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A Revision of the Moths of
the Subfamily Geometrinae
of America North of Mexico
(Insecta, Lepidoptera)

Douglas C. Ferguson

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CONTENTS

ABSTRACTS (ENGLISH, GERMAN, RUSSIAN)	1
1. INTRODUCTION	3
Definition of the Subfamily Geometrinae	3
Distribution	4
Classification	5
Characters used in this revision	6
Materials and methods	12
2. KEYS TO TRIBES OF GEOMETRINAE OF AMERICA NORTH OF MEXICO	14
3. SYSTEMATIC ACCOUNT OF THE TRIBE NEMORIINI	16
4. SYSTEMATIC ACCOUNT OF THE TRIBE DICHORDOPHORINI	137
5. SYSTEMATIC ACCOUNT OF THE TRIBE SYNCHLORINI	141
6. SYSTEMATIC ACCOUNT OF THE TRIBE LOPHOCHORISTINI	182
7. SYSTEMATIC ACCOUNT OF THE TRIBE HEMITHEINI	190
8. LIST OF THE GENERA AND SPECIES OF GEOMETRINAE OF UNITED STATES AND CANADA WITH THEIR KNOWN DIS- TRIBUTION	236
9. ACKNOWLEDGEMENTS	241
LITERATURE CITED	243
INDEX TO TAXONOMIC NAMES	248
ILLUSTRATIONS (at back of book)	
Venation	PLATES 1-5
Male genitalia	PLATES 6-29
Female genitalia	PLATES 30-41
Figures of adults	PLATES 42-49



ABSTRACT

A new classification of the Geometrinae of the United States and Canada is presented, based largely on original investigations of male and female genitalia and larval characters. Ninety-one species of the previous literature, plus 10 new ones herein described and 5 added as new records of occurrence for the region covered, are reduced to a total of only 75, mostly by revised synonymy. These 75 species are placed in 15 genera and 5 tribes. Four new tribal names are proposed, namely: Nemoriini, Dichordophorini, Synchlorini, and Lophochoristini. The 5th tribal name, Hemitheini, has had previous application in the Palaearctic fauna. In the Hemitheini, 2 new generic names are proposed, *Xerochlora* (type: *Synchlora viridipallens* Hulst), and *Hethemia* (type: *Nemoria ? pistasciaria* Guenée). There are 11 new species names, as follows: in *Nemoria*, 9 new species are described, 4 from the southeastern United States and 5 from the southwest, plus one new name proposed to replace a homonym; in *Xerochlora*, one new species is described, from New Mexico and western Texas.

The North American Geometrinae are overwhelmingly austral in distribution, with all included species and genera, as well as 4 of the 5 tribes, exclusively American. In origin or affinity they are thus distinctly Neotropical rather than Eurasian.

ZUSAMMENFASSUNG

Eine neue Klassifizierung der Geometrinae in den Vereinigten Staaten und Kanada wird vorgelegt, hauptsächlich basiert auf Originaluntersuchungen von männlichen und weiblichen Genitalia und Raupenmerkmalen. Einundneunzig Arten, bekannt aus der bisherigen Literatur, sowie 10 neue Arten, die in dieser Arbeit beschrieben sind, und dazu 5 Arten, die neue Vorkommensbelege für Nordamerika sind, wurden, hauptsächlich durch Revision der Synonymie, zu 75 Arten reduziert. Diese 75 Arten sind auf 15 Gattungen in 5 Stämmen verteilt. Vier neue Stammesnamen werden vorgeschlagen: Nemoriini, Dichordophorini, Synchlorini und Lophochoristini. Der fünfte Stammesname, Hemitheini, ist schon früher in der paläarktischen Fauna gebraucht worden. In den Hemitheini werden zwei neue Gattungsnamen vorgeschlagen: *Xerochlora* (Type: *Synchlora viridipallens* Hulst) und *Hethemia* (Type: *Nemoria ? pistasciaria* Guenée). Elf neue Artnamen sind angewandt: 9 neue Arten sind in *Nemoria* beschrieben, davon 4 von den südöstlichen Vereinigten Staaten und 5 von den südwestlichen; dazu kommt ein neuer Name, um ein Homonym zu ersetzen; eine neue Art wird in *Xerochlora* von New Mexico und West Texas beschrieben.

Die Verbreitung der nordamerikanischen Geometrinae ist hauptsächlich südlich, wobei alle eingeschlossenen Arten und Gattungen, sowie 4 von den 5 Stämmen ausschliesslich amerikanisch sind. In Ursprung oder Affinität sind sie daher ausgesprochen eher neotropisch, als eurasisch.

РЕВИЗИЯ МОТЫЛЬКОВЫХ ПОДСЕМЕЙСТВА ГЕОМЕТРИНЫ, ОБИТАЮЩИХ
В АМЕРИКЕ К СЕВЕРУ ОТ МЕКСИКО (Насекомые, Мотыльковые)

ДУГЛАС К. ФЕРГУСОН

РЕЗЮМЕ

Представляемая здесь новая классификация геометрин Соединенных Штатов и Канады основана значительной частью на оригинальном исследовании половых органов самцов и самок и особенностей личинок. Количество видов — 91 вид, ранее описанный в научной литературе, 10 описанных здесь новых видов и 5 других, которые в первый раз обнаружены в данном районе, сокращено только до 76-и, главным образом за счет устранения синонимов. Эти 76 видов были разделены на 15 родов и 5 инфрасемейств. Предлагаются 4 новых названия инфрасемейств: *Nemoriini*, *Dichordophorini*, *Synchlorini*, *Lophochoristini*.

Название 5-го инфрасемейства *Hemitheini*, применялось раньше при описании палеарктической фауны. В составе этого инфрасемейства *Hemitheini*, были предложены два новых родовых названия: *Xerochlora* (type: *Synchlora viridipallens* Hulst), *Hethemia* (type: *Nemoria ? pistasciaria* Guenée). Есть 11 новых видовых названий, а именно: в составе *Nemoria* было описано 9 новых видов, 4 из юго-восточной части США и 5 из юго-западной, и еще одно новое название для замены существующего омонима. В числе *Xerochlora* описан новый вид из Нового Мексико и Западного Техаса.

Северо-американские геометрины имеют подавляющим множеством южное распространение; все их виды и роды, а тоже 4 из 5 инфрасемейств, исключительно американские. По происхождению или по родству они определенно принадлежат к неотропической, а не Евразийской фауне.

1. INTRODUCTION

DEFINITION OF THE SUBFAMILY GEOMETRINAE

It is difficult to give a satisfactory definition of the subfamily as there are few characters that occur consistently throughout the group or that are peculiar to it. There are, however, tendencies toward certain kinds of specializations, but at least some of these appear to have developed independently in different genera.

The geometrine antenna tends to be short, usually bipectinate in the male and either simple or bipectinate in the female. The inner and outer rows of pectinations are usually of unequal length. The tongue is usually well developed, and the palpi often have the third segment much lengthened in the female. The hind tibia may have either one or two pairs of spurs, and the male often has an apical extension or process extending beyond the base of the tarsus. The male hind tibia also is often swollen and prismatic, with a recessed hair pencil. The relationship of slender body to ample wing area follows the pattern typical of the Geometridae and the wings are always well developed, never rudimentary. In the venation, R_1 of the forewing nearly always arises from the cell; R_{2-5} is stalked, with M_1 usually arising from the base of the stalk. In the hindwing R is closely appressed or fused to Sc for a short distance, R and M_1 are stalked, and M_3 and Cu_1 are frequently stalked. M_2 is present in both wings and always originates from the end of the cell well above its middle. The third anals are commonly present in both wings but may be vestigial or wanting. The most characteristic features of the venation are probably the stalked condition of R_{2-5} , and the point of origin of M_2 much nearer to the base of $R_{2-5} + M_1$ than to M_3 .

The frenulum is usually present but rather small in the male, replaced by a weak tuft of bristles or wanting in the female. The subfamily shows a tendency toward loss of the male frenulum, and it is entirely wanting in genera of several different tribes, suggesting that its loss has occurred in these groups independently. For example, the frenulum is wanting in the Old World genera *Iodis*, *Comostola*, and *Thetidia* (placed in different tribes by Inoue, 1961), as well as in the New World *Dichordophora*. Among such obviously divergent forms, loss of the frenulum cannot be assumed to imply relationship. Lack of the frenulum may be accompanied by compensatory expansion of

the humeral lobe as in *Comostola* (Inoue, 1961, fig. 46), or in *Iodis* (Prout, 1912, p. 5, fig. 3), but this does not seem to be true of *Dichordophora*.

The male genitalia of the Geometrinae show a variety of specializations in the loss or modification of certain structures, and it is difficult to find any characters that are consistently present or which would distinguish the Geometrinae from other groups. All basic components of the male genitalia may be present and well developed, as in *Nemoria*, although the valve is usually very simplified. The uncus may be well developed or wanting, and in the latter case its prominent position, and presumably its function, is taken over by sclerotized socii. The socii are well developed and seem to play an important role almost throughout the subfamily, occurring as membranous flaps, or as rigid prongs or hooks, although they appear to be wanting in the Terpnini. The gnathos is frequently present as a complete, toothed ring, but may be reduced or missing. The transtilla and juxta are both nearly always present and assume many different shapes. The aedeagus is highly variable, as is also the shape of the eighth sternite.

The female genitalia seem to offer no exclusive subfamily characters, although they are very helpful for distinguishing species.

Color is rarely given serious consideration as a major group character, but in the Geometrinae an exception could be made. In its utilization of green pigment for cryptic simulation of green foliage, the subfamily has achieved a degree of success found in no other group of moths. Here and there in the Noctuoidea and Geometroidea there are small groups of species or genera characterized by green coloring, but nowhere else does this feature pervade almost an entire subfamily of worldwide distribution. As far as I could ascertain, about 85% of the species are at least partly green, and those that are not green belong almost entirely to Old World genera such as *Pingasa*, *Terpna*, and *Dindica*. There seem to be only three or four New World species that are not green, e.g., *Chloropteryx albidata* (Warren), none of them North American. A few Nearctic species are brown but also have green forms

Prominent dorsolateral abdominal protuberances are characteristic of the larvae of the American tribes Nemoriini and Synchlorini, and also occur in the Old World genera *Geometra* (Geometrini), and *Comibaena* (Comibaenini). In the tribe Synchlorini and the genus *Comibaena*, these processes bear special hooks by means of which the larvae clothe themselves with bits of plant material, although the two groups appear unrelated otherwise. The habit of feeding on flowers is common in the American species of two tribes, the Synchlorini and the Hemitheini, although these have larvae that are very different structurally. In the Old World there are at least several distinctive types of larvae that have no known New World counterparts as, for example, those of the genera *Terpna*, *Aracima*, and *Neohipparchus* in Japan.

DISTRIBUTION

The Geometrinae, comprising something of the order of 1,400 species, are found on all the large continental land masses of the world, but their numbers diminish rapidly toward the polar regions. The vast majority are tropical or

subtropical, and of the 75 species occurring within the region covered by this revision, most are concentrated in the states bordering on Mexico or the Gulf of Mexico. Only one North American species, *Mesothea incertata*, is exclusively boreal, and is mostly Canadian in distribution.

The American fauna is very distinct from that of Eurasia and, with but one possible exception, there is not a single genus common to both hemispheres. Prout assigned the West Indian species, *dominicaria* Guenée, to the Old World genus *Eucrotes*, but I have not as yet investigated this relationship. *Mesothea* and *Hethemia*, in the Hemitheini, are undoubtedly close to Palaeartic forms, but this is the only Old World tribe that I have been able to recognize in the American fauna. The Nemoriini, Synchronini, Lophochoristini, and Dichordophorini appear to be exclusively American, and the first is overwhelmingly dominant in number of species. The Neotropical fauna is rich and much in need of detailed study, although I suspect that most of the species will belong to the same tribes represented in North America.

The striking division between the Hemitheini and the other North American tribes, manifested most obviously in the two different types of green pigment that I discuss in the section on characters, together with apparent differences in larval structure, led me to wonder if the Hemitheini might not be a more remotely isolated group, not as closely related to the rest of the subfamily as had been supposed. However, the Lophochoristini, having both a hemitheine type of larva and the bright green coloring of the Nemoriini and Synchronini, seem to tie the two divisions together.

If one supposes that the New World geometrine fauna was derived through colonization from Eurasia, then at least two separate invasions are apparent. The more recent faunal interchange would have been that of the Hemitheini, still only slightly differentiated from their Palaeartic counterparts. The Nemoriini, Synchronini, and all other American groups, however, no longer show any close relationships to Old World forms, and hence their isolation, mainly in the Neotropics, is of great antiquity.

CLASSIFICATION

The uncertainty as to whether Hemitheinae or Geometrinae should be the accepted name for this subfamily was finally settled by Opinion 450 of the International Commission on Zoological Nomenclature, published March 8, 1957. This validated the generic name *Geometra* Linnaeus, 1758, p. 519, with *Phalaena papilionaria* Linnaeus, 1758, p. 522, as the type species, by designation under the Plenary Powers. This species had been designated as the type of *Geometra* by Duponchel in 1829.

The previous classification of the North American Geometrinae was based almost entirely on the work of Louis B. Prout, who published a world synopsis of the group in 1912 (*Genera Insectorum*, fasc. 129), and a later, somewhat modified treatment of the American species in 1931-33 (*In* Seitz, *Macrole-*

pidoptera of the World, vol. 8). James H. McDunnough did no revisional work in this group, and the arrangement and nomenclature of his 1938 check list was adapted virtually unchanged from Prout's publications. Although Prout had an uncanny ability to deduce relationships from superficial characters, he was severely limited by a lack of adequate American material and by a lack of information on genitalic structure. Brief comments on genitalia here and there in his paper of 1912 reveal that he was aware of their possibilities, but the highly refined techniques of dissection and microscopy that the present-day taxonomist accepts as routine developed after Prout's time, and indeed are still developing now.

The only real departure from the classification of Prout was that of Forbes (1948), where he combined *Racheospila* and *Nemoria*, an action that has proved to be correct. The only previously published genitalic figures were by Forbes (1948), who provided seven drawings of the male genitalia of eastern species of *Nemoria*, and by Todd (1955), who figured genitalia of both sexes of *Dichordophora*. There is not a single original description of a North American species accompanied by an illustration of genitalia.

Genitalic structure forms the basis of the present classification, and a comparison with Prout's arrangement of the same species (as in McDunnough, 1938), will show many changes. McDunnough listed 80 species, and 11 more were subsequently described, mostly by Sperry, bringing the total number of species for this region recognized in the literature to 91. Even with the addition of 10 new species names proposed in this paper, plus 5 new United States records, I have still reduced the number of recognized species to 75. This has resulted mainly from the synonymizing of names. For example, *Nemoria lixaria* and *N. unitaria* each were listed under four different names. *Nemoria bistriaria* was listed under three different names in two genera, and the four species of *Chlorochlamys* were treated as ten in the previous literature. I have eliminated *Eucrostes dominicaria* Guenée, included by McDunnough in his check list, because I found no evidence of its occurrence in the United States. Hulst's original record of *dominicaria* from Key West, Florida (1895, p. 71) was based on misidentified specimens of *Synchlora herbaria hulstiana*, one of which still exists in the United States National Museum.

Apart from Europe, where so much of the fauna has been studied intensively, the only part of the world that has been adequately covered by recent revisional work on this group is Japan. An excellent treatment of the Japanese species by Hiroshi Inoue was published as Part 4, Series 1 of *Insecta Japonica* (1961). This work provides good illustrations of the male genitalia of all included species, as well as of other structural details (but not female genitalia), and sets forth a classification in which the 65 Japanese species are divided into 13 tribes and 28 genera.

CHARACTERS USED IN THIS REVISION

The taxonomic conclusions are based for the most part on an evaluation of the following characters, or groups of characters:

1. WING SIZE. The length of the forewing, measured from base to apex in

millimeters is used as an index of size. Usually only the limits are given, but in some cases where size differences are critical, mean wing length is also given, based on a stated number of specimens. Wing expanse is not used as a measure of size because of its susceptibility to error, depending on how the wings are spread.

2. WING SHAPE. This varies considerably within the subfamily and even within genera, the wings being broad or somewhat narrowed, or sometimes with the apices produced and the hindwings angulate.

3. COLOR. There is wide variation in the shade of green from species to species, and some have the hindwings paler than the forewings. A few species are polymorphic with both green and brown forms, and one species of a monotypic genus, *Hethemia pistasciaria*, is sexually dimorphic in the coloring of the underside.

4. INTENSITY AND STABILITY OF THE GREEN PIGMENT. There seem to be two distinct types of green pigment involved in the American Geometrinae, although I have made no effort to investigate the chemistry of these. That of the Hemitheini is relatively dull and unstable, fading or discoloring readily. Museum specimens tend to lose much of their green coloring in time, even when stored under the best conditions of darkness. The green pigment found in the other tribes tends to be more intense and does not fade readily. Specimens of *Nemoria* or *Synchlora* a hundred years old may be almost as bright as when caught.

5. WING MARKINGS. These include the character and color of the lines, discal spots, costa, fringes, and striation or irroration of the ground color.

6. THORACIC AND ABDOMINAL MARKINGS OR TUFTING. The dorsal spots or stripes, especially of the abdomen, are important for the identification of species and may be diagnostic. Dorsal tufting (cresting) of the metathorax or abdomen is not as important in the Nearctic species but does occur (e.g., in *Lophochorista*). The abdominal markings are frequently in the form of pale spots on the first four segments, surrounded by red or brownish shading, but white spots may occur without red shading or vice versa. These markings may assume the form of a pale mid-dorsal stripe instead of spots, or the abdomen may be entirely without markings except for varying degrees of green shading. In my key to the species of *Nemoria* I rely heavily on abdominal markings and it is important that specimens be good enough for these to be visible. Specimens of some species, such as *bistriaria*, *biflata*, and *lixaria*, are not readily distinguished if the abdomens have become greasy, discolored or lost. A classic case of misassociation of specimen and abdomen resulted in the description of *Nemoria associaria* (Barnes and McDunnough) as a new species. This proved to be an example of *lixaria* to which a striped abdomen of *biflata* had been glued, but the name remained in the literature as a valid species for 50 years. I mention it here to emphasize the importance of the abdominal markings. The value of this character may lead to a dilemma when an abdomen needs to be removed for dissection. If the specimen is a valuable one, such as a type, one solution is to photograph it while still intact, but in any event a brief

label should be affixed to the specimen describing the abdominal markings, or confirming the resemblance to undissected specimens if it is one of a series.

7. ANTENNAE. These are either bipectinate or simple throughout the group, except in a few intermediate cases where they could be described as dentate or fasciculate. The relationship of antennal structure to sex varies considerably. Males nearly always have bipectinate antennae, and females either simple or bipectinate antennae with branches (pectinations) shorter than those of the male. There are rare cases in which the female antennae have pectinations longer than those of the male, but in the Nearctic fauna this is limited to *Lophochorista* and *Phrudocentra neis*. There are also rare cases in which both sexes have simple antennae (e.g., in *Hethemia*). The form of the antenna varies as a result of the length of the branches. These may be short and continue with little reduction almost to the tip, as in *Nemoria*, or the branches may be very long for the basal half or two thirds of the antennal length, then diminish rather abruptly toward the tip, as in the *Synchlorini*. As a measure of the length of the pectinations, I compare the longest with the thickness of the antennal shaft at the same point; e.g., "longest antennal branches equal to 4-5 times thickness of shaft." Usually the outer (lateral) branches are distinctly longer than the inner (mesial) ones, but in the genus *Chlorosea* this is reversed.

8. PALPI. These vary little in general form but greatly in length, especially of the third segment. I have expressed palpal length in several ways: by comparison of the second and third segments, by comparison of the third segment with the height or width of the front, or by stating the proportion of the palpal length that appears to extend beyond the front, in lateral view, when the palpi are in a normal position. The male and female palpi may be very different and if so, those of the female are always longer.

9. EYES. The eyes tend to vary only slightly but I refer to them as a character in the generic definitions. Sometimes they differ in the sexes, those of the female being smaller. The abnormally small eyes of the diurnal genus, *Mesothea*, provide a major character in this one unusual case.

10. FRONT. In the Nearctic forms there is little structural variation in the front, except that its form may be almost square, or more or less trapezoidal. Its main value as a character is in its coloring. Sometimes the frontal coloring is a reliable key character for species, but there are instances where its variability within species has been misunderstood; for example, in the *Synchlora aevata* complex and in *Chlorochlamys phyllinaria*. *C. phyllinaria* and *C. zelleraria* had been regarded as separate species on the basis of whether the front was red or green, but I am treating them as one species.

11. LEGS. Apart from coloring, I have consistently used only characters of the hind tibia. Of importance here is whether the hind tibia of the male is swollen (dilated), the presence or absence of a terminal tibial extension (apical process) in the male, and the presence or absence of the first or preapical pair of hind tibial spurs in both sexes. The second pair, the apical spurs, are always present. The length of the spurs varies somewhat, as does the length of both the tibia and tarsus. The dilated hind tibia apparently implies the

presence of a long tibial hair pencil, which is ensheathed or recessed within the tibia. Only occasionally does it show, unless dissected out. Because of the difficulty of actually seeing this hair pencil, I do not refer to it frequently.

12. TONGUE, PROBOSCIS, OR HAUSTELLUM (GALEAE OF THE MAXILLAE). The tongue is present and presumably functional in all Nearctic species. It varies somewhat in size but not enough to be of much value as a character.

13. VENATION. Although certain characters of the venation are important, especially at the generic level, these must be used with caution because of the degree of variability even within species. Earlier authors from Packard to Prout tended to overemphasize the value of the venation in geometrid classification because, without knowledge of the genitalia, they were hard pressed for tangible characters. To demonstrate both its usefulness and its limitations, I have illustrated the venation of many species, covering all genera. *Annemoria*, of Packard, a monobasic genus with type *unitaria*, was erected partly on the strength of minor venational differences, but these break down if a number of specimens are examined. To show the degree of variability that must be expected in one of these characters, I give figures drawn from three different specimens of *unitaria* (Pl. 1, figs. 3-5). In the wing preparations I found such anomalies as spurious veins, missing veins, and asymmetry to occur with a frequency of over 15%, whereas comparable abnormalities in the genitalia are very rare, occurring in fewer than 1% of the specimens examined. The terminology of the venation is that of the Comstock-Needham system.

14. FRENULUM. The frenulum is not strongly developed in the Nearctic forms but it is always present in the males with the sole exception of *Dichordophora*. In the female, the frenulum is replaced by a weak tuft of bristles or is entirely wanting.

15. MALE GENITALIA. These provide numerous characters for recognition of taxa at specific, generic and tribal levels, and have proved immensely helpful in determining relationships. Of the 75 species treated, at least 62 are immediately recognizable on the basis of male genitalia alone. The remainder may be readily assigned to particular species groups and then determined to species by some non-genitalic character. There are several such groups of closely related siblings.

A number of distinct lines of specialization are evident in the male genitalia, and against this background most of the tribes and genera have fallen into place. The main genitalic components that provide useful characters are: the UNCUS, which may be normally developed, as in *Nemoria*, reduced to a small, obscure basal sclerite only, as in *Synchlora*, or completely divided into two separate elements as appears to be the case in *Dichordophora*; the SOCI, which vary from small membranous flaps to long semi-rigid processes as long as the uncus and resembling the latter in shape; the GNATHOS, basically a complete ring, often with a sharp distal tooth, but in many forms atrophied in whole or in part, occasionally with the sides disconnected distally leaving two separate arms; the TRANSTILLA, sometimes of distinctive shape; the JUXTA, very often of distinctive shape and occurring either as a plate, or in other forms

that I describe as cup-shaped or conical; the VINCULUM, somewhat variable in form; the SACCUS, also variable in shape, either reduced and rounded, or more or less produced and entire, or incised as in most species of *Nemoria*; the VALVE, highly variable in shape and with several types of specialized developments often characteristic of whole genera, including, as in *Nemoria*, a sclerotized costal margin with both distal and basal processes (the latter referred to as the LABIDES by Inoue, 1961, but probably not homologous to structures termed the LABIDES in other groups); the COREMATA (sing., COREMA), hairy, extensile glands, possibly scent-producing organs, contained within ventrolateral cavities at the bases of the valves, about in the usual position of the sacculi; the AEDEAGUS, often varying slightly or not at all from species to species within closely related groups, but highly characteristic of larger groups, hence a useful character at the tribal and generic levels.

The abdominal integument, which should be mounted intact on the same slide as the genitalia, provides another good character in the shape of the 8TH STERNITE. This may be convex, concave, deeply emarginate, or bear conspicuous processes on its posterior margin.

16. FEMALE GENITALIA. Characters of the female genitalia proved to be almost as helpful as those of the male, and there are one or two instances where the genitalia of two species are seemingly identical in the male but readily distinguishable in the female (e.g., in *Nemoria extremaria* and *N. elfa*). It is a common practice to remove part of the integument of the 8th segment for a better view of the DUCTUS BURSAE and DUCTUS SEMINALIS, but in the Geometrinae this is definitely not to be recommended. This segment should be left intact as I have shown it in most of the accompanying illustrations. The various folds, ridges and sclerites that occur on the ventral side of this segment are often diagnostic, and a distorted impression of these is likely to result if any of the integument is torn away. The DUCTUS BURSAE usually shows through clearly, and the position of the DUCTUS SEMINALIS tends to be so constant that it is of little or no value as a character.

The various structures associated with the ostial opening, comprising what is often called the GENITAL PLATE, or STERICMA, provide the most important group of characters in the female genitalia. In the more simple forms, this part of the integument may be entirely membranous and unspecialized, but various degrees of complexity have developed in most groups, usually beginning with a shallow, pouch-like fold, the LAMELLA ANTEVAGINALIS, just preceding the OSTIUM. In some forms this has become large and heavily sclerotized, and in *Nemoria* there has been a tendency for it to unite with the ostium to form a rather elaborate, sclerotized OSTIAL ENTRANCE. Sclerotized plates or ridges of various configurations have also tended to develop just posterior to the ostium. Sometimes this area is connected with the preostial structure, forming a continuous genital plate or a sclerotized ring encircling the ostium. But more commonly they are discontinuous and I refer to them separately as the PRE-OSTIAL FOLD, OR PLATE (= LAMELLA ANTEVAGINALIS) and the POSTOSTIAL PLATE (=LAMELLA POSTVAGINALIS). Perhaps next in importance for distinguishing species is the DUCTUS BURSAE, which varies in length, stoutness, and sclerotiza-

tion. The shape of the BURSA COPULATRIX (or perhaps more correctly, the CORPUS BURSAE) varies from group to group, but is usually rather constant within groups of closely related species. A SIGNUM may be present or absent in the Nemoriini and Synchronini, absent in the other tribes. It varies little among closely related species. In a few cases, especially in the Hemitheini, the length and shape of the ANTERIOR APOPHYSES proved to be a useful species character. The OVIPOSITOR LOBES (PAPILLAE ANALES) are almost invariable throughout the subfamily, at least in North America.

17. LARVAE. Something is known of larval structure in 11 of the genera and 32 species, and this information has given strong support to the division of the Nearctic species into several tribes. The known larvae fall into three distinct groups on the basis of structure and habits: 1) those that are slender and twig-like, with a bifid head (Hemitheini, Lophochoristini), 2) those with moderate dorsolateral processes bearing specialized hooks for the attachment of plant fragments as an aid to concealment (Synchronini), and 3) those with large dorsolateral processes not specialized for the attachment of plant matter (Nemoriini). Of those represented in North America, only the tribe Dichordophorini remains entirely unknown in its early stages. The three types of larvae are highly characteristic of whole tribes, as indicated, and vary relatively little within these groups as far as is known.

18. HOST PLANTS. I give all available information on host plants, but far too little is known to allow many general statements regarding host plant specificity. Yet certain trends are apparent, such as the flower feeding habits of the Synchronini and some Hemitheini, usually on Compositae, and the apparent restriction of the genus *Dichorda* to species of *Rhus*. Many species will probably prove to be highly host specific but have not been studied in this regard. On the other hand, at least a few species that one might have guessed were somewhat specialized have turned out to be very generalized in their feeding habits. For *Nemoria mimosaria*, one of the best known northeastern species, 21 different trees and shrubs have been recorded as host plants, including even 4 species of conifers. *Nemoria rubrifrontaria*, formerly thought to be specific on *Comptonia* and *Myrica*, has been reared on *Rhus copallina*. *Mesothea* occurs in habitats where one would expect that it should be specialized on *Vaccinium* or some other heath plant, but it has been found feeding naturally on four different host plants, none of them ericaceous.

19. BEHAVIORAL CHARACTERS. In this category little information is available, but two things should be mentioned. Diurnal flight habits are characteristic of the genus *Mesothea*. I have no knowledge of either the eastern or western subspecies ever having been collected at light, although all other North American Geometrinae seem to be nocturnal. A striking behavioral character in larvae of the tribe Synchronini is that of deliberately attaching bits of plant matter to the tuberculate process of the abdomen, although this is of course correlated with a structural character—the presence of the hooks to which the plant fragments adhere.

MATERIAL AND METHODS

This monograph is based on study of 14,600 spread adult specimens and 914 genitalia slides. I have also been able to examine living or preserved larvae of about 28 species; good descriptions or figures of several additional species exist in the literature. During the course of the investigation I studied the material available in most of the major collections in the United States and Canada, as discussed under acknowledgements, and was able to see most of the types involved except those in European collections. Arrangements were made to have nearly all of the relevant Walker types and some of the Prout types in the British Museum (Natural History) photographed in color, and this greatly facilitated the identification of these species. This paper contains 33 lectotype designations.

The drawings, intended to be unmodified representations of genitalic preparations, were made from slides with the aid of a micro-projector (Bausch and Lomb Tri-Simplex; wings were drawn with a Bausch and Lomb VH micro-projector). The genitalic drawings are always of ventral views except for the aedeagus, which is usually shown in right lateral view. In most Synchlorini, however, the aedeagus is also shown ventrally because of its forked internal structure. I made the drawings and all of the genitalic preparations illustrated except where otherwise acknowledged in the explanations of the plates.

The genitalia of the Geometrinae are delicate and require careful dissection and staining if the diagnostic structures are to be seen in undistorted form. The preparations were stained with Eosin-Y (water and alcohol soluble), a stain that is simple to use and which gives highly satisfactory results.

The name or initials of an individual following the data of a specimen always indicates the collector, unless "collection of" or some equivalent expression is included, in which case the collection, but not the collector, is implied. The name or abbreviation of an institution indicates the museum collection in which the material is deposited.

The abbreviations used in this monograph are as follows:

- AMNH — American Museum of Natural History, New York, N.Y.
- BM — British Museum (Natural History), London, England
- CNC — Canadian National Collection, Entomology Research Institute, Canada Department of Agriculture, Ottawa, Ont.
- CPK — Mr. Charles P. Kimball, West Barnstable, Mass. and Sarasota, Fla.
- CU — Cornell Collection, Department of Entomology, Cornell University, Ithaca, N.Y.
- DCF — Dr. Douglas C. Ferguson, Yale University, New Haven, Conn.
- FHR — Dr. Frederick H. Rindge, American Museum of Natural History, New York, N.Y.
- JGF — Dr. John G. Franclemont, Department of Entomology, Cornell University
- LACM — Los Angeles County Museum, Los Angeles, California
- MCZ — Museum of Comparative Zoology, Harvard University, Cambridge, Mass.
- USNM — United States National Museum, Washington, D.C.

YPM — Peabody Museum of Natural History, Yale University, New Haven, Conn.

Since the sexes in the Geometrinae are nearly always much alike, I have not described males and females separately, but have emphasized differences where they occur. I have designated lectotypes where there have been no difficulties, but have generally avoided doing so in the following two kinds of situations: 1) When an available syntype was incomplete or otherwise unsatisfactory and there seemed to be a possibility that more and better specimens of the type lot may eventually turn up. 2) When I have been unable to see the types, such as those in European collections.

Because of a convenient distribution throughout the group of easily defined character differences, it has been possible to construct keys that should work well, even to species. However, good material is essential. Worn or discolored specimens may be difficult or impossible to identify, except by genitalia.

2. KEYS TO TRIBES OF GEOMETRINAE OF AMERICA
NORTH OF MEXICO

KEY TO TRIBES BASED ON SUPERFICIAL CHARACTERS

1. Small species with only one pair of hind tibial spurs in male; green coloring dull except in some species when very fresh; green pigment unstable, soon fading to gray-green, olivaceous or yellowish (but two species dimorphic with brown forms); hindwing never with an antemedial line; fore- and hindwings nearly always colored alike Hemitheini
- Small to large species, those of hemitheine size with 2 pairs of hind tibial spurs in male (except Lophochoristini, which are otherwise easily recognized); green coloring vivid (except in a few yellowish Arizona species); green pigment relatively stable, not readily fading, but discoloring to buff on excessive exposure to moisture; hindwing with or without an antemedial; hindwing either like forewing or paler 2
2. Length of longest male antennal pectinations hardly exceeding 3 times thickness of shaft, always distinctly shorter except in the two species of *Phrudocentra*, in which they may slightly exceed this length 3
- Length of longest male antennal pectinations clearly much greater than 3 times thickness of shaft 4
3. Male without a frenulum; southwestern only Dichordophorini
- Male always with a frenulum; widely distributed Nemoriini
4. Male hind tibia clavate, strongly swollen toward distal end, with one pair of spurs; small, rare species, Fla. and Ariz. Lophochoristini
- Male hind tibia more uniformly dilated or undilated, with both pairs of spurs except in *Cheteoscelis* which, however, has the hind tibia undilated; widely distributed Synchlorini

KEY TO TRIBES BASED ON MALE GENITALIA

1. Uncus without the usual long process, consisting of a small basal portion only, to which the rather large socii are articulated or fused; aedeagus containing two subequal sclerotized prongs arising from a proximal stem Synchlorini
- Uncus well developed; aedeagus not as described above 2

- 2. Uncus divided into two separate prongs flanked by socii of somewhat similar shape; valve a deep, U-shaped notch in the cephalad margin **Dichordophorini**
 Uncus single, normal; socii variable; valve never with a notch as described above **3**

- 3. Socii semi-membranous flexible flaps, much shorter than uncus and of different shape **Nemoriini**
 Socii sclerotized, partly rigid, almost as long as, or sometimes even longer than uncus and tending to be of similar shape **4**

- 4. Valve with a distinctive mesial sclerite, either a long curved spine or an obliquely transverse, finely toothed plate **Lophochoristini**
 Valve without such a sclerite **Hemitheini**

3. SYSTEMATIC ACCOUNT OF THE TRIBE NEMORIINI

Size extremely variable, very small to large, with the majority of the species falling about half way between; wing shape variable, usually rounded or but slightly angulate; green pigment very bright and relatively stable compared to that of the Hemitheini; color predominantly green (either green or brown in a few dimorphic species of *Nemoria*), marked with a normal pattern of whitish lines, of which the antemedial of the hindwing, or sometimes of both wings, may be wanting. Venation with Sc and R of hindwing touching, or not quite touching, where they come together, not fused; third anal of hindwing usually present and better developed than in any other tribe with the possible exception of the Dichordophorini; frenulum present in male, replaced by tuft of bristles or wanting in female. Antenna bipectinate in male, simple in female except for a few species of *Phrudocentra*, in which it is bipectinate like that of the male; abdomen untufted but often with white or reddish markings; hind tibia variable but always with two pairs of spurs in both sexes except in genus *Chlorosea*, in which there is only one pair.

