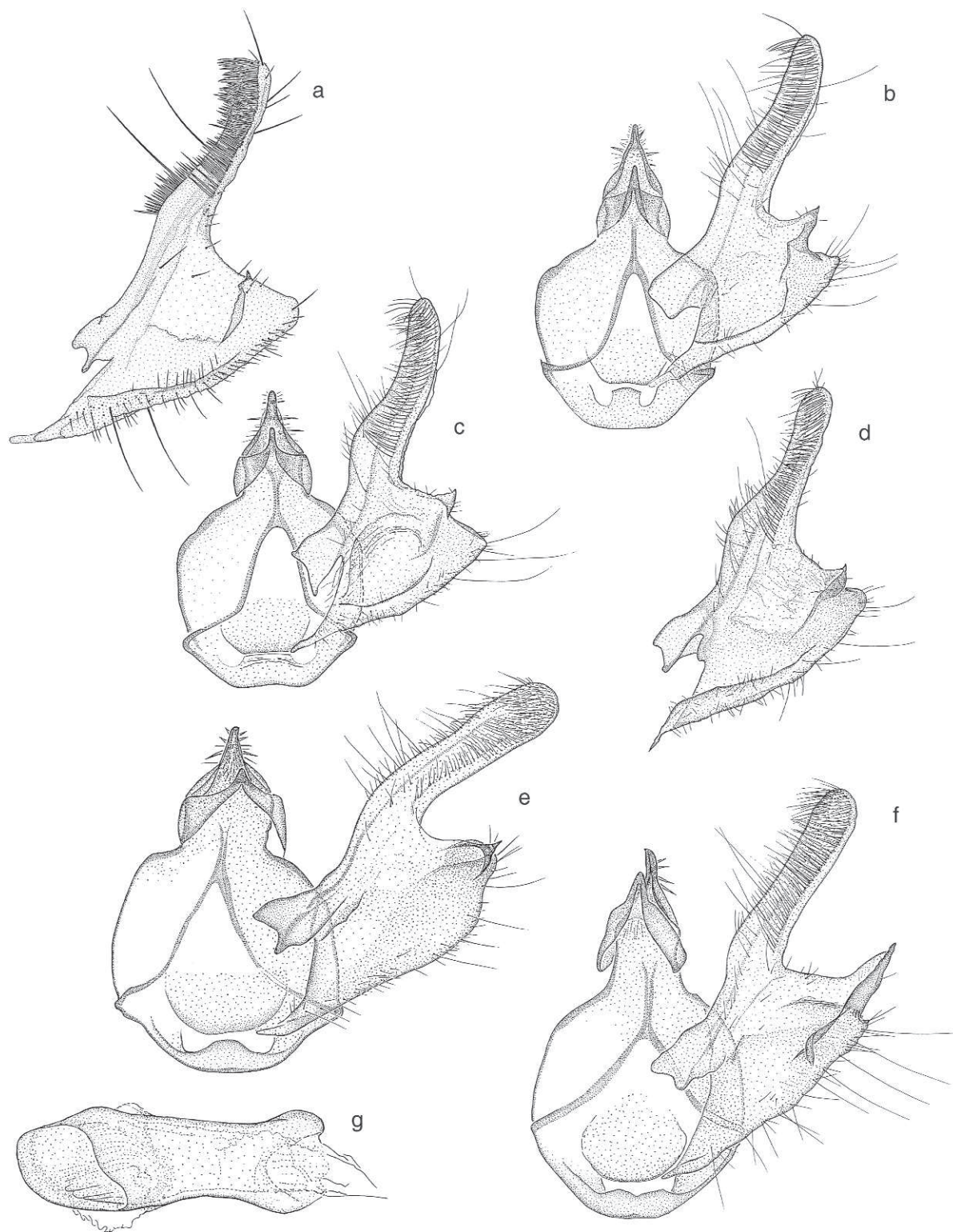
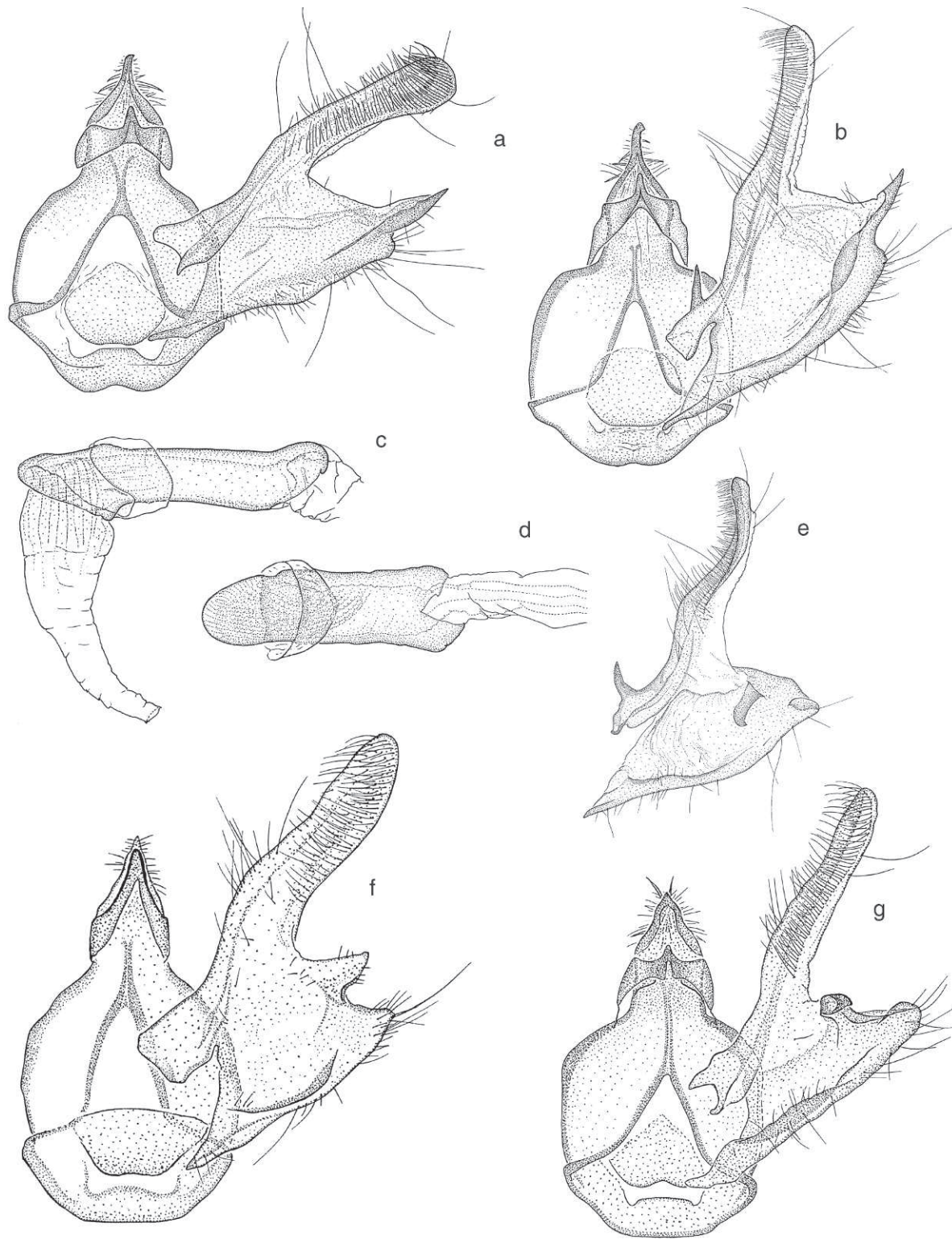


FIGURE 56: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. plemmelata, right valva; Dayton, Yamhill County, Oregon (USNM 57564). *b. D. spinata*, (paratype of *vernata*), genital capsule; Lebanon, Marshall County, Oklahoma (CNC 573a). *c. D. spinata* (holotype of *vernata*), genital capsule; Brownsville, Cameron County, Texas (CNC 571). *d. D. indeterminata*, right valva; Plattsmouth, Cass County, Nebraska (CNC 572). *e. D. indeterminata*, genital capsule; Taloga, Dewey County, Oklahoma (HWC 819). *f. D. subminiata*, genital capsule; Greenville, Washington County, Mississippi (USNM 53082). *g. D. indeterminata*, paratype, aedeagus; Taloga, Dewey County, Oklahoma (HWC 819).

FIGURE 57: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. *D. gilletteata*, holotype, genital capsule; Colorado (USNM 57061). b. *D. mellistrigata*, genital capsule; Cherry County, Nebraska (USNM 57040). c. *D. gilletteata*, holotype, aedeagus; Colorado (USNM 57061). d. *D. mellistrigata*, aedeagus; Cherry County, Nebraska (USNM 57040). e. *D. puertata*, right valva; La Puerta Valley, San Diego County, California (USNM 53079). f. *D. fieldi*, genital capsule; Roaring Springs, Grand Canyon, Coconino County, Arizona (HWC 7171). g. *D. minuta*, genital capsule; Donley County, Texas (DCF 1545).

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illustrated. The female genitalia do not differ noticeably from those of *decorata*.

The food plant, willow, *Salix* sp. (Salicaceae), and life history, appear to be similar to those of *D. decorata*.

TYPES. Holotype ♂. USNM. Anderson Springs, Lake County, California; 25 June 1949; W. R. Bauer. Paratypes: (11 ♂, 9 ♀). California. Same data as for holotype; 4 August 1951 (1 ♀). Stebbins-Cold Canyon Preserve, 10 mi W of Winters, Solano County; two males reared from larvae on *Salix* sp., 19, 27 March 1989; B. Scaccia (2 ♂, 1 ♀). Sacramento, Sacramento County; 18 May 1968, 21 July 1968, 21 August 1969, 16 August 1967; R. A. Belmont (6 ♀). El Portal, Mariposa County; 10 August 1968; G. A. Gorelick (1 ♂). Goodyear Creek, Sierra County; 10 July 1926; E. H. Nast (1 ♂). Oroville, Butte County; 14 April 1926, 19 July 1927; H. H. Keifer (2 ♂). Carrville, 2,400–2,500', Trinity County; 17 June 1934; E. C. Van Dyke (1 ♂). Oregon. Kerby, Josephine County; 20 July 1990; D. C. Ferguson (1 ♀). McMinnville, Yamhill County; 14 May 1940; K. M. and D. M. Fender (1 ♂). Dayton, Yamhill County; 1 August 1960; R. Albright (1 ♂). 5 mi W of Mill City, N Fork Santiam River, Oregon Highway 22, Marion County; 2 July, 5 August 1961; C. W. Nelson (2 ♂). CAS, RAB, UCB, USNM.

The type data above represent all that is known about the distribution and flight period. The species is bivoltine and possibly trivoltine.

Digrammia spinata (McDunnough)

PL. 7, FIGS. 53, 54 (adult); TEXT FIG. 56 b, c (♂ gen.) (RWH 6390, 6391).

Semiothisa spinata McDunnough, 1939, *Can. Ent.*, **71**: 256.

Type locality: Lugert, Oklahoma. [CNC]

Semiothisa vernata McDunnough, 1939, *Can. Ent.*, **71**: 255, NEW SYNONYMY.

Type locality: Brownsville, Texas. [CNC]

NOTE—McDunnough described as *vernata* the more grayish winter and early spring specimens from Brownsville, Texas, and then, on the next page, described the reddish summer form as *spinata*, not realizing that they were seasonal forms of the same species. The above names were published simultaneously, and *vernata* has page priority (position precedence). However, I exercise the option of the first reviser in choosing to apply the name *spinata* because it is appropriate and easy to remember. The spined foretibia of the male is a major feature of this species.

This little-known species of the southern Great Plains resembles *subminiata*, having similar red-

dish coloring and corresponding black-banded and unbanded forms. Its overall coloring tends to be less reddish, however, and spring specimens may be gray. It is easily distinguished from *subminiata*, *fieldi*, and most others by the genitalia and by the presence of a sharp spine or claw protruding well beyond the covering scales at the base of the foretibia in both sexes. Otherwise, among *Digrammia* species of the plains region, only *indeterminata* (text figure 3 f) and a few *decorata* have such a claw, and that of *decorata*, when present, is not as well developed. *Digrammia spinata* occurs in the Great Plains from southmost Texas to Nebraska; its close counterpart, *indeterminata*, is known from Oklahoma, Nebraska, and South Dakota. Both may occur with or without dark transverse bands on the forewing, although, in the few specimens examined, the bands of *spinata* seem to be more frequently present and better developed. *Digrammia spinata* may be reddish brown (mainly summer specimens), resembling *subminiata* or *fieldi*, or it may be gray (winter or spring specimens), resembling *decorata*, or any shade between; whereas *indeterminata* is predominantly gray or gray brown, fading to yellowish brown, not usually as well marked as *decorata*, and with the wing surfaces appearing more granulated. Examination of the genitalia will often be required for positive separation of *spinata* and *indeterminata*. Both species are rare in collections.

Wings with ground color gray to reddish brown, appearing finely granulated but not as coarsely so as in *indeterminata*. Forewing antemedial line with or without a partial black band running between inner margin and cubital stem, absent in costal half of wing; postmedial line in banded specimens sharply outlined with black from inner margin about to M₁, this band vaguely S-shaped and with wide band of brown shading on outside and thin edging of pale brown or whitish on inner (proximal) side; discal spot a small dark ring filled with the ground color, usually elongated; terminal line absent or indistinct; usually no other markings; fringes unicolorous. Hindwing same gray to reddish-brown color, finely granulated, a partial dark postmedial band sometimes present toward inner margin in dark banded specimens; minute discal dot and very thin terminal line usually present. Head and body usually concolorous with ground color of wings. Undersides similar in coloring but mostly unmarked. Unbanded moths lacking all blackish

bands, although diffuse reddish-brown transverse bands may be present, and one unbanded male has a faint reddish-brown medial band. A largely unmarked gray male from Nebraska closely resembles *indeterminata* but has the genitalia of *spinata*. Wing length: males, 11–12 mm (n = 3); females, 10–13 mm (n = 5).

Male genitalia (text figure 55 *b, c*) similar to those of *indeterminata* but differing in several respects. Pointed conical process of saccular lobe of valve situated near middle of distal margin, outer half of which is flattened or bevelled, not rounded; saccular lobe more nearly triangular in shape, with ventrodiscal corner angled, not rounded; conical process itself more or less symmetrically conical, with neither side prominently convex or appearing swollen; terminal process of gnathos long, slender, tapered, length two or more times greater than width which is considerably longer than that of *indeterminata*; distal third of aedeagus distinctly tapered to a blunt, rounded apex (in *indeterminata* less tapered, continuing wide toward apex, then subtruncate with corners rounded); deep excavation of eighth sternum with sides nearly parallel in most specimens (in *indeterminata* somewhat flared toward open end). Male genitalia of both species most closely resemble those of *decorata* and *fieldi* (n = 4).

It should be explained that the male genitalia differ from those of *decorata* in lacking the sharp process near the base of the valve at the costal margin. However, the distal margin of the ventral lobe of the valve has a somewhat larger process, which tends to lie in the same plane as the valve (i.e., not inclined mesad), and which generally lacks the acuminate, thornlike point at its apex. Also, the two posterior apices of the eighth sternum are not produced to points as in *decorata*. The male genitalia of *fieldi* are also similar but differ in having the distal process of the ventral lobe of the valve flattened, lamellate and distally truncated rather than pointed.

Female genitalia are close to those of *indeterminata* (text figure 59 *c*) but differ in the shape of the central component of the sterigma (the small sclerotized structure that appears to have a round depression in the middle and two short, posterior processes). Although similar overall, this structure narrower in *spinata*, without such bulging, convex sides. "Wings" of sterigma present in both species but reduced and lightly sclerotized, being less conspicuous than the drawing of *indeterminata* (text figure 59 *c*) suggests. Fe-

male genitalia of *spinata* and *indeterminata* most closely resemble those of *Digrammia minuta* (text figure 59 *e*), but the male genitalia are clearly different (*spinata*, n = 2).

The early stages of *Digrammia spinata* are unknown, but it belongs to what is mainly a willow-feeding group and has at least two generations.

I have seen about 17 specimens, from the following places: Valentine Natl. Wildlife Refuge, Cherry County, Nebraska; Lebanon, Lugert, and Sayre [Beckham County], Oklahoma; and Paducah, Cottle County and Brownsville, Cameron County, Texas. This probably says more about the inadequacy of southern plains material in collections than about the rarity of the species. The 12 types from Brownsville were collected 1 February–19 March 1937, and those from Oklahoma 2–6 July 1937. Two specimens from Cottle County, Texas were taken 17 April and 11 July, and a specimen from Cherry County, Nebraska was taken 8 June. These dates, plus the presence of the summer form in both Texas and Oklahoma, suggest two broods in the southern part of the range.

Digrammia spinata may not occur together with any closely related species except *subminiata* and *indeterminata*, overlapping with the latter between Oklahoma and Nebraska. *Digrammia decorata* extends as far east as Manitoba but only in the North, and *fieldi* is known only from as far east as Presidio and Brewster counties in Texas. The size range of *spinata* is about equal to that of *decorata* and *subminiata*, but *fieldi* is somewhat smaller.

Digrammia indeterminata (McDunnough), NEW COMBINATION

PL. 7, FIGS. 55, 56 (adult); TEXT FIG. 3 *f* (leg); TEXT FIG. 56 *d, e, g* (♂ gen.); TEXT FIG. 59 *c* (♀ gen.) (RWH 6392).

Semiothisa indeterminata McDunnough, 1939, *Can. Ent.*, **71**: 256.

Type locality: Stillwater, Oklahoma. [CNC]

NOTE—*Tephriopsis indeterminata* Warren (1906: 533), from Oaxaca, Mexico, (holotype in USNM) is clearly the same species as *Semiothisa cydica* Rindge (1959: 11) from Tehuacan, Puebla, Mexico. The male genitalia match so closely as to leave no doubt that *cydica* is a junior synonym. It is a member of the *s-signata*-group and was so treated by Rindge (1959) at the time of the original description of *cydica*. As this species group is now included in my new genus, *Rindgea*, a replacement name is not

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needed. Had the species of *Rindgea* been left in *Digrammia*, then *indeterminata* McDunnough would have been a junior homonym of *indeterminata* Warren.

This species appears to replace *spinata* in much of the midplains region, but, like *spinata*, it is so rare in collections that little can be said without reservation. It is a nondescript, gray or gray-brown species closely related to and quite resembling *spinata*, but not or only rarely reddish, and lightly marked or almost unmarked. It commonly has hardly any transverse bands or lines at all. The wing surfaces tend to have an especially granular appearance owing to a dense scattering of darker scales or aggregations of such scales on a lighter background. Discal spots of the forewing may be prominent. Also, like *spinata*, it has a long foretibial claw protruding well beyond the covering scales in both sexes (text figure 3 f). The genitalia of *indeterminata* (text figures 56 d, e, g, 59 c) appear to be diagnostic but the differences are slight.

Wings gray or gray brown, finely and evenly granulated with darker scales or patches of scales, more coarsely so than those of *spinata*. Forewing antemedial band faintly or incompletely indicated, almost straight, bending somewhat basad near costa; postmedial band varying from absent to thinly but completely outlined with blackish, forming a slightly sinuous to nearly straight, thin line, roughly parallel to outer margin; outer third of forewing often divided transversely down middle by obsolescent submarginal band, forming a paler outer half toward margin and a darker inner half toward postmedial line as in many species, including *spinata* and *decorata*, but with little contrast in *indeterminata*; forewing discal spot often prominent and, as in *spinata*, usually ring-like with a paler center. Overall coloring very bland because of weak markings, and with the gray sometimes fading to yellowish brown in weathered specimens. Fringes concolorous with membrane. Hindwing same color as forewing, almost without markings; discal spot weak to absent. Head and body concolorous with wings. Undersides of wings similarly colored but with a faint reddish to yellowish tint, almost unmarked. Wing length: males, 12 mm (n = 2); females, 12–14 mm (n = 4).

Male genitalia (text figure 56 d, e, g) differing from those of *spinata* as follows: saccular lobe of valve not angled at ventrodistal corner but round-

ed, more nearly lobate; conical process on distal margin of saccular lobe not in middle of outer margin but situated more toward ventrodistal corner of valve; process appearing to have swollen base and sharply pointed acuminate tip as in *hebetata* or *decorata* but more so; process of gnathos short compared to that of *spinata*, length hardly exceeding width; aedeagus not regularly tapering in distal third to a rounded apex but subtruncate, with distal corners rounded off; excavation in eighth sternum with sides not parallel but slightly flared toward open end (n = 2).

Female genitalia (text figure 59 c) differing from those of *spinata* only slightly in shape of central component of sterigma (structure posterior to ostium with depression in middle and two posterolateral processes), which has its sides more convex, making this structure wider or seemingly more rounded than that of *spinata*. Elsewhere this type of sterigmal component may be seen only in *spinata* and *minuta* (n = 1).

The early stages of *Digrammia indeterminata* are unknown, but it belongs to a mainly willow-feeding group.

I have seen relatively few specimens, all from the following places: Taloga and Stillwater, Oklahoma; Genoa [Nance County], Plattsmouth, and Hackberry Lake, Valentine National Wildlife Refuge (North Unit), Cherry County, Nebraska; Big Buffalo Creek, N of Cedar Pass, Jackson County, South Dakota; Burkburnett, Red River, Wichita County, Texas, and Paducah, Texas. Although most specimens examined were collected in summer, the recorded flight period is 3 May–11 August, with a late capture on 23 September at Paducah, Texas. This would seem to indicate two broods with a possible third or partial third in September.

Digrammia yavapai (Grossbeck)

PL. 7, FIGS. 57–59 (adult); TEXT FIG. 55 a, c (♂ gen.); TEXT FIG. 59 a (♀ gen.) (RWH 6393).

Sciagraphia yavapai Grossbeck, 1907, *Can. Ent.*, **39**: 346.

Type locality: Yavapai County, Arizona. [AMNH]

NOTE—Described from one female specimen.

This is a light brown, indistinctly marked, southwestern species that usually may be recognized by a fortuitous combination of features. Fresh specimens have a slight violaceous tint, especial-

ly on the forewings; the weak transverse lines on the forewing, especially the postmedial, are in part outlined by a few red or orange-red scales in more than half of the specimens examined, and these are diagnostic for the species when present (probably always present in fresh specimens); and the discal spot of the forewing is an elongate-oval ring of dark scales with its light center matching the general ground color of the wing. A rare color form has black bands following the course of the antemedial and postmedial lines of the forewing, as in corresponding forms of many other species, such as *D. rippertaria* and *D. hebetata*. The genitalia of both sexes suggest that *yavapai* is related to species of the *rippertaria*-group, despite its different foodplant. Antenna of male ciliate, the setae about as long as width of shaft; of female, filiform, minutely setose. Front somewhat protruding, but outwardly flat in profile except for crested lower edge, rounded in anterior view. Palpi normal for group, hardly exceeding front. Hindtibia of male enlarged, about twice as long as tarsus. Scales of body, head, and legs nearly matching color of wings.

Uppersurface grayish brown with a faint lilac tint, lightly and variably flecked with darker scales; fore- and hindwing colored alike; discal spot of forewing relatively conspicuous as an elongate, dark brown ring, pale in the center; three main lines of forewing nearly always incomplete, reduced to thin, weak, brown lines, or sometimes to partial series of small, dark, vein dots; antemedial or medial, or both, sometimes missing altogether; postmedial, and sometimes also medial, represented most obviously by small blackish spot or bar at costa, even when otherwise obsolescent, that at costal terminus of medial line usually adjoining discal spot; postmedial of forewing, and to lesser extent the other transverse lines, faintly outlined with red to ochreous-orange scales in over 50% of the specimens, an important recognition feature for *yavapai*; forewing with or without a diffuse brown patch immediately distad of postmedial, centered between veins M_3 and CuA_1 ; terminal line usually represented by incomplete series of black dots between veins; fringes of both wings concolorous with gray-brown ground color, unmarked. Hindwing with small, faint discal spot, and with or without faint remnants of medial and postmedial lines, the latter sometimes indicated by a row of reddish scales as on forewing. Undersurface with whitish ground color, heavily flecked or suffused with

brown; forewing dusker than hindwing and slightly ochreous toward apex; fore- and hindwing beneath with small, equally developed brown discal spots, and sometimes with faint indications of postmedial band. Wing length: males, 14–17 mm ($n = 106$); females, 13–17 mm ($n = 66$).

As in many other species of *Digrammia*, *yavapai* has a form in which the antemedial and postmedial lines of the forewing are boldly outlined in black, but the form occurs much less frequently in *yavapai* than in most. For example, no more than 3% of 407 specimens of *yavapai* examined had the black band; whereas the figure approaches 40% for *rippertaria* and *hebetata*.

Male genitalia (text figure 55 *a, c*) with small, dentate process near base of costa; tip of ventral lobe of valve curved inwardly in characteristic manner and lacking thornlike papilla of *hebetata* and *rippertaria*. Eighth sternum with sides of V-shaped notch each having a wide, sclerotized flange that is not present, or at least not so exaggerated in the other species.

Female genitalia (text figure 59 *a*) easily recognized by bursa copulatrix being even wider than those of other members of the group, and by elongated mesial component of sterigma being about twice as long as wide (more nearly square in *hebetata* and *rippertaria*).

The larva of *D. yavapai* feeds on New Mexico locust, *Robinia neomexicana* A. Gray (Fabaceae). It was reared in Arizona by J. G. Franclemont, and his reared adults are in the Cornell University collection. Newly hatched larvae from eggs laid by a female that I took in the Santa Catalina Mountains in July 1998 immediately took to the foliage of this tree and fed rapidly. Upon my return to Maryland, when the larvae were half grown, I assumed that they would accept the similar eastern *Robinia pseudoacacia* Linnaeus. However, they totally refused the eastern *Robinia*, and all starved.

I have seen this species from Coconino, Yavapai, Mohave, Pima, Gila, Santa Cruz, Cochise, Graham, and Apache counties, Arizona; Otero, Socorro, Los Alamos and Sandoval counties, New Mexico; Zion National Park, Utah; and Florissant, Teller County, and Rock Creek Canyon, Colorado. Most specimens examined are from Coconino County, Arizona, near Flagstaff. I collected it on the Kaibab Plateau, near Jacob Lake, also in Coconino County, in an almost pure stand of ponderosa pine, and near White Rock, Los Al-

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amos County, in mixed xerophytic woodland where *Robinia neomexicana* was plentiful. It also occurs high in the Santa Catalina Mountains, where the food plant is present. Collection dates range from April to September with no apparent break.

Digrammia mellistrigata (Grote)

PL. 7, FIGS. 60, 61 (adult); TEXT FIG. 57 *b*, *d* (♂ gen.) (RWH 6397).

Phasiane mellistrigata Grote, 1873, *Bull. Buffalo Soc. Nat. Hist.*, 1: 12, pl. 1, fig. 11.

Type locality: Buffalo, New York. [BMNH]

This easily recognized, bluish-gray, widespread northern and midwestern species resembles *D. neptaria* except that the postmedial line of the forewing is abruptly angled just before the costal margin, meeting the costa at nearly 90°; and for most of its length, this line is neither parallel to the outer margin nor slightly S-shaped as in most species, but is regular and slightly concave, mirroring instead of following the curve of the outer margin. The postmedial line in *neptaria* is not angled and may be slightly curved parallel to the outer margin. In *mellistrigata* the antemedial and postmedial lines of the forewing are ochreous tinted, either reddish or yellowish, and variably bordered or shaded with blackish brown on one or both sides. The hindwing usually has a prominent, dark postmedial line, also angled before reaching the costa. *Digrammia mellistrigata* is unusually constant in color, pattern and size and should be recognized easily from the illustrations. It never attains the large size of some western *neptaria*. Wing length: males, 12–14 mm; females, 13–15 mm; average for both sexes: about 13.5 mm (n = 132).

Male genitalia (text figure 57 *b*, *d*) most similar to those of *subminiata* and *gilletteata* but differ in presence of a prominent, sharp-pointed spine on costa near base of valve. *D. decorata* and *puertata* also have such spines, but valves of those species are differently shaped, and in other respects the moths are not likely to be confused. *Digrammia neptaria*, the other bluish-gray species, with which *mellistrigata* is widely sympatric, lacks the spine, and ventral lobe of its valve is apically rounded, not pointed.

Female genitalia differ from those of *subminiata* and *gilletteata* in larger winglike plates on sterigma, wider ostium, and greater breadth of bursa copulatrix toward its posterior (ostial) end.

D. neptaria (text figure 59 *g*) differs somewhat in shape of sterigma and has two pairs of depressions or invaginations in integument of seventh sternum rather than just the one pair laterad of sterigma.

This species has been reared many times from willow (Prentice, 1963; McGuffin, 1972; Ferguson, 1954, 1975), and the larva was described by McGuffin. The last instar larva was described as light brown with five pairs of fine, gray or brown lines dorsally and three pairs ventrally, and a gray or brown lateral patch on each of abdominal segments two to five; the head was russet green or brown with brown markings on the lobes. McGuffin (1972: fig. 216) gave illustrations of the genitalia, larval head and setal maps, pupal cremaster, and adults. A larva that I found and reared in Pictou County, Nova Scotia in 1944 was on one of the pussy willows of the *Salix bebbiana-discolor*-group.

Digrammia mellistrigata occurs from Nova Scotia and New Brunswick at least to Wayne County, Pennsylvania, and Nashville, Tennessee (one record for 10 May 1901, in CMNH), westward as far as Edmonton, Alberta, Nebraska, and to Yuma County, Colorado (D. J. Wright Collection). It almost reaches but does not seem to penetrate the Rocky Mountains. The species is generally uncommon in collections, although represented from all provinces and most states within the boundaries of the range outlined. Single specimens in the USNM labeled Kansas and Colorado do not give specific localities. Seventy-six specimens that I collected in 1983 in the Valentine and Fort Niobrara National Wildlife Refuges, Nebraska, where it was abundant, represent the largest sample seen from one area. Like *D. subminiata*, this species may often be overlooked because of its restricted habitat in willow swales and along creek margins where most of the native willows grow.

The flight period from Nova Scotia to Ontario is 5 June–4 August, with one second brood record for 28 August from Marmora, Ontario. For the Prairie Provinces the records span the period 24 May–23 August (mostly in July), except for single captures as early as 10, 15, and 16 May at Lloydminster, Alberta. Available dates for the United States extend from 7 May (Ithaca, New York) to 25 August (Wisconsin), again with most records for July. My long series from Nebraska was collected 4–30 June, but there are other Nebraska records for August. *Digrammia mellistri-*

gata evidently has a partial or even a full second generation throughout much of its range although there are not enough data to clarify this by region.

Digrammia gilletteata (Dyar)

PL. 7, FIGS. 62, 63 (adult); TEXT FIG. 57 *a*, *c* (♂ gen.) (RWH 6400).

Sciagraphia gilletteata Dyar, 1904, *Proc. Ent. Soc. Washington*, **6**: 105.

Type locality: Colorado. [USNM]

This is a doubtful species of which only seven specimens are known, all taken in Colorado and New Mexico shortly before or after 1900. The male genitalia (text figure 57 *a*, *c*) resemble those of *subminiata*, of which *gilletteata* may be a form or aberration with the black overlay of both antemedial and postmedial bands missing. However, the black bands are replaced by ochreous or orange or yellow, giving the moth a peculiar appearance unlike that of any form of *subminiata* and more like *mellistrigata* or, as might be imagined, a hybrid between the two. Also, the background coloring is more gray and less granulated in appearance than that of the unbanded form of *subminiata*. Many normal *subminiata* have been collected in Colorado and New Mexico in recent years, and if *gilletteata* were a rare color form or recurring aberration, more examples should have been found. It appears to be sympatric with *subminiata* and could hardly be regarded as a subspecies. It is not known to be sympatric with *mellistrigata*, and for that reason would be an unlikely hybrid. Therefore, as *gilletteata* cannot clearly be relegated to the synonymy of any known species, I leave its status unchanged until more evidence accumulates. The size is about the same as that of *subminiata*. Wing length of holotype male: 14 mm; other males (2), 14 mm; females (3), 13–15 mm.

The genitalia (text figure 57 *a*, *c*), of which I show those of the holotype, appear indistinguishable from those of *subminiata* in both sexes.

The early stages are unknown, but the food plant would be expected to be willow.

The locality label on the type simply says "Colo.," but labels on other specimens are more specific, as follows: "Chimney Gulch, Col., 6/26/[18]98," 1 ♂; "Denver, Colo.," 1 ♀; "Jemez Spgs., N.M., Sept. 1–7," 2 ♂ (without date), 1 ♀; "Hot Springs, N. Mex., 7,000 ft. alt., Aug.," 1 ♀. All are in the USNM except for one male from Jemez Springs in the CNC.

Digrammia subminiata (Packard)

PL. 8, FIGS. 1–3 (adult); PL. 15, FIG. 9 (larva); TEXT FIG. 3 *e* (leg); TEXT FIG. 56 *f* (♂ gen.); TEXT FIG. 59 *d* (♀ gen.) (RWH 6398, 6399, 6401).

Panagra subminiata Packard, 1873, *Proc. Boston Soc. Nat. Hist.*, **16**: 25.

Type locality: Goose Lake, Siskiyou Co., California. [MCZ]

NOTE—The only specimen labeled as a type of *subminiata* in the MCZ is a badly broken and partly repaired female, with left forewing intact and two broken hindwings, and no abdomen. It is the plain (unbanded) form of the same species as *meadiaria* and *snoviata*.

Phasiane meadiaria Packard, 1874, *Ann. Peabody Acad. Sci.*, **6**: 47.

Type locality: Denver, Colorado. [MCZ]

NOTE—The type, probably a holotype, has had a genitalia slide made (Slide CNC K[laus] B[olte] 1327). It was illustrated by McGuffin (1972, fig. 131). The name on the original type label (*meadiaria*) has been crossed out and changed to "*meadiata*," one of the names he used for this species in the "Monograph" (Packard, 1876: 269, pl. 10, fig. 2) and an unjustified emendation.

Phasiane snoviata Packard, 1876, *Monograph of the Geometrid Moths or Phalaenidae of the United States*, in Hayden, F.V., *Rept. U. S. Geol. Surv. Terr.*, **10**: 268, pl. 10, fig. 2.

Type locality: Lawrence, Kansas. [MCZ]

NOTE—Two specimens in the MCZ are labeled as types, one of which is a male with wings on the left side only. I designate as lectotype the other, also a male, of which a genitalia slide has been made (Slide CNC K[laus] B[olte] 1328). It was illustrated by McGuffin (1972, fig. 132).

Digrammia subminiata is a widespread species of the West and Midwest, usually identified by its distinctive reddish-brown color and conspicuous dark bands marking the antemedial and postmedial lines. Like other members of the willow-feeding group, however, it has a plain form without dark bands, and such specimens may be confused with similar forms of related species. Unbanded specimens of *subminiata* usually retain some of the reddish tint, or they may be determined by their association with the black-banded form, which is likely to be more commonly collected in the same localities. *Digrammia spinata* of the plains region from Nebraska to Texas, may

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be somewhat reddish and outwardly similar, but it has a foretibial spine (text figure 3 *f*) that is lacking in *subminiata* (text figure 3 *e*). *Digrammia decorata* is similar in pattern, but its wings are gray rather than reddish brown. Comparison should also be made with the closely related *D. gilletteata*, with respect to specimens from Colorado and New Mexico. Some examples of *D. fieldi* from southern California may closely resemble *subminiata*, but *subminiata* does not occur there.

Forewing of banded form with boldly defined, fairly thick, blackish bands following antemedial and postmedial lines but not reaching costa, that of antemedial line occasionally reduced or wanting; postmedial band shaded distally with dark reddish brown for half distance between it and outer margin; remaining space between postmedial and outer margin lighter brown; median space often contrastingly pale, and costal area tinted with red; discal spot usually a fine blackish ring. Hindwing light reddish brown with faint dark discal spot; postmedial often well marked toward inner margin. Undersurfaces plain, hardly marked, uniformly dusted with clumps of red or pink scales.

Unbanded form similarly colored or less reddish, and lacking blackish bands marking antemedial and postmedial lines, thus leaving these lines thin, reddish brown, and often faint. Also, dark shading beyond postmedial usually lighter and with less contrast than in banded form, occasionally wanting altogether, and median space usually not contrastingly pale. *Digrammia subminiata* is a medium to large species for the group. Wing length: 13–15 mm in both sexes.

Male genitalia (text figure 56 *f*) recognized by characteristic shape of ventral lobe of valve, which bears a prominent apical extension resembling only those of *mellistrigata* and *gilletteata*. Genitalia seemingly identical to those of the doubtfully distinct *gilletteata*.

Female genitalia (text figure 59 *d*) similar to those of *decorata* but with winglike processes of sterigma considerably larger, and with pair of particularly well-formed, rounded, slightly sclerotized depressions in the sternal integument immediately laterad of winglike plates. Female genitalia indistinguishable from those of *gilletteata*.

The larval host is willow, but the adults seem to be of such localized occurrence that they may be associated in nature only with a few kinds of willow. I took note of this in the field and con-

cluded that they have an affinity for certain shrubby species, common in the West, with narrow, linear, whitish-pubescent leaves. I tentatively identified one of these plants as coyote willow, *Salix exigua* Nuttall (= *S. melanopis* Nuttall, now regarded as a form). Newly hatched larvae that avoided a smooth-leaved willow that was offered did eat a species of the pussy willow group and fed still more readily on the above species with pubescent, linear leaves, which the pale green larvae closely matched. In later instars the larvae may be less restricted. They were easily transferred in the last instar to foliage of an eastern stream-bottom willow with glabrous, somewhat pubescent, lanceolate leaves (possibly *S. caroliniana* Michx.).

The following larval description, the first for this species, is based on live material reared from a female that I collected on the Cimarron River, ca. 6,600', five miles west of Cimarron, Colfax County, New Mexico, on 26 July 1989. Larva with the typical, slightly flattened body form and pale, longitudinal stripes characteristic of most *Digrammia* larvae; head held prognathously in repose. Body leaf green to whitish green, with a pair of closely set, thin, whitish longitudinal stripes on each side of the green middorsal stripe, and, in the paler larvae, nine very thin, faint, pale stripes in the ventral area; lateral stripe pale yellow, distinct, continuous from anal proleg to side of head; head otherwise green with reddish mouth parts and some reticulate whitish markings dorsally. All setae pale, inconspicuous. Thoracic and abdominal legs green, faintly and variably tinted with red laterally. One individual in this brood of 15 larvae was of a strikingly different color form, having the entire body and head bright reddish brown, obscuring all green and white areas, except that the lateral stripe was evident in a lighter shade of brown. Length at maturity: 27 mm.

Digrammia subminiata occurs from Wisconsin, Illinois, Indiana, Ohio, western Pennsylvania, Kentucky, Tennessee, and Mississippi westward to California, and in Canada from Point Pelee National Park, Essex County, Ontario and southern Manitoba, across the Prairie Provinces to the southern interior of British Columbia. On the West Coast it occurs to Siskiyou County, California, but thence southward apparently only on the east side of the Sierras through Mono and Inyo counties to Independence and Lone Pine (LACM, UCB). The species is locally common

in the West and on the Great Plains, and it is recorded from 15 localities in Missouri (J. R. Heitzman, in litt.), but in general is collected only rarely east of the Mississippi River. The easternmost records are from Columbus, Ohio (USNM); Newton County, Indiana (Metzler); New Brighton, Beaver County, Pennsylvania (USNM); Jefferson County, Kentucky (Covell); Monteagle, 2,000', Grundy County, Tennessee (CU); and Greenville, Mississippi (USNM). Southward it reaches the White Mountains, Arizona (USNM); northern New Mexico; Texas; and Louisiana. I know of one Texas record, a specimen from College Station, Brazos County (USNM).

In most of its range this species has a long flight period from May to September, even in western Canada, and from the latitude of Missouri southward may emerge as early as mid-April. This must represent two or more broods, although most records are for July or August.

Digrammia subminiata is fairly uniform in appearance, and both color forms occur throughout its range. Some specimens from California have the black antemedial band of the forewing reduced or lost, the postmedial band more nearly straight, and the brown shading beyond it intensified. Initially I thought that these might be another species but found no tangible differences in the genitalia or otherwise. Also, every degree of variation between this form and the "normal" black-banded form seems to occur in the same region.

The names *meadiaria* and *snoviata* of Packard were correctly reduced to the status of junior synonyms of *subminiata* by McGuffin (1972: 43), who examined all three types and illustrated two of them in color: namely, *meadiaria* (fig. 131) and *snoviata* (fig. 132), both of which represent the well-marked, dark banded form. The holotype of *subminiata*, which is in poor condition, is a specimen of the plain, unbanded form and was illustrated by Packard (1876: pl. 10, fig. 6).

Digrammia neptaria (Guenée)

PL. 8, FIGS. 4–7 (adult); PL. 15, FIG. 8 (larva); TEXT FIG. 4 c (head); TEXT FIG. 58 a, c (♂ gen.); TEXT FIG. 59 g (♀ gen.) (RWH 6396).

Tephрина neptaria Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 99.

Type locality: California ("Californie. Un male, envoyé par M. Lorquin.") [type lost?]

Panagra flavofasciata Packard, 1871, *Proc. Boston Soc. Nat. Hist.*, 13: 394.

Type locality: California. [MCZ]

NOTE—Three syntypes survive, all badly damaged. I designate as lectotype a male labeled "California," with the left wings only and no abdomen.

Phasiane sinuata Packard, 1874, *Ann. Rept. Peabody Acad. Sci.*, 6: 45.

Type locality: Victoria, Vancouver Island, British Columbia. [MCZ]

Phasiane trifasciata Packard, 1874, *Ann. Rept. Peabody Acad. Sci.*, 6: 46, REVISED STATUS.

Type locality: Berlin Falls, New Hampshire. [MCZ]

NOTE—Although formerly treated as an eastern subspecies, *trifasciata* does not differ from western *neptaria* in any significant way. The type is a male labeled with the locality and the date, "Aug. 9, 1868."

Phasiane cinereata Bates, 1886, *Can. Ent.*, 18: 75.

Type locality: Elko, Nevada. [AMNH]

This widespread western and northern transcontinental species has blue-gray wings with regular, nearly parallel, yellowish antemedial and postmedial bands, the latter not sharply angled inward near the costa as in *mellistrigata* but only slightly curved subparallel to the outer margin. The ochreous-yellow filling of the postmedial band is commonly compressed between darker lines and is sometimes wholly obscured by blackish. Dark shading beyond the postmedial may be present or absent. The small discal spot of the forewing is in the form of a blackish ring with a gray filling, and that of the hindwing is more often just a faint dot. In the West *neptaria* is most likely to be confused with *irrorata*, which has a similar pattern but is nearly always light brown to reddish brown, more flecked or granulated with dark scales in the ground color of the wings, and sometimes with pale veins on the forewing. In the East *neptaria* most resembles *mellistrigata* but differs clearly in the course of the postmedial line where it approaches the costa, as mentioned above.

In any locality or region *neptaria* may be variable in size, in the granulated nature, if any, of the background coloring, the amount of dark

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shading in the outer third of the forewing, presence or absence of a dark, sinuous, usually diffuse medial band on the forewing, and whether the antemedial and postmedial bands of the forewing are yellow filled or all blackish. However, it is never dimorphic in the sense of having discrete black-banded and plain forms as do *subminiata*, *decorata*, *hebetata*, *spinata*, *fieldi*, and others. Although the average wing length is about 15 mm, some western specimens, particularly from Colorado, may reach 19 mm in both sexes, about as large as any species of the genus in North America. Wing length: males, 12–19 mm; females, 13–19 mm.

Although geographically variable in the West, *neptaria* does not lend itself to clear separation into eastern and western subspecies, as formerly treated. Eastern specimens are not significantly different from most western ones. Regional differences in the West, especially in California, are much greater. The following geographical variants are noticeably different, but I do not understand the limits or significance of this variation: 1) Specimens from coastal southern California tend to be evenly colored and pale, except that some have the outer third of the forewing all suffused with dark brown, in bold contrast to the rest of the wing, which is light gray, or the wing may be all sooty brown. 2) A strange form that I collected in Mono County (plate 8, figure 5), and of which I have seen few others, is larger, has a granulated appearance, and solid black transverse forewing bands in half of the 22 specimens. This might be taken for a distinct species, but the genitalia show nothing distinctive. Great Basin specimens from Elko County, Nevada show tendencies in the same direction. 3) Those from most of California, the Cascades and Pacific Northwest, and the entire Rocky Mountain region from Alberta to New Mexico and Arizona, are much alike and hardly differ from Great Plains or eastern specimens.