Male genitalia always with long, well developed uncus, linear or spatulate, rarely pointed; socii as flexible, hairy, semimembranous flaps, much shorter than uncus; gnathos often slender but always complete, with distal tooth; transtilla bilobate; juxta variable; saccus variable: rounded (*Chlorosea*, *Nemoria*), notched (most species of *Nemoria*), produced and pointed (*Dichorda*), or reduced and knob-like (*Phrudocentra*); valve simple or with a differentiated, sclerotized costal region that may include basal and distal processes (*Chlorosea*, *Nemoria*); valve without mesial sclerites such as those found in the Lophochoristini; coremata usually wanting or vestigial, but sometimes extremely developed (*Phrudocentra*); aedeagus simple, or with apical or marginal teeth; eighth sternite variable: usually notched, but roundly convex in *Dichorda*, usually with paired or multiple teeth in *Chlorosea*.

Female genitalia with bursa copulatrix elongate, usually slender, membranous, with or without a signum; ductus bursae membranous or sclerotized, connecting with bursa terminally or subterminally; ostial region variable: either completely simple, without sclerotized structures, or with a semi-rigid, shallow, pouch-like preostial fold which, in the most specialized stages of development, combines with the ductus bursae to form a large, elaborately sclerotized, funnel-like entrance to the ostium; separate postostial plate apparently never present.

Larvae of tribe Nemoriini among the most strikingly characteristic and specialized geometrid larvae known. Dorsolateral tuberculate processes of both

thorax and abdomen, but especially of abdominal segments 1 to 5, bearing setae I and II, developed as dorsoventrally compressed protuberances (sometimes enormously so as in *Dichorda*). These protuberances squarely or obliquely truncated in the form of large rectangular or trapezoidal, laterally extended, dorsal segmental plates, with setae at the outer corners. Integument otherwise densely granular or rugose, with complex cryptic patterns of brown, white and green, in simulation of dried, withered leaf. All known Nemoriini are solitary foliage feeders, not flower feeders like the Synchlorini or some Hemitheini. Grown larvae do not attach fragments of plant material to their dorsal setae but young first instar larvae apparently sometimes do so (e.g., *Nemoria bistriria*). Like most if not all geometrine larvae, those of the Nemoriini tremble and weave from side to side when agitated.

KEY TO THE NORTH AMERICAN GENERA OF THE TRIBE NEMORIINI

- 1. One pair of hind tibial spurs in both sexes *Chlorosea*
 Two pairs of hind tibial spurs in both sexes 2
- 2. Postmedials strong, almost straight, oblique; palpi and legs conspicuously spotted with dark brown; costa dusted with purplish brown *Dichorda*
 Not as above 3
- 3. Postmedials present but brown, not white, complete or as series of vein dots only; conspicuous brown patches often present in the tornus of the forewing, or inner margin of hindwing, or both *Phrudocentra*
 Postmedials, if present, white or yellowish, not brown; wings never with brown patches as described above *Nemoria*

CHLOROSEA Packard

Chlorosea Packard, 1874, p. 31.

TYPE SPECIES: *Chlorosea nevadaria* Packard, 1874, monobasic.

ADULT CHARACTERS. Size large, length of forewing 13.5 to 21 mm; wings normal, rounded, rather broad, bright green, usually with some whitish striation; hindwing nearly always paler than forewing, at least in anterior half; costa usually with very thin pale margin; antemedials of both wings wanting; postmedials white, regular, that of forewing straight or slightly convex, often oblique, that of hindwing strongly convex, also often oblique, bisecting wing near middle; discal spots wanting; terminal line wanting; fringes green or white, unmarked; abdomen with or without reddish dorsal markings.

Venation would fit within limits of variation found in *Nemoria*. $M_3 + Cu_1$ unstalked in both wings, the latter actually arising before end of cell; third anal of forewing present but weak, of hindwing present as vestige or wanting; frenulum of male present, normal, replaced in female by tuft of bristles.

Antenna of male bipectinate almost to tip, branches of moderate length, the longest hardly exceeding twice thickness of shaft, mesial branches generally longer than lateral ones, a reversal of usual tendency; antenna of female simple, finely ciliate beneath; palpi of sexes similar, third segment in female not elongate; eyes of male somewhat larger than those of the female, and squarish front narrower; tongue well developed as in *Nemoria*; hind tibia of male only moderately dilated, prismatic or compressed, with no terminal extension, and with apical pair of spurs only; hind tibia of female undilated or but slightly so distally, also with only one pair of spurs.

Male genitalia simple and quite unmodified. Uncus large as in *Nemoria* but more flattened; socii small, semi-membranous; gnathos a somewhat moveable ring with a large distal tooth; juxta an essentially flattened plate, not funnel-shaped; saccus evenly rounded, entire, not incised; valve simple, the costa with a thin, sclerotized distal extrusion, terminating in a blunt tooth, but with little or no development of basal process; no coremata; aedeagus simple, without spines or teeth; eighth sternite with posterior margin convex, hardly if at all emarginate, and, in some species, with paired marginal teeth which are stout, pointed, sometimes multiple, and diagnostic when present.

Female genitalia with very characteristic, greatly elongated bursa copulatrix with slender "neck region" and greatly abbreviated ductus bursae; small signum present in lower, expanded portion of bursa. Female genitalia entirely membranous except for very feeble sclerotized band at ostial opening.

LARVAL CHARACTERS. The only information available on the early stages is contained in a larval description of *Chlorosea banksaria* by Rindge (1949). It is a detailed description, including indications of how the setal pattern differs from that of *Nemoria*. The larva of *Chlorosea* is characterized by the same exaggerated lateral processes and must appear very similar to that of *Nemoria*.

Last instar with head subrectangular, slightly bilobed, coarsely rugose, with anterior surface flattened. Thorax with very prominent dorsal and lateral protuberances. Prothorax anteriorly with very high median conical pair of projections, extending dorsoanteriorly over the head, and with smaller pair laterad of these; two smaller pairs of protuberances posteriorly along dorsum, the posterior of these being quite small and inconspicuous. Mesothorax with three pairs of median humps dorsally, the anterior two rounded swellings, the posterior a prominent pair of protuberances. Metathorax with single pair of small median lobes. Dorsolateral margins of meso- and metathorax produced into prominent lateral extensions. Abdomen dorsally with anterior mid-line paired swellings on each segment, these being quite small and inconspicuous on anterior segments but increasing in size posteriorly, on last segment very high and conspicuous. Lateral margins of each segment produced into long prominent extensions extending laterally and upwards but not beyond anterior margins of segments, being most produced at anterior margins of segments and most prominent on segments two, three, four and five; on posterior three segments reduced to large rounded swellings.

Body green, matching leaves of food plant; head and legs reddish brown, thoracic markings reddish, abdominal markings red-brown with purple cast. All setae very small, inconspicuous.

Rindge stated that the larva of *Chlorosea banksaria* may be distinguished from those of *Chlorochlamys chloroleucaria* and *Nemoria rubrifrontaria* (as described by Dethier, 1942) by the following characters: "Front of head more square and broader; first and second adfrontal setae equidistant from first posterior setae; third anterior setae on same level with first adfrontal setae, as are the second adfrontal setae and the first posterior setae; anterior setae almost form a right angle. The larvae of *Chlorochlamys* are without the prominent lateral thoracic and abdominal projections and so are immediately distinguishable. *Chlorosea* and *Nemoria* may be further differentiated in the body regions by the very small and inconspicuous setae of the former; and that the lateral abdominal processes do not extend caudad of their respective segments, and are truncate anteriorly, usually extending anteriorly at right angles from the mid-line when viewed from above."

Rindge's paper provides much additional detail, including descriptions of penulti-

mate instar and pupa, based on a single larva collected April 12, 1948, from *Ceanothus thyrsiflorus* Esch. in the vicinity of Kings Mountain, San Mateo County, Calif., at about 2000' altitude. It was reared (from the antepenultimate instar) on this food plant, pupated April 29, and the adult emerged May 16, 1948.

DISTRIBUTION. Known only from region between the Rocky Mts. of Wyoming, Colorado and New Mexico and the Pacific Coast, south to near Mexican border, north to southern British Columbia.

REMARKS. *Chlorosea* is a small, localized group that I treat here as four species, but since *nevadaria*, *banksaria* and *margaretaria* are so close as to be doubtfully distinct, only two basic types are represented. *Banksaria* differs from *nevadaria* only in having red dorsal markings on the abdomen, but integrades having very reduced markings occur in Washington and British Columbia. *Margaretaria* is distinguished mainly by its straight, prominent and usually oblique lines, but again there are forms that appear intermediate in Utah and Nevada. *Roseitacta* differs from the others in genitalia and is unique among North American Geometrinae in the characteristic red marking on the inner margin of the hindwing.

The relationship between *Chlorosea* and *Nemoria* is obviously close, and the genitalia of some of the least specialized species that I place near the beginning of the *Nemoria* series could almost be those of *Chlorosea*. However, *Chlorosea* is peculiar in its large size, complete loss of antemedial lines, and in the hind tibia of the male having only one pair of spurs and no terminal process. The separation from *Nemoria* appears to be further supported by certain larval characters.

Key to Species of the Genus *Chlorosea*

- 1. Abdomen with red dorsal markings 2
 Abdomen without red dorsal markings 4
- 2. Hindwing with narrow red patch on inner margin. Ariz., N.M., Utah, Colo. *roseitacta*
 Hindwing without such markings 3
- 3. Wings dark green like those of *roseitacta*, postmedial lines often indistinct or wanting.
 So. Calif. *banksaria gracearia*
 Wings paler green, lines distinct. Central Calif. to B.C. *banksaria banksaria*
- 4. Large, lines parallel to outer margin or nearly so. Rocky Mts. from B.C. to Ariz. and N.M. *nevadaria*
 Smaller, lines of forewing straighter, oblique, running from middle of inner margin toward apex. Sierra Nevada Mts., Calif., Utah *margaretaria*

Chlorosea nevadaria Packard

Plate 6, figures 3, 3a, 3b; Plate 30 figure 1; Plate 42, figures 4-6.

Chlorosea nevadaria Packard, 1874, p. 31; 1876, p. 378 (partim). Hulst, 1896, p. 315. Dyar, 1902 [1903], p. 301. Prout, 1912, p. 116. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 42 (partim). McDunnough, 1938, p. 141 (partim). Sperry, 1944, pp. 33-39.
Chlorosea proutaria Pearsall, 1911b, p. 250. Prout, 1912, p. 116. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 42. McDunnough, 1938, p. 141. Sperry, 1944, pp. 33-39. New synonymy.

DIAGNOSIS. A large form similar to and perhaps even conspecific with *banksaria*, differing mainly in the absence of red markings on the abdomen, a character shared only with *margaretaria*; but unlike that species, *nevadaria* has postmedial lines approximately parallel to the outer margin. *Nevadaria* tends to be a very slightly deeper shade of green than *banksaria* with less white striation, although these characters overlap. Their geographical ranges do not overlap but appear to be completely allopatric, with *nevadaria* occurring in the Rocky Mt. system from interior B.C. to Ariz. and N. M., and *banksaria* in the Coast Ranges.

TYPES. The original description was based on one male and two females with the locality stated only as "Nevada (Edwards)." In the MCZ, I have been able to find only two of the original three, these bearing red type labels, and the specimen marked "Type 2227," now consisting of two front wings only, has a second label with the word "Type" in what I believe to be Packard's handwriting. This should probably be regarded as the actual type. If the type material came from Nevada, as stated, it could represent no other species as only one seems to occur there.

The type of *proutaria* Pearsall, from Chimney Gulch, Golden, Colo., now in the AMNH, is *nevadaria*, and I hereby designate this specimen as the lectotype. The female type of *proutaria*, from Eureka, Utah and in the same collection, looks like *margaretaria*.

SYNONYMY. The only synonym is *proutaria* Pearsall, a name that all authors up to the present have considered to represent a separate species. Pearsall based his name on type material that included two species. His male type, from Colo., is clearly *nevadaria* but the female type, like a number of other Utah specimens in collections, appears to be *margaretaria*. These specimens, looking somewhat different, remained associated with the name *proutaria* for 50 years. It is strange that Sperry (1944) failed to associate his Sierra Nevada material with the Utah "*proutaria*," or the Colorado type of *proutaria* with *nevadaria*.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs as described for genus. Antennal shaft white; interantennal fillet white, sometimes with thin red posterior margin; front pale, almost white, usually with rosy shading at sides or bottom, rarely with admixture of green scales; palpi tinged with pink; legs whitish to pale brown with coxae and femora at least partly green, tibiae rose red; thorax bright green above, paler below; abdomen greenish dorsally toward base, fading to white caudally, unmarked.

Forewing and outer half of hindwing bright green; hindwing variable, sometimes much paler; forewing costa thinly edged with white; both wings marked by white postmedial lines, subparallel to outer margins, that of hindwing being less distinct and crossing at about middle. Hindwing shading to white basally and costally, as in other species. Green may be coarsely striated with white as in *banksaria* but many specimens virtually lack striation, the variance at least partly geographical. Fringes white, green, or with basal half green and outer edge white. No discal spots. Underside paler, marked by postmedial which often shows through on forewing only.

Length of forewing: males, 16.5-19.5 mm (average of 11 specimens, 18.75 mm); females, 15.5-19.5 mm (average of 8 specimens, 18.15 mm).

MALE GENITALIA. Similar to those of *banksaria* and *margaretaria*. An apparent tendency for uncus to be a little broader than in *banksaria*, but doubtfully consistent. Teeth on eighth sternite double on both sides in one male examined and asymmetrical in all others, being single on one side and double on the other. This asymmetry is characteristic of *banksaria* and *margaretaria*, but all *roseitacta* and some *banksaria* from B.C. lack the teeth entirely.

FEMALE GENITALIA. Similar to those of other species of *Chlorosea*.

MATERIAL EXAMINED. 65 males, 125 females, including types; 10 male, 8 female slides.

DISTRIBUTION. BRITISH COLUMBIA: Kaslo; Cranbrook. IDAHO: Wallace. OREGON: Wetmore Campground, Baker Co. WYOMING: Bottle Cr. Camp, 8800', 7 mi. SW of Encampment, Carbon Co.; Louis L., 28 mi. SW of Lander, Fremont Co.; 13 mi. NE of Jackson, Teton Co.; Fossil Station, Lincoln Co. COLORADO: Chimney Gulch, Golden; Glenwood Springs; Maysville; Valley View Lodge, 7600', 10 mi. S of Steamboat Springs, Routt Co.; State Bridge, near Bond, 7000', Eagle Co.; Almont, Gunnison Co.; Fort Collins Mt. Recreation Area, 6600', 33 mi. W of Fort Collins, Larimer Co.; Estes Park, 7800', Larimer Co. NEVADA: Kyle Canyon, 6000-8100', Mt. Charleston, Clark Co.; Reno; Verdi. UTAH: Bryce Canyon, 8000', Garfield Co.; Eureka; Fish Lake, Sevier Co.; near Grantsville, Tooele Co., 7400'; 25 mi. N of Vernal, Uintah Co., 8700'; Bonanza, Uintah Co.; 11 mi. SE of Panguitch, 7100', Garfield Co.; Tropic, 18 mi. N of Escalante, 8000', Garfield Co. ARIZONA: Prescott, 5400', Yavapai Co.; Slate Mt. Loop Road, 6900', 20 mi. NW of Flagstaff, Coconino Co.; 7 mi. E of Jacob Lake, 6800', Coconino Co.; Mile 252, Route 180, 6600', near Ebert Mt., Coconino Co.; Oak Creek Canyon, Coconino Co. NEW MEXICO: Bursum Camp and Pine Camp, 8600', near Cloudcroft, Otero Co.; Cimarron Canyon, 7900', Sangre de Cristo Mts., Colfax Co.; Bear Trap Camp, 8500', 28 mi. SW of Magdalena, Socorro Co.

GEOGRAPHICAL VARIATION. Throughout most of the range there is little variation but two trends are noticeable. Specimens from the interior of B.C. are among the largest and palest, exactly resembling *banksaria* except for the absence of red abdominal markings. Specimens from southern Nevada (Clark Co.) are rather intensely green, unstriated, with the forewing a little more pointed than usual and the forewing postmedial line tending to be straight and oblique, thus varying in the direction of *margaretaria*. But in these Nevada specimens the postmedial remains narrow, not as wide as in *margaretaria*. The convergent trend apparent in this population emphasizes the unsolved problem of relationship between *nevadaria* and *margaretaria*. More material needs to be studied from intervening localities in s. Nev., adjacent Calif., and Utah.

FLIGHT PERIOD. Mostly June 24 to Aug. 5. At Prescott, Ariz., June 11-30, and one from Wallace, Idaho, taken Aug. 25.

EARLY STAGES. Unknown.

REMARKS. Packard (1874) described *nevadaria* from one male and two females from Nevada. Later (1876) he redescribed it, having in the meantime acquired one additional male and three females from Victoria, B.C., and Calif. These Pacific Coast specimens were, of course, the species we now distinguish as *banksaria*, and Packard emended the later description as follows: "Abdomen white, tinged with pinkish at the base with two conspicuous round spots, having an irregular v-shaped, pink spot between them and another behind." The original description, which states that the abdomen is white and makes no mention of spots, agrees with the present understanding of *nevadaria* in all respects but one. Packard failed to see the postmedial line on the hindwing, which is clearly visible in the types as it is in all specimens of both *nevadaria* and *banksaria*. In the original description he twice stressed "the want of any markings on the hind wings," although he corrected this in the description of 1876. This minor inaccuracy is of no significance here, but I use it as evidence in my identification of Packard's long controversial *Annemoria unitaria*.

Chlorosea banksaria banksaria Sperry

Plate 1, figure 1; plate 6, figures 2, 2a, 2b, 2c; Plate 30, figure 2; Plate 42, figures 7-9.

Chlorosea nevadaria Packard, 1876, p. 378 (partim). Prout, 1932, p. 42 (partim). McDunnough, 1938, p. 141 (partim).

Chlorosea banksaria Sperry, 1944, p. 36. Rindge, 1949, pp. 24-26 (early stages).

DIAGNOSIS. This is the commonest species of *Chlorosea* in collections. It closely resembles *nevadaria* except for the minor disparity in size (smaller males, larger females), somewhat paler coloring (in the nominate form), and, most important of all, the presence of pink dorsal markings on the abdomen, a character shared with *roseitacta* but not *margaretaria* or *nevadaria*. It is the only species of *Chlorosea* in the northern Pacific Coast region, becoming subspecies *gracearia* southward in Los Angeles and San Bernardino Counties, Calif.

TYPES. Holotype male, from Puyallup, Washington, July 26, 1939 (S. E. Crumb), in the MCZ. Allotype, from Inverness, Marin Co., Calif., in the CNC. Sperry designated 88 paratypes, now widely distributed in various collections.

SYNONYMY. None.

FURTHER DESCRIPTION. Similar to *nevadaria* except for red abdominal markings already mentioned, and tendency toward a paler green aspect caused by coarser white striation of green areas. The diagnostic abdominal markings are in the form of white or yellowish dorsal v-shaped spots on segments 2 and 3, separated and surrounded by variable amounts of rose shading which may also encroach upon segments 1, 4, or both. The width of the white postmedial line is also variable but averages about the same as in *nevadaria*. If there is a difference, that of *banksaria* is wider, contrary to Sperry's statement (1944, p. 36) that this line is twice as wide in *nevadaria* as in *banksaria*. In one specimen, a female from San Leandro, Calif., the white interantennal fillet has a pink posterior margin but normally this is green, as in other species of *Chlorosea*.

Specimens in which the abdomen is lost or badly discolored are virtually impossible to distinguish from *nevadaria*, except by the locality labels.

Length of forewing: males, 15-21 mm (average of 24 specimens, 18 mm); females, 16.5-21 mm (average of 16 specimens, 19.06 mm).

MALE GENITALIA. Probably indistinguishable from those of *nevadaria* and *margaretaria*. Teeth on posterior margin of the eighth sternite may however be single, double, single on one side and double on the other, or entirely lacking in both sides (see Geographical Variation). Elsewhere in the genus only *roseitacta* lacks these teeth, but there consistently so.

FEMALE GENITALIA. Similar to those of other species of *Chlorosea*.

MATERIAL EXAMINED. 77 males, 90 females, including holotype; 9 male, 4 female slides.

DISTRIBUTION. BRITISH COLUMBIA: Victoria; Wellington, V. I.; Duncans, V.I. Goldstream; Shawnigan. WASHINGTON: Puyallup; Berne; Seattle; Satus Creek, Yakima Co.; Ellensburg; Dayton; Brewster. OREGON: Caves National Monument, Rogue River National Forest; Bend; Wallowa Lake. CALIFORNIA: Shasta Retreat; Bartle and Grass Valley, Siskiyou Co.; Hat Creek P.O., Shasta Co.; Carrville, Trinity Co.; Laytonville, Mendocino Co.; Mohawk and Smith Lake, 6200', Plumas Co.; The Geysers and Glen Ellen, Sonoma Co.; Pine Crest and Dodge Ridge Ski area, Tuolumne Co.; San Leandro, Alameda Co.; Inverness, Marin Co.; Kings Mountain, San Mateo Co.; El Portal and Miami Ranger Station, Mariposa Co.; Mt. St. Helena and Spring Mountain, Napa Co.; San Joaquin Experimental Range, Madera Co.; Cedar Grove (Kings River Canyon) and Lakeshore, 7000', Fresno Co.; Mt. Pinos, Kern Co.; Temple City and Buckhorn Camp Exit Road, Los Angeles Co.; Camp Baldy, San Bernardino Co.; "Sanzalito" [Sausalito]; Carmel; Castella; Dunsmuir; Santa Monica.

There are also paratypes that I have not seen from the following localities in California: "Modoc Co."; "Monterey Co."; Huntington Lake, Fresno Co.; top of Mt. Wilson; Half Moon Bay; Deer Park Springs, Lake Tahoe; Oakland; La Sierra Heights; Paraiso Springs; San Antonio Canyon; Roscoe, Los Angeles Co.; Laguna, San Diego Co.

GEOGRAPHICAL VARIATION. *Banksaria* varies little throughout most of its range but toward southern California it becomes more intensely green, with a narrowing and eventual obsolescence of the postmedial lines in subspecies *gracearia* from Los Angeles, San Diego and San Bernardino Counties. Extremes of this, such as the type of *gracearia*, are known only from a limited area in the San Bernardino and San Gabriel Mts., and Mt. Palomar, San Diego Co., but a dozen specimens in the USNM and the AMNH from Camp Baldy, San Bernardino Mountains, Calif., apart from being just a little less striate than usual, are much like normal *banksaria* from the northwest. It is possible that *gracearia* will prove to be a distinct species, as Sperry regarded it, but as yet there is not enough good material available from possible blend zone areas. I have imagined that a few specimens from Mt. Pinos, Kern Co. and Lake Hughes, Los Angeles Co., are intermediate, but this is still doubtful.

The ranges of *banksaria* and *nevadaria* are mostly separated by great desert areas, and by the southern Sierra Nevada Range which seems to be exclusively occupied by *margaretaria*. To the north it seems likely that *banksaria* and *nevadaria* must meet somewhere, especially in Washington or British Columbia, and indeed the specimens from Satus Creek and Brewster, Wash. have the red abdominal markings considerably reduced, suggesting intermediacy. The *nevadaria* from Kaslo, B.C. have the pale look of *banksaria* but show no sign of red markings. Here again much more material is needed from crucial intermediate areas.

There seems to be some geographic variation in the male genitalia. The teeth normally present on the posterior margin of the eighth sternite were found to be entirely wanting in the several specimens examined from Vancouver Island, B.C.

FLIGHT PERIOD. Vancouver Island: June 17–Aug. 8. Wash.: May 29–July 12. Ore.: July 4–31. N. and central Calif.: May 18–July 18, with one record for May 2 (Madera Co.). S. Calif.: June 12–July 9, Aug. 28. Among specimens from Laytonville, Mendocino Co., Calif. (R. F. Sternitzky), there is one dated May 5 and another Sept. 26.

EARLY STAGES. Rindge (1949) published a detailed description of a single larva collected from *Ceanothus thyrsiflorus* in San Mateo Co., Calif. I have given a summary of his account in the generic description.

REMARKS. The confusion of localities cited above under distribution, some being in southern California and within the supposed range of *gracearia*, is partly a result of the poor condition of some of the material examined and the difficulty of deciding whether such specimens should be regarded as *gracearia*. In faded specimens the critical characters are often lost. Also, Sperry included among his paratypes a number of specimens that should almost certainly be referred to *gracearia*. Most of these I have not seen.

***Chlorosea banksaria gracearia* Sperry, new combination**

Plate 7, figures 1, 1a, 1b, 1c, 1d; Plate 42, figure 10.

Chlorosea gracearia Sperry, 1946, pp. 137-138.

DIAGNOSIS. This form is much more intensely green than *banksaria*, often with quite coarse white striation, but this varies. The postmedial lines are reduced in width and may be entirely absent; when the latter condition occurs it is a unique character within the genus. The pink abdominal markings tend to be more extensive than in *banksaria*, showing clearly on all of the first four segments.

TYPES. Holotype male from Barton Flats, San Bernardino Co., Calif., Sept. 4, 1945, in the AMNH. Allotype in same collection, and single paratypes in the USNM and CNC.

SYNONYMY. None.

FURTHER DESCRIPTION. The darker shade of green characteristic of *gracearia* approaches that of *roseitacta*, and the fringes tend to be greener than those of *banksaria*. The costal quarter of the hindwing is almost pure white, but beyond this the green shading intensifies until, toward the anal angle, it becomes almost as dark as on the forewing. Thus the contrast between the white and green areas of the hindwing is greater than in *banksaria* or *nevadaria*, but the postmedial line, perhaps as a corollary of its near absence, does not form the boundary between green and white areas as it often does in the other species. The underside is paler green with scarcely a trace of the lines.

On the head, the front and interantennal fillet are pale tan color, with pink shading at the sides of the front only. In *banksaria* the front and fillet tend to be paler, often white, and the front may be heavily shaded with pink. The palpi are similar in the two forms. Sperry's description mentions a rose collar as one of the characters, without comparisons or any reference to variability. In nearly all specimens that I examined, the posterior edge of the fillet is green, not pink, and so it would seem that, as in *banksaria*, only occasional variants have the pink collar. In size, *gracearia* does not seem to differ significantly from *banksaria*.

MALE GENITALIA. There appear to be tendencies toward genitalic differences but nothing that decisively separates *gracearia* from *banksaria*. The uncus is very broad, whereas in *banksaria* and *nevadaria* it may be similarly broad or narrower. The valve also is wider with perhaps a somewhat less prominent costal protrusion. I have illustrated valves from three specimens to indicate the variation that is to be expected. Similar variation may be found in the other species of *Chlorosea*. The teeth on the eighth sternite appear always to be present and may be single or multiple.

FEMALE GENITALIA. Indistinguishable from those of the other species.

MATERIAL EXAMINED. 19 males, 19 females, including holotype; 8 male, 2 female slides.

DISTRIBUTION. CALIFORNIA: Tanbark Flat and Chilao, San Gabriel Mountains; Big Rock Creek, Upper Shake Canyon, Mt. Wilson, Lake Hughes, Malibou Canyon, Charlton Flat, Temple City, Cloudburst Canyon (Angeles Crest), and Buckhorn Camp exit road, Los Angeles Co.; Barton Flats, Big Bear Lake, Upper Santa Ana River and Lake Arrowhead, San Bernardino Co.; Mt. Palomar State Park, San Diego Co.

GEOGRAPHICAL VARIATION. This is covered in the remarks below and in the discussion of *banksaria*.

FLIGHT PERIOD. May 22 to Sept. 10, more or less continuously but with a majority of records for June.

EARLY STAGES. Unknown.

REMARKS. The status of *gracearia* is very much in doubt and it is perhaps an inconsistency to regard this as only a subspecies while keeping *banksaria* and *nevadaria* separate. I treated a series from Camp Baldy, San Bernardino Mts. (ex Barnes Collection) under *banksaria* although these, in their uniform, slightly darker coloring, show a suggestion of intermediacy. Certainly most of them can be distinguished from northern *banksaria*. A few others, such as a single example from Mt. Pinos, Kern Co., and two of three specimens from Lake Hughes, Los Angeles Co., are even more suggestive of intergradation, but it may be that if they were fresher specimens they could be clearly assigned to *gracearia*. In a series of 11 males and 16 females in the AMNH there is nothing that is clearly intermediate.

In summary, *banksaria* and *gracearia* are essentially if not entirely allopatric, and look enough alike to be related as subspecies, yet the existence of undoubted transitional or introgressive populations is not yet established. This may only imply a deficiency of good material from appropriate localities.

Chlorosea margaretaria Sperry

Plate 6, figures 1, 1a, 1b; Plate 30, figure 3; Plate 42, figures 1-3.

Chlorosea proutaria Pearsall, 1911b, p. 250 (partim).

Chlorosea margaretaria Sperry, 1944, pp. 37-38.

DIAGNOSIS. This is a rather distinctively marked species known only from the Sierra Nevada Mts., Calif., and from Eureka and Bryce Canyon, Utah. It is characterized chiefly by the smooth-textured and only faintly striate green scaling, the strongly marked and almost straight white postmedial line, directed more obliquely toward the apex of the forewing than in any other species, and a tendency for the similarly well defined line of the hindwing to mark off a basad pale area from an outer green area. It is smaller in size than *nevadaria* or *banksaria*; about the same as *roseitacta*. The genitalia are hardly if at all distinct.

TYPES. Holotype male, from Lundy Creek, Mono Co., Calif., July 11, 1937 (Lloyd Martin), is type No. 5259 in the CNC. Allotype female in the AMNH. The 64 paratypes are distributed among various North American collections, but most are in the LACM.

SYNONYMY. None.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs as in the other species of the genus. Antennal shaft and interantennal fillet essentially white; front and palpi white, variably tinged with pink or tan color; legs white with some green vestiture on major segments, and with fore tibiae and apices of fore and middle femora pink; thorax green; abdomen white with partial green shading dorsally and ventrally, no red markings. There are possible exceptions in the case of the last character, as two large females from Monache Meadows, Tulare Co., California, show distinct but reduced abdominal markings similar to those of *banksaria*.

Upperside of wings bright green of a slightly bluish hue, color often paler than in other species of the genus, very even, relatively fine textured; white striations, if present, faint and minute; costa thinly edged with white; postmedial line of forewing thick and prominent, usually almost straight, sometimes curved, but not, as in the other species, parallel with outer margin. A unique feature of *margaretaria* is the oblique position of the postmedial line, starting at or just beyond the middle of the inner margin and running either straight toward the apex or closer to it than in any other species of *Chlorosea*. The postmedial line of the hindwing is curved, less prominent, but it tends to be correspondingly oblique. There is a tendency for this line to separate a basad whitish area from a pale greenish outer area, dividing the hindwing approximately in half. Antemedial lines wanting; fringes pure white; no discal spots. Underside paler with same lines repeated indistinctly.

Length of forewing: males, 13.5-16.5 mm (average of 10 specimens, 15.25 mm); females, 16-18 mm (average of 10 specimens, 16.39 mm).

MALE GENITALIA. It is doubtful if there are any genitalic characters by which *margaretaria* may be distinguished from *nevadaria* or *banksaria*. Any differences apparent in the drawings are within the range of variation of all three species. The teeth on the eighth sternite may be single or double.

FEMALE GENITALIA. Similar to those of the other species.

MATERIAL EXAMINED. 39 males, 28 females, including holotype and allotype; 5 male, 3 female slides.

Sperry (1944, p. 38) gives data from 39 specimens in the Los Angeles County Museum that I have not seen.

DISTRIBUTION. CALIFORNIA: Coleville, Lundy Creek, Virginia Lakes, Mammoth Lake, Mammoth Camp, Walker River, Casa Diablo Hot Springs, Leevining, Rock Creek (7300'), Silver Lake, and Sierra Junction, Mono Co.; Smoky Valley, Lower Chimney Meadows and Monache Meadows, 8000', Tulare Co.; Argus Mountains and Round Valley, Inyo Co.; "Inyo Co." (O. C. Poling), and "near Topaz, Calif." UTAH: Eureka; Bryce Canyon (9 females from Utah, collected by Tom Spalding). ARIZONA: "Mohave Co."

GEOGRAPHICAL VARIATION. The range is hardly great enough for much variation. The Utah and Arizona specimens do not differ significantly from the Californian ones, except perhaps for a tendency toward slightly narrower lines that increases the chances of confusion with *nevadaria*.

FLIGHT PERIOD. July 11 to Aug. 11 in most localities; June 8 and 11 at Walker River; May 6 to 31 in the Argus Mts. (series of 30 specimens ex C. H. Ingham collection). 6 males (ex Poling collection) from Inyo Co. dated June 1-30; the two Arizona females, "June 8-15." The 9 Utah specimens dated May 27, June 24, July 11, July 17, and Aug. 1.

EARLY STAGES. Unknown.

REMARKS. In the California localities *margaretaria* seems to be the only species of *Chlorosea* represented, but at Eureka, Utah, *nevadaria* and *roseitacta* are also present. The female type of *proutaria*, from Eureka, Utah, May 27, 1910 (AMNH) is *margaretaria*, but the male type from Colorado is *nevadaria*. Utah specimens of both *nevadaria* and *margaretaria* have been generally confused, and often labeled *proutaria*.

Chlorosea roseitacta Prout

Plate 7, figures 2, 2a, 2b; Plate 30, figure 4; Plate 42, figures 11, 12

Chlorosea roseitacta Prout, 1912, p. 116. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 42. McDunnough, 1938, p. 141. Sperry, 1944, p. 38.

DIAGNOSIS. This is the only species of the genus with which there is no problem of identification. The narrow red patch on the inner margin of the hindwing is diagnostic, and the relatively small size and deep green coloring also provide good characters. The male genitalia, although not very different from others of the group, are clearly the most distinctive. The teeth on the eighth sternite, generally characteristic of the species of *Chlorosea*, are always lacking in *roseitacta*. This is frequently the only species of *Chlorosea* present in Ariz., N. M., Utah and southern Colo.

TYPES. A male from Palmerlee, Ariz. in the BM (ex collection L. B. Prout). Described from one specimen.

SYNONYMY. None.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs about the same as in other

species of the genus. Scales of antennal shaft white; interantennal fillet white or pink; if pale, with faint tan colored posterior margin; front and palpi light tan to white, tinged with pale red, sometimes all red; legs with coxae and femora green, first and second tibiae plus distal end of femora tinged with red; legs otherwise white; thorax deep green above, paler beneath; abdomen white, pale green beneath, and with red and yellow markings above. The abdominal markings follow the same pattern as in *banksaria*, with central pale spots on segments A1, A2 and A3, but the spots are more often yellow than white, and the surrounding shade is a faded brick red rather than the deep rose of other species.

Upperside of forewing deep green, darker than in any other species of *Chlorosea* with the exception of *gracearia*; costa thinly edged with white; hindwing deep green near anal angle, becoming gradually paler toward costa; both wings evenly and very finely striated with white; postmedial lines regular or very slightly irregular, very thin but always present, parallel with outer margins; hindwing with a trace of the antemedial line, not usually visible in other species of *Chlorosea*; hindwing with a bright red elongate patch or bar, often edged with yellow, on the inner margin between the antemedial and postmedial lines, an obvious and unique character of *roseitacta*; fringes of both wings green with distal edge white. Underside as above but much paler, darkest near costa of forewing, with only the postmedial lines visible, not the antemedial or the diagnostic red patch.

Length of forewing: males, 14-16.5 mm; females, 16.5-18.5 mm.

MALE GENITALIA. These differ from the genitalia of the other species mainly in the form of the valve, which is narrower near the base and then widens abruptly from about the middle outward, this being mostly a result of the very prominent sclerotized costal protrusion. The form of the apical tooth on this protrusion is quite variable. The uncus similarly is narrower than usual near the base and widens distally. The tooth on the gnathos is very well developed. The eighth sternite is almost unique in having no teeth on its posterior margin, but some *banksaria* also lack these.

FEMALE GENITALIA. Similar to those of other species of *Chlorosea*.

MATERIAL EXAMINED. 66 males, 56 females; 10 male, 8 female slides.

DISTRIBUTION. ARIZONA: Paradise, Cochise Co.; Chiricahua Mountains, 5400', 5 mi. W. of Portal, Cochise Co.; Chiricahua Monument, Cochise Co.; Cave Creek Canyon (Portal), Cochise Co.; Palmerlee; Madera Canyon, 4880' and 5600', Santa Rita Mountains, Santa Cruz Co.; Fort Valley, 7350', 7½ mi. NW of Flagstaff, Coconino Co.; West Fork, 6500', 16 mi. SW of Flagstaff; Oak Creek Canyon, Coconino Co.; Walnut Canyon, 6500', near Flagstaff, Coconino Co.; White Mts., 7200'; Washington Mts.; Sierra Vista, Ramsey Canyon and Carr Canyon, Huachuca Mountains; McNary; Williams. NEW MEXICO: 13 mi. N. of Rodeo, Hidalgo Co.; MacMillan Camp, 14 mi. N. of Silver City, Grant Co.; Sitting Bull Falls, 42 mi. S.W. of Carlsbad, Eddy Co.; Frijoles Canyon, Bandelier National Monument, 6050'; Hot Springs, 7000'. UTAH: Eureka. COLORADO: Rock Creek Park; Chimney Gulch, Golden; Lookout Mountain, Jefferson Co., 7000'; Glenwood Springs; Manitou.

GEOGRAPHICAL VARIATION. Little variation can be seen in the material available.

FLIGHT PERIOD. June 9 to Oct. 25. Apparently two or more generations in Ariz.

EARLY STAGES. Unknown.

REMARKS. Until recently *roseitacta* was known from relatively few specimens, but in the period from 1959 to 1964, Dr. J. G. Franclemont collected a fine series of 39 in Madera

Canyon and in the vicinity of Flagstaff. The AMNH also has a good series of 42 from localities in all of the states where it occurs, mostly taken in recent years by Dr. F. H. Rindge.

NEMORIA Hübner

Nemoria Hübner, 1818, p. 25.

Racheospila Guenée, 1857, p. 374.

Aplodes Guenée, 1857, p. 377.

Hipparchiscus Walsh, 1864, p. 301.

Anaplodes Packard, 1876, p. 392.

Annemoria Packard, 1876, p. 376.

TYPE SPECIES. Of *Nemoria*, *bistriaria* Hübner, 1818, monobasic; of *Racheospila*, *Racheospila lixaria* Guenée, 1857, designated by Hulst, 1896, p. 314; of *Aplodes*, *Aplodes mimosaria* Guenée, 1857, designated by Hulst, 1896, p. 315; of *Hipparchiscus*, *venustus* Walsh, 1864 = *Nemoria mimosaria* (Guenée), monobasic; of *Anaplodes*, *pistacearia* Packard, 1876, monobasic; of *Annemoria*, *Eunemoria unitaria* Packard, 1874 = *Annemoria unitaria* Packard, 1876, monobasic (= *Nemoria unitaria*, new combination).

ADULT CHARACTERS. Size variable, mostly intermediate to quite large for the subfamily, forewing length 8-18 mm; wings normal in shape, not angulate or strongly produced; color commonly bright green, but varying in shade from yellowish to bluish, occasionally brown, with or without pale striation; costa pale; lines pale, normal, antemedial of hindwing usually present; discal spots present or absent; terminal line and fringes marked with red in many species; abdomen with or without dorsal markings. A few species, including *bistriaria*, are dimorphic, with both green and brown forms.

Venation variable in minor details; Sc, R₁ and R₂ sometimes fused, sometimes all separate; R₂₋₅ + M₁ commonly unstalked, but distinctly stalked in some species; hindwing with M₃ + Cu₁ stalked or unstalked, third anal usually present; frenulum in male normal, usually well developed for the group, in female present as a weak tuft of bristles, or obsolete.

Male antennae bipectinate but not heavily so, length of longest branches not exceeding twice thickness of shaft; antennae tapering gradually toward tips; female antennae simple, finely ciliate beneath; male palpi of moderate length, often only slightly exceeding front, the third segment small and conical; female palpi variable, like those of the male or up to almost twice that length, with the third segment cylindrical and three-fourths as long as the second; eyes of the sexes similar or those of the male slightly larger; front almost square, flat or with a slightly raised ridge across the bottom; tongue normal, well developed; hind tibia of male nearly always strongly dilated, somewhat prismatic, with an apical extension and two pairs of spurs, the latter separated by a distance not exceeding length of longest spur; hind tibia of female undilated or but slightly so, also with two pairs of spurs but no apical extension.

Male genitalia basically like those of *Chlorosea* but with a tendency toward greater complexity and diversity of structure. Uncus long, slender, linear or slightly spatulate; socii rounded, moveable, semi-membranous flaps, larger than in *Chlorosea* or *Dichorda*; gnathos a closed loop with a sharp distal tooth as in *Chlorosea*, but generally more slender; juxta a flat plate, or cone-shaped, or funnel-shaped narrowing to a closed papilliform process (a form paralleled in some Hemitheini); saccus rounded and entire, or with a deep U-shaped emargination, or of any intermediate stage; valve simple, without costal processes or coremata in the supposedly unspecialized species, but showing the development of both in the more numerous specialized forms; coremata, if present, are small, but marked in some species by conspicuous dark tufts of bristly hair; costal portion of valve differentiated by heavy sclerotization, posterior portion

membranous; costal processes of valve, when present, highly variable, occurring as a lobate or pointed distal process and a peculiar basal structure (sometimes termed the labides) that may be a stout lobe or tooth, a long, pointed, heavily sclerotized process, or a thin, leaf-like process, either flat or spirally twisted; aedeagus slender and linear to rather stout and bowed, simple or with various arrangements of marginal teeth toward distal end; eighth sternite distinctly notched, often deeply, and with its anterior margin tending to be deeply concave. The basal costal process of the valve, when developed, is highly characteristic of *Nemoria*, found nowhere else in the Nearctic Geometrinae except as a vestige in *Chlorosea*.

Female genitalia extremely variable, probably with no exclusive generic characters, but following an orderly sequence from simple to more elaborate development. Bursa copulatrix elongated but not as much so as in *Chlorosea*, not twisted as in *Dichorda*; signum present with few exceptions and, as in *Chlorosea*, consisting of a small, pouch-like invagination of chitin in the bursa wall; bursa usually with ductus bursae adjoining subterminally, ductus seminalis terminally; ductus bursae stout, longer than that of *Chlorosea*, often sclerotized and hardly differentiated from adjacent bursa except by position. Sclerotized structures associated with the ostial opening, lacking in the least specialized forms at the beginning of the series, appear with increasing complexity in the more specialized species. The trend begins with a simple transverse, shallow, pouch-like preostial fold of semi-rigid membrane, found also in the Hemitheini, but this may become very large (often bilobate), or form a deep, funnel-shaped, sclerotized entrance to the ductus bursae, the many variations providing important species characters.

LARVAL CHARACTERS. The peculiar dorsolateral abdominal processes, believed to be characteristic of the tribe, are well developed in all known larvae of *Nemoria*. These are never as extreme as in *Dichorda*, where they have become large rectangular dorsal plates. Larvae otherwise as described under the tribal heading.

DISTRIBUTION. The genus occurs from southern Canada to South America, with the species becoming most numerous toward the tropics. About forty species occur north of the Mexican border but only five reach Canada.

REMARKS. The old division of this group into *Nemoria* and *Racheospila*, based on female palpal length, is totally untenable, and Forbes (1948) was correct in synonymizing the latter name. The *Racheopsila* of Prout, followed by McDunnough (1938), was a peculiar assemblage. Both Prout and Forbes had expressed suspicion that some of the species belonged elsewhere, and my studies of the genitalia at once confirmed this. "*Racheopsila*" *gerularia*, *herbaria*, *cupedinaria*, *irregularia* and *noel* (*diaphana* auct.) are Synchlorini, and I have put them in the genus *Synchlora*. "*Racheopsila*" *rubromarginaria* and *rubrolineararia* are conspecific with *bistriaria*, the type of *Nemoria*. *Festaria* is a member of the *Nemoria intensaria* group, and *glaucomarginaria* is so similar to *Nemoria darwiniata* that they may sometimes be distinguished only by the genitalia. Of the remaining names that were listed as species under *Racheopsila*, no less than four all refer to *lixaria*. The relationships of the numerous Neotropical species that Prout included in *Racheopsila* need to be reevaluated on the basis of genitalic structure, but it seems likely that the majority will go here. If so, *Nemoria* will become the world's largest genus in the Geometrinae, with somewhere between one and two hundred species.

An interesting feature of *Nemoria* is a tendency for the species to be of rather limited distribution. Twelve of the species treated here are known from only one state, and fourteen others occur in only two or three states. This contrasts with the situation in the Synchlorini and Hemitheini, where over half the species have relatively wide distributions, some being both Nearctic and Neotropical, and a few even extending all the way from the Canadian zone to the subtropics. Not a single species of *Nemoria* is known to have such an extensive distribution. Ten of the eleven new taxa described in

this paper are in the genus *Nemoria*, four from the southeast, one from Texas, the remainder from Arizona and New Mexico.

Key to the Species of *Nemoria*

1. General coloration green 2
 General coloration brown 42
2. Hindwings not like the forewings but paler, with the markings less distinct or even obsolete; no red terminal line 3
 Hindwings same color as forewings or, if paler, with red terminal line 9
3. Fringes green and red; Calif. *pulcherrima*
 Fringes white, yellowish, or pink 4
4. Fringes tinged with pink or, if white, abdomen distinctly greenish beneath 5
 Fringes plain white or yellowish; abdomen always whitish below 6
5. Forewings relatively pointed at the apices; antemedials wanting on both wings; postmedial of forewing straight and oblique toward apex, and outer margin almost straight; upperside of abdomen green without markings; New Mexico *rindgei*
 Wing shape normal; antemedials well developed on forewing; postmedial of forewing feebly curved or S-shaped, not oblique; outer margin distinctly convex; abdomen with three dorsal whitish spots with reddish or yellowish edging; southwestern
 *caerulescens* and *intensaria*, in part. See also couplet 32 and refer to descriptions.
6. Hindwing pure white, without markings. A very pale, fragile species *albaria*
 Hindwing with some green and always with at least the postmedial visible 7
7. Dorsum of abdomen green and unspotted in both sexes; front green; often a pale area in median space *diamesa*
 Dorsum of abdomen shaded with pinkish brown in one or both sexes; front pink or with a mixture of pink and green scales; no pale area in median space 8
8. Abdomen with a dorsal row of white spots on a pinkish ground in both sexes; hindwings decidedly paler than forewings; forewing with antemedial as wide as postmedial, which is subparallel to outer margin; Colo., Utah *viridicaria*
 Abdomen without white spots in either sex; abdomen pinkish brown on dorsum in female, green in male; hindwings sometimes almost as dark as forewings; forewing with antemedial thinner than postmedial; postmedial erect; New Mexico *subsequens*
9. Costa of forewing bordered with purplish brown; wings striated or dappled with yellowish; southwestern 10
 Not as described above 11
10. Wings opaque, lines well defined; antemedial, at least on forewing, distinct *arizonaria*
 Wings subhyaline; lines indistinct, antemedials virtually wanting *daedalea*

11. Costa and upperside of thorax and abdomen shaded with bright pink; no abdominal spots; a rather large, pale species; Ariz., Utah *latirosaria*
 Not as described above 12

12. Wings with red terminal line, which may be continuous or interrupted 13
 Wings without red terminal line 24

13. Abdomen with dorsal markings in the form of discrete whitish spots, usually encircled with red or brown 14
 Abdominal markings, if present, not in the form of spots 21

14. Underside of wings almost as green as upperside; underside of abdomen green; white lines unusually wide and prominent, regular; Colo., Ariz., N.M., Nev., Calif. *obliqua obliqua, obliqua hennei*
 Underside decidedly paler than upperside; underside of abdomen whitish; white lines narrower 15

15. Female palpi the same as in the male, minute, hardly exceeding front; abdominal spots small, commonly 4 in number; postmedials strongly dentate; Fla. *catachloa*
 Female palpi always longer than those of the male; abdominal spots generally larger and 3 in number, that of segment 2 commonly wanting; lines regular or slightly waved, rarely dentate 16

16. Fore tibia red or brownish with an oblique white band across the middle of the anterior side 17
 Fore tibia red or brownish but without the white band across the middle 20

17. Postmedial of forewing even, straight or slightly concave; fringes white, almost unmarked; females large, wing length up to 16 mm; Ariz., N.M. *zelotes*
 Postmedial of forewing convex, often slightly sinuous; fringes usually with reddish rays; smaller species; eastern 18

18. White lines thin and indistinct, usually slightly waved or dentate; fringes with bright, contrasting red rays; female palpi exceeding front by about half their total length; uncus of male genitalia distinctly expanded at tip (often visible without dissection); southeastern *lixaria*
 White lines more distinct and regular; fringes with red rays less contrasting, sometimes all suffused, sometimes obsolete; female palpi exceeding front by about one third their total length; uncus of male genitalia linear or but very slightly expanded at tip; eastern .. 19

19. Lines thin but distinct; wings opaque; fringes with red rays distinct or obsolete; N.J. to Ga., west to Mo. and eastern Texas *bistriaria bistriaria*
 Similar but from the region north of the above area *bistriaria rubromarginaria*, summer generation.
 Similar but from central Texas *bifilata planuscula*
 Lines quite wide but diffuse, regular; wings almost subhyaline; fringes with red rays very diffuse, often suffusing the whole fringe; northeast only *bistriaria rubromarginaria*, spring generation.

20. Abdominal spots with very little red around them; spot on segment 2 wanting; Texas *bifilata planuscula*, summer broods.
Abdomen with variable amount of red, sometimes suffusing whole dorsum; spot on segment 2 commonly present, but reduced; Ariz., N.M. *festaria*
21. Antemedial and postmedial lines of forewing convergent toward costa; hindwing paler than forewing; Ariz., Chihuahua, Durango *splendidaria*
Lines of forewing divergent toward costa in the normal way; hindwing not paler than forewing; eastern 22
22. Abdomen with a white or cream-colored dorsal stripe; east coast region from N.J. to Fla. *bifilata bifilata*
Abdomen without white dorsal markings 23
23. Light green, unstriated; abdomen marked with a large chocolate brown dorsal patch in the middle; fringes white with deep red rays like *lixaria* but often darker and more contrasting; Gulf states to N.C. *saturiba*
Deep green, finely striated; upperside of abdomen green, unmarked; fringes yellow and unmarked; Fla. *outina*
24. Abdomen marked with 3 or more pale dorsal spots that are usually encircled with red or brown (except *unitaria*) 25
Abdomen without pale markings or with only one small white spot at base 33
25. Wings coarsely striated with white; fringes pale yellowish with no pink; antemedials preceded by a solid green (unstriated) shadow line; pale yellowish costal border as wide as the fringe; fore tibia entirely whitish; Ariz. *aemularia* females, in part.
Wings finely striated or unstriated; fringes often with some pink, at least a trace at the apex of the forewing; antemedials not preceded by a contrasting solid green shade; pale costal border narrower than fringe; fore tibia reddish 26
26. Abdominal segments 1, 2 and 3 with pure white dorsal spots and no red or brown shading; antemedial and postmedial of hindwing united before reaching inner margin, forming a closed loop that is diagnostic if fully visible, but often with the lines fading out before inner margin so that the loop is incomplete; Forewings somewhat acute; Rocky Mt. region *unitaria*
Abdominal segments 1, 2 and 4 with whitish spots, more or less encircled with brown or reddish shading, the spot on segment 2 usually wanting; lines of hindwing not united; forewings not especially acute 27
27. Large species, average length of forewing greater than 13 mm; fringes generally whitish with from one to several pink rays toward apex 28
Smaller species, average length of forewing less than 13 mm; fringe whitish at base and uniformly tinged with pink distally, or all white (*caerulescens*); the pink in the fringes is a delicate shade that fades to white in old specimens 30
28. Wings with well developed reddish brown discal spots; abdominal spots encircled with a very dark shade of reddish or purplish brown which may encroach upon and obliterate them; San Francisco Bay to Baja California, Ariz. *darwiniana punctularia*
Wings with discal spots vestigial or wanting; abdominal spots encircled with a pale, dull shade of red or brown 29

29. Abdominal spots of normal size, pure white encircled with pale red; spot on abdominal segment 2 lacking in both sexes. This and the following species may often be separated with certainty only by their distinctive genitalia; B.C. to northern Calif., Nev., Utah, Colo. *darwiniata darwiniata*
- Abdominal spots commonly larger, especially in females, and often cream colored rather than white (but this is inconsistent); abdominal spots encircled with dull reddish brown; spot on abdominal segment 2 present or absent in both sexes; mountains of Pacific coast region from Wash. to San Diego Co., Calif. *glaucomarginaria*
30. Mainly northeastern, N.C. to Mo., S.D. and north *rubrifrontaria*
- Southwestern or Texan 31
31. Lines thin and indistinct; fringes pink; abdomen whitish ventrally; hindwings always same color as forewings; southwestern Texas *albilineata*
- Lines wide and conspicuous or, if narrow, abdomen not as above; fringes white or pink; abdomen green ventrally; hindwings often paler than forewings but this is variable (see also couplet 5) 32
32. Color bluish green; fringes white or but faintly pinkish; interantennal fillet with hind edge faintly yellowish but not red; abdominal spots small and almost devoid of reddish shading; lines usually wide, postmedial often wider than fringe but in some variants much narrower (see comment below); extreme western Texas, N.M., eastern Ariz. *caerulescens*
- Color deep pea green as in *obliqua*; fringes decidedly pinkish, often with diffuse rays; interantennal fillet with or without a red hind margin; abdominal spots of more normal size, usually surrounded by conspicuous red shading; lines usually wide and distinct but rarely wider than fringe (Californian *intensaria* may have the forewing postmedial still further reduced and even partly obsolete); N.M., Ariz., Utah, Nev., Calif. *intensaria*
- Note: Some Arizona specimens will not key out clearly either to *caerulescens* or *intensaria*. These look like *caerulescens* with very narrow lines, and may represent a third species.
33. Coastal Calif. only; wings deep green, somewhat striated; no brown discal spots; fringes bright pink with a pale line at the base; white interantennal fillet with deep rose hind margin; upperside of abdomen green (very rarely marked with pink) .. *leptalea*
- Not as above 34
34. Wings conspicuously striated 35
- Wings unstriated or only faintly so 38
35. Femur and tibia of foreleg deep rose anteriorly; dark brown discal spots usually well developed; Calif. *pistacearia*
- Femur and tibia of foreleg brown or white; brown discal spots wanting; Ariz. 36
36. Forelegs entirely whitish; wings yellowish green; antemedials and postmedials both well developed; postmedial and pale costal border about as wide as fringe; abdomen of male mostly whitish, that of female shaded with pinkish brown above, and with or without white spots (see also couplet 25) *aemularia*
- Forelegs with some brown; wings bluish green; antemedials obsolete, postmedials thin or obsolete; pale costal border narrower than fringe; upperside of abdomen green in both sexes 37

37. Front of fore tibia brown with an oblique white band across the middle; postmedials obsolescent, dentate where visible, that of forewing parallel to outer margin; a large species, female wing length 12-18 mm; Ariz., N.M. *strigataria*
- Front of fore tibia solid brown without white band; postmedials thin but fairly distinct, straight, that of forewing erect; a smaller species of about the same size and wing shape as *pistacearia*; Madera Canyon, Ariz., and Mexico *mutaticolor*
38. Fringes green, concolorous with wings; Texas *zygotaria*
- Fringes white or pink 39
39. Upperside of abdomen with a small pure white spot on the first segment, which is green; white costal border without yellowish hind edge separating it from the green area of the wing; fringes white; northeastern, south to Va. *mimosaria*
- Upperside of abdomen greenish near the base but without white spot; white costal border with a yellowish hind edge; fringes white or pink; southeastern 40
40. Size and appearance much like *mimosaria*; length of forewing more than 10 mm; no discal spots; fringes white; front brown; known only from Va., W. Va., N.C. *tuscarora*
- Size and appearance not like *mimosaria*; length of forewing nearly always less than 10 mm (except for a few large females of *elfa* which may reach 12 mm); blackish discal spots often present; fringes pink or white; front pink or green 41
41. Fringes pale pink; white interantennal fillet with a pink hind border; front pink; Fla., Miss. *extremaria*
- Fringes white; white interantennal fillet without a pink hind border; front green; Fla., S.C., N.C. Texas *elfa*
42. Hindwings not like forewings but paler, more diffusely marked; postmedials not pale but dark brown; Calif. *pulcherrima*,
brown form
- Hindwing similar to forewing; postmedials pale; eastern states and Texas 43
43. Front of fore tibia with a white bar across the middle 44
- Front of fore tibia without a white bar across the middle 45
44. South of the latitude of New York City (approximately) *bistriaria bistriaria*,
spring brood
- North of the latitude of New York City (approximately) *bistriaria rubromarginaria*,
spring brood (in part)
45. Northern Fla. and Ala. to Long Island, N.Y. *bifilata bifilata*, spring brood
- Texas *bifilata planuscula*, spring brood

Group I. The *unitaria* group. Three species, perhaps not closely related, but with strong genitalic similarities.

Nemoria pulcherrima (Barnes and McDunnough)

Plate 2, figure 1; Plate 7, figures 3, 3a, 3b; Plate 30, figure 5; plate 42, figures 13-16.

Chlorosea pulcherrima Barnes & McDunnough, 1916a (November 27), p. 20; pl. 2, fig. 10; 1917a, p. 100.

Chlorosea naidaria Swett, 1916 (December 15), pp. 10-11.

Nemoria naidaria Comstock and Dammers, 1937, pp. 74-78, pls. 36-40 (early stages)

Nemoria pulcherrima Prout, 1932, p. 24. McDunnough, 1938, p. 141. Comstock, 1960, p. 436, 437.

DIAGNOSIS. *Nemoria pulcherrima* is an odd species that stands quite apart from all others in the region covered. The genitalia are very close to those of *Chlorosea* and, although there are two pairs of spurs on the hind tibia, the first pair is commonly so closely appressed into grooves in the tibia as to be impossible to see in a cursory examination. The hind tibia of the male is only slightly dilated and without the usual apical extension of *Nemoria*. These features, together with the obsolescence of the antemedial lines, explain why *pulcherrima* was originally placed in *Chlorosea*. The 3rd anal of the hindwing is best developed of all the species of *Nemoria* examined, reaching or surpassing the mid-point of the inner margin. Otherwise the venation is typical of the group.

Although there is a rare brown form, *pulcherrima* normally has bright green forewings with red-spotted fringes and paler, diffusely marked hindwings, whitish and somewhat translucent if worn. The species occurs in California, where it is the only *Nemoria* with contrastingly paler hindwings.

TYPES. *Pulcherrima* was based on 7 males from Eldridge, Sonoma Co., Calif., Feb. 1-7 (Barnes collection), although the labels just give as the locality "Sonoma Co." I designate the specimen figured (Barnes and McDunnough, 1916, pl. 2, fig. 10) as lectotype. It is in the USNM.

Naidaria was described from San Diego, Calif. The holotype male, taken Jan. 26, 1912, and allotype female, Jan. 21, 1912, are in the MCZ. There were 5 male and 5 female paratypes, some of which are in the AMNH.

SYNONYMY. The name *naidaria*, published only 18 days after *pulcherrima*, is the only synonym. As the species is distinctive, and all the type material has been available for study, there are no synonymic problems.

FURTHER DESCRIPTION. Venation as figured; hind tibiae as described under diagnosis. Retractable first pair of spurs on hind tibia frequently not evident, or with only one spur showing; no hair pencils. Male antenna bipectinate to near the tip, with shaft and branches thinner and more delicate than is usual in *Nemoria*; female antenna ciliate and normal for the genus; male and female palpi of almost equal length, moderate, exceeding front by about the length of the small terminal segment; palpi and front red, interantennal fillet white followed by a wide red collar; legs whitish, extensively shaded with red on the tibiae and femora; thorax green above, whitish below; abdomen white with bright red dorsal markings on the first three segments; segments A1 and A2 each with a white dorsal spot surrounded by red.

Forewing deep green striate with white; costa cream-colored to red; if pale, becoming reddish at the base; white postmedial line thin but distinct, straight or evenly excurved, often parallel to outer margin; antemedial line faint or wanting; blackish dorsal spot usually present; fringes green, variably spotted with red, the red spots limited to the apical region (most commonly) or in some specimens so extensive as to color almost the entire fringe. Hindwings similar to forewings but contrastingly paler, especially toward costa, the markings more diffuse; in older specimens the hindwings tending to become whitish and translucent. Probably less than 10% show any red fringe spots on the hindwing. Underside similar but paler, with lines obsolete.

A form occurs in which all of the green is replaced by light brown, the red by darker brown, and with the normally white postmedial lines also dark brown. I have seen only five males and three females of this form, from Sacramento, Atascadero, Walnut Creek, and the Mariposa Co. locality. One male and one female from Lafayette,

Contra Costa Co., are pale and yellowish, with dark brown shading on the inner side of the lines.

Length of forewing: male, 13.5-15.5 mm; female, 11.5-14 mm.

MALE GENITALIA. Simple in form and most closely resembling those of *Chlorosea*. They differ mainly in shape of costal portion of valve, which lacks toothed costal protrusion of *Chlorosea*. Also, eighth sternite definitely of the *Nemoria* type, with posterior margin cleft into two lobes. Juxta a flattened plate and saccus rounded, without indentation, both characters typical of this first section of *Nemoria*. Aedeagus much like that of *Chlorosea*.

A singular feature of this species is that the abdominal integument of both sexes tends to have extensive areas of dark brown pigmentation unlike any other *Nemoria* examined, but resembling that of *Hethemia*. The brittleness of this integument in dissection suggests that it is invested with more than the usual amount of chitin.

FEMALE GENITALIA. Ostium simple and of the usual type found in species of the first section of *Nemoria*. Bursa copulatrix a simple membranous sack, relatively smaller in proportion to abdomen than that of most species of *Nemoria* and much smaller than in *Chlorosea*, with well defined invaginated signum at bottom.

MATERIAL EXAMINED. 88 males, 26 females; 8 male, 6 female slides.

DISTRIBUTION. CALIFORNIA; San Diego; Lower Mint Canyon, Spring Creek and Singing Spring (Angeles Forest), Angeles Crest Highway, 4000', and Burbank, Los Angeles Co.; Wrightwood, San Bernardino Co.; Palm Springs and Glen Ivy Hot Springs, Riverside Co.; Atascadero, San Luis Obispo Co.; Los Gatos; Sagus; Palo Alto; Newhall; Tujunga; Padua Hills; Glendale; Walnut Creek and Lafayette, Contra Costa Co.; Spring Mountain, Napa Co.; Sacramento; Petaluma; Mill Valley and Inverness, Marin Co.; Head of E. fork Piney Creek, 2200', near Coulterville, Mariposa Co.; Anderson Springs, Cobb Mt., Lake Co.; Eldridge, The Geysers, Glen Ellen and Guerneville, Sonoma Co.; Mather, Tuolumne Co. OREGON: In the American Museum of Natural History there are three males labeled McMinnville, Oregon, Feb. 15 and Feb. 17. These records should be verified.

GEOGRAPHICAL VARIATION. None apparent in the material available.

FLIGHT PERIOD. Dec. 21–May 18, with majority of records Jan. 14–Mar. 19. The earlier records tend to be from the southern counties but the difference in flight period from south to north is not as great as might be expected.

EARLY STAGES. The larva and pupa were described and figured by Comstock and Dammers (1937, pp. 74-78, pls. 36-40). The larvae fed on a *Quercus* species.

Nemoria mutaticolor Prout

Plate 8, figures 1, 1a, 1b; plate 42, figure 17.

Anaploides pistacearia Druce (nec Packard), 1882, p. 89, pl. 49, fig. 20.

Nemoria mutaticolor Prout, 1912, p. 113; 1932, p. 23.

DIAGNOSIS. *Nemoria mutaticolor* is a blue green species strongly and evenly striate with white and without abdominal markings; it is readily confused with either *strigataria* or *pistacearia*. The color is almost exactly like that of *strigataria* but *mutaticolor* differs

in its more rounded wing form and straighter postmedial lines, that of the forewing meeting the inner margin at 90°. The rounded wing form is similar to that of *pistacearia* but the shade of green is bluer, discal spots are lacking, and the postmedial line of the forewing is more erect. *Mutaticolor* also somewhat resembles *coruscula* Dyar from Mexico, but the latter has more pointed wings and very oblique postmedial lines, that of the hindwing bending inward and forming a vaguely defined loop, much after the fashion of *unitaria*.

On the basis of genitalic structure, I have removed *mutaticolor* from close association with the two species it superficially resembles (*pistacearia* and *strigataria*) because of the flattened juxta, rounded saccus, short, stubby socii, and shallowly excavated posterior margin of the eighth sternite. These are all characteristic of the first section of the genus from *pulcherrima* through *albaria*.

Types. One male in the BM from Sierra Madre, Tepic, Mexico (Richardson), ex collection Godman and Salvin.

SYNONYMY. None.

FURTHER DESCRIPTION. (based on male only). Antennae normal; palpi moderate, exceeding front by the length of the small terminal segment; hind tibia only slightly dilated, with a weak hair pencil, the two pairs of spurs large and prominent, and no terminal extension; front rusty red, fillet white, collar green; palpi and legs pale tan to ivory, somewhat tinged with rusty red; fore coxae green; thorax green above, paler below; abdomen green above, unmarked. Wings blue-green, heavily and evenly striated with white; costa ivory, faintly reddish near base; fringes blue-green basally, ivory outwardly; antemedial lines wanting; postmedial line of forewing white, straight and even, not parallel to outer margin, crossing wing just beyond the middle and meeting inner margin at 90°; postmedial of hindwing straight, crossing about the middle, disappearing just before reaching inner margin; both wings colored alike. Underside similar but much paler, except near costa of forewing.

Length of forewing: male, 14 mm.

MALE GENITALIA. Uncus linear, broadly rounded at tip but scarcely dilated; valve slender, somewhat curved and, as in *pulcherrima*, basal costal processes undeveloped; juxta plate-like, saccus rounded, socii short, hind margin of eighth sternite shallowly emarginate, all being characters common to the first eleven species of *Nemoria*; aedeagus of the simple *Chlorosea* type and featureless.

FEMALE GENITALIA. Unknown.

MATERIAL EXAMINED. Two males in the collection of Dr. J. G. Franclemont at Cornell University; one male slide.

DISTRIBUTION. ARIZONA: Madera Canyon, 5600', Santa Cruz Co. MEXICO: Sierra Madre, Tepic (type).

GEOGRAPHICAL VARIATION. Not studied.

FLIGHT PERIOD. The two Arizona specimens were taken July 1, 1963.

EARLY STAGES. Unknown.

REMARKS. All series of *Nemoria strigataria* should be carefully scrutinized for mis-determined *mutaticolor*, as should any material of *pistacearia* from Arizona or Mexico.

One must also be alert as to the distinctions between these species and the Mexican *coruscula* Dyar. The extent of distribution of *coruscula* and *mutaticolor* in Mexico is unknown.

Nemoria unitaria (Packard), new combination

Plate 1, figures 3, 4, 5; plate 8, figures 2, 2a, 2b; plate 30, figure 6; plate 42, figures 18-21.

Eunemoria unitaria Packard, 1874, p. 30. **New synonymy.**

Annemoria unitaria Packard, 1876, p. 376. Hulst, 1896, p. 312. Dyar, 1902 [1903], p. 299. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 42. McDunnough, 1938, p. 141.

Aplodes junctolinearia Graef, 1881, p. 87, and vol. 4, fig. 7. Hulst, 1886b, p. 140. **New synonymy.**

Anaplodes junctolinearia Hulst, 1896, p. 316. Dyar, 1902 [1903], p. 302.

Nemoria junctolinearia Prout, 1912, p. 112; 1932, p. 24. Barnes and McDunnough, 1917a, p. 99. McDunnough, 1938, p. 141.

Aplodes hudsonaria Taylor, 1906, p. 206. **New synonymy.**

Nemoria hudsonaria Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

Aplodes unilinearia Taylor, 1908, p. 60. **New synonymy.**

Nemoria unilinearia Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

DIAGNOSIS. *Nemoria unitaria* is a very wide-ranging and common species of the Rocky Mountain system, occurring from 6000' to over 9000' in Utah, Arizona and New Mexico, and at generally lower elevations northward. In appearance it quite closely resembles the eastern *mimosaria*, even to the extent of having similar white dorsal spots near the base of the abdomen. However, the forewings are narrower and the lines of the hindwing, if complete, are united before reaching the inner margin to form a rounded loop. Sometimes the antemedial portion of this loop is indistinct, especially in poor specimens, but when the confluence of the two lines is apparent it is a diagnostic character.

The species appears to have no near relatives, but the genitalic combination of flat juxta plate, rounded saccus, short socii, poorly developed basal costal processes, and weakly emarginate eighth sternite assigns it to a position near the beginning of the *Nemoria* series. The rather unspecialized female genitalia would place it in about the same position.

TYPES. *Eunemoria unitaria*, stated to be from "Nevada" (Henry Edwards), is in the MCZ. The type is now fragmentary, consisting only of the right forewing, almost denuded of scales, and right hind leg, glued to the remains of the thorax on a pin. It is labeled "Type 2230," and "Nevada."

Aplodes junctolinearia was from Colo. (collected by H. K. Morrison), and is in the USNM. The abdomen is now missing but it is otherwise intact and readily identifiable.

Aplodes hudsonaria was described from "two males, taken at light on July 7, 1905, by Mr. A. F. Hudson, at a point on the Red Deer River, 50 mi. N.E. of Gleichen, Alberta" (Taylor, 1906, p. 206). They were from the F. H. Wolley Dod collection. I designate as lectotype the specimen in the USNM which is labeled: "♂ gen. 267 . . . FHB."