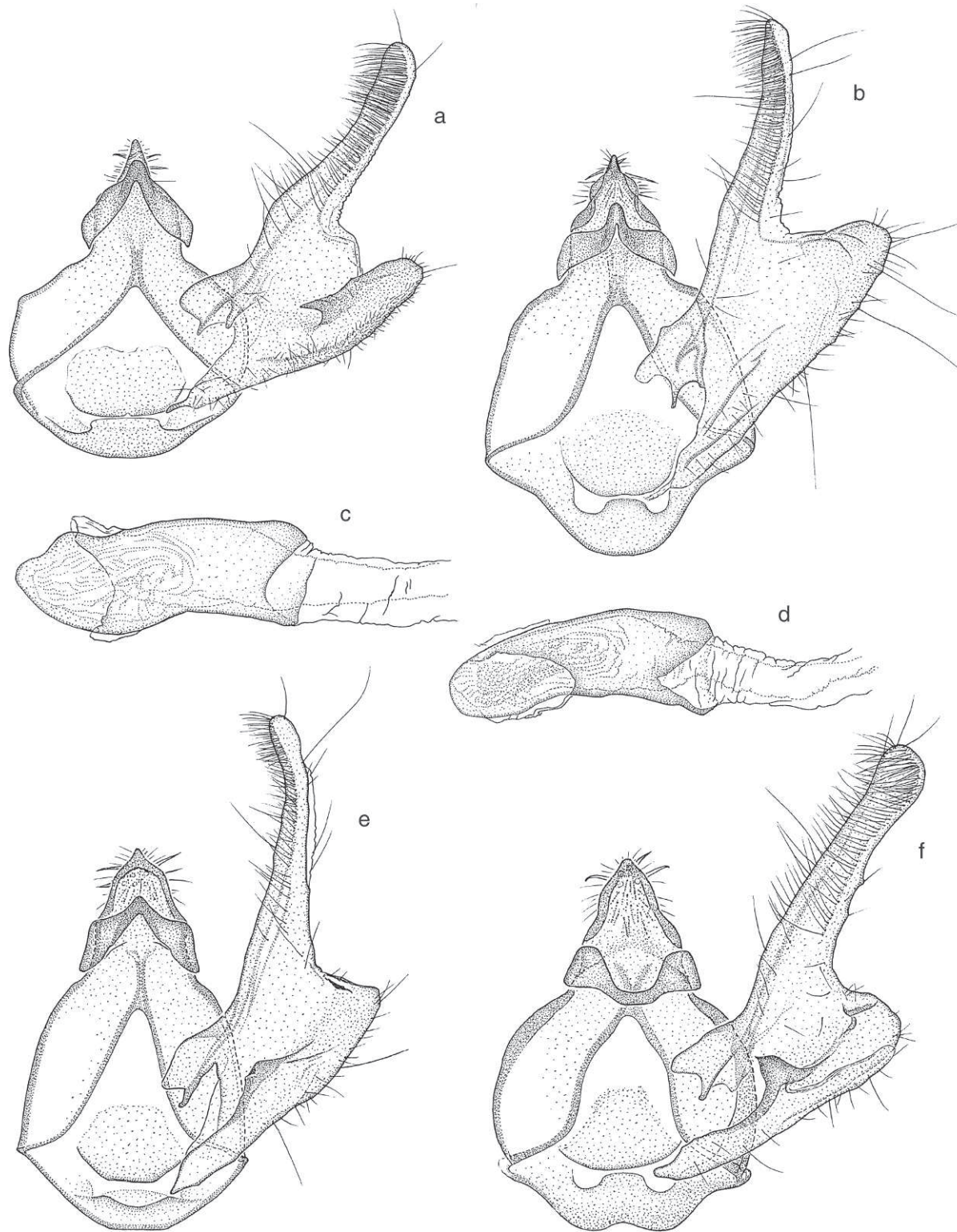
Male genitalia characterized by an extended distal accessory lobe on ventral lobe of valve, bearing toward its base a stout, sclerotized, dentate process directed toward base of valve. This unique configuration separates *neptaria* from *irrorata*, *mellistrigata*, and all other related species.

Female genitalia unique in having unusually large sterigma with elongated winglike processes, and two pairs of pits or depressions in integument of seventh sternum: one pair of pouchlike pits beneath winglike processes, and a laterally elon-

gated pair of shallower, scale-filled depressions anterior to ostium. Latter character would be destroyed in preparations in which that part of integument is torn away, as used to be customary in female genital preparations.

Digrammia neptaria has been reared many times on species of *Salix* and occasionally on *Populus* (Salicaceae) (Dyar, 1906b; Ross and Evans, 1958; Prentice, 1963; McGuffin, 1972). I found reared specimens with (mostly unpublished) host data in various collections as follows: from willow at Riverside, California, C. M. Dammers; *Salix lasiolepis* Benth. on the Ventura River, Ventura County, California, T. E. Dimock (LACM); from larvae beaten from *Salix* in May, adults in June–July, in Los Angeles County, California (UCB); from *Salix laevigata* Bebb. at El Monte, Los Angeles County, California, C. Henne (LACM); from eggs on *Salix* species in Walnut Canyon, Coconino County, Arizona, J. G. Franclemont (CU); and from larva on *Populus tremuloides* Michx. at Springdale, Newfoundland (CNC). I reared *neptaria* in 1981 from a female collected near Ephraim, Sanpete County, Utah. These larvae fed on several kinds of willow, but mostly I gave them the conveniently available weeping willow, *Salix babylonica* Linnaeus. The mature larvae were light pinkish brown, plain, with thin, barely visible, lighter longitudinal stripes on the dorsum, and a very faint, discontinuous yellow lateral stripe that became conspicuous only on the prothorax, where it turned from yellow to white. Two small, dark brown lateral spots, one above the other, were present on the mesothorax, and repeated on the metathorax with the addition of a black ring on the proximal segment of the metathoracic leg; a similar pair of lateral dark spots or patches repeated again on the second abdominal segment were larger, diffuse, and confluent; the abdominal legs were pinkish, and the head largely shaded with dark brown. The larvae of this brood were not dimorphic. McGuffin (1972) also described the larva, presumably from Canadian material, and reported it as having green and gray color forms. The green form was reported as having a yellow-green body with double green lines and a gray-green head with brown shading. The gray form has a light brown to reddish-yellow body with double gray or brown lines and a light gray to light brown head.

Digrammia neptaria occurs across Canada from Newfoundland and Nova Scotia to Vancou-

FIGURE 58: MALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. neptaria, genital capsule; Orange County, California (USNM 52986). *b. D. irrorata*, genital capsule; San Diego, San Diego County, California (USNM 52985). *c. D. neptaria*, aedeagus; Orange County, California (USNM 52986). *d. D. irrorata*, aedeagus; San Diego, San Diego County, California (USNM 52985). *e. D. gnophosaria*, genital capsule; Maryland (USNM 53126). *f. D. gnophosaria*, genital capsule; Devil's River, Sutton County, Texas (USNM 53129).



FIGURE 59: FEMALE GENITALIA OF *DIGRAMMIA* SPECIES

a. D. yavapai; Grand County, Colorado (USNM 53358). *b. D. decorata*, S8, ostium bursae and ductus bursae; Vineyard, Utah County, Utah (USNM 53308). *c. D. indeterminata*, S8, ostium bursae and ductus bursae; Genoa, Nance County, Nebraska (USNM 53315). *d. D. subminiata*, S8, ostium bursae and ductus bursae; Inyo County, California (USNM 58023). *e. D. minuta*; Tempe, Maricopa County, Arizona (USNM 53316). *f. D. fieldi*, S8, ostium bursae and ductus bursae; Indian Gardens, Grand Canyon, Coconino County, Arizona (HWC 7172). *g. D. neptaria*, S8, ostium bursae and ductus bursae; San Bernardino, San Bernardino

ver Island, at least as far north as the Opinaka River, km 416, James Bay Highway, Quebec (11 June 1982, 30 specimens in CNC), and to Yellowknife and the Great Slave Lake region, Northwest Territories. The specimen mentioned from Grand Lake, Newfoundland by Forbes (1948: 48) and Morris (1980: 248) is in the USNM (collected 15 August 1906 by O. Bryant), but a more recent one in the CNC was reared from trembling aspen at Springdale, Newfoundland in 1966. For the United States east of the Rocky Mountains, I know of records only for Maine (21 localities—Brower, 1974); New Hampshire; New York; Michigan; and near Chicago, Illinois. It occurs in suitable habitats throughout the western states from the Rocky Mountains westward, and as far south as San Diego, California, including Santa Cruz and Santa Catalina islands, and it has been taken in Mexico at Cañon las Cruces, Distrito Norte (D. Meadows) and Sierra San Pedro Martir, 6,000', Baja California (J. Powell).

The apparent flight periods in the Northeast are 9 May–10 July and 28 July–10 September, although records as early as May and as late as September are rare. The earliest eastern record seen is one that I collected in Kings County, Nova Scotia, 9 May 1949, and the next earliest is one taken 30 May 1937 in Oscoda County, Michigan (USNM). The September record is from Maine. Dates for the Pacific Northwest span late April–late August with no apparent break. Dates for the Rocky Mountains and Great Basin are mostly from mid-June to mid-August but may begin in late May (Colorado) and span April–September in Arizona. Californian dates span at least March–September, a period that would be compressed in the northern counties and at high elevations. This species is mostly bivoltine but becomes multivoltine in California and univoltine in far northern and high mountain habitats. It is one of the more common geometrids in western collections, and I examined well over 1,000 specimens.

Digrammia irrorata (Packard)

PL. 8, FIGS. 8–12 (adult); TEXT FIG. 58 *b*, *d* (♂ gen.); TEXT FIG. 59 *i* (♀ gen.) (RWH 6395).

Phasiane irrorata Packard, 1876, Monograph of the Geometrid Moths or Phalaenidae of the United States, in Hayden, F. V., *Rept. U. S. Geol. Surv. Terr.*, **10**: 273, pl. 10, fig. 7.

Type locality: San Diego, California. [MCZ]

Semiothisa irrorata var. *venosata* McDunnough, 1939, *Can. Ent.*, **71**: 254, SUBSPECIES.

Type locality: Summerland, British Columbia. [CNC]

Digrammia irrorata rubricata Ferguson, NEW SUBSPECIES.

Type locality: Ripley, Riverside County, California. [USNM]

This widespread western species most closely resembles *neptaria*, and the two are sometimes confused. They are nearly alike in basic wing pattern, but the yellow postmedial band of *irrorata* does not have a dark reddish-brown to blackish margin on the inner (proximal) side and most often not on either side. The postmedial band of *neptaria* typically involves a thin yellow line compressed between a dark reddish-brown inner border and blackish outer border, although it may be all suffused with black. The color of *irrorata* is commonly brown rather than gray, but even gray specimens lack the subtle bluish tint of *neptaria*. Also, the wings of *irrorata* are more conspicuously irrorated or flecked with blackish scales, sometimes so coarsely as to give an irregularly spotted appearance, especially in the positions of the median and subterminal bands (both wings). The size of *irrorata* is average among the larger members of the willow-feeding group, although considerably surpassed by the largest specimens of *neptaria*. It is generally less common than *neptaria*, being represented in the larger collections by only half as many specimens.

Male genitalia easily recognized by simplified valve, which lacks hooklike process on inner face of ventral lobe that distinguishes *neptaria*, and lacks as well all other accessory lobes and processes that distinguish related species of the group.

Female genitalia differ from those of *neptaria*

←

County, California (USNM 53327). *h. D. puertata*, S8, ostium bursae and ductus bursae; La Puerta Valley, San Diego County, California (USNM 53309). *i. D. irrorata*, S8, ostium bursae and ductus bursae; Riverside County, California (USNM 53301).

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mainly in the much reduced sterigma, with comparable sclerotized structures being little more than half the size, and in this respect more similar to genitalia of the relatively distantly related *D. spinata*.

Although most similar to *neptaria* in our fauna, *irrorata* is most closely related to a Mexican species, *D. quadarana* (Schaus, 1898: 149), described from Oaxaca and Guadalajara. Although the two species are superficially indistinguishable, the male genitalia of *quadarana* differ in having a prominent, heavily sclerotized, downturned, apical process on the ventral lobe of the valve and somewhat more massive uncus and gnathos.

Digrammia irrorata is a polytypic species with three recognizably distinct geographical segregates that I treat as subspecies.

Digrammia irrorata irrorata (Packard)

PL. 8, FIGS. 8, 9; TEXT FIG. 58 *b, d* (♂ gen.); TEXT FIG. 59 *i* (♀ gen.) (RWH 6395).

Phasiane irrorata Packard, 1876.

Type locality: San Diego, California. [MCZ]

Specimens from most of the western United States, from the central plains (Iowa) to California and the northern plains (Montana) to the Mexican border, may be referred to the nominate subspecies. It varies from gray to light yellowish brown but not reddish; rarely has any indication of whitish scales outlining the longitudinal wing veins, although occasionally the veins may be yellowish brown; and it does not normally have the outer third of the forewing or both wings uniformly darker than the median space. The underside may show the postmedial bands in reduced intensity and diffuse discal spots, but is otherwise unmarked. Specimens from California, most of the intermountain and mountain regions, and West Texas have a tendency to be light tawny brown, and those from the central Great Plains are often grayish and darker, but these color differences are not consistent. Adults fly from March to October in the Southwest, to early August in the North. Wing length: males, 12–15 mm; females, 13–17 mm.

I have not reared *irrorata*, but the larva was described briefly by Dyar (1894: 63), based on larvae from a *Populus* species (cottonwood) at Phoenix, Arizona and again in more detail (1902: 310) from Denver, Colorado, where the host was *Populus fremontii* S. Wats. (Salicaceae), although

he said that they would also eat willow. I have seen three adults reared from larvae on a *Salix* species in the Huachuca Mountains, Arizona (R. Wielgus coll.). McGuffin (1972: 40; figs. 115, 116) repeated Dyar's 1902 description, which was based on the nominate subspecies, not the Canadian one (*venosata*) that McGuffin was discussing. Although larvae of the two populations probably are alike, one cannot count on it.

Digrammia irrorata venosata McDunnough

PL. 8, FIG. 10 (adult) (RWH 6395a).

Semiothisa irrorata var. *venosata* McDunnough, 1939.

Type locality: Summerland, British Columbia. [CNC]

This subspecies of the Pacific Northwest is light gray to pale grayish brown, and it stands out as different mainly in two features of its wing coloring. In most specimens the outer third of the forewing, and sometimes the hindwing, is uniformly dark shaded, contrasting with the paler median and basal areas; and the longitudinal veins of the forewing and sometimes also the outer third of the hindwing are thinly outlined with pale yellow to nearly white scales. Also, the subterminal, intervenular dusky spots are reduced or obscured and do not stand out as conspicuously as in the nominate subspecies, and the yellowish part of the postmedial band tends to be thin and pale. The genitalia do not differ from those of the nominate subspecies. The size of the moths is similar to that of subspecies *irrorata* or larger.

Subspecies *venosata* occurs in Oregon, Washington, Idaho, and the southern interior of British Columbia. The adults fly in May, June, July, and August, which would seem to reflect two broods with emergence varying in accordance with local differences in climate or elevation. I found no indication that it has been reared.

Digrammia irrorata rubricata Ferguson,
NEW SUBSPECIES PL. 8, FIGS. 11, 12 (adult).

Digrammia irrorata rubricata Ferguson.

Type locality: Ripley, Riverside County, California. [USNM]

This very different form is bright reddish brown, with a tendency for the light yellow postmedial bands to be strongly developed and conspicuous on both wings. The outer third of both fore- and

hindwings, distad of the postmedial, is often much darker than the medial area, and the basal area of the forewing may also be darker. The darker outer third is a feature shared with subspecies *venosata*, but the overall coloring is very different, and *rubricata* never has pale wing veins. This subspecies averages small, with males much smaller than females; but with spring specimens (March–May) usually larger than summer or fall ones. Wing length: holotype, 12 mm; other males, 10–14 mm; females, 12–15 mm.

Male genitalia show slight differences from those of nominate *irrorata*, but these may be variable and inconsistent. Spinelike setae on dorsal side of uncus larger in *rubricata*; tip of ventral lobe of valve less produced or not produced at all, and it does not have the obtusely pointed, slightly sclerotized tip sometimes present in nominate *irrorata*; and near base of costa there is a low hump or protuberance that is lacking or nearly so in the other two subspecies. Female genitalia show no differences.

The early stages of *rubricata* are unknown.

TYPES. Holotype ♂. USNM. Blythe, Riverside County; 8 October 1958 Paratypes (26 ♂, 14 ♀). California. Same locality; 4 May 1960, 8 May 1959, 11 June 1959, 11, 19 October 1958, 25 October 1960, 20 October 1962, 30 October 1958, 1, 3, 9 November 1960; G. W. Magoon, H. L. Japport, or without collector's name (5 ♂, 6 ♀). Same locality; 26 September 1932, 19 October 1931; J. A. Comstock (1 ♂, 1 ♀). Same locality; 22 June 1948; F. H. Rindge (1 ♂). 9 mi W of Blythe, Riverside County; 5 March 1935; G. Willett (1 ♀). Indio, Riverside County; 26 October 1959; C. E. James (1 ♂). Pincho [not located, ed.]; 10 April 1910 (4 ♂). Bard, Imperial County; 26 October 1960 (1 ♂). Calexico, Imperial County; 23 November 1959; C. R. Waegner (1 ♂). Holtville, Imperial County; 22 October, 19 November 1959; C. R. Waegner (2 ♀). Winterhaven, Imperial County; 11 April 1961; A. Maxwell (1 ♀). Palm Springs, Riverside County; 18 May 1950; A. H. Rindge (1 ♂). Palm Springs, Riverside County; 17 April 1921 (1 ♂). Ripley, Riverside County, California; ex argon light trap; 11 October 1958, 6 Apr. 1961; H. L. Japport, donated by W. R. Bauer/J. S. Buckett (3 ♂, 1 ♀). Arizona. Ft. Yuma, Yuma County; 11 May, 15, 16 June 1948; J. L. Sperry (5 ♂). Yuma, Yuma County; July 24–31 (1 ♂). Cibola, La Paz County; 10 April 1910 (2 ♀). Tempe, Maricopa County; "June 14, 20," E. V. Walter, M. Martinez (1 ♂). AMNH, UCD, USNM.

Nearly all material seen is from localities near the Colorado River between Riverside and Imperial counties, California and Yuma County, Arizona, in one of the warmest places in the United

States. Individual specimens from Palm Springs and Indio, California and Tempe, Arizona appear to agree, although two others from Tempe in the USNM appear to be subspecies *irrorata*.

This subspecies is so well differentiated that I had thought it might be a species, and it still might be, although structural differences are few and possibly not constant. More information is needed. Nominate *irrorata* was described from San Diego, not far away, but the populations of coastal California are not at all like *rubricata*, agreeing essentially with the gray-brown form widespread through most of the West.

Digrammia fieldi (Swett)

PL. 8, FIGS. 13, 14 (adult); TEXT FIG. 57 *f* (♂ gen.); TEXT FIG. 59 *f* (♀ gen.) (RWH 6402).

Macaria fieldi Swett, 1916, *Can. Ent.*, **48**: 326.

Type locality: La Puerta Valley, California. [MCZ]

Macaria grossbecki Swett, 1916, *Can. Ent.*, **48**: 327.

Type locality: La Puerta Valley [San Diego County], California. [MCZ]

Semiothisa fieldi var. *comstocki* Sperry, 1949, *Bull. So. California Acad. Sci.*, **48**: 7.

Type locality: Independence [Inyo Co.], California. [LACM]

Digrammia fieldi is a southwestern species that resembles *S. subminiata* in wing pattern, but its black-banded form is gray, without the reddish tints of *subminiata*. These gray specimens may be hard to distinguish from the generally more northern *D. decorata* except by dissection. Its dimorphism, with a black-banded form (*fieldi*) and a plain, unbanded form (*comstocki*) is typical of the willow-feeding group. The well-marked form has the usual black band on the postmedial line of the forewing and may occur with or without a black band or bar on the antemedial line. Although the well-marked form is gray and can resemble *decorata*, the unbanded form is often more reddish and almost indistinguishable from the corresponding form of *subminiata*. However, *fieldi* and *subminiata* do not seem to occur together except in the Owens Valley, California. *Digrammia decorata* also occurs in Mono and Inyo counties but perhaps not in the same desert habitats as *fieldi*. The similarly dimorphic *D.*

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puertata of southern California is a smaller, brighter species, but again the nondescript, unbanded specimens could be confused.

The postmedial line of the forewing in *D. fieldi* has a tendency to be more nearly straight than those of *subminiata* or *decorata* and, as in those species, may be with or without extensive dark shading beyond it. For areas where any of these other species might occur, genital dissections may be necessary for positive identification. Specimens from eastern Riverside County (Blythe) and probably Imperial County are more reddish than specimens from elsewhere, a trend repeated to a greater degree by *irrorata* in the same area. *Digrammia fieldi* is generally smaller than *subminiata* and *decorata* but larger than *puertata*. Wing length: males, 11–13 mm; females, 11–14 mm.

The male genitalia of *fieldi* (text figure 57 *f*) appear most similar to those of *Digrammia minuta* and *D. spinata* but are readily distinguished by the distal median process of the ventral lobe of the valve being a thin, almost flexible flap or flange, rather than a more three-dimensional, conelike process. No basal spine is present on the costa of the valve.

The female genitalia (text figure 59 *f*) differ from those of *minuta* only in the slightly different shape of the components of the sterigma, as may be seen from the illustration.

Nothing is known of the life history of this species, except that one specimen (USNM Slide No. 57,342) from Glendale [Maricopa Co.], Arizona, is labeled as having been reared from willow.

Digrammia fieldi occurs from Kern and Ventura counties to Riverside County in California and probably farther south, as I have seen a specimen labeled Yuma, Arizona. It is also present in the Mojave Desert, up the Owens Valley to southern Mono County, and in the Panamint and New York Mountains. Elsewhere its presence is indicated only by scattered records from near Fallon, Douglas County, Nevada; Glendale and Tempe, Arizona; Phantom Ranch, Grand Canyon, Coconino County, Arizona; Mesilla Park, Dona Ana County, New Mexico; Vineyard, Utah County, Utah; Presidio, Presidio County, and the Chisos Mountains, Brewster County, Texas, where it was taken in Boquillas Canyon. Within this wide region it has been missed in many other localities where equally intensive collecting has been done. The collection dates range from March to August

in California, but are mostly in June. Data from elsewhere indicate a June–October flight period.

Digrammia puertata (Grossbeck)

PL. 8, FIGS. 15–17 (adult); TEXT FIG. 57 *e* (♂ gen.); TEXT FIG. 59 *h* (♀ gen.) (RWH 6404).

Macaria puertata Grossbeck, 1912, *Jour. New York Ent. Soc.*, 20: 286.

Type locality: La Puerta Valley, California. [AMNH]

NOTE—Described from 14 syntypes. I hereby designate as lectotype a female labeled La Puerta Valley, 7–11, FHR [F. H. Rindge] Slide 2403.

Digrammia puertata is a small, usually brightly marked, gray to reddish-brown species with black antemedial and postmedial bands on the forewing (in the well-marked form), separated by a pale, almost cream-colored median space and relatively large but not contrasting, ringlike discal spot. The black postmedial may be repeated on the hindwing prominently, but this is variable. As in nearly all of the willow feeding species, the moths are dimorphic, with a plain, unbanded form, which is less often collected than the well-marked form, and which is almost indistinguishable from the corresponding form of *fieldi*. Specimens of both forms are commonly confused with *fieldi* in collections, but obvious differences in the male genitalia leave no doubt that *puertata* is a separate species.

The black-banded form of *puertata* is more reddish brown than gray in overall coloration, the black postmedial band is more S-shaped than that of *fieldi* and more likely to reach the costa, and the black bar on the antemedial line is unusual in being wider than the postmedial band. The presence of a well-defined, blackish postmedial band on the hindwing in many specimens of this species, often nearly extending full-length from inner margin to costa, is a unique feature within the willow-feeding group; but it has limitations as a key character because it is not well developed in all specimens. The outer third of both wings may be split into a darker brown proximal half and lighter brown distal half, or it may be almost uniformly reddish brown. The pale median area of the forewing and a pale border along the outer edge of the postmedial band of the hindwing lends contrast to the markings and gives the moth a bright, boldly marked appearance. The unbanded form (plate 8, figure 17) is drab and nonde-

script by comparison and almost exactly resembles the corresponding form of *fieldi*. *Digrammia puertata* is a small species, hardly larger than the partly sympatric *D. minuta*, or about the size of the eastern *D. gnophosaria*. Wing length: males, 9–10 mm; females, 10–12 mm.

Male genitalia of *puertata* (text figure 57 *e*) unmistakable, having a pointed, spinelike costal process at base of valve about twice as large as that of *decorata*, equally long medial distal process on ventral lobe of valve that is somewhat hooklike, and a rounded flange at apex of ventral lobe. The two outer processes of ventral lobe usually erect, at right angles to plane of valve as mounted on slide and directed toward viewer. However, in example chosen for illustration, median process is appressed against inner face of valve, allowing its profile to be seen.

Female genitalia (text figure 59 *h*) have larger postostial plate than do those of *fieldi*, almost as wide and elaborate as that of *decorata* and with variable pattern of small folds or pleats toward anterior margins of “wings.”

I found no record of *puertata* having been reared, but the food plant would be expected to be a species of *Salix*.

This species is known only from arid regions in Inyo, San Bernardino, Los Angeles, Riverside, San Diego, and Imperial counties, California; Yuma County, Arizona; and Dona Ana County, New Mexico. It probably occurs in adjacent Mexico. Some specific localities are Mesquite Spring, 1,800', Death Valley (many in LACM); and Panamint Valley and Shoshone, Inyo County; Baldy Mesa, Barstow, Yermo, and Newberry Springs, San Bernardino County; Bouquet Canyon, Los Angeles County; Blythe, Riverside County; Mason Valley, San Felipe Wash, and Sentenac Canyon, San Diego County; and San Felipe Valley, Imperial County, California; Ehrenburg, Yuma County, Arizona; and Mesilla Park, New Mexico. The specimen labels indicate a long flight period of April–September.

Digrammia minuta (Hulst)

PL. 8, FIGS. 18, 19 (adult); TEXT FIG. 57 *g* (♂ gen.); TEXT FIG. 59 *e* (♀ gen.) (RWH 6403).

Diastictis minuta Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 334.

Type locality: Arizona. [USNM]

NOTE—Described from an unspecified number of female specimens from Texas and Arizona. Two syntypes from Arizona are in the USNM and one from Texas is in the AMNH. As noted by Rindge (1955: 148), the type was “restricted” by Barnes and McDunnough (1916: 183) to a specimen from the Neumögen collection, an action commonly accepted as the equivalent of a lectotype designation. The Neumögen material was acquired by the USNM, and I have labeled as lectotype the specimen restricted by Barnes and McDunnough. It also bears an earlier USNM red type label bearing the number 3872. The specimen is a female in fairly good condition, and on comparison with others from the same region is easily recognized as the present species, although its abdomen is missing.

Digrammia minuta is a relatively rare, small, nondescript, grayish species that may closely resemble the unbanded forms of *D. puertata* and *fieldi*, although it is usually smaller, with a more peppered or granulated effect in the wing coloring, and with less brown and more gray and more contrast between the darker outer third and paler medial and basal areas. The discal spots are usually quite prominent, that of the forewing being a dark ring with a light center. Antemedial, medial, and postmedial bands may or may not be apparent but, when present, are weak. They never have the black forewing bands that distinguished the well-marked forms of most other species of this group. The dusky transverse lines may show more boldly on the undersides of both wings and be more prominent than in *fieldi* but not more prominent than in *puertata*. Also, in fresh specimens, the hindwing fringes may be more noticeably checkered above and beneath, but this is not reliable. Sometimes it is impossible to distinguish *minuta* without reference to the male genitalia, mainly because both *puertata* and *fieldi* are highly variable, and some specimens may almost exactly resemble *minuta*. Wing length: males, 8–10 mm; females, 10–11 mm.

Male genitalia resemble those of *puertata* except for absence of sharp spine on costa of the valve near base, and shape of the posterior processes of eighth sternum, which have more rounded, spatulate apices. Those of *puertata* pointed; those of *fieldi* broadly rounded but considerably shorter. The illustrations will show other differences in the male genitalia. The female genitalia (text figure 59 *e*) most resemble those of *fieldi*, and, although both are shown, they may not really be distinguishable.

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The early stages are unknown, although the larva would be expected to feed on willow, as do its nearest relatives.

Digrammia minuta occurs from southeastern California to Brewster County, Texas, but discontinuously. Recorded localities are few. I have seen specimens from Holtville, Imperial County; Blythe, Riverside County; the Providence Mountains and Needles, San Bernardino County, all in California; from Tempe (near Phoenix); Tucson; and Madera Canyon, Santa Cruz County, Arizona; and from Hot Springs, Big Bend National Park, Texas. It may be a localized desert species that is not present in the mountains, lush canyons, or riparian habitats where most collectors go, although that seems hard to reconcile with its apparent relationships within a willow-feeding group. Many of the specimens are labeled as collected at light or in light traps. I saw about 36 specimens, which bear dates in April, May, July, August, September, and October.

The difficulties of recognizing *minuta* are such that I repeatedly confused it with other species, especially the plain, nondescript examples of *puertata*. However, once a male from a particular area is identified by dissection, others of both sexes from the same place can usually be associated with it by comparison of size, pattern, and coloring relative to *puertata* and *fieldi*.

Digrammia gnophosaria (Guenée)

PL. 8, FIGS. 20, 21 (adult); PL. 15, FIG. 10 (larva); TEXT FIG. 58 *e, f* (♂ gen.); TEXT FIG. 60 (♀ gen.) (RWH 6405).

Tephрина gnophosaria Guenée, 1857 [1858], *Histoire Naturelle des Insectes, Species Général des Lépidoptères*, 10: 99.

Type locality: New York. [USNM]

Camptogramma? infectata Walker, 1862, *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*, 25: 1,332.

Type locality: Not given ("From Mr. Milne's collection."). [BMNH]

NOTE—Many specimens in the Milne collection came from John Abbot, and it is possible that the type locality for both *infectata* and *reductaria* is in Georgia.

Macaria reductaria Walker, 1862, *ibidem*, 26: 1,654.

Type locality: Not given ("From Mr. Milne's collection."). [BMNH]

Semiothisa caesiaria Hulst, 1888, *Ent. Americana*, 3: 217.

Type locality: New York. [USNM]

NOTE—Described from two males and two females from the "Eastern U.S." I have not located the males, but one female syntype from northern Illinois is in the AMNH, and the other, from "N.Y.," is in the USNM. I hereby designate as lectotype of *caesiaria* the specimen in the USNM, and it is so labeled.

Macaria da Dyar, 1916, *Proc. U. S. Natl. Mus.*, 51: 24.

Type locality: Teapa, Tabasco, Mexico. [USNM]

Digrammia gnophosaria is a small, obscure, dappled-gray species of the eastern half of the United States and at least part of Mexico. It seems most common in the southeastern United States, barely reaching the northernmost states and southern Canada, and occurring there probably only as a seasonal vagrant, appearing to be somewhat migratory. Despite its nondescript aspect, *gnophosaria* is easily recognized by its small size, rounded wing margins, and irregular spotty pattern, consisting mainly of a large, diffuse, dusky discal spot on the forewing and various fragments of the transverse bands, most commonly three dark spots marking the juncture of the three main transverse lines of the forewing with the costa; farther out, a similar remnant of the subterminal line; and, on the hindwing, remnants of the transverse lines toward the inner margin. Sometimes the antemedial, medial, and postmedial bands, or lines, of the forewing are all present and complete; this is highly variable. Wing length: males, 9–11 mm; females, 10–12 mm.

The species is dimorphic with respect to the presence or absence of a conspicuous black band superimposed upon the antemedial and postmedial lines of the forewing, as in other members of the willow-feeding group. Occasional specimens may even resemble well-marked examples of *puertata* but without the brown tints. Unlike what we know of related species, however, the dimorphism in *gnophosaria* is geographically variable. Black-banded specimens are mainly southern, found mixed with unbanded ones in varying proportions from South Carolina to Florida, across the Gulf States to Texas, and down into Mexico. Although not present in the Northeast, banded specimens do occur northward with some frequency in the Midwest to Illinois, Iowa,

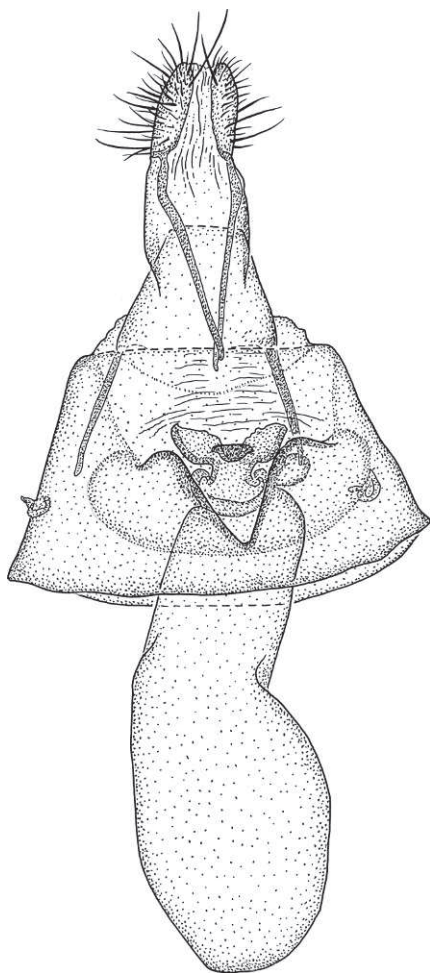


FIGURE 60: FEMALE GENITALIA OF *DIGRAMMIA GNOPHOSARIA*

Dallas, Dallas County, Texas (USNM 53237).

and Nebraska, which raises the question of whether these are the progeny of migrants from Texas or Mexico. About one-third of the specimens seen from Texas are of the black-banded form. The type of *Macaria da* Dyar, from Mexico, is one of the black-banded individuals.

The male genitalia (text figure 58 *e, f*) suggest those of *fieldi*, with a somewhat similar flange or process at the outer margin of the ventral lobe. A larger, lamellate process arising from the inner face of the valve toward the base has no counterpart among related species, however. The eighth sternum has a wide, V-shaped notch, with its posterior apices configured more elaborately than usual. The male genitalia seem unusually variable. At first I thought that two species were involved, a notion that additional dissections soon dispelled.

The female genitalia (text figure 60) are typical of the willow feeders but may be recognized by the absence of the two longitudinal, convexly curved pleats on the genital plate posterior to the ostium.

I reared *gnophosaria* from eggs of a female collected in Montgomery County, Maryland in 1980. The larvae ate and did well on weeping willow, *Salix babylonica* Linnaeus, an exotic species that happened to be the willow most readily available. Others have reported willow as the food plant, but it is not known which native willows *gnophosaria* prefers. The following is a description of last instar larvae based on colored photographs and preserved specimens.

Larva relatively small, hardly exceeding 20 mm at maturity, and slightly fusiform, being thickest in the middle or slightly toward posterior end. Body green, variably marked with stripes and blotches of dark purplish brown. Dark markings consist of a variable, distinct to indefinite, dorsolateral stripe, which may be absent in lighter specimens but at least always apparent where it continues onto side of head; and variable, lateral dark spots or blotches on abdominal segments three to six, or on all abdominal segments in most heavily marked larvae, in which they become confluent on sides of segments six to nine. A full-length, yellowish-white lateral stripe present in lighter colored larvae, reduced or absent in larvae with more extensive dark markings; lateral stripe, when present, interrupted by dark spots on abdominal segments two to five. Dorsum light to grayish green, often with thin whitish addorsal and subdorsal stripes, and with each of abdominal segments one to six marked by four small, dark dots, which are pinacula of the dorsal setae. Venter greenish, with segmentally interrupted traces of light or dark longitudinal stripes. Head green, boldly marked with purplish brown laterally, and with tinge of white ventrolaterally. All legs dark colored laterally, thoracic legs blackish brown, prolegs shaded with purplish brown. With respect to the dark lateral spots or blotches on the last-instar larva, *gnophosaria* happens to resemble at least three species of *Macaria* that may have such markings, these being *M. notata*, *aequiferaria*, and occasional specimens of *signaria*, and also the not very closely related *Digrammia colorata*.

Digrammia gnophosaria occurs regularly from Miami-Dade County, Florida and Cameron County, Texas northward as far as New York, Connecticut, Ohio, Illinois, and Nebraska; it occurs

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less regularly, perhaps as a seasonal vagrant, to Michigan, Wisconsin, southern Ontario, and southern Quebec. It came to my light abundantly in the gallery forest of the Yellowstone River just south of Sidney, Richland County, Montana in July 1999, where willow was plentiful.

This species was illustrated from South Carolina by Covell (1984, pl. 50, fig. 21); from Annapolis County, Nova Scotia (the only Atlantic Provinces record) by me (Ferguson, 1954: pl. 15, fig. 17); in color by McGuffin (1972: figs. 134, 135) from Ontario, and by Handfield (1999, figs. 6405-1 and 2) from Quebec. Brower (1974) did not list it from Maine. The westernmost records for which I have data are from Kerr County, Texas; Cherry County, Nebraska, where it was common; and eastern Montana. It is not known how far north the species overwinters or how far into the tropics its range extends. I have not seen it from the Caribbean islands.

GENUS

Rindgea Ferguson, NEW GENUS

Type species: *Eubolia cyda* Druce, 1893, *Biologia Centrali-Americana, Insecta, Lepidoptera Heterocera*, 2: 177; 3: pl. 58, fig. 4.

Moths of this genus, although superficially resembling species of *Digrammia*, represent an abrupt departure in the highly modified structure of their genitalia. The males have conspicuous and often large accessory lobes or processes on the valves that are usually bilaterally asymmetrical, and which generally show no indication of being homologous to any features in *Digrammia*; they have angled, curved, or seemingly misshapen costal lobes; a variously shaped uncus, sometimes compressed and ending in an acuminate terminal process, sometimes broad and more normal for the tribe; and, in most species, long, single or double, sclerotic, lanceolate, forked, or serrated aedeagal extensions that have more the appearance of weapons than intromittent organs. These processes are not cornuti but are rigid, integral parts of the sclerotized, cylindrical, outer wall of the aedeagus. The species to species diversity in these structures is extraordinary and represents the antithesis of the ultraconservative genus *Macaria* as it is represented in North America.

The female genitalia agree with those of *Digrammia* and *Letispe* in having lost the signum, but they have an elaborately developed sterigma,

again showing great diversity in size, shape, and presence or absence of components.

The larvae of most species are unknown and cannot be characterized reliably, although those examined have unusually prominent setae and pinacula, and thus sometimes a rough-textured integument. The setal pattern does not seem to differ from that of other Macariini according to my observations and those of McGuffin (1964). All the known host plants are desert Fabaceae with pinnately compound leaves such as mesquite, acacia, mimosa, and ebony (*Pithecellobium*).

Species of *Rindgea* occur mainly in the Southwest and Mexico, but two species sometimes range far northward in the Midwest in the same manner as *Psamatodes abydata*, probably as vagrants from Texas.

The genus, which I think is diphyletic, includes two species-groups based mainly on differences in the genitalia. They may be sister-groups, but that is uncertain. Although in each group the homology of parts is quite easily seen, there is no indication of homology of those parts between one group and the other. For example, the various nodules, processes, and lobes on the valve of the male genitalia that run through the various species of the *maricopa*-group are not to be found in the *s-signata*-group. The latter group has an essentially normal, deep or V-shaped incision in the eighth sternum, whereas the *maricopa*-group tends toward loss of the incision. Asymmetry is prevalent in both, but involves different structures in each. I had difficulty in deciding how these groups should be treated, whether as one genus or two. For a time I had them lumped with *Digrammia* in a more expansive concept of that genus similar to that of Scoble and Krüger (2002: 307–311). The present arrangement is perhaps an awkward compromise.

KEY TO SPECIES-GROUPS OF *RINDGEA* BASED ON MALE GENITALIA

1. Costal lobe highly variable in shape but never with a large lobate protruberance or process near middle of costal margin; saccular lobe with one or more discrete nodules, processes, or lobes, or short, simple truncated; juxta not prominently bilobate *maricopa*-group
p. 323
- Costal (dorsal) lobe of valve bearing a large lobate protruberance or process near middle of its costal margin; saccular lobe sometimes bent or distorted but without nodules, processes, or lobes *s-signata*-group
p. 337

The *maricopa*-GROUP

Moths of this group have one to three processes on the saccular lobe of the valve of the male genitalia. These processes may be large, soft and lobelike, or small; and those that may appear as a valvula in some species are almost certainly not homologous with the valvulae of other genera. Costal lobe variously bent or misshapen, but without processes on its costal margin. The genitalia are very diverse and nearly always asymmetrical. The aedeagus may be heavily armed with a long process as described above, or there may be none. The uncus is often bilaterally compressed and elongate, terminating in a slender acuminate process. The eighth sternum is also extremely variable, showing a tendency toward loss of the posteromedial incision. The incision may be absent, or in the form of a wide, shallow concavity or notch; and in some species there is a pair of long or stout sclerotized processes extending backward from the posterolateral corners of the sternum. The shallow incision in some species has a clump of long, non-deciduous hairs that do not come off during dissection. The female genitalia are unusual in nearly always having a large, complex, massively sclerotized sterigma with diverse configurations of sclerotized components, but without the conspicuous, shield-shaped or subquadrate genital plate of the *s-signata*-group. The sterigma is difficult to describe in both groups, and should be better understood from the illustrations.

The *maricopa*-group includes nine species [*subterminata*, *nigricomma*, *piccoloi*, *parcata*, *disparcata*, *stipularia*, *prolificata*, *maricopa*, and *flaviterminata*, ed.] in the United States and at least five more that I identified from Mexico, Central America, and northern South America.

KEY TO SPECIES OF THE
MARICOPA-GROUP BASED ON MALE
GENITALIA

(Includes *hypoethrata* of the *s-signata*-group)

1. Costal lobe of valve curved or angled 2
 - Costal lobe of valve straight or nearly so 7
2. Costal lobes somewhat curved, irregularly thickened; saccular lobes conspicuously asymmetrical with two long distal processes on right valve only 3
 - Costal lobes strongly curved or angled; saccular lobe with two marginal processes or flaps on both valves or none 4
3. Aedeagus with long, rigidly sclerotized process that is forked and Y-shaped, ending in two large, stout, pointed, widely divergent apices . . . *maricopa* p. 334
 - Aedeagus with long, stoutly sclerotized process bearing apically a quadrate hatchet-shaped end that is coarsely serrated on its outer (lateral) side *flaviterminata* p. 335
4. Costal lobe curved about 165°, apically bifid with two unequal lobes; saccular lobe without processes, but short, angularly truncated; uncus wide, curiously bent over ventrad; aedeagus with stout, long process, bent beyond middle, dilated and minutely spiculate apically (placed in the *s-signata*-group) *hypoethrata* p. 343
 - Not as described above; always with one or more processes or extrusions on saccular lobe 5
5. Costal lobes abruptly angled near middle; each saccular lobe with a pair of marginal, subapical processes that are bilaterally asymmetrical, with processes on left side longer *prolificata* p. 332
 - Costal lobes curved; two marginal processes or flaps on saccular lobe of each side that may or may not be asymmetrical 6
6. Costal lobes strongly curved outwardly and recurved just before apex; saccular lobes each with two nearly symmetrical processes, but apical one is hardly developed, other one is interlobular, i.e., in position of a valvula (as in *Speranza*); aedeagus without a long, sclerotized process *subterminata* p. 324
 - Costal lobes curved outwardly but not recurved; saccular lobes each with two marginal processes, those of two sides unequal in size, one process apical, one on ventral margin; aedeagus with long, slender, somewhat curved process, bifid with two small points at tip *stipularia* p. 330
7. Saccular lobes of irregular shape, having sclerotized processes but not apically; aedeagus without a large, prominent sclerotized process exceeding half aedeagal length 8
 - Saccular lobes of regular, rather rounded shape, each with a sclerotized apical nodule or process; aedeagus with two large, prominent, sclerotized processes, longer more than half length of cylindrical part of aedeagus 9

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8. Saccular lobe of valve with an elongate, lobe-like, apical extension that is about $2 \times$ as long as wide; valves nearly symmetrical; aedeagus pointed but without a large cornutus or cornutuslike inclusion *nigricomma*
p. 325
- Saccular lobe of valve with wider, more nearly obtuse apex; saccular lobe of right side with a thornlike process not present on left side; aedeagus with what appears to be a large cornutus *piccoloi*
p. 327
9. Aedeagus with one of the two long, sclerotized, terminal processes $\frac{1}{3}$ longer than the other and thick, curved, sharp pointed; shorter one slender, lanceolate *parcata*
p. 329
- Aedeagus with one of two long terminal processes $2 \times$ as long as other; both equally slender, linear, nearly straight *disparcata*
p. 330

Rindgea subterminata (Barnes and McDunnough), NEW COMBINATION
PL. 8, FIGS. 22–24 (adult); TEXT FIG. 61 *a*, *c* (σ gen.); TEXT FIG. 62 *a* (φ gen.) (RWH 6413).

Macaria subterminata Barnes and McDunnough, 1913, *Contrib. Nat. Hist. Lep. N. Amer.*, 2: 126, pl. 6, figs. 13–15.

Type locality: San Benito, [Cameron County], Texas. [USNM]

NOTE—Described from six male and three female syntypes, of which six remain in the U. S. National Museum of Natural History. I designate as lectotype the specimen labeled “Type male,” which was illustrated with the original description (pl. 6, fig. 14) and is still in good condition.

NOTE—*Semiothisa oaxacana* Schaus (1898: 146), from Oaxaca and Morelos, Mexico, is closely related to *subterminata*, with genitalia differing only in minor details, and in lacking all the dark spots or patches on the wings, both above and beneath. It is here referred to *Rindgea* as *R. oaxacana* (Schaus), NEW COMBINATION.

Rindgea subterminata is a brown Texan species not clearly related to any other in the United States, although it might easily be confused with *flaviterminata* or with the less common *stipularia*. However, it lacks the ochreous tints in the outer third of both wings above and on the hindwing beneath, and it seems to be unique in having a ventral collar of whitish scales between the head and the bases of the foretibiae. If well developed, this pale collar is diagnostic. Also, a conspicuous

black spot is usually present in the subterminal area of the forewing opposite the discal cell. This spot is generally much smaller or absent in *flaviterminata* but may be present in *stipularia*. The extent and intensity of the dark band or series of patches beyond the postmedial line on both wings beneath is often enough to distinguish this species from *flaviterminata* and *maricopa*; *stipularia* may have such a band but its undersurface is grayer, without any reddish or ochreous coloring. Males of all of these species are usually identifiable by the genitalia without dissection if some scales are brushed away from the tip of the abdomen under a dissecting microscope. The genitalia of both sexes of *subterminata* are extremely distinct from those of *Rindgea* species.

Male antenna more coarsely setose-lamellate than those of the most similar species mentioned above, with shaft at least as thick as haustellum, and setae as long as thickness of shaft. Hindtibia twice length of hindtarsus or less. Collar of mostly whitish scales beneath head, overlapping bases of forecoxae. Uppersurface with only postmedial line distinct and complete on both wings, and it is regular, thin, pale, thinly bordered with brown on each side and thus sometimes appearing double; basal and medial areas whitish, variably suffused with brown; outer third beyond postmedial darker brown on both wings and usually with a rounded, contrasting dark spot opposite discal cell on forewing. Underside as above with outer third much darker, variably suffused with blackish in proximal half, paler in outer half; usually some ochreous tinting toward outer margin or apex of forewing and sometimes in middle of dark band on hindwing but not toward outer margin of hindwing. Sexes nearly alike. Wing length: males, 10–12 mm; females, 10–13 mm.

Male genitalia with costal lobe of valve strongly curved downward (outward as mounted and illustrated) and recurved toward tip; recurved, flattened, sclerotized process arising where two lobes join; and ventral lobe reduced, simple, tapering to blunt, incurved, laminate apex. Unit comprised of uncus and gnathos stout, truncated, except for fine, slender prolongation of tip of uncus. Uncus bearing only two stout, bristlelike, dorsal setae. Aedeagus short, asymmetrically pointed distally but without elaborate, sclerotized extensions or processes.

Female genitalia with rigid, ribbed ductus bursae and elaborate sterigma as shown, with large, central, hollow, knoblike structure surmounting

ostium. Ostium tunnellike with crenulated rim, partly surrounded beneath by a thin, semicircular, collarlike flange.

Early stages and food plant unknown.

Rindgea subterminata appears to be more widespread in southern Texas than *flaviterminata*, with records from Cameron, Starr, Hidalgo, Duval, La Salle, San Patricio, and Jackson counties. Twenty-two of the 33 examples seen were collected in October and November, but a few, mainly single specimens, were taken in December, May, and June, and the type series is labeled March and April.

Rindgea nigricomma (Warren), NEW COMBINATION

PL. 8, FIGS. 25, 26 (adult); TEXT FIG. 61 *b*, *d* (♂ gen.); TEXT FIG. 62 *b* (♀ gen.) (RWH 6407).

Semiothisa nigricomma Warren, 1904, *Nov. Zool.*, **11**: 127.

Type locality: Guadalajara, Mexico. [BMNH]

NOTE—McDunnough, in his 1938 check list, misspelled this name *nigrocomina*, and the error was repeated by several authors in subsequent North American literature.

This acacia-feeding species of the southern Midwest and Southwest is gray to gray brown with the slightly sinuous transverse lines nearly parallel; the outer third of the wings, beyond the postmedial line, somewhat darker than the pale but heavily granulated or clouded medial and basal areas; and usually with black costal spots at the ends of the medial and postmedial lines and at the intersection of M_3 and the postmedial line. On the underside the outer third of both fore- and hindwing is dark and boldly contrasting, being a variegated mixture of dark gray and yellowish to chestnut brown. This description fits several species of the same group; namely, *R. piccoloi* (Rindge) of Baja California and Arizona; *R. adjacens* (Dognin), NEW COMBINATION, of Mexico and Central America; an apparently undescribed species from northern South America that is superficially indistinguishable from both *nigricomma* and *adjacens*; and *R. heliothidata* (Guenée, 1857 [1858]: 79), NEW COMBINATION, of Hispaniola, nearby islands, and probably Venezuela, [*heliothidata* is aberrant in other ways, having, for example, a bifid uncus, and it may not belong here]; and *Rindgea stipularia* (Barnes and Mc-

Dunnough), of southern Texas, is also related but lacks black costal spots and most of the dark shading in the outer areas of the wings. Dissection of the genitalia may be necessary for positive identification of these moths, although north of the immediate Mexican border region *R. nigricomma* is the only member of the group to be expected.

Ground color of wings light gray. Upperside of forewing with three gray-brown, slightly irregular transverse lines; antemedial line often convex, but medial and postmedial lines approximately straight and parallel except where they turn basad and expand to form wedge-shaped black spots at costa. Postmedial line of forewing straddled by closely set cluster of two or three black spots at intersection of M_3 . Area distad of postmedial line variably clouded or shaded with darker gray but not strongly contrasting with rest of wing. Discal spot inconspicuous. Upperside of hindwing similarly colored but without black spots other than small discal spot. A terminal row of minute, intervenular black spots or wedges; fringes concolorous with wings and usually faintly checkered. Underside with ground color paler than above plainer and without black spots, but with a darker, much more contrasting outer third. With magnification, the antenna, costa, and transverse lines of the upperside may be seen to have many yellow scales in *R. nigricomma* and *R. piccoloi* but not in *R. stipularia*. Wing length: males, 10–13 mm; females, 11–14 mm.

No seasonal or geographic variation is apparent other than the usual tendency of winter and spring specimens to be slightly larger than summer and fall ones.

Male genitalia (text figure 61 *b*, *d*) nearly symmetrical, with saccular lobe produced to a blunt apex and bearing a transverse flange on its inner face at base of extended apical process. A small, digitiform process arises on each side in zone between costal and saccular lobes, that on right side being slightly thicker than the other. Costal lobe wide and flattened, with sharp differentiation between sclerotized costal part and membranous ventral part. Aedeagus rather wide, terminating distally in a thin, extended, thornlike process. Eighth sternum highly asymmetrical, with an elongate, slender, slightly curved, almost spatulate process arising from left side of posterior margin, and a much wider, bladelike process on right side. Male genitalia similar to those of *R. piccoloi*, which differ in presence of a long pro-

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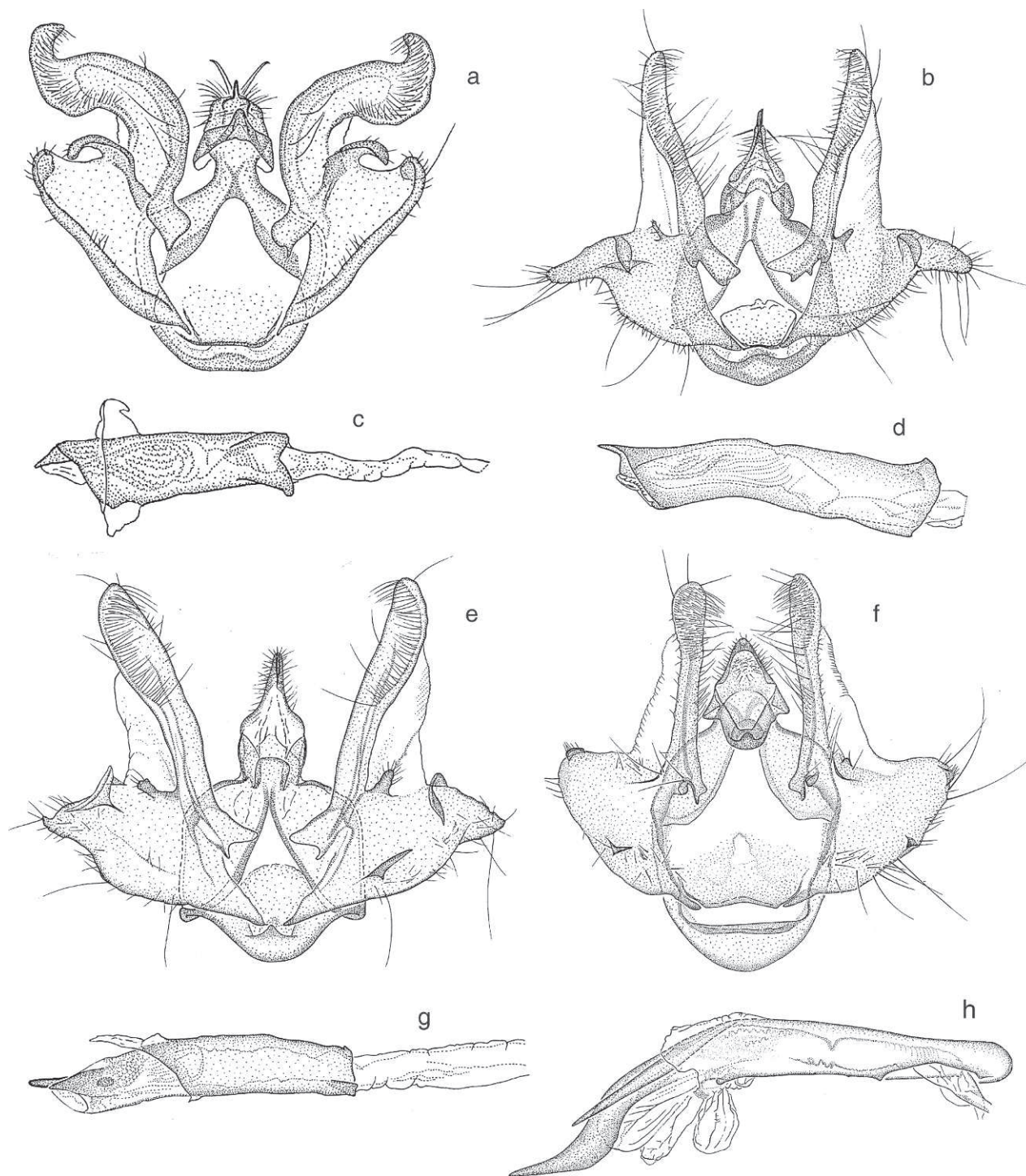


FIGURE 61: MALE GENITALIA OF *RINDGEA* SPECIES

a. *R. subterminata*, genital capsule; Sinton, San Patricio County, Texas (AB 1314). b. *R. nigricomma*, genital capsule; Brownsville, Cameron County, Texas (USNM 52993). c. *R. subterminata*, aedeagus; Sinton, San Patricio County, Texas (AB 1314). d. *R. nigricomma*, aedeagus; Brownsville, Cameron County, Texas (USNM 52993). e. *D. piccoloi*, genital capsule; Las Parras, Baja California (USNM 53387). f. *D. parcata*, genital capsule; Pima County, Arizona (USNM 53046). g. *R. piccoloi*, aedeagus; Las Parras, Baja California (USNM 53387). h. *R. parcata*, aedeagus; Pima County, Arizona (USNM 53046).

cess near ventral edge of saccular lobe toward base, a shorter apex on this lobe, a more slender aedeagus, smaller posterior processes on eighth sternum, and a narrower cleft between them. *Rindgea adjacens*, which occurs in Mexico, differs most conspicuously from *nigricomma* in its asymmetrical saccular lobes, that on the left having a long, narrow, distal, compressed and flange-like extension. Also, it has only one pointed process on the saccular lobes, that on ventral margin of right side. Sharp process on aedeagus is preapical, and processes of eighth sternum are flattened, leaflike, and rounded, that on right broadly attached at base, the one on left petiolate.

Female genitalia (text figure 62 *b*) with two earlike, bulbous lobes on postostial plate that distinguish this species from all others in region covered, with possible exception of *piccoloi*. Differences are discussed under that species. Female of *R. adjacens* has not been identified.

The larva has not been described, although I identified adults that had been reared from larvae on *Acacia smallii* Isely (= *A. farnesiana* (Linnaeus) Willd.) (Fabaceae) at Puerto Escondido, Oaxaca, Mexico in 1985, and from the same plant near Del Rio, Val Verde County, Texas in 1975, both lots collected in connection with research on biocontrol of weeds.

Rindgea nigricomma occurs mainly across the southernmost states from Louisiana to Arizona but is most common in southern Texas. It is collected most frequently in the region between Brownsville and Houston and west to Presidio and Jeff Davis counties. The Arizona specimens examined are from Cochise, Pima, and Santa Cruz counties. Eastward and northward of its usual range it was collected several times at Edgard, St. John the Baptist Parish, Louisiana (V. A. Brou), and in Jackson, Barton, Jasper, and St. Louis counties, Missouri (R. H. Heitzman). It may, of course, feed on other species of *Acacia*, or on *Prosopis*. However, the Missouri specimens are probably vagrants, suggesting a dispersal pattern approaching that of *Psamatodes abydata*. In Texas, *nigricomma* was collected in every month except January and July, but with a preponderance of records for October and November; in Louisiana, it was collected in June, September, and October; in Missouri, in June, July, August, and September; and in Arizona, in August, September, and October. Records of this species (as "*Semiothisa nigrocomina*") for the northern United States and Canada in earlier literature

were based on misidentified specimens of *Diagrammia ocellinata* (Guenée).

Rindgea piccolo (Rindge), NEW COMBINATION

PL. 8, FIGS. 27, 28 (adult); TEXT FIG. 61 *e*, *g* (♂ gen.) (RWH 6408).

Semiothisa piccolo Rindge, 1976, *Amer. Mus. Nov.*, No. 2592: 3.

Type locality: El Coyote, Baja California Sur, Mexico. [AMNH]

This species is similar to *R. nigricomma* or *R. adjacens* (Dognin), except that the transverse lines are poorly defined. It more closely resembles summer-brood specimens of *Rindgea prolificata* from Arizona, and also *R. heliothidata* (Guenée) from Hispaniola, although the genitalia reveal a much closer relationship to *nigricomma*. *Rindgea piccolo* probably cannot be recognized except by the genitalia. Males may be identified easily by the presence of an extra process toward the base of the saccular lobe of the right valve. The species occurs in Baja California and apparently rarely in southern Arizona.

Inasmuch as the appearance of *piccoloi* exactly matches that of some *Rindgea prolificata*, a detailed description of external features would not be useful save to emphasize that the moth is paler and less distinct in wing pattern than *R. nigricomma*, almost without discrete lines, but with the distal third of both wings heavily shaded with dark grayish brown, above and beneath, as in related species. Wing length: males, 10–12 mm; females, 11–12 mm, apparently averaging about 1 mm less than *R. nigricomma*.

The male genitalia (text figure 61 *e*, *g*) are similar to those of *R. nigricomma* but asymmetrical, with one fingerlike process on the left valve and two on the right. Also, the apex of the saccular lobe of the valve is more stout and less produced. The gnathos is spatulate and turned up distally, but delicate, diaphanous, and inconspicuous. In the drawing, I over emphasized it just to show that it is there.

The female genitalia are much like those of *nigricomma* but with the sterigma in part less heavily sclerotized, and with the bulbous, earlike lobes posterior to the ostium larger and more rounded. The ductus bursae is narrower, with a shorter sclerotized neck.

The immature stages and larval hosts are unknown.

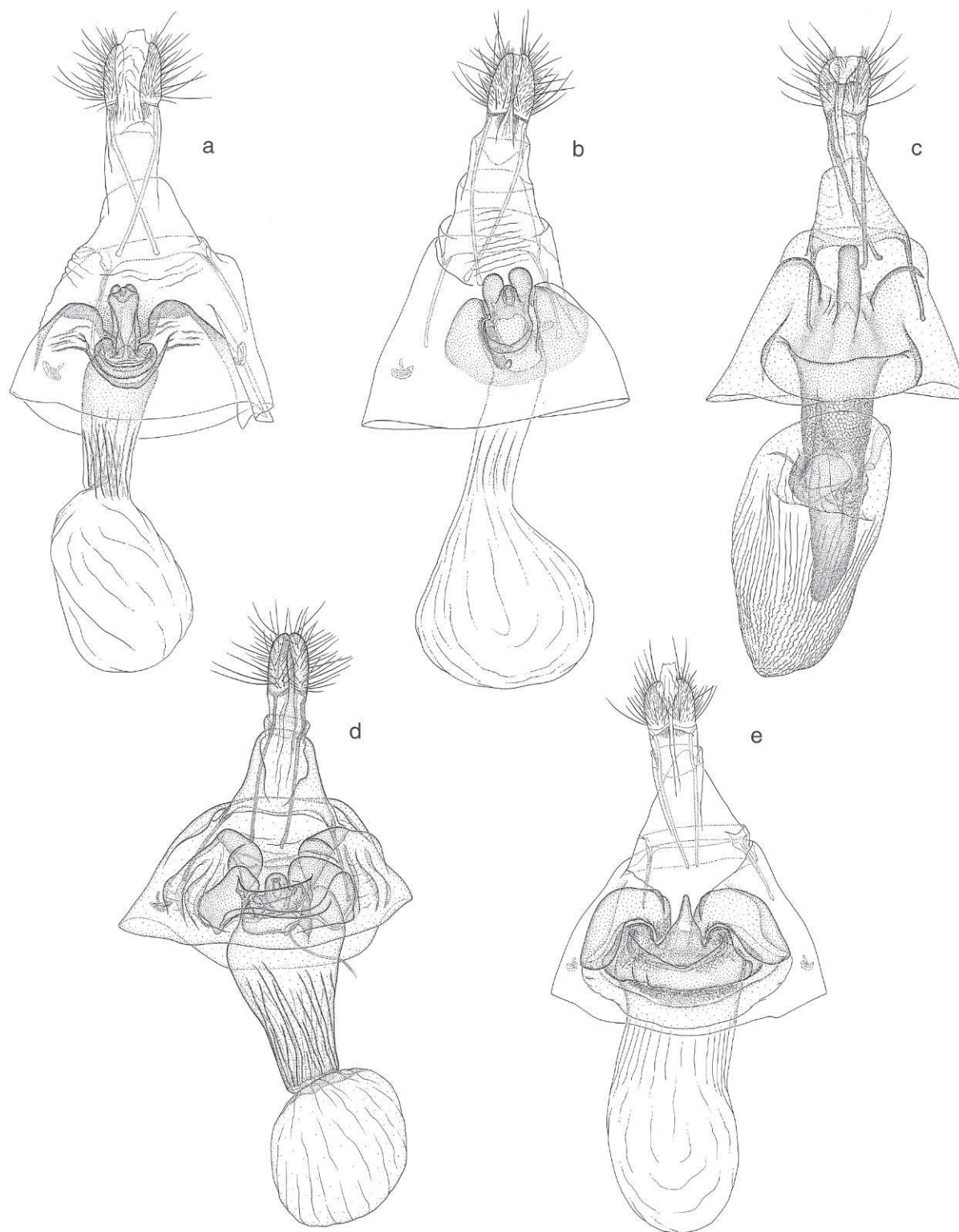


FIGURE 62: FEMALE GENITALIA OF *RINDGEA* SPECIES

a. R. subterminata, cotype; San Benito, Cameron County, Texas (USNM 53412). *b. R. nigricomma*; Shafter, Presidio County, Texas (AB 5030). *c. R. parcata*; Sabine, Jefferson County, Texas (USNM 53366). *d. R. stipularia*; Brownsville, Cameron County, Texas (AB 4018). *e. R. prolificata*; Cochise County, Arizona (USNM 53411).

According to Rindge (1976: 5), the species occurs widely in the Baja California peninsula, from the Cape Region in the south to the vicinity of Rosarito near the U. S. border. His paratypes included two males from Arizona: one from Madera Canyon, Santa Cruz County, 5 September 1956, and one from the Laguna Mountains, Yuma County, 20 January 1949, FHR Slide 14015. I found no other specimens from the United States in the USNM or in any other collection. Text figure 61 *e*, *g* of the male genitalia was drawn from a specimen in the USNM from "Los Parros, Lower California."

Rindgea parcata (Grossbeck), NEW COMBINATION

PL. 8, FIGS. 29–31 (adult); TEXT FIG. 61 *f*, *h* (♂ gen.); TEXT FIG. 62 *c* (♀ gen.) (RWH 6406).

Sciagraphia parcata Grossbeck, 1908, *Jour. New York Ent. Soc.*, **16**: 26.

Type locality: Yavapai County, Arizona. [AMNH]

NOTE—Described from two females, of which I labeled one as the lectotype. It was collected on 29 May (no year given); the genitalia are on F. H. Rindge Slide No. 2,040.

This featureless, mottled gray, finely dark speckled southwestern species can be distinguished reliably from other members of its immediate complex only by examination of the genitalia. The removal of a few scales from the tip of the abdomen with a fine brush readily exposes enough of the genitalia for identification of nearly all specimens of both sexes without dissection. Also, it is helpful to remember that *parcata* of Arizona and its very close relative, *disparcata* of Texas, are not known to be sympatric, although *prolificata* is present in both regions.

Rindgea parcata commonly lacks the dark, somewhat diffuse spot, bordered outwardly with whitish, in the outer third of the forewing opposite the cell. This is a prominent feature of most *prolificata* males, but is variable and may be poorly developed in that species also, especially in females. Variation occurs that is not easily explained, but it may be partly geographical and partly seasonal. Winter specimens (December–February) from Tucson are large, toward the upper end of the size range, and they are pale, lightly granulated, with a partly developed dark spot in the outer third of the forewing, and tend to be

slightly brownish. Summer specimens from the same place are small, gray, unusually dark, and without a dark spot in the outer third of the forewing. Series of summer specimens from Coconino and Santa Cruz counties agree in being small but pale, with a whitish ground color, densely flecked or granulated with grayish brown, and nearly always without the large, diffuse dark spot in the outer third of the forewing. Winter and early spring specimens are especially hard to distinguish from those of *prolificata*. Wing length: males, 10–13 mm; females, 10–14 mm.

Male genitalia (text figure 61 *f*, *h*) with sacular lobe of valve usually short, broad, rounded, symmetrical or nearly so, shaped like that of *disparcata*; each valve with distal process of sacular lobe short, stubby. Aedeagus with very large, two-pronged, sclerotic process, the longer prong of which is somewhat curved, compressed and bladelike, not linear like that of *disparcata*. Genitalia of *prolificata* so different in every respect that the illustrations should show all that is needed for comparison. If scales are brushed from end of the abdomen, it may be seen that eighth sternum has long posterolateral processes, distinguishing *parcata* from *prolificata* (but make sure that the "process" observed is an integral part of the sternum and not the costal lobe of the valve, which may emerge from within the eighth segment at about the same position). The protruding end of the long process of the aedeagus is curved and bladelike, not straight and cylindrical like that of *disparcata*.

Female genitalia (text figure 62 *c*) hardly differ from those of *disparcata*, having the same kind of large, tunnellike ostium, but three parts of the genitalia seem subtly but consistently different in shape or position. The ventral lip of the ostial opening is distinctly emarginate (concave) in *parcata*, nearly straight to convex in *disparcata*; the longitudinal plates forming the sides of the sterigma could not be described as S-shaped in *parcata*, but are somewhat so in *disparcata*; and the longitudinal flange inside the ostial funnel, tapered to a point posteriorly, tends to be more acutely tapered and situated near the middle in *parcata*, obtusely tapered and far to the left in *disparcata*. *Rindgea parcata* and *R. disparcata* perhaps cannot be distinguished by what may be seen of the female genitalia externally; the large hole marking the entrance to the ostium is similarly conspicuous in each if the covering scales are brushed off, and it presents an altogether dif-

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ferent aspect from the massively sclerotized, dark colored sterigma of *prolificata*, which is easily revealed by similar examination.

The early stages have not been described although *parcata* has been reared from desert species of Fabaceae. Adults were reared from larvae on mesquite (*Prosopis* sp.) by L. M. Martin at Wickenburg, Arizona (LACM); and I was given a series reared on *Acacia constricta* Benth. by R. Nagle at Tucson, Arizona.

North of Mexico, true *parcata* has been identified only from Arizona and New Mexico, where it appears to be locally common from the Mexican border northward at least to the vicinity of Flagstaff, Coconino County (J. G. Franclemont), and from Saddlerock Canyon, Grant County, New Mexico (C. D. Ferris). Rindge (1969: 31) reported it from Baja California and Sonora, Mexico. Specimens of similar appearance from southern California proved to be *prolificata* when dissected. *Rindgea parcata* has been collected in every month of the year.

Rindgea disparcata Ferguson, NEW SPECIES

PL. 8, FIGS. 32, 33 (adult); TEXT FIG. 63 *a*, *c* (♂ gen.).

Rindgea disparcata Ferguson.

Type locality: North Padre Island, Nueces County, Texas. [USNM]

This cryptic species, which is rare in collections, is known only from central and southern Texas. It is the sister-species of the closely related *parcata*. However, *disparcata* usually has less variegated, less granulated wing coloring, often with a more contrasting, dark gray outer band beyond the postmedial band on both wings, which may be even more boldly defined and contrasting beneath. Such specimens begin to resemble *A. nigricomma*. The dark spot in the outer third of the forewing opposite the cell is absent or only faintly developed, although three specimens show a blackish thickening of the postmedial line at that point, giving the two plainer ones so much the appearance of *maricopa* that I mistook them for that species before doing dissections. Little else need be said about the appearance of *disparcata*; the genitalia provide the only definitive character differences for this species. Wing length: holotype, 11 mm; other males, 10–12 mm (n = 7); females, 11–13 mm (n = 6).

Male genitalia (text figure 63 *a*, *c*) similar to those of *parcata* except as follows: apical process on saccular lobe of valve long, 4–6 × longer than wide, and that on left side more sharply pointed than the one on the right (both short and blunt in *parcata*); and long process of aedeagus linear, cylindrical, not flattened and bladelike. The aedeagal process and shape of the eighth sternum, both useful for distinguishing this species from *prolificata*, may be seen by brushing scales from the tip of the abdomen.

Female genitalia like those of *parcata* except that the ventral lip of the very large ostial opening is convex to nearly straight, not emarginate; the lateral, longitudinal plates of the sterigma are doubly curved so as to appear slightly S-shaped; and the longitudinal flange inside the ostial funnel tends to be more abruptly tapered than that of *parcata*, although it requires careful comparison of slides of the two species to appreciate this difference.

The early stages of *disparcata* are unknown although the host plants would be expected to be similar to those of *parcata*.

TYPES. Holotype ♂. N Padre Island, Nueces County, Texas; 9 September 1974; A. & M. E. Blanchard. USNM. Paratypes: 7 ♂, 3 ♀. Texas. Welder Wildlife Refuge, Sinton, San Patricio County; A. & M. E. Blanchard (1 ♂). Lake Brownwood State Park, Brown County; 20 April 1966; A. & M. E. Blanchard (1 ♂). Roma, Starr County; 24 March 1978; E. C. Knudson (1 ♀). 10 mi W of Hunt, Kerr County; 1 September 1980; E. C. Knudson (1 ♀). Laredo, Webb County; 27 May; E. A. Schwarz (1 ♂). Cotulla, La Salle County, 11, 12 May 1906; Crawford & Pratt (1 ♂). Fort Worth, Tarrant County; 13 June 1963; E. Jäckh, Jr. (1 ♂). San Benito, Cameron County; 24–30 March (1 ♀). Sabinal, Uvalde County; March 1910; F. C. Pratt (1 ♀). Nueces River [no further data] (1 ♀). ECK, USNM.

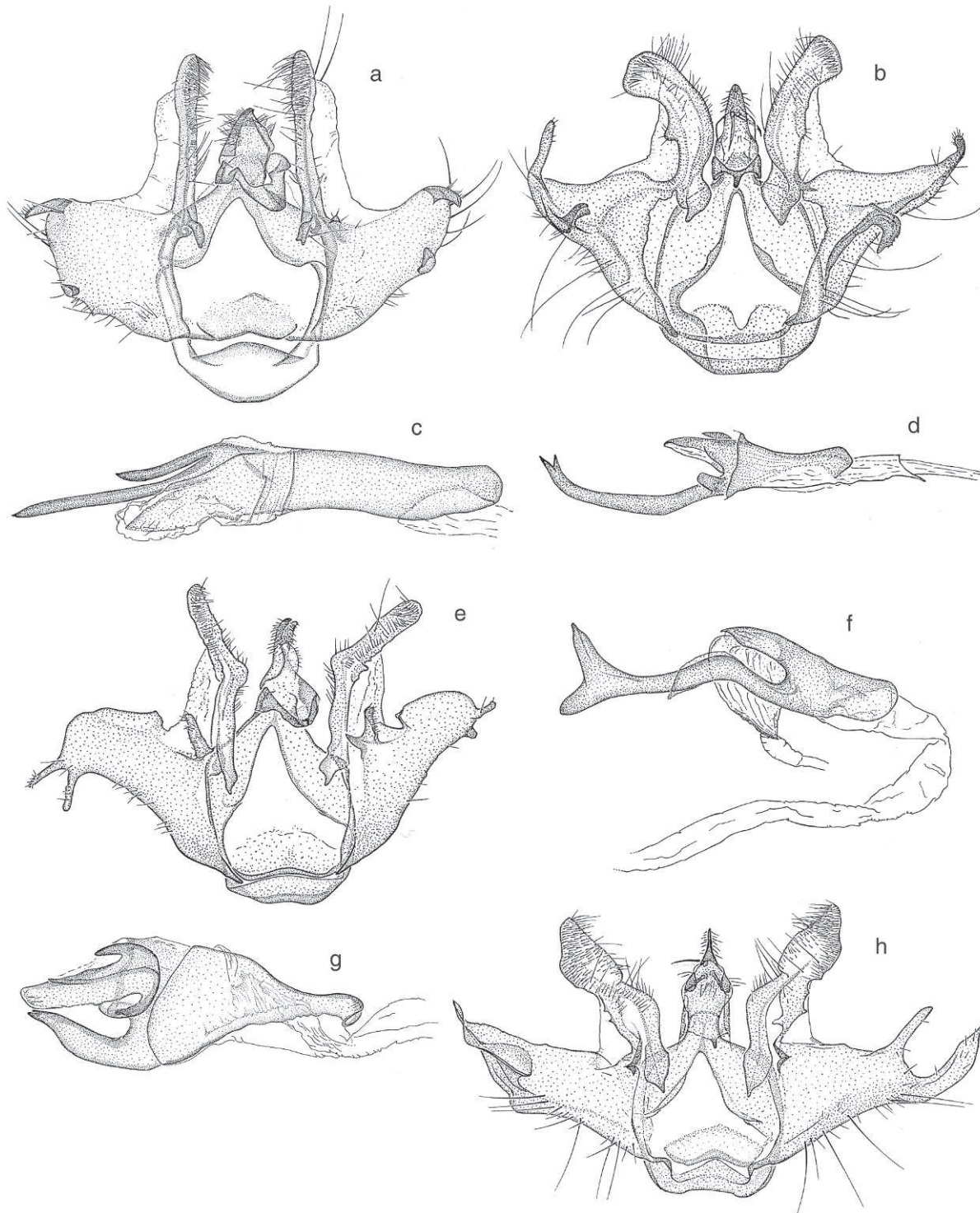
These localities cover all that is known about the distribution and flight period of this species.

Rindgea stipularia (Barnes and McDunnough), NEW COMBINATION

PL. 8, FIGS. 34, 35 (adult); TEXT FIG. 63 *b*, *d* (♂ gen.); TEXT FIG. 62 *d* (♀ gen.) (RWH 6409).

Macaria stipularia Barnes and McDunnough, 1913, *Contrib. Nat. Hist. Lep. N. Amer.*, 2: 127, pl. 6, fig. 17.

Type locality: Brownsville, Texas. [USNM]

FIGURE 63: MALE GENITALIA OF *RINDGEA* SPECIES

a. R. disparcata, genital capsule; Laredo, Webb County, Texas (USNM 53051). *b. R. stipularia*, genital capsule; Brownsville, Cameron County, Texas (USNM 57005). *c. R. disparcata*, aedeagus; Laredo, Webb County, Texas (USNM 53051). *d. R. stipularia*, aedeagus; Brownsville, Cameron County, Texas (USNM 57005). *e. D. prolifica*, holotype, genital capsule; Smith Canyon, Guadalupe Mountains, Culberson County, Texas (USNM 52951). *f. D. maricopa*, aedeagus; Baboquivari Mountains, Pima County, Arizona (USNM 53076). *g. R. prolifica*, holotype, aedeagus; Smith Canyon, Guadalupe Mountains, Culberson County, Texas (USNM 52951). *h. R. maricopa*, genital capsule; Baboquivari Mountains, Pima County, Arizona (USNM 53076).

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This is a rarely collected species of undistinguished appearance but with extremely distinct genitalia, in which the male has a long, distally bifid process on the aedeagus that may be seen without dissection. The moth somewhat resembles *Rindgea nigricomma* but is more mottled and brownish rather than gray, and it has no black markings where the transverse lines of the forewing meet the costa. I have seen only six specimens, including the holotype, all from Cameron County, Texas.

External structural features similar to those of *nigricomma*. Male antenna slender, with setae about as long as thickness of shaft; male hindtibia slightly longer than twice length of hindtarsus. Forewing pale brown with three dark gray-brown transverse lines almost equally distinct, nearly straight, subparallel, not boldly emphasized with black except sometimes on postmedial opposite discal cell, where this dark bar may be further reflected distally by a small, diffuse dark spot in subterminal space; this spot not as conspicuous as that of *nigricomma*. Outer third (subterminal space) gray brown, paler in distal half. Hindwing essentially similar to forewing, but postmedial line sinuous. Underside pale brown with same lines as upperside; outer third dark gray proximally, contrastingly paler distally, with tinge of ochreous yellow in some specimens; postmedial line of hindwing separated from dark subterminal band. Sexes nearly alike, although the one female is not as distinctly marked as the males. Wing length: holotype, 11.0 mm; other males, 11.0–12.0 mm; female, 10.5 mm.

Male genitalia (text figure 63 *b, d*) with valves asymmetrical and uniquely shaped, as shown. The gnathos is normally developed with a distal process, but small. However, the most unusual feature is the elongated, slender, sclerotized process that nearly doubles the length of the aedeagus. This process, which is somewhat curved and bifid at the tip, was visible in each of the several males examined without dissection, once some scales had been removed from the tip of the abdomen.

Female genitalia (text figure 62 *d*) with curiously elaborate sterigma in which the usual wing-like lateral lobes are present but dwarfed by other lateral, sclerotized cavities adjoining them anteriorly. Ductus bursae sclerotized, ribbed, and much distended, progressively widening posteriorly. Ovipositor lobes unusually slender in the one specimen available.

The early stages and food plant are unknown.

Rindgea stipularia is known only from Brownsville (6), Laguna Atascosa (1), and the Sabal Palm Sanctuary (1), all in Cameron County, Texas. All were collected within the period 10–28 November except the holotype, which is labeled 1–7 March, and one other collected 3 December 1925 (CAS). The most recently collected specimen is one female taken by P. A. Opler on 16 November 1990 at the Sabal Palm Sanctuary. Others were collected by A. Blanchard on 10 November 1968 at Brownsville and 16 November 1973 at Laguna Atascosa. Three specimens from Mexico in the USNM were taken in Nuevo Leon, Tamaulipas, and Jalisco in July 1966 and August 1963. Like other localized Lepidoptera of the Lower Rio Grande, *stipularia* is endangered in the United States by habitat destruction, but it has a chance of survival in Laguna Atascosa National Wildlife Refuge and the other sanctuaries.

Rindgea prolificata Ferguson, NEW SPECIES

PL. 8, FIGS. 36–38 (adult); TEXT FIG. 63 *e, g* (♂ gen.); TEXT FIG. 62 *e* (♀ gen.).

Rindgea prolificata Ferguson.

Type locality: Smith Canyon, 5,750', Guadalupe Mts., Culberson County, Texas. [USNM]

This widespread southwestern species, which occurs from the Gulf Coast of Texas to southern California, has generally been misidentified as “*Semiothisa*” *parcata* or *pallidata* in Texas and as *parcata* in Arizona and California although it is extremely distinct structurally. It is a variegated, lightly flecked, gray-brown moth, which outwardly resembles *parcata* and *disparcata* closely. The “*Macaria parcata*” illustrated from San Benito, Texas by Barnes and McDunnough (1913, pl. 6, figs. 10–12) are *prolificata*. Their three specimens are in the USNM collection and are here included among the paratypes.

Ground color slightly darker than that of related species, faintly brown rather than whitish. A fairly large, rounded, diffuse blackish spot on forewing in subterminal area opposite cell, or straddling postmedial line, often broadly shaded with pale gray or whitish distally, is characteristic of males of this species. Such a spot also present in some females, but in most females it is undeveloped or barely noticeable. Holotype is an especially light, well-marked specimen that shows

some repetition of above dark spot on hindwing. Wing length: holotype, 13 mm; other males, 10–13 mm; females, 10–13 mm.

This species, like *parcata*, shows considerable variation that is probably seasonal, and it is particularly noticeable in females. Winter and spring specimens (plate 8, figures 36, 37) are relatively large, grayish, and mostly without a complete, intense, dark gray border in the outer third of both wings on the underside. Late fall specimens in October and November are often darker gray than spring ones but may be just as large and similarly without a dark border beneath. Summer specimens (plate 8, figure 38), from June to September, may be very small and heavily dark bordered above and beneath, and these are hard to reconcile as the same species until verified by genitalia.

Male genitalia (text figure 63 *e*, *g*) entirely unlike those of *parcata* and *disparcata* and show more of a relationship to *maricopa* and *flaviterminata*. Costal lobe of valve angled; saccular lobe apically bifurcate with two slender terminal processes, which may be asymmetrical as in the holotype (text figure 63 *e*); saccular lobe also with elongate, lobelike process in angle between costal and saccular lobes that is commonly double on the right side, single on the left. Gnathos essentially normal, but with a short distal process. Aedeagus (text figure 63 *g*) complex and unique, unlike any other, with its two main processes stout and massively sclerotized. Eighth sternum without posterolateral processes or medial notch; with only a shallow medial depression, from which arises a dense tuft of stiff, bristlelike setae that are not easily removed in dissection. Males of *prolificata* easily identified without genital dissection by brushing away deciduous scales from posterior margin of eighth sternum to reveal central tuft of bristles and to make sure that posterolateral processes of eighth sternum, characteristic of *disparcata* and *parcata*, are missing.

Female genitalia (text figure 62 *e*) also unique, with unusually massive, heavily sclerotized, dark colored sterigma. Enough of the sterigma often may be seen for identification without further dissection, once some of the covering scales have been brushed off.

The larva feeds on *Acacia smallii* Isely (determined as *A. farnesiana*) and on another, unidentified, *Acacia*-like shrub with few leaflets and elongate (not globular) blooms, according to four reared adults from near Tucson, Arizona that I saw in the collection of Robert Reich.

TYPES. Holotype ♂. Smith Canyon, 5,750', Guadalupe Mts., Culberson County, Texas; 22 May 1973; D. C. Ferguson. USNM. Paratypes: 52 ♂, 59 ♀. Texas. Same data as for holotype (5 ♂). Cherry Canyon, 5,096', Guadalupe Mts., Culberson County; 24 May 1973; D. C. Ferguson (19 ♂, 19 ♀). McKittrick Canyon, 5,000', Guadalupe Mts., Culberson County; 23 May 1973; D. C. Ferguson (4 ♂, 4 ♀). Same data but collected by A. & M. E. Blanchard (1 ♀). Nickle Creek, 5,000', Guadalupe Mts., Culberson County; 10 July 1968; A. & M. E. Blanchard (1 ♀). Sierra Diablo [Wildlife Management Area], 6,000', 20 mi NNW of Van Horn, Culberson County; 29 May 1973; D. C. Ferguson (3 ♀). Same locality; collected 31 March 1970; A. & M. E. Blanchard (2 ♂). Same locality; 31 August 1970; J. G. Franclemont (1 ♂). Panther Pass, Chisos Mts., 6,000', Brewster County; 2, 4 June 1973; D. C. Ferguson (3 ♂, 3 ♀). K-Bar Ranch, 3,400', Chisos Mts., [Big Bend National Park], Brewster County; 5 June 1973; D. C. Ferguson (1 ♂, 3 ♀). Dugout Wells, Big Bend National Park; 12 May 1966; A. & M. E. Blanchard (1 ♂). Same data but from Oak Spring; 11 May 1966; D. C. Ferguson (3 ♀). Same data but from Green Gulch, 10 May 1966; D. C. Ferguson (2 ♀). The Basin, Big Bend Natl. Park; 16 May 1959; M. R. MacKay (1 ♀). Fort Davis, Jeff Davis County; 29 July 1964, 9 October 1965, 17 May, 13 October 1966, 26 March 1968, 21, 23 October 1973; A. & M. E. Blanchard (6 ♂, 5 ♀). Davis Mts. State Park, Jeff Davis County; 1 September 1975; E. C. Knudson (2 ♀). Palo Duro Canyon State Park, Randolph County; 11 September 1966; A. & M. E. Blanchard (1 ♀). Paducah, Cottle County; 17 April 1968; A. & M. E. Blanchard (1 ♀). Rio Frio, Real County; 2 June 1964; A. & M. E. Blanchard (1 ♀). Lake Corpus Christi State Park, San Patricio County; 6 June 1969; Richard Heitzman (1 ♂). Laguna Atascosa, Cameron County; 24, 28 February, 16 November 1973; A. & M. E. Blanchard (5 ♂, 2 ♀). Clint's Palm Nursery, Brownsville, Cameron County; 26 June 1969; R. Heitzman (1 ♂, 1 ♀). Santa Ana National Wildlife Refuge, Hidalgo County; 10 April 1966; A. & M. E. Blanchard (1 ♀). San Benito, Cameron County; 16–23 March, 24–30 April [no year or collector given]; (Barnes Coll.) (1 ♂, 3 ♀). Brownsville, Cameron County; December 1928; F. H. Benjamin (1 ♀); 20 October 1939; (Sperry Coll.) (1 ♂). Same locality; 6–10 March 1967; E. L. Todd (1 ♂). Fort Worth, Tarrant County, 16 March 1963; E. Jäckh, Jr. (1 ♀). AMNH, BMNH, CNC, CU, ECK, JRH, USNM.

Although the species occurs also in New Mexico, Arizona and California, I limited the type series to Texas. I once found this species very abundant at the shop windows of White City, New Mexico in March.

Rindgea prolificata occurs across most of Texas from Cameron, San Patricio, and Kerr counties, through the Big Bend region, Davis and Guadalupe Mountains northward at least to Eddy

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and Grant counties, New Mexico, in southern Arizona (Cochise, Santa Cruz, Pima, and Mojave counties), and in southern California, where it was collected at Jacumba and Mason Valley, San Diego County, and in the Joshua Tree National Monument, San Bernardino County. The paratype labeled Fort Worth, Texas (USNM), from north of the usual range, may have been a vagrant.

Label data for Texas indicate a flight period that includes every month except January. Available Arizona records are for the period April–October, and in California the species was collected in March, July, and September.

Rindgea maricopa (Hulst), NEW COMBINATION

PL. 8, FIGS. 39–43 (adult); TEXT FIG. 63 *f*, *h* (♂ gen.); TEXT FIG. 64 *a* (♀ gen.) (RWH 6369, 6411).

Diastictis maricopa Hulst, 1898, *Can. Ent.*, **30**: 164.

Type locality: Arizona. [AMNH]

Semiothisa sirenata McDunnough, 1934, *Can. Ent.*, **71**: 254, NEW SYNONYMY.

Type locality: Baboquivari Mountains, Arizona. [CNC]

This is another plain, light reddish-brown to gray-brown species of the Southwest, found from southern California to the Mexican border region of Texas. It is easily confused with *Digrammia californiaria*, *D. pervolata*, *R. parcata*, *D. colorata*, or with plainer specimens of *R. flaviterminata* where both occur in Texas. The genitalia resemble those of *flaviterminata* but have a differently shaped aedeagus. The species is confusingly variable and difficult to describe. However, this variation in some populations leads to forms that are easily recognized. In Arizona, males may have the forewing fully clouded with blackish brown between the base and subterminal line (plate 8, figure 39), and the females often have the black bar on the postmedial line opposite the end of the discal cell, highlighted with white or pale yellow on the proximal side (plate 8, figure 40). Both features are diagnostic when present. Females may have the forewing slightly dark clouded, but never to the same degree as males. Other Arizona specimens and those I have seen from California are especially featureless and may be nearly impossible to identify except by

genitalia. Those from Arizona tend to have a granulated appearance, with all three lines of the forewing relatively well marked. Those from California may have the appearance of small, pale *Digrammia californiaria*.

The Texas population, of which I have seen 10 specimens, appears to be more uniform, without dark forms (plate 8, figure 42), and almost without white highlights against the postmedial band. It is less granulated, and the transverse lines or bands are less distinct (one male shows none). However, an ochreous, reddish-brown to dark gray outer border beyond the postmedial lines on the underside is much better developed in nearly all specimens, often resembling that of *flaviterminata* but not as bright (plate 8, figure 43). Most differences that distinguish Texas from Arizona *maricopa* represent variation in the direction of closer similarity to *flaviterminata* where the two overlap. A well-marked *maricopa* could be confused with a poorly marked *flaviterminata*, except that the latter is likely to have a strong black component in the more colorful outer border of the undersurface (plate 8, figure 47). Also, the black postmedial band of the forewing is incomplete to obsolete in *maricopa* and tends to be complete or nearly so in *flaviterminata*.

It should be noted also that *maricopa* has an unusually long male hindtibia, which is more than twice the length of the hindtarsus and longer than that of *flaviterminata*. The latter, like most species, has a hindtibia that is no longer than twice the length of the hindtarsus. *Digrammia californiaria* may have a similarly elongated male hindtibia, but in that species it seems consistent only in southern California.

WING LENGTH. California males, 11.0–12.0 mm (n = 3); females, 10.0–12.5 mm (n = 4); Arizona males, 10.0–13.0 mm (n = 16); females, 10.0–13.0 mm (n = 10); Texas males, 9.5–11.0 mm (n = 4); females, 11.0–13.5 mm (n = 6).

Male genitalia (text figure 63 *f*, *h*) closely match those of *flaviterminata*, except that the very different, heavily sclerotized aedeagus is greatly extended to terminate in a stout, widely divergent, forked apex. Shaft of this extension always bent before midpoint. The gnathos is obsolescent; little more than the reduced terminal process remains visible.

Female genitalia (text figure 64 *a*) with sterigma in form of massively sclerotized, capsulelike structure, differing from that of *flaviterminata* in

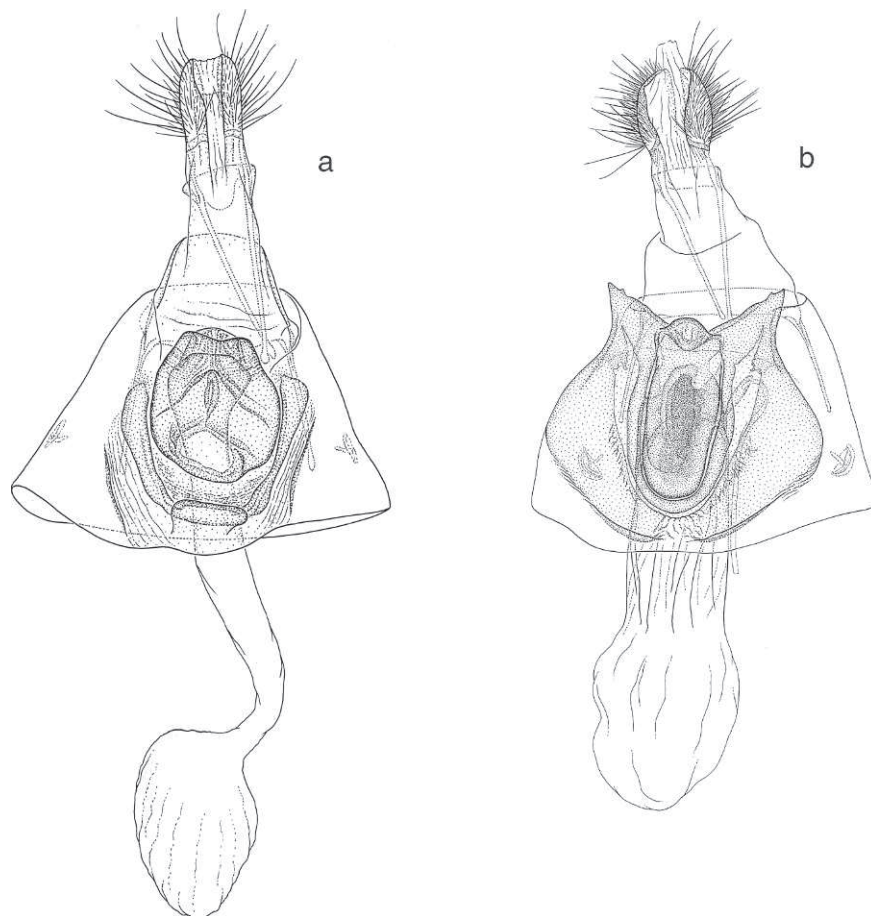


FIGURE 64: FEMALE GENITALIA OF *RINDGEA* SPECIES
a. R. maricopa; Fort Davis, Brewster County, Texas (AB 4015). *b. R. hypaethrata* [no locality data] (HWC 1381).

being nearly globose rather than elongated or ovoid, and in having somewhat different, hard-to-describe details of internal structure.