Concerning *Aplodes unilinearia*, Taylor (1908, p. 60) tells us only that "Mr. Cockle brought with him four specimens taken at Kaslo [British Columbia] and dated August, 1907 (a female), and 7, 14, 21 July, 1907 (3 males)." The male specimen segregated in the type collection at the USNM has no locality data, and was taken July 10, 1907 (F. H. Benjamin's slide No. 268). Judging from the date it would seem that this is not one of the original type lot and should probably not be regarded as the type. A female specimen at Ottawa labeled 6-VIII-1907, Kaslo, B.C., Coll. J.W. Cockle, is marked as a cotype, and bears a more recent label that says Paratype No. 1015. The

Ottawa specimen is almost certainly the female mentioned in the original description and I hereby designate it as the lectotype, since no type was originally specified.

SYNONYMY. *Unitaria* Packard, 1874, is the oldest name for this species although it is one that has never been associated with *Nemoria*, least of all by Packard himself who erected a new genus for it. The subsequent history of the name has been a taxonomists' game of "Pin the Tail on the Donkey," but I feel confident that the present identification of *unitaria* is the correct one (see discussion below under remarks).

Junctolinearia Graef, 1880, is the name by which the species has been most generally known from that date to the present. Graef's type, description and figure are thoroughly unambiguous and for that reason it is unfortunate that *unitaria* has turned out to be the same species.

Hudsonaria and *unilinearia* of Taylor were still listed as species by McDunnough (1938, p. 141), and consequently have remained segregated as vague entities in most collections, mostly on the strength of locality labels. McDunnough simply followed Prout, who had nothing to go by but Taylor's descriptions. I have found no justification for regarding them as even subspecifically distinct from each other or from *unitaria*.

Northern specimens from western Canada do show more of a tendency for the lines of the hindwing to fade out before joining to form the loop, although such specimens occur throughout the range of *unitaria*, and some Canadian specimens do have a well defined loop. However, Taylor's material happened to be of the former type, and so he did not associate it with Graef's species. His description of *hudsonaria* is an exact, if somewhat restricted, account of *unitaria*. In his description of *unilinearia* two years later, Taylor stated that "the difference between *Hudsonaria* [sic] and *unilinearia* is that in the males of the latter the inner lines on all the wings are obsolete, and the outer line on the hindwing in both sexes is further from the base of the wing and takes a different course, for while the same line in *Hudsonaria* would, if produced, reach the base of the wing, in *unilinearia* it would touch the middle point of the inner margin. *A. unilinearia* is a trifle larger than *Hudsonaria*, but not quite so large as *Darwiniata*." There is nothing in either description or in Taylor's material, some of which I have seen, that violates in any way the present concept of *unitaria*, and so I assign his two names to the synonymy.

FURTHER DESCRIPTION. Male antennae decidedly stouter than those of *pulcherrima*, but typical of the remainder of the genus; female antennae ciliate and normal; upper side of antennal shaft clothed in white scales. Male palpi rather large, when fully scaled squarish, and protruding beyond front by a distance about equal to their greatest vertical width; third segment distinct. Female palpi long, exceeding front by almost half their total length; third palpal segment of female almost half the length of the second but often half covered by the scales of the second. Male hind tibia only moderately dilated, with long but rather weak hair pencil; terminal extension and spurs well developed.

Interantennal fillet white, collar green, front red with usually a white band across the bottom, palpi pink; legs whitish, fore tibiae red dorsally, middle tibiae sometimes reddish; thorax green above, white below; abdomen white with first three or four segments green on the dorsum, and with rounded white dorsal spots on the first three, the second and third spots often flanked by a few inconspicuous red scales. Fore- and hindwings evenly colored a shade of bright green very similar to that of *mimosaria*, the coloring very smooth and unstriated; costa white, faintly reddish towards the base of the wing; fringes white with usually one or more pink spots apically. Not infrequently the pink spotting is more extensive and it may occasionally occur throughout the fringes of both wings, the spots spaced as in *pulcherrima* but of a much paler shade. Lines white, rather thin but sharply defined, except sometimes the antemedials which may be indistinct or even obsolete; antemedial of forewing evenly curved; postmedial straight or with a slight concavity, oblique, approximately paralleling outer margin; lines of hindwing strongly curved and nearly parallel anteriorly, but uniting at the fold between cubitus

and the second anal vein to form the characteristic loop mentioned in the diagnosis. In those areas where the antemedials are indistinct the lines fade out before reaching the point where they join, and Packard's type of *unitaria* must have been such a specimen. Discal spots are virtually lacking. Underside as above but much paler.

Length of forewing: male, 12.5-15.5 mm, female, 15-16.5 mm.

MALE GENITALIA. Basically of the *Chlorosea* type and rather similar to those of *Nemoria pulcherrima*. Saccus rounded; juxta a flattened plate; socii short; basal costal process fairly large but thin and leaf-like, rounded; eighth sternite weakly emarginate; tooth on gnathos large and prominent; uncus flattened and dilated towards the tip, often more so than in the specimen figured; valve slender with an apically pointed blade-like edge developing especially toward the distal end of the costa.

A specimen in the USNM from Quamichan District, B.C. (F. H. Benjamin slide No. 269) has an uncus that is strikingly aberrant, and Benjamin marked the slide "n. sp.". The uncus is very much widened toward the end and cleft into two lobes, so that the outer third is heart-shaped. In other respects this specimen looks perfectly normal and I am confident that it is just a variant of *unitaria*. Slides of two males from Twin Forks, Idaho and Seton Lake, B.C., in the AMNH, show an intermediate condition, with the uncus strongly dilated and slightly incised at the tip.

FEMALE GENITALIA. Ostium and ductus bursae simple and unsclerotized; bursa copulatrix short and very stout, with a small invaginated signum at the bottom. At first I overlooked the signum and did not include it in the drawing.

MATERIAL EXAMINED. 370 males, 78 females, including types; 17 male, 5 female slides.

DISTRIBUTION. BRITISH COLUMBIA: Victoria; Duncans; Quamichan District, V. I.; Cultus Lake; Summerland; Shingle Creek Road, Keremeos; Seton Lake, Lillooet; Kaslo. ALBERTA: Red Deer River, 5 mi. N.E. of Gleichen. SASKATCHEWAN: Attons Lake, Cut Knife; South Arm, Last Mountain Lake; Lloydminster. WASHINGTON: Dayton, 3500'. OREGON: Wallowa Lake; Chief Joseph Mountain, Joseph. MONTANA: Helena; Big Timber Creek, 7 mi. N. of Big Timber, Sweetgrass Co.; University of Montana Biological Station, Flathead Lake. IDAHO: Alturas Lake, Blaine Co., 7000'; Twin Falls; Wallace. SOUTH DAKOTA: Hill City, Black Hills, Pennington Co. WYOMING: Mt. Washburn, 9000', Yellowstone National Park; Moran; Old Ford on Green River, Sweetwater Co.; Sacajawea Camp, 24 mi. W. of Big Piney, Sublette Co.; 7 mi. S.E. of Encampment, Carbon Co.; 5 mi. N. of Sundance, Crook Co.; Louis Lake, 28 mi. S.W. of Lander, Fremont Co.; near Fossil Station, Lincoln Co. COLORADO: Estes Park; Glenwood Springs; Durango; Clear Creek; Salida; Rocky Mountain National Park; Capital City, Hinsdale Co.; near Steamboat Springs, Routt Co.; Maysville; Great Sand Dunes National Monument, Alamosa Co. UTAH: Beaver, 6400'; Stockton; Eureka; Bucks Valley, Iron Co.; Provo; near Grantsville, Tooele Co., 7400'; near Monticello, San Juan Co., 8500'; Red Canyon, 12 mi. S.E. Panguitch, Garfield Co., 7200'; Blue Spruce Camp, 8000', 18 mi. N. Escalante, Garfield Co.; 28 mi. E.S.E. of Moab, Grand Co., 9200'; Fish Lake, Sevier Co.; Kaler Hollow Camp, 22 mi. N.N.W. of Vernal, Uintah Co., 8900'. NEVADA: Lee Canyon, 7400', 39 mi. N.W. of Las Vegas, Clark Co.; Kingston Camp, 7300', 30 mi. S. of Austin, Lander Co.; Baker Creek Camp, 7700', 8 mi. W. of Baker, White Pine Co. CALIFORNIA: White Mountains; Coleville, Mono Co.; "Inyo Co." (O. C. Poling). ARIZONA: Redington; Alpine; S. Fork Camp, and Greer, 8500', White Mountains, Apache Co.; Bear Wallow, Santa Catalina Mountains; Oak Creek Canyon, Coconino Co.; Hart Prairie, 8500', 10 mi. N.N.W. of Flagstaff, Coconino Co.; West Fork, 6500', 16 mi. S.W. of Flagstaff, Coconino Co.; Pine Crest, 7300', Mt. Graham, Graham Co.; S.W. Research Station of the American Museum of Natural History, Portal, Cochise Co. NEW MEXICO: Cimarron Canyon, 7900', Sangre de Cristo Mts., Colfax Co.; McGaffey, Zuni Mts., 7500', McKinley Co.; Beulah, 8000'; Jemez Springs; Fort Wingate; Bursum Camp, 18 mi. E. of Alma, Catron Co.; Cedar Creek Camp, 2 mi.

N. of Ruidoso, Lincoln Co.; Horseshoe Springs Camp, 2 mi. W. of La Cueva, Sandoval Co.; MacMillan Camp, 14 mi. N. of Silver City, Grant Co.; 10 mi. N.E. of Santa Fe; Little Tesuque Canyon, near Santa Fe; Frijoles Canyon, 6050' Bandelier National Monument.

GEOGRAPHICAL VARIATION. Variation is slight except that, as already noted, specimens from the southern portions of the range tend to have the lines more distinct and complete, with the loop on the hindwing usually showing clearly. Those from the northern part of the range, especially Alta. and B.C. (*hudsonaria* and *unilinearia*) tend to have the antemedials partly obsolescent. Also, a higher proportion of the Canadian specimens have red-spotted fringes. Two Wyoming specimens are without white dorsal spots on the abdomen. I should stress that these are tendencies only, and it is doubtful if most specimens from opposite extremities of the range could be distinguished.

FLIGHT PERIOD. In the northwest, June 14–Aug. 20, starting in June in B.C., elsewhere mostly in July; one very worn B.C. specimen Sept. 13. In Alta., Sask., Idaho, Mont., July 5–26. Ore., July 10–Aug. 10. Wyo., S.D., Colo., Utah, July 4–Aug. 11. N.M., July 3–31. Ariz., June 12–Aug. 16.

EARLY STAGES. These have not been described. In *Forest Lepidoptera of Canada recorded by the Forest Insect Survey* (R. M. Prentice, compiler, 1963, p. 307), host plant records of cedar and Douglas Fir are given for this species (as *unilinearia*) at Sidney, B.C., with one adult having been reared in each case. There is a specimen in the CNC reared from a larva on *Ribes* in B.C., and having discussed the history of this record with the collector, Dr. W. C. McGuffin, I think it likely that *Ribes* will prove to be the true host plant. In 1964 I obtained eggs from a female near Hill City, S.D., and fed the larvae *Quercus macrocarpa*, which was abundant in the vicinity. These fed and grew slowly for a considerable time but did not mature, the food apparently being unsuitable. The young larvae were typical of *Nemoria*, much resembling *mimosaria* and the others that have been studied.

REMARKS. As Prout said in discussing *Annemoria unitaria*, Packard's indications are inadequate, but I think we now know the western fauna sufficiently well to identify *unitaria* by a process of elimination. Packard's description does give just enough detail to make this possible, and his fragmentary type, which I have examined, does not violate the present conclusion in any way.

Considering all the genera that may occur in that region, we find that the swollen hind tibia with two pairs of spurs at once removes *unitaria* from association with *Chlorosea* and *Cheteoscelis*. Much larger size, course of the lines, and form of the antennae distinguish it from *Synchlora* (*Annemoria unitaria* with "antennae pectinated nearly to the ends, the branches short, those in the middle of the antennae about twice as long as the joints"). *Dichorda*, *Dichordophora* and *Chlorochlamys* are easily eliminated by wing form, size, color and other considerations. *Merochlora* has antennal pectinations much longer than specified for *unitaria*, unswollen hind tibiae, and almost white hindwings. Packard's description does not actually say so, but allows us to conclude that fore- and hindwings are colored alike. Since that exhausts the possibilities, I am led to the belief that *Annemoria unitaria* must be a species of *Nemoria*.

Within the genus *Nemoria*, the combination of characters given by Packard virtually eliminates all but the present species, and those characters that seem inconsistent with this conclusion I shall explain later. "Palpi pink; front red" agrees exactly with what we find in *junctolinearia*. The "single common white line" that crosses both wings just beyond the middle, straight on the forewing, "well curved" on the hindwing is of particular importance. His mention of the white fringe with outer edge pinkish, and the two anterior pairs of legs being reddish should also be noted. I had considered that

unitaria might equal *darwinata*, but the only slightly bent hindwing postmedial and very conspicuous abdominal spots of that species seem to preclude such a possibility.

In Packard's description there are four separate points of possible disagreement with the present conclusion, and I resolve these as follows:

1. The mention of "a single common white line" carries the implication that antemedial lines are lacking, and this confounded most earlier authors. Of the 407 specimens I studied there were actually a great many in which the antemedial lines were so reduced as to be only faintly visible. It is not improbable that Packard had such a specimen. Elsewhere, as here, there is some reason to suspect that his eyesight at that time was not too good, or else it was just carelessness, but in describing *Chlorosea nevadaria* Packard twice stressed "the want of any markings on the hind wings", although in his types lines on the hindwings are still clearly visible.
2. The abdomen of *unitaria* is supposed to have been white, whereas in *junctolinearia* it is green above with small dorsal white spots on the first two or three segments. However, abdomens fade readily, and it is not unlikely that it had turned pale or greasy, making the white spots indistinct.
3. Packard figured the forewing venation of *unitaria* (1876, pl. 4:10), and this at first seemed to disagree in certain details with my first drawing (pl. 1, fig. 5), especially in the stalked condition of $R_{2-5} + M_1$. However, an examination of more specimens showed this to be highly variable, and figs. 3 and 4 on plate 1 were drawn to show other specimens that come closer to Packard's figure.
4. Perhaps a little more puzzling still is Packard's statement: "Fringe white, on the outer edge pinkish". This sounds like *intensaria*, *caerulescens*, or perhaps *darwinata*, but these do not fit otherwise. Actually the fringes of *junctolinearia* are often diffusely spotted with very pale pink, but not with the outer edge pinkish. Here one can only guess that Packard was overlooking precise details and that this is how the fringes appeared to him. The single remaining wing of the type does not show any fringe coloring at all.

Recent material collected by Dr. F. H. Rindge has shown that the species does indeed occur in Nevada, as would be expected, but I had previously examined 390 specimens without finding a single Nevada record.

Group II. The *arizonaria* group. A natural complex of 8 southwestern species, of which the last 4 comprise a subgroup of very similar, closely related forms.

Nemoria latirosaria (Pearsall)

Plate 8, figures 3, 3a, 3b; plate 30, figure 7; plate 43, figure 1.

Aplodes latirosaria Pearsall, 1906, pp. 206, 214.

Nemoria latirosaria Prout, 1912, p. 12. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140.

DIAGNOSIS. A very distinctive and rather large species with the whole costa of the forewing, and uppersides of thorax and abdomen, all colored a bright pink. The wings are delicately colored, almost unstriated, and subhyaline. The lines are regular and much as in *aemularia* and *arizonaria* but thinner and white, not yellowish. The species occurs in Utah and Arizona.

TYPES. A male in the USNM from Beaver Valley, Utah, July (ex collection Brooklyn Museum); in fair condition and still with an abdomen.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae bipectinate for three quarters of their length, rather delicate, the longest branches three times the width of the shaft; female antennae very slender, finely ciliate; male palpi slender, exceeding front by a little more than the length of the third segment, female palpi similar; hind tibia of male only slightly swollen, with a weak hair pencil and no terminal extension; spurs of the usual length but very thin.

Interantennal fillet white, collar pink; front, palpi, first pair of legs, dorsum of thorax and abdomen pink; remainder of body and legs ivory. Wings light green, thinly scaled and subhyaline, the second pair only slightly paler than the first; costa broadly bordered with pink above and below, the scales rubbed off or partly faded to yellowish in older specimens; lines white; postmedial of forewing two thirds of the way out, straight and erect, closest to outer margin near anal angle, that of hindwing evenly curved and usually closer to middle of wing; fringes white and unmarked. Underside similar with lines indistinct.

Length of forewing: male, 15-16.5 mm; female, 15-16 mm.

MALE GENITALIA. Saccus rounded, juxta a flat plate, socii short, basal costal processes present but vestigial; uncus simple with outer third tapered; tooth on gnathos stout and blunt; valve quite slender, widest near middle, then tapering, a short, blunt apical tooth on the well developed costa; aedeagus rather long and slender, differently shaped from those of the preceding species, and armed with five or six distinct teeth near the end; posterior edge of the eighth sternite with shallow, V-shaped excavation.

FEMALE GENITALIA. Ostium simple; ductus bursae not distinct per se, but gradually dilating to form part of the bursa in a striate and somewhat sclerotized "neck region"; bursa with a small pouch-shaped signum.

MATERIAL EXAMINED. 9 males, 13 females, including type; 3 male, 2 female slides.

DISTRIBUTION. UTAH: Beaver Valley; Timpanogos Cave National Monument; Blue Spruce Camp, 18 mi. N. of Escalante, Garfield Co., 8000'. ARIZONA: Turkey Creek, Alpine, White Mountains; Williams; Rustler's Camp, Chiricahua Mountains, Cochise Co.; Oak Creek Canyon, Coconino Co.; Walnut Canyon, 6500', near Flagstaff, Coconino Co. Most specimens are from Turkey Creek (6) and Oak Creek Canyon (5).

GEOGRAPHICAL VARIATION. None apparent.

FLIGHT PERIOD. In Ariz., mostly June 1-21, but the five Oak Creek Canyon specimens taken May 10, 1962. In Utah, July 1-2, 1963 at Blue Spruce Camp (2 females) and May 21, 1963 at Timpanogos Cave National Monument (2 females).

EARLY STAGES. Unknown.

REMARKS. *Latirosaria* remains one of the rarest species in collections, and all but six of those examined are in the AMNH.

Nemoria aemularia Barnes and McDunnough

Plate 2, figure 2; plate 8, figures 4, 4a, 4b; plate 31, figure 1; plate 43, figures 2-4.

Nemoria aemularia Barnes and McDunnough, 1918, p. 134. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

DIAGNOSIS. *Aemularia* is very close structurally to *latirosaria* as well as to *arizonaria* and *daedalea*. The male genitalia are distinguished by the narrower valve, with sides

almost straight and parallel, and by the squarish, almost truncate saccus. The aedeagus is stouter than in *latirosaria*, similar to that of the other species except that in *daedalea* the teeth are ventral. In *latirosaria*, *aemularia* and *arizonaria* they are commonly dorsal.

In its heavy cream-colored lines and striations *aemularia* closely resembles *arizonaria*, but the costa is not red and the white abdominal spots are reduced to vestiges or wanting. *Aemularia* is known only from Arizona and New Mexico.

Types. Described from five males and four females from Paradise and Palmerlee, Cochise Co., Ariz. Although the description does not specify a holotype, the specimens bear labels with the indications "Type" and "Paratype" in McDunnough's handwriting. I hereby designate as lectotype the male labeled "Type", now segregated in the type collection at the USNM.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae bipectinate for more than three quarters, delicate, with a thin shaft, length of longest branches three times the thickness of shaft; front almost flat; male palpi slender as in *latirosaria*, exceeding front by a little more than the length of the third segment; female palpi much longer, exceeding front by almost half their length, third joint prominent, about half the length of the second, rather thick and rounded; male hind tibia only moderately swollen, terminal extension not well developed, spurs rather short and stout, weak hair pencil presumably present but recessed and not apparent in nearly all specimens examined.

Front, palpi and fore tibiae pink or with a mixture of pink and white scales; legs otherwise whitish; interantennal fillet white, sometimes thinly edged with pink behind; collar yellowish; thorax green above, whitish below; abdomen of male white with some dorsal green shading on the first three segments. The first two segments may have indistinct, pale reddish-brown dorsal spots or shading, rarely with minute white spots only. The abdomen of the female differs in having no green but rather extensive pale red shading that extends to segment A5.

Wings green, colored alike, densely striated with white or pale yellowish; costa rather broadly edged with pale yellowish; no trace of red on the wings except faintly near their bases; postmedial lines white to yellowish, regular, prominent, about equal in width to the pale costa or to the fringe; antemedials less distinct; lines of forewing fairly straight, erect, subparallel or with antemedial inclined basad from inner margin; lines of hindwing slightly curved; antemedials outwardly, and postmedials inwardly, edged with solid green; veins often thinly outlined with yellowish; fringes pale yellowish. Underside much paler, markings indistinct.

Length of forewing: male, 11-13 mm; female, 12.5-15 mm.

MALE GENITALIA. Fairly close to those of *latirosaria* but somewhat lengthened in form, with the saccus produced and squarish; basal costal processes small, rather weak and pointed; uncus dilated beyond middle and then tapered to a point; valve long, slender, the sides subparallel, its costa with a short, obtuse tooth at the apex; aedeagus much stouter than that of *latirosaria*, with a prominent row of teeth dorsally near the posterior end. *Arizonaria* has a wider, more rounded valve, and a slimmer, more tapered saccus. The genitalia of *daedalea* are of stouter form, with a broadly rounded saccus and a distally dilated, very rounded valve.

FEMALE GENITALIA. Very close to those of *arizonaria*. Ostium wider than that of *latirosaria*, with a small collar; ductus bursae in the form of a somewhat sclerotized neck region, unstriated, thicker at the ostial end than that of *latirosaria*; bursa copulatrix shorter and stouter than that of *latirosaria*, about the same as in *arizonaria*.

MATERIAL EXAMINED. 113 males, 171 females, including male and female types and 6 paratypes; 5 male and 3 female slides.

DISTRIBUTION. ARIZONA: Palmerlee and Paradise, Cochise Co.; Cave Creek Canyon, 5400', East Turkey Creek, 6400', Onion Saddle, 7600', and Portal Ranger Station, 4950', all in Chiricahua Mts., Cochise Co.; Washington Mts.; Prescott; Huachuca Mts.; Sierra Vista, Miller Canyon, Ramsey Canyon, and Carr Canyon, Huachuca Mts.; SW Research Station of the AMNH, near Portal, Cochise Co.; Sonoita Creek, 10 mi. S of Patagonia, Santa Cruz Co.; Hidden Spring Canyon, 19 mi. E of Sonoita, Santa Cruz Co.; Mud Springs, Santa Catalina Mts.; Madera Canyon, 4880', Santa Rita Mts., and Peña Blanca, 3950', Santa Cruz Co. NEW MEXICO: MacMillan Camp and Cherry Creek Camp, near Silver City, Grant Co.

GEOGRAPHICAL VARIATION. None apparent.

FLIGHT PERIOD. Feb. 24–March 13; June 15–Aug. 12.

EARLY STAGES. Unknown.

REMARKS. *Aemularia* has been known from little more than the type series until recent years. The material studied for the present revision included 132 taken by Franclemont in Santa Cruz and Cochise Counties, Ariz., in the period 1959-66, and 86 in the AMNH, mostly taken in recent years by Rindge and by R. F. Sternitzky.

Nemoria arizonaria (Grote)

Plate 9, figures 1, 1a, 1b; plate 31, figure 2; plate 43, figures 5, 6.

Aplodes arizonaria Grote, 1883, pp. 125-126.

Anaplodes arizonaria Dyar, 1902 [1903], p. 302. Pearsall, 1906, p. 206.

Nemoria arizonaria Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140.

Anaplodes festaria Dyar, 1902 [1903], p. 302.

Nemoria olivearia Cassino, 1927, p. 68. Prout, 1932, p. 23. McDunnough, 1938, p. 140. **New synonymy.**

DIAGNOSIS. This is a large and distinctive species from Arizona, resembling *aemularia* and *daedalea* in being heavily irrorated or striated with yellowish. The lines are almost exactly as in *aemularia*, but *arizonaria* may at once be distinguished by the wine-colored costa and large white abdominal spots. *Daedalea* also has the wine-colored costa and white spots, but *arizonaria* differs from that species in being greener (*daedalea* is quite yellowish), more opaque, and in having stronger, more crisply defined lines. The male genitalia have a wider, more rounded valve than those of *aemularia*.

TYPES. *Arizonaria* was based on one male from the Neumoegen collection, with the locality given only as "Arizona". The type, now in the USNM, lacks its abdomen but is otherwise in fair condition. Of *olivearia*, the holotype male and allotype female, from Paradise, Ariz., April 3, are in the MCZ.

SYNONYMY. In some collections, the species I am describing as *daedalea* has been determined as *olivearia*, but I found that the types of *olivearia* are the same as *arizonaria*. Cassino's name is the only synonym.

FURTHER DESCRIPTION. Structure of male antennae, front, palpi and hind tibiae about the same as *aemularia*. Female palpi very long, longer than those of *aemularia*, the third joint, when fully visible, as long as the second.

Interantennal fillet white with hind border often brown; collar pink; front deep rose, fading to pink, with white lower margin; palpi pink with third joint white-tipped; fore tibiae pink, remaining legs and underside of body whitish or ivory; thorax green above with some white and yellow scales; abdomen red-brown above, usually with large white spots on the first four segments, although the spots may be reduced or absent, especially in males; very rarely with brown abdominal coloring reduced, leaving minute white dorsal spots on green background.

Wings green, colored alike, usually yellower in hue than *aemularia*, heavily dusted or striated with yellowish, but solid green just after the antemedials and just before the postmedials; lines and fringes almost exactly as in *aemularia* but usually yellower, veins less inclined to stand out in paler outline; entire costa with dark wine colored edging, mixed with yellowish scales behind. In some females there is a well defined bright yellow or orange border on the inner margin of the hind wing. This is variable in width and may be entirely lacking. Underside almost white with markings obsolete.

Length of forewing: male, 13.5-16 mm; female, 15-16.5 mm.

MALE GENITALIA. Characteristic of the first section of the genus and similar to those of *aemularia* except for the wider, more rounded valve, and more tapered and rounded saccus. Costa of valve in *arizonaria* and *daedalea* convex, in *aemularia* almost straight or concave; aedeagus with row of dorsal teeth near the end like *aemularia*. *Daedalea* is similar but has the valve more widened distally, the saccus more shortened and obtuse, and the teeth on the aedeagus nearer the end and situated ventrally.

FEMALE GENITALIA. Much like those of *aemularia* and scarcely distinguishable. In *arizonaria* the ductus bursae seems to narrow at the ostium, and the membrane just below the sclerotized neck is thicker and striated.

MATERIAL EXAMINED. 98 males, 136 females; 4 male, 2 female slides.

DISTRIBUTION. ARIZONA: Prescott, Yavapai Co.; Paradise and Palmerlee, Cochise Co.; Cave Creek Canyon, 5400', Chiricahua Mts., Cochise Co.; S.W. Research Station of the AMNH, near Portal, Cochise Co.; Miller Canyon, Carr Canyon, Ramsey Canyon, and Sierra Vista, Huachuca Mountains; Baboquivari Mountains, Pima Co.; Madera Canyon, 4880', Santa Rita Mountains, Santa Cruz Co.

One would assume that the species is essentially Mexican, although I have not seen it from there. The CNC has a closely similar but probably distinct species from Durango, Mexico.

GEOGRAPHICAL VARIATION. None apparent.

FLIGHT PERIOD. Feb. 23-May 6. A specimen collected by Poling in the Baboquivari Mountains labeled "1-15 June, 1924."

EARLY STAGES. Unknown.

Nemoria daedalea, new species

Plate 9, figures 2, 2a, 2b; plate 31, figure 3; plate 43, figures 7-11.

DIAGNOSIS. This is a delicate, thinly scaled, plain, yellowish mottled species of Arizona and northern Mexico, closely related to *arizonaria*, having the same kind of abdominal

markings and purplish-red costa. It differs mainly in being less intensely colored, yellowish and subhyaline, with rather bright yellow fringes and obsolescent lines. The antemedials are wanting and the postmedials often very nearly so.

The genitalic differences are slight and consist mainly in *daedalea* having the basal costal processes longer and more pointed, and the ventral half of the tegumen wider and more rounded. The female genitalia differ slightly in having heavier sclerotization in the region of the ductus bursae.

There are two separate flight periods which I believe represent spring and summer broods, but this needs to be proved. The moths of these broods differ considerably in size and appearance, and slightly in genitalic morphology. The name *daedalea* is based on the spring brood.

Types. Holotype male, Madera Canyon, 5600', Santa Rita Mountains, Santa Cruz Co., Arizona, April 24, 1963 (J. G. Franclemont); genitalia on slide No. 870 (D. C. Ferguson). Paratypes, 4 males, 5 females, same locality and collector, Apr. 11–May 10, 1963; 3 males, 6 females, Ramsey Canyon, Huachuca Mts., Ariz., Apr. 29, May 3, 6, 9, 28, 1964 (R. F. Sternitzky); 4 males, 1 female, Miller Canyon, Huachuca Mts., Ariz., Apr. 29–May 4 (R. F. Sternitzky); 2 males, same locality, May 4, 5, 1948 (A. L. Melander); 1 male, Palmerlee, Ariz., Coll. J. A. Grossbeck. The holotype and Madera Canyon paratypes are in the collection of Dr. J. G. Franclemont at Cornell University; most of the remainder are in the collection of the AMNH.

SYNONYMY. None.

FURTHER DESCRIPTION. Spring brood: Structure of antennae, front, palpi and hind tibiae about the same as in *arizonaria*, except that the male palpi seem to be slightly longer. Coloring of head and body almost exactly as in *arizonaria*. Interantennal fillet white with yellowish-brown posterior border; front rose colored with white lower margin; second and third joints of palpi pink, the latter with a whitish tip; legs whitish except for pink fore tibiae; upperside of thorax pink just behind the head, shading to yellow and then green, but generally yellower than that of *arizonaria*; abdomen of male yellowish-brown above, sometimes tinged with pinkish, and usually with small white dorsal spots on the first three or four segments, although these may be very reduced or absent; female abdomen similar except that the white spots tend to be larger and appear to be always present.

Wings of both sexes light green, evenly and densely, but diffusely, striated with pale yellowish; very thinly scaled and sufficiently translucent that one might almost read the labels through the wings. Costa deep purplish red, mixed with yellow scales posteriorly; lines in about the same positions as in *arizonaria* but very reduced and indistinct. Postmedials usually showing faintly but antemedials in most examples not visible. As in *arizonaria*, the terminal margin of both wings, adjoining the fringes, is edged with yellow, and within this edging there are small patches of reddish scales between the veins, usually visible only with magnification. Fringes solid bright yellow in fresh specimens. Underside very pale and unmarked except that the dark costa and faint reddish terminal markings are exaggerated.

Length of forewing (spring brood): type, 16 mm; other males, 14.5–16 mm; females, 14–16 mm. Average male, 15.25 mm; average female, 15.25 mm.

Summer brood: These differ from the spring brood in their smaller size, slightly paler coloring, wider and more distinct (but still diffuse) postmedial lines, and reduced abdominal markings. The white abdominal spots tend to be very minute or absent, in females as well as males.

Length of forewing (summer brood): males, 11.5–12 mm; females, 12–13.5 mm. Average male, 11.92 mm; average female, 12.93 mm.

MALE GENITALIA. Similar to those of *arizonaria* but differing in the following respects: basal costal processes better developed but still weakly sclerotized, often drawn out to

a long point; ventral half of tegumen (which terminates in saccus) wider with sides usually convex, not concave as in *arizonaria*; valves with a tendency to be narrower at the base and wider beyond the middle, this being quite variable; aedeagus with several strong ventral teeth very near the tip, whereas the specimens of *arizonaria* examined had these teeth in a lateral position (right side) and farther back from the tip.

The summer brood differs slightly in the valve having shorter basal costal processes of jagged outline (several smaller points on the margin), and perhaps in having a thinner valve.

FEMALE GENITALIA. These scarcely differ from the female genitalia of *arizonaria*, but perhaps have more extensive sclerotization of the ductus bursae. Two female slides of the summer brood show still greater sclerotization of the ductus bursae and partial sclerotization of the adjoining upper portion of the bursa copulatrix. In this respect the summer females of *daedalea* differ more from the spring ones than the latter do from *arizonaria*.

MATERIAL EXAMINED. Spring brood, 16 males, 12 females; 5 male, 2 female slides. Summer brood, 17 males, 25 females; 3 male, 3 female slides.

DISTRIBUTION. ARIZONA: Madera Canyon, 5600', Santa Rita Mts., Santa Cruz Co.; Sonoita Creek, 10 mi. S. of Patagonia, Santa Cruz Co.; Miller Canyon and Ash Canyon, Huachuca Mts.; Palmerlee; Montezuma Pass, Cochise Co. MEXICO: 10 mi. W. of El Salto, Durango, 9000'; Buenos Aires, 9000', 10 mi. W. of La Ciudad, Durango.

GEOGRAPHIC VARIATION: A spring male and two summer females from Durango are larger and have more distinct postmedial lines than the Arizona ones. Also, the male has a thin but complete red terminal line; the females have only traces of such a line.

EARLY STAGES. An adult female of this species was reared from a larva on oak at El Salto, Durango, Mexico, by Dr. McGuffin (CNC). This was a specimen of the summer generation, emerging Aug. 3, 1964.

REMARKS. When Dr. Franclemont spent the summer in Madera Canyon in 1960 he collected 37 specimens of what I am regarding as the summer form of *daedalea*, between the dates mentioned above. In 1963 he spent the spring season in the same locality and collected the 10 Madera Canyon specimens in the type series. Most of the balance of the known material is in the AMNH.

The smaller size of the summer generation is perhaps a reflection of the more arid seasonal conditions under which the larvae would be feeding, but the test of rearing is needed before we can be certain that this form is not actually another species.

The dappled yellowish green coloring, subhyaline wings, bright yellow fringes, and plain aspect due to the near absence of lines are distinctive features of *daedalea*.

Nemoria viridicaria (Hulst)

Plate 9, figures 3, 3a, 3b; plate 31, figure 4; plate 43, figures 12, 13, 27, 28.

Aplodes viridicaria Hulst, 1880b, p. 41. Dyar, 1902 [1903], p. 302.

Anaplodes viridicaria Hulst, 1896, p. 316.

Nemoria viridicaria Prout, 1912, p. 212. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

DIAGNOSIS. This species begins a second subgroup of Group 1, an odd series of four species in which the hindwings are not colored like the forewings but are usually much paler.

For the most part the male genitalia are of the same type as those of the previous three species, with flat juxta, tapered uncus, short socii, toothed aedeagus and weakly emarginate eighth sternite. However, the saccus shows the beginnings of the concavity typical of later groups. The female genitalia also are little changed from those of the last few species but may be distinguished by minor details.

Viridicaria is the largest of the group, has a pink front and palpi, and is the only one that has white dorsal spots on the abdomen. It is known from Colorado, Utah, and New Mexico.

TYPES. A male from Colorado ("Col.") in the ANMH.

SYNONYMY. None.

FURTHER DESCRIPTION. Antennae of both sexes normal; male palpi small, exceeding front by the length of the third segment; female palpi about the same length but thinner; hind tibia of male moderately dilated, the terminal extension apparent but very short; spurs normal.