The early stages and hosts of *maricopa* are unknown.

I have seen *maricopa* from various localities in Los Angeles, Riverside, and San Bernardino counties, California; from many localities in Pima, Yuma, Santa Cruz, and Cochise counties, Arizona; from Current, Nye County, Nevada (two on 24 May 1954); from Big Bend National Park, Fort Davis, Presidio, and Brownsville, Texas; and from Sonora, Baja California Norte, and Baja California Sur, Mexico (Mexican specimens in AMNH). Although mainly a species of lower canyon and desert habitats, I took one at 7,800' in the pine-Douglas-fir zone of the Santa Catalina Mountains, Arizona. There are collection dates in all months except September for California; in every month of the year for Arizona; and May–June and September–November for Texas. This

is not usually a common species in collections; I examined about 100 specimens.

Rindgea flaviterminata (Barnes and McDunnough), NEW COMBINATION

PL. 8, FIGS. 44–47 (adult); PL. 15, FIG. 11 (larva); TEXT FIG. 65 *a, c* (♂ gen.) (RWH 6412).

Macaria flaviterminata Barnes and McDunnough, 1913, *Contrib. Nat. Hist. Lep. N. Amer.*, 2: 125, pl. 6, figs. 7–9.

Type locality: San Benito, [Cameron County], Texas. [USNM]

NOTE—No holotype was specified, and I designate as lectotype the specimen of the type series labeled as the type male, although it was not illustrated. The male genitalia are the more distinctive in this species, and the male figured by Barnes and McDunnough (fig. 7) is a “Cotype” that has since lost its abdomen. Nine of the 12 original type specimens

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from Brownsville and San Benito survive intact in the USNM.

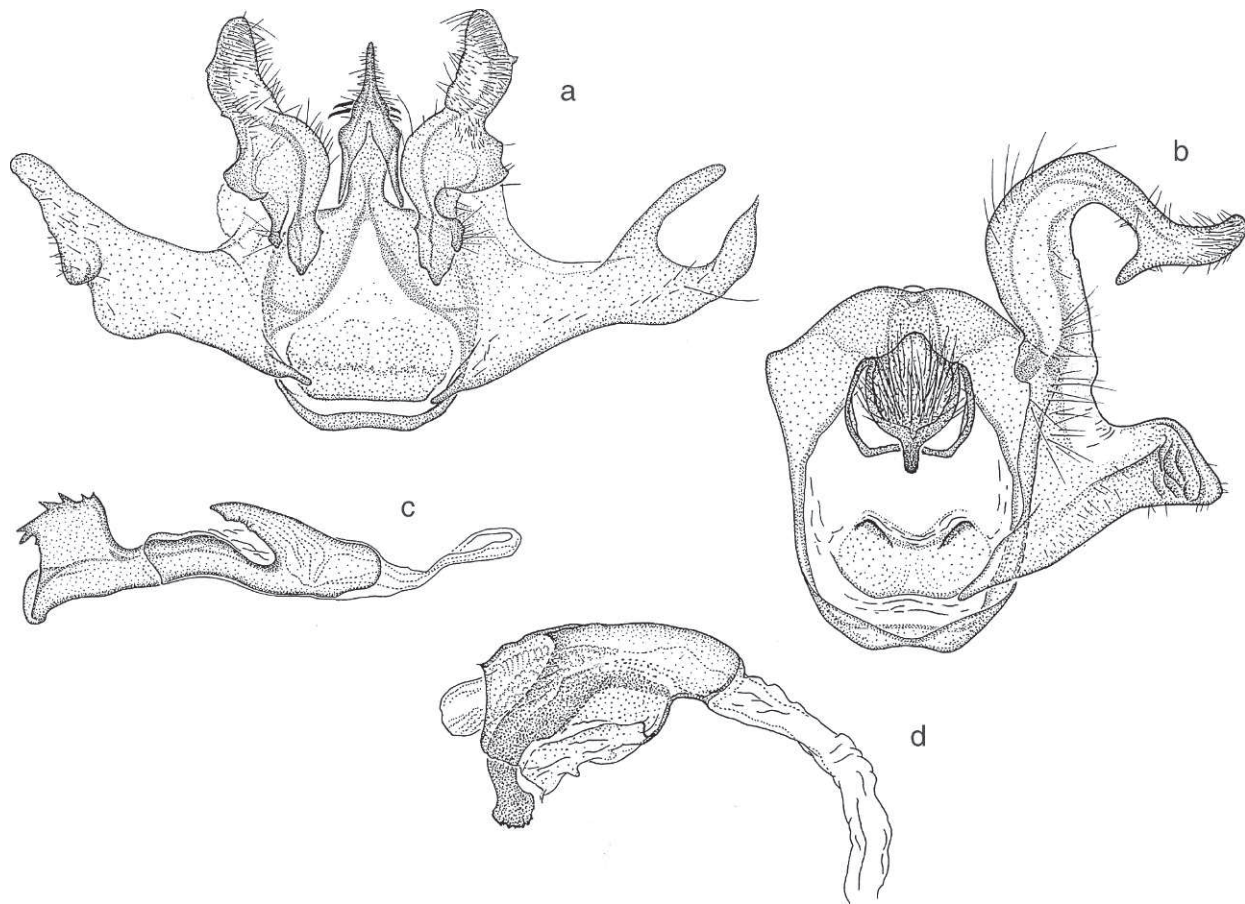
Rindgea flaviterminata is most closely related to *maricopa* as indicated by similarity of genitalia, but the moths are more likely to be confused with those of *A. subterminata* in southern Texas where all three of these species occur. Both *flaviterminata* and *subterminata* have contrasting brown outer borders beyond the postmedial lines on the fore- and hindwings, above and beneath, but the borders in *flaviterminata* are light reddish ochreous; the postmedial line of the forewing on the uppersurface is often heavily outlined with black and not closely paralleled distally by a thin, pale line; the dark spot in the subterminal area of the forewing opposite the discal cell may be present but is not usually large and conspicuous; and the outer third of both wings on the undersurfaces is uniformly light reddish brown to ochreous, variably clouded with dark brown but not suffused with dark brown or black for all or most of its length as in *subterminata*. Texas specimens of *maricopa* may have an ochreous border like that of *flaviterminata* on the undersurface only. Several other superficial features are useful for distinguishing *flaviterminata*. One of the most reliable of these may be seen on the underside of the hindwing, where the outer third is uniformly ochreous toward the outer margin in *flaviterminata*. In *subterminata*, the outer third is nearly always split into a very dark proximal sector and a pale brown to whitish outer-marginal sector without ochreous tints. Both *flaviterminata* and *maricopa* lack the whitish ventral collar between the bases of the forecoxae and the head that distinguishes *subterminata*, and both have unusually long male hindtibiae, at least twice as long as the hindtarsus. However, the male hindtibia of the present species is not as long as that of *maricopa*, in which it is clearly more than twice as long as the hindtarsus. *Rindgea flaviterminata*, also like *maricopa*, has a slender male antennal shaft, appearing no thicker than the haustellum near its base. The antennal shaft of *subterminata* is thicker than the haustellum. Wing length: males, 10–13 mm, females, 10–14 mm, showing a slight tendency to be larger between November and March than in the warmer months.

Male genitalia (text figure 65 *a, c*) similar only to those of *maricopa*, differing most obviously in shape of aedeagus and shape of the asymmetrical valves. On bifurcate ventral lobe of right valve,

dorsal fork is as long or longer than ventral fork in *flaviterminata*, shorter than ventral fork in *maricopa*. Serrated subapical process on aedeagus is unique to *flaviterminata* and may be more coarsely toothed than example shown.

Female genitalia (not shown) even more like those of *maricopa*, but oblong, capsulelike sterigma is larger in *flaviterminata*. Also, rigidly tubular part of ductus bursae at least three times as long as unsclerotized part in *flaviterminata*, no more than about twice as long and usually less in *maricopa*.

Larvae were collected from Texas ebony, *Pithecellobium ebano* (Berl.) C. H. Mull. (Fabaceae) in the Audubon Sabal Palm Sanctuary, Cameron County, Texas in December 2000 (D. L. Wagner) (plate 15, fig. 11), and the species identified from adults that were reared. The host is further verified by two adults in USNM labeled as having been reared from ebony [*Pithecellobium* sp.] at Progreso, Hidalgo County, Texas, by P. T. Riherd, 28 September 1962. Larvae from Cameron County were bright lime green with narrow yellow rings at the caudal edge of abdominal segments one to five and fainter yellowing along the trailing edge of segments six and seven; a thin, often broken, lateral line runs the length of the body, although it is often weakened across thoracic segments two and three and along the posterior abdominal segments; the lateral line is well developed on the prothorax and carries forward across gena, where it is prominently expressed, to the antenna; dorsal, subdorsal, and supraspiracular stripes essentially absent, replaced by faint spots; spiracles tan to orange with brown peritreme; blackened setae arise from minute, undifferentiated pinacula; distal extremities of prolegs, thoracic legs, and mouthparts often tinged with pink. Head capsule green and essentially unmarked above. Larval images of what appear to represent the gray-brown form of this species are marked with fine lines and patches of reddish brown; a vague, interrupted whitish or yellowish lateral stripe present, but largely overshadowed and obscured by light reddish brown, especially along posterior portion of body; one individual with black line below each spiracle on abdominals segments 1–5; setae arising from dark pinacula, especially the L1 behind and below spiracle. Head reddish brown, heavily marked with dark brown reticulation, large, dark pinacula, and white extension of lateral body stripe. [Description of larva modified by D. L. Wagner, ed.]

FIGURE 65: MALE GENITALIA OF *RINDGEA* SPECIES

a. *R. flaviterminata*, genital capsule; Brownsville, Cameron County, Texas (USNM 52997). b. *R. hypaethrata*, genital capsule; Paradise, Cochise County, Arizona (HWC 1380). c. *R. flaviterminata*, aedeagus; Brownsville, Cameron County, Texas (USNM 52997). d. *R. hypaethrata*, aedeagus; Paradise, Cochise County, Arizona (HWC 1380).

This species is known only from Cameron and Hidalgo counties, Texas, where specimens were collected at Brownsville, San Benito, and in the Sabal Palm Preserve, Santa Ana National Wildlife Refuge, and Bentsen-Rio Grande Valley State Park. This species has been collected through most of the year, from February to late November. Collection dates fall within the following periods: February–April; June; and August–late November. Although it is known from only two counties, 102 specimens were examined.

The *s-signata*-GROUP

Members of this group may resemble certain species of *Digrammia* in size, wing shape, and pattern but are unique mainly in their genitalia. The wings are brown, varying from pale tan or buff to a darker shade heavily irrorated with dark scales. Most specimens have a black postmedial

band, curved or waved in a vague, S-shaped configuration that closely resembles the wing markings of *Digrammia subminiata*, *D. decorata*, *D. hebetata*, *D. spinata*, and others. The species of the *s-signata*-group all have about the same range of variation and are so much alike in external appearance that most can be distinguished reliably only by the genitalia. Rindge (1959: 2), who revised this group, wrote: "All four species are very similar to one another in color and maculation, so much so that it is almost impossible to separate them by these criteria. Usually there is more variation within a species than there is between the different species."

The male genitalia, although different in form for each species [and with exceptional features in *hypaethrata*, ed.], have common features that unite them as a group. They are the only species in which a large, sclerotized, lobelike or pointed

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protrusion arises from the costa of the dorsal lobe of each valve, extending outward roughly perpendicular to the main axis of the dorsal lobe. The uncus is wide and triangular in outline. The aedeagus terminates in two or three elongate processes, one of which is finely but distinctly dentate. The eighth sternum is cleft, but the depth of the incision is variable. The shape of the incision in the cleft eighth sternum is diagnostic for each species and may be used for identification of nearly all male specimens without dissection but by brushing away the covering scales. [Rindge (1959) illustrated the eighth sternum of each species, ed.] As in the *maricopa*-group, the male genitalia tend to be asymmetrical. A distinctive juxta with two earlike lobes is characteristic, except that the lobes are vestigial in *hypoethrata*. Most females may be identified by examining the sterigma after brushing away the covering scales.

The group consists of five species, four of which occur north of Mexico and three of which occur in both Mexico and the United States. *Rindgea indeterminata* (Warren, 1906: 533, *Tephrotopsis*), NEW COMBINATION is known only from Mexico and is the senior synonym of *Rindgea cydica* (Rindge, 1959: 11, *Semiothisa*), NEW COMBINATION, NEW SYNONYMY according to the male genitalia of the type of *indeterminata* (USNM slide # 57069). *Rindgea s-signata* (Packard) occurs in Texas and New Mexico; *Rindgea ballandrata* (W. S. Wright) in the far Southwest; and *Rindgea cyda* (Druce) occurs from Louisiana to southern California. *Rindgea cyda* may be somewhat migratory, reaching as far as Missouri and Colorado as a vagrant, well beyond the limit of its known host. That species and perhaps all members of the group feed on species of *Prosopis* (Fabaceae).

Scoble and Krüger (2002) illustrate in different genera the male genitalia of two closely related species as *Digrammia cyda* (figs. 221, 222) and *Hypephyra s-signata* (figs. 228, 229). This must have been unintentional because no mention is made of *s-signata* in the text for *Hypephyra*, which is an Asian genus. Their figures of *cyda* and *s-signata* are representative of the *s-signata*-group, and of *nigricomma* (figs. 219, 220), of the *maricopa*-group, as treated here.

KEY TO SPECIES OF THE *S-SIGNATA*-GROUP BASED ON MALE GENITALIA

NOTE—*Rindgea hypoethrata* is treated in the key to species of the *maricopa*-group p. 323.

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1. Valves symmetrical or nearly so, with large protruberance on costal lobe only; eighth sternum with deep incision extending about halfway into segment 2
- Valves conspicuously asymmetrical, with a large process or protusion on both costal and saccular lobes; eighth sternum with shallow incision much less than half length of segment *ballandrata*
p. 342
2. Costal lobe of each valve with a large, simple (not bilobed) protrusion near middle of costa; incision of eighth sternum narrowly U-shaped or V-shaped, its sclerotized edges not widened nor curved outward 3
- Costal lobe of each valve with a very wide, flared or bilobed protrusion beyond midpoint of costa; incision of eighth sternum with its sclerotic edges widened and curved outward (known from Mexico only) *indeterminata*
3. Protrusion of costa not much longer than wide, squarish in outline; lobes of juxta large, longer than wide; incision of eighth sternum deeply, narrowly U-shaped, lateral margin bluntly rounded [Rindge, 1959, fig. 1, ed.] *s-signata*
p. 338
- Protrusion of costa decidedly longer than wide, bluntly pointed; lobes of juxta small, not or hardly longer than wide; incision of eighth sternum deeply, narrowly V-shaped, lateral margin strongly produced with apex acute [Rindge, 1959, fig. 2, ed.] *cyda*
p. 339

Rindgea s-signata (Packard), NEW COMBINATION

PL. 8, FIGS. 48–50 (adult); TEXT FIG. 66 *a*, *c* (♂ gen.); TEXT FIG. 67 *a* (♀ gen.) (RWH 6414).

Macaria s-signata Packard, 1873, *Rept. Peabody Acad. Sci.*, 5: 63.

Type locality: Texas. [MCZ]

NOTE—The type is probably from Bosque County, but this is uncertain because Belfrage collected in other Texas localities (Geiser, 1933). A male was designated as lectotype by Rindge (1959: 8).

Rindgea s-signata is mainly a species of southern Texas and adjacent Mexico and is much less common in collections than *R. cyda* of the same region. The two species have the same wide range of variation and cannot be distinguished except by genitalia.

Ground color of wings pale brown, variably flecked and mottled with dark brown; sexes alike. Forewing usually somewhat darker than hind-

wing, and with antemedial band convex, dark brown, often inconspicuous or incomplete, never with a black bar superimposed upon it as in many *ballandrata*; medial band nearly straight, diffuse, usually incomplete or absent, but nearly always indicated at least by a dark patch at costa; postmedial line boldly marked for most of its length by a black, vaguely S-shaped band between inner margin and vein M_1 , where it may end more or less abruptly, leaving a gap between its anterior end and the somewhat offset dark spot that marks its costal terminus. This waved, black, postmedial band may have a thin, pale yellowish inner margin and broad, diffuse brown or gray shading outwardly, filling most of the space between the postmedial and the position of the usually absent subterminal band. Subterminal, if present, indicated by a vague pale line or band about midway between postmedial and outer margin. Very rare individuals may lack the black postmedial band. Hindwing with an almost uniform overlay of dusky scales on a pale ground; basal half may be slightly paler; darker brown postmedial band usually apparent, convex, curving posteriorly near inner margin. Inner margin with a contrastingly pale edge that is obvious only in dark specimens. Fringes uniformly colored, essentially unmarked; discal spots negligible. Underside of wings similar but all markings lighter and very diffuse. Wing length: males, 10–13 mm; females, 10–15 mm.

The variation is partly seasonal, as winter and spring specimens (February–May) average larger than summer ones (June–October). Specimens with a wing length of only 10–11 mm are the norm in June. Light and dark specimens seem to occur at any season.

The male genitalia (text figure 66 *a, c*) are symmetrical, with a large, almost square, sclerotized flange arising from near the middle of the costa of the valve, and a bilobed, U-shaped juxta with two large, rounded, lightly sclerotized lobes. The costal protrusion or flange is bent inward 90° (toward the viewer) on its distal margin. The eighth sternum is deeply incised for more than half its length, and its lateral margin is bluntly rounded [Rindge, 1959, fig. 1, ed.]

The female genitalia (text figure 67 *a*) are the most simple of the group. The sterigma is almost without folds, pleats, or pointed processes, and the ostium is only two-thirds as wide as that of *R. cyda*.

The larva of *Rindgea s-signata* has not been described or illustrated, but I identified a specimen that had been reared from mesquite, *Prosopis glandulosa* Torr. (Fabaceae) at Tucson, Arizona (R. Nagle).

The species occurs in southern Texas, mainly south of the latitude of San Antonio, although one in the USNM was collected by A. Blanchard at Town Bluff, Tyler County. There is one record for New Mexico, a male that I collected in Cimarron Canyon, Colfax County, at 6,600', 26 July 1989. Rindge (1959) reported it from Coahuila.

Rindgea cyda (Druce), NEW COMBINATION
PL. 8, FIGS. 51–54 (adult); PL. 15, FIGS. 12, 13 (larva); TEXT FIG. 66 *b, d* (♂ gen.); TEXT FIG. 67 *b* (♀ gen.) (RWH 6415).

Eubolia cyda Druce, 1893, *Biologia Centrali-Americana, Insecta, Lepidoptera Heterocera*, 2: 177; 3: pl. 58, fig. 4.

Type locality: Durango, Durango, Mexico. [BMNH]

NOTE—Rindge (1959: 10) designated a lectotype [ed.]

This is a much more widespread and abundant species than *R. s-signata*, and it occurs together with *s-signata* in Texas and with *ballandrata* in Arizona and northwestern Mexico. Because these species can hardly be distinguished except by genitalia, a detailed description of color and pattern would be repetitious. The size range, measured by wing length, is the same as for *R. s-signata*.

The male genitalia (text figure 66 *b, d*) have a large sclerotized process on the costa of the valve, as in *s-signata*, but it is longer, sometimes nearly twice as long as wide; the juxta is bilobed, but the lobes are short, no longer than they are wide; each valve has a small, erect process arising from the middle of its inner face about two-thirds of the way out. The aedeagus is also different, but the distinguishing features are subtle. The incision on the eighth sternum is deep, U-shaped, and the two sclerotized sides of the incision end in sharp points produced well beyond the posterior margin of the eighth segment [Rindge, 1959, fig. 2, ed.]. They are diagnostic. Males of *R. cyda* are thus easily identified without dissection by brushing off some scales.

The female genitalia (text figure 67 *b*) have a characteristic fold in the preostial part of the gen-

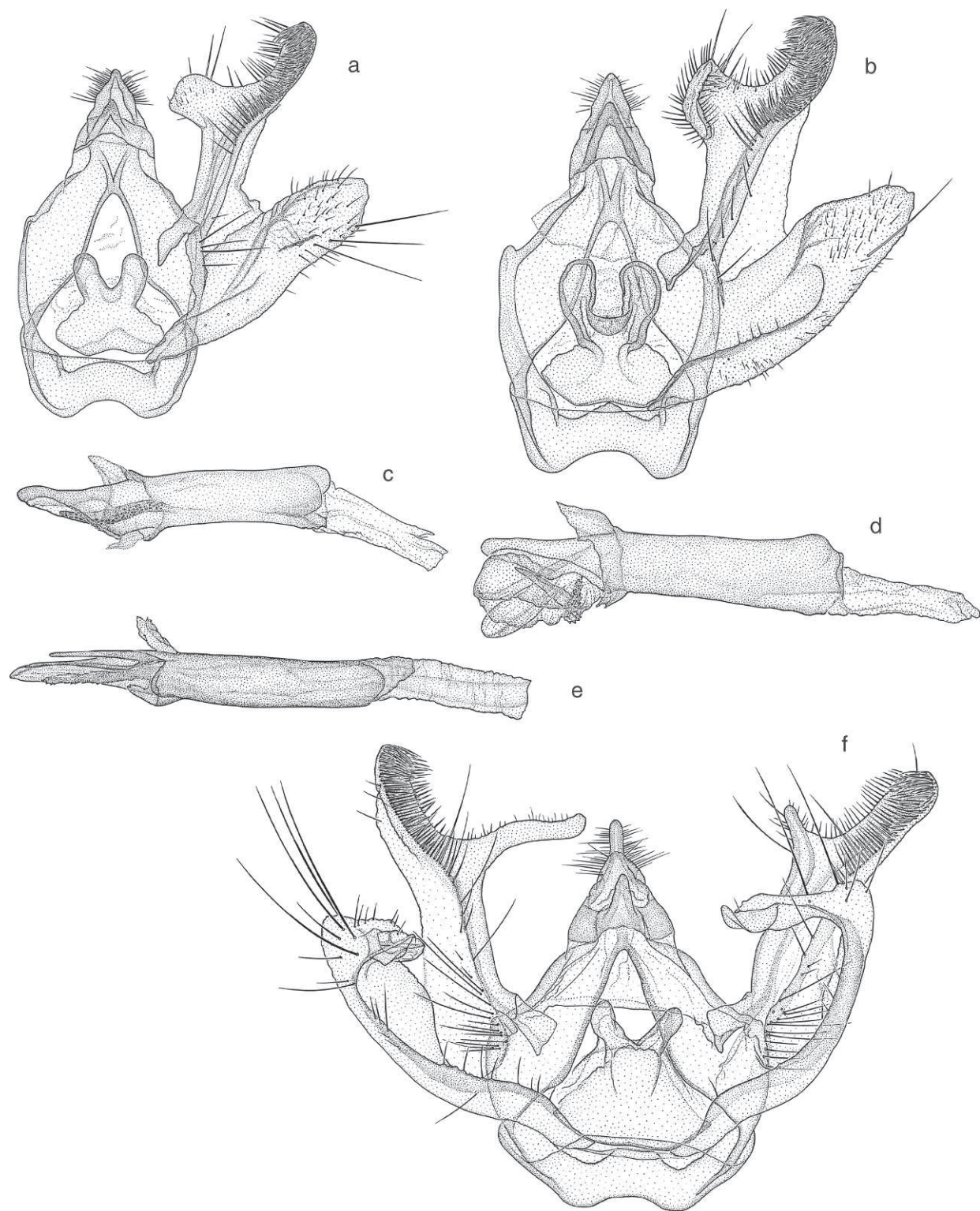
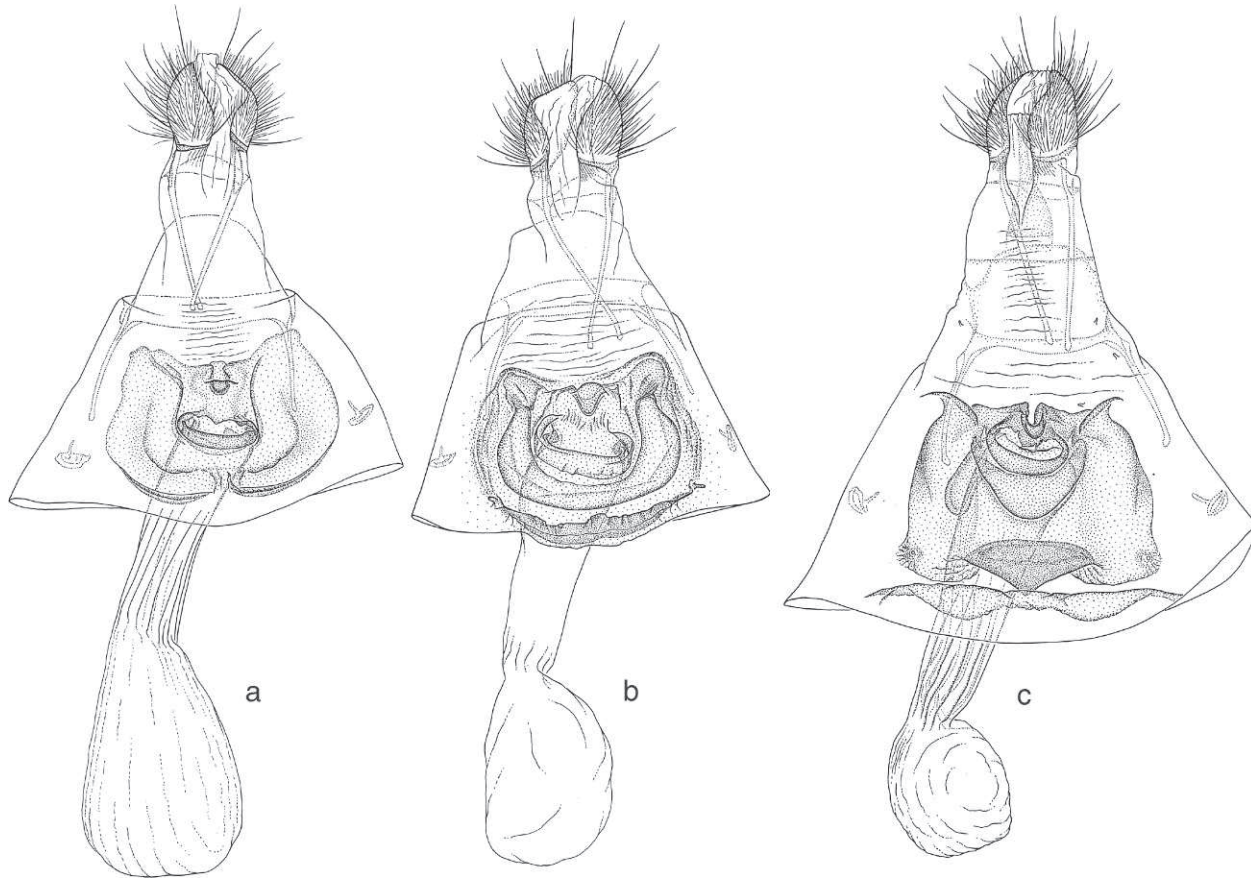


FIGURE 66: MALE GENITALIA OF *RINDGEA* SPECIES

a. R. s-signata, genital capsule; Cimarron Canyon, Colfax County, New Mexico (USNM 57553). *b. R. cyda*, genital capsule; Houston, Harris County, Texas (USNM 57543). *c. R. s-signata*, aedeagus; Cimarron Canyon, Colfax County, New Mexico (USNM 57553). *d. R. cyda*, aedeagus; Houston, Harris County, Texas (USNM 57543). *e. D. ballandrata*, aedeagus; Tempe, Maricopa County, Arizona (USNM 57541). *f. D. ballandrata*, genital capsule; Tempe, Maricopa County, Arizona (USNM 57541).

FIGURE 67: FEMALE GENITALIA OF *RINDGEA* SPECIES

a. *R. s-signata*; Victoria, Victoria county, Texas (USNM 53433); ovipositor lobes; Brownsville, Cameron County, Texas (53450).
 b. *R. cyda*; K-Bar Ranch, Big Bend National Park, Brewster County, Texas (USNM 53438). c. *R. ballandrata*; Pima County, Arizona (USNM 53435).

ital plate or lamella antevaginalis that half surrounds the ostium. Anterior to this lies a pair of sclerotized transverse ridges or flanges, one on each side. The protruding, sclerotized lip located medially on the posterior margin of the lamella postvaginalis is three or four \times larger than that of either *s-signata* or *ballandrata*, and it conceals from view the notch in this margin that lies behind it. This feature makes it possible to identify females without dissection.

Larvae collected from *Prosopis glandulosa* J. Torr. (Fabaceae) near Brownsville, Texas (D. L. Wagner) later yielded adults, from which the species was identified. The larva has the usual green and brown color forms. **Green form** (plate 15, figure 12)—A typical green macariine larva with longitudinal pale stripes. Body leaf green with a distinct, regular, almost uninterrupted, light yellow spiracular stripe, ending on the side of the

head anteriorly and on the lateral side of the anal proleg posteriorly; a similarly colored, thinner, subdorsal stripe; middorsal and addorsal yellowish-white stripes present but very thin, faint; head green with a faintly brownish tint, unmarked, pinkish around mouth parts. **Brown form** (plate 15, figure 13)—Similar but the green body color is entirely replaced by light pinkish brown; same pale stripes present but whitish, not yellow, all thinly bordered with darker brown and more irregular than in green form; white stripes not strongly contrasting with pale-pink background; two subdorsal, two or three lateral, and a few subventral setae on each segment have large, dark brown pinacula that are not so colored in green form; setae of body long and dark but pinaculae are not elevated; small, black, longitudinal streak present beneath lateral fold in middle of most segments, including one at base of first proleg;

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confluent, dark gray spots on hypoproct and laterally on anal proleg; head light pinkish purple with extensive dark brown reticulation plus extra spots and patches.

McGuffin (1967: 1,216) described green and brown larvae collected from *Prosopis* near Durango, Mexico. His account differs only in his mention that the subdorsal and various dorsal stripes were white, not yellow, and that whitish subventral, adventral, and midventral stripes were present. He noted that the brown larvae were reddish brown on dorsum and reddish green on venter, whereas the body of those from Texas appears to be pinkish brown both dorsally and ventrally. Other details may be found in McGuffin's paper.

More than 12 reared specimens from other sources leave no doubt that the food plant of *R. cyda* is mesquite. Seven adults sent to me for identification from near Temple, Bell County, Texas, were reared from larvae on leaves of *Prosopis glandulosa*. They were collected in 1976–77 (T. Robbins and C. L. Seedle) in connection with research on biological control of weeds. I identified one that was reared in 1971 from the same plant near Gallego, Chihuahua, Mexico, and have another reared 9 September 1990 from *Prosopis articulata* S. Wats. at Comitán, Chiapas (Cecilia Jimenez). I reared an adult from a larva found on mesquite on the bank of the Rio Grande in Presidio County, Texas in March 1993. Another specimen in the USNM from the Huachuca Mountains, Cochise County, Arizona was reared from a larva beaten from “mesquite catkins” on 10 May 1988, emerging 20 May (R. Wielgus). A note on the label describes the larva as apple green with a white lateral stripe on each side.

Rindgea cyda is known from Edgard, St. John the Baptist Parish, Louisiana (V. A. Brou); Jasper, Benton, Jackson, and Lewis counties, Missouri (J. R. Heitzman); Arkansas, Kansas (Rindge, 1959), and Oklahoma (AMNH); and from numerous localities through Texas, New Mexico, southern Nevada, and Arizona to San Bernardino, Riverside, and San Diego counties, California. It occurs in Mexico, including Baja California, to Veracruz, Puebla, and Chiapas. The species may be present wherever mesquite grows and sometimes beyond. Isolated records for Iowa (Rindge, 1959), Teller County, Colorado (C. V. Covell, Jr.), plus the records from Missouri, Arkansas, Kansas, and Oklahoma probably represent vagrants. The species flies throughout the year in warmer parts of its range.

Rindgea ballandrata (W. S. Wright), NEW COMBINATION

PL. 8, FIGS. 55–57 (adult); TEXT FIG. 66 *e*, *f* (♂ gen.); TEXT FIG. 67 *c* (♀ gen.) (RWH 6416).

Phasianae s-signata ballandrata Wright (forma nova), 1923, *Proc. Calif. Acad. Sci.*, 4th ser., 12: 115.

Type locality: Loreto, Lower California. [CAS]

NOTE—Loreto is in Baja California Sur, on the eastern coast at about 26° N.

Semiothisa melanderi Sperry, 1948, *Bull. Brooklyn Ent. Soc.*, 43: 58.

Type locality: Baboquivari Mountains, Pima County, Arizona. [AMNH]

NOTE—The name *melanderi* has been used for this species, but according to Article 45.6.4 of the *International Code of Zoological Nomenclature* (Fourth Ed., 1999), the name *ballandrata* Wright, 1923, proposed for a form that might have been interpreted as infrasubspecific, is nevertheless available.

This species cannot always be recognized by its appearance, but it tends to be smaller, paler, and more boldly marked with black bands than *R. cyda* or *R. s-signata*. However, where *R. ballandrata* and *cyda* occur together in Arizona, the latter also is unusually pale. About 75% of all *R. ballandrata* examined have a distinct black bar on the antemedial line similar to that on the postmedial, unlike *cyda* and *s-signata*, which are never so marked. Also, this species is known only from Arizona and northwestern Mexico, where it overlaps with *cyda* but not with *s-signata*. Further description would not be helpful, as usually there are no external differences to describe. Wing length: males, 10–13 mm; females 11–13 mm.

The male genitalia are asymmetrical, with the distal end of the right ventral lobe of the valve abruptly bent inward; and the costal processes on the dorsal lobe of the valves long and pointed, that on the left valve longer and more slender than the one on the right. The juxta is bilobate and V-shaped, and the aedeagus has two slender distal processes, one on each side. The incision in the eighth sternum is a relatively shallow V-shaped notch occupying less than one-third of the total length of the eighth segment [Rindge, 1959, fig. 4, ed.].

The female genitalia have a large, smooth genital plate, or sterigma, without folds, but with a divergent ridge on each posterolateral corner that

is produced as a pointed, spinelike process. A fan-shaped, triangular, preostial patch of dark colored sclerotin is characteristic, as is a thickened, sclerotized medial notch in the posterior margin of the genital plate. The ductus bursae is wider than that of the other species of the group, more heavily sclerotized, and longitudinally rugose.

The early stages and food plant of *R. ballandrata* are unknown.

This species seems to have a very limited distribution. Most specimens in collections are from the Baboquivari Mountains (Brown's Canyon; Indian Oasis), Pima County, Arizona, but I found one specimen from Tempe, Maricopa County. Otherwise the species is known only from the type locality in Baja California and from Sonora (Morrison, one specimen in USNM). The collection dates of the 20 specimens examined are in March, April, May, August, September, and November.

Rindgea hypaethrata (Grote), NEW COMBINATION

PL. 8, FIGS. 58–60 (adult); PL. 15, FIG. 15 (larva); TEXT FIG. 65 *b, d* (♂ gen.); TEXT FIG. 64 *b* (♀ gen.) (RWH 6417).

Macaria hypaethrata Grote, 1881, *Papilio*, 1: 167.

Type locality: Tucson, Arizona. [USNM]

In this complex of generally unpretentious moths, the southwestern *R. hypaethrata* stands out as unusually colorful. The contrasting, clear-yellow median space on an otherwise mostly dark brown forewing distinguishes it from all others in the tribe. The yellow median area is sharply set off by evenly curved, blackish antemedial and postmedial lines. Also on the forewing, a weak discal spot and slight infuscation of the yellow area near the costa, as well as a pale, sinuous, nearly obsolescent subterminal line and pale brown to yellowish apical patch may be present. Rarely, the median space may be extensively suffused with dark brown. The light brown hindwing, with its one or two, regular or sinuous, brown transverse bands, is unlike the forewing. The underside is light brown with the dark areas of the upperside showing through with reduced intensity. The male antenna is about as wide as the haustellum and lamellate-fasciculate, with relatively long setae about equal to the thickness of the antenna. The labial palp is relatively long in this species, surpassing the front for about half its total length

in both sexes, and the male hindtarsus is unusually long, being $\frac{2}{3}$ the length of the only slightly swollen hindtibia. Wing length: males, 13–15 mm; females, 12–15 mm.

Male genitalia (text figure 65 *b, d*) distinctive, with strongly curved costal lobe and somewhat reduced, simplified, truncated ventral lobe of valve. Uncus and gnathos as shown are folded over ventrally because they are rigidly fixed in that position and cannot be straightened out in dissection without breakage or distortion; aedeagus with heavily sclerotized, curved, knoblike distal end, which is minutely dentate. Eighth sternum with a relatively shallow, V-shaped incision. My hypothesis is that the process, ancestrally on the costa of the dorsal lobe, has migrated to the end.

Female genitalia (text figure 64 *b*) also unlike those of any other species. Sterigma in form of large, shieldlike plate nearly as wide as abdomen, with separate, large, longitudinally ovate, central ring encircling sclerotized ostium, and a wide, ribbed, sclerotized ductus bursae.

Larvae of *hypaethrata* were reared from eggs on mesquite (*Prosopis* sp.) (Fabaceae) and photographed by B. Scaccia (plate 15, figure 14). The only image available shows a last-instar larva that appears to have recently molted and thus may not have the appearance of a fully mature specimen. The dark, mottled brown integument is very rough. The large setae and their pinacula are conspicuous, and each pinaculum is on a raised base, resembling a chalaza. These apparent chalazae would presumably disappear beneath the integument in a fully fed, expanded larva. The body has a broken pattern of closely set, fine, longitudinal, alternating light and dark stripes among the irregular tracery of dark markings; and a wide, interrupted black middorsal stripe is present. The head is unicolorous brown with the black herring-bone markings commonly found in *Macariini*. It is possible that this is the brown morph of a dichromatic species that has the usual green and brown forms.

Most material of *hypaethrata* in collections is from Pima, Santa Cruz, and Cochise counties, Arizona, where it is evidently fairly common. Elsewhere, it has been collected near Rodeo, Hidalgo County, New Mexico (12 July 1948); near the Mexican border at Presidio, and in Big Bend National Park, Texas; and in Chihuahua, Sonora, Puebla, and both northern and southern Baja California, Mexico. Collection dates for Arizona in-

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clude every month within the periods January–June and August–November, and for Texas, April–June and September–October. As I saw only 10 specimens from Texas, those dates may reflect collecting activity rather than the true flight period.

This unique species was difficult to place but probably fits better in the *s-signata*-group where certain aspects of its genital morphology, especially of the female, show some resemblances. However, there is little that reveals any clear affinity to either group, and the larva, described above, seems somewhat unusual.

GENUS

Fernaldella Hulst

Fernaldella Hulst, 1896, *Trans. Amer. Ent. Soc.*, **23**: 318.

Type species: *Fidonia fimetaria* Grote and Robinson, 1870, *Trans. American Ent. Soc.*, **3**: 182, pl. 2, figs. 84–86. Original designation.

The three species of this endemic North American genus show remarkable superficial similarities to the Palearctic species of *Narraga* Walker and have been referred to that genus, but they are not as closely related as they might appear. Within our fauna, *Fernaldella* is the ultimate in macariine differentiation. Apart from their distinctive appearance and unique underside pattern, species of *Fernaldella* differ from other Macariini, including *Narraga*, in having an elaborately sculptured, carinate, frontal prominence, which has a vertical, medial, serrated ridge, flanked laterally by another vertical ridge on each side, and with a horizontal, shelflike ridge at both upper and lower margins, the lower one being the more prominent (text figure 68). The male genitalia (text figure 68 *c–e*) are unique among all Macariini examined in having lost the gnathos; and the female genitalia have a unique signum consisting of a small, irregularly shaped, sclerotized disk, bearing one or more erect thornlike processes on its inner surface. The following combination of characters distinguishes *Fernaldella* from all other North American genera: chaetosemata elongated transversely in the usual macariine manner; antennae bipectinate in both sexes; fovea absent; foretibia greatly shortened, thickened, and bearing a large, double spine; haustellum apparently absent or with only a minute rudiment sometimes

remaining; gena scaled and with a triangular, flat, unscaled process projecting downward beneath eye; pecten on the third abdominal sternum absent; third anal vein of hindwing absent; eighth sternum simple, not incised; costal lobe of valve usually with a conspicuous notch on ventral margin two-thirds from base; valvula absent; and larva with crochets in two groups, like those of *Epeilis*, *Heliomata*, and *Protitame*.

The following table lists in two columns the characters that distinguish *Fernaldella* from its superficially similar Palearctic counterpart, *Narraga* Walker, 1862 (Type species: *Geometra cecraria* Hübner, a junior synonym of *Phalaena fasciolaria* Hufnagel (= *Narraga fasciolaria* (Hufnagel))).

Table 2.
Differential Character States of
Fernaldella and *Narraga*

<i>Fernaldella</i>	<i>Narraga</i>
sternum 8 entire	sternum 8 incised
haustellum minute or absent	haustellum small but coiled or straight
foretibia short and thick	foretibia unmodified, without with large claw
front protruding, carinate	front nearly flat, plain, with or without complex ridges
female antenna bipectinate	female antenna simple
gnathos absent	gnathos well developed
costal lobe of valva with notch in ventral margin; obsolescent in <i>georgiana</i>)	costal lobe of valva without notch in ventral margin
saccular lobe of valva reduced, shorter than costal lobe	saccular lobe of valva large and produced, as long as costal lobe
secular lobe of valva without process on inner face	saccular lobe of valva with large dentate processes

It appears that the two genera are not closely related at all, and the similarity must be assumed

to be a result of convergence. Before investigating these characters, I followed Povolný and Moucha (1959) in synonymizing *Fernaldella* under *Narraga* in the 1983 check list.

These distinctive little moths exhibit the most elaborate part of their wing pattern on the under-surfaces, much in the manner of such larentine genera as *Stamnodes* Guenée and *Ceratotalia* Packard, and satyrine butterflies of the genera *Coenonympha* Hübner and *Oeneis* Hübner. Similarly, they rest with their wings folded together dorsally and with only the pattern of the underside of the hindwing and tip of the forewing showing. The species may be both diurnal and nocturnal. Although *fimetaria* is usually collected at light, the type material of *georgiana* was reported as having been found flying about patches of the food plant in bright sunlight. The species are at least double brooded, and apparently over-winter as pupae.

The genus is confined to the United States, southwestern Canada, and northern Mexico, and west of the Mississippi River except for the recently described *georgiana*, which is known only from Georgia.

KEY TO SPECIES OF THE GENUS *FERNALDELLA*

1. Wings dark brown; spaces between white submarginal spots on underside of hindwing about equal to width of spots; spaces between three vertical ridges (carinae) of front not sulcate (ridges often concealed by scales); Georgia *georgiana*
p. 349
- Wing medium brown to ochreous orange; spaces between white submarginal spots on underside of hindwing much less than width of spots; spaces between three vertical ridges (carinae) of front sulcate; west of Mississippi River 2
2. Upperside of fore- and hindwing brown to light gray brown, generally without conspicuous patches or shading of ochreous orange; underside of forewing with basal $\frac{1}{2}$ – $\frac{2}{3}$ dark brown to gray brown; front (profile) usually protruding less than distance equal to horizontal width of eye *fimetaria*
p. 345
- Upperside of fore- and hindwing usually with large areas of ochreous orange; underside of forewing with basal $\frac{1}{2}$ – $\frac{2}{3}$ usually orange, but may be suffused with brown in dark specimens; front (profile) usually protruding more than distance equal to horizontal width of eye . . . *stalachtaria*
p. 350

Fernaldella fimetaria (Grote and Robinson)

PL. 8, FIGS. 61–63 (adult); PL. 15, FIG. 15 (larva); TEXT FIG. 2 *d* (venation); TEXT FIG. 68 *b, c* (♂ gen.); TEXT FIG. 68 *a* (♀ gen.); TEXT FIG. 68 *g* (head) (RWH 6420).

Fidonia fimetaria Grote and Robinson, 1870, *Trans. Amer. Ent. Soc.*, **3**: 182, pl. 2, figs. 84–86.

Type locality: Texas. [type lost?]

NOTE—Collected in Texas in August by Belfrage. Number of syntypes and sex not given.

Fidonia halesaria Zeller, 1875, *Verh. zool.-bot. Ges. Wien*, **25**: 42.

Type locality: Dallas County, Texas. [BMNH]

NOTE—Two male syntypes from the Zeller collection are in The Natural History Museum, London.

Fidonia partitaria Grote, 1883, *Can. Ent.*, **15**: 130.

Type locality: Arizona. [USNM]

NOTE—Described from “Several specimens. Coll. Neumögen.” Four of them bearing Grote labels are in the USNM, but only two, a male and female, have “Col. B. Neumögen” labels. The remaining two have Oberthür and Barnes Collection labels, and may have been sent to Oberthür by Grote or Neumögen, later reaching the USNM through purchase. Without Neumögen labels, however, they might be spurious types. All are labeled Arizona except the male with the Neumögen label, but I hereby designate it as the lectotype because it is in good condition, and the female candidate is without an abdomen.

Fernaldella fimetaria angelata W. S. Wright, 1923, *Proc. California Acad. Sci.* (4th series), **12**: 114.

Type locality: Angeles Bay, Lower [Baja] California, Mexico. [CAS]

NOTE—These specimens have a little more orange-brown coloring on the upper surfaces of the wings, as well as elongated submarginal spots on the underside of the hindwing, but they probably fall within the expected variation of *fimetaria*. I have seen a few examples resembling *angelata* from Big Bend National Park and Arizona.

Fernaldella fimetaria is the smallest and by far the most widespread and common species of the genus, occurring in most states west of the Mississippi, and from northern Mexico to Alberta. Although *fimetaria* is easily recognized by the

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male genitalia and usually by color and size, it is difficult to point to any one external feature that will unfailingly distinguish it. All species have the same basic wing pattern and mostly the same external structure. Separating *finetaria* from *georgiana* is no problem because the latter is localized and much larger and darker, with less prominent frontal carinae, and the two are widely allopatric. *Fernaldella finetaria* usually can be distinguished from the largely sympatric *stalachtaria* by its more uniformly brown wings, without the extensive orange banding or shading of *stalachtaria*, and never with bright orange coloring on the underside of the forewing. However, Mexican border specimens (*angelata*) and some Arizona and Utah specimens (*partitaria*) may also have some orange-brown shading on the upper surfaces. Also, the head and palpi are less hairy in *finetaria*, the medial frontal carina is a little less prominent, and the eyes tend to be larger (more protuberant) than those of *stalachtaria* although eye size is not reliable.

Fernaldella finetaria is geographically variable, with a darker, more unicolorous form (*finetaria*) occupying most of the range, including the Chihuahuan Desert (Texas); and a paler, more variegated form (*partitaria*) concentrated mainly in the Sonoran and Mohave Desert regions. The differences are much more apparent in females than in males. These forms were formerly regarded as subspecies or even species but show too much intergradation for subspecific names to be very meaningful. However, I describe them separately. **Dark form** (*finetaria*)—Male with wings either uniformly chocolate brown or faintly and diffusely variegated with lighter markings, which are a reflection of the undersurfaces showing through; forewing with prominent whitish or yellowish subapical costal patch compressed within what would be the space between the postmedial and subterminal bands, which are not necessarily apparent; and with less distinct, diffuse, pale, costal or subcostal shading between postmedial band and wing base, but weakening toward base and cut medially by a brown bar that represents the costal end of the medial transverse band. Fringes boldly checkered with brown and whitish on forewing, less so on hindwing; often preceded by a few short, whitish or yellowish terminal rays on forewing near apex. Undersurface of hindwing light olivaceous yellow brown with a complex pattern of white bands and spots, and a few

blackish markings; better understood from the illustrations. This pattern is diagnostic for the genus but not for species. Undersurface of forewing dark brown (never orange as it usually is in *stalachtaria*) and unmarked except toward apex, where it resembles that of the hindwing. Fringes as above. Wing length: males, 8–11 mm (n = 127). Female usually larger, colored either like male or paler brown; a few almost as light colored as the palest southwestern specimens but grayish, rarely with any of the orange clouding that distinguishes *stalachtaria*. Undersurface like that of male but may be paler, with most of the forewing uniformly light gray brown rather than dark brown. Wing length: females, 10–12 mm (n = 40). **Light southwestern form** (*partitaria*)—Males hardly differing from those of previous form, but with slight tendency to be more variegated with lighter brown. Wing length: males, 8–11 mm (n = 78). Females mostly much paler than males and paler than females from Texas and most other parts of the range. Wings banded and spotted with pale tan to yellowish on a brown to light grayish background; or conversely, with wide, brown or light grayish medial, postmedial, and subterminal bands on a pale tan to yellowish background. The brown and white checkered fringes, submarginal series of pale spots on both wings, and constrictions or other irregularities in the pale transverse bands of both wings give somewhat the appearance of a checkerboard pattern. Undersurface of forewing light gray brown to darker brown, except for apex, which is colored much like hindwing; without the bright-orange tint characteristic of *stalachtaria*. Wing length: females, 10–12 mm (n = 39).

A few other trends in geographic variation should be noted. Southern California north to Kern County is occupied by populations that appear to be a mixture of the dark and light forms described above, although those from the Owens Valley (Bishop, Olancho) are different (all specimens seen are males). These are a tawny reddish to yellowish brown, to a degree unusual for males and suggestive of *stalachtaria*, and they have the undersurface of the hindwing very pale, with the submarginal white spots of the hindwing touching one another or confluent in three of five specimens. Mexican specimens (*angelata*) have some orange-brown clouding on the upperside, and the white submarginal spots of the hindwing beneath are elongated longitudinally, fusiform, and espe-

cially well separated, not confluent. I have seen one specimen resembling *angelata* from Big Bend National Park, Texas, 9 August 1983 (E. C. Knudson), and somewhat less distinct examples from southern Arizona. It is otherwise known from Baja California Sur and Sonora, Mexico.

Seasonal variation is negligible. Summer brood specimens seem about as large as spring ones.

The male genitalia (text figure 68 *b, c*) are easily distinguished from those of *stalachtaria* and *georgiana* by the shape of several components. Costal lobe of valve with prominent notch on ventral margin that is obsolescent in *georgiana* and twice as deep in *stalachtaria*. Saccular lobe short, stubby, obliquely truncated, not much wider than costal lobe (usually $2-3 \times$ as wide in other species). Juxta small, about as wide as base of saccus (wider than base of saccus in other species). Saccus strongly tapered to a blunt apex (broad and more rounded in *stalachtaria*; tapered to a point in *georgiana*). Aedeagus also differs in overall shape.

Female genitalia (text figure 68 *a*) extremely difficult to dissect well and also variable within species, thus of limited value for identification purposes. May be distinguished from those of *stalachtaria* by nature of the sclerotized ductus bursae, which is usually shorter, not much longer than an ovipositor lobe; whereas that of *stalachtaria* is much longer than an ovipositor lobe, and usually also wider. The main difference separating *fimetaria* from *georgiana* is in the shape of the transverse, postostial sclerite, which has a straight posterior margin in *fimetaria*; that of *georgiana* is arched, with a prominent U-shaped emargination medially.

The following larval description of *fimetaria* is based on live material and color photographs obtained by N. McFarland in Ash Canyon, Huachuca Mountains, Arizona. Mature larva typically macariine, green, moderately elongate, cylindrical but slightly widening toward posterior end, with multiple, fine, longitudinal lines. Lateral stripe white to yellowish white, prominent, with the small, purplish-brown spiracles lying near its dorsal margin. Dorsolateral stripe slightly thinner, more sinuous, yellow, becoming white only on thorax. Lateral and dorsolateral stripes separated by about three thin, pale, sinuous, longitudinal lines on a darker green background. Dorsum occupied by two pairs of thin, pale, longitudinal lines edged with blackish; middorsal line or stripe bluish gray. Ventral space similarly marked by

several pale, thin, closely set longitudinal lines, usually edged with blackish. Legs green to faintly brownish. Head highly prognathous, depressed, mottled or marbled green and brown, with pale lateral patch where lateral stripe encroaches onto head. Pupa (20–22 mm) with thorax and wings bright green, abdomen brown, retaining this color until nearly ready to emerge. Eggs obtained 28 August produced mature larvae about the beginning of October.

The larvae from Arizona were reared from eggs on a *Gutierrezia* species, probably *sarothrae* (Pursh) Britt. & Rusby (broom snakeweed) (Asteraceae). A specimen in the Los Angeles County Museum was reared from a larva on threadleaf snakeweed, *Gutierrezia microcephala* (DC.) Gray (as *G. lucida* (Greene) Greene), at Apple Valley, San Bernardino County, California, in June 1960 (McFarland, 1975: 118); and three specimens in the U. S. National Museum of Natural History were reared from larvae swept from leaves of broomweed, *Amphiachyris dracunculoides* (DC.) Nutt. (Asteraceae) near Temple, Bell County, Texas on 6–8 July 1977 (P. Psencik). The *Gutierrezia* species are low shrubs, and broomweed is a stout weedy annual. Both are reported to be toxic to livestock and made more abundant by overgrazing, so that the moths might be expected to be most numerous on overgrazed land.

Fernaldella fimetaria occurs across the western United States from Iowa, Missouri, Arkansas, and Texas to California, and from northern Mexico to southern Alberta. The easternmost records seen are from Sioux City, Iowa; Willard, Greene County, Missouri; Hope, Hempstead County, Arkansas; Dallas, and Jackson, San Patricio, and Cameron counties, Texas. It extends thence to San Diego, San Bernardino, Los Angeles, Ventura, Kern, and Inyo counties, California; and it has been collected at Wendell, Gooding County, Idaho; in Oregon; and at Lethbridge, Alberta. It seems especially common in Texas, New Mexico, Arizona, and in desert areas of California and southern Nevada. It is primarily a species of arid or semi-arid areas.

The flight period for the central Midwest and Plains Region to Utah and northward is 16 May–27 August; and from Arkansas and Texas to California, 18 March–24 September, with no clear breaks between broods in either region, although the dates would be expected to represent two broods northward and three or four in warmer areas.

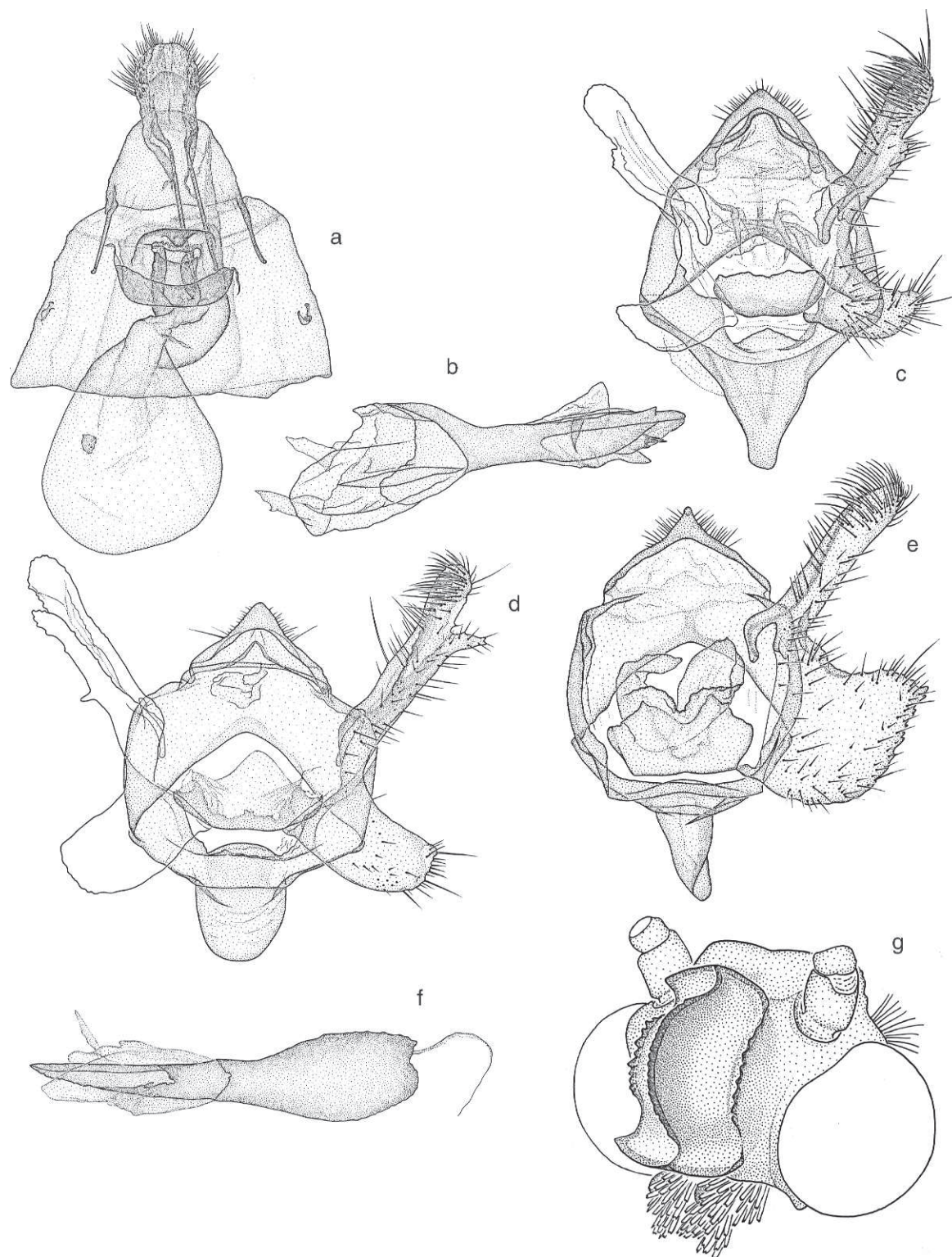


FIGURE 68: GENITALIA AND HEAD OF *FERNALDELLA* SPECIES

a. *F. fimetaria*, female; Irving, Dallas County, Texas (USNM 58892). b. *F. fimetaria*, aedeagus; Loja area, Ecuador (USNM 57573).
c. *F. fimetaria*, genital capsule; Loja area, Ecuador (USNM 57573). d. *F. stalachtaria*, genital capsule; Loja area, Ecuador (USNM 57576). e. *F. georgiana*, genital capsule; Loja area, Ecuador (USNM 57577). f. *F. stalachtaria*, aedeagus; Loja area, Ecuador (USNM 57576). g. *F. fimetaria*, anterolateral view of head; Victoria, Victoria County, Texas.

Fernaldella georgiana (Covell, Finkelstein, and Towers), NEW COMBINATION
PL. 8, FIGS. 64–66 (adult); TEXT FIG. 68 *e*
(♂ gen.).

Narraga georgiana Covell, Finkelstein, and Towers, 1984, *Jour. Res. Lep.*, **23**: 161–168.
Type locality: Ohoopee Dunes, Tattnall County, Georgia. [USNM]

This species is known almost exclusively from a unique and limited habitat of dwarfed evergreen oaks, shrubs, and ground lichens growing on ancient dunes along the Ohoopee River, which is a tributary of the Altamaha. Compared to other species of the genus, *georgiana* is large and very dark, with the usual spots near the forewing costa yellowish and rather diffuse. The white spots and bands of the undersurfaces are widely spaced, and the submarginal spots of the hindwing are elongated.

The following description emphasizes those features that distinguish *georgiana*. Upper surfaces of wings dark brown, more so than the darkest specimens of *finetaria*, with the yellowish costal area on the forewing divided into segments in the usual way by the otherwise invisible medial, postmedial, and subterminal bands; hindwing sometimes with vague indications of the underside pattern showing through in lighter brown. Undersurface of forewing dark brown, marked only toward apex with a white subapical, costal, bar-shaped spot and two or three elongated white submarginal spots on a dark ochreous background; and with a dusting of yellowish scales along costa. Undersurface of hindwing brown, with veins more or less broadly outlined with dull ochre, and with the usual white pattern of *Fernaldella* well developed but spaced out, as though the white markings had not enlarged in proportion to the larger wing size of this species. The white markings appear much more crowded in both *finetaria* and *stalachtaria*, and in those species the ochreous coloring does not follow the veins but fills nearly all spaces between the spots. The submarginal white spots of *georgiana* are decidedly elongated, but mostly rounded at each end, not pointed.

Foretibial spine long and slender but hardly differing from that of related species; haustellum absent; front bulging and carinate as in other species except that individual ridges do not stand out prominently because the spaces between the three vertical ones are not sulcate, and the carinae are

largely concealed from view by overlying scales; eye slightly reduced in volume so that its protuberance, viewed frontally, appears about equal to one-half width of front, measured horizontally across middle (often equal to more than half in *finetaria*).

Male genitalia (text figure 68 *e*) easily distinguished by width of saccular lobe of valve, which is at least 4 × width of costal lobe, whereas it hardly is more than twice that width in other species. Also, notch on ventral margin of costal lobe, prominent in other species of *Fernaldella*, is hardly evident in *georgiana*.

Female genitalia with unusually long ductus bursae, which may not appear long because half of it is abruptly twisted sideways toward its junction with bursa copulatrix. The only other noticeable difference is in the prominently arched and emarginate nature of the postostial sclerite.

The life history and larva were described in the original description. The food plant is shrub goldenrod, *Chrysoma pauciflosculosa* (Michx.) Greene (Asteraceae). The mature larva is 23–24 mm in length, green, with grainy, irregular, yellowish-green longitudinal striations and an irregular lateral stripe described as yellowish. It is highly cryptic on leaves of the host. The larva burrows in the sand to pupate and makes a loose cocoon of sand cemented with silk. The reared larvae fed for 30 days from hatching until the beginning of pupation, and adults reared from larvae in late summer emerged 30 October–6 November 1981, too late in the season for a continuation of breeding; so these pupae almost certainly would have overwintered under normal outdoor conditions. Although adults were collected in mid-April and early September, representing the first and last broods of the season, the length of the generational cycle indicates that there is a midsummer brood also and that *georgiana* is a triple-brooded species.

A trivoltine life history is further suggested by the second, more successful rearing reported by Covell, Finkelstein, and Towers (1984). Eggs from females collected 13 April 1983 were kept for rearing and produced adults over a long period between June and October. Again, the reported finding of a full-grown larva on 27 August 1982 is evidence of a summer brood or broods, because if prolonged aestivation occurred over the hot midsummer period, it would most likely be in the pupal stage. This larva, from which an

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adult was reared, also confirmed that shrub goldenrod is the correct host.

Fernaldella georgiana is known from only two sites five miles apart in Tattnall and Emanuel counties, both in the Ochopee Dunes habitat, and from a single male in the Carnegie Museum from near Baxley, Appling County, Georgia, labeled July 22–31, Sweadner coll. The Baxley site is south of the Altamaha River and about 45 miles south of the type locality. The Ochopee Dunes are elliptical dunes of deep, coarse sands believed to be of Pleistocene origin, and they straddle the Tattnall-Candler County line on the east side of the Ochopee River, about two-fifths of the way from Savannah to Macon. This habitat supports an unusual flora with a ground cover of lichens and various herbs, and with dwarfed trees, predominantly long-leaf pine and turkey oak (Wharton, 1978).

Adult moths were seen flying by day at Ochopee Dunes on April 11, 13, and September 6 and 11. These early and late dates are evidently connected by at least one summer brood in June and July. Although the moths have no haustellum and thus cannot feed, the captive females lived 7–8 days. Finkelstein and Towers (*in* Covell, Finkelstein, and Towers, 1984) made significant field observations. The type material was collected in close association with *Chrysoma pauciflosculosa* (Michx.) Greene. Although not seen ovipositing on this plant, the moths flew close by concentrations of it and were not found where the plant was absent. The moths were observed to fly in a slow, erratic flight within 18 inches of the ground. They were found only in open areas in bright sunlight between 10:30 a.m. and noon, disappearing after noon when temperatures rose. They alight abruptly with wings folded together over the back, resting on twigs, blades of grass, or other vegetation. None was seen in nearby wooded areas. They remained close to patches of the food plant and diminished in numbers where the food plant became less plentiful. As no light collecting has been done in this area, it is not known whether *georgiana* will come to light.

Fernaldella stalachtaria (Strecker)

PL. 8, FIGS. 67–69 (adult); TEXT FIG. 68 *d*, *f* (♂ gen.) (RWH 6421).

Fidonia stalachtaria Strecker, 1878, *in* E. H. Ruffner, *Annual Report upon Explorations and Surveys in the Department of the Mis-*

souri, being Appendix SS of the Annual Report of the Chief of Engineers for **1878**: 1863. Govt. Printing Office, Washington.

Type locality: “Rio Navajo, near mouth of cañon of its headwaters.” [Archuleta County, Colorado]. [FMNH]

Fidonia alternaria Grote, 1883, *Can. Ent.*, **15**: 27.

Type locality: New Mexico

Although widespread in the West, especially in the Rocky Mountain Region, *stalachtaria* is much less common in collections than *fimetaria*, possibly because of its diurnal flight habits. Little is known about *stalachtaria*, and I have never encountered it in the field. It is larger than *fimetaria*, and the wings are bright orange ochre with brown bands, including a wide, brown, diffusely defined outer border. The underside of the forewing usually is also mostly orange to orange brown, although sometimes suffused with brown, whereas that of *fimetaria* is never orange.

Upper surface of wings bright ochreous orange, fading to dull orange yellow or brownish yellow in weathered specimens. Forewing mostly orange basad of brown postmedial band, except for a short brown bar in the middle from end of discal cell to costa; usually a dusting of pale yellowish scales on costa, and veins often lightly outlined with brown; outer border of forewing brown, more or less separated from postmedial band by a poorly defined orange band of about same width as postmedial, terminating at costal end in a fairly prominent, pale yellow subapical spot. Hindwing similar except that there is no discal spot or bar, and what appears to be the postmedial is really a subterminal band. It is separated from the terminal brown band by a thin orange band sandwiched between them. Fringes of both wings pale yellow or white checkered with brown, less boldly so on hindwing. Occasional specimens may be more heavily suffused with brown, leaving only small areas of orange color showing toward base of wings. Undersurface similar to those of *fimetaria*, but with white pattern of hindwing and apex of forewing on an olive-brown to dusky background, and basal two-thirds of forewing bright ochreous orange. Wing length: males, 9–12 mm, most commonly about 11 mm; females, 10–12 mm. Females average no larger than males, possibly slightly less.

Male genitalia with costal lobe of valve deeply incised on ventral margin, leaving a part of this

margin with a protruding free end as long as width of costal lobe; saccular lobe in outline about as large as saccus (smaller in *finetaria*); saccus large, broad, rounded, not tapered; tympanic structures in base of abdomen very large, their diameter surpassing width (longitudinal dimension) of second abdominal segment (about equal to width of second segment in *finetaria*). Female genitalia do not differ greatly from those of other species, although postostial sclerite is bow shaped and continuous, not emarginate or incised in the middle.

The early stages and hosts of *stalachtaria* are unknown.

Fernaldella stalachtaria is known from Custer County, South Dakota; Platte County (6,000'), and Park County, Wyoming; Larimer and Pueblo

counties and Denver, Colorado; the counties of San Miguel, Otero, Bernalillo (7,200'), McKinley (Fort Wingate), and Socorro (Gran Quivira National Monument), New Mexico; Signal Peak, Texas; Humboldt County, Nevada (dune area 10 mi N of Winnemucca); Malheur, Lake, and Harney counties, Oregon; and Inyo County (6,000'), California.

Recorded flight periods for different regions are as follows: South Dakota: 9 August; Wyoming: 31 July; Colorado, 14–25 June; New Mexico, 9 May, 16 June–31 August; Nevada, 27 May; Oregon, 18 May–15 June; California, 4–5 July. The species may be univoltine or mostly so, emerging as early as May in warmer, low elevation habitats, but as late as July and flying even into August in cool, high mountain areas.

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COLOR PLATES

Geometroidea

PLATE 1

Geometroidea

GEOMETRIDAE

figs. 1–76

NATURAL SIZE 1:1

1. *Ligdia wagneri* Fgn. & Adams, ♂. Holotype. 1.8 road miles E of Chimney Tops Picnic area, 3,200', Great Smoky Mountains National Park, Newfound Gap Road, Sevier Co., Tennessee, 19 May 2001, Wagner, Brown, & Ferguson (USNM). (p. 23).
2. *Ligdia wagneri* Fgn. & Adams, ♂. Vicinity of Cosby house, 35° 46.66 N, 83° 12.82 W, 533 m, Great Smoky Mountains National Park, Cooke Co. [in error for Cocke Co.], Tennessee, 22–25 June 2001, D. & M. Davis (USNM). (p. 23).
3. *Ligdia wagneri* Fgn. & Adams, ♂. Underside. 1.8 road miles E of Chimney Tops Picnic area, 3,200', Great Smoky Mountains National Park, Newfound Gap Road, Cocke Co. [in error for Sevier Co.], Tennessee, 19 May 2001, Wagner, Brown, & Ferguson (USNM). (p. 23).
4. *Nematocampa resistaria* (H.-S.), ♀. McKethan Lake Rec. Area, Withlacoochee State Forest, Hernando Co., Florida, emerged 7 May 1983, H. D. Baggett (USNM). (p. 29).
5. *Nematocampa resistaria* (H.-S.), ♂. Seton Creek, Lillooet, British Columbia, 4 July 1991, D. C. Ferguson (USNM). (p. 29).
6. *Nematocampa resistaria* (H.-S.), ♂. Sycamore Landing, Seneca, Montgomery Co., Maryland, 28 May 1977, D. C. Ferguson (USNM). (p. 29).
7. *Nematocampa resistaria* (H.-S.), ♀. Underside. Gronnel Road, Elsie, Clatsop Co., Oregon, 6 September 1968, E. L. Griepentrog (USNM). (p. 29).
8. *Nematocampa brehmeata* (Grossb.), ♀. San Antonio, Marin Co., California, 21 July 1939 (USNM). (p. 32).
9. *Nematocampa brehmeata* (Grossb.), ♂. Anderson Springs, Lake Co., California, 3 July 1949, W. R. Bauer (USNM). (p. 32).
10. *Nematocampa brehmeata* (Grossb.), ♀. Anderson Springs, Lake Co., California, 26 July 1952, W. R. Bauer (USNM). (p. 32).
11. *Nematocampa brehmeata* (Grossb.), ♂. Underside. Anderson Springs, Lake Co. California, 3 July 1949. W. R. Bauer (USNM). (p. 32).
12. *Nematocampa baggettaria* Fgn., ♀. Paratype. Torreya State Park, Liberty Co., Florida, 19 August 1982, H. D. Baggett (USNM). (p. 33).
13. *Nematocampa baggettaria* Fgn., ♂. 4.2 mi NE Abita Springs, sec 24 T6 SR12E, St. Tammany Parish, Louisiana, 25 May 1984, V. A. Brou, Jr. (USNM). (p. 33).
14. *Nematocampa baggettaria* Fgn., ♂. McClellanville, Charleston Co., South Carolina, 28 March 1971, R. B. Dominick, Charles R. Edwards (USNM). (p. 33).
15. *Nematocampa baggettaria* Fgn., ♀. Underside. 4.2 mi NE Abita Springs, sec 24 T6 SR12E, St. Tammany Parish, Louisiana, 14 May 1984, V. A. Brou, Jr. (USNM). (p. 33).
16. *Taeniogramma quadriliniata* (Schaus), ♂. Holotype. Oribaza, Mexico (USNM). (p. 36).
17. *Taeniogramma octolineata* (Hulst), ♂. Ash Canyon, 5,100', Huachuca Mountains, Cochise Co., Arizona, 9 August 1991, D. C. Ferguson (USNM). (p. 36).
18. *Taeniogramma octolineata* (Hulst), ♀. Ash Canyon, 5,100', Huachuca Mountains, Cochise Co., Arizona, 10 August 1991, D. C. Ferguson (USNM). (p. 36).
19. *Taeniogramma octolineata* (Hulst), ♀. Underside. Ash Canyon, 5,100', Huachuca Mountains, Cochise Co., Arizona, 9 August 1991, D. C. Ferguson (USNM). (p. 36).
20. *Taeniogramma mendicata* (Hulst), ♂. Ash Canyon, 5,100', Huachuca Mountains, Cochise Co., Arizona, 9 August 1991, D. C. Ferguson (USNM). (p. 37).
21. *Taeniogramma mendicata* (Hulst), ♂. Green Gulch, Big Bend National Park, Brewster Co., Texas, 6 May 1972, A. & M. E. Blanchard (USNM). (p. 37).
22. *Taeniogramma tenebrosata* (Hulst), ♂. Ash Canyon, 5,100', Huachuca Mountains, Cochise Co., Arizona, 9 August 1991, D. C. Ferguson (USNM). (p. 38).
23. *Taeniogramma tenebrosata* (Hulst), ♀. Ash Canyon, 5,100', Huachuca Mountains, Cochise Co., Arizona, 10 August 1991, D. C. Ferguson (USNM). (p. 38).
24. *Protitame virginalis* (Hulst), ♂. Great Basin Experimental Station near Ephraim, 8,850', Sanpete Co., Utah, 22 July 1980, D. C. Ferguson (USNM). (p. 40).
25. *Protitame virginalis* (Hulst), ♂. T19N R15E, Sec 16, Oktibbeha Co., Mississippi, 10 July 1990, D. M. Pollock (USNM). (p. 40).
26. *Protitame virginalis* (Hulst), ♀. Fort Niobrara, Cherry Co., Nebraska, 25 June 1983, D. C. Ferguson (USNM). (p. 40).

27. *Protitame subalbaria* (Pack.), ♂. Kerby, Josephine Co., Oregon, 17 July 1990, D. C. Ferguson (USNM). (p. 44).
28. *Protitame subalbaria* (Pack.), ♀. Lee Vining Creek, 7,200', 6 mi W Mono Lake, Mono Co., California, emerged 11 August 1987, D. C. Ferguson (USNM). (p. 44).
29. *Protitame cervula* (Rindge), ♂. Christopher Creek, 5,800', Mogollon Rim, Gila Co., Arizona, 17 June 1957, L. M. Martin, R. J. Ford, & W. A. Rees (AMNH). (p. 45).
30. *Protitame cervula* (Rindge), ♀. Patagonia, Santa Cruz Co., Arizona, 4 May 1948, L. M. Martin (AMNH). (p. 45).
31. *Heliomata cycladata* G. & R., ♀. Near Troutdale, 36° 43' N, 81° 28' W, 3,300', Grayson Co., Virginia, 16 June 1992, D. C. Ferguson (USNM). (p. 51).
32. *Heliomata cycladata* G. & R., ♀. Underside. Balsam, 3,200', Jackson Co., North Carolina, 21 June 1974, D. C. Ferguson (USNM). (p. 51).
33. *Heliomata scintillata* Fgn., ♂. Holotype. Bovina, Warren Co., Mississippi, 10 May 1974, B. Mather (USNM). (p. 54).
34. *Heliomata scintillata* Fgn., ♀. Paratype. Vicksburg, Warren Co., Mississippi, 29 April 1993, B. Mather (USNM). (p. 54).
35. *Heliomata infulata* (Grt.), ♂. Wall, Allegheny Co., Pennsylvania, 12 June 1932, Chermock (USNM). (p. 55).
36. *Heliomata infulata* (Grt.), ♀. Underside. Finleyville, Washington Co., Pennsylvania, 11 June 1937, H. Engel (USNM). (p. 55).
37. *Isturgia dislocaria* (Pack.), ♂. 9 mi S of Chadron, Chadron Creek, Dawes Co., Nebraska, 5 July 1993, D. C. Ferguson (USNM). (p. 57).
38. *Isturgia dislocaria* (Pack.), ♂. Sheffield, Pecos Co., Texas, 31 March 1967, A. & M. E. Blanchard (USNM). (p. 57).
39. *Isturgia dislocaria* (Pack.), ♂. Guadalupe Canyon, 4,250', Peloncillo Mountains, Cochise Co., Arizona, 15 May 1976, J. & S. Werner (USNM). (p. 57).
40. *Isturgia dislocaria* (Pack.), ♀. Black River near Rattlesnake Spring, Eddy Co., New Mexico, 27 March 1993, D. C. Ferguson (USNM). (p. 57).
41. *Isturgia dislocaria* (Pack.), ♂. Fort Niobrara, Cherry Co., Nebraska, 17 June 1983, D. C. Ferguson (USNM). (p. 57).
42. *Eumacaria madopata* (Gn.), ♂. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 9 June 1983, D. C. Ferguson (USNM). (p. 62).
43. *Eumacaria madopata* (Gn.), ♂. St. Petersburg, Pinellas Co., Florida, 24–30 March 19–, Barnes Collection (USNM). (p. 62).
44. *Eumacaria madopata* (Gn.), ♂. Priest River Experimental Forest, 2,500', Bonner Co., Idaho, 28 June 1979, D. C. Ferguson (USNM). (p. 62).
45. *Eumacaria madopata* (Gn.), ♂. Underside. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 9 June 1983, D. C. Ferguson (USNM). (p. 62).
46. *Mellilla xanthometata* (Wlk.), ♀. USF golf course, Tampa, Hillsborough Co., Florida, 30 April 1984, H. D. Baggett (USNM). (p. 64).
47. *Mellilla xanthometata* (Wlk.), ♂. Burden Falls, Shawnee National Forest, Pope Co., Illinois, emerged 18 January 1986, D. C. Ferguson (USNM). (p. 64).
48. *Mellilla xanthometata* (Wlk.), ♀. Burden Falls, Shawnee National Forest, Pope Co., Illinois, emerged 3 March 1986, D. C. Ferguson (USNM). (p. 64).
49. *Mellilla xanthometata* (Wlk.), ♂. Town Bluff Dam B, Tyler Co., Texas, 15 September 1975, A. & M. E. Blanchard (USNM). (p. 64).
50. *Mellilla xanthometata* (Wlk.), ♂. Underside. Burden Falls, Shawnee National Forest, Pope Co., Illinois, emerged 5 February 1986, D. C. Ferguson (USNM). (p. 64).
51. *Trigrammia quadrinotaria* H.-S., ♂. Clifty Falls State Park, Jefferson Co., Indiana, 7 June 1951, R. H. Leuschner (USNM). (p. 67).
52. *Trigrammia quadrinotaria* H.-S., ♂. Cranberry Glades Campground, Monongahela National Forest, Pocahontas Co., West Virginia, 1 July 1967, R. Heitzman (USNM). (p. 67).
53. *Trigrammia quadrinotaria* H.-S., ♀. West foot of Big Black Mountains, Harlan Co., Kentucky, 20 April 1979, C. V. Covell, Jr. (USNM). (p. 67).
54. *Trigrammia quadrinotaria* H.-S., ♀. Balsam, 3,200', Jackson Co., North Carolina, 21 June 1974, D. C. Ferguson (USNM). (p. 67).
55. *Trigrammia quadrinotaria* H.-S., ♀. Walker Mountains north of Marion, 36° 54' N, 81° 32' W, 3,650', Smyth Co., Virginia, 19 June 1992, D. C. Ferguson (USNM). (p. 67).
56. *Trigrammia quadrinotaria* H.-S., ♂. Screven Co., Georgia, 7 April 1946, Otto Buchholz (USNM). (p. 67).
57. *Trigrammia quadrinotaria* H.-S., ♂. McClellanville, Charleston Co., South Carolina, 13 April 1974, R. B. Dominick (USNM). (p. 67).
58. *Speranza varadaria* (Wlk.), ♀. Archbold Biological Station, Lake Placid, Highlands Co., Florida, 13 April 1985, D. C. Ferguson (USNM). (p. 72).
59. *Speranza varadaria* (Wlk.), ♂. Archbold Biological Station, Lake Placid, Highlands Co., Florida, 14 April 1985, D. C. Ferguson (USNM). (p. 72).
60. *Speranza varadaria* (Wlk.), ♂. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 7 August 1986, D. C. Ferguson (USNM). (p. 72).
61. *Speranza varadaria* (Wlk.), ♀. Underside. Archbold Biological Station, Lake Placid, Highlands Co., Florida, 15 April 1985, D. C. Ferguson (USNM). (p. 72).
62. *Speranza marcescens* (Gn.), ♂. Middle California, Barnes Collection (USNM). (p. 75).
63. *Speranza marcescens* (Gn.), ♂. Conn Creek near Rutherford, Napa Co., California, 15 September 1985, D. C. Ferguson (USNM). (p. 75).
64. *Speranza marcescens* (Gn.), ♀. Underside. Berkeley, Alameda Co., California, 14 May 1931, D. Meadows (USNM). (p. 75).
65. *Speranza brunneata* (Thunb.), ♂. Topsail, Avalon Peninsula, Newfoundland, 23 July 1954, D. C. Ferguson (USNM). (p. 76).
66. *Speranza brunneata* (Thunb.), ♂. Wigwam Creek, Cadomin Road 8 mi S of Hinton, Alberta, 16 July 1984, D. C. Ferguson (USNM). (p. 76).
67. *Speranza brunneata* (Thunb.), ♂. Silverton, San Juan Co., Colorado, 1–7 August, Barnes Collection (USNM). (p. 76).
68. *Speranza brunneata* (Thunb.), ♀. Silverton, San Juan Co., Colorado, 1–7 August, Barnes Collection (USNM). (p. 76).
69. *Speranza brunneata* (Thunb.), ♀. Calgary, Alberta, F. H. Wolley-Dod (USNM). (p. 76).
70. *Speranza brunneata* (Thunb.), ♀. Mount Katahdin, 1,800', Piscataquis Co., Maine, 12 July 1952, D. C. Ferguson (USNM). (p. 76).
71. *Speranza inextricata* (Wlk.), ♀. Tampa, Hillsborough Co., Florida (USNM). (p. 79).
72. *Speranza inextricata* (Wlk.), ♂. 15 mi W Cocoa, Orange Co., Florida, 6 May 1966, R. H. Leuschner (USNM). (p. 79).
73. *Speranza inextricata* (Wlk.), ♀. Bon Secour National Wildlife Refuge, 30° 14' 10" N, 87° 49' 49" W, Baldwin Co., Alabama, 11 May 1994, R. L. Brown, D. Pollock (USNM). (p. 79).
74. *Speranza exonerata* Fgn., ♂. Paratype. Lost River State Park, Hardy Co., West Virginia, 28 June 1968, J. F. G. Clarke, T. M. Clarke (USNM). (p. 80).
75. *Speranza exonerata* Fgn., ♀. Paratype. Whitesbog, Burlington Co., New Jersey, 30 June 1940, E. P. Darlington (USNM). (p. 80).
76. *Speranza exonerata* Fgn., ♀. Paratype. Underside. New Lisbon, New Jersey, 28 June 1941, E. P. Darlington (USNM). (p. 80).

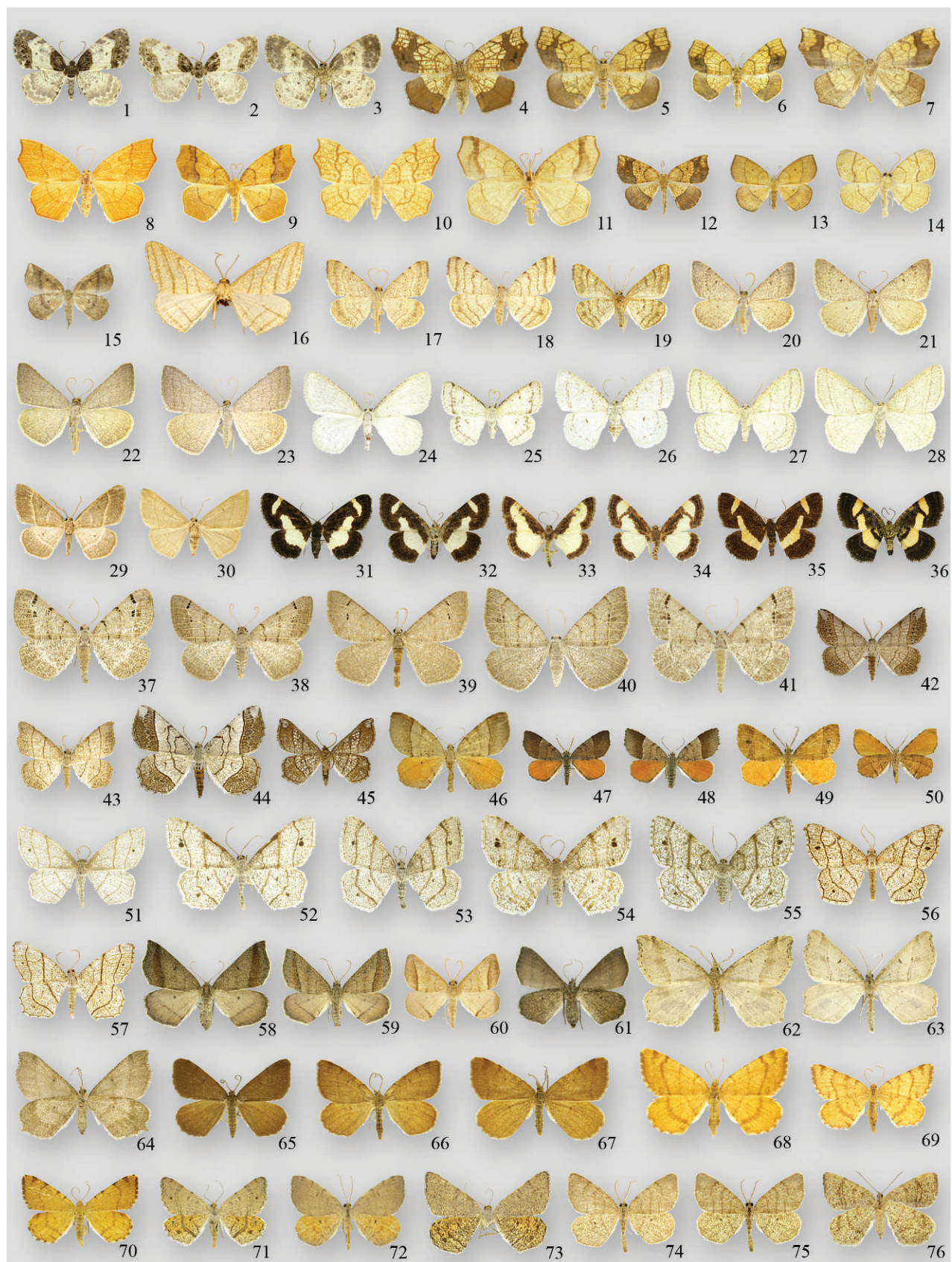


PLATE 2

Geometroidea

GEOMETRIDAE

figs. 1–67

NATURAL SIZE 1:1

1. *Speranza sulphurea* (Pack.), ♂. Beckley Bog near Norfolk, Litchfield Co., Connecticut, 21 June 1965, D. C. Ferguson (USNM). (p. 82).
2. *Speranza sulphurea* (Pack.), ♂. Caledonia, Queens Co., Nova Scotia, 12 July 1961, D. C. Ferguson (USNM). (p. 82).
3. *Speranza sulphurea* (Pack.), ♀. Beckley Bog near Norfolk, Litchfield Co., Connecticut, 21 June 1965, D. C. Ferguson (USNM). (p. 82).
4. *Speranza sulphurea* (Pack.), ♀. Mount Uniacke, Nova Scotia, 21 July 1950, D. C. Ferguson (USNM). (p. 82).
5. *Speranza sulphurea* (Pack.), ♀. Underside. Mount Uniacke, Nova Scotia, 8 July 1950, D. C. Ferguson (USNM). (p. 82).
6. *Speranza amboflava* (Fgn.), ♂. Scott State Park, Scott Co., Kansas, 24 September 1999, G. J. Balogh (USNM). (p. 84).
7. *Speranza amboflava* (Fgn.), ♂. Scott State Park, Scott Co., Kansas, 24 September 1999 G. J. Balogh (USNM). (p. 84).
8. *Speranza amboflava* (Fgn.), ♀. Vineyard, Utah Co., Utah, 10 July 1912, T. Spalding (USNM). (p. 84).
9. *Speranza amboflava* (Fgn.), ♂. Underside. Scott State Park, Scott Co., Kansas, 24 September 1999, G. J. Balogh (USNM). (p. 84).
10. *Speranza abruptata* (Wlk.), ♂. 15 mile Creek, Green River State Forest, Allegheny Co., Maryland, 13 June 1992, D. C. Ferguson (USNM). (p. 86).
11. *Speranza abruptata* (Wlk.), ♀. Thunder Bay, Ontario, 30 July 1940, H. S. Parish (USNM). (p. 86).
12. *Speranza abruptata* (Wlk.), ♀. Underside. Port Franks, Ontario, emerged 24 June 1971, Bolte & White (USNM). (p. 86).
13. *Speranza umbriferata* (Hulst), ♂. French Creek, Detroit Lake, Marion Co., Oregon, 3 June 1995 (USNM). (p. 87).
14. *Speranza umbriferata* (Hulst), ♀. French Creek, Detroit Lake, Marion Co., Oregon, 3 June 1995 (USNM). (p. 87).
15. *Speranza umbriferata* (Hulst), ♂. Underside. French Creek, Detroit Lake, Marion Co., Oregon, 3 June 1995 (USNM). (p. 87).
16. *Speranza anataria* (Swett), ♂. Underhill State Park, Mt Mansfield, Chittenden Co., Vermont, 14 July 1993, J. R. Grehen (USNM). (p. 88).