International fillet white, collar pink or light brown; front, palpi and front legs pale pink, or with a mixture of pink and white scales; other legs whitish; thorax white below, green with a few white scales above; abdomen whitish with a weak dorsal pinkish-brown shade on the first four segments, a white dorsal spot consistently present on segment 1, often repeated less distinctly on 2 and 3.

Wings thinly scaled, in worn specimens subhyaline. Front wings bright green, faintly dusted with white; costa narrowly edged with white or yellowish; fringes white; lines white, broad, about the width of the fringes, diverging towards costa; antemedial straight or slightly convex. Hindwings much paler, whitish except for green shading along the lines and toward the outer margin where there may be a feeble subterminal of a yellowish-green shade; fringes of hindwings white; lines of hindwings white, poorly defined, curved, diverging towards costa, closer together than those of *N. subsequens*; postmedial situated just beyond middle of wing. Three of the females from Colo. have a scattering of pink scales along the inner margin of the hindwing, visible only under magnification. Underside paler with only the lines of the forewing showing distinctly.

Length of forewing: male, 14-16 mm; female, 15-16 mm.

MALE GENITALIA. Very close to those of *subsequens* except as follows: 1) uncus more dilated, 2) costa of valve decidedly concave and without a prominent convexity in the middle, 3) saccus truncate and slightly emarginate in outline, not rounded as in *subsequens*, 4) sides of the ventral portion of the tegumen (terminating in the saccus) straight or but very slightly concave in *viridicaria*, strongly concave in *subsequens*, 5) tooth on gnathos better developed, 6) teeth on the aedeagus numbering about three in *viridicaria*, situated well back from the tip; four to five in *subsequens*, occurring just before the tip, 7) notch in the eighth sternite a little deeper and V-shaped in *viridicaria*.

Nemoria diamesa also has similar male genitalia but these may be distinguished by the larger, more pointed basal costal processes, more linear uncus, and by other characters discussed under that species. *Nemoria albaria* may at once be separated by the peculiar needle-like form of the basal costal process, extending outward over half-way to the tip of the valve.

FEMALE GENITALIA. Close to those of *subsequens* and *diamesa*. Ductus bursae with a clear-cut sclerotized middle section, not obscured by a thickened, deep-staining ductus wall as in *subsequens*; ostium without a collar. *Albaria* differs in having a collar, and also a longer sclerotized ductus bursae which is wider at the ostium and constricted where it joins the bursa.

MATERIAL EXAMINED. 31 males, 24 females, including type; 4 male, 1 female slides.

DISTRIBUTION. COLORADO: Glenwood Springs; Valley View Lodge, 10 mi. S of Steamboat Springs, 7600'; Uncompahgre Plateau, 7800-8100', 16 mi. SW of Montrose, Montrose Co. UTAH: Dalton Springs Camp, 5 mi. W of Monticello, San Juan Co.; Buckboard Flat Camp, 7 mi. W of Monticello, San Juan Co. NEW MEXICO: 16 mi. E of Taos; Bear Trap Camp, 28 mi. SW of Magdalena, Socorro Co., 8500'.

The one male and two females seen from N. M. (AMNH) definitely belong here rather than with *subsequens*.

GEOGRAPHICAL VARIATION. None apparent.

FLIGHT PERIOD. June 24-July 25.

EARLY STAGES. Unknown.

REMARKS. The small, distinctive group comprised of *viridicaria*, *subsequens*, *diamesa* and *albaria* has not been well understood. McDunnough (1938) treated them as one species, *viridicaria*, with *albaria* as a race. The name *viridicaria* has most often been applied in collections to the Arizona species I am describing as *diamesa*, although the type of *viridicaria* clearly represents the larger, darker Colorado-Utah species. Material of the true *viridicaria* was almost nonexistent in collections before the recent collecting by Dr. F. H. Rindge in Utah and in the last two of the Colo. localities cited. I have seen only four older specimens, including the type.

Nemoria subsequens, new species

Plate 9, figures 4, 4a, 4b; plate 31, figure 6; plate 43, figures 14-17, 29, 30.

DIAGNOSIS. This is a New Mexican species very closely related to *viridicaria* but a little smaller, a more intense shade of green, with the hindwings often almost as dark as the forewings, and with the lines narrower and tending to be farther apart on both wings. It is perhaps most easily separated from *viridicaria* by the dorsal coloring of the abdomen, which is green in the male and lightly shaded with brown in the female. There are no spots. *Viridicaria* has a dorsal brown shade and fairly obvious white spots in *both* sexes. Genitalic differences are minor but apparently consistent.

TYPES. Holotype female, Pine Camp, 2 mi. N.E. of Cloudcroft, Otero Co., N.M., 8600', July 5, 1964 (F., P., and M. Rindge), DCF slide No. 970. Paratypes, 9 males, 16 females, same locality and collectors, July 1-6, 1964. Holotype and most of paratypes in the AMNH.

SYNONYMY. None.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs in both sexes the same as *viridicaria*. Interantennal fillet white with a yellowish or pale brownish collar behind, often with a few green (as in the holotype) or red scales mixed in; front variable, either pink or green with a white lower margin or, more commonly, with some mixture of red, yellowish, green and white scales (holotype with red and green scales mixed in about equal proportions); palpi tinged with pink; femur and tibia of foreleg red on anterior side, middle leg also tinged with reddish; remainder of legs and entire underside of body whitish; upperside of thorax green with a few scattered white scales; dorsum of abdomen in male shaded with green on the first 4 segments, in the female with pinkish or yellowish brown. Unlike *viridicaria*, which has brown on the abdomen in the male as well as the female, there are no white dorsal spots.

Forewing bright green, the coloring more intense than that of *viridicaria*, with fewer white scales mixed in; costa edged with ivory or whitish but more thinly so than in *viridicaria*. Hindwings paler and more translucent than forewings, but greener than those of *viridicaria* or *diamesa*; fringes of both wings whitish; lines of the wings distinct, especially those of the forewing, but little more than half the width of the lines in *viridicaria*, and quite consistently farther apart than in the latter species; antemedial of forewing more erect and usually angled inward just before costa. In *viridicaria* the lines of the hindwing converge strongly toward the inner margin but in *subsequens* they remain well apart, the postmedial usually crossing beyond the middle of the wing. In *viridicaria* this postmedial commonly crosses at or very near the middle of the wing.

Length of forewing: male, 14 mm; female, 14-15 mm; holotype female, 14 mm.

MALE GENITALIA. Like those of *viridicaria* except for the following differences: costa of valve convex, not concave; saccus squarish but rounded off, not flattened or emarginate; transtilla with wider anterolateral processes; aedeagus with the cluster of teeth dorsal and very near the tip (in *viridicaria* seemingly lateral and farther back from the tip); eighth sternite more shallowly notched. As in *viridicaria*, the basal costal processes are virtually undeveloped.

FEMALE GENITALIA. Similar to those of *viridicaria* except that the ductus bursae is somewhat more rigidly sclerotized, with this thickening of the membrane (which stains red with eosin Y and is not chitin) extending to the adjoining upper portion of the bursa copulatrix. The corresponding portion of the bursa in *viridicaria* is thinly membranous and flexible. The brown sclerotized band which partially encircles the ductus bursae in *viridicaria* is reduced or absent in *subsequens*.

MATERIAL EXAMINED. The type series only; 2 male, 3 female slides.

DISTRIBUTION. Seen only from the type locality.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. July 1-6.

EARLY STAGES. Unknown.

Nemoria diamesa, new species

Plate 1, figure 2; plate 10, figures 1, 1a, 1b; plate 31, figure 5; plate 43, figures 18-21, 31, 32.

DIAGNOSIS. A pale, delicately colored species of Ariz., Colo., and N.M., smaller than the two preceding, but closely related. The palpi, legs and abdomen are shaded with green in both sexes. With the sole exception of *albaria*, *diamesa* has the palest hindwings of all the species of *Nemoria* treated in this revision. The lines of the forewing are diagnostic as these are unusually close together and almost parallel. In *viridicaria* and *subsequens* the lines diverge towards the costa, and in *albaria* they tend to converge. *Diamesa* is most like *albaria* but retains some green on the hindwing, whereas the hindwing of *albaria* is pure white. The male genitalia may at once be distinguished from those of *albaria* by the absence of the needle-like extension of the basal costal process.

TYPES. Holotype male, Pine Camp, 2 mi. N.E. of Cloudcroft, Otero Co., N.M., 8600', July 6, 1964 (F., P., and M. Rindge), DCF slide No. 925, in the AMNH. Paratypes, 55 males, 11 females, same locality and collectors, July 1-6, 1964; 2 males, Bear Trap Camp,

8500', 28 mi. S.W. of Magdalena, Socorro Co., N.M., same collectors, July 2, 5, 1965; 4 males, 1 female, Bursum Camp, 18 mi. E. of Alma, Catron Co., N.M., 9000', July 9, 15, 1961, (same collectors); 4 males, 1 female, Davenport Camp, 8500', 36 mi. S. of Florence, Custer Co., Colo., same collectors, June 30, July 1, 4, 1967; 1 male, S.W. Research Station of the AMNH, Portal, Cochise Co., Ariz., 5400', July 23, 1958 (M. A. Cazier); 1 male, same locality, May 26, 1961 (M. Statham); 1 female, same locality, July 26, 1957 (M. Statham); 2 males, Rustler Park, Cochise Co., Ariz., June 11, 1950 (E. C. Johnston). The last two paratypes in the CNC; the remainder in the AMNH.

SYNONYMY. None.

FURTHER DESCRIPTION. Structure of antennae, front, palpi and legs in both sexes about as in *viridicaria*, *subsequens* and *diamesa*. Interantennal fillet white, green behind, with a narrow white collar between head and thorax; front solid green with a white lower margin; palpi light green, not pink as in the preceding species of this group; front legs also tinged with green rather than pink; other legs and underside of body whitish; upperside of thorax green with a few white scales; upperside of abdomen lightly shaded with green on the first 4 segments, otherwise white; no abdominal spots.

Forewings green, heavily dusted with white, somewhat subhyaline, costa thinly edged with white; hindwing subhyaline, almost white, the lines defined with a contrasting green shade after the antemedial and before the postmedial, and the outer margin faintly tinged with green; fringes of both wings white; lines of forewing white, very wide (usually wider than the fringes) and boldly defined by a solid green shade after the antemedial and before the postmedial, (between which the median space is contrastingly paler). Postmedial of forewing normal, straight or slightly convex, approximately parallel to outer margin; antemedial of forewing unusual in being almost perfectly erect, straight or concave, and subparallel to the postmedial; if not parallel, the lines very slightly divergent towards costa. As the distance separating the lines at the inner margin is almost maintained to the costa, the lines have the appearance of being closer together than in all the others of this group except *albaria*. The lines of the hindwing are visible only because of the green shade that follows them, with the antemedial almost obsolete, the postmedial evenly curved and crossing the wing just beyond the middle. Underside of both wings as above but paler.

Length of forewing: males, 12.5-14 mm; females, 12.5-13.5 mm., except for one unusually large female of 15 mm from Bursum Camp; holotype male, 13 mm.

MALE GENITALIA. Closest to those of *viridicaria* but almost 25% larger, in spite of the smaller size of the moth. Tegumen and valves more elongated in form; saccus more produced, distinctly emarginate; basal costal process of valve produced to a tapering point directed outwards, showing the beginning of the trend that culminates in the curiously long, pointed process of *albaria*; valve elongate, the sides subparallel, the costa concave but a little less so than in *viridicaria*; uncus linear, undilated; transtilla less constricted mesially; juxta larger, somewhat angulate, produced to an obtuse point anteriorly on the side that is rounded off or notched in *viridicaria* and *subsequens*; *aedeagus* with the usual row of teeth, situated dorsally or nearly so, and well back from the tip as in *viridicaria*; eighth sternite with a shallow V-shaped notch about the same as *viridicaria*.

FEMALE GENITALIA. Ductus bursae heavily sclerotized like that of *subsequens*, but with adjoining upper portion of bursa remaining thinly membranous; posterior margin of seventh sternite doubled over in a well defined crescentic fold (preostial plate), covering the ostial opening; ostium bordered posteriorly by a thin but regular sclerotized ring (postostial plate). Neither of the last two characters occur in *viridicaria* or *subsequens*; both do appear in somewhat modified form in *albaria*.

MATERIAL EXAMINED. 74 males, 14 females; 4 male, 2 female slides.

DISTRIBUTION. Besides the type series, I have seen specimens from only one other locality. In the Franclemont collection there are 4 males from Madera Canyon, 5800', Santa Rita Mts., Santa Cruz Co., Ariz., June 26-29, 1960, 1963 (JGF).

GEOGRAPHICAL VARIATION. The specimens from N.M., Colo., and Cochise Co., Ariz. appear to be alike, but those from Madera Canyon, Ariz., differ slightly from the type series in both appearance and genitalia. The Madera Canyon specimens are more coarsely and evenly dusted with white, and there is more green on the hindwing. The male genitalia of one of these specimens show an exaggeration of the elongated aspect of the tegumen and valves.

FLIGHT PERIOD. June 11-July 26, except for one specimen taken near Portal, Ariz., May 26.

EARLY STAGES. Unknown.

REMARKS. In a number of characters this species seems intermediate between *viridicaria* (and its close ally, *subsequens*) and *albaria*, but there is no doubt that it is sufficiently distinct from both to be regarded as a separate species.

Diamesa is the species that has been called *viridicaria* in most collections, mainly because the true *viridicaria* has remained almost unknown and uncollected since the time of its original description, whereas a few collectors here and there have turned up specimens of *diamesa*.

Nemoria albaria (Grote)

Plate 10, figures 2, 2a, 2b; plate 32, figure 1; plate 43, figures 22-24.

Chlorosea albaria Grote, 1883, p. 126. Prout, 1912, p. 112 (as doubtful synonym of *viridicaria*).

Aplodes viridicaria albaria Hulst, 1886b, p. 140.

Anaplodes viridicaria albaria Dyar, 1902 [1903], p. 302.

Nemoria viridicaria albaria Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

DIAGNOSIS. This is the smallest species of the *viridicaria* group, readily recognized by the unmarked hindwings, the slight convergence toward the costa of the lines on the forewing, and the peculiar character of the basal costal processes in the male genitalia. It is the only species of *Nemoria* treated in this revision that has an almost pure white, unmarked hindwing. The forewing is very much like that of *diamesa* except that in the latter the lines are parallel or slightly divergent rather than convergent. *Albaria* is known only from Ariz. and is rare in collections.

TYPES. The type is a male labeled "Arizona, Col. B. Neumögen," in the AMNH. The abdomen is missing, as Grote mentioned, and this perhaps led to his incorrect conclusion that the specimen was a female. The type has the hindwings pure white, the forewings perhaps more solidly green than is usual, the lines quite wide, straight, and slightly convergent toward costa. I consider that there is no doubt about its identity even though the genitalia are lost.

SYNONYMY. *Albaria* is the only name available and apparently it has not been misapplied to any other species.

FURTHER DESCRIPTION. Antennae and legs normal for the *viridicaria* group; palpi of about the same length as those of the other species but very slender and feeble, the third

joint in the female being a little longer than that of the male. Interantennal fillet white, greenish behind, followed by a thin collar of white scales between head and thorax; front in both sexes green or with a mixture of green and white scales; palpi tinged with green; legs whitish with usually some green scales on the front coxa and femur, and some brown on the front tibia; abdomen in both sexes entirely whitish with a trace of green on the first three tergites; thorax above with green and white scales in about equal proportions.

Forewing green, dusted or striated with white but not as densely so as in *diamesa*; the median space often not contrastingly paler as in *diamesa*, but with the lines tending to be emphasized by solid green shadow lines in much the same way. Lines wide, distinct and regular as in *diamesa*, but with the antemedial straighter (usually *not* concave) and inclined slightly outward from the inner margin, so that toward the costa the antemedial and postmedial are closer together than at the inner margin; costa very thinly edged with white; fringes white; hindwing almost entirely white, immaculate, subhyaline, sometimes with just a few green scales toward the anal angle. Under-side as above but paler.

Length of forewing: male, 10.5-13 mm; female, 12-12.5 mm.

MALE GENITALIA. Basically most similar to those of *viridicaria* but with the basal costal processes very strangely developed, each in the form of a long needle-like spine joined for over half its length to the costa of the valve, and with the free end extending outward parallel to the concave costal margin; tip of the process reaching as far as at least two-thirds of the way to the distal extremity of the costa; uncus dilated as in *viridicaria* but a little shorter; socii narrower; saccus broader and more deeply emarginate. Apart from the peculiar basal costal processes, the valves appear to be exactly the same as those of *viridicaria*. The aedeagus, in addition to having the usual slightly elevated cluster of subapical teeth (but nearer the end, as in *subsequens*), has half of its dorsal surface covered by a dense patch of smaller teeth. The eighth sternite has a shallow V-shaped notch like that of *viridicaria*.

The curiously formed basal costal processes and elongated patch of teeth on the dorsal surface of the aedeagus at once distinguish the male genitalia of *albaria*.

FEMALE GENITALIA. These are closest to the male genitalia of *diamesa* but have the ductus bursae somewhat constricted and bent at an angle before entering the bursa. Like that of *diamesa*, the ductus is relatively long and rigidly sclerotized, although the sclerotization appears to be uniformly chitinous, rather than the combination of chitin and thickened membrane seen in *diamesa*. The posterior margin of the seventh sternite has a well defined, crescentic, preostial fold. The ostium has a chitinous dorsal lip but this is not in the form of a clean-cut ring as in *diamesa*. The signum is of the invaginated, pouch-like type common throughout the genus, but it is larger than in any other species of the *viridicaria* group.

MATERIAL EXAMINED. 10 males, including type, 2 females; 2 male, 2 female slides.

DISTRIBUTION. ARIZONA: Pine Crest, 7300', Mt. Graham, Pinaleno Mountains, Graham Co.; Upper Camp, Pinery Canyon, Chiricahua Mts., Cochise Co.; Rustler Park, 9000', and S.W. Research Station of the AMNH, Chiricahua Mts., Cochise Co.; Madera Canyon, 5800', Santa Rita Mts., Santa Cruz Co.; "Tuscon."

GEOGRAPHICAL VARIATION. None apparent.

FLIGHT PERIOD. June 23-July 17. June 28-29, 1955 and July 9, 1951 on Mt. Graham. July 3, 1956 in Pinery Canyon. July 4, 1956 at the S.W. Research Station. July 15, 1927 in Rustler Park. June 23, 1955 and July 17, 1947 in Madera Canyon.

EARLY STAGES. Unknown.

Group III. One species, *pistacearia*, the relationships of which are not clear.

Nemoria pistacearia (Packard)

Plate 2, figure 3; plate 10, figures 3, 3a, 3b; plate 32, figure 2; plate 43, figures 25, 26.

Anaplodes pistacearia Packard, 1876, p. 392; pl. 13, fig. 58. Hulst, 1896, p. 316.

Eucrostes chloroleucaria var. *unistrigata* Gumpfenberg, 1895, p. 489.

Nemoria pistacearia Dyar, 1902 [1903], p. 302. Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140.

DIAGNOSIS. *Nemoria pistacearia* is a medium sized, broad winged, white striated species with no abdominal markings and usually no antemedial lines, occurring in the coastal counties of California. It commonly has distinct dark brown or red discal spots like *N. darwiniata punctularia* of the same region, but the latter has very prominent abdominal markings as well as other differences. *Pistacearia* is more likely to be confused with the somewhat similarly colored *Nemoria leptalea*, which has the same plain green abdomen and may be somewhat striated. However, *leptalea* has the antemedials and postmedials about equally developed and the discal spots, if present, green rather than brown or red.

Pistacearia has a strong superficial resemblance to *Nemoria mutaticolor*, and the reader should refer to the discussion of that species for an account of the differences. *Nemoria coruscula* Dyar, of Mexico, is also similar and I have seen specimens of this misdetermined as *pistacearia*. However, *coruscula* has good genitalic characters that place it near *mutaticolor*.

In his description of the genus *Anaplodes*, of which *pistacearia* is the type, Packard said that the hind tibia was not dilated. This is not correct. The hind tibia is moderately dilated and the terminal extension moderately developed, as in most of the preceding species, although neither is developed to the same extent as in many of the species of *Nemoria* Groups IV to VIII. The hind tarsus of *pistacearia* is long, two-thirds to four-fifths the length of the tibia, as in *mutaticolor*, *arizonaria*, *viridicaria* and their relatives.

The papillate juxta, long socii, and other characters of the male genitalia clearly remove *pistacearia* from Groups I and II of *Nemoria*, although the simplified form of the genitalia is quite suggestive of *pulcherrima*, *mutaticolor* and others of the preceding division. The very simple female genitalia also link it to the first part of the series.

Judging from the genitalia, *pistacearia* has no really close relatives north of the Mexican border, and the combination of characters found in the male genitalia readily distinguishes it.

TYPES. The type of *pistacearia* is a male from Sanzalito [probably in error for Sausalito, Marin Co.], Calif., June 30, 1875 (Behrens), in the MCZ. It is in fair condition, still with its abdomen, and is labeled "Type 2221."

No separate type specimen was designated for *unistrigata*. Gumpfenberg regarded *pistacearia* Packard as preoccupied and hence proposed a substitute name.

SYNONYMY. *Unistrigata*, discussed above, is the only synonym.

FURTHER DESCRIPTION. Male antennae normal, fairly wide, the longest branches at least equal to twice the length of the segments; female antennae normal; male palpi rather small, subtruncate, exceeding front by a little more than the length of the third segment, which is minute and mostly concealed by the scales of the second; female palpi similar but more slender; front almost square, somewhat wider than that of the *bistriaria* group, this varying independently from species to species, and thus not having

the importance that Packard ascribed to it in his characterization of *Anaploides*. Hind tibia moderately dilated, with a moderate terminal extension shorter in length than the longer of the two apical spurs; first pair of hind tibial spurs much longer than apical pair; hind tarsus long, almost equal to the hind tibia exclusive of terminal process.

Fillet white with green hind margin; front red with thin white edging at bottom; palpi and inner side of foreleg red, middle and hind tibiae usually also with some red, otherwise the legs and underside of body whitish; thorax and abdomen green dorsally, the latter without spots; fore- and hindwings of both sexes bright green, evenly striated with white; costa and fringes whitish, except near extreme apex of forewing where both may be faintly marked with pink, sometimes with whole fringe tinged with pink; ante-medial lines obsolete; postmedials white, usually distinct except near costa, approximately parallel to outer margin; postmedial of forewing straight or slightly concave, that of hindwing straight or convex; discal spots on both wings small but contrastingly dark and distinct, red or brown; rarely green or absent. Underside as above but much paler toward inner margins and base; basal half of costa beneath strongly marked with red.

Length of forewing: males, normally 12-16 mm, but single specimens of 10 and 11 mm seen from San Diego; females, 13-16 mm.

MALE GENITALIA. Valve simple, costa ending in a blunt point; uncus simple, slightly dilated; socii of the long type and juxta papillate, like those of all the species of *Nemoria* that follow; saccus truncate or emarginate; basal costal processes rather well developed, more so than in any preceding species, somewhat flattened, bent and wrinkled but with a blade-like edge, moderately but not heavily sclerotized; aedeagus simple, without teeth; eighth sternite with a deep U-shaped excavation on posterior margin.

FEMALE GENITALIA. Rather simple and featureless, completely membranous except for very slight sclerotization in the ductus bursae just before the ostial opening; edge of the seventh sternite folded to form a fairly distinct crescentic lip or collar over the ostium; signum elongated and pointed at both ends.

MATERIAL EXAMINED. 81 males including type, 34 females; 8 male, 4 female slides.

DISTRIBUTION. CALIFORNIA: Trinidad, Humboldt Co.; Laytonville, Mendocino Co.; Petaluma, Sonoma Co.; Spring Mountain, Napa Co.; Inverness and Mill Valley, Marin Co.; Bear Creek Road and Orinda, Contra Costa Co.; Oakland, Alameda Co.; San Francisco; Ben Lomond, Santa Cruz Co.; Eden Vale, Monterey Co.; Morro Bay, San Luis Obispo Co.; Singing Springs, Verdugo Hills and Santa Catalina Is., Los Angeles Co.; San Diego and Julian, San Diego Co.

A single male in the USNM labeled Redington, Ariz. (ex Barnes collection) and another in the AMNH labeled Salida, Colo., 7-18-46, H. Ramstadt (ex Sperry collection) probably represent cases of mislabeling, as the known range is otherwise restricted to a narrow coastal strip in Calif. and perhaps northern Mexico.

GEOGRAPHICAL VARIATION. The only apparent variation is a tendency for southern specimens, especially those from San Diego and Los Angeles counties, to be smaller than more northern ones.

FLIGHT PERIOD. Apr. 22-July 16, and Aug. 2-Sept. 14 in northern Calif., but most in June and July. Apr. 1-July 3, and Sept. 23-Oct. 23 in Los Angeles and San Diego counties, but with a preponderance of spring records. The dates indicate at least two generations per year.

EARLY STAGES. Unknown.

REMARKS. *Pistacearia* is especially well represented in collections from the region of San Francisco Bay and from the vicinity of San Diego, suggesting that it is common in these areas at least. Perhaps the intervening coastal counties have not been so intensively collected.

Group IV. The *extremaria* group. A complex of 5 southeastern species, most with good superficial characters but similar genitalia.

Nemoria extremaria (Walker), new combination

Plate 10, figures 4, 4a, 4b; plate 32, figure 3; plate 44, figures 1, 2.

Racheospila ? *extremaria* Walker, 1861, p. 584.

Racheospila extremaria Barnes and McDunnough, 1917a, p. 99; 1917b, p. 218. Prout, 1932, p. 25. McDunnough, 1938, p. 140.

DIAGNOSIS. This and the following species are the smallest species of *Nemoria* known to occur in the United States. Both have unspotted abdomens, small blackish discal spots and plain fringes without terminal lines. Both occur in the southeast, *extremaria* mainly in Florida. However, the solid pink fringes, red front and palpi, and red posterior border on the interantennal fillet at once separate *extremaria* from *elfa*, in which these features are green or white. The characters mentioned, together with the small size and the long laminate basal coastal processes typical of the male genitalia in this group should make it a simple matter to distinguish *extremaria* from all other species of *Nemoria*.

TYPES. *Extremaria* was described from two specimens, a male and female, but the one surviving type, without abdomen and in rather poor condition, is a female. No locality was given ("Country unknown"), but the description as well as the specimen seem to agree in every respect with the species I here associate with the name. The specimens could easily have come from Florida as Walker received and described many species from there.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae with a rather stout shaft, clothed with white scales, rough, bipectinate over three-quarters of the way to the tip; female antennae ciliate, white dorsally, rather rough scaled; palpi of both sexes small and feeble, hardly exceeding front; hind tibia of male strongly dilated, with terminal extension quite well developed; hair pencil presumably present but recessed.

Interantennal fillet white with thin red posterior margin; no white collar between head and thorax; front thinly covered with small scales, red with the usual pale lower edging reduced to a pair of white maculae; palpi yellowish to pink; fore coxae green, remainder of forelegs reddish; middle tibiae reddish, otherwise whitish; hindlegs entirely white; underside of body whitish; thorax and abdomen bright green dorsally, the green extending back to the seventh or eighth tergite.

Wings bright green, unstriated, with no terminal spots or lines; costa of forewing white at the extreme edge, followed by pink or yellowish, shading to deeper pink towards base and apex; fringes of both wings solidly colored a delicate shade of light pink; wings with thin white lines, slightly waved, the antemedials barely visible; both wings with small, distinct, dark brown discal spots. Underside as above but much paler, the lines obsolescent, and the costa rather broadly defined with orange-yellow or pink.

Length of forewing: male, 8.5-10 mm; Female, 9-9.5 mm.

MALE GENITALIA. Uncus linear, scarcely dilated; socii rounded, gnathos tapering to a fairly long point; transtilla slender, delicate, with the anterolateral processes short; juxta with papilliform process large, in one example slightly bulbous; saccus variable but tending to be deeply emarginate, leaving the vinculum with its tips projecting as processes at each side. A triangular mesial flap of the saccus tends to be folded backward, providing an apparent third process that divides the emargination in the middle. (The single specimen from Hastings, Fla. has a shallow emargination with the medial, but not the lateral, processes). Valve rather evenly rounded at the end except for a blunt tooth at the distal end of the costa; basal costal processes of the long, pointed, laminate type peculiar to this group, the tips somewhat curved mesially and dorsally. The specimen from Hastings, Fla., mentioned above, is also atypical in having the basal costal processes wider distally and with a serrated ventral edge. In addition, the uncus of this specimen is widened at the tip. The aedeagus and eighth sternite of *extremaria* are like others of the group.

FEMALE GENITALIA. Very simple; ductus bursae and bursa copulatrix thinly membranous; genital plate present but weakly sclerotized; ostium enclosed posteriorly by a thinly sclerotized ring; signum rounded.

MATERIAL EXAMINED. 22 males, 6 females; 5 male, 3 female slides.

DISTRIBUTION. FLORIDA: Oneco, Manatee Co.; Archbold Biological Station, Lake Placid, Highlands Co.; Orlando, Orange Co.; Hastings, [St. Johns Co.]; Apalachicola. MISSISSIPPI: Camp Shelby, near Hattiesburg.

GEOGRAPHICAL VARIATION. None apparent in the material available.

FLIGHT PERIOD. Mostly Mar. 21–Apr. 1. One specimen at the Archbold Biological Station on Dec. 25, 1955, two females from the same locality, May, 1961, and the single female from Miss. labeled Sept. 15–30, 1944. Two males in the MCZ were taken at Apalachicola by Roland Thaxter Feb. 6 and “Mar.,” 1876.

EARLY STAGES. Unknown.

REMARKS. The combination of characters given by Walker for *extremaria* points to the conclusion that it is a species of *Nemoria*, and L. B. Prout, who was able to examine the type over 50 years ago, placed it here (in *Racheospila*). Judging from the colored photograph sent to me by Mr. J. D. Bradley of the British Museum, the type certainly looks like a *Nemoria*. If so, it should be American, and the characters quite readily narrow it down to the small Florida species here associated with the name

Prout (1912, p. 104) seems to have first connected the name *extremaria* with a species in the North American fauna, but the species he chose was not the right one. He thought that Walker's *extremaria* was the same as the species to which Packard (1876, p. 389) had applied the name *rubromarginaria* (which I consider to be the northern population of *bistriaria*), and there is indeed some similarity in the red front and pink fringes. However, the fringes of *rubromarginaria* are at least faintly checkered, not uniformly pink, and are preceded by a distinct red terminal line which is definitely not apparent in the type of *extremaria*. Also the character of the other lines and the discal spots are different.

Barnes and McDunnough (1916b, p. 170) expressed doubt as to the correctness of Prout's identification, and later (1917b, p. 218) discussed *extremaria* at greater length, quoting the following description of the “unique female type in the British Museum” written and sent to them by Prout: “Face and vertex green strongly mixed with red, a white fillet between the antennae; palpus short and slender, third joint slender, exposed, but not elongate (hardly a *Racheospila*); lines extremely vague, the postmedian ap-

parently waved but not crenulate; no red terminal line; fringe pink with very narrow pale line at base; abdomen lost."

This description differs from Walker's mainly in the different use of the term vertex, and the mention of "green strongly mixed with red" as the color of the face and vertex. The latter discrepancy is slightly puzzling as I have not seen specimens with anything but pure red scales on the front and in the space just behind the white fillet (Prout restricted the term vertex to the narrow space, often evident as a colored border, just posterior to the white fillet; Walker called the fillet the vertex). However, the mixing of red and green scales on the head is such a common form of variation within species of *Nemoria* that such a condition as Prout described would not be unexpected. It should be noted that Prout's description implied that there were red scales on the vertex (= posterior margin of fillet), and this is an important character of *extremaria*, distinguishing it from *elfa*.

In the above paper of 1917b, Barnes and McDunnough doubtfully referred a specimen from Hastings, Fla., to *extremaria*, and that appears to have been the first correct identification of this species. I have examined the Hastings specimen (now in the USNM), including its genitalia, and agree with their determination.

The *Racheospila extremaria* of Kimball (1965, pp. 161-162), in part, is my *Nemoria outina*, new species, but his Oneco records apparently refer to 14 males and 2 females taken by Dr. J. G. Franclemont at that locality, Mar. 22-Apr. 1, 1954. These were correctly determined as *extremaria* by Franclemont and the data made available to Mr. Kimball. The Oneco series (JGF collection) is the largest from any one locality, and in fact the largest block of specimens known in any collection.

***Nemoria elfa*, new species**

Plate 11, figures 1, 1a, 1b; plate 32, figure 4; plate 44, figures 3-5.

DIAGNOSIS. This is a very small southeastern species close to *extremaria* in size and appearance, but differing in the following characters: male antennae more widely pectinate; front of head and hind margin of vertex, which are red in *extremaria*, entirely green in *elfa*; costa not flushed with red at base but entirely whitish; fringes, always pink in *extremaria*, pure white in *elfa*; white lines of wings wider and more distinct in *elfa*, tending to be more irregular. In the genitalia there seem to be differences only in the females. Both species occur in Fla. but *elfa* is the more widespread, reaching N.C. and central Texas.

TYPES. Holotype male, University of Florida Conservation Reserve, Welaka, Putnam Co., Fla., Mar. 15, 1962 (D.C. Ferguson), DCF slide No. 926, in the YPM. Paratypes, 1 male, Fort Myers, Fla., Apr. 1, 1912 (F. H. Rindge slide No. 5415, AMNH); 1 female, Waccasassa River, Gulf Hammock, Levy Co., Fla., Mar. 20, 1954 (J. G. Franclemont and in his collection); 1 female, Punta Gorda, Fla., June 10, 1951, H. Ramstadt (AMNH); 1 female, Monticello, Fla., Mar. 16, 1919, W. A. Hoffman (Cornell collection); 4 males, 11 females, The Wedge plantation, South Santee River, Charleston Co., S.C., Mar. 28-29, 1967, and a reared series of 18 males, 8 females, same locality, May 22-June 2, 1967 (D. C. Ferguson); 2 males, 4 females, same locality, July 7, 12, 21, Aug. 1, 4, 1967 (J. W. Porter); 3 males, 7 females, Leland, N. C., June 16-18, 1946, Otto Buchholz (AMNH). Paratypes have also been distributed to the CNC, USNM, YPM, and the R. B. Dominick collection.

FURTHER DESCRIPTION. External structure nearly the same as in *extremaria* but male antennae with longer and thinner pectinations; length of longest branches almost equal to 4 times diameter of shaft at same point; corresponding branches in *extremaria* little more than half this length. Palpi of both sexes small, scarcely exceeding front, apparently about the same as in *extremaria*.

Antennal scales and interantennal fillet pure white; hind margin of fillet green; front green, sometimes yellowish or partly so (perhaps discolored), but without reddish tints, with or without a whitish lower margin; palpi white or greenish, very faintly tinged with pink, especially on the third segment, anterior side of foreleg pale rusty orange or dull reddish, middle tibia sometimes with a trace of the same shade but legs otherwise whitish; underside of body white; upperside of thorax and first three or four abdominal segments light green with a slight mixture of white scales; posterior half of abdomen entirely white or with a trace of dorsal green scales continuing to segment 8.