17. *Speranza boreata* Fgn., ♂. Paratype. Nordegg, Alberta, 21 July 1921, Barnes Collection (USNM). (p. 92).
18. *Speranza boreata* Fgn., ♂. Paratype. Ester Dome, 64° 53' N, 148° 03' W, 2,300', Alaska, 24 July 1970, K. W. Philip (USNM). (p. 92).
19. *Speranza boreata* Fgn., ♂. Paratype. Underside. Nordegg, Alberta, 21 July 1921, Barnes Collection (USNM). (p. 92).
20. *Speranza coloradensis* (Hulst), ♂. Big Springs Ranch, Florissant, Teller Co., Colorado, 18 July 1960, T. C. Emmel (USNM). (p. 93).
21. *Speranza exauspicata* (Wlk.), ♂. Lost River State Park, Hardy Co., West Virginia, 29 June 1968, J. F. G. Clarke, T. M. Clarke (USNM). (p. 94).
22. *Speranza exauspicata* (Wlk.), ♀. Lost River State Park, Hardy Co., West Virginia, 29 June 1968, J. F. G. Clarke, T. M. Clarke (USNM). (p. 94).
23. *Speranza exauspicata* (Wlk.), ♂. Underside. 5 mi SE Franklin, Pendleton Co., West Virginia, 27 June 1968, J. F. G. Clarke, T. M. Clarke (USNM). (p. 94).
24. *Speranza confederata* (B. & McD.), ♀. Snake Creek ca. 3 mi NW of Midway, Wasatch Co., Utah, 31 July 1971, D. C. Ferguson (USNM). (p. 95).
25. *Speranza confederata* (B. & McD.), ♀. Paralectotype. Glenwood Springs, Garfield Co., Colorado, 16–23 July (USNM). (p. 95).
26. *Speranza confederata* (B. & McD.), ♀. Underside. Major's Flat near Ephraim, 7,100', Sanpete Co., Utah, 22 July 1981, D. C. Ferguson (USNM). (p. 95).
27. *Speranza extemporata* (B. & McD.), ♂. NAS Miramar, San Diego Co., California, 18 June 1997, N. Bloomfield (USNM). (p. 96).
28. *Speranza extemporata* (B. & McD.), ♀. Anderson Springs, Lake Co., California, 26 June 1954, W. R. Bauer (USNM). (p. 96).
29. *Speranza coortaria* (Hulst), ♂. Tennessee Colony, Anderson Co., Texas, 1 May 1970, A. & M. E. Blanchard (USNM). (p. 99).
30. *Speranza coortaria* (Hulst), ♀. River Grove, Cook Co., Illinois, 14 July 1935, A. K. Wyatt (USNM). (p. 99).
31. *Speranza hesperata* Fgn., ♂. Holotype. Willow Creek Road near Ephraim, 7,500', Sanpete Co., Utah, 20 July 1981, D. C. Ferguson (USNM). (p. 101).
32. *Speranza hesperata* Fgn., ♀. Paratype. Great Basin Experiment Station near Ephraim, 8,850', Sanpete Co., Utah, 5 August 1981, D. C. Ferguson (USNM). (p. 101).
33. *Speranza prunosata* Fgn., ♂. Holotype. Road 50 (Beaver Creek Road), R78W T1N sec 15, 7,600', Grand Co., Colorado, 22 July 1987, T. S. Dickel (USNM). (p. 102).
34. *Speranza prunosata* Fgn., ♂. Paratype. Radium State Wildlife Area, County Road 11 & Blacktail Creek, R82W T1S sec 22, 7,040', Grand Co., Colorado, 19 July 1987, T. S. Dickel (USNM). (p. 102).
35. *Speranza bitactata* (Wlk.), ♂. Great Basin Experiment Station near Ephraim, 8,850', Sanpete Co., Utah, 21 July 1980, D. C. Ferguson (USNM). (p. 103).
36. *Speranza bitactata* (Wlk.), ♀. Great Basin Experiment Station near Ephraim, 8,850', Sanpete Co., Utah, 9 August 1981, D. C. Ferguson (USNM). (p. 103).
37. *Speranza bitactata* (Wlk.), ♂. Hill City, Pennington Co., South Dakota, 20 July 1964, D. C. Ferguson (USNM). (p. 103).
38. *Speranza bitactata* (Wlk.), ♀. Joe Dollar Gulch, Hill City, Pennington Co., Black Hills, South Dakota, 23 July 1964, D. C. Ferguson (USNM). (p. 103).
39. *Speranza wauaria* (L.), ♂. Berlin, Germany (USNM). (p. 107).
40. *Speranza wauaria* (L.), ♂. Berlin, Germany (USNM). (p. 107).
41. *Speranza subcessaria* (Wlk.), ♂. New Brighton, Beaver Co., Pennsylvania, 3 July 1905, H. D. Merrick (USNM). (p. 110).
42. *Speranza subcessaria* (Wlk.), ♀. New Brighton, Pennsylvania, 10 July 1905, H. D. Merrick (USNM). (p. 110).
43. *Speranza denticulodes* (Hulst), ♂. Fourmile Creek, 8,500', 4 mi N Buena Vista, Chaffee Co., Colorado, 14 July 1982, D. C. Ferguson (USNM). (p. 111).
44. *Speranza semivolata* (Dyar), ♀. Lebec, Kern Co., California, emerged 16 June 1937, J. A. Comstock (USNM). (p. 112).
45. *Speranza semivolata* (Dyar), ♀. Lebec, Kern Co., California, emerged 17 June 1937, J. A. Comstock (USNM). (p. 112).
46. *Speranza decorata* (Hulst), ♂. Poncha Springs, 7,000', Chaffee Co., Colorado, 6 August 1982, D. C. Ferguson (USNM). (p. 113).
47. *Speranza decorata* (Hulst), ♂. Zapata Ranch, 9,600', Alamosa Co., Colorado, 27 June 1982, D. C. Ferguson (USNM). (p. 113).
48. *Speranza decorata* (Hulst), ♂. Near Lee Vining, 6,700', Mono Co., California, 3 July 1987, D. C. Ferguson (USNM). (p. 113).
49. *Speranza decorata* (Hulst), ♀. Near Lee Vining, 6,700', Mono Co., California, 3 July 1987, D. C. Ferguson (USNM). (p. 113).
50. *Speranza colata colata* (Grt.), ♂. Walnut Canyon, 6,500', 6½ mi EESE Flagstaff, Coconino Co., Arizona, 2 July 1965, R. W. Poole (USNM). (p. 115).
51. *Speranza colata colata* (Grt.), ♀. Walnut Canyon, 6,500', 6½ mi EESE Flagstaff, Coconino Co., Arizona, 31 July 1965, R. W. Poole (USNM). (p. 115).
52. *Speranza colata colata* (Grt.), ♂. Granite Wells, San Bernardino Co., California, 24 May 1939, G. H. & J. L. Sperry (CNC). (p. 115).
53. *Speranza colata correllata* (Hulst), ♂. Angel Lake Road above Wells, 7,000', Elko Co., Nevada, 22 July 1971, D. C. Ferguson (USNM). (p. 116).
54. *Speranza colata correllata* (Hulst), ♀. Angel Lake Road above Wells, 7,000', Elko Co., Nevada, 15 July 1971, D. C. Ferguson (USNM). (p. 116).
55. *Speranza occiduaria* (Pack.), ♂. Rist Canyon, 9.3 mi NW of Bellvue, Larimer Co., Colorado, 1 August 1989, P. Opler (USNM). (p. 118).
56. *Speranza occiduaria* (Pack.), ♂. Road 50 (Beaver Creek Road), R78W T1N sec 15, 7,680', Grand Co., Colorado, 24 June 1988, T. S. Dickel (USNM). (p. 118).
57. *Speranza occiduaria* (Pack.), ♂. Calgary, Alberta, 20 July 1902, F. H. Wolley-Dod (USNM). (p. 118).
58. *Speranza occiduaria* (Pack.), ♂. Rising Sun, 4,500', Glacier National Park, Flathead Co., Montana, 29 July 1973, E. Jäckh (USNM). (p. 118).
59. *Speranza andersoni* (Swett), ♂. Baddeck, Cape Breton Island, Nova Scotia, 30 July 1970, D. C. Ferguson (USNM). (p. 122).
60. *Speranza andersoni* (Swett), ♂. Tatamagouche, Colchester Co., Nova Scotia, 5 July 1958, D. C. Ferguson (USNM). (p. 122).
61. *Speranza andersoni* (Swett), ♂. Paratype of *orientis*. Auburn, Kings Co., Nova Scotia, 30 June 1951, D. C. Ferguson (USNM). (p. 122).
62. *Speranza argillacearia* (Pack.), ♂. Phippsburg, Sagadahoc Co., Maine, 26 June 1936 (USNM). (p. 123).
63. *Speranza argillacearia* (Pack.), ♀. Augusta, Kennebec Co., Maine, 27 June 1942, A. E. Brower (USNM). (p. 123).
64. *Speranza evagaria* (Hulst), ♂. New Brighton, Beaver Co., Pennsylvania, 8 June 1902, H. D. Merrick (USNM). (p. 124).
65. *Speranza evagaria* (Hulst), ♂. Fort Niobrara, Cherry Co., Nebraska, 19 June 1983, D. C. Ferguson (USNM). (p. 124).
66. *Speranza evagaria* (Hulst), ♀. Fort Niobrara, Cherry Co., Nebraska, 21 June 1983, D. C. Ferguson (USNM). (p. 124).
67. *Speranza evagaria* (Hulst), ♀. Underside. Fort Niobrara, Cherry Co., Nebraska, 19 June 1983, D. C. Ferguson (USNM). (p. 124).



PLATE 3

Geometroidea

GEOMETRIDAE

figs. 1–67

NATURAL SIZE 1:1

1. *Speranza flavicaria* (Pack.), ♂. Fourmile Creek, 8,500', 4 mi N of Buena Vista, Chaffee Co., Colorado, 14 July 1982, D. C. Ferguson (USNM). (p. 125).
2. *Speranza flavicaria* (Pack.), ♀. Fourmile Creek, 8,500', 4 mi N of Buena Vista, Chaffee Co., Colorado, 14 July 1982, D. C. Ferguson (USNM). (p. 125).
3. *Speranza helena* (Cass.), ♂. Stockton, Tooele Co., Utah, 21 July 1913, T. Spalding (USNM). (p. 127).
4. *Speranza helena* (Cass.), ♂. Spring Creek, Baker Co., Oregon, 29 June 1960, J. H. Baker (USNM). (p. 127).
5. *Speranza helena* (Cass.), ♀. Big Timber Creek, 7 mi N Big Timber, Sweetgrass Co., Montana, 27 July 1966, D. C. Ferguson (USNM). (p. 127).
6. *Speranza ribearia* (Fitch), ♀. Ottawa, Ontario, emerged 2 July 1903 (USNM). (p. 127).
7. *Speranza ribearia* (Fitch), ♀. Cranberry Glades Campground, Monongahela National Forest, Pocahontas Co., West Virginia, 1 July 1967, R. Heitzman (USNM). (p. 127).
8. *Speranza ribearia* (Fitch), ♂. Lethbridge, Alberta, 19 July 1922, H. L. Seamans (CNC). (p. 127).
9. *Speranza ribearia* (Fitch), ♀. Regina, Saskatchewan, 24 July 1903, Willing (USNM). (p. 127).
10. *Speranza simplex* (Dyar), ♂. The Garden Wall, 7,000', Glacier National Park, Flathead Co., Montana, 8 August 1973, E. Jäckh (USNM). (p. 130).
11. *Speranza simplex* (Dyar), ♀. The Garden Wall, 7,000', Glacier National Park, Flathead Co., Montana, 30 August 1973, E. Jäckh (USNM). (p. 130).
12. *Speranza lorquinaria* (Gn.), ♂. Great Basin Experiment Station near Ephraim, 8,850' Sanpete Co., Utah, 1 August 1981, D. C. Ferguson (USNM). (p. 131).
13. *Speranza lorquinaria* (Gn.), ♀. Major's Flat near Ephraim, 7,100' Sanpete Co., Utah, 28 July 1980, D. C. Ferguson (USNM). (p. 131).
14. *Speranza lorquinaria* (Gn.), ♀. Little North Fork Santiam River, 5 mi W Mill City, Hwy 22, Marion Co., Oregon, 16 July 1960, C. W. Nelson (USNM). (p. 131).
15. *Speranza lorquinaria* (Gn.), ♀. Siskiyou National Forest near Kerby, Josephine Co., Oregon, 18 July 1990, D. C. Ferguson (USNM). (p. 131).
16. *Speranza loricaria* (Evers.), ♂. Great Basin Experiment Station near Ephraim, 8,850', Sanpete Co., Utah, 31 July 1981, D. C. Ferguson (USNM). (p. 134).
17. *Speranza loricaria* (Evers.), ♂. Caroquet, New Brunswick, 10 July 1950, D. C. Ferguson (USNM). (p. 134).

18. *Speranza plumosata* (B. & McD.), ♂. Seton Creek, Lillooet, British Columbia, 4 July 1991, D. C. Ferguson (USNM). (p. 136).
19. *Speranza plumosata* (B. & McD.), ♀. Seton Creek, Lillooet, British Columbia, 3 July 1991, D. C. Ferguson (USNM). (p. 136).
20. *Speranza plumosata* (B. & McD.), ♂. Tucson, Pima Co., Arizona (USNM). (p. 136).
21. *Speranza plumosata* (B. & McD.), ♀. Palmerlee, Cochise Co., Arizona (USNM). (p. 136).
22. *Speranza pustularia* (Gn.), ♂. Halifax, Nova Scotia, 2 August 1973, D. C. Ferguson (USNM). (p. 138).
23. *Speranza pustularia* (Gn.), ♀. Near Dillsburg, York Co., Pennsylvania, 19 June 1969, George Werschkow (USNM). (p. 138).
24. *Speranza pustularia* (Gn.), ♀. Balsam, 3,200', Jackson Co., North Carolina, 17 July 1974 D. C. Ferguson (USNM). (p. 138).
25. *Speranza pustularia* (Gn.), ♂. Balsam, 3,200', Jackson Co., North Carolina, 20 June 1974, D. C. Ferguson (USNM). (p. 138).
26. *Speranza pustularia* (Gn.), ♀. Tennessee Colony, Anderson Co., Texas, 2 June 1965, A. & M. E. Blanchard (USNM). (p. 138).
27. *Speranza pustularia* (Gn.), ♀. University Reserve, Welaka, Putnam Co., Florida, 18 April 1973, D. C. Ferguson (USNM). (p. 138).
28. *Speranza quadrilinearia* (Pack.), ♂. 4 mi SW Buena Vista, 8,700', Chaffee Co., Colorado, 10 July 1982, D. C. Ferguson (USNM). (p. 140).
29. *Speranza quadrilinearia* (Pack.), ♀. 4 mi SW Buena Vista, 8,700', Chaffee Co., Colorado, 10 July 1982, D. C. Ferguson (USNM). (p. 140).
30. *Speranza quadrilinearia* (Pack.), ♂. Green Ridge Road 1120, Jefferson Co., Oregon, 22 June 1995, D. C. Ferguson (USNM). (p. 140).
31. *Speranza quadrilinearia* (Pack.), ♀. Metolius, Green Ridge Road 1490, Jefferson Co., Oregon, 26 June 1995, D. C. Ferguson (USNM). (p. 140).
32. *Speranza trilinearia* (Grossb.), ♂. Huachuca Mountains, Cochise Co., Arizona (USNM). (p. 143).
33. *Speranza trilinearia* (Grossb.), ♀. Mohave Co., Arizona, 8–15 June (USNM). (p. 143).
34. *Speranza guenearia* (Pack.), ♂. Illinois River, Siskiyou National Forest near Kerby, Josephine Co., Oregon, 22 July 1990, D. C. Ferguson (USNM). (p. 145).
35. *Speranza guenearia* (Pack.), ♀. Illinois River, Siskiyou National Forest near Kerby, Josephine Co., Oregon, 22 July 1990, D. C. Ferguson (USNM). (p. 145).
36. *Speranza austrinata* Fgn., ♂. Paratype. NAS Miramar, San Diego Co., California, 10 April 1997, N. Bloomfield (USNM). (p. 146).
37. *Speranza austrinata* Fgn., ♀. Holotype. NAS Miramar, San Diego Co., California, 20 May 1943, S. S. Nicolay (USNM). (p. 146).
38. *Speranza deceptrix* (Dyar), ♂. Guadalupe Canyon, 4,250', Peloncillo Mountains, Cochise Co., Arizona, 19 June 1976, J. & S. Werner (USNM). (p. 148).
39. *Speranza deceptrix* (Dyar), ♀. 1230 East Placita Del Cervato, Tucson, Pima Co., Arizona, 22 April 1990, R. Weilgus (USNM). (p. 148).
40. *Speranza graphidaria* (Hulst), ♀. Brownsville, Cameron Co., Texas, 5 December 1975, A. & M. E. Blanchard (USNM). (p. 149).
41. *Speranza graphidaria* (Hulst), ♀. Welder Wildlife Refuge, Sinton, San Patricio Co., Texas, 7 October 1963, A. & M. E. Blanchard (USNM). (p. 149).
42. *Speranza schatzeata* (Cass.), ♂. Cherry Canyon, 5,063', Guadalupe Mountains, Culberson Co., Texas, 24 May 1973, D. C. Ferguson (USNM). (p. 152).
43. *Speranza schatzeata* (Cass.), ♀. Cherry Canyon, 5,063', Guadalupe Mountains, Culberson Co., Texas, 24 May 1973, D. C. Ferguson (USNM). (p. 152).
44. *Speranza benigna* (Hulst), ♂. Mohave Co., Arizona, 8–15 June (USNM). (p. 153).
45. *Speranza benigna* (Hulst), ♀. Mohave Co., Arizona, 8–15 October (USNM). (p. 153).
46. *Speranza perornata* (B. & McD.), ♂. Redington, Pima Co., Arizona (USNM). (p. 154).
47. *Speranza grossbecki* (B. & McD.), ♂. Santa Ana Wildlife Refuge, Hidalgo Co., Texas, 20 October 1970, A. & M. E. Blanchard (USNM). (p. 156).
48. *Speranza grossbecki* (B. & McD.), ♀. Cotype. Brownsville, Cameron Co., Texas (USNM). (p. 156).
49. *Speranza grossbecki* (B. & McD.), ♀. Cotype. Brownsville, Cameron Co., Texas (USNM). (p. 156).
50. *Speranza saphenata* Fgn., ♂. Holotype. Green Gulch, Big Bend National Park, Texas, 12 October 1969, A. & M. E. Blanchard (USNM). (p. 157).
51. *Speranza saphenata* Fgn., ♀. Paratype. Smith Canyon, 5,750', Guadalupe Mountains, Culberson Co., Texas, 22 May 1973, D. C. Ferguson (USNM). (p. 157).
52. *Speranza saphenata* Fgn., ♂. Paratype. Sierra Diablo Wildlife Management Area, 6,000', Culberson Co., Texas, 31 March 1970, A. & M. E. Blanchard (USNM). (p. 157).
53. *Speranza simplicata* (B. & McD.), ♂. Sierra Diablo Wildlife Management Area, 6,000', Culberson Co., Texas, 31 March 1970, A. & M. E. Blanchard (USNM). (p. 160).
54. *Speranza simplicata* (B. & McD.), ♂. Davis Mountains State Park, Jeff Davis Co., Texas, 29 June 1985, E. C. Knudson (USNM). (p. 160).
55. *Speranza simplicata* (B. & McD.), ♂. Paradise, Cochise Co., Arizona, 24–30 April (USNM). (p. 160).
56. *Speranza pallipennata* (B. & McD.), ♂. Ash Canyon, 5,100', Huachuca Mountains, Cochise Co., Arizona, 9 August 1991, D. C. Ferguson (USNM). (p. 161).
57. *Speranza pallipennata* (B. & McD.), ♀. 4 mi W Portal, 5,300', Chiricahua Mountains, Cochise Co., Arizona, 3–6 August 1964, D. R. Davis (USNM). (p. 161).
58. *Speranza pallipennata* (B. & McD.), ♂. Oak Spring, Big Bend National Park, Brewster Co., Texas, 8 May 1972, A. & M. E. Blanchard (USNM). (p. 161).
59. *Speranza pallipennata* (B. & McD.), ♂. Government Spring, Big Bend National Park, Brewster Co., Texas, 10 May 1972, A. & M. E. Blanchard (USNM). (p. 161).
60. *Epelis truncataria* (Wlk.), ♂. Bethany Bog, New Haven Co., Connecticut, 13 May 1968, D. C. Ferguson (USNM). (p. 162).
61. *Epelis truncataria* (Wlk.), ♀. Hardy Work Center, T3N R1E S30, Lawrence Co., South Dakota, 19 June 1965, R. W. Hodges (USNM). (p. 162).
62. *Epelis truncataria* (Wlk.), ♀. Bethany Bog, New Haven Co., Connecticut, 13 May 1968, D. C. Ferguson (USNM). (p. 162).
63. *Epelis truncataria* (Wlk.), ♀. Bog E of Big Indian Lake, Halifax Watershed, Nova Scotia, 25 May 1959, D. C. Ferguson (USNM). (p. 162).
64. *Epelis truncataria* (Wlk.), ♂. Underside. Augusta, Kennebec Co., Maine, 21 June 1964, A. E. Brower (USNM). (p. 162).
65. *Psamatodes pallidata* (Warr.), ♀. Santa Ana Wildlife Refuge, Hidalgo Co., Texas, 9 March 1977, A. & M. E. Blanchard (USNM). (p. 167).
66. *Psamatodes pallidata* (Warr.), ♀. Santa Ana Wildlife Refuge, Hidalgo Co., Texas, 18 November 1966, A. & M. E. Blanchard (USNM). (p. 167).
67. *Psamatodes pallidata* (Warr.), ♀. Underside. Brownsville, Cameron Co., Texas, 14 October 1928, F. H. Benjamin (USNM). (p. 167).

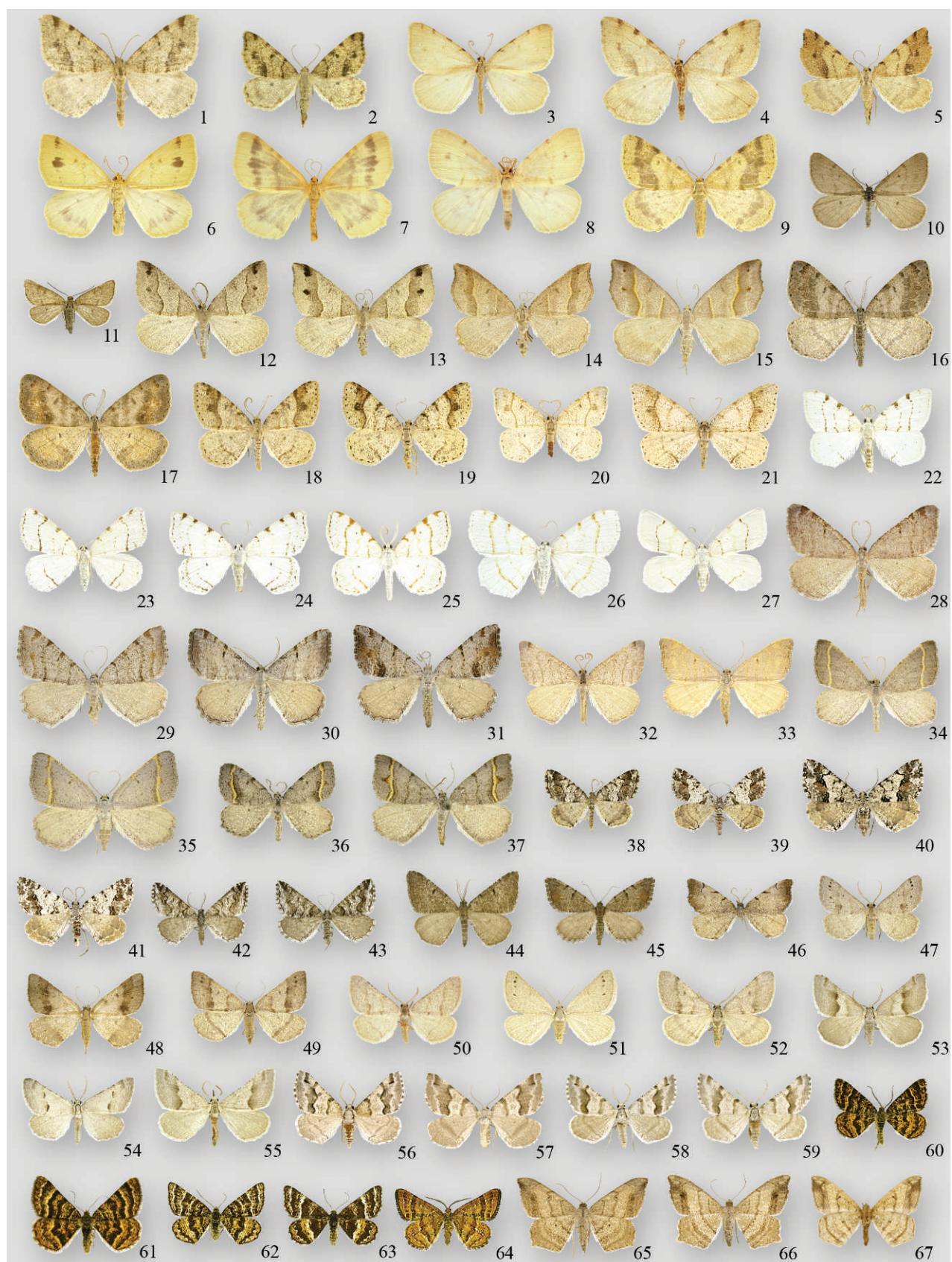


PLATE 4

Geometroidea

GEOMETRIDAE

figs. 1–61

NATURAL SIZE 1:1

1. *Psamatodes atrimaculata* (B. & McD.), ♀. Rio Grande State Park, Bentsen, Hidalgo Co., Texas, 28 June 1988, R. L. Heitzman (USNM). (p. 168).
2. *Psamatodes atrimaculata* (B. & McD.), ♂. Rio Grande State Park, Bentsen, Hidalgo Co., Texas, 28 June 1988, R. L. Heitzman (USNM). (p. 168).
3. *Psamatodes atrimaculata* (B. & McD.), ♂. Underside. Rio Grande State Park, Bentsen, Hidalgo Co., Texas, 28 June 1988, R. L. Heitzman (USNM). (p. 168).
4. *Psamatodes rectilineata* (Warr.), ♀. Loggerhead Key, 1.9 mi S of Cudjoe Key, Monroe Co., Florida, 15–17 February 1973, R. Thorington, J. Layne, P. Cone (USNM). (p. 169).
5. *Psamatodes rectilineata* (Warr.), ♀. Loggerhead Key, 1.9 mi S of Cudjoe Key, Monroe Co., Florida, 15–17 February 1973, R. Thorington, J. Layne, P. Cone (USNM). (p. 169).
6. *Psamatodes abydata* (Gn.), ♀. Padre Island National Seashore, Kenedy Co., Texas, 17 May 1976, A. & M. E. Blanchard (USNM). (p. 171).
7. *Psamatodes abydata* (Gn.), ♂. Alpine, Brewster Co., Texas, 13 September 1963 A. & M. E. Blanchard (USNM). (p. 171).
8. *Psamatodes abydata* (Gn.), ♂. Devil's Den State Park, Washington Co., Arkansas, 11 July 1966, R. W. Hodges (USNM). (p. 171).
9. *Psamatodes abydata* (Gn.), ♂. Underside. Santa Ana Wildlife Refuge, Hidalgo Co., Texas, 21 February 1965, A. & M. E. Blanchard (USNM). (p. 171).
10. *Psamatodes trientata* (H.-S.), ♂. Homestead, Miami-Dade Co., Florida, 15 May 1978, D. C. Ferguson (USNM). (p. 175).
11. *Psamatodes trientata* (H.-S.), ♀. Kerrville, Kerr Co., Texas (USNM). (p. 175).
12. *Psamatodes trientata* (H.-S.), ♀. Underside. Homestead, Miami-Dade Co., Florida, 14 May 1978, D. C. Ferguson (USNM). (p. 175).
13. *Psamatodes everiata errata* (McD.), ♂. Baboquivari Mountains, Pima Co., Arizona, 26 April 1938, G. H. & J. L. Sperry (CNC). (p. 177).
14. *Psamatodes everiata errata* (McD.), ♂. Baboquivari Mountains, Pima Co., Arizona, 15–30 June 1923, O. C. Poling (CNC). (p. 177).

15. *Psamatodes everiata errata* (McD.), ♂. 5131 Bannock St., Pueblo Del Sol, Huachuca Mountains, Cochise Co., Arizona, 29 March 1988, R. S. Wielgus (USNM). (p. 177).
16. *Psamatodes everiata errata* (McD.), ♂. Lower Garden Canyon, 5,100', Fort Huachuca, Cochise Co., Arizona, 5 October 1994, D. C. Ferguson (USNM). (p. 177).
17. *Psamatodes everiata errata* (McD.), ♀. Underside. Lower Garden Canyon, 5,100', Fort Huachuca, Cochise Co., Arizona, 5 October 1994, D. C. Ferguson (USNM). (p. 177).
18. *Macaria notata notata* (L.), ♂. Waverley, Nova Scotia, 12 July 1948, D. C. Ferguson (USNM). (p. 182).
19. *Macaria notata notata* (L.), ♀. Gisborne Mountain, 5,000', Bonner Co., Idaho, 26 June 1979, D. C. Ferguson (USNM). (p. 182).
20. *Macaria notata notata* (L.), ♂. Underside. St. Paul Island, Cabot Strait, Nova Scotia, 25 July 1985, D. C. Ferguson (USNM). (p. 182).
21. *Macaria notata appalachiata* Fgn., ♂. Holotype. Waterlock Knob, 5,800', Jackson Co., North Carolina, 16 July 1974, D. C. Ferguson (USNM). (p. 182).
22. *Macaria notata appalachiata* Fgn., ♀. Paratype. Waterlock Knob, 5,800', Jackson Co., North Carolina, 17 July 1974, D. C. Ferguson (USNM). (p. 182).
23. *Macaria notata appalachiata* Fgn., ♂. Underside. Richland Balsam Mt., 6,000', Jackson-Haywood Co., North Carolina, 3 July 1967, D. C. Ferguson (USNM). (p. 182).
24. *Macaria aemulataria* Wlk., ♂. National Agriculture Research Center, Beltsville, Prince George's Co., Maryland, 17 May 1971, D. C. Ferguson (USNM). (p. 183).
25. *Macaria aemulataria* Wlk., ♀. Underside. Colesville, Montgomery Co., Maryland, 2 July 1975, D. C. Ferguson (USNM). (p. 183).
26. *Macaria aemulataria* Wlk., ♀. Clear Creek Canyon, Jefferson Co., Colorado, 17 May 1927 (CNC). (p. 183).
27. *Macaria juglandata* Fgn., ♂. Holotype. 90027 Carnavon Way, Los Angeles, Los Angeles Co., California, 29 March 1989, F. P. Sala (USNM). (p. 185).
28. *Macaria juglandata* Fgn., ♀. Paratype. Benedict Canyon, 5 mi N Beverly Hills, Los Angeles Co., California, 24 August 1956, N. McFarland (USNM). (p. 185).
29. *Macaria juglandata* Fgn., ♀. Paratype. Underside. Benedict Canyon, 5 mi N Beverly Hills, Los Angeles Co., California, 17 August 1957, N. McFarland (USNM). (p. 185).
30. *Macaria promiscuata* (Fgn.), ♀. Town Bluff Dam B, Tyler Co., Texas, 15 September 1975, A. & M. E. Blanchard (USNM). (p. 186).
31. *Macaria promiscuata* (Fgn.), ♀. Alexandria (Rose Hill), Fairfax Co., Virginia, 20 July 1976, P. A. Opler (USNM). (p. 186).
32. *Macaria promiscuata* (Fgn.), ♂. Underside. Lake Tenkiller, 2 mi NW Blackgum, Sequoyah Co., Oklahoma, 14–16 July 1983, D. & M. Davis 187(USNM). (p. 186).
33. *Macaria solisata* Fgn., ♂. Holotype. Rancho del Cielo, 3,500', 6 km NNW Gomez Farias, Tamaulipas, Mexico, July 1982, M. A. Solis (USNM). (p. 188).
34. *Macaria solisata* Fgn., ♀. Paratype. Underside. Rancho del Cielo, 3,500', 6 km NNW Gomez Farias, Tamaulipas, Mexico, July 1982, M. A. Solis (USNM). (p. 188).
35. *Macaria carpo* (Druce), ♂. Homestead, Miami-Dade Co., Florida, 18 November 1976, D. C. Ferguson (USNM). (p. 189).
36. *Macaria carpo* (Druce), ♀. Homestead, Miami-Dade Co., Florida, 19 November 1976, D. C. Ferguson (USNM). (p. 189).
37. *Macaria carpo* (Druce), ♀. Homestead, Miami-Dade Co., Florida, 19 November 1976, D. C. Ferguson (USNM). (p. 189).
38. *Macaria carpo* (Druce), ♀. Underside. Homestead, Miami-Dade Co., Florida, 18 November 1976, D. C. Ferguson (USNM). (p. 189).
39. *Macaria aequiferaria* Wlk., ♂. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 6 April 1977, D. C. Ferguson 191(USNM). (p. 192).
40. *Macaria aequiferaria* Wlk., ♀. University of Florida Preserve, Welaka, Putnam Co., Florida, 25 March 1987, D. C. Ferguson (USNM). (p. 192).
41. *Macaria aequiferaria* Wlk., ♀. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 2 June 1978, D. C. Ferguson (USNM). (p. 192).
42. *Macaria aequiferaria* Wlk., ♀. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 2 May 1972, D. C. Ferguson (USNM). (p. 192).
43. *Macaria aequiferaria* Wlk., ♀. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 19 August 1968, D. C. Ferguson (USNM). (p. 192).
44. *Macaria aequiferaria* Wlk., ♀. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 22 August 1968, D. C. Ferguson (USNM). (p. 192).
45. *Macaria aequiferaria* Wlk., ♀. Underside. University of Florida Preserve, Welaka, Putnam Co., Florida, 16 May 1987, D. C. Ferguson (USNM). (p. 192).
46. *Macaria bisignata* (Wlk.), ♂. Troutdale, 36° 43' N 81° 28' W, 3,300', Grayson Co., Virginia, 16 June 1992, D. C. Ferguson (USNM). (p. 194).
47. *Macaria bisignata* (Wlk.), ♀. National Agriculture Research Center, Beltsville, Prince George's Co., Maryland, 23 October 1986, D. C. Ferguson (USNM). (p. 194).
48. *Macaria bisignata* (Wlk.), ♂. Water Rock Knob, 5,800', Jackson Co., North Carolina, 16 July 1974, D. C. Ferguson (USNM). (p. 194).
49. *Macaria bisignata* (Wlk.), ♀. Henson Creek, Oxon Hill, Prince George's Co., Maryland, 25 August 1979, D. R. Davis (USNM). (p. 194).
50. *Macaria bisignata* (Wlk.), ♀. Underside. Balsam, 3,200', Jackson Co., North Carolina, 20 June 1974, D. C. Ferguson (USNM). (p. 194).
51. *Macaria masquerata* Fgn., ♂. Holotype. Purcell's Cove, Halifax Co., Nova Scotia, 12 July 1962, D. C. Ferguson (CNC). (p. 196).
52. *Macaria masquerata* Fgn., ♀. Paratype. Caraquet, New Brunswick, 10 July 1950, D. C. Ferguson (USNM). (p. 196).
53. *Macaria masquerata* Fgn., ♀. Paratype. Underside. Purcell's Cove, Halifax Co., Nova Scotia, 8 July 1956, D. C. Ferguson (USNM). (p. 196).
54. *Macaria bicolorata* (F.), ♂. Beltsville, Prince George's Co., Maryland, 2 October 1986, D. C. Ferguson (USNM). (p. 198).
55. *Macaria bicolorata* (F.), ♂. Colesville, Montgomery Co., Maryland, 7 September 1980, D. C. Ferguson (USNM). (p. 198).
56. *Macaria bicolorata* (F.), ♂. Underside. Beltsville, Prince George's Co., Maryland, 30 September 1986, D. C. Ferguson (USNM). (p. 198).
57. *Macaria adonis* B. & McD., ♂. Priest River Experimental Forest, 2,500', Bonner Co., Idaho, 21 June 1979, D. C. Ferguson (USNM). (p. 199).
58. *Macaria adonis* B. & McD., ♂. Spring Creek, 4,000', Blue Mountains, Baker Co., Oregon, 30 May 1970, J. H. Baker (USNM). (p. 199).
59. *Macaria adonis* B. & McD., ♂. South Lake Tahoe, 6,250', El Dorado Co., California, emerged 20 April 1988, D. C. Ferguson (USNM). (p. 199).
60. *Macaria adonis* B. & McD., ♂. Ward Creek, 2 mi S Tahoe City, Placer Co., California, 26 July 1969, N. Westerland (USNM). (p. 199).
61. *Macaria adonis* B. & McD., ♂. Underside. Priest River Experimental Forest, 2,500', Bonner Co., Idaho, 28 June 1979, D. C. Ferguson (USNM). (p. 199).

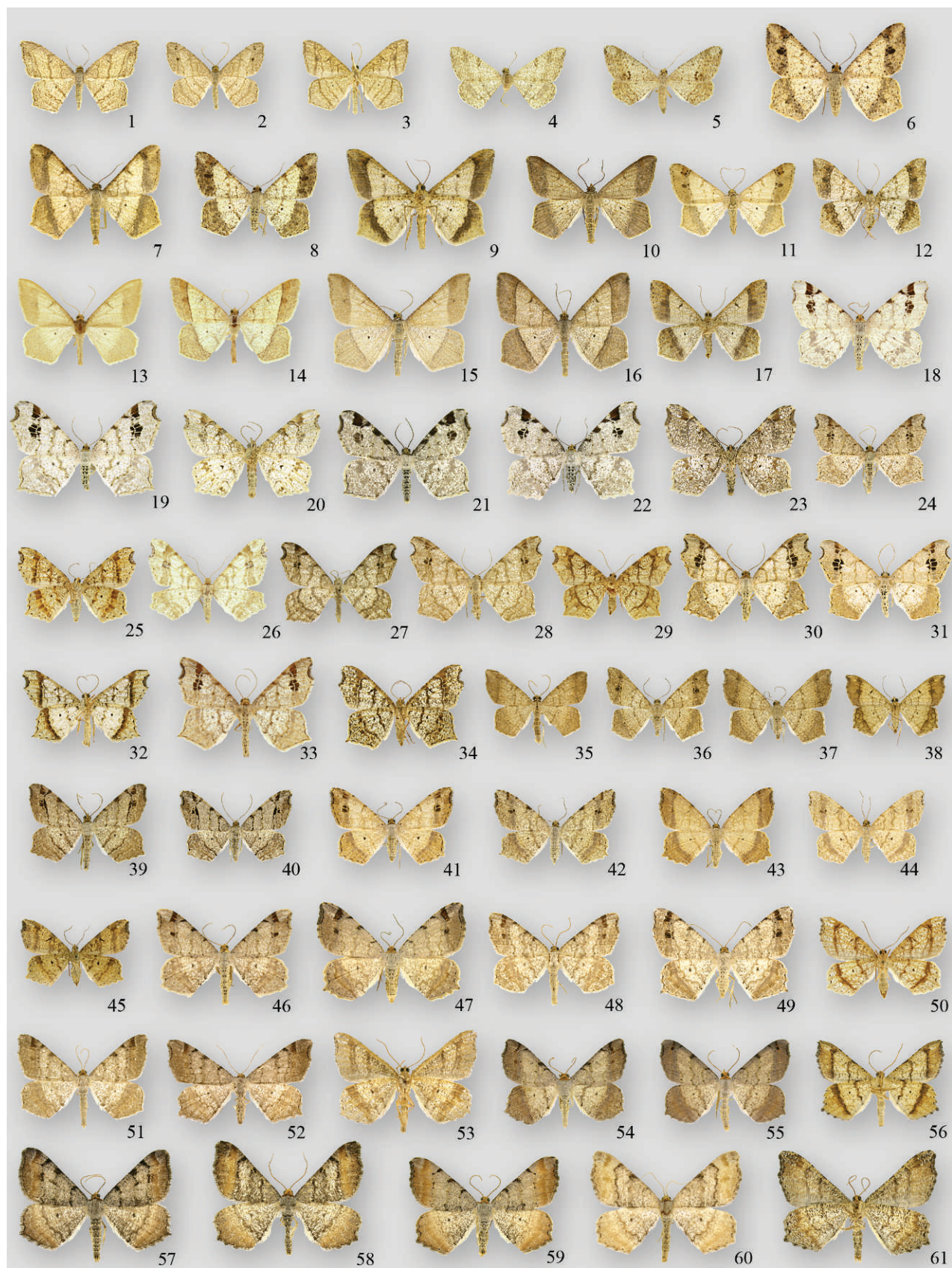


PLATE 5

Geometroidea

GEOMETRIDAE

figs. 1–64

NATURAL SIZE 1:1

1. *Macaria ponderosae* Fgn., ♂. Holotype. Fort Niobrara, Cherry Co., Nebraska, 21 June 1983, D. C. Ferguson (USNM). (p. 201).
2. *Macaria ponderosae* Fgn., ♀. Paratype. Fort Niobrara, Cherry Co., Nebraska, 19 June 1983, D. C. Ferguson (USNM). (p. 201).
3. *Macaria ponderosae* Fgn., ♂. Paratype. Underside. Fort Niobrara, Cherry Co., Nebraska, 21 June 1983, D. C. Ferguson (USNM). (p. 201).
4. *Macaria transitaria transitaria* Wlk., ♂. Charleston, Charleston Co., South Carolina, 28 June 1982, D. C. Ferguson (USNM). (p. 203).
5. *Macaria transitaria transitaria* Wlk., ♀. Charleston, Charleston Co., South Carolina, 28 June 1982, D. C. Ferguson (USNM). (p. 203).
6. *Macaria transitaria transitaria* Wlk., ♂. Underside. Charleston, Charleston Co., South Carolina, 5 July 1982, D. C. Ferguson (USNM). (p. 203).
7. *Macaria transitaria resinosae* Fgn., ♂. Holotype. Lake Kejimkujik, Queens Co., Nova Scotia, 20 June 1960, D. C. Ferguson (CNC). (p. 203).
8. *Macaria transitaria resinosae* Fgn., ♀. Paratype. Lake Kejimkujik, Queens Co., Nova Scotia, 18 June 1957, D. C. Ferguson (CNC). (p. 203).
9. *Macaria transitaria resinosae* Fgn., ♀. Paratype. Underside. Bar Harbor, Hancock Co., Maine, 21 July 1938, A. E. Brower (USNM). (p. 203).
10. *Macaria distribuaria* (Hbn.), ♂. Palatka, Putnam Co., Florida, 21 January 1990, H. D. Baggett (USNM). (p. 204).
11. *Macaria distribuaria* (Hbn.), ♀. University Conservation Reserve, We-laka, Putnam Co., Florida, 18 June 1962, D. C. Ferguson (USNM). (p. 204).
12. *Macaria distribuaria* (Hbn.), ♂. Underside. Homestead, Miami-Dade Co., Florida, 16 May 1978, D. C. Ferguson (USNM). (p. 204).
13. *Macaria sanfordi* (Rindge), ♂. Archbold Biological Station, Lake Placid, Highlands Co., Florida, emerged 30 April 1985, D. C. Ferguson (USNM). (p. 206).
14. *Macaria sanfordi* (Rindge), ♂. Underside. Archbold Biological Sta-

- tion, Lake Placid, Highlands Co., Florida, emerged 28 April 1985, D. C. Ferguson (USNM). (p. 206).
15. *Macaria sanfordi* (Rindge), ♂. Welaka, University Preserve, Putnam Co., Florida, 7 April 1972, D. C. Ferguson (USNM). (p. 206).
 16. *Macaria minorata* Pack., ♂. Colesville, Montgomery Co., Maryland, 5 October 1989, D. C. Ferguson (USNM). (p. 207).
 17. *Macaria minorata* Pack., ♀. Armdale, Halifax Co., Nova Scotia, 9 August 1973, D. C. Ferguson (USNM). (p. 207).
 18. *Macaria minorata* Pack., ♂. Underside. Troutdale, 3,300', Grayson Co., Virginia, 36° 43' N, 81° 28' W, 17 June 1992, D. C. Ferguson (USNM). (p. 207).
 19. *Macaria sexmaculata sexmaculata* Pack., ♀. Beckley Bog near Norfolk, Litchfield Co., Connecticut, 21 June 1965, D. C. Ferguson (USNM). (p. 211).
 20. *Macaria sexmaculata sexmaculata* Pack., ♀. Bethierville, Ontario, 30 July 1943, Forest Insect and Disease Survey 1943 (USNM). (p. 211).
 21. *Macaria sexmaculata sexmaculata* Pack., ♀. Underside. Bog E of Big Indian Lake, Halifax Watershed, Halifax Co., Nova Scotia, 27 June 1963, D. C. Ferguson (USNM). (p. 211).
 22. *Macaria sexmaculata incolorata* Dyar, ♂. Gisborne Mountain, 5,000', Bonner Co., Idaho, 27 June 1979, D. C. Ferguson (USNM). (p. 212).
 23. *Macaria sexmaculata incolorata* Dyar, ♀. Gisborne Mountain, 5,000', Bonner Co., Idaho, 24 June 1979, D. C. Ferguson (USNM). (p. 212).
 24. *Macaria sexmaculata incolorata* Dyar, ♂. Underside. Priest River Experimental Forest, 2,500', Bonner Co., Idaho, 17 June 1979, D. C. Ferguson (USNM). (p. 212).
 25. *Macaria submarmorata* Wlk., ♂. Doyle's, Codroy Valley, Newfoundland, 13 July 1959, D. C. Ferguson (USNM). (p. 213).
 26. *Macaria submarmorata* Wlk., ♀. Doyle's, Codroy Valley, Newfoundland, 4 August 1962, D. C. Ferguson (USNM). (p. 213).
 27. *Macaria submarmorata* Wlk., ♀. Underside. Bog E of Big Indian Lake, Halifax Watershed, Halifax Co., Nova Scotia, 10 July 1968, D. C. Ferguson (USNM). (p. 213).
 28. *Macaria marmorata* (Fgn.), ♂. Paratype. Debert, Colchester Co., Nova Scotia, 19 July 1961, D. C. Ferguson (USNM). (p. 214).
 29. *Macaria marmorata* (Fgn.), ♂. Newport, Lincoln Co., Oregon, 8 July 1968, Brown & Goeden (USNM). (p. 214).
 30. *Macaria marmorata* (Fgn.), ♀. Underside. Gold River, British Columbia, emerged 18 March 1952, Forest Insect Survey 1951 (USNM). (p. 214).
 31. *Macaria signaria* (Hbn.), ♂. St. Basile, New Brunswick, 2 June 1982, H. Hensel (CNC). (p. 216).
 32. *Macaria signaria* (Hbn.), ♀. Upper Spring Creek near Hill City, Black Hills, Pennington Co., South Dakota, 27 June 1964, D. C. Ferguson (USNM). (p. 216).
 33. *Macaria signaria* (Hbn.), ♀. South Milford, Nova Scotia, 29 June 1934, J. McDunnough (CNC). (p. 216).
 34. *Macaria signaria* (Hbn.), ♀. Wellington, Vancouver Island, British Columbia, 3 August 1959, R. Guppy (CNC). (p. 216).
 35. *Macaria signaria* (Hbn.), ♀. Near Clingman's Dome, 6,000', Great Smoky Mountains National Park, Sevier Co., Tennessee, 12 October 1986, D. C. Ferguson (USNM). (p. 216).
 36. *Macaria signaria* (Hbn.), ♀. Underside. Near Clingman's Dome, 6,000', Great Smoky Mountains National Park, Sevier Co., Tennessee, 7 October 1986, D. C. Ferguson (USNM). (p. 216).
 37. *Macaria unipunctaria* (Wgt.), ♂. Gisborne Mountain, 5,000', Bonner Co., Idaho, 27 June 1979, D. C. Ferguson (USNM). (p. 219).
 38. *Macaria unipunctaria* (Wgt.), ♀. Telluride, 8,745', San Miguel Co., Colorado, 7 July 1977, D. C. Ferguson (USNM). (p. 219).
 39. *Macaria unipunctaria* (Wgt.), ♀. Half Moon Park, 6,500', Big Timber Canyon, Crazy Mountains, Sweetgrass Co., Montana, 6 July 1966, D. C. Ferguson (USNM). (p. 219).
 40. *Macaria unipunctaria* (Wgt.), ♀. Summerhaven, 7,800', Santa Catalina Mountains, Pima Co., Arizona, 27 July 1998, D. C. Ferguson (USNM). (p. 219).
 41. *Macaria unipunctaria* (Wgt.), ♀. Deer Park Springs, California, 24–30 June (USNM). (p. 219).
 42. *Macaria unipunctaria* (Wgt.), ♀. Underside. Summerhaven, 7,800', Santa Catalina Mountains, Pima Co., Arizona, 27 July 1978, D. C. Ferguson (USNM). (p. 219).
 43. *Macaria pinistrobata* (Fgn.), ♂. Armdale, Halifax Co., Nova Scotia, 11 July 1972, D. C. Ferguson (USNM). (p. 221).
 44. *Macaria pinistrobata* (Fgn.), ♀. Paratype. Armdale, Halifax Co., Nova Scotia, 30 June 1960, D. C. Ferguson (USNM). (p. 221).
 45. *Macaria pinistrobata* (Fgn.), ♂. Purcell's Cove, Halifax Co., Nova Scotia, 21 June 1976, D. C. Ferguson (USNM). (p. 221).
 46. *Macaria pinistrobata* (Fgn.), ♂. Underside. Armdale, Halifax Co., Nova Scotia, 11 July 1972, D. C. Ferguson (USNM). (p. 221).
 47. *Macaria fissinotata* (Wlk.), ♂. Catherine Furnace Area, Page Co., Virginia, 20 June 1980, J. M. Coffman (USNM). (p. 223).
 48. *Macaria fissinotata* (Wlk.), ♂. Ringwood Reserve near Dryden, Tompkins Co., New York, 21 May 1965, D. C. Ferguson (USNM). (p. 223).
 49. *Macaria fissinotata* (Wlk.), ♀. Colesville, Montgomery Co., Maryland, 9 June 1974, D. C. Ferguson (USNM). (p. 223).
 50. *Macaria fissinotata* (Wlk.), ♀. Underside. Colesville, Montgomery Co., Maryland, 19 April 1977, D. C. Ferguson (USNM). (p. 223).
 51. *Macaria oweni* (Swett), ♂. Near Big Indian Lake, Halifax Watershed, Halifax Co., Nova Scotia, 24 June 1963, D. C. Ferguson (USNM). (p. 224).
 52. *Macaria oweni* (Swett), ♀. Near Big Indian Lake, Halifax Watershed, Halifax Co., Nova Scotia, 10 July 1968, D. C. Ferguson (USNM). (p. 224).
 53. *Macaria oweni* (Swett), ♀. Underside. Near Big Indian Lake, Halifax Watershed, Halifax Co., Nova Scotia, 24 June 1963, D. C. Ferguson (USNM). (p. 224).
 54. *Macaria granitata* Gn., ♂. Beltsville, Prince George's Co., Maryland, 1 September 1973, D. C. Ferguson (USNM). (p. 225).
 55. *Macaria granitata* Gn., ♂. Colesville, Montgomery Co., Maryland, 25 August 1978, D. C. Ferguson (USNM). (p. 225).
 56. *Macaria granitata* Gn., ♀. South Haven, 38° 57' 55" N, 76° 35' 26" W, Anne Arundel Co., Maryland, 31 May 1987, H. G. Stevenson (USNM). (p. 225).
 57. *Macaria granitata* Gn., ♀. Underside. Colesville, Montgomery Co., Maryland, 23 April 1981, D. C. Ferguson (USNM). (p. 225).
 58. *Macaria multilineata* Pack., ♂. Warsaw, Benton Co., Missouri, 9 July 1962, J. R. Heitzman (USNM). (p. 227).
 59. *Macaria multilineata* Pack., ♀. Goose Creek near Ashburn, Loudoun Co., Virginia, 22 May 1991, D. C. Ferguson (USNM). (p. 227).
 60. *Macaria multilineata* Pack., ♂. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 1 May 1972, D. C. Ferguson (USNM). (p. 227).
 61. *Macaria multilineata* Pack., ♀. Shell Bluff, Crescent Lake, Flagler Co., Florida, 5 April 1989, H. D. Baggett (USNM). (p. 227).
 62. *Macaria multilineata* Pack., ♂. Underside. Burden Falls, Shawnee National Forest, Pope Co., Illinois, 23 July 1985, D. C. Ferguson (USNM). (p. 227).
 63. *Macaria ochrifascia* (Warr.), ♂. Bermuda, February 12, F. M. Jones (USNM). (p. 231).
 64. *Macaria ochrifascia* (Warr.), ♂. Bermuda, February 15, F. M. Jones (USNM). (p. 231).