Upperside of both wings light green, paler than *extremaria*, unstriated; white lines distinctly wider than in *extremaria* and more inclined to be irregular, even slightly dentate; antemedials convex, not quite as well defined as postmedials; postmedials almost parallel to outer margin, that of the hindwing noticeably bent at Cu_1 ; discal spots very small and blackish in Florida specimens, generally smaller than those of *extremaria*; in South Carolina specimens either green or blackish, varying from prominent to obsolete; either lacking, or green instead of blackish, in all examples seen from elsewhere; costa white with a luteous subcostal border separating it from the green area of the wing as in other species of the *extremaria* group; fringes white except for a faint trace of pink at the apex of the forewing. Underside much paler, with lines and discal spots obsolete, and with the costa faintly flushed with orange or pink.

Length of forewing: males, 8-10 mm; females, 10-12 mm; holotype male, 9 mm. Females apparently averaging considerably larger than males.

MALE GENITALIA. Apparently indistinguishable from those of *extremaria*.

FEMALE GENITALIA. Close to those of *extremaria* but with a larger preostial fold that is more coarsely rugose along the posterior margin, and with conspicuous areas of coarsely ribbed integument on both sides of the eighth sternite, radiating out from the sides of the ostium.

MATERIAL EXAMINED. 35 males, 35 females; 2 male, 2 female slides.

DISTRIBUTION. FLORIDA: Fort Myers; Bonita Springs; Punta Gorda; Hastings; Orlando; Waccasassa River, Gulf Hammock, Levy Co.; Welaka, Putnam Co.; Monticello, Jefferson Co. SOUTH CAROLINA: The Wedge Plantation, South Santee River, Charleston Co. NORTH CAROLINA: Leland. TEXAS: Kerrville; Kerrville State Park, Kerr Co.; Pharr.

GEOGRAPHICAL VARIATION. Specimens from N.C. and Texas tend to lack the blackish discal spots present in nearly all Fla. specimens. N.C. examples are light green like Fla. ones, but tend to have a slight darker green shade along the inner side of the postmedials and on both sides of the antemedials. The Texas specimens are uniformly colored but a slightly deeper, more intense shade of green than the type material, and consequently with the white lines emphasized in greater contrast. Those from S.C. are similar to Fla. specimens. There is little or no variation in size.

FLIGHT PERIOD. Mostly Mar. 8-Apr. 1 in Fla., but one on May 3 at Orlando and one on June 10 at Punta Gorda. Mar. 28-Nov. 22 in S.C. Taken only on June 16, 17 and 18, 1946, at Leland, N.C. In Texas, taken on June 3 and 5, 1948 (Buchholz) and July 1, 1962 (R. O. Kendall) at Kerrville, and July 7, 1948, at Pharr (Buchholz).

EARLY STAGES. In 1967 I reared *elfa* from a female taken in March at The Wedge Plantation, near McClellanville, S.C., and the young larvae were much like those of other species of *Nemoria*. From the various plants offered, these larvae showed a distinct preference for sweet gum, *Liquidambar styraciflua*. They otherwise fed, but

only slightly, on bayberry. The 26 reared adults of this brood, included in the paratype series, emerged between May 22 and June 2, 1967.

Nemoria tuscarora, new species

Plate 11, figures 2, 2a, 2b; plate 32, figure 7; plate 44, figures 6-8.

DIAGNOSIS. This species of the southern Appalachian Mountains looks almost exactly like *Nemoria mimosaria* but the genitalia, which are strikingly different, place it in the *extremaria* group. The wings are just slightly different in shape from those of *mimosaria*, being wider and less produced at the apices with the lines thicker, and the characteristic white abdominal spots of *mimosaria* lacking. Both male and female genitalia of *tuscarora* are exceedingly close to those of *extremaria* but larger. They are not at all like anything in the group to which *mimosaria* belongs.

TYPES. Holotype female, Highlands, 3865', Macon Co., N.C., June 25, 1958 (J. G. Franclemont), DCF slide No. 883, in the Franclemont collection at Cornell University. Paratypes, one male, same locality and collection, July 27, 1958; one female, same locality and collection, July 13, 1958; one male and one female, Mountain Lake, Va., July 1, 1938, and July 20, 1940, respectively (L. J. and M. J. Milne), in the CNC; one male, Cranberry Glade, vicinity of Richwood, W. Va., June 27, 1953 (A. B. Klots), in the AMNH.

SYNONYMY. None.

FURTHER DESCRIPTION. Antennae normal for the group; palpi of the two sexes nearly the same length, rather small, exceeding front by a distance about equal to the length of the third segment, which is approximately one-third the length of the second; legs normal for the group.

Head with the usual white fillet between the antennae, behind which the head is green; front faded rusty red with a variable white lower margin. In the type this white frontal margin is wide and continuous but it may be divided into two spots or reduced to a vestige. Palpi paler, faintly tinged with the same rusty red; front coxae with some green vestiture, front femora and tibiae tinged with pale rust red; middle tibiae also faintly reddish, remainder of legs and underside of body whitish. On the dorsum the thorax is green, as is the abdomen to the fourth or fifth tergite; the last three or four abdominal segments are entirely white. There are no abdominal spots.

Wings solid bright green, the same shade as *mimosaria*; costa thinly edged with white, usually followed subcostally (as in the type) by a faint orange or apricot colored line just one or two scales in width, this orange shade suffusing the whole pale costal margin at the base; fringes of both wings pure white; no terminal line; antemedial and postmedial lines white, almost exactly as in *mimosaria* but wider, those of the females regular, of the males slightly sinuous; antemedials evenly convex; postmedial of forewing almost straight, usually bent inward very slightly and becoming indistinct just before the costa; postmedial of hindwing angled at vein Cu_1 just as in *mimosaria*; no discal spots. Underside much paler, with costal edging luteous and the faint postmedials preceded by a diffuse but contrastingly darker green shade.

Length of forewing: males, 11-11.5 mm; females, 12-13 mm; holotype female, 12 mm.

MALE GENITALIA. Almost exactly like those of *extremaria* but larger, the valves perhaps longer, and the tooth at the distal end of the costa more prominent and

pointed. Uncus slightly more dilated towards the tip and eighth sternite more deeply incised, but these characters are probably variable.

FEMALE GENITALIA. Hardly distinguishable from others of the *extremaria* group except in size, being the largest, even slightly exceeding those of *catachloa*. *Tuscarora* seems to differ from *catachloa* only in having a slightly smaller preostial fold.

MATERIAL EXAMINED. 3 males, 3 females; 2 male, 3 female slides

DISTRIBUTION. NORTH CAROLINA: Highlands, 3865', Macon Co. WEST VIRGINIA: Cranberry Glade, vicinity of Richwood. VIRGINIA: Mountain Lake.

GEOGRAPHICAL VARIATION. None apparent.

FLIGHT PERIOD. June 25–July 27.

EARLY STAGES. Unknown.

REMARKS. When I first saw specimens of this species I thought they were southern Appalachian representatives of *mimosaria* (which does reach Va.), but a look at the genitalia soon dispelled this idea. I found that Dr. F. H. Rindge of the AMNH had already made a slide of the male from W. Va. and had been impressed by the remarkably different genitalia. At first it seemed likely that investigation of the long series of *mimoseria* available in various collections would provide additional material of *tuscarora* but this has not proved to be the case. It is still known from only six specimens.

The species is named after the Tuscarora Indians, who originally inhabited the Carolinas before they moved northward into Pennsylvania and New York to become the sixth Iroquois Nation.

***Nemoria catachloa* (Hulst), new combination**

Plate 11, figures 3, 3a, 3b; plate 32, figure 6; plate 44, figures 9-10.

Aplodes catachloa Hulst, 1898, p. 160. Dyar, 1902 [1903], p. 302.

Racheospila catachloa Prout, 1912, p. 104. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 26. McDunnough, 1938, p. 140. Kimball, 1965, p. 161.

DIAGNOSIS. *Nemoria catachloa* is a small- to medium-sized Florida species that is distinctive and easily recognized when one knows the characters, although it has been commonly confused with other species, especially *lixaria*. *Catachloa* has discal spots, a red terminal line, red-checked fringes, and abdominal markings, as does *lixaria*, but there are many differences. It is much smaller, the lines are more definitely dentate, the fringes are more heavily suffused with red of a brighter color, the dorsal abdominal spots are smaller and white rather than cream colored. Both sexes of *catachloa* have very small palpi in which the second segment does not exceed the front, a characteristic of the group in which I have placed it. The fore tibiae are solidly shaded with red anteriorly and without white markings across the middle. The genitalia are similar to those of the other species in this group and not at all like those of *lixaria*. *Catachloa* is the only known species of the *extremaria* group with a spotted abdomen.

TYPES. A male from Charlotte Harbour, Fla. (Mrs. A. T. Slosson) in the AMNH (ex Hulst collection). The specimen is somewhat rubbed, but intact and recognizable.

SYNONYMY. None.

FURTHER DESCRIPTION. Antennae, palpi and legs normal for the group; palpi of both sexes very short, those of the female smaller; head with the usual white fillet and a band of red behind; front deep rust red, with or without a white lower margin; if present, the white margin is usually interrupted in the middle; palpi tinged with red but paler; front coxae with some green vestiture; front leg faintly reddish in the same way; hind leg white and underside of body whitish; dorsum of thorax solid green; dorsum of abdomen shaded with green which diminishes posteriorly, although traces of green may occur on all tergites. Within the green area, a series of white dorsal abdominal spots on segments 4 to 6, surrounded or flanked by variable amounts of red; the spot on segment 2 often reduced or absent, not a reliable character as it may be present in both sexes and just as large as the spot on segment 1.

Wings bright green, sometimes slightly striated with white, and with a few white scales on the veins in the outer third; costa with the usual white edging, followed, as in *tuscarora*, by an ochreous or orange line which turns to reddish at the base and apex; in *catachloa* this ochreous line often as wide as the white costal edging. Wings with a strong red terminal line, feebly interrupted at veins. Fringes heavily suffused with red, being crisply checkered with white basally but with the red areas becoming confluent outwardly. The usual lines of the wings white, thin, distinct in fresh specimens; antemedial of forewing slightly convex, sinuous, the two ends about equidistant from the base; antemedial of hindwing well rounded; postmedials decidedly dentate and subparallel to outer margins; dark brown or blackish discal spots distinct on both wings. Underside much paler with the lines obsolescent, and with a wider luteous margin along the costa of the forewing.

Length of forewing: males, 8.5-10.5 mm; females, 10.5-12.5 mm.

MALE GENITALIA. Essentially as in the other species of the *extremaria* group, differing most noticeably in the form of the basal costal processes, which are the longest of all the species, extending well beyond the end of the tegumen, evenly curved and sickle-shaped. Saccus deeply emarginate, between the rather swollen, rounded processes of the vinculum. Eighth sternite deeply incised like that of *tuscarora*. Aedeagus showing no special characters.

FEMALE GENITALIA. Almost exactly like those of *extremaria* and *tuscarora* but with a tendency to have a larger preostial fold.

MATERIAL EXAMINED. 131 males, 44 females; 6 male, 5 female slides.

DISTRIBUTION. FLORIDA: Welaka, Putnam Co.; Cassia, Lake Co.; Lake Placid and Hi-coria, Highlands Co.; Oneco, Manatee Co.; Sarasota; Orlando; Dickinson State Park; Altamont; Fort Meade; Fort Meyers; St. Petersburg; Port Sewall, Martin Co.; Keystone Heights; Weekiwachee Springs; Bonita Springs; Dunedin; Kissimmee; Biscayne Bay; Charlotte Harbour.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. Nov. 13-May 8, almost continuously; July 15-31 (one specimen); Aug. 24 (one specimen). No records seen for June, Sept. or Oct., but Kimball (1965, p. 161) reports a few for June. So much of the Florida field work has been done by visiting collectors during the winter and early spring months that this might have given a false impression of the period of occurrence. Of the 170 specimens examined, I collected 56 and Dr. Franclemont 55, all within the spring period from Mar. 9 to Apr. 15. We have not been there at any other time.

EARLY STAGES. Unknown.

REMARKS. It is interesting to note that there are remarkably few old specimens of *catachloa* in collections. The USNM had only 5; the CNC none. Over 80% of the material examined was collected only within the last 10 or 12 years and prior to that time one might easily have concluded that *catachloa* was a rare or very local species. Yet during a 6 week field trip to two widely separated localities in Florida in 1962 I was able to collect as many specimens of *Nemoria catachloa* as of any other geometrid. I am sure that the apparent increase in abundance in recent years is nothing more than a reflection of more intensive field work and perhaps more refined collecting methods.

Nemoria outina, new species

Plate 11, figures 4, 4a, 4b; plate 32, figure 5, plate 44, figures 11-12.

Nemoria extremaria Kimball, 1965, pp. 161-162, partim.

DIAGNOSIS. This is a rather small, intensely green, Floridian species, finely striated with white, with plain yellow fringes, a red terminal line, and green, unmarked abdomen. The wings have a somewhat distinctive shape, being relatively acute at both the apex of the forewing and the anal angle of the hindwing. *Outina* is the only southeastern species of *Nemoria* with the combination of red terminal line, plain fringes, and green, unspotted abdomen.

TYPES. Holotype male, Archbold Biological Station, Lake Placid, Highlands Co., Fla., Mar. 25, 1962 (D. C. Ferguson), DCF slide No. 927, deposited in YPM. Paratypes, 1 female, same locality and collector, Mar. 28, 1962; 4 males, same locality, Feb. 11, Mar. 13, 17, 25, 1958 (Roger Pease); 1 female, same locality and collector, Apr. 2, 1958; 1 female, same locality, May, 1961 (H. E. and M. A. Evans); 1 male, same locality, Mar. 27, 1967 (Robert G. Beard); 7 males, 4 females, Port Sewall, Martin Co., Fla., Feb. 1, Feb. 4, Mar. 2, Mar. 31, Nov. 16-18, 24-26, Dec. 6-12, Dec. 14-27, Dec. 19, 1938 (L. C. and L. J. Sanford); 1 male, Weekiwachee Springs, Fla., Feb. 25, 1955 (J. F. May); 2 males, Orlando, Fla., Mar. 16, 1942, Mar. 26, 1946 (D. F. Berry); 1 male, Florida City, Fla., Jan. 3, 1938. Paratypes mostly in the AMNH, a few in the YPM, MCZ, CNC, and the collection of the author.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antenna bipectinate almost to tip, with branches long, the longest equal to four or five times diameter of shaft; female antenna slender, ciliate beneath in the usual way; male palpi minute, not or only barely reaching front; female palpi a little longer, slightly exceeding front. In both sexes third palpal joint about half length of second. Legs normal; hind tibia of male dilated and with a distinct terminal process; hind tarsus three-fifths the length of the tibia.

On the head, the usual white interantennal fillet with a thin bright red border behind; scales on male antenna pinkish white to yellowish, on female antenna white; front deep red with a very few green scales mixed in; palpi reddish; front coxa greenish; front femur and tibia reddish with yellow scales mixed in; front tarsus and middle leg yellowish; hind leg white; underside of abdomen white; upperside of thorax and abdomen bright green, in the male reduced to a trace on the last two or three segments.

Wings broad but slightly produced, outer margins less convex than is normal, so that apex of the forewing and anal angle of the hindwing are unusually pointed. Color bright green of an intense shade when fresh, finely and evenly striated with white; costa white with a red patch at the base and shading to yellowish at the apex.

A thin yellowish edging along the hind margin of the costa separating the white from the green, as in every species of the *extremaria* group. Fringes plain, decidedly yellowish, paler towards the base; wings with a thin but well defined bright red terminal line, slightly interrupted at the veins; antemedial lines indistinct; postmedial of forewing vague, whitish, quite regular, straight and almost erect; postmedial of hindwing slightly sinuous, curving with the outer margin and almost disappearing toward the inner margin; discal spots small, blackish, as in *catachloa*.

Length of forewing: males, 9-10 mm; females, 10-10.5 mm; holotype male, 10 mm.

MALE GENITALIA. Hardly distinguishable from the male genitalia of *extremaria* or *tuscarora*. Valve longer and thinner than that of *extremaria*, about the same as in *tuscarora*. Excavation of the saccus a little different from that in the others, being shallowly V-shaped, with the hind margin of the eighth sternite only very feebly incised. Aedeagus similar to that of all the species in the *extremaria* group.

FEMALE GENITALIA. Very close to the others of the group, but bursa with a thinner, more constricted neck region; poststrial part of genital plate unsclerotized; ostium with the beginnings of a bilobed cavity beneath the preostial fold, possibly as a precursor to the type found in *bistriaria* and *bifilata*; signum a slender invaginated crescent of chitin.

MATERIAL EXAMINED. 20 males, 8 females; 7 male, 3 female slides.

DISTRIBUTION. FLORIDA: Lake Placid, Highlands Co., Weekiwachee Springs, Hernando Co.; Port Sewall, Martin Co.; St. Petersburg; Orlando; Florida City.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. Jan. 3; Feb. 1-Mar. 31; "Aug.;" "Nov. 16-18," "24-26"; Dec. 19, "6-12," "14-27." Most of the known records are for Mar. and Feb.

EARLY STAGES. Unknown.

REMARKS. A few specimens of this species have been misdetermined as *extremaria* but only once did this get into print. Part of the records cited by Kimball (1965, pp. 161-162) for *extremaria* are *outina* and part are the real *extremaria*.

Group V. The *lixaria* group. Two southeastern species, superficially similar and apparently related, although not especially close.

Nemoria lixaria (Guenée)

Plate 2, figure 4; plate 12, figures 1, 1a, 1b; plate 33, figure 1; plate 44, figures 13-16.

Racheospila lixaria Guenée, 1857, p. 374. Walker, 1861, p. 581. Packard, 1876, p. 384. Hulst, 1896, p. 314. Dyar, 1902, [1903], p. 300. Prout, 1912, p. 103. Barnes and McDunnough, 1917a, p. 99; 1917b, p. 217. Prout, 1932, p. 25. McDunnough, 1938, p. 140. Kimball, 1965, p. 161.

Nemoria species from Georgia, Forbes, 1948, p. 114, and fig. 124.

Geometra inclusaria Walker, 1861, p. 508. Packard, 1876, p. 395. Hulst, 1886b, p. 140.

Racheospila inclusaria Dyar, 1902 [1903], p. 300 (as synonym of *lixaria*).

Synchlora texana Hulst, 1898, p. 160. Dyar, 1902 [1903], p. 301. Prout, 1912, p. 116. **New synonymy.**

- Racheospila texana* Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 26. McDunnough, 1938, p. 140.
Racheospila associaria Barnes and McDunnough, 1917b, p. 219. Prout, 1932, p. 26. McDunnough, 1938, p. 140. Kimball, 1965, p. 161. New synonymy.
Racheospila knobelaria Cassino, 1927, p. 66. Prout, 1932, p. 26. McDunnough, 1938, p. 140. Kimball, 1965, p. 162. New synonymy.

DIAGNOSIS. *Nemoria lixaria* is a medium-sized to quite large species of the southeast from Fla. to Texas, and northward at least to N.C. and Ark. It has very thin, slightly sinuous or sometimes dentate lines, dark discal spots, a red terminal line, crisply checkered fringes (in fresh specimens), variable whitish to cream colored abdominal spots bordered with red, long palpi, whitish spots at the upper corners of the red front in addition to the white lower border, and an irregular white band across the middle of the red front tibia. It is easily distinguished from *catachloa* by the latter's smaller size, much shorter palpi, more dentate lines, lack of white markings on the front tibia and lack of the upper spots on the front. Other species of the *extremaria* group differ from *lixaria* in their small palpi and lack of abdominal markings. *Saturiba* has no white bands on the front tibiae, has the abdominal markings mostly concentrated in the form of a large central brown patch, and of course different genitalia, although it is otherwise very similar. The green form of *Nemoria bistriaria* has many characters in common with *lixaria* and I think is most likely to cause confusion. In *bistriaria* the palpi are also long, and the front, tibiae, abdomen and fringes tend to be similarly marked but less intensely so. The lines of *bistriaria* are inclined to be straighter and more regular, but the two species may overlap in this character. Again the genitalia are very different.

Lixaria is very distinctive in the genitalia of both sexes and appears to have no near relatives in this region. Two Prout species from Mexico, *cosmeta* and *toxeres*, look extremely close to *lixaria* but have genitalia that place them nearer *obliqua*.

Occasional melanics occur with very unusual looking dark-brown lines and fringes. These are the only examples of melanism I have seen in the Geometrinae.

TYPES. The type of *lixaria* is a male in the USNM bearing 6 labels that I quote as follows: 1) Etats uni [sic], 2) Ex Musaeo Achille Guenée, 3) Typical Specimen, 4) Oberthur Collection, 5) *Racheospila Lixaria*, Guenée, Sp. G No. 601. Ameriq. Septentr., 6) *Lixaria* Gn. Am. bor. The type has been badly stained, chewed and mildewed, and only the outer halves of the wings now retain the original color and markings. The red margin and discal spots show distinctly, and the postmedial line is dentate, as Guenée stated. The outer end of the abdomen has been eaten away and the remaining basal half is so badly discolored that the dorsal markings are no longer visible. A short piece of the left antenna remains, showing that the specimen is a male. The size is just right, and it was my impression when I examined the type that it could hardly represent any other species in this fauna. Recourse to Guenée's description provides additional detail that I think makes the identification conclusive; for example: "Ailes . . . avec un liseré rouge fin, très-net, interrompu par des points blancs vis-à-vis des traits rouges qui entrecouperent la frange. . . . Abdomen avec de grandes taches blanches liserées de rouge".

It is generally assumed that American specimens described by Guenée with the notation, "Coll. Gn.", originated with John Abbot in Georgia, a very likely place for *lixaria* to have been found. The AMNH actually has specimens from Screven Co., Ga., where Abbot is believed to have spent most of his life, and I have seen many from the vicinity of Charleston and McClellanville, S.C., so apparently the species is not uncommon in that region.

Inclusaria Walker was described from seven specimens collected by Edward Doubleday at "St. John's Bluff, East Florida" (now the site of Fort Caroline National Memorial, about 5 miles up the St. John's River, Duval Co., Fla.). The surviving type is a female in the BM.

The type of *texana* Hulst, a male from Austin, Texas, is in the AMNH.

The type of *associaria* Barnes and McDunnough is a female (repaired with wrong abdomen; see Synonymy below) from Fort Myers, Fla., Apr. 16-23. It is in the USNM (ex Barnes collection).

Knobelaria Cassino was based on 6 males and 2 females from Hope, Ark., collected by Miss Louise Knobel. The holotype male, taken Aug. 5 [1923], allotype female, July 31, and 5 male and one female paratypes, June 8-Aug. 30, are all in the MCZ (ex Cassino collection), except one paratype which is in the CNC. It has been stated that the types of *knobelaria* could not be found (Kimball, 1965, p. 162), but when I visited the MCZ in April, 1965, I was able to locate them. I have examined the entire type series of *knobelaria*.

SYNONYMY. The original description of *inclusaria* Walker is most unsatisfactory, mentioning mainly those characters common to all species of *Nemoria*, but the surviving female type in the BM, of which I have a colored photograph, is quite definitely *lixaria*. The large size (26 mm expanse), long palpi, dark discal spots, strong red terminal line and sinuous postmedial virtually eliminate other possibilities. The abdomen is lost. *Lixaria* certainly occurs at St. Johns Bluff as I collected one there on Apr. 20, 1962.

The type of *texana* Hulst is abnormal for *lixaria* in several respects. It is very pale green, almost translucent; the fringe coloring is heavier and darker, almost exactly as in *saturiba*; the dark brown discal spots are very large, even larger than in *saturiba*; the postmedial lines are quite strongly dentate and faintly shaded inwardly with brownish, especially near the costa. The abdominal spots and the genitalia are exactly like those of *lixaria*, and it seems likely that the differences noted fall well within the variational limits of *lixaria* (see further description).

It seemed strange that no species to match the unique type of *associaria* Barnes and McDunnough had ever turned up, and my examination of this specimen in the USNM proved especially enlightening. This type is clearly a large, badly worn female of *lixaria* to which has been glued a female abdomen of *Nemoria bifilata*. McDunnough either did not notice this or ignored it, although it is very evident that the abdomen has been repaired. Of course at that time McDunnough still did not know *lixaria*, but it is a little surprising that he was not suspicious as the almost unique striped abdomen was identical to that of the species he had just described (as *abdominaria*) in a preceding paragraph.

There is no doubt that *knobelaria* is another synonym, although this has not been previously suggested. There is nothing about the type series or the description to indicate that it is anything other than *lixaria*. I have seen one or two specimens from Hope, Arkansas, with the melanic tendencies discussed elsewhere, but the types of *knobelaria* are normal green specimens just like *lixaria* from Florida or Georgia, and the genitalia are indistinguishable. All of the four new species of this genus described by Cassino in his paper of 1927 are synonyms.

FURTHER DESCRIPTION. Male antennae rather narrowly bipectinate, gradually tapering and becoming simple three-quarters of the way to the tip; longest branches no more than twice the diameter of the shaft; female antennae very slender and ciliate; male palpi moderately large, the second segment exceeding the front by a distance at least equal to the length of the small, rounded third segment; female palpi very long, the second segment exceeding front for half its length, the third segment almost as long as the second; hind tibia of male strongly dilated and with a well developed terminal process two-fifths the length of the tarsus; hind tarsus of male less than one-half the length of the tibia.

Antennal shaft in both sexes white near the base, turning luteous and then reddish distally; interantennal fillet white with a red border behind; collar green; front red with a white border at the bottom and a cream-colored spot in each upper corner; palpi with basal segment whitish, second and third segment heavily tinged with rose red, and third segment with a white tip; fore coxae with green and white

vestiture, femur luteous with a red tip, fore tibia red anteriorly, with an oblique white band across the middle, an apical tuft of white scales, and with a tuft of long brown hair-like scales posteriorly; middle femur with a small apical red patch; legs otherwise whitish; underside of body whitish; thorax above solid green; dorsum of abdomen green, diminishing on the last four segments. Abdominal segments 1, 3 and 4 always with distinct, cream-colored or whitish dorsal spots surrounded by red, that of segment 2 being present or absent but, if present, usually reduced in size. Segments 5 to 7 may also have reduced spots, especially in females, and the metathorax may have a red lunule adjacent to the first abdominal spot. When the abdominal spots are large, especially as in some females, those on segments 3, 4 and 5 may appear almost confluent.

Wings (normal form) bright green; costa with the usual whitish edging and a trace of red at the base; terminal line crimson, quite strongly developed and continuous except for minute whitish interruptions at the veins; fringes whitish or ivory, rather boldly checkered with pinkish-red rays opposite the veins; lines of the wings white, very thin and vague, the antemedials often scarcely visible; antemedial of forewing somewhat waved, rounded, the two ends about equidistant from the wing base; antemedial of hindwing similar, nearer the base; postmedial of forewing slightly sinuous to dentate, subparallel to outer margin for most of its length but bending slightly inward and almost disappearing toward costa; postmedial of hindwing similar, less inclined to be dentate, often quite sharply bent on vein Cu_1 ; dark brown discal spots present but sometimes very small.

There is a rare form of *lixaria* that shows the beginnings of melanism, and in collections these have most often been tentatively determined as *texana* or *knobelaria*. According to the types, however, neither of these names really represents this form, although *texana* does have a suggestion of a dark shade along the postmedial line. In these specimens, which are the only melanic Geometrinae I have seen, the red coloring of the head, legs, abdomen and fringes is replaced, entirely or in part, by dark brown, the lines of the wings are a dark brown, almost black, and the dark discal spots are abnormally large. In addition, the more extreme examples may have the green areas of the wings heavily intermixed with a sprinkling of dark scales; although still obviously green, such specimens appear much darker than normal ones. Along with the dark lines and almost black and white fringes, such coloring gives them a strange aspect. This melanic form is not a discrete one; variation is a continuum from those specimens that show only traces of darkening along the lines to the extreme condition just described. Only about 13 melanic specimens are known, of which I have seen 10. They tend to occur in the more western portions of the range (see Geographical Variation).

Length of forewing: male, 10.5-13 mm; female, 12-15 mm.

MALE GENITALIA. Very distinctive. Uncus stout, bending downward and abruptly dilated as a wide, flattened and rounded expansion towards the tip, the sides of this expansion being folded downward and the rounded tip reflexed; socii large, subequal in length to the free portion of the uncus; gnathos with a long but relatively slender apical hook; transtilla a wide, even, sclerotized band, usually with a slight arcuate thickening at the middle; juxta of the usual papilliform type but stout; sides of vinculum strongly convergent towards saccus, which has a very deep, U-shaped excavation; valve thickened and almost subcylindrical but not wide, rather straight-sided, the tip rounded and membranous, and with a blunt tooth at the outer end of the costa; basal costal processes large, laminate but rigidly sclerotized, rounded and somewhat reniform in outline, strongly concave on the inner surfaces; aedeagus stout, the sclerotized distal end acuminate, and with a prominent semicircular, serrated, dorsal process at about the middle; eighth sternite usually quite deeply incised.

FEMALE GENITALIA. Ductus bursae and bursa entirely membranous, with a small invaginated signum of the usual type; caudal end of bursa evenly rounded and with

ductus entering at the side; genital plate wide, vaguely defined anteriorly but becoming strongly sclerotized toward the posterior margin, which is irregularly sinuated. The poststrial part of the genital plate is thin but has the posterolateral extremities sclerotized. Opposite the genital plate on the sternite of the eighth segment, there is a triangular membranous evaginated lobe.

MATERIAL EXAMINED. 152 males, 155 females; 25 male, 6 female slides.

DISTRIBUTION. FLORIDA: Miami; Florida City; Daytona Beach; Fort Myers; St. Petersburg; Port Sewall, Martin Co.; Ormond Beach; Oneco, Manatee Co.; Siesta Key; Sarasota; Titusville; Lake Placid, Highlands Co.; Winter Park; New Smyrna; DeLand; Vero Beach; Gainesville; Welaka, Putnam Co.; St. Johns Bluff, Duval Co.; Warrington; Quincy, Gadsden Co.; Pensacola. GEORGIA: Okefinokee Swamp; Savannah; Screven Co. SOUTH CAROLINA: Charleston; Bull Is., Cape Romain Wildlife Refuge; Arrowhead Lake, Myrtle Beach; Beaufort; Coosawhatchee; Wedge Plantation, South Santee R., Charleston Co. NORTH CAROLINA: Leland, Raleigh. ALABAMA: Ozark. MISSISSIPPI: Biloxi, Harrison Co.; Jackson, Bolton and Clinton, Hinds Co.; Pearl, Rankin Co. LOUISIANA: Lafayette; Winnfield; Lake Charles. ARKANSAS: Hope. TEXAS: Town Bluff, Tyler Co.; Spring, Harris Co.; College Station, Brazos Co.; Conroe, Montgomery Co.; Austin. TENNESSEE: "Tenn." (1 female). NEW JERSEY: Lakehurst, a single male, June 11-20 (Lemmer).

GEOGRAPHICAL VARIATION. There appears to be little geographical variation apart from the tendency for melanic individuals to occur mostly in the western part of the range. Few have been taken near the Atlantic coast, but there is one from Savannah, Ga. (CU), and one from the Wedge Plantation, near McClellanville, S.C. (YPM). The other records are as follows: Warrington, Fla., Feb. 18, 1961; Siesta Key, Fla., Jan. 16, 1961; W. Pensacola, Fla., July 12, 1961; Clinton, Hinds Co., Miss., Jan. 26, 1960 (all in AMNH); Lafayette, La., Feb. 27, 1922; Lake Charles, La., Dec. 25 (MCZ); Town Bluff, Tyler Co., Texas, Mar. 11, 1966 (AMNH); Hope, Ark., Oct. 22, 1931 (CNC). Kimball (1965, p. 162, as *knobelaria*?) also reports records that I believe to be of this form from Escambia Co. and Quincy, Fla., and he figures specimens from Warrington and West Pensacola (Pl. XXI, figs. 13, 15). All of the specimens with melanic tendencies I have seen have been males. Kimball's figure 15 is stated to be that of a female but looks like a male. The type of *texana*, from Austin, Texas, has a suggestion of the dark shading on the antemedial lines.

FLIGHT PERIOD. In Fla. this species probably flies throughout the year although I have seen no records for June, Aug. or Oct., and only about one each for May, July, Sept. and Nov. There are numerous records through the winter months, with a peak being reached in Mar. and Apr. Again, this may only be indicative of collecting activity. For Ga., Ala. and Miss., most records are also for the spring period, Apr. 2-June 10, with a few in July and Aug., a single Ga. record for Oct. 10, and a Miss. record for Jan. 26. The three La. records were taken Aug. 14, and Dec. 25 and 27. For S.C., the available dates are Apr. 10-June 9, July 8-Aug. 23, and Nov. 20; for N.C., June 21 and "early Oct."; for Ark., July 25, Aug. 7, Sept. 18 and Oct. 22; for Texas, Mar. 11-27, May 1, and Sept. 10.

EARLY STAGES. In 1962 I successfully reared two broods of *lixaria* from females taken at Welaka, Fla., April 18, and Charleston, S.C., April 28. Both broods were fed northern red oak, *Quercus borealis*, and between June 15 and July 1, 1962, produced fine series of full sized adults. *Quercus borealis*, just leafing out, was the only oak available when I returned from Florida to the northeast.

The larva of *lixaria* is of the same type as all other known larvae of this genus, with large, fleshy, dorsolateral protuberances on abdominal segments 2, 3 and 4, and lesser protuberances on the remaining abdominal and thoracic segments. The processes

on segments A2 and A3 are larger than those in *bistriaria*, *mimosaria* or *rubrifrontaria*, and rather acutely pointed, with the usual pair of setae at the tips; the process on segment A4 is much shorter, and rounded or truncated. The processes on these three segments in the other species are more nearly equal. *Lixaria* does not have dorsal spots as do the above species, but has three rather prominent dark brown longitudinal stripes on each segment between the dorsolateral processes, and is otherwise variegated with a pattern of dark brown on a lighter brown background.

Nemoria saturiba, new species

Plate 12, figures 2, 2a, 2b; plate 33, figure 2; plate 44, figures 17-21.

Nemoria lixaria Forbes, 1948, p. 114 and fig. 123.

Racheospila [integra (Warren)] Kimball, 1965, p. 162.

DIAGNOSIS. A rather conspicuous but long overlooked species of the southeast, superficially similar to *lixaria* but differing in its distinctive abdominal markings and unique genitalia. The abdomen has a large mesial dorsal patch of dark brown scales, and usually a smaller basal spot of the same color, these markings replacing the row of white spots characteristic of *lixaria* and many other species. Rare individuals of *saturiba* have the brown markings replaced by red, and these had best be determined by genitalia. In the valve of the male, a straight sclerotized costa is sharply differentiated from the remaining, membranous portion, and these two parts are cleft into separate lobes at the end. In the female, the genital plate is much larger than that of *lixaria*, extending the full width of the seventh sternite.

TYPES. Holotype male, University of Florida Conservation Reserve, Welaka, Putnam Co., Fla., Mar. 18, 1962 (D. C. Ferguson), DCF slide No. 941, deposited in the YPM. Paratypes, 1 male, same locality and collector, Mar. 19, 1962; 1 male, Camp Rucker, Ozark, Ala., Mar. 25, 1943 (J. G. Franclemont); 1 male, Savannah, Ga., Jan. 28, 1947 (M. H. Mead); 8 males, the Wedge Plantation, S. Santee River, Charleston Co., S.C., Mar. 26-29, 1967 (D. C. Ferguson); 8 males, same locality and collector, Mar. 16-27, 1968; 2 males, same locality, June 11, 20, 1967 (R. B. Dominick); 2 males, 6 females, same locality, July 12, 14, 21, 27, Aug. 8, 13, 1967 (J. W. Porter); 1 female, Tryon, N.C., May 20, 1903 (Fiske); 1 female, Clinton, Hinds Co., Miss., May 20, 1963 (Bryant Mather); 1 female, Screven Co., Ga., May 18 (Otto Buchholz); 1 male, Gainesville, Fla., Feb. 22, 1955 (R. A. Morse); 1 female, Gainesville, Fla., Apr. 21, 1963 (R. P. Esser). There are paratypes in the collections of the YPM, AMNH, USNM, CNC, CU, J. G. Franclemont, C. P. Kimball, R. B. Dominick, and D. C. Ferguson.

SYNONYMY. None.

FURTHER DESCRIPTION. Antennae, palpi and legs of both sexes similar to those of *lixaria*; male palpus more slender than that of *lixaria* but about the same length, exceeding front by about the length of the third segment, which is half the length of the second; legs also more slender; hind tibia very much dilated and with a terminal process almost half the length of the tarsus.

Interantennal fillet white with a few reddish-brown scales on the posterior margin; front red to deep reddish-brown, with a white lower border interrupted at the middle, and with or without white maculae near the upper corners; palpi reddish-brown with white tips; fore tibia pinkish to brown; front femur with an apical brown spot, which may also occur in the middle femur; legs otherwise whitish; underside of body whitish;

upperside of thorax light green, this color extending to the first three tergites of the abdomen. There is a small dark brown dorsal spot on abdominal segment 1, and on segments 3-4 a larger brown patch that may overlap slightly onto segment 5. There may also be small traces of brown or green on the dorsum of segments 7 and 8. Otherwise the last 3 or 4 segments are entirely white.

Wings green, a little paler than *lixaria*, and with the spots and lines more distinct; lines white, very thin but visible for their full length, the antemedials and postmedials about equally distinct; antemedials slightly sinuous, curved; postmedial of forewing straight or only slightly convex in the males, curved and subparallel to outer margin in the females; in both sexes even or very slightly sinuous, not dentate as is often the case in *lixaria*; postmedial of hindwing similar but convex, strongly bent on vein Cu₁; costa edged with white, followed by a cream colored line separating it from the green, and tinged with reddish at the base and apex; wings with red or reddish brown terminal line, darker than that of *lixaria*, slightly interrupted at the veins; fringes white with red rays opposite the veins; terminal line with slight concavities between the veins, making the fringe appear crenulate, this being more noticeable than in any other species examined. The outer margin of the hindwing is perceptibly produced and angulate at vein M₃—a slight but, for *Nemoria*, a distinctive character. Discal spots dark brown, tending to be over twice the size of the spots in *lixaria*. Underside very pale, paler than *lixaria*; costa bordered with yellowish; lines obsolescent; discal spot prominent on forewing only.

Length of forewing: males, 10-12 mm; females, 13-14 mm; holotype, 11 mm.

MALE GENITALIA. Uncus thin, spatulate; socii membranous, rounded, very long, almost as long as uncus; gnathos rather delicate, with the usual tooth at the end; transtilla deeply concave on anterior side, arcuated; juxta with papilliform process tapered almost to a point in one example, quite dilated in another; vinculum delicate (as compared with that of *lixaria*); saccus with a moderately deep, U-shaped excavation; basal costal processes moderate, in length a little shorter than the gnathos tooth, irregularly conical, with folds in the sides, and with the apex compressed. The valve of *saturiba* is very peculiar and unlike that of any other species examined. It is longitudinally divided into two sharply differentiated parts: a rigidly sclerotized, straight, almost ribbon-like costa, rounded or tapered at the end, and a mostly membranous anterior portion extending from the sacculus to the tip. These two halves of the valve are divided distally by a deep excavation, separating them into free, rounded lobes at the outer end. The relative lengths of the two halves of the valve vary. In the type, the sclerotized costal portion exceeds the membranous lobe, but two specimens examined from Texas showed the reverse. The dorsal surface of the sclerotized costa is distinctively marked with a dense pattern of short, fine, longitudinal striae. The aedeagus lacks the prominent serrate process of *lixaria*, but has a long, sclerotized, trough-shaped depression along its left side, bearing a row of small teeth. The eighth sternite has a deep V-shaped excavation which divides the posterior margin into two rounded lobes.

FEMALE GENITALIA. These are also very distinctive. The preostial fold has developed around the ostium as a large, bilobate, sclerotized invagination on the inner side of the hind margin of the seventh sternite. This structure extends the entire width of the posterior edge of the seventh segment. The ostium, thus enclosed, is itself rather elaborately sclerotized, with rigid processes at each side. The ductus bursae is thick and marked with ribs that continue down the whole length of the bursa neck. The bursa copulatrix has a long but stout neck region that opens into a semiglobular portion at the end. The signum is a small invaginated ridge of chitin.

MATERIAL EXAMINED. 35 males, 11 females; 4 male, 2 female slides.

DISTRIBUTION. NORTH CAROLINA: Tryon. SOUTH CAROLINA: the Wedge Plantation, S. Santee River, Charleston Co. GEORGIA: Screven Co.; Savannah. FLORIDA: Gainesville; Welaka, Putnam Co. ALABAMA: Ozark. MISSISSIPPI: Clinton, Hinds Co. TEXAS: Town Bluff, Tyler Co.; 3 mi. S of Conroe, Montgomery Co.

GEOGRAPHICAL VARIATION. Ten Texas specimens examined average somewhat darker, and the usual red scaling on legs, front, and palpi has an admixture of brown. The brown abdominal patches show more of a tendency to be marked with vestiges of the white segmental spots that are normally obsolete in *saturiba*.

FLIGHT PERIOD. Feb. 22–Aug. 20, earliest in Fla., later northward, except that the Savannah specimen is dated "28 I 1947". In S.C. it flies at least in Mar., June, July and Aug. The Texas records were taken Mar. 3-27.

EARLY STAGES. In 1968 I reared *saturiba* from a female taken at the Wedge Plantation, McClellanville, S.C., in Aug. The larvae, which fed on *Liquidambar*, were unusually stout, with shorter, more obtuse protuberances than in any other species of *Nemoria* examined. They were brown, except for abdominal segments 1, 3 and 5, which were green laterally.

REMARKS. I compared this species with what is supposed to be *integra* from South America and decided that they could not possibly be the same. The chief point of resemblance is that both have a brown patch on the abdomen, but many diverse Neotropical species have such markings.

The uncus and peculiar valve of *saturiba* are readily seen in males that have the genitalia even just partly extruded, and positive determination of such specimens, based on genitalia, is possible without making slides. But in nearly all of the specimens I have seen the brown abdominal patches have been conspicuous, and since this also is a unique character for the geographical region concerned, recognition of *saturiba* should not be a difficult matter.

The name is that of a sixteenth century Timucua Indian chief who lived in the St. Johns River region of Florida.

Group VI. The *obliqua* group. Three western species, apparently related but not especially close.

Nemoria darwiniata darwiniata (Dyar)

Plate 12, figures 3, 3a, 3b, 4, 4a, 4b; plate 13, figures 1, 1a, 1b; plate 33, figure 3; plate 44, figures 22-24.

Aplodes rubrifrontaria var. *darwiniata* Dyar, 1904a, p. 903.

Aplodes darwiniata Dyar, 1904b, p. 121. Taylor, 1908, p. 100, 170.

Nemoria darwiniata Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140. Prentice, 1963, p. 306 (host plant records)

Nemoria oregonensis Cassino, 1927, p. 67. Prout, 1932, p. 23. McDunnough, 1938, p. 140. **New synonymy.**

Nemoria mentastii Guedet, 1941, p. 190. **New synonymy.**

DIAGNOSIS. *Nemoria darwiniata* is a medium sized to large western species, occurring in the nominate form from San Francisco Bay northward, and southward as subspecies *punctularia*. It has white abdominal spots bordered with red, a red front and red

palpi, and cream colored fringes, often with weak pink rays toward the apex. Small red or green discal spots may be present or absent. The species looks as though it belonged in the *bistriaria* complex but there are certain genitalic features that are different. *Nemoria glaucomarginaria* is the species most commonly confused with *darwiniata*, and specimens of the latter without discal spots and with faded abdominal markings may be virtually impossible to determine on superficial characters. There are structures in the genitalia of both sexes that are strikingly different, however, and reveal that the two species are not as close as they appear. The basal costal processes in the male genitalia of *darwiniata* are small, compressed and inconspicuous; those of *glaucomarginaria* are long and bifurcate. In the female, *darwiniata* has a normal, unmodified type of ductus bursae; in *glaucomarginaria* the ductus is dilated and funnel-shaped, ending in a greatly enlarged ostium.

TYPES. *Darwiniata* was described from sixteen specimens taken (as inferred from the introductory remarks, Dyar, 1904a, p. 781) by Dyar at Kaslo, British Columbia, June 9, 16, 20, 23, 25, 30, July 4, 19, Aug. 3, 5, 6, 7 [1903]. The original description ends with the statement: "Type—Cat. No. 7104, U.S. National Museum." There are now seven cotypes in the USNM all labeled "Type No. 7104." Only two of these are labeled Kaslo; of the remainder, four are from Arrowhead Lake, B.C. and one, which appears to be *glaucomarginaria*, from Martinez, Calif. (Coll. C. V. Riley). Neither of the Kaslo specimens bears a date. I hereby designate as lectotype the male in the USNM which bears, among others, the following three labels: Kaslo Cr., B.C.; H. G. Dyar, Collector; 19138. Dr. Ronald Hodges kindly made a genitalia slide of this specimen which has enabled me to provide the accompanying figure. The abdomen of the lectotype had very reduced white dorsal spots only faintly edged with orange red (presumably faded); it has no discal spots and the fringes are entirely whitish except for one red ray at the apex. It is one of those specimens that could be mistaken for *glaucomarginaria*, but the genitalia clearly establish its identity.

The type of *oregonensis* is a male from Corvallis, Oregon, July 22, in the MCZ. It and the following were described from single specimens.

The type of *mentastii* is a female from Glen Ellen, Sonoma Co., Calif. May 12, 1940. It is in the collection of the California Academy of Sciences, San Francisco.

SYNONYMY. *Oregonensis*, which Cassino thought to be "quite unlike any other known 'green'", is a minor aberration of *darwiniata* in which the lines of the forewing almost come together at the inner margin. Such variation is not uncommon in this species as the distance between the lines is somewhat unstable. The genitalia of the type of *oregonensis*, which I figure, are perfectly normal for *darwiniata*.

The type of *mentastii*, which I have been unable to examine, is almost certainly a more exaggerated *oregonensis* type of aberration in which the lines of the forewing actually meet at the inner margin. The original description is just detailed enough so that one may narrow it down to *darwiniata* with a fair degree of certainty, although there remains a possibility that it could be *glaucomarginaria*. Guedet's description, including the size (27 mm. expanse), would fit either of these species closely except for the aberrant lines on the forewing. There is no other known species in that part of California with the combination of characters given.

FURTHER DESCRIPTION. Male antenna bipectinate for a little over two-thirds, the distal end ciliate like that of the female; length of longest branches about two and one half times the diameter of the shaft; female antenna very slender, minutely ciliate beneath; male palpi short, stubby, almost truncate, exceeding front by about the same distance as the basal segment of the antenna; third segment very short, wide, and rounded; female palpi longer, extending beyond front twice as far as the male palpi, and with a more elongated third segment which may, however, be partly concealed by scales of the second. The structure of the legs is normal for *Nemoria* Groups VI to VIII.

Scales of antennae luteous; white fillet with a reddish hind margin varying from a few red and yellowish scales to a complete red border; front shield-shaped with a variable white lower border interrupted at the middle, or reduced to just a few white scales at the corners, often also with small white spots in the upper corners; palpi heavily shaded with rose outwardly; forelegs shaded with rose anteriorly, except the coxae, which have green and white vestiture; the legs, and the underside of the body, otherwise whitish; thorax green above; dorsum of abdomen green near the base, fading to white on segment 4 or 5, and with white dorsal spots encircled by red on segments 1, 3 and 4. The red on the abdomen, when not discolored, is usually deep rose or crimson, not the dull rust red characteristic of *glaucomarginaria*.

Fore- and hindwings light green, faintly striated with whitish, often with a bluish tint, close to the shade of *rubrifrontaria* but perhaps not as intense; lines white, thin but usually distinct; antemedials convex, usually but not always well rounded, even or slightly sinuous; postmedial of forewing straight or bending in slightly near costa, subparallel to outer margin; postmedial of hindwing crossing just beyond the middle, often distinctly bent at vein Cu₁, or may be almost straight or evenly convex; costa white, tinged with red at the base and apex; fringes whitish, very faintly checkered with pink, especially toward apex, the amount of pink in the fringes being variable; no terminal line; discal spots present or absent; if present, variable from yellowish to bright red.

Length of forewing: male, 13-16 mm; female, 14-18.

MALE GENITALIA. Large but with the parts tending to be slender and delicate. Uncus thin and slightly spatulate; socii large, broad and rounded; gnathos long and slender with the usual tooth at the end; transtilla with a deep U-shaped or circular excavation; saccus deeply emarginate. The valve usually appears rather elongated and slender (the figure of *oregonensis* was drawn from Cassino's slide, and the preparation is flattened out); basal process of costa small to moderate, compressed and slightly twisted, or concave on the inner face; tooth at distal end of costa large and rounded, with the membranous outer end of the valve produced well beyond it; aedeagus simple, with a long, pointed sclerotized tip but no teeth; eighth sternite moderately incised.

FEMALE GENITALIA. Bursa copulatrix large, elongate, entirely membranous; signum semicircular; posterior end of bursa with a lateral swelling from which the ductus seminalis arises; ductus bursae membranous; preostial plate a thinly sclerotized band occupying two-thirds the width of the segment; postostial plate an irregular, sclerotized, sinuated half circle around the ostium.

MATERIAL EXAMINED. 184 males, 110 females; 11 male, 4 female slides. Two inflated larvae, two pupal shells. Lectotype and cotypes of *darwiniana*, holotype of *oregonensis*.

DISTRIBUTION. BRITISH COLUMBIA: Victoria; Duncans; Saanichton; Cameron Lake; Quamichan District; Thetis Island; Wellington; Departure Bay; Arrowhead Lake; Diamond Head Trail, Squamish, 3200'; Kaslo; Peachland; Nelson; Hulcar; Sirdar. ALBERTA: Waterton Lake. WASHINGTON: Friday Harbour; Lake Crescent; Olympic Mountains; Toutle; Bremerton; Factoria, King Co.; Brewster, Okanagan Co., 900'; Dayton, Columbia Co. OREGON: Baker; McMinnville; Corvallis; Dayton. CALIFORNIA: Shasta Retreat, Mt. Shasta and Dunsmuir, Siskiyou Co.; Hat Creek Ranger Station, Shasta Co.; Laytonville, Mendocino Co.; Mohawk and Keddie, Plumas Co.; 4 mi. W. of Pinecrest, Tuolumne Co.; Cisco, Placer Co.; Anderson Springs and Mt. San Hedron, Lake Co.; Jackson, Amador Co.; Miami Ranger Station, Mariposa Co.; Glen Alpine and Meeks Bay, Lake Tahoe; Shady Rest Camp Ground, Mammoth Camp, Mono Co.; Coleville, Mono Co.; The Geysers, Sonoma Co.; Spring Mountain and Mt. St.

Helena, Napa Co. IDAHO: Wallace; Moscow Mountains near Troy, 3500'; Gibsonville, Lemhi Co., 5200'. MONTANA: Near Lolo Hot Spring, Missoula Co., 4000'; Trout Valley. WYOMING: Jenny Lake; Moran; 18 mi. S.W. of Big Horn, Sheridan Co.; Louis Lake, 28 mi. S.W. of Lander, Fremont Co. COLORADO: 10 mi. S. of Steamboat Springs, Routt Co.; Poncha Springs. UTAH: Stockton; Glendale; Provo; Bryce; Tropic; Red Canyon Camp, 11 mi. S.E. of Panguitch, Garfield Co. NEVADA: "Nevada." ARIZONA: Prescott, 6 mi. E. of Prescott, and Mayer, Yavapai Co.; Todd's Lodge, Oak Creek Canyon; Sedona, Pinal-Gila Co. line; Cochise Stronghold [Stronghold Canyon?] Dragoon Mountains (Cochise Stronghold is in the Chiricahua Mts.); Wheeler Canyon, Hualpai Mts., Mohave Co.

I list all the Arizona records here although many Arizona specimens look more like *punctularia* (see below).

GEOGRAPHICAL VARIATION. British Columbian examples are mostly without discal spots and with the abdominal markings encircled with pale red. The tendency toward the development of red discal spots and more intense red abdominal shading increases southward and the frequency becomes fairly high in northern Calif., although the discal spots are still not as large as in real *punctularia* from southern Calif. It may well be that there is no actual break between the two populations in Calif., but everything from south of San Francisco Bay seems to show the characters of *punctularia*, such as they are.

Where the ranges of *darwiniata* and *glaucomarginaria* overlap in Calif., the trend is for the distinguishing characters to be intensified, culminating in *punctularia* which, because of its discal spots and dark red abdominal coloring, is nearly always readily distinguishable from *glaucomarginaria*. Recognition of the latter species, with its dull red abdominal markings and lack of discal spots, becomes more of a problem northward, as in Ore. and Wash., where these characters in the two species become almost identical. *Glaucomarginaria* does tend to have the abdominal spots larger, and cream colored rather than white, but apart from these subtle tendencies and the distinctive genitalia, I have been unable to find any other consistent differences.

Darwiniata remains quite constant down through the Rocky Mts. to Utah and Colo., but the Ariz. populations are confusing and need further study. The material available from Ariz. is inadequate but most of the specimens I have seen look quite like *punctularia*. A series of eight in the USNM from the Hualpai Mountains goes a step farther in one respect, having the fringes bright pink with a pale line at the base. The abdominal markings of Ariz. specimens are like *punctularia* but the discal spots are not especially well developed. Since the Ariz. material seems to be intermediate, and also probably varies in other directions from one mountain range to another, I have listed all the records under *darwiniata*.

FLIGHT PERIOD. The records as a whole extend continuously over a long season from Apr. 18 (Mt. St. Helena, Napa Co., Calif.) to Sept. 14 (Anderson Springs, Lake Co., Calif.). There is good evidence of two generations per season. The dates available to me for Vancouver Island, B.C. extend from June 3 to Aug. 23 with no apparent break, but this long a flight period suggests that two broods are represented. The available dates for northern Calif. do seem to break into two periods, Apr. 18–July 10, and Aug. 12–Sept. 14. The other northwestern records in general also fit this pattern. For Wyo., Colo. and Utah the dates span a midsummer period from June 23 to Aug. 9, suggesting that at higher elevations the season is compressed, as one might expect. The dates for Ariz. are Apr. 11–June 20, and Sept. 10–Oct. 29.

EARLY STAGES. The egg and larva were described in detail by Dyar (1904b, p. 121), and I have been able to examine two of his inflated larvae from Kaslo now in the USNM. In gross aspect these are very similar to all the other known *Nemoria* larvae except that the lateral processes are relatively short on all segments. Only the processes on abdominal segments 2, 3 and 4 are prominent, all others being reduced to small

tubercles. The integument is densely spinulate granulate, almost velvety. Although the larvae of different *Nemoria* species look much alike there appear to be wide differences in the texture of the integument and in the form of the many rather elaborate setigerous tubercles.

The common host plant of *darwiniata* appears to be willow. Dyar's brood was reared on willow, and the Canadian Forest Insect Survey (Prentice, 1963, p. 307) reports three collections on willow and one on *Arbutus*. In the CNC, the single specimens from Nelson and Hulcar, B.C. were reared from willow, and another specimen, from Sirdar, B.C., was reared from "*C. sanguineus*." The emergence dates for the last three specimens were June 27, 1960, July 14, 1953, and Sept. 6, 1960 respectively. Assuming that the winter is passed in the pupal stage, and that the specimens were collected as larvae, these late dates indicate second or even third generation emergences.

***Nemoria darwiniata punctularia* Barnes and McDunnough, new status**

Plate 13, figures 2, 2a, 2b; plate 33, figure 4; plate 44, figures 25, 26.

Nemoria punctularia Barnes and McDunnough, 1918, p. 135. Prout, 1932, p. 24, McDunnough, 1938, p. 140. Comstock, 1960, pp. 436, 437.

Nemoria darwiniata californica Prout, 1932, p. 23. McDunnough, 1938, p. 140 (as synonym of *punctularia*).

Nemoria pistacearia Comstock and Henne, 1940, pp. 78-80, pls. 9-11 (nec Packard) (early stages).

DIAGNOSIS. *Punctularia* is a southern Californian population closely related to *darwiniata* but distinguished by rather prominent red discal spots and differences in the coloring of the abdomen. Previous authors have generally treated it as a distinct species but as such it has seemed to me to be indefinable. There is evidence of a clinal connection with *darwiniata* in the region of San Francisco Bay, and many examples from well within the range of each race show in varying degree the characters of the other. The known food plants of *darwiniata* and *punctularia* are different and there appear to be minor differences in the genitalia.

Material from Arizona tends to look like *punctularia*, but as these specimens are inconsistent and in some respects intermediate, I have listed all Arizona records under *darwiniata*.

TYPES. *Punctularia* was described from one male from San Francisco, Calif., and two females from Camp Baldy, San Bernardino Mts., Calif., now in the USNM (ex Barnes Collection). I hereby designate the male from San Francisco as the lectotype (F. H. Benjamin's slide of male genitalia No. 263). The two females are labeled as female type and paratype in McDunnough's handwriting.

Californica was from San Diego, Calif., and the type is in the Tring Museum. The sex of the type was not stated.

SYNONYMY. Prout's description of *californica* consists only of the following statement: "*californica* (Tayl., MS.) *subsp. nov.* has larger cell-dots, suggesting a transition to the following species" [*punctularia*]. I have been unable to see the type, but considering the locality and Prout's opinion regarding it as a subspecies of *darwiniata*, there seems to be no reason to doubt its identity.

FURTHER DESCRIPTION. Almost exactly like *darwiniata* except for the following differences: red or brownish discal spots always present and usually large enough to be conspicuous; white abdominal markings with a tendency to be reduced in size and sometimes obliterated by the surrounding red shading, which tends to be deep reddish

purple, or even brown. McDunnough's characterization of *punctularia* was entirely based on these features, but actually many southern Californian specimens have the white abdominal spots just as large as *darwiniata*. The reddish shade on the abdomen is nearly always darker, however.

Length of forewing: males, 13.5-15 mm; females, 13.5-16 mm.

MALE GENITALIA. Differing from those of *darwiniata* only in their slightly more slender and delicate structure, smaller size, and less prominent basal and distal costal processes.

FEMALE GENITALIA. Exactly like those of *darwiniata* except that the postostial portion of the genital plate tends not to be sclerotized.

MATERIAL EXAMINED. 62 males, 34 females; 6 male, 4 female slides.

DISTRIBUTION. CALIFORNIA: Mill Valley, Marin Co.; San Francisco; San Mateo, San Mateo Co.; Santa Cruz; Lower Shenley Meadows, Greenhorn Mountains, Kern Co.; 2 mi. S. of Painted Cave, Santa Barbara Co.; Table Mountain, Singing Springs, and Cloudburst Canyon, San Gabriel Mountains; Buckhorn Camp, 6800', and near Buckhorn Flat, Angeles Crest, Los Angeles Co.; Upper Shake Canyon, Los Angeles Co.; Santa Monica Mts., 5 mi. N. of Beverley Hills, 1100'; Beverley Terrace, Los Angeles Co.; Mint Canyon, Los Angeles Co.; Phelan; Witch Creek; Lake Arrowhead; Idyllwild, San Jacinto Mts., Riverside Co.; Thermal, Riverside Co.; Glen Ivy; San Diego; La Mesa and Julian, San Diego Co.; Borrego; Descanso; Big Bear Lake, San Bernardino Co.; Barton Flats and Upper Santa Ana River, San Bernardino Co.; Camp Baldy, San Bernardino Mts. MEXICO: 11 mi. E. of Ensenada, Baja California.

GEOGRAPHICAL VARIATION. This is not especially noticeable except for the Arizona populations discussed under *darwiniata*, and which might just as well be placed here. Arizona specimens tend to have the fringes entirely pink except for a pale line at the base, the discal spots smaller than *punctularia*, and the white abdominal spots un-reduced although still surrounded by the deep reddish purple shade of *punctularia*. One of a series of eight specimens from the Hualpai Mountains, Mohave Co., has the two outer abdominal spots replaced by a solid brown patch, but the others have normal spots.

FLIGHT PERIOD. Apr. 14-July 11; July 27-Sept. 4; Sept. 24-Oct. 11; "Nov"; Dec. 12-Jan. 3. The dates are listed so as to indicate gaps as they appear from the material available. It is not to be assumed that these periods all represent generations; more adequate sampling will undoubtedly reveal greater continuity of flight times, at least in some areas.

EARLY STAGES. Egg, larva and pupa described and figured (as *Nemoria pistacearia*) by Comstock and Henne (1940, pp. 78-80, pls. 9-11). The food plants reported were *Ceanothus spinosus* and an unidentified species of *Quercus*.

REMARKS. I have included three specimens from Mill Valley, Marin Co., Calif. as *punctularia* as they have the characters well developed. So the geographical boundary, if there is one, is perhaps not San Francisco Bay itself but the northern limit of the lowlands surrounding it.

***Nemoria zelotes*, new species**

Plate 13, figures 3, 3a, 3b; plate 33, figure 5; plate 44, figures 27-29.

? *Racheospela* (sic) *texaria* Pearsall, 1906, p. 206.

DIAGNOSIS. This is a medium-sized to large species of southern Ariz. and adjacent N.M., characterized by a rather intense green coloring, somewhat angulate hindwing, pure white abdominal spots surrounded by reddish brown, a strong, deep red terminal line, whitish fringes, reddish discal spots, and rather thin white lines of which the postmedial of the forewing is straight and the antemedial evenly curved. The female palpi are long but not quite as long as those of *obliqua*. The genitalia of both sexes are very close to those of *obliqua* but the males, at least, can be distinguished by differences in the shape of the valve. *Zelotes* does not look like *obliqua*, mainly because the white lines are much less prominent and the wing shape is different; the forewings of *zelotes* are more pointed and the outer margins less convex, although there is a tendency for the hindwing to be slightly angulate. *Zelotes* looks more like the Arizona form of *darwiniana* but may at once be distinguished by the presence of a terminal line. The only near relative that *zelotes* closely resembles superficially is *Nemoria toxeres* Prout of Mexico and Central America; at least this is the closest species of which I am aware. However, *toxeres* has genitalic characters that differ even more than do those of *obliqua*.

TYPES. Holotype male, Madera Canyon, 4880', Santa Rita Mts., Santa Cruz Co., Ariz., June 22, 1963 (J. G. Franclemont), DCF slide No. 969. Paratypes, 129 males, 19 females, same locality and collector, June 11–July 25, and Aug. 22–Oct. 19, 1959, 1960 and 1963, mostly in late June and early July; 2 males, same locality, "Aug. 20–Sept. 5, 1957" (T. W. Davies); 4 males, 2 females, Sunnyside, W. side Huachuca Mts., Cochise Co., Ariz., July 7–17, 1958 (T. W. Davies); 1 male, 1 female, Ramsey Canyon, Huachuca Mts., Ariz., Oct. 7, 1965, July 27, 1964 (R. F. Sternitzky); 1 female, Miller Canyon, Huachuca Mts., Ariz., July 1, 1964 (R. F. Sternitzky); 14 males, 1 female, Cave Creek Canyon, 5400', Chiricahua Mts., Cochise Co., Ariz., May 20, June 10–July 19, Sept. 3, 1966 (J. G. Franclemont); 1 male, East Turkey Creek, 6400', same area and collector, June 28, 1966; 1 male, Onion Saddle, 7600', same area and collector, July 12, 1966; 1 male, S.W. Research Station of the AMNH, near Portal, Cochise Co., Ariz., May 25, 1961 (M. Statham); 1 male, same locality and collector, July 29, 1959; 4 males, 2 females, same locality and collector, July 3, 1959; 1 male, Palmerlee, Cochise Co., Ariz., July; 1 female, Washington Mts., Ariz., no date; 2 males, MacMillan Camp, 7000', 14 mi. N of Silver City, Grant Co., N.M., July 12, 15, 1964 (F., P. and M. Rindge). Holotype and most paratypes in the Franclemont collection at Cornell University; other paratypes in AMNH, USNM, and YPM.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs almost exactly as in *obliqua*. Third segment of male palpus rounded rather than conical; of the female long and cylindrical, about as long as that of *obliqua*.

Antennal scales luteous, becoming red distally; interantennal fillet white with a variable red posterior border, which may be reduced almost to the point of obsolescence and luteous rather than red; front dull red, often with a mixture of green scales, and nearly always with white maculae in the lower and upper corners; palpi tinged with rose, the third segments pale at the tips, fore tibia dull red anteriorly with an oblique white band across the middle; fore tarsi also faintly reddish; fore coxae with some green hair, but legs otherwise whitish; underside of thorax and abdomen whitish; upperside of thorax green like the wings; upperside of abdomen also green except that the last segment is whitish and segments 1, 3 and 4 have pure white spots surrounded by variable amounts of dark reddish-brown shading. The white spots, as in most males, may be rather small, laterally compressed and encircled with a minimum of brown or, as in most females, large and round, with much more brown surrounding them. A white spot never seems to occur on segment 2.

Upperside of both wings bright green, paler than *obliqua*, about the same shade as *festaria* but unstriated or very nearly so. White lines usually thin but distinct; antemedials strongly convex, on the forewing slightly wavy; postmedial of forewing regular, straight or slightly concave, often disappearing just before costa; postmedial of hindwing fairly regular, subparallel to outer margin, with a convex curve at M_2 - Cu_1 and a

slight concave bend between Cu_2 and the second anal vein. Dark brown discal spots normally present, often prominent, terminal line strongly developed, deep crimson with a paler inner edge, slightly interrupted at veins, often slightly crenulate, especially on the hind wing; fringes white at the base, luteous on outer half, sometimes with faint pink rays opposite the veins; costa white, slightly flushed with red at base and apex, and with a thin yellowish border behind.

Length of forewing: males, 12-14 mm; females, 13.5-16.5 mm; holotype, 13.5 mm. The females average considerably larger than the males, the size difference being greater than in many other species.

MALE GENITALIA. These are of the same type as those of *obliqua*, but the valve is wider, the distal process of the costa larger and more rounded, and the basal process of the costa with a long, thin, spine-like extension which, if present at all in *obliqua*, is normally vestigial. The brush-like tufts arising from the coremata are similar in the two species but are slightly longer and darker in *zelotes*. The aedeagus differs only in being somewhat stouter in *zelotes*.

FEMALE GENITALIA. Very close to those of *obliqua* but with the ductus bursae a little more heavily sclerotized and the preostial portion of the genital plate differently shaped. *Nemoria toxeres* has the ductus bursae entirely membranous and the preostial plate larger than that of either *obliqua* or *zelotes*. *N. cosmata*, another Mexican species, has the preostial plate still larger, about as wide as the entire posterior edge of the seventh sternite.

MATERIAL EXAMINED. 186 males, 31 females; 4 male, 2 female slides.

DISTRIBUTION. ARIZONA: Madera Canyon, 4880', Santa Rita Mountains, Santa Cruz Co.; Sunnyside, W. side of Huachuca Mountains, Cochise Co.; Ramsey Canyon, Huachuca Mountains; Palmerlee, Cochise Co.; Cave Creek Canyon, 5400', East Turkey Creek, 6400', and Onion Saddle, 7600', Chiricahua Mts., Cochise Co.; S.W. Research Station of the AMNH, 5400', 5 mi. W. of Portal, Cochise Co.; Oracle, Pinal Co.; S. Fork Camp, White Mountains; Washington Mountains. NEW MEXICO: MacMillan Camp, 7000', 14 mi. N. of Silver City, and Cherry Creek Camp, 6900', 13 mi. N. of Silver City, Grant Co.

GEOGRAPHICAL VARIATION. None apparent in the material examined.

FLIGHT PERIOD. The 150 specimens from Madera Canyon fall into two periods, indicating at least two generations, June 11-July 25 and Aug. 22-Oct. 19. The specimens from near Portal, Ariz. bear dates that extend with fair continuity from Mar. 23 to July 26. The few New Mexican specimens were taken by Dr. F. H. Rindge July 10-19.

EARLY STAGES. Unknown.

REMARKS. In connection with the identification of this species, Mr. D. S. Fletcher of the BM very kindly made slides of the types of *cosmeta* and *toxeres* of Prout, two supposedly related Mexican species, and with his assistance I have been able to establish that neither of these is the same as *zelotes*. *Toxeres*, of which I have seen the genitalia of several specimens, has some minor differences in the coremata and in the shape of the valve and its processes, and has a very distinctive aedeagus with two dorsal humps and a row of prominent teeth on the same side. *Cosmeta* is very peculiar because, according to Mr. Fletcher's sketch made from the type, the valve is actually split into two lobes, the ventral one membranous and the dorsal one (the costa) slender and sclerotized. This suggests the kind of valve found in *Nemoria saturiba*, n. sp., but in that species the two parts of the valve, although sharply defined, are separated into lobes only at the end.

Zelotes is not uncommon in southern Ariz., judging from the specimens seen, and a few of the older ones found in collections go back to the time of Barnes and McDunnough. I looked for and failed to find this species in the Mexican material at the USNM and AMNH, but it must surely follow the Sonoran zone southward.

Nemoria obliqua obliqua (Hulst)

Plate 13, figures 4, 4a, 4b; plate 33, figure 6; plate 44, figures 30-32.

Aplodes obliqua Hulst, 1898, p. 161.

Anaplodes obliqua Dyar, 1902 [1903], p. 302.

Nemoria obliqua Prout, 1912, p. 112.

Racheospila obliqua Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 26. McDunnough, 1938, p. 140.

Geometra bellonaria Strecker, 1899, p. 8.

Anaplodes billonaria [sic] Dyar, 1902 [1903], p. 302, as synonym of *obliqua*.

Nemoria bellonaria Prout, 1912, p. 112, as synonym of *obliqua*.

Racheospila obliqua bellonaria Barnes and McDunnough, 1917a, p. 99. McDunnough, 1938, p. 140.

Racheospila obliqua form *bellonaria* Prout, 1932, p. 26.