PLATE 6

Geometroidea

GEOMETRIDAE

figs. 1–65

NATURAL SIZE 1:1

1. *Letispe metanemaria* (Hulst), ♂. Carr Canyon, 5,600', Huachuca Mountains, Cochise Co., Arizona, emerged 22 September 1999, D. C. Ferguson (USNM). (p. 232).
2. *Letispe metanemaria* (Hulst), ♀. Placita del Cervato, 1,230', Tucson, Pima Co., Arizona, 8 April 1990, emerged 17 April 1990, R. Wielgus (USNM). (p. 232).
3. *Letispe metanemaria* (Hulst), ♀. Underside. Carr Canyon, 5,600', Huachuca Mountains, Cochise Co., Arizona, emerged 23 September 1999, D. C. Ferguson (USNM). (p. 232).
4. *Digrammia californiaria* (Pack.), ♀. Avalon, Santa Catalina Island, Los Angeles Co., California, 29 October 1931, D. Meadows (USNM). (p. 236).
5. *Digrammia californiaria* (Pack.), ♀. Rowdy Creek Road, 2,000', 6 mi E Smith River, Del Norte Co., California, 26 July 1990, D. C. Ferguson (USNM). (p. 236).
6. *Digrammia californiaria* (Pack.), ♀. Mineral King, Tulare Co., California, 8–15 July (USNM). (p. 236).
7. *Digrammia californiaria* (Pack.), ♀. Walnut Canyon, 6,500', 6½ mi ESE Flagstaff, Coconino Co., Arizona, 20 August 1964, R. W. Poole (USNM). (p. 236).
8. *Digrammia californiaria* (Pack.), ♂. Hill City, Pennington Co., South Dakota, 5 July 1964, D. C. Ferguson (USNM). (p. 236).
9. *Digrammia colorata* (Grt.), ♂. Rio Grande, 6 mi W of Lajitas, Brewster Co., Texas, emerged 16 May 1993, D. C. Ferguson (USNM). (p. 237).
10. *Digrammia colorata* (Grt.), ♀. 5135 N Camino Real, Tucson, Pima Co., Arizona, 24 December 1980, R. Nagle (USNM). (p. 237).
11. *Digrammia colorata* (Grt.), ♀. Sierra Vista, Cochise Co., Arizona, 8 October 1994, D. C. Ferguson (USNM). (p. 237).
12. *Digrammia colorata* (Grt.), ♂. Underside. Sierra Diablo, 6,000', 20 mi NNW Van Horn, Culberson Co., Texas, 29 May 1973, D. C. Ferguson (USNM). (p. 237).
13. *Digrammia pervolata* (Hulst), ♂. White Rock, 6,700', Los Alamos Co., New Mexico, 7 August 1989, D. C. Ferguson (USNM). (p. 241).
14. *Digrammia pervolata* (Hulst), ♀. Major's Flat near Ephraim, 7,100', Sanpete Co., Utah, 12 August 1981, D. C. Ferguson (USNM). (p. 241).
15. *Digrammia pervolata* (Hulst), ♂. Manzanita Springs, Guadalupe Mountains, Culberson Co., Texas, 24 May 1973, D. C. Ferguson (USNM). (p. 241).
16. *Digrammia pervolata* (Hulst), ♀. McKittrick Canyon, Guadalupe Mountains, Culberson Co., Texas, 23 May 1973, D. C. Ferguson (USNM). (p. 241).
17. *Digrammia aliciata* (Cass.), ♀. Wrightwood, 6,100', San Bernardino Co., California, 12 June 1964, C. A. Hill (USNM). (p. 242).

18. *Digrammia alicata* (Cass.), ♂. Leeds, Washington Co., Utah, 6 June 1965, W. D. Davis (USNM). (p. 242).
19. *Digrammia sexpunctata* (Bates), ♂. Angel Lake Road above Wells, 7,500', Elko Co., Nevada, 13 July 1971, D. C. Ferguson (USNM). (p. 243).
20. *Digrammia sexpunctata* (Bates), ♀. Angel Lake Road above Wells, 7,500', Elko Co., Nevada, 13 July 1971, D. C. Ferguson (USNM). (p. 243).
21. *Digrammia delectata* (Hulst), ♂. Telluride, 8,745', San Miguel Co., Colorado, 27 June 1977, D. C. Ferguson (USNM). (p. 244).
22. *Digrammia delectata* (Hulst), ♀. Ephraim Canyon, 6,000', Sanpete Co., Utah, 13 July 1980, D. C. Ferguson (USNM). (p. 244).
23. *Digrammia delectata* (Hulst), ♂. Big Timber Canyon, N of Cedar Pass, Jackson Co., South Dakota, 8 July 1964, D. C. Ferguson (USNM). (p. 244).
24. *Digrammia ubiquitata* Fgn., ♂. Holotype. Telluride, 8,745', San Miguel Co., Colorado, 27 June 1977, D. C. Ferguson (USNM). (p. 247).
25. *Digrammia ubiquitata* Fgn., ♂. Paratype. Zapata Ranch, 8,200', Alamosa Co., Colorado, 23 June 1982, D. C. Ferguson (USNM). (p. 247).
26. *Digrammia ubiquitata* Fgn., ♂. Paratype. Underside. Angel Lake Road above Wells, 7,000', Elko Co., Nevada, 18 July 1971, D. C. Ferguson (USNM). (p. 247).
27. *Digrammia denticulata* Grt., ♂. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 3 June 1983, D. C. Ferguson (USNM). (p. 249).
28. *Digrammia denticulata* Grt., ♀. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 9 June 1983, D. C. Ferguson (USNM). (p. 249).
29. *Digrammia denticulata* Grt., ♂. Underside. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 15 June 1983, D. C. Ferguson (USNM). (p. 249).
30. *Digrammia pictipennata* (Hulst), ♂. Peña Blanca Lake Recreation Area, 3,950', Santa Cruz Co., Arizona, 10 August 1999, D. C. Ferguson (USNM). (p. 250).
31. *Digrammia pictipennata* (Hulst), ♀. Peña Blanca Lake Recreation Area, 3,950', Santa Cruz Co., Arizona, 11 August 1999, D. C. Ferguson (USNM). (p. 250).
32. *Digrammia pictipennata* (Hulst), ♀. Underside. Sierra Vista, Cochise Co., Arizona, 8 October 1994, D. C. Ferguson (USNM). (p. 250).
33. *Digrammia terramalata* Fgn., ♂. Big Buffalo Creek, N of Cedar Pass, Jackson Co., South Dakota, 8 July 1964, D. C. Ferguson (USNM). (p. 251).
34. *Digrammia terramalata* Fgn., ♀. Paratype. Big Buffalo Creek, north of Cedar Pass, Jackson Co., South Dakota, 8 July 1964, D. C. Ferguson (USNM). (p. 251).
35. *Digrammia nubiculata* (Pack.), ♂. Mosca Creek, 8,300', Great Sand Dunes National Monument, Alamosa Co., Colorado, 28 June 1982, D. C. Ferguson (USNM). (p. 253).
36. *Digrammia nubiculata* (Pack.), ♂. Mosca Creek, 8,300', Great Sand Dunes National Monument, Alamosa Co., Colorado, 28 June 1982, D. C. Ferguson (USNM). (p. 253).
37. *Digrammia nubiculata* (Pack.), ♀. Zapata Ranch, 7,900', Alamosa Co., Colorado, 26 June 1982, D. C. Ferguson (USNM). (p. 253).
38. *Digrammia palodurata* Fgn., ♂. Holotype. Palo Duro Canyon, Randall Co., Texas, 9 May 1981, E. C. Knudson (USNM). (p. 254).
39. *Digrammia curvata* (Grt.), ♂. Great Basin Experiment Station near Ephraim, 8,850', Sanpete Co., Utah, 6 August 1981, D. C. Ferguson (USNM). (p. 255).
40. *Digrammia curvata* (Grt.), ♂. Great Sand Dunes National Monument, 8,200', Alamosa Co., Colorado, 25 June 1982, D. C. Ferguson (USNM). (p. 255).
41. *Digrammia curvata* (Grt.), ♀. Underside. Great Sand Dunes National Monument, 8,200', Alamosa Co., Colorado, 16 June 1982, D. C. Ferguson (USNM). (p. 255).
42. *Digrammia pallidata* (Pack.), ♂. Inks Lake State Park, Burnet Co., Texas, 27 September 1986, E. C. Knudson (USNM). (p. 256).
43. *Digrammia pallidata* (Pack.), ♂. Laguna Park, Bosque Co., Texas, 16 March 1971, A. & M. E. Blanchard (USNM). (p. 256).
44. *Digrammia pallidata* (Pack.), ♀. Laguna Park, Bosque Co., Texas, 27 March 1973, A. & M. E. Blanchard (USNM). (p. 256).
45. *Digrammia pallidata* (Pack.), ♂. Underside. Laguna Park, Bosque Co., 27 March 1973, A. & M. E. Blanchard (USNM). (p. 256).
46. *Digrammia triviata* (B. & McD.), ♀. Carr Canyon, 5,600', Huachuca Mountains, Cochise Co., Arizona, 15 August 1999, D. C. Ferguson (USNM). (p. 258).
47. *Digrammia triviata* (B. & McD.), ♀. Lower Garden Canyon, 5,000', Fort Huachuca, Cochise Co., Arizona, 5 October 1994, D. C. Ferguson (USNM). (p. 258).
48. *Digrammia triviata* (B. & McD.), ♂. Zapata Ranch, 7,900', Alamosa Co., Colorado, 23 June 1982, D. C. Ferguson (USNM). (p. 258).
49. *Digrammia triviata* (B. & McD.), ♀. Great Sand Dunes National Monument, 8,200', Alamosa Co., Colorado, 22 June 1982, D. C. Ferguson (USNM). (p. 258).
50. *Digrammia continuata* (Wlk.), ♀. Colesville, Montgomery Co., Maryland, 16 July 1976, D. C. Ferguson (USNM). (p. 261).
51. *Digrammia continuata* (Wlk.), ♂. Colesville, Montgomery Co., Maryland, 26 April 1981, D. C. Ferguson (USNM). (p. 261).
52. *Digrammia continuata* (Wlk.), ♀. Colesville, Montgomery Co., Maryland, 31 August 1984, D. C. Ferguson (USNM). (p. 261).
53. *Digrammia pertinata* (McD.), ♂. Fish Canyon, Guernsey State Park, Platte Co., Wyoming, 12 July 1993, D. C. Ferguson (USNM). (p. 264).
54. *Digrammia pertinata* (McD.), ♂. Fish Canyon, Guernsey State Park, Platte Co., Wyoming, 12 July 1993, D. C. Ferguson (USNM). (p. 264).
55. *Digrammia pertinata* (McD.), ♀. Two Buttes Dam, Prowers Co., Colorado, 21 July 1990, P. A. Opler (USNM). (p. 264).
56. *Digrammia pertinata* (McD.), ♂. Underside. Fish Canyon, Guernsey State Park, Platte Co., Wyoming, 12 July 1993, D. C. Ferguson (USNM). (p. 264).
57. *Digrammia setonana* (McD.), ♂. Mile 1124, Alaska Highway, Yukon, emerged 21 July 1958, Forest Insect Survey (USNM). (p. 265).
58. *Digrammia setonana* (McD.), ♂. Fort Steele, British Columbia, emerged 11 March 1960, Forest Insect Survey (USNM). (p. 265).
59. *Digrammia setonana* (McD.), ♂. Underside. Canal Flats, British Columbia, emerged 28 January 1959, Forest Insect Survey (USNM). (p. 265).
60. *Digrammia napensis* (McD.), ♂. Berkeley, Alameda Co., California, emerged 2 January 1994, D. C. Ferguson (USNM). (p. 266).
61. *Digrammia napensis* (McD.), ♀. Petaluma, Sonoma Co., California, 17 June 1936, E. C. Johnston (USNM). (p. 266).
62. *Digrammia napensis* (McD.), ♀. Petaluma, Sonoma Co., California, 30 July 1946, W. R. Bauer (USNM). (p. 266).
63. *Digrammia imparilata* Fgn., ♂. Holotype. Phoenix, Maricopa Co., Arizona, 20 March 1976, R. Wielgus (USNM). (p. 267).
64. *Digrammia imparilata* Fgn., ♂. Paratype. Phoenix, Maricopa Co., Arizona, 14 March 1976, R. Wielgus (USNM). (p. 267).
65. *Digrammia imparilata* Fgn., ♀. Paratype. Phoenix, Maricopa Co., Arizona, 19 January 1976, R. Wielgus (USNM). (p. 267).



PLATE 7

Geometroidea

GEOMETRIDAE

figs. 1–63

NATURAL SIZE 1:1

1. *Digrammia excurvata* (Pack.), ♂. Radium State Wildlife Area, County road 11 & Blacktail Creek, R82W T1S sec 22, 7,040', Grand Co., Colorado, 24 May 1988, T. S. Dickel (USNM). (p. 268).
2. *Digrammia excurvata* (Pack.), ♀. Hunter's access road to Black Ridge adjacent to Colorado National Monument, T11S R2W S36, 6,479', Mesa Co., Colorado, 27 May 1988, T. S. Dickel (USNM). (p. 268).
3. *Digrammia excurvata* (Pack.), ♀. Hunter's access road to Black Ridge adjacent to Colorado National Monument, T11S R2W S36, 6,479', Mesa Co., Colorado, 27 May 1988, T. S. Dickel (USNM). (p. 268).
4. *Digrammia excurvata* (Pack.), ♂. Underside. Major's Flat near Ephraim, 7,100', Sanpete Co., Utah, 22 July 1981, D. C. Ferguson (USNM). (p. 268).
5. *Digrammia pallorata* Fgn., ♂. Holotype. Major's Flat near Ephraim, 7,100', Sanpete Co., Utah, 22 July 1981, D. C. Ferguson (USNM). (p. 270).
6. *Digrammia pallorata* Fgn., ♀. Paratype. Ephraim Canyon, 6,000', Sanpete Co., Utah, 23 July 1981, D. C. Ferguson (USNM). (p. 270).
7. *Digrammia pallorata* Fgn., ♀. Paratype. Underside. Ephraim Canyon, 6,000', Sanpete Co., Utah, 23 July 1981, D. C. Ferguson (USNM). (p. 270).
8. *Digrammia cinereola cinereola* (Hulst), ♂. Poncha Springs, 7,000', Chaffee Co., Colorado, 13 July 1982, D. C. Ferguson (USNM). (p. 272).
9. *Digrammia cinereola cinereola* (Hulst), ♀. Lee Vining Creek, 7,200', 6 mi W Mono Lake, Mono Co., California, 30 June 1987, D. C. Ferguson (USNM). (p. 272).
10. *Digrammia cinereola septemberata* (B. & McD.), ♂. Madera Canyon, Davis Mountains, Jeff Davis Co., Texas, 25 March 1993, D. C. Ferguson (USNM). (p. 274).
11. *Digrammia cinereola septemberata* (B. & McD.), ♂. 5131 Bannock Street, Pueblo Del Sol, Huachuca Mountains, Cochise Co., Arizona, 1 May 1981, R. S. Wielgus (USNM). (p. 274).
12. *Digrammia burneyata* (McD.), ♂. Siskiyou National Forest near Kerby, Illinois River, Josephine Co., Oregon, emerged 20 March 1991, D. C. Ferguson (USNM). (p. 274).
13. *Digrammia burneyata* (McD.), ♀. Siskiyou National Forest near Kerby, Illinois River, Josephine Co., Oregon, emerged 20 March 1991, D. C. Ferguson (USNM). (p. 274).
14. *Digrammia atrofasciata* (Pack.), ♂. Guadalupe Canyon, 4,250', Peloncillo Mountains, Cochise Co., Arizona, 19 June 1976, J. & S. Werner (USNM). (p. 276).
15. *Digrammia atrofasciata* (Pack.), ♂. Belton Reservoir, Bell Co., Texas, 6 April 1970, A. & M. E. Blanchard (USNM). (p. 276).
16. *Digrammia atrofasciata* (Pack.), ♀. Junction, Kimble Co., Texas, 17 August 1972, D. C. Ferguson (USNM). (p. 276).

17. *Digrammia atrofasciata* (Pack.), ♂. Ephraim Canyon, 6,000', Sanpete Co., Utah, 25 July 1981, D. C. Ferguson (USNM). (p. 276).
18. *Digrammia modocata* Fgn., ♂. Paratype. Hwy 20, 10 mi E Bend, Deschutes Co., Oregon, 24 July 1993 (USNM). (p. 277).
19. *Digrammia modocata* Fgn., ♀. Paratype. Kahneetah Hot Springs, 1,600', [west of] Deschutes River, Jefferson Co. [in error for Wasco Co., ed.], Oregon, 20 June 1968, C. W. Nelson (USNM). (p. 277).
20. *Digrammia modocata* Fgn., ♂. Paratype. Underside. Stinkingwater Mountain, Harney Co., Oregon, 24 June 1961, J. H. Baker (USNM). (p. 277).
21. *Digrammia muscariata muscariata* (Gn.), ♀. Greenhorn Mountains, Tulare Co., California, 3 July 1932, J. Comstock (CNC). (p. 281).
22. *Digrammia muscariata respersata* (Hulst), ♀. Angel Lake Road above Wells, 7,500', Elko Co., Nevada, 13 July 1971, D. C. Ferguson (USNM). (p. 281).
23. *Digrammia muscariata respersata* (Hulst), ♀. Major's Flat near Ephraim, 7,100', Sanpete Co., Utah, 10 July 1980, D. C. Ferguson (USNM). (p. 281).
24. *Digrammia muscariata teucaria* (Stkr.), ♂. Quamichan, Vancouver Island, British Columbia, 5 June 1906 (CNC). (p. 281).
25. *Digrammia extenuata* Fgn., ♂. Paratype. Mohawk, Plumas Co., California, 19 June 1946, W. R. Bauer (USNM). (p. 282).
26. *Digrammia extenuata* Fgn., ♀. Paratype. Angel Lake Road above Wells, 7,500', Elko Co., Nevada, 13 July 1971, D. C. Ferguson (USNM). (p. 282).
27. *Digrammia ocellinata* (Gn.), ♂. Lake Tenkiller, 2 mi NW Blackgum, Sequoyah Co., Oklahoma, 14–16 July 1983, D. & M. Davis (USNM). (p. 283).
28. *Digrammia ocellinata* (Gn.), ♀. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 24 June 1983, D. C. Ferguson (USNM). (p. 283).
29. *Digrammia ocellinata* (Gn.), ♂. Underside. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 24 June 1983, D. C. Ferguson (USNM). (p. 283).
30. *Digrammia ordinata* (Wlk.), ♀. Lathrop, Clinton Co., Missouri, 28 June 1955, E. C. Becker (CNC). (p. 287).
31. *Digrammia ordinata* (Wlk.), ♀. Fort Niobrara, Cherry Co., Nebraska, 19 June 1983, D. C. Ferguson (USNM). (p. 287).
32. *Digrammia ordinata* (Wlk.), ♂. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 9 June 1983, D. C. Ferguson (USNM). (p. 287).
33. *Digrammia ordinata* (Wlk.), ♂. Underside. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 9 June 1983, D. C. Ferguson (USNM). (p. 287).
34. *Digrammia sublacteolata* (Hulst), ♂. Fort Niobrara, Cherry Co., Nebraska, 11 June 1983, D. C. Ferguson (USNM). (p. 288).
35. *Digrammia sublacteolata* (Hulst), ♂. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 4 June 1983, D. C. Ferguson (USNM). (p. 288).
36. *Digrammia sublacteolata* (Hulst), ♂. Underside. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 9 June 1983, D. C. Ferguson (USNM). (p. 288).
37. *Digrammia eremiata* (Gn.), ♂. Arbuckle Mountains, 1 km W Turner Falls, Murray Co., Oklahoma, 19–30 July 1984, D. & M. Davis (USNM). (p. 290).
38. *Digrammia eremiata* (Gn.), ♀. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 6 June 1978, D. C. Ferguson (USNM). (p. 290).
39. *Digrammia eremiata* (Gn.), ♀. Underside. Wedge Plantation, McClellanville, Charleston Co., South Carolina, 10 August 1968, D. C. Ferguson (USNM). (p. 290).
40. *Digrammia equivocata* Fgn., ♂. Holotype. West Tisbury, Martha's Vineyard, Dukes Co., Massachusetts, 15 July 1947, D. C. Ferguson (USNM). (p. 292).
41. *Digrammia equivocata* Fgn., ♂. Paratype. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 22 June 1983, D. C. Ferguson (USNM). (p. 292).
42. *Digrammia rippertaria* (Dup.), ♂. Vermilion Pass, 5,400', Banff National Park, Alberta, 30 June 1991, D. C. Ferguson (USNM). (p. 295).
43. *Digrammia rippertaria* (Dup.), ♂. Vermilion Pass, 5,400', Banff National Park, Alberta, 30 June 1991, D. C. Ferguson (USNM). (p. 295).
44. *Digrammia hebetata* (Hulst), ♂. Tioga Pass, 9,940', Mono Co., California, 5 July 1987, D. C. Ferguson (USNM). (p. 298).
45. *Digrammia hebetata* (Hulst), ♀. Great Basin Experiment Station near Ephraim, 8,850', Sanpete Co., Utah, 24 July 1980, D. C. Ferguson (USNM). (p. 298).
46. *Digrammia hebetata* (Hulst), ♂. Below Cottonwood Pass, 11,600', Chaffee Co., Colorado, 14 July 1982, D. C. Ferguson (USNM). (p. 298).
47. *Digrammia decorata* (Grossb.), ♂. Mono Lake, 6,400', Mono Co., California, emerged 17 August 1987, D. C. Ferguson (USNM). (p. 299).
48. *Digrammia decorata* (Grossb.), ♂. Summerland, British Columbia, 21 May 1981, A. N. Gartrell (CNC). (p. 299).
49. *Digrammia decorata* (Grossb.), ♂. Mono Lake, 6,400', Mono Co., California, emerged 17 August 1987, D. C. Ferguson (USNM). (p. 299).
50. *Digrammia plemmelata* Fgn., ♂. Holotype. Anderson Springs, Lake Co., California, 25 June 1949, W. R. Bauer (USNM). (p. 301).
51. *Digrammia plemmelata* Fgn., ♀. Paratype. Kerby, Josephine Co., Oregon, 20 July 1990, D. C. Ferguson (USNM). (p. 301).
52. *Digrammia plemmelata* Fgn., ♂. Paratype. Conn Creek near Rutherford, Napa Co., California, 15 September 1985, D. C. Ferguson (USNM). (p. 301).
53. *Digrammia spinata* (McD.), ♀. Paratype of *D. vernata* (McD). Brownsville, Cameron Co., Texas, 19 March 1937, T. N. Freeman (CNC). (p. 304).
54. *Digrammia spinata* (McD.), ♀. Allotype of *D. vernata* (McD). Brownsville, Cameron Co., Texas, 7 March 1937, T. N. Freeman (CNC). (p. 304).
55. *Digrammia indeterminata* (McD.), ♂. Holotype. Stillwater, Payne Co., Oklahoma, 29 May 1937, R. W. Kaiser (CNC). (p. 305).
56. *Digrammia indeterminata* (McD.), ♂. Paratype. Taloga, Dewey Co., Oklahoma, 6 June 1937, Standish-Kaiser (CNC). (p. 305).
57. *Digrammia yavapai* (Grossb.), ♂. Carr Canyon, 5,600', Huachuca Mountains, Cochise Co., Arizona, 16 August 1999, D. C. Ferguson (USNM). (p. 306).
58. *Digrammia yavapai* (Grossb.), ♀. Carr Canyon, 5,600', Huachuca Mountains, Cochise Co., Arizona, 25 July 1998, D. C. Ferguson (USNM). (p. 306).
59. *Digrammia yavapai* (Grossb.), ♀. Summerhaven, 7,800', Santa Catalina Mountains, Pima Co., Arizona, 17 July 1998, D. C. Ferguson (USNM). (p. 306).
60. *Digrammia mellistrigata* (Grt.), ♂. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 15 June 1983, D. C. Ferguson (USNM). (p. 308).
61. *Digrammia mellistrigata* (Grt.), ♀. Fort Niobrara, Cherry Co., Nebraska, 29 June 1983, D. C. Ferguson (USNM). (p. 308).
62. *Digrammia gilletteata* (Dyar), ♂. Chimney Gulch, Jefferson Co., Colorado, 26 June 1898 (USNM). (p. 309).
63. *Digrammia gilletteata* (Dyar), ♂. Jemez Springs, Sandoval Co., New Mexico (USNM). (p. 309).



PLATE 8

Geometroidea

GEOMETRIDAE

figs. 1–69

NATURAL SIZE 1:1

1. *Digrammia subminiata* (Pack.), ♂. Seven Sisters State Recreation Area, 47° 34' 33" N, 104° 15' 43" W, West Bank Yellowstone River S of Sidney, Crane, Richland Co., Montana, 17 July 1999, D. C. Ferguson (USNM). (p. 309).
2. *Digrammia subminiata* (Pack.), ♂. Seven Sisters State Recreation Area, 47° 34' 33" N, 104° 15' 43" W, West Bank Yellowstone River S of Sidney, Crane, Richland Co., Montana, 17 July 1999, D. C. Ferguson (USNM). (p. 309).
3. *Digrammia subminiata* (Pack.), ♀. Muir Springs Park and Recreation Area, 4,300', Fort Morgan, Morgan Co., Colorado, 19 May 1987, T. S. Dickel (USNM). (p. 309).
4. *Digrammia neptaria* (Gn.), ♀. Loma Linda, San Bernardino Co., California, May 16–23 (USNM). (p. 311).
5. *Digrammia neptaria* (Gn.), ♀. Lee Vining Creek, 7,200', 6 mi W Mono Lake, Mono Co., California, 30 June 1987, D. C. Ferguson (USNM). (p. 311).
6. *Digrammia neptaria* (Gn.), ♀. 4 mi SW Buena Vista, 8,700', Chaffee Co., Colorado, 10 July 1982, D. C. Ferguson (USNM). (p. 311).
7. *Digrammia neptaria* (Gn.), ♂. Opinaca River, Km 416 James Bay Highway, Quebec, 11 June 1982, K. Bolte & R. Smith (CNC). (p. 311).
8. *Digrammia irrorata irrorata* (Pack.), ♂. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 8 June 1983, D. C. Ferguson (USNM). (p. 316).
9. *Digrammia irrorata irrorata* (Pack.), ♀. Hackberry Lake, Valentine National Wildlife Refuge, Cherry Co., Nebraska, 15 June 1983, D. C. Ferguson (USNM). (p. 316).
10. *Digrammia irrorata venosata* (McD.), ♂. Dayton, 2,000', Columbia Co., Washington, 29 April 1961, R. E. Miller (USNM). (p. 316).
11. *Digrammia irrorata rubricata* Fgn., ♂. Paratype. Blythe, Riverside Co., California, 8 October 1958, Buckett & Bauer (USNM). (p. 316).
12. *Digrammia irrorata rubricata* Fgn., ♀. Paratype. Blythe, Riverside Co., California, 1 September 1960, H. L. Japport (USNM). (p. 316).
13. *Digrammia fieldi* (Swett), ♂. La Puerta Valley, San Diego Co., California, July 1911, G. H. Field (USNM). (p. 317).
14. *Digrammia fieldi* (Swett), ♂. Mint Canyon, Hwy 6, Los Angeles Co., California, 2 April 1959, C. W. Nelson (USNM). (p. 317).
15. *Digrammia puertata* (Grossb.), ♂. La Puerta Valley, San Diego Co., California, July 1911, G. H. Field (USNM). (p. 318).
16. *Digrammia puertata* (Grossb.), ♀. Mason Valley, San Diego Co., California, 5 September 1937, D. Meadows (USNM). (p. 318).
17. *Digrammia puertata* (Grossb.) ♂. Imperial Co., California, 10 October 1961 (USNM). (p. 318).
18. *Digrammia minuta* (Hulst), ♂. Tempe, Maricopa Co., Arizona, 30 August 1920, E. May, W. M. Martinez (USNM). (p. 319).
19. *Digrammia minuta* (Hulst), ♂. Madera Canyon, Santa Rita Mountains, Santa Cruz Co., Arizona, 20 July 1947, J. A. Comstock & L. M. Martin (USNM). (p. 319).
20. *Digrammia gnophosaria* (Gn.), ♂. Seven Sisters State Recreation Area, 47° 34' 33" N, 104° 15' 43" W, West Bank Yellowstone River S of Sidney, Crane, Richland Co., Montana, 17 July 1999, D. C. Ferguson (USNM). (p. 320).
21. *Digrammia gnophosaria* (Gn.), ♂. Seven Sisters State Recreation Area,

- 47° 34' 33" N, 104° 15' 43" W, West Bank Yellowstone River S of Sidney, Crane, Richland Co., Montana, 17 July 1999, D. C. Ferguson (USNM). (p. 320).
22. *Rindgea subterminata* (B. & McD.), ♂. Welder Wildlife Refuge, Sinton, San Patricio Co., Texas, 15 November 1966, A. & M. E. Blanchard (USNM). (p. 324).
 23. *Rindgea subterminata* (B. & McD.), ♀. Welder Wildlife Refuge, Sinton, San Patricio Co., Texas, 15 November 1966, A. & M. E. Blanchard (USNM). (p. 324).
 24. *Rindgea subterminata* (B. & McD.), ♀. Underside. Welder Wildlife Refuge, Sinton, San Patricio Co., Texas, 28 October 1964, A. & M. E. Blanchard (USNM). (p. 324).
 25. *Rindgea nigricomma* (Warr.), ♂. Santa Ana Refuge, Hidalgo Co., Texas, 10 November 1979, A. & M. E. Blanchard (USNM). (p. 325).
 26. *Rindgea nigricomma* (Warr.), ♀. Santa Ana Refuge, Hidalgo Co., Texas, 22 February 1965, A. & M. E. Blanchard (USNM). (p. 325).
 27. *Rindgea piccoloi* (Rindge), ♂. Paratype. Madera Canyon, Santa Rita Mountains, Arizona, 5 September 1956 (AMNH). (p. 327).
 28. *Rindgea piccoloi* (Rindge), ♀. Paratype. Todos Santos, Baja California, Mexico, 19–20 March 1974, R. W. Holland (AMNH). (p. 327).
 29. *Rindgea parcata* (Grossb.), ♀. 5135 N Camino Real, Tucson, Pima Co., Arizona, 8 July 1979, R. B. Nagle (USNM). (p. 329).
 30. *Rindgea parcata* (Grossb.), ♂. 5135 N Camino Real, Tucson, Pima Co., Arizona, 25 August 1980, R. Nagle (USNM). (p. 329).
 31. *Rindgea parcata* (Grossb.), ♂. Underside. 5135 N Camino Real, Tucson, Pima Co., Arizona, 29 September 1982, R. Nagle (USNM). (p. 329).
 32. *Rindgea disparcata* Fgn., ♀. Paratype. 10 mi W Hunt, Kerr Co., Texas, 1 September 1980, E. C. Knudson (USNM). (p. 330).
 33. *Rindgea disparcata* Fgn., ♂. Holotype. North Padre Island, Nueces Co., Texas, 9 September 1974, A. & M. E. Blanchard (USNM). (p. 330).
 34. *Rindgea stipularia* (B. & McD.), ♂. Laguna Atascosa, Cameron Co., Texas, 16 November 1973, A. & M. E. Blanchard (USNM). (p. 330).
 35. *Rindgea stipularia* (B. & McD.), ♂. Brownsville, Cameron Co., Texas, 28 November 1927, F. H. Benjamin (USNM). (p. 330).
 36. *Rindgea prolificata* Fgn., ♀. Paratype. Cherry Canyon, 5,096', Guadalupe Mountains, Culberson Co., Texas, 24 May 1973, D. C. Ferguson (USNM). (p. 332).
 37. *Rindgea prolificata* Fgn., ♀. Paratype. Underside. Cherry Canyon, 5,096', Guadalupe Mountains, Culberson Co., Texas, 24 May 1973, D. C. Ferguson (USNM). (p. 332).
 38. *Rindgea prolificata* Fgn., ♂. Ship-On-The-Desert, Guadalupe Mountains National Park, Culberson Co., Texas, 29–30 July 1989, E. C. Knudson (ECK). (p. 332).
 39. *Rindgea maricopa* (Hulst), ♂. 5135 N Camino Real Tucson, Pima Co., Arizona, 20 February 1982, R. Nagle (USNM). (p. 334).
 40. *Rindgea maricopa* (Hulst), ♀. 5135 N Camino Real Tucson, Pima Co., Arizona, 23 February 1983, R. Nagle (USNM). (p. 334).
 41. *Rindgea maricopa* (Hulst), ♀. Panther Pass, 6,000', Chisos Mountains, Brewster Co., Texas, 2 June 1973, D. C. Ferguson (USNM). (p. 334).
 42. *Rindgea maricopa* (Hulst), ♀. Brownsville, Cameron Co., Texas, 22 November 1966, A. & M. E. Blanchard (USNM). (p. 334).
 43. *Rindgea maricopa* (Hulst), ♀. Underside. 5135 N Camino Real Tucson, Pima Co., Arizona, 17 January 1982, R. Nagle (USNM). (p. 334).
 44. *Rindgea flaviterminata* (B. & McD.), ♂. Alamo, Santa Ana Wildlife Refuge, Hidalgo Co., Texas, 4 October 1964, A. & M. E. Blanchard (USNM). (p. 335).
 45. *Rindgea flaviterminata* (B. & McD.), ♂. Santa Ana Wildlife Refuge, Hidalgo Co., Texas, 20 November 1966, A. & M. E. Blanchard (USNM). (p. 335).
 46. *Rindgea flaviterminata* (B. & McD.), ♀. Santa Ana Wildlife Refuge, Hidalgo Co., Texas, 15 November 1965, A. & M. E. Blanchard (USNM). (p. 335).
 47. *Rindgea flaviterminata* (B. & McD.), ♀. Underside. Brownsville, Cameron Co., Texas, 23 February 1965, A. & M. E. Blanchard (USNM). (p. 335).
 48. *Rindgea s-signata* (Pack.), ♂. Artesia Wells, La Salle Co., Texas, 21 June 1972, D. C. Ferguson (USNM). (p. 338).
 49. *Rindgea s-signata* (Pack.), ♀. Texas (USNM). (p. 338).
 50. *Rindgea s-signata* (Pack.), ♀. Pedernales Falls State Park, Blanco Co., Texas, 4 May 1973, A. & M. E. Blanchard (USNM). (p. 338).
 51. *Rindgea cyda* (Druce), ♂. Hwy 36, 4 mi NW Temple, Bell Co., Texas, 13 September 1977, Robbins & Seedle (USNM). (p. 339).
 52. *Rindgea cyda* (Druce), ♂. Fort Davis, Jeff Davis Co., Texas, 9 October 1965, A. & M. E. Blanchard (USNM). (p. 339).
 53. *Rindgea cyda* (Druce), ♀. K-Bar Ranch, 3,400', Chisos Mountains, Brewster Co., Texas, 5 June 1973, D. C. Ferguson (USNM). (p. 339).
 54. *Rindgea cyda* (Druce), ♂. Laguna Atascosa, Cameron Co., Texas, 24 February 1973, A. & M. E. Blanchard (USNM). (p. 339).
 55. *Rindgea ballandrata* (Wgt.), ♂. Sells Post Office, Indian Oasis, Pima Co., Arizona, 15–30 April 1923, O. C. Poling (USNM). (p. 342).
 56. *Rindgea ballandrata* (Wgt.), ♀. Sells Post Office, Indian Oasis, Pima Co., Arizona, 1–15 April 1923, O. C. Poling (USNM). (p. 342).
 57. *Rindgea ballandrata* (Wgt.), ♀. Baboquivari Mountains, Pima Co., Arizona, 27 April 1938, J. A. Comstock (USNM). (p. 342).
 58. *Rindgea hypaethrata* (Grt.), ♂. 5131 Bannock Street, Pueblo Del Sol, Huachuca Mountains, Cochise Co., Arizona, 30 November 1986, R. S. Wielgus (USNM). (p. 343).
 59. *Rindgea hypaethrata* (Grt.), ♂. Dugout Wells, Big Bend National Park, Brewster Co., Texas, 28 September 1981, E. C. Knudson (USNM). (p. 343).
 60. *Rindgea hypaethrata* (Grt.), ♀. Underside. Dugout Wells, Big Bend National Park, Brewster Co., Texas, 1 May 1972, A. & M. E. Blanchard (USNM). (p. 343).
 61. *Fernaldella fimetaria* (G. & R.), ♂. Mayer, Yavapai Co., Arizona, 30 August 1959, R. F. Sternitzky (USNM). (p. 345).
 62. *Fernaldella fimetaria* (G. & R.), ♀. Mayer, Yavapai Co., Arizona, 30 August 1959, R. F. Sternitzky (USNM). (p. 345).
 63. *Fernaldella fimetaria* (G. & R.), ♂. Underside. Mayer, Yavapai Co., Arizona, 30 August 1959, R. F. Sternitzky (USNM). (p. 345).
 64. *Fernaldella georgiana* (Covell, Finkelstein, & Towers), ♂. Paratype. Oohoopee Dunes, Tatnall Co., Georgia, 11 September 1981, I. L. Finkelstein (USNM). (p. 349).
 65. *Fernaldella georgiana* (Covell, Finkelstein, & Towers), ♀. Oohoopee Dunes, Tatnall Co., Georgia, emerged 13 June 1987, I. L. Finkelstein (USNM). (p. 349).
 66. *Fernaldella georgiana* (Covell, Finkelstein, & Towers), ♂. Underside. Oohoopee Dunes, Emanuel Co., Georgia, 13 April 1982, I. L. Finkelstein (USNM). (p. 349).
 67. *Fernaldella stalachtaria* (Stkr.), ♂. Diamond, 6,000', Platte Co., Wyoming, 31 July 1926 (USNM). (p. 350).
 68. *Fernaldella stalachtaria* (Stkr.), ♀. Near Rockville, ~15 mi N Sheaville, Malheur Co., Oregon, 18 May 1961 (USNM). (p. 350).
 69. *Fernaldella stalachtaria* (Stkr.), ♂. Underside. Sand dune area 10 mi N Winnemucca, Humboldt Co., Nevada, 27 May 1974, J. F. G. Clarke (USNM). (p. 350).

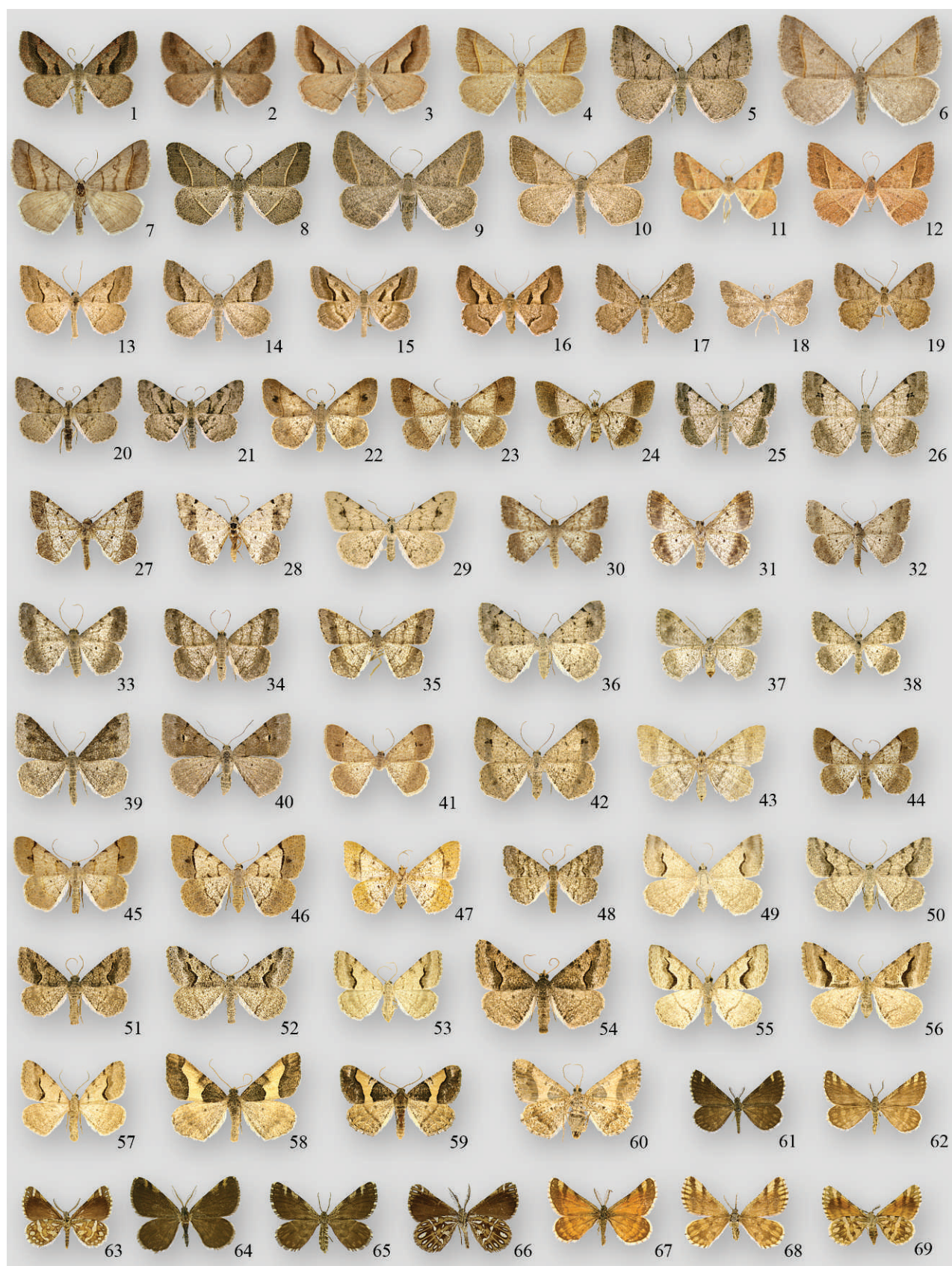


PLATE 9

Geometroidea

GEOMETRIDAE

figs. 1–15

VARIABLE SIZES

1. *Nematocampa resistaria* (H.-S.). Larva on *Fraxinus*. Mansfield, Tolland Co., Connecticut; photograph by D. L. Wagner. (p. 29).
2. *Taeniogramma tenebrosata* (Hulst). Ex ovum on *Calliandra*. Ash Canyon, Huachuca Mountains, Cochise Co., Arizona; photograph by D. C. Ferguson. (p. 38).
3. *Protitame virginalis* (Hulst). Ex ovum on *Populus tremuloides*. Granville Ferry, Annapolis Co., Nova Scotia; photograph by D. C. Ferguson. (p. 40).
4. *Protitame virginalis* (Hulst). Ex ovum on *Populus tremuloides*. Granville Ferry, Annapolis Co., Nova Scotia; photograph by D. C. Ferguson. (p. 40).
5. *Protitame subalbaria* (Pack.). Ex ovum on *Populus tremuloides*. Lee Vining, Mono Co., California; photograph by D. C. Ferguson. (p. 44).
6. *Heliomata cycladata* G. & R. Ex ovum on *Robinia*. Goose Creek, Loudoun Co., Virginia; photograph by D. C. Ferguson. (p. 51).
7. *Heliomata infulata* (Grt.). Larva on *Robinia hispida*. Fort Bragg, Hoke Co., North Carolina; photograph by D. L. Wagner. (p. 55).
8. *Isturgia dislocaria* (Pack.). Larva on *Celtis*. Fort Niobrara, Cherry Co., Nebraska, Virginia; photograph by D. C. Ferguson. (p. 57).
9. *Eumacaria madopata* (Gn.). Ex ovum on *Prunus serotina*. Anthony, Marion Co., Florida; photograph by D. C. Ferguson. (p. 62).
10. *Mellilla xanthometata* (Wlk.). Larva on *Gleditsia triacanthos*. Burdon Falls, Pope Co., Illinois; photograph by D. C. Ferguson. (p. 64).
11. *Trigrammia quadrinotaria* H.-S. Ex ovum on *Aesculus*. Walker Mountain, Marion, Smyth Co., Virginia; photograph by D. C. Ferguson. (p. 67).
12. *Speranza varadaria* (Wlk.). Ex ovum on *Baccharis halimifolia*. Lake Placid, Highlands Co., Florida; photograph by D. C. Ferguson. (p. 72).
13. *Speranza marcescens* (Gn.). Larva on *Baccharis*. [No locality given, ed.]; photograph by B. Scaccia. (p. 75).
14. *Speranza marcescens* (Gn.). Larva on *Baccharis*. [No locality given, ed.]; photograph by B. Scaccia. (p. 75).
15. *Speranza brunneata* (Thunb.). Larva on *Vaccinium angustifolium*. Gogama, Ontario; photograph by K. N. Barber. (p. 76).