DIAGNOSIS. A colorful southwestern species in which the wings are a deep, intense, opaque green, the white lines wide and well defined, the antemedial of the forewing quite straight and oblique, making an almost equilateral triangle of the basal area, and the fringes pinkish and preceded by a red terminal line. The body is green above and below except for dull red and whitish dorsal abdominal markings. The palpi of both sexes are the longest that I have seen in this genus, those of the female exceeding the front by a distance equal to the entire length of the head. *Obliqua* ranges from Colo. and Utah south into Mexico, with the doubtfully distinct race *hennei* in the Sierra Nevada Range, Calif., and apparently also in the Spring Mts., Nev.

The genitalia place *obliqua* in a position close to the preceding species and to *toxeres* Prout, of Mexico. These form a small group distinguished by the heavy tufts of dark, bristle-like hair that arise from the extensile glands (coremata) in the sacculus of the male.

TYPES. Both *obliqua* and *bellonaria* were described from single specimens collected in Colo. by Bruce, but the exact type localities are not known. The type of *obliqua* is a male, now in the AMNH. It is an abnormally small specimen and quite faded. I have not seen the type of *bellonaria* but presume that it is with the Strecker collection in the Chicago Natural History Museum. In the USNM there is a small pencil sketch of Strecker's type with comments on the coloring, and this, together with the original description, indicates conclusively that *bellonaria* represents the same species as *obliqua*. Also in the USNM there are four or five more of Bruce's Colorado specimens, and these agree well with the drawing.

SYNONYMY. *Bellonaria*, discussed above, is the only synonym. The somewhat dwarfed and colorless condition of Hulst's type seems to have caused reluctance on the part of certain earlier authors to recognize it as equalling *bellonaria*. Dyar (1903) and Prout (1912) were correct; Prout later (1932) suggested that they might be seasonal forms of the same species. Barnes and McDunnough (1917a) and McDunnough (1938) listed *obliqua* and *bellonaria* as two subspecies, in spite of the probability that they came from the same locality.

FURTHER DESCRIPTION. Male antennae normal, the longest branches about twice the diameter of the shaft; female antennae ciliate beneath in the usual way; male palpi

long, exceeding front by about one-third their length; third segment moderate, obtusely pointed, slightly decumbent; female palpi very long, exceeding front by a distance about equal to the entire length of the head; third segment long and cylindrical, about equal in length to the second; legs normal, with the hind tibia like that of *darwiniata* and many other species.

Antennae of both sexes whitish at the base, turning red distally; white fillet with or without a luteous border behind; front dull rust to luteous, sometimes with a few green scales mixed in, and with or without a cream colored lower margin; palpi and fore tibiae lightly tinged with red; front coxae and femora greenish; legs otherwise whitish or luteous; thorax and abdomen above and below green, except for the last two abdominal segments which are whitish; abdominal segments 1, 3 and 4 with white dorsal spots encircled by dull red, which may extend to segments 5 and 6. The spots are not infrequently cream colored rather than white, and may be reduced or obsolete.

Wings a deep, intense shade of green, uniform, unstriated, opaque, the fore- and hindwings alike; lines quite wide and sharply defined, white, regular; antemedial of forewing slightly sinuous but almost straight, oblique, meeting costa and inner margin at points almost equidistant from the base; antemedial of hindwing strongly curved and nearer the base; postmedial of forewing almost straight, subparallel to outer margin, curving in slightly towards costa; postmedial of hindwing curved but a little less so than outer margin; costa cream colored, faintly pinkish towards base and apex; terminal line thin, bright red; fringes whitish at the base, pink outwardly, with diffuse pink irrorations opposite the veins; discal spots present or absent (see Geographical Variation), brown, often encircled by a paler shade. Underside as above but paler and with the lines diffuse; darker and more uniformly green beneath than most species.

Length of forewing: male, 11.5-14.5 mm; female, 13-15 mm.

MALE GENITALIA. Somewhat more heavily sclerotized than those of *darwiniata*. Uncus hardly spatulate; costal process at base of valve variable but quite large, flattened, usually with the edges curled inward, and tapering to a point at the end, sometimes abruptly; distal costal process large, prominent, usually pointed, with the membranous end of the valve continuing outward well beyond it; coremata with large tufts of dark brown bristles—the most conspicuous genitalic feature of *obliqua*, *toxeres* and *zelotes*. Saccus as in *darwiniata*; aedeagus with a suggestion of some small teeth just beyond the middle, otherwise like that of *darwiniata*; eighth sternite quite deeply incised with a U-shaped notch.

FEMALE GENITALIA. Almost exactly like those of *darwiniata*. Poststrial portion of genital plate unsclerotized and hence more like that of *punctularia*.

MATERIAL EXAMINED. 62 males, 84 females; 5 male, 1 female slides.

DISTRIBUTION. COLORADO: Glenwood Springs; "Colo., Bruce." UTAH: Bryce Canyon Lodge, Bryce Canyon National Park. ARIZONA: Fort Defiance; 3 mi. W. of Eagar, 7100', Apache Co., Pinon-juniper life zone; Prescott, 5400', Yavapai Co.; Walnut Canyon, 6500', near Flagstaff, Coconino Co.; West Fork, 6500', 16 mi. S.W. of Flagstaff; Hereford; Chiricahua Nat'l. Monument, Cochise Co.; Cave Creek Canyon, Portal, Cochise Co.; Madera Canyon, 4880', Santa Rita Mts., Santa Cruz Co., 7000'; NEW MEXICO: McGaffey, Zuni Mts., McKinley Co., 7500'; Frijoles Canyon, Bandelier National Monument, 6050'; 13 mi. N. of Silver City, Grant Co.; 6 mi. N.E. of Santa Fe; 28 mi. S.W. of Magdalena, Socorro Co.; Taos. MEXICO: 1 mi. S. of Cedritos, Coahuila, R. Zweifel (in AMNH).

GEOGRAPHICAL VARIATION. Colo. material tends to have the conspicuous brown discal spot on the forewing like subspecies *hennei*, which is only doubtfully distinct, but specimens from Ariz. and N.M. almost always have the discal spot much reduced or absent, and their coloring is a little paler and duller.

FLIGHT PERIOD. Apr. 11–May 6; June 18–Aug. 31; the one Mexican specimen June 22. Most records in late July, early Aug.

EARLY STAGES. *Obliqua* was reared by Mr. R. W. Poole from a female taken in Walnut Canyon, near Flagstaff, Ariz. The food plant was *Rhus trilobata*. Preserved larvae from this brood, in the Franclemont collection, are normal for the genus in basic structure, although the integument is unusually rough and tuberculate, and there are mid-dorsal processes between the dorso-lateral ones and almost as prominent as the latter. The usual dorso-lateral processes resemble those of most other species but are rather short and truncate. The color appears to have been a very coarsely variegated pattern of light and dark brown, with some finely mottled markings of an almost whitish shade laterally and ventrally.

***Nemoria obliqua hennei* (Sperry), new combination**

Plate 14, figures 1, 1a, 1b; plate 45, figures 1, 2.

Racheospila hennei Sperry, 1953, p. 26.

DIAGNOSIS. This form is similar to *obliqua*, especially to topotypical Colorado specimens, but somewhat more intensely green and with the red and pink shades exaggerated. The brown discal spots are characteristic. There also seem to be slight differences in the genitalia, but *hennei* is probably a minor subspecies at best. It is known only from the Sierra Nevadas in Tulare Co. and the Greenhorn Mts., Calif., and from Mt. Charleston, Clark Co., Nev.

TYPES. Holotype male from Smoky Valley, elevation 6300 ft., Tulare Co., Calif., June 15, 1945 (C. Henne), and allotype female, same locality, June 18, 1943, in the AMNH (ex Sperry Collection). There were also 27 male and 14 female paratypes from the same locality, and from Lower Chimney Meadows and Quaking Aspen, Tulare Co., and the Greenhorn Mts. (2 males), Calif., mostly now in the AMNH.

SYNONYMY. None.

FURTHER DESCRIPTION. *Hennei* differs from *obliqua* only in the more intense coloring mentioned above. Discal spots are present on both wings, with that on the forewing being larger and encircled with a paler shade. These are all characters that occur, but less consistently, in *obliqua*.

MALE GENITALIA. Like those of *obliqua* except for one seemingly consistent difference. The distal process on the costa of the valve, instead of being as in *obliqua*, is rounded or truncated.

FEMALE GENITALIA. Similar to those of *obliqua*.

MATERIAL EXAMINED. 17 males, 6 females, including holotype, allotype and some of the paratypes; 4 male, 2 female slides.

DISTRIBUTION. CALIFORNIA: Smoky Valley, 6300', and XYZ Valley, Tulare Co.; Lower Chimney Meadows, Tulare Co.; Quaking Aspen, Tulare Co.; Greenhorn Mountains. NEVADA: Kyle Canyon, 8100', Mt. Charleston, Clark Co. (one male, July 4, 1965, T. W. Davies).

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. June 7–July 4.

EARLY STAGES. Unknown.

REMARKS. At first it was my intention to relegate *hennei* to the synonymy, but after finding the slight difference in the male genitalia, I decided to leave it as a subspecies for the present. But it is not a very well differentiated subspecies, and my decision is an uncertain one.

The range of *hennei* seems far removed from that of *obliqua* however, and is of rather limited extent. *Hennei* is known only from two or three valleys on the southwestern slope of the Sierra Nevada Range, in addition to the single Nevada record.

In some ways Sperry's description of *hennei* is confusing and it would seem that he did not know *obliqua*, or else he would have realized their close relationship. He observed that the male genitalia of *hennei* were closer to those of *obliqua* than to any other species, but stated: "Superficially, this species [*hennei*] seems closest to *glaucomarginaria*"—a species that actually differs in virtually all of the most obvious characters. In his genitalic comparisons, I think Sperry failed to take into account the problem of infraspecific variability, and quite possibly examined only one slide of each.

Group VII. The *splendidaria* group. Two species, superficially very different and not closely related, but grouped together because of genitalic similarity.

Nemoria splendidaria (Grossbeck)

Plate 14, figures 2, 2a, 2b; plate 34, figure 1; plate 45, figures 3-5.

Aplodes splendidaria Grossbeck, 1910, p. 204. Barnes and McDunnough, 1912, pl. 23, fig. 10. *Nemoria splendidaria* Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

DIAGNOSIS. *Splendidaria* is a rare and strikingly distinctive species of Arizona and Mexico, unique in the course of the antemedial line, which is inclined strongly outward from inner margin to costa; that is, it begins at the inner margin near the base and approaches the costal margin beyond the middle. The forewings are a deep, rich green, the hindwings paler; the costa and fringes are pink; the terminal line prominent and deep crimson; the abdomen is green and unmarked; the palpi short in both sexes. The genitalia have some good characters but do not look aberrant. They suggest a position somewhere between the *obliqua* and *bistriaria* groups.

TYPES. The type is a male from Palmerlee [Cochise Co.], Ariz., in the USNM (ex Barnes collection). It was figured by Barnes and McDunnough (1912, pl. 23, fig. 10.). The type is in fairly good condition and intact, except for missing legs, some of which have been glued on. The abdomen had gone greasy so that its original coloring was not apparent. The front has faded to brown and the costa to cream color. The name was based on a single example, which remained for 48 years the only specimen known.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae bipectinate to near the tip in the usual way; the shaft rather slender and the longest branches equal to three times the diameter of the shaft; female antennae very slender, minutely ciliate below; front flat; palpi of

both sexes rather slender, those of the female exceeding the front by about one-third of their length, those of the male by about one-fifth; palpi uniformly rough-scaled; the third palpal segment, moderate in the female and minute in the male, being conical and set among the apical scales of the second segment in such a way as to be difficult to distinguish as a separate segment. In these respects the female palpi are very different from those of such species as *lixaria* and *obliqua*, in which the long third segment is close-scaled and cylindrical. Legs slender; hind tibia of male moderately dilated with its terminal process not very long; hind tarsus two-thirds the length of the tibia.

Antennal shaft above white near the base, shading to reddish distally; interantennal fillet white with a slight pink border behind; this border sometimes all green, as in the type, and the fillet itself sometimes with a sprinkling of green scales; front entirely red; palpi, fore and middle tibiae tinged with rose; hind tibiae also faintly pinkish; tarsi cream colored; coxae and femora green; abdomen entirely green except for the last three segments below and the last two segments above, which are yellowish; thorax green above.

Forewings above deep, intense green, very opaque; costa broadly margined with salmon pink; terminal line prominent, deep crimson, one-third to one-half the width of the fringes; inner half of fringes whitish, outer half pink, not checkered; antemedial and postmedial lines pure white, wide and sharply defined; postmedial rather near the outer margin, almost straight, curving inward slightly near costa; antemedial very peculiar in originating at the inner margin near the base and thence running outward in an even convex curve to a point beyond the middle of the costal margin, actually with the antemedial usually disappearing just before reaching the pink costal border; no discal spots. The green of the hindwings is usually much paler, with the white lines diffuse and not contrasting. The antemedial of the hindwing may be obsolescent but the postmedial is fairly distinct, approximately parallel to the outer margin; the terminal line and fringes are the same as on the forewing. Underneath the wings are quite uniformly green, colored alike, and just slightly paler than the upperside of the forewing; the white lines are diffuse; the costa, terminal line and fringes as above.

Length of forewing; male, 14-16 mm; female, 13.5-16 mm.

MALE GENITALIA. Uncus long, linear, socii rather long and pointed, slightly sclerotized; tooth on gnathos relatively short but pointed; transtilla broad with a deep U-shaped emargination on the anterior side; juxta stout with the papilliform process widened at the base; vinculum with sides evenly rounded inwards toward the saccus, the latter being rather feebly incised; basal costal processes long and sclerotized, flattened, spatulate or lanceolate; valve long, with the concave costa and an elevated median ridge sclerotized; the usual tooth at the distal end of the costa expanded into a large, flattened, chitinous prominence; aedeagus simple, without teeth, the end long, slender, pointed; eighth sternite shallowly incised.

FEMALE GENITALIA. Bursa and ductus bursae membranous; bursa with a long, constricted neck region that ends in a slight, bulbous dilation where the ductus bursae and ductus seminalis enter; preostial part of genital plate similar to that in the *extremaria* group, almost the width of the whole segment but very lightly sclerotized, deeply emarginate opposite the ostium; postostial plate mostly membranous; ostium to some extent ringed by semi-circular striations in the membrane; signum squarish, with a thin transverse ridge of thicker chitin; anterior apophyses unusual in being comparatively thicker and more heavily sclerotized than the posterior apophyses.

MATERIAL EXAMINED. 42 males, 62 females, all Mexican except the type and one other male from Ariz. Slides: 2 male, 2 female.

DISTRIBUTION. ARIZONA: Palmerlee [Cochise Co.], one male (type); Sunnyside, west side Huachuca Mountains, Cochise Co., July 7-17, 1958, one male (T. W. Davies). MEXICO:

Mesa del Huracan, 108° 15' 30" 4', Chihuahua, 7400', July 21-25, 1964, one female (J. E. H. Martin); 10 mi. west of El Salto, Durango, 9000', June 11-July 28, 1964, 40 males, 61 females (J. E. H. Martin, W. C. McGuffin).

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. June 11-July 28.

EARLY STAGES. Unknown.

REMARKS. Except for the peculiar antemedial line, pale hindwing, shorter palpi, and lack of discal spots and abdominal markings, this colorful species resembles *obliqua* more than any other, especially northern *obliqua* from Colo. or "*hennei*" from the Sierra Nevadas. They cannot be considered close relatives, however.

Until 1958, *splendidaria* was known only from the unique type, but in that year Mr. Thomas W. Davies of San Leandro, Calif., took the second known Arizona specimen in the Huachuca Mts. This specimen is in the Los Angeles County Museum and was kindly loaned to me for study. In 1964, a field party of taxonomists from the Entomology Research Institute, Canada Department of Agriculture, collected a superb series of Mexican specimens. This series provided material of the previously unknown female, and made possible what I hope is an adequate characterization of the species. There is no doubt that the Arizona type and this Mexican material represent the same species.

Nemoria strigataria (Grossbeck)

Plate 2, figure 5; plate 14, figures 3, 3a, 3b; plate 34, figure 2; plate 45, figures 6, 7.

Aplodes strigataria Grossbeck, 1910, p. 204. Barnes and McDunnough, 1912, pl. 24, fig. 20.
Nemoria strigataria Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140.

DIAGNOSIS. *Strigataria* is a large, bluish-green species of Ariz. and N.M., rather aberrant looking for a species of *Nemoria* and unlike any other (except for a superficial resemblance to *mutaticolor*—see comments under that species). The wings are heavily striated with white, the lines indistinct, the fringes yellowish, and the abdomen green and unmarked. The male genitalia are very distinctive but still normal for the genus, with the socii pointed and basal costal processes flattened and tapering like those of *splendidaria*. The female genitalia are close to those of *splendidaria*, with the same type of genital plate, but with the postostial portion of the plate, as well as the ductus bursae, a little more sclerotized.

TYPES. Grossbeck had seven specimens of this species which he labeled as male type, female type and cotypes (one male and 4 female). No holotype was specified, so I hereby designate the male type from Redington, Ariz., now in the USNM (ex Barnes Collection) as lectotype. This is the specimen that was figured by Barnes and McDunnough in the "Contributions," Vol. 1(4), pl. 24, fig. 20. The lectotype is a somewhat rubbed specimen but it is complete and easily identified. The female type was from "Huachuca Mts., Arizona, July," and the cotypes from the Huachuca Mts. and "South Arizona, July 15-30." The female type and one male cotype are in the AMNH (ex Grossbeck Collection). Three of the remaining cotypes are in the USNM, and the present location of the other, stated to be a "female from Mr. Frank Haimbach and in his collection," is uncertain, although it may now be at the Carnegie Museum, Pittsburgh.

FURTHER DESCRIPTION. Male antennae normal, the longest branches about two and one half times the diameter of the shaft; female antennae normal, slender, ciliate beneath; front flat; male palpi small with an inconspicuous, conical third segment, barely exceeding front; female palpi longer, the second segment, ending at the front, and the third segment, when fully exposed, almost half the length of the second and cylindrical; legs typical of *Nemoria*; hind tibia of male moderately swollen, with a terminal process about one quarter the length of the tarsus; hind tarsus slightly less than one half the total length of the tibia.

White interantennal fillet entirely green behind; antennal shaft white only near the base, then becoming yellowish, and, towards the end, reddish; front and third palpal joint rust red; second palpal joint with a sprinkling of red scales; front tibia pale rusty red with an oblique whitish bar across the middle; front tarsus and middle leg also slightly tinged with the same reddish color; hind leg and underside of body whitish; thorax and abdomen entirely green dorsally, except for white caudal tufts on segment 8.

Fore- and hindwings colored alike, bluish green, heavily and evenly striated with white; antemedial lines virtually lacking; postmedials vague, thin, finely dentate, white followed by a hardly contrasting inner shade of solid green, approximately parallel to outer margins; veins in outer third sometimes thinly outlined with white; faint green discal spots sometimes discernible; costa thinly edged with yellowish, often pinkish toward the apex; fringes yellow, usually with a few light pink rays opposite the veins near the apex of the forewing and toward the middle on the hindwing; no terminal line. Underside as above but much paler, especially the hindwing.

Length of forewing: males, 12-15.5 mm; females, 15-18 mm.

MALE GENITALIA. Distinctive in several respects, especially in the form of the valve, the basal costal processes and the socii. Uncus linear, not dilated; socii long and tapering, somewhat like those of *splendidaria*; gnathos tooth rather stout; valve broadened at the base, with an enlarged sacculus; tooth at distal end of costa in the form of a rounded hump; vinculum also disproportionately enlarged, as if to accommodate the large sacculus; sacculus with coremata just a little less prominent than those of *obliqua*; succus with a small excavation as in *splendidaria*; basal costal processes flattened, long, slender and tapering, united with the costa near base, subequal in length to the uncus, most similar to those of *splendidaria*; aedeagus with an acuminate sclerotized tip like that of many other species, no special features; eighth sternite with only a shallow depression on its posterior margin.

FEMALE GENITALIA. Bursa copulatrix elongated and tapering to a constricted area two-thirds of the way towards the posterior end, then dilating again into a zone of slightly thickened, striated membrane toward the end where the ductus enters; ductus bursae slightly sclerotized, entering end of bursa off to one side; preostial fold crescentic, lightly sclerotized, like that of *splendidaria* but more strongly decurved; postostial part of genital plate slightly sclerotized; ostium partly ringed with striated membrane; signum a very small, arcuate, invaginated ridge of chitin.

MATERIAL EXAMINED. 68 males, including type, 66 females; 3 male, 1 female slides.

DISTRIBUTION. ARIZONA: Redington; Palmerlee; Sierra Vista, Ramsey Canyon, Miller Canyon and Carr Canyon, Huachuca Mountains; Todd's Lodge, Oak Creek Canyon, Coconino Co.; S.W. Research Station of the AMNH, 5400', Cave Creek Canyon, 5400', and East Turkey Creek, 6400', Chiricahua Mountains, Cochise Co.; Madera Canyon, 4880' and 5800', Santa Rita Mountains, Santa Cruz Co. NEW MEXICO: Cherry Creek Camp, 13 mi. N. of Silver City, Grant Co.; MacMillan Camp, 14 mi. N. of Silver City, Grant Co.

GEOGRAPHICAL VARIATION. None apparent in the material examined.

FLIGHT PERIOD. June 13–July 22.

EARLY STAGES. Unknown.

REMARKS. *Strigataria* stands very much by itself and it has been a problem deciding where it should go in the sequence of species. Although the male genitalia look somewhat unusual, they have the basic characters of long socii, papilliform juxta and incised saccus that undoubtedly associate them with the major assemblage of *Nemoria* species. The female genitalia are not in the least unusual but rather nondescript, extremely close to those of the *extremaria* group. Genitalic characters suggest more in common with *obliqua* and *splendidaria* than any others, but in appearance the moth looks as though it should have no connection with either of those species. It might have been derived from something close to the ancestral stock of *splendidaria* and *obliqua* but is now far removed.

Group VIII. The *bistriaria* group. The largest segment of the genus, including 12 species with many close superficial and structural similarities.

Nemoria zygotaria (Hulst)

Plate 14, figures 4, 4a, 4b; plate 34, figure 3; plate 45, figures 8, 9.

Aplodes zygotaria Hulst, 1886a, p. 121.

Anaplodes zygotaria Hulst, 1896, p. 316. Dyar, 1902 [1903], p. 302.

Nemoria zygotaria Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140.

DIAGNOSIS. This is a small to medium-sized species known only from South Central Texas, readily distinguished by its exaggerated green coloring. In pattern and structure *zygotaria* is clearly one of the *bistriaria* group, but it is an unusually deep shade of green, including almost the entire body and the fringes. The white costa and thin lines of the wings are normal and about the same as in *mimosaria*; the abdomen is unmarked; only the front is not green but pale brown. *Zygotaria* seems to be the only *Nemoria* in the region covered that has solid green fringes, concolorous with the wings and never marked with red. The male genitalia are quite close to those of *bistriaria* and others, but the basal process of the costa is distinctive

TYPES. *Zygotaria* was described from one male and six females from "Texas. Coll. Graef, Hulst," without further data. I hereby designate as lectotype the male type in the AMNH. This is a fairly good specimen and there is virtually no doubt that it represents the species to which the name is herein applied. One of the females of the type series, which I am labeling as a paralectotype, is in the USNM, but the location of the others is unknown.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae with length of longest branches about twice the diameter of the shaft; female antennae ciliate in the usual way; male palpi rather small, exceeding front by about the length of the third segment which is half the length of the second; female palpi similar, scarcely differing from those of the male; structure of the legs similar to that of other species of the *bistriaria* group.

Interantennal fillet white, bordered by green behind; scales of antennae white; front light brown; palpi white, tinged with green which gives way to brownish distally; legs pale green to whitish; body pale green beneath, entirely deep green above, without markings on abdomen.

Wings a deep, uniform pea green, with a suggestion of weak, white striation which in some specimens does not show; fringes almost solid green, exactly the same color as the wings, with just the tips of a few white scales showing along the outer edge; lines white, very thin, distinct in fresh specimens but soon lost in worn ones; postmedial of forewing almost straight, parallel to outer margin, bending inward slightly near costa; postmedial of hindwing curved, traversing wing just beyond the middle, sometimes noticeably bent at vein Cu_1 ; antemedial of forewing rather evenly convex, that of hindwing curving in abruptly towards inner margin; no discal spots. Underside as above but much paler inwardly and the lines vague.

Length of forewing: male, 11-12.5 mm; female, 11.5-14 mm.

MALE GENITALIA. Uncus linear, slightly flattened and widened at the end; socii quite long, tapering, mostly membranous, gnathos stoutly toothed; transtilla a straight band, with a rolled anterior edge; lateral components of the anellus uniting with the transtilla at right angles, leaving a large square opening through which the aedeagus passes; juxta rather compact and stout; sides of the vinculum converge to a somewhat reduced saccus which has a semicircular excavation; valve with a concave costa, ending in a prominent bluntly pointed tooth which is produced outwardly just as far as the membranous half of the valve. As mounted on a slide, the costa is almost entirely concealed beneath the sharp, elevated, sclerotized median ridge of the valve. No coremata are apparent. The aedeagus is quite long, swollen at the middle, and, off to one side, subdorsally or laterally near the middle, there is a longitudinal raised ridge bearing a row of 8 to 10 small, sharp teeth. The eighth sternite is moderately incised with an obtuse, V-shaped excavation.

FEMALE GENITALIA. These are distinguished by a rather large, moderately sclerotized preostial fold, strongly decurved in the middle (arcuate). Ventrally, beneath the fold, the ostial opening is partially encircled by a sclerotized band. Otherwise the female genitalia are like others of the *bistriaria* group.

MATERIAL EXAMINED. 18 males, 27 females, including the lectotype male and paralectotype female mentioned. Slides: 3 male, 3 female.

DISTRIBUTION. TEXAS: Blanco Co.; Kerrville State Park and Kerrville, Kerr Co.; Boerne, Kendall Co.; San Antonio, Bexar Co.; Garner State Park, Uvalde Co.; Sinton and Welder Wildlife Foundation, San Patricio Co.; San Diego, Duval Co.; San Benito and Brownsville, Cameron Co.; Jack Springs; Shovel Mt.; Del Rio [Val Verde Co.].

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. Feb. 20 (Brownsville); Mar. 10 (Uvalde Co.) Apr. 9-May 23; June 6; July 1-21; Sept. 4, 9; Oct. 17-28; Nov. 24.

EARLY STAGES. Unknown.

REMARKS. Although relatively little material is available from Texas, *zygotaria* has turned up consistently in collections from the south central part of the state, indicating that it is not uncommon there.

Nemoria leptalea, new name

Plate 15, figures 1, 1a, 1b; plate 34, figure 4; plate 45, figures 10-11.

Anaploides delicataria Dyar, 1908c, p. 57.

Nemoria delicataria Prout, 1912, p. 112. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140. Comstock, 1945, pp. 20-21, pls. 9-10 (early stages). Comstock, 1960, pp. 424-426, figs. 1-3 (early stages). **Homonym.**

DIAGNOSIS. Previously well known to Californian lepidopterists as *Nemoria delicataria*, this medium sized to quite large Pacific coast species ranges from the region of San Francisco Bay to Baja California. The wings are slightly striated with white, the fringes uniformly pink with a pale line at the base, like those of *rubrifrontaria*, the discal spots, if present, are green, not brown or red, the front, palpi and hind margin of the fillet are bright pink, and the abdomen above is green and nearly always unmarked. *Nemoria pistacearia* of the same region is more heavily striated, often has red or brown discal spots, has much less pink in the fringes, and *does not* have a pink hind margin on the vertex. *Punctularia* is at once distinguished by the prominent red and white markings on the abdomen. The male genitalia are very close to those of related species but show a combination of characters in the costal processes of the valve, the arrangement of teeth on the aedeagus, and the notches in the saccus and eighth sternite that readily distinguishes them.

TYPES. *Delicataria* was described from "Two males, one female, San Diego, Cal [ifornia], July 23, 29, October 9 (G. H. Field)." I hereby designate the specimen taken July 29 (labeled "7-29" and "Type No. 11703, USNM") as type both of the preoccupied name *delicataria* Dyar and of the replacement name *leptalea*. It is a male in the USNM. I have not found the remaining two specimens of Dyar's type series.

SYNONYMY. With the synonymizing of *Nemoria*, *Anaploides* and *Racheospila*, *delicataria* Dyar, 1908 becomes a junior secondary homonym of *Nemoria delicataria* Moeschler, 1881, Verh. Zool.-bot. Ges. Wien, vol. 31, p. 402, pl. 17 fig. 9, from Paramaribo, Surinam. Prout (1912, p. 105) included *delicataria* Moeschler in his *diarita* group of *Racheospila*. The generic name *Lissochlora* Warren is available for this group but Prout placed it within his concept of *Racheospila* in such a way that it seems fairly certain to fall, like most of *Racheospila*, to *Nemoria*.

FURTHER DESCRIPTION. Male and female antennae normal; length of longest branches in male equal to twice the diameter of the shaft; male palpi moderate, exceeding front by about half the length of the second segment; third segment short, rounded, only one quarter the length of the second; female palpi long, exceeding front by almost half their total length; third segment cylindrical, almost as long as the second; legs normal for the group; scales of antennae white, becoming reddish distally; interantennal fillet white with a variable, often slight, pink border behind; front, palpi and fore tibiae bright rose; fore tarsi and middle tibiae also tinged with pink but legs otherwise cream colored; body whitish beneath, green above as far back as the caudal tufts, which are whitish; abdomen normally without dorsal spots, but a single male from San Diego with red abdominal spots without white centers on segments 3 to 6. Wings above bright green of a fairly intense shade, not bluish, slightly striated with white; lines white, thin but quite distinct, especially the postmedials; antemedial of forewing sinuous, convex, of hindwing even, curved inward strongly towards inner margin; postmedian of forewing straight or slightly concave, of hindwing almost straight from costa to Cu, then bent towards inner margin; costa cream colored or whitish with a slight tinge of pink at base and apex; fringes uniformly light pink outwardly, white at their base; discal spots, if present, weak and marked by a darker shade of green, never red or brown. Underside as above but much paler.

Length of forewing: males, 12-16 mm; females, 13.5-16.5 mm.

MALE GENITALIA. Uncus thin, mostly linear, flattened and truncate at the end; socii large and delicate, rounded; gnathos elongated, with a thin but fairly long hook at the end; transtilla a straight band, uniting with the lateral elements of the anellus in such a way as to form a large squarish opening for the aedeagus, much as in *zygotaria*; juxta rather heavy with the papilliform process short and stout; arms of the vinculum almost straight, converging gradually towards the deeply incised saccus; valves broad, almost rectangular, the costa only slightly concave; median ridge of valve, unlike that of *zygotaria*, low and not concealing the costa; basal costal process strongly sclerotized and acutely pointed, but rather short; distal costal process moderately prominent but rounded, with the membranous outer lobe of the valve continuing beyond it; aedeagus rather short, swollen in the middle, the distal end blunt, and with a longitudinal row of small teeth extending along the left side from the middle to near the tip; eighth sternite with a very large, deep, U-shaped excavation dividing the hind margin into two prominent rounded lobes.

FEMALE GENITALIA. Ductus bursae broadly dilated in funnel-like fashion toward the ostium and extensively sclerotized; ostium consequently very large; preostial part of genital plate seemingly incorporated into the funnel-like structure; postostial part of genital plate obsolete; signum an invaginated half circle of chitin.

MATERIAL EXAMINED. 99 males, 25 females; 8 male, 4 female slides; 6 last instar larvae in alcohol.

DISTRIBUTION. CALIFORNIA: Mt. St. Helena, Napa Co.; Petaluma, Sonoma Co.; Mill Valley, Marin Co.; Oakland, Berkeley and San Leandro, Alameda Co.; San Francisco and San Mateo, San Mateo Co.; Palo Alto and Los Gatos, Santa Clara Co.; Santa Barbara and Carpinteria, Santa Barbara Co.; Los Angeles, Newhall, Burbank, Beverley Terrace, Glendale, Claremont and Glendora, Los Angeles Co.; Avalon, Santa Catalina Island, Los Angeles Co.; San Clemente, Orange Co.; Rancho la Sierra and Arlington, Riverside Co.; Del Mar, San Diego and La Mesa, San Diego Co.; Roscoe; Hayward; Castro Valley; Griffith Park Observatory. MEXICO: near Ensenada, Baja California.

GEOGRAPHICAL VARIATION. No apparent geographical trends, although this species seems to be quite variable in size everywhere.

FLIGHT PERIOD. Appears to extend over the whole year with records quite evenly distributed throughout all twelve months.

EARLY STAGES. The egg, larva and pupa have been described and figured by Comstock (1945, pp. 20-21, pls. 9-10; 1960, pp. 424-426, figs. 1-3). Judging from the preserved larvae, *leptalea* seems to have a smoother integument than the eastern species examined, and the lateral protuberances on abdominal segments 2-4 are uniform in length like those of *mimosaria* but more slender and more obviously notched at the tips. Comstock mentions that a mature larva was collected on *Eriogonum fasciculatum* var. *foliolosum* (Nuttall) Stokes, and that the brood he reared was fed *Photinia arbutifolia* Lindley.

Nemoria caerulescens Prout

Plate 15, figures 2, 2a, 2b; plate 34, figure 5; plate 45, figures 12-16.

Nemoria caerulescens Prout, 1912, p. 113. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

Nemoria albilineata Cassino, 1927, pp. 69-70 (partim).

DIAGNOSIS. This is a rather small to average sized, white striated, blue-green species, typically with wide white lines, of which the postmedial of the forewing is often feebly S-shaped (convex near costa, concave below). The hindwing is a little paler than the forewing, the fringes white, tipped with pale pink in fresh specimens, the body green above and below, the legs pink, the dorsal abdominal spots small and pure white, or encircled with a few luteous scales only—no reddish shading on the abdomen. The genitalia are like those of *intensaria*. *Caerulescens* occurs in N.M., extreme western Texas, the Chiricahua Mts., Ariz., and has just recently been taken in Colo.

TYPES. The type of *caerulescens* is a male in the BM from "La Cueva, at about 5300 ft., Organ Mountains, N.M., 31st August (coll. Townsend)". It is a monotype and was figured by Prout (1932, pl. 3b).

SYNONYMY. The type material of *Nemoria albilineata* Cassino consists of three species, and two of the male paratypes from Alpine, Texas (both in the CNC) appear to be *caerulescens*. I confirmed this with a genitalia slide of one of them but the other has lost its abdomen.

FURTHER DESCRIPTION. Antennae of both sexes typical of the group. Palpi of male rather short, exceeding front by the length of the small, rounded third segment only; second segment three or four times as long as third; female palpi only slightly longer than those of the male; structure of the legs normal for the group.

Scales of antennae luteous, becoming slightly reddish distally; white fillet with just a few luteous or occasionally pinkish scales behind; front pale dull red to brownish; palpi and legs pale red; thorax and abdomen green above and below; abdominal segments 1, 3, 4 and 5 with small white dorsal spots encircled by a few luteous scales; no red markings on abdomen.

Wings green, often but not always of a slightly bluish shade, finely striated with white; hindwings slightly paler than forewings; the white lines of the forewings wide and prominent (usually wider than the fringe), those of the hindwings equally wide but less contrasting; antemedial of forewing straight or slightly sinuous, almost erect, meeting inner margin at or near the middle; antemedial