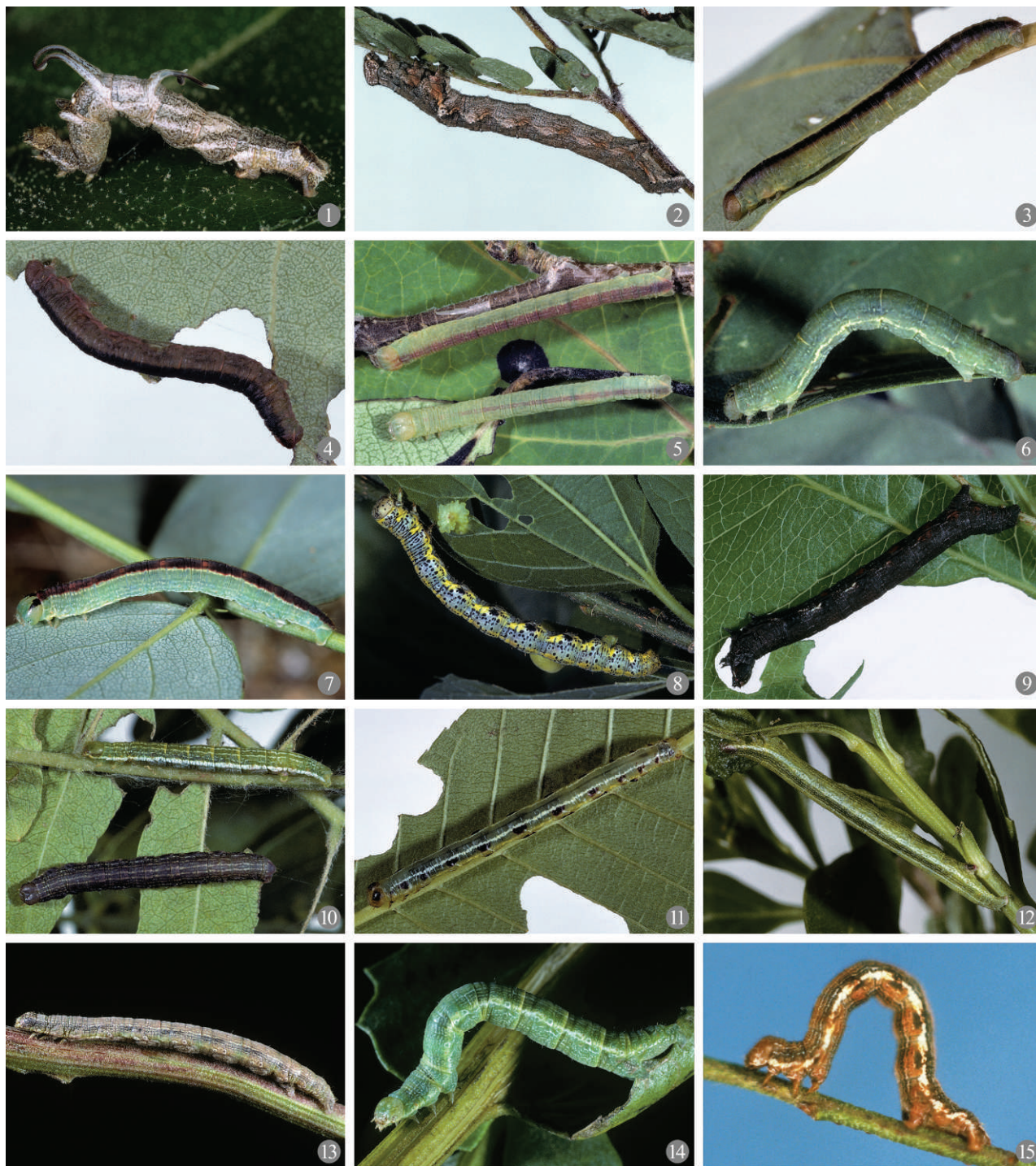


PLATE 10

Geometroidea

GEOMETRIDAE

figs. 1–15

VARIABLE SIZES

1. *Speranza sulphurea* (Pack.). Larva on *Vaccinium macrocarpon*. Bois-Francis, Quebec; photograph by J.-F. Landry. (p. 82).
2. *Speranza exauspicata* (Wlk.). Larva on *Prunus emarginata*. Blue Canyon, Placer Co., California; photograph by B. Scaccia. (p. 94).
3. *Speranza exauspicata* (Wlk.). Larva on *Quercus rubra*. Canada; photograph from Canadian National Collection. (p. 94).
4. *Speranza extemporata* (B. & McD.). Larva on *Cercocarpus betuloides*. [No locality given, ed.]; photograph by B. Scaccia. (p. 96).
5. *Speranza coortaria* (Hulst). Larva on *Malus sylvestris*. Mansfield, Tolland Co., Connecticut; photograph by D. L. Wagner. (p. 99).
6. *Speranza bitactata* (Wlk.). Larva on *Ribes cereum*. Metolius Basin, 20 miles NW Sisters, Jefferson Co., Oregon; photograph by J. C. Miller. (p. 103).
7. *Speranza subcessaria* (Wlk.). Larva on *Ribes*. Spruce Knob, Pendleton Co., West Virginia; photograph by D. L. Wagner. (p. 110).
8. *Speranza subcessaria* (Wlk.). Larva on *Ribes*. Spruce Knob, Pendleton Co., West Virginia; photograph by D. L. Wagner. (p. 110).
9. *Speranza colata correllata* (Hulst). Larva on *Purshia tridentata*. [No locality given, ed.]; photograph by B. Scaccia. (p. 116).
10. *Speranza colata correllata* (Hulst). Larva on *Purshia tridentata*. Santiam Pass, 5 miles NW Sisters, Deschutes Co., Oregon; photograph by J. C. Miller. (p. 116).
11. *Speranza andersoni* (Swett). Larva on *Vaccinium*. Canada; photograph from Canadian National Collection. (p. 122).
12. *Speranza argillacearia* (Pack.). Larva on *Vaccinium angustifolium*. Spruce Knob, Pendleton Co., West Virginia; photograph by D. L. Wagner. (p. 123).
13. *Speranza ribearia* (Fitch). Larva on *Ribes*. Spruce Knob, West Virginia; photograph by D. C. Ferguson. (p. 127).
14. *Speranza lorquinaria* (Gn.). Larva on *Alnus sinuata*. Lane Co., Oregon; photograph by B. Scaccia. (p. 131).
15. *Speranza lorquinaria* (Gn.). Larva on *Alnus rhombifolia*. Mendocino Co., California; photograph by B. Scaccia. (p. 131).



PLATE 11

Geometroidea

GEOMETRIDAE

figs. 1–15

VARIABLE SIZES

1. *Speranza plumosata* (B. & McD.). Larva on *Acer glabrum*. Metolius Basin, 20 miles NW Sisters, Jefferson Co., Oregon; photograph by J. C. Miller. (p. 136).
2. *Speranza pustularia* (Gn.). Larva on *Acer rubrum*. Storrs, Mansfield, Tolland Co., Connecticut; photograph by V. Giles. (p. 138).
3. *Speranza quadrilinearia* (Pack.). Larva on *Ceanothus velutinus*. Warm Springs Indian Reservation (south boundary with Metolius Basin), Jefferson Co., Oregon; photograph by J. C. Miller. (p. 140).
4. *Speranza quadrilinearia* (Pack.). Larva on *Ceanothus velutinus*. Plumas Co., California; photograph by B. Scaccia. (p. 140).
5. *Speranza guenearia* (Pack.). Larva on *Rhamnus californica*. Lake Berryessa, Yolo Co., California; photograph by B. Scaccia. (p. 145).
6. *Speranza graphidaria* (Hulst). Larva on *Bumelia celastrina*. Sabal Palm Audubon Refuge, Cameron Co., Texas; photograph by D. L. Wagner. (p. 149).
7. *Epelis truncataria* (Wlk.). Ex ovum on *Chamaedaphne calyculata*. New Salem, Franklin Co., Massachusetts; photograph by D. L. Wagner. (p. 162).
8. *Psamatodes abydata* (Gn.). Larva on *Leucaena leucocephala*. Honolulu, Hawaii; photograph by D. Preston. (p. 171).
9. *Psamatodes abydata* (Gn.). Larva on *Prosopis glandulosa*. Port Brownsville, Cameron Co., Texas; photograph by D. L. Wagner. (p. 171).
10. *Psamatodes trientata* (H.-S.). Larva reared on *Pithecellobium ebano*. Audubon Sabal Palm Sanctuary, Cameron Co., Texas; photograph by D. L. Wagner. (p. 175).
11. *Macaria notata* (L.). Ex ovum on *Betula populifolia*. Granville Ferry, Nova Scotia; photograph by D. C. Ferguson. (p. 180).
12. *Macaria notata* (L.). Larva on *Betula papyrifera*. Wilmington, Essex Co., New York; photograph by D. L. Wagner. (p. 180).
13. *Macaria aemulataria* Wlk. Ex ovum on *Acer negundo*. Bear Canyon, Pima Co., Arizona; photograph by D. C. Ferguson. (p. 183).
14. *Macaria aemulataria* Wlk. Ex ovum on *Acer rubrum*. Colesville, Montgomery Co., Maryland; photograph by D. C. Ferguson. (p. 183).
15. *Macaria promiscuata* Fgn. Larva on *Cercis canadensis*. Colesville, Montgomery Co., Maryland; photograph by D. C. Ferguson. (p. 186).



PLATE 12

Geometroidea

GEOMETRIDAE

figs. 1–15

VARIABLE SIZES

1. *Macaria aequiferaria* Wlk. Ex ovum on *Taxodium*. Welaka, Putnam Co., Florida; photograph by D. C. Ferguson. (p. 192).
2. *Macaria bisignata* (Wlk.). Ex ovum on *Pinus strobus*. Beltsville, Prince George's Co., Maryland; photograph by D. C. Ferguson. (p. 194).
3. *Macaria bisignata* (Wlk.). Ex ovum on *Pinus virginiana*. Beltsville, Prince George's Co., Maryland; photograph by D. C. Ferguson. (p. 194).
4. *Macaria adonis* B. & McD. Larva on *Pinus virginiana*. South Lake Tahoe, Eldorado Co., California; photograph by D. C. Ferguson. (p. 199).
5. *Macaria ponderosae* Wlk. Ex ovum on *Pinus ponderosa*. Chadron, Dawes Co., Nebraska; photograph by D. C. Ferguson. (p. 201).
6. *Macaria ponderosae* Wlk. Ex ovum on *Pinus ponderosa* and *P. virginiana*. Chadron, Dawes Co., Nebraska; photograph by D. C. Ferguson. (p. 201).
7. *Macaria transitaria resinosae* Fgn. Larva on *Pinus resinosa*. Bourne, Barnstable Co., Massachusetts; photograph by D. L. Wagner. (p. 203).
8. *Macaria transitaria resinosae* Fgn. Ex ovum on *Pinus resinosa*. Griswold, New London Co., Connecticut; photograph by D. L. Wagner. (p. 203).
9. *Macaria distribuaria* (Hbn). Larva on *Pinus taeda*. Holly Shelter State Game Lands, Pender Co., North Carolina; photograph by D. L. Wagner. (p. 204).
10. *Semiothisa sanfordi* (Rindge). Ex ovum on *Pinus clausa*. Archbold Biological Station, Highlands Co., Florida; photograph by D. C. Ferguson. (p. 206).
11. *Macaria minorata* Pack. Ex ovum on *Pinus strobus*. Colesville, Montgomery Co., Maryland; photograph by D. C. Ferguson. (p. 207).
12. *Macaria sexmaculata sexmaculata* Pack. Ex ovum on *Larix* (reared on *Cedrus deodara*). Upper Economy, Nova Scotia; photograph by D. C. Ferguson. (p. 211).
13. *Macaria sexmaculata sexmaculata* Pack. Ex ovum on *Larix* (reared on *Cedrus deodara*). Upper Economy, Cumberland Co., Nova Scotia; photograph by D. C. Ferguson. (p. 211).
14. *Macaria submarmorata* Wlk. Ex ovum on *Larix*. Upper Economy, Cumberland Co., Nova Scotia; photograph by D. C. Ferguson. (p. 213).
15. *Macaria signaria* (Hbn.). Ex ovum on *Pseudotsuga menziesii*. Quilcene, Jefferson Co., Washington; photograph by D. C. Ferguson. (p. 216).



PLATE 13

Geometroidea

GEOMETRIDAE

figs. 1–15

VARIABLE SIZES

1. *Macaria signaria* (Hbn.). Ex ovum on *Picea pungens*. Clingman's Dome, Swain Co., North Carolina; photograph by D. C. Ferguson. (p. 216).
2. *Macaria unipunctaria* (Wgt.). Ephraim, Sanpete Co., Utah; photograph by D. C. Ferguson. (p. 219).
3. *Mascaria pinistrobata* (Fgn.). Ex ovum on *Pinus strobus*. Armdale, Halifax Co., New Scotia; photograph by D. C. Ferguson. (p. 221).
4. *Macaria fissinotata* (Wlk.). Larva on *Tsuga canadensis*. Roaring Fork, Sevier Co., Tennessee; photograph by D. C. Ferguson. (p. 223).
5. *Macaria oweni* (Swett). Larva on *Larix*. Bloomingdale Bog, Franklin Co., New York; photograph by D. L. Wagner. (p. 224).
6. *Macaria granitata* Gn. Ex ovum on *Pinus virginiana*. Beltsville, Prince George's Co., Maryland; photograph by D. C. Ferguson. (p. 225).
7. *Macaria granitata* Gn. Ex ovum on *Pinus virginiana*. Beltsville, Prince George's Co., Maryland; photograph by D. C. Ferguson. (p. 225).
8. *Macaria multilineata* Pack. Ex ovum on *Juniperus virginiana*. Colesville, Montgomery Co., Maryland; photograph by D. C. Ferguson. (p. 227).
9. *Letispe metanemaria* (Hulst). Ex ovum on *Baccharis*. Carr Canyon, Huachuca Mountains, Cochise Co., Arizona; photograph by D. C. Ferguson. (p. 232).
10. *Digrammia californiaria* (Pack.). Larva on *Lupinus*, *Medicago*, and *Vicia*. [No locality given, ed.]; photograph by B. Scaccia. (p. 236).
11. *Digrammia colorata* (Grt.). Ex ovum on *Larrea divaricata*. Lajitas, Brewster Co., Texas; photograph by D. C. Ferguson. (p. 237).
12. *Digrammia colorata* (Grt.). Ex ovum on *Larrea divaricata*. Lajitas, Brewster Co., Texas; photograph by D. C. Ferguson. (p. 237).
13. *Digrammia sexpunctata* (Bates). Larva on *Purshia tridentata*. Graeagle, Plumas Co., California; photograph by B. Scaccia. (p. 243).
14. *Digrammia sexpunctata* (Bates). Ex ovum on *Purshia tridentata*. [No locality given, ed.]; photograph by B. Scaccia. (p. 243).
15. *Digrammia delectata* (Hulst). Larva on *Ceanothus cuneatus*. [No locality given, ed.]; photograph by B. Scaccia. (p. 244).



PLATE 14

Geometroidea

GEOMETRIDAE

figs. 1–15

VARIABLE SIZES

1. *Digrammia triviata* (B. & McD.). Ex ovum on *Juniperus deppeana*. Madera Canyon, Davis Mountains, Jefferson Davis Co., Texas; photograph by D. C. Ferguson. (p. 258).
2. *Digrammia triviata* (B. & McD.). Ex ovum on *Juniperus deppeana*. Madera Canyon, Davis Mountains, Jefferson Davis Co., Texas; photograph by D. C. Ferguson. (p. 258).
3. *Digrammia triviata* (B. & McD.). Ex ovum on *Juniperus deppeana*. Madera Canyon, Davis Mountains, Jefferson Davis Co., Texas; photograph by D. C. Ferguson. (p. 258).
4. *Digrammia continuata* (Wlk.). Ex ovum on *Juniperus virginiana*. Colesville, Montgomery Co., Maryland; photograph by D. C. Ferguson. (p. 261).
5. *Digrammia setonana* (McD.). Larva on *Juniperus*. Radium, British Columbia; photograph by P. S. Debnam (Canadian Forestry Service). (p. 265).
6. *Digrammia napensis* (McD.). Ex ovum on *Juniperus*. Berkeley, Alameda Co., California; photograph by D. C. Ferguson. (p. 266).
7. *Digrammia napensis* (McD.). Ex ovum on *Juniperus*. Berkeley, Alameda Co., California; photograph by D. C. Ferguson. (p. 266).
8. *Digrammia pallorata* Fgn. Ex ova on *Juniperus monosperma* and *J. pinchotii*. White's City, New Mexico; photograph by D. C. Ferguson. (p. 270).
9. *Digrammia pallorata* Fgn. Ex ova on *Juniperus monosperma* and *J. pinchotii*. Lower Ephraim Canyon, Sanpete Co., Utah; photograph by D. C. Ferguson. (p. 270).
10. *Digrammia cinereola* (Hulst). Larva on *Juniperus monosperma* and *J. pinchotii*. Madera Canyon, Davis Mountains, Fort Davis Co., Texas; photograph by D. C. Ferguson. (p. 272).
11. *Digrammia cinereola septemnerata* (B. & McD.). Ex ovum on *Juniperus monosperma*. Lower Ephraim Canyon, Sanpete Co., Utah; photograph by D. C. Ferguson. (p. 274).
12. *Digrammia burneyata* (McD.). Ex ovum on *Calocedrus decurrens*. Cave Junction, Josephine Co., Oregon; photograph by D. C. Ferguson. (p. 274).
13. *Digrammia atrofasciata* (Pack.). Ex ovum on *Juniperus*. Fort Davis, Fort Davis Co., Texas; photograph by D. C. Ferguson. (p. 276).
14. *Digrammia modocata* Fgn. Larva on *Juniperus occidentalis*. Prineville Overlook, 1 mile W Prineville, Crook Co., Oregon; photograph by J. C. Miller. (p. 277).
15. *Digrammia muscariata muscariata* (Gn.). Ex ovum on *Quercus garryana*. Cave Junction, Josephine Co., Oregon; photograph by D. C. Ferguson. (p. 281).



PLATE 15

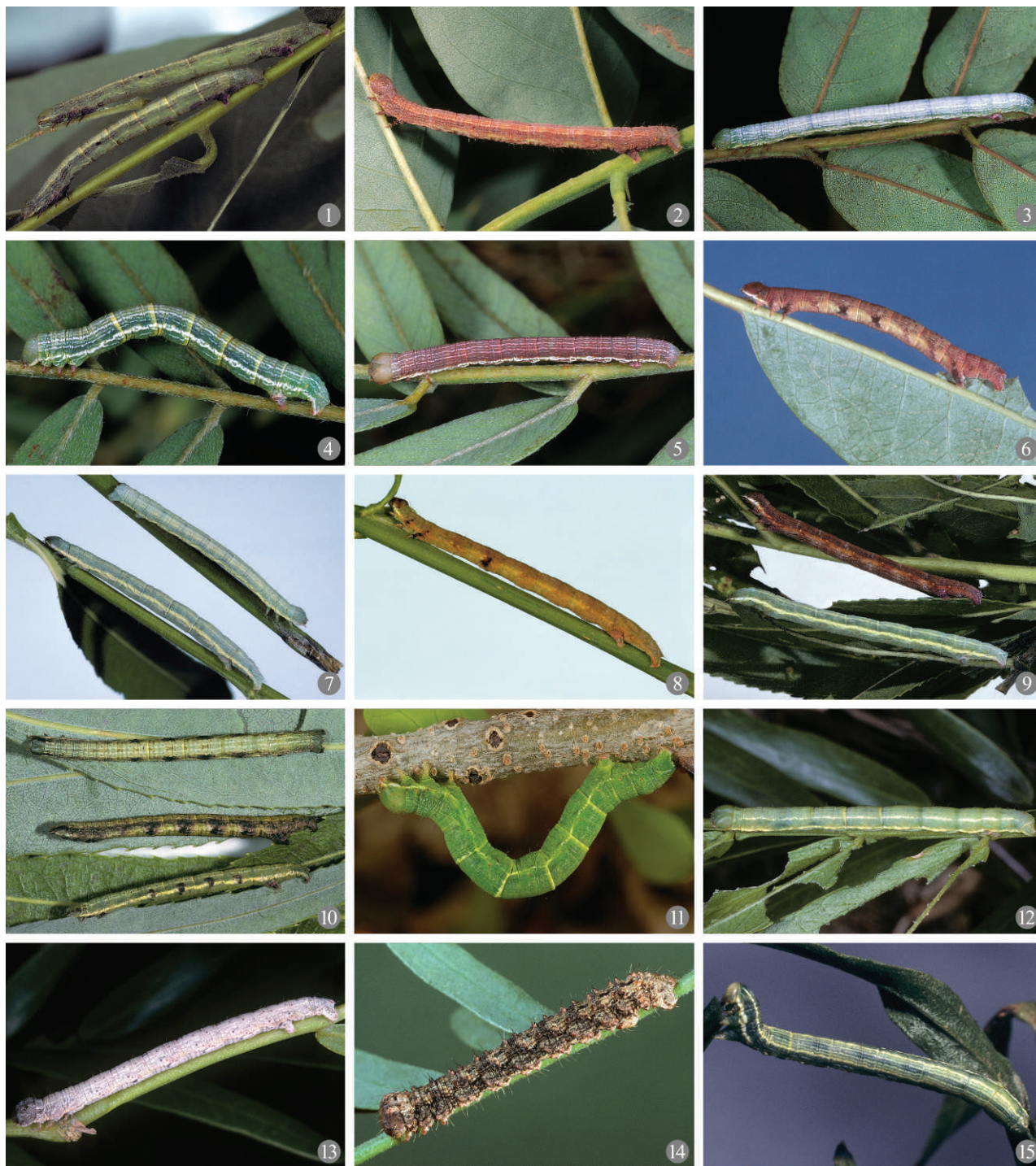
Geometroidea

GEOMETRIDAE

figs. 1–15

VARIABLE SIZES

1. *Digrammia ocellinata* (Gn.). Ex ovum on *Robina pseudacacia*. Colesville, Montgomery Co., Maryland; photograph by D. C. Ferguson. (p. 283).
2. *Digrammia ocellinata* (Gn.). Ex ovum on *Robina pseudacacia*. Mansfield, Tolland Co., Connecticut; photograph by D. L. Wagner. (p. 283).
3. *Digrammia ordinata* (Wlk.). Larva on *Amorpha fruticosa*. Big Island, Green Swamp, Brunswick Co., North Carolina; photograph by D. L. Wagner. (p. 287).
4. *Digrammia eremiata* (Gn.). Larva on *Tephrosia virginiana*. Weymouth Woods, Hoke Co., North Carolina; photograph by D. L. Wagner. (p. 290).
5. *Digrammia eremiata* (Gn.). Larva on *Tephrosia virginiana*. Weymouth Woods, Hoke Co., North Carolina; photograph by D. L. Wagner. (p. 290).
6. *Digrammia rippertaria* (Dup.). Larva on *Salix*. Luscar, circa 40 km south of Hinton, Alberta; photograph by P. S. Debnam (Canadian Forestry Service). (p. 295).
7. *Digrammia decorata* (Grossb.). Ex ovum on *Salix babylonica*. Mono Lake, Mono Co., California; photograph by D. C. Ferguson. (p. 299).
8. *Digrammia neptaria* (Gn.). Ex ovum on *Salix babylonica*. Weymouth Major's Flat, Ephraim, Sanpete Co., Utah; photograph by D. C. Ferguson. (p. 311).
9. *Digrammia subminiata* (Pack.). Larva on *Salix*. Cimarron, Cimarron Co., New Mexico; photograph by D. C. Ferguson. (p. 309).
10. *Digrammia gnophosaria* (Gn.). Ex ovum on *Salix babylonica*. Colesville, Montgomery Co., Maryland; photograph by D. C. Ferguson. (p. 320).
11. *Rindgea flaviterminata* (B. & McD.). Larva on *Pithecellobium ebano*. Southmost, Cameron Co., Texas; photograph by D. L. Wagner. (p. 335).
12. *Rindgea cyda* (Druce). Larva on *Prosopis glandulosa*. Port Brownsville, Cameron Co., Texas; photograph by D. L. Wagner. (p. 339).
13. *Rindgea cyda* (Druce). Larva on *Prosopis glandulosa*. Port Brownsville, Cameron Co., Texas; photograph by D. L. Wagner. (p. 339).
14. *Rindgea hypaethrata* (Grt.). Ex ovum on *Prosopis glandulosa*. Winkelman, Gila Co., Arizona; photograph by B. Scaccia. (p. 343).
15. *Fernaldella fimetaria* (G. and R.). Ex ovum on *Gutierrezia sarothrae*. Ash Canyon, Huachuca Mountains, Cochise Co., Arizona; photograph by N. McFarland. (p. 345).



NOTES

1. ABBREVIATIONS FOR COLLECTORS AND COLLECTIONS

(Institutions receiving private collections in square brackets after name of private collector, e.g., Henry Hensel, Edmunston, New Brunswick [CNC])

AMNH	American Museum of Natural History, New York
ANSP	Academy of Natural Sciences, Philadelphia
BM	Bryant Mather, Clinton, Mississippi [MEM]
BMNH	The Natural History Museum (formerly British Museum (Natural History)), London
CAS	California Academy of Sciences, San Francisco
CMNH	Carnegie Museum of Natural History, Pittsburgh
CNC	Canadian National Collection, Ottawa
CSUC	Colorado State University, Fort Collins
CU	Cornell University, Ithaca, New York
ECK	Edward C. Knudson, Belaire, Texas
GSNP	Museum Collection Great Smoky Mountains National Park, Gatlinburg, Tennessee
HH	Henry Hensel, Edmunston, New Brunswick [CNC]
JDG	John D. Glaser, Berkeley Springs, West Virginia
JGF	John G. Franclemont, Ithaca, New York [CU, USNM]
JKA	James K. Adams, Calhoun, Georgia
JRH	J. Richard Heitzman, Independence, Missouri
JSN	John S. Nordin, Laramie, Wyoming
LACM	Los Angeles County Museum of Natural History, Los Angeles
LGC	Lars G. Crabo, Bellingham, Washington
LLC	Laurence L. Crabtree, Bieber, California
MCZ	Museum of Comparative Zoology, Cambridge, Massachusetts
MEM	Mississippi Entomological Museum, Mississippi State
MSU	Michigan State University, East Lansing
OSUO	Oregon State University, Corvallis
RAB	Robert A. Belmont, Sanford, Florida
RHL	Ronald H. Leuschner, Manhattan Beach, California
RMNH	National Natuurhistorische Museum, Leiden
RN	Ray Nagle, Tucson, Arizona
ROM	Royal Ontario Museum, Toronto
SDNHM	San Diego Natural History Museum, California
SMFD	Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt-am-Main, Germany
TSD	Terhune S. Dickel, Anthony, Florida

UCB	University of California, Berkeley [Essig Museum of Entomology]
UCMS	Department of Ecology and Evolutionary Biology, University of Connecticut at Storrs
USNM	National Museum of Natural History (formerly United States National Museum), Washington, DC
VAB	Vernon A. Brou, Abita Springs, Mississippi
ZMHB	Museum für Naturkunde der Humboldt Universität, Berlin
ZSBS	Zoologische Sammlung Bayerischen Staats, Munich

2. COMMON NAMES

The use of an asterisk "*" in the text denotes a name listed in *Common Names of Insects & Related Organisms* 1989, published by the Entomological Society of America.

French-language common names have been taken from Benoit, P. et al., 1975, *French Names of Insects in Canada* published for the Quebec Society for the Protection of Plants, Quebec. The abbreviation "m" after a name indicates that it is masculine, "f" that it is feminine.

3. CITATIONS OF AUTHORITIES

Authors' names without parentheses indicate that the specific name is associated with the genus in which it was described.

Authors' names in parentheses indicate that the specific name has been transferred from the genus in which it was described to another genus.

4. WING LENGTH

Wing length is the measurement in millimeters from the base to the apex of the forewing.

5. LOCATION OF TYPE SPECIMEN

The current location of the type specimen is given by the appropriate abbreviation in square brackets immediately following the type locality. The word "lost" indicates that it no longer exists or has not been located after extensive search.

6. NOMENCLATURE FOR LARVAL SETAE

Hinton's (*Trans. Royal Ent. Soc. London*, 97: 1–37, 1946) terminology as modified by Stehr (Order Lepidoptera, in Stehr, F. W., *Immature Insects*, 288–304, 1987) is used to refer to larval setae.

THE MOTHS OF NORTH AMERICA

CHECK LIST

Species recorded from Mexico but not from America north of Mexico are indicated by an asterisk (*).

ENNOMINAE

Abraxini Warr., 1893

LIGDIA Gn., 1857 [1858]
Harpicostia Wehrli, 1936
wagneri Fgn. & Adams, 2008

Cassimini Holloway, 1993

NEMATOCAMPA Gn., 1857 [1858]
resistaria (H.-S., 1855)
limbata (Haw., 1809), preocc.
vestitaria (H.-S., 1855)
filamentaria (Gn., 1857 [1858])
expunctaria Grt., 1872
brunneolineata (Hulst, 1900)
chagnoni (Swett, 1913)
orfordensis C. & S., 1922
brehmeata (Grossb., 1907)
baggettaria Fgn., 1993

TAENIOGRAMMA Dognin, 1913
PROPHASIANE McD., 1939
quadrianea (Schaus, 1901)
quadrifasciata (Tayl., 1906)
octolineata (Hulst, 1887)
mendicata (Hulst, 1887)
tenebrosata (Hulst, 1887)
lamitaria (Dyar, 1913)

PROTITAME McD., 1939
SPERRYA Rindge, 1958
virginalis (Hulst, 1900)
subalbaria (Hulst, 1896), preocc.
hulstaria (Tayl., 1906)
discalis McD., 1939
albescens McD., 1939
subalbaria (Pack., 1873)
matilda (Dyar, 1904)
pallicolor (Dyar, 1923)
cervula (Rindge, 1958)

Macariini Gn., 1857 [1858]
SEMIOTHISINI Warr., 1894
FERNALDELLINAE Hulst, 1896

HELIOMATA G. & R., 1866
PEPASMENOPTERA Gump., 1887
cycladata G. & R., 1866
fulliola B. & McD., 1917
scintillata Fgn., 2008
infulata (Grt., 1863)
elaborata (Grt., 1863), identity uncertain

ISTURGIA Hbn., 1816 [1823]
HISTURGIA Agassiz, 1847, unjustified emend.

ENCONISTA Led., 1853
TEPHRINA Gn., 1844 [1854]
BICHROMA Gump., 1887
dislocaria (Pack, 1876)
malefactaria (B. & McD., 1917)

EUMACARIA Pack., 1873
madopata (Gn., 1857 [1858])
latiferrugata (Wlk., 1862 [1863])
brunneata Pack., 1873

MELLILLA Grt., 1873
GONILYTHRIA Gump., 1887
xanthometata (Wlk., 1862)
chamaechrysaria Grt., 1873
rilevaria (Pack., 1876)
snoviaria (Pack., 1876)

TRIGRAMMIA H.-S., 1850–1858 [1855]
quadrinotaria H.-S., 1850–1858 [1855]
quadriguttaria (Wlk., 1861)
determinataria (Wlk., 1863)
septemfluaria (Grt., 1881)

SPERANZA Curtis, 1828
DIASTICTIS Hbn., 1816 [1823], preocc. by *Diastictis* Hbn., 1818
HALIA Dup., 1829 [4 April], preocc. by *Halia* Risso, 1826
GRAMMATOPHORA Steph., 1829 [June]
EUISTERIA Bdv., 1840
THAMNONOMA Led., 1853
FIDONIA H.-S., 1855, preocc. by *Fidonia* Tr., 1825
EUFITCHIA Pack., 1876
CATASTICTIS Gump., 1887
ELPISTE Gump., 1887
PHYSOSTEGANIA Warr., 1894
DYSMIGIA Warr., 1895, rev. syn.
SYMPHERTA Hulst, 1896, preocc. by *Sympherta* Förster, 1868
GLADELA Grossb., 1909, replacement name
PROUTICTIS Bryk, 1938, replacement name
ITAME; auth., not Hbn., 1823

VARADARIA-group
varadaria (Wlk., 1860)
inaptata (Wlk., 1861)
abbreviata (Wlk., 1862 [1863])
donataria (Wlk., 1862 [1863]), nomen nudum
florida (Hulst, 1896)
marcescaria (Gn., 1857 [1858])
cineraria (Pack., 1871)

BRUNNEATA-group
brunneata (Thunb., 1784)
fulvaria (Villers, 1789)
pinetaria (Hbn., 1796 [1799])
quinquaria (Hbn., 1796 [1822])
sylvaria Curt., 1828
ferruginaria (Pack., 1873)
inextricata (Wlk., 1861)
floridensis (Hulst, 1898)

GEOMETROIDEA

exonerata Fgn., 2008
sulphurea (Pack., 1873)
sulphuraria (Pack., 1876)
olivalis (Hulst, 1898)
amboflava (Fgn., 1953)

ABRUPTATA-group
abruptata (Wlk., 1862)
pallidula (Hulst, 1896)
umbriferata (Hulst, 1887)
umbrifasciata (Hulst, 1896), nomen nudum

EXAUSPICATA-group
anataria (Swett, 1913)
boreata Fgn., 2008
coloradensis (Hulst, 1896)
aegaria (Stkr., 1899)
exauspicata (Wlk., 1861)
confederata (B. & McD., 1917)
extemporata (B. & McD., 1917)

COORTARIA-group
coortaria (Hulst, 1887)
enigmata (B. & McD., 1917)
hesperata Fgn., 2008
prunosata Fgn., 2008

BITACTATA-group
bitactata (Wlk., 1862)
atrosignata (Wlk., 1862)
packardaria (Mösch., 1883)
epigenata (B. & McD., 1917)
wauaria (L., 1758), introduced
fuscaria (Thunb., 1792), preocc.
v-nigraria (Haw., 1809)
vauaria (Haw., 1809), emend.
a. **chinensis** (Sterneck, 1928), extralimital
b. **africana** (Zerny, 1934), extralimital
c. **koreaebia** (Bryk, 1949), extralimital
subcessaria (Wlk., 1861)
perarcuata (Wlk., 1862)
denticulodes (Hulst, 1896)
semivolata (Dyar, 1923)
decorata (Hulst, 1896)

COLATA-group
colata (Grt., 1881)
sericeata (Hulst, 1898)
a. **correllata** (Hulst, 1896)

RIBEARIA-group
occiduaria (Pack., 1874)
andersoni (Swett, 1916)
orientis (Fgn., 1953)
argillacearia (Pack., 1874)
modestaria (Hulst, 1895)
evagaria (Hulst, 1900)
flavicaria (Pack., 1876)
subfalcata (Hulst, 1896)
helena (Cass., 1928)
ribearia (Fitch, 1848)
sigmaria (Gn., 1857 [1858])
annisaria (Wlk., 1860)

aniusaria (Wlk., 1863)
fascioferaria (Hulst, 1887)
simplex (Dyar, 1907)

UNASSOCIATED SPECIES
lorquinaria (Gn., 1857 [1858])
tripunctaria (Pack., 1873)
loricaria (Evers., 1837)
vinctaria (Zell., 1846)
julia (Hulst, 1896)
nubilata (Warr., 1904)
plumosata (B. & McD., 1917)
pustularia (Gn., 1857 [1858])

QUADRILINEARIA-group
quadrilinearia (Pack., 1873)
inquinaria (Hulst, 1887)
disparata (Warr., 1904)
pallescens (Grossb., 1907)
trilinearia (Grossb., 1910)
guenearia (Pack., 1876)
austrinata Fgn., 2008

GRAPHIDARIA-group
deceptrix (Dyar, 1913)
sobriaria (B. & McD., 1917)
graphidaria (Hulst, 1887)
schatzeata (Cass., 1927)
dimidiata (Cass., 1927)
minata (Cass., 1928)
benigna (Hulst, 1898)
perornata (B. & McD., 1916)

PALLIPENNATA-group
grossbecki (B. & McD., 1913)
saphenata Fgn., 2008
simpliciata (B. & McD., 1918)
pallipennata (B. & McD., 1912)

EPELIS Hulst, 1896
truncataria (Wlk., 1862)

PSAMATODES Gn., 1857 [1858]
XENOECISTA Warr., 1897

PALLIDATA-group
pallidata (Warr., 1897)
trimaculata (Warr., 1906)
atrimacularia (B. & McD., 1913)
rectilineata (Warr., 1900)
fragilis (Warr., 1904)

ABYDATA-group
abydata (Gn., 1857 [1858])
infusata (Gn., 1857 [1858])
diffusata (Gn., 1857 [1858])
lataria (Wlk., 1861)
santaremaria (Wlk., 1861)
punctolineata (Pack., 1873)
adrasata (Snell., 1874)
simulata (Hulst, 1887)

THE MOTHS OF NORTH AMERICA

ochrata (Warr., 1900)
vagabunda (Inoue, 1991)
trientata (H.-S., 1870)
everiata (Gn., 1857 [1858]), extralimital
rithrusaria (Wlk., 1860)
tegularia (Wlk., 1860)
 a. **errata** (McD., 1939)

MACARIA Curt., 1826
EUTROPA Hbn., 1825 [1831]
PHILOBIA Dup., 1829
SCIAGRAPHIA Hulst, 1896
SEMIOTHISA; auth, not Hbn., 1818

NOTATA-group

notata (L., 1758)
notataria (ID. & S.), 1775), emend.
notaria (Morris, 1861), emend.
ulsterata (Pears., 1913)
kirina Wehrli, 1940, subsp., extralimital
 a. **appalachiata** Fgn., 2008
aemulataria Wlk., 1861
sectomaculata Morr., 1874
perplexata (Pears., 1913)
versitata (Pears., 1913)
aspirata (Pears., 1913)
juglandata Fgn., 2008
promiscuata (Fgn., 1974)
solisata Fgn., 2008*

UNASSOCIATED SPECIES

carpo (Druce, 1893)
fidelis Warr., 1897
punctistriata Warr., 1906

BICOLORATA-group

aequiferaria Wlk., 1861
postrema Wlk., 1861
subpunctaria Wlk., 1861
morosaria Wlk., 1861
bisignata (Wlk., 1866)
consimilata Zell., 1872
galbineata Zell., 1872
festa (Hulst, 1896)
masquerata Fgn., 2008
bicolorata, (Fgn., 1954), misidentification
bicolorata (F., 1798)
praeatomata (Haw., 1809)
consepia Wlk., 1861
grassata Hulst, 1881
adonis B. & McD., 1918
ponderosae Fgn., 2008
transitaria Wlk., 1861
 a. **resinosae** Fgn., 2008
distribuaria (Hbn, 1825 [1831])
oppositaria Gn., 1857 [1858]
proxanthata Wlk., 1863
antaurata (Wlk., 1863)
sanfordi (Rindge, 1958)
minorata Pack., 1873

SIGNARIA-group

sexmaculata Pack., 1867
unimodaria Morr., 1874
labradoriata (Mösch., 1883)
deleta (Hulst, 1900)
 a. **incolorata** Dyar, 1904
purcellata (Tayl., 1908)
submarmorata Wlk., 1861
marmorata (Fgn., 1972)
banksianae (Fgn., 1974), replacement name
signaria (Hbn., [1800]–[1809] [1809])
dispuncta (Wlk., 1860)
inordinaria (Wlk., 1860)
subapiciaria Wlk., 1861
haliata Wlk., 1861
irregulata Wlk., 1861
exnotata (Wlk., 1862)
quadrisignata Wlk., 1866
fraserata (Fgn., 1974)
unipunctaria (Wgt., 1916)
perplexa McD., 1927
pinistrobata (Fgn., 1972)
fissinotata (Wlk., 1862 [1863])
retinotata Wlk., 1862 [1863]
oweni (Swett, 1907)
granitata Gn., 1857 [1858]
succosata Zell., 1872

MULTILINEATA-group

multilineata Pack., 1873
patriciata (Grt., 1883)
ochrifascia (Warr., 1897), Bermuda, extinct*
verrilliata (Dyar, 1902)

LETISPE Fgn., 2008

metanemaria (Hulst, 1887)
castalia (Druce, 1893)

DIGRAMMIA Gump., 1887

ASMATE Gump., 1887
SPINUNCINA Wehrli, 1937
SEMIOTHISA; auth., not Hbn., 1818

CALIFORNIARIA-group

californiaria (Pack., 1871)
colorata (Grt., 1883)
godmani (Druce, 1892)
conarata (Grossb., 1908)
pervolata (Hulst, 1880)
davisata (Cass., 1928)
aliciata (Cass., 1928)

DENTICULATA-group

sexpunctata (Bates, 1886)
delectata (Hulst, 1887)
ubiquitata Fgn., 2008
denticulata (Grt., 1883)

NUBICULATA-group

pictipennata (Hulst, 1898)
terramalata Fgn., 2008
nubiculata (Pack., 1876)
palodurata Fgn., 2008

GEOMETROIDEA

curvata (Grt., 1880)
cruciata (Grt., 1883)

PALLIDATA-group

pallidata (Pack., 1873)
azureata (Cass., 1928)
triviata (B. & McD., 1917)
woodgateata (Cass., 1928)

CONTINUATA-group

continuata (Wlk., 1862)
strigularia (Wlk., 1862 [1863])
orillata (Wlk., 1862 [1863])
pertinata (McD., 1939)
setonana (McD., 1927)
napensis (McD., 1939)
imparilata Fgn., 2008
excurvata (Pack., 1874)
spodopterata (Hulst, 1898)
pallorata Fgn., 2008
cinereola (Hulst, 1896)
a. **septemberata** (B. & McD., 1917)
burneyata (McD., 1939)
atrofasciata (Pack., 1876)
nigroalbana (Cass., 1928)
modocata Fgn., 2008

MUSCARIATA-group

muscariata (Gn., 1857 [1858])
a. **respersata** (Hulst, 1880)
subacuta (Hulst, 1896)
b. **teucaria** (Stkr., 1899)
extenuata Fgn., 2008

EREMIATA-group

ocellinata (Gn., 1857 [1858])
duplicata (Pack., 1873)
ordinata (Wlk., 1862)
maculifascia (Hulst, 1896)
aucillaria (Stkr., 1899)
sublacteolata (Hulst, 1887)
lapitaria (Stkr., 1899)
humillima (Bastelberger, 1908)
eremiata (Gn., 1857 [1858])
relectata (Wlk., 1861)
retentata (Wlk., 1861)
gradata (Wlk., 1861)
subcinctaria (Wlk., 1862 [1863])

EQUIVOCATA-group

equivocata Fgn., 2008
ordinata; auth., not (Wlk., 1862)

RIPPERTARIA-group

rippertaria (Dup., 1830)
ponderosa (B. & McD., 1917)
demaculata (B. & McD., 1917)
a. **flavularia** (Püngeler, 1902), extralimital
hebetata (Hulst, 1881)
tulareata (C. & S., 1923)
innotata (C. & S., 1923)

decorata (Grossb., 1907)
sinuata (Warr., 1904), preocc.
arubrescens (McD., 1939)
suffusata (McD., 1939)
plemmelata Fgn., 2008
spinata (McD., 1939)
vernata (McD., 1939)
indeterminata (McD., 1939)
yavapai (Grossb., 1907)
mellistrigata (Grt., 1873)
gilletteata (Dyar, 1904)
subminiata (Pack., 1873)
meadiaria (Pack., 1874)
snoviata (Pack., 1876)
neptaria (Gn., 1857 [1858])
flavofasciata (Pack., 1871)
sinuata (Pack., 1874)
trifasciata (Pack., 1874)
cinereata (Bates, 1886)
irrorata (Pack., 1876)
a. **venosata** (McD., 1939)
b. **rubricata** Fgn., 2008
fieldi (Swett, 1916)
grossbecki (Swett, 1916)
comstocki (Sperry, 1949)
puertata (Grossb., 1912)
minuta (Hulst, 1896)
gnophosaria (Gn., 1857 [1858])
infectata (Wlk., 1862)
reductaria (Wlk., 1862)
caesiaria Hulst, 1888)
da (Dyar, 1916)

RINDGEA Fgn., 2008

MARICOPA-group

subterminata (B. & McD., 1913)
nigricomma (Warr., 1904)
nigricomina (McD., 1938), missp.
piccoloi (Rindge, 1976)
parcata (Grossb., 1908)
disparcata Fgn., 2008
stipularia (B. & McD., 1913)
prolificata Fgn., 2008
maricopa (Hulst, 1898)
sirenata (McD., 1934)
flaviterminata (B. & McD., 1913)

S-SIGNATA-group

s-signata (Pack., 1873)
cyda (Druce, 1893)
ballandrata (Wgt., 1923)
melanderi (Sperry, 1948)
hypaethrata (Grt., 1881)

FERNALDELLA Hulst, 1896

NARRAGA of authors, not Wlk., 1862
finetaria (G. & R., 1870)
halesaria (Zell., 1875)
partitaria (Grt., 1883)
angelata Wgt., 1923
georgiana (Covell, Finkelstein, and Towers, 1984)
stalachtaria (Stkr., 1878)
alternaria (Grt., 1883)

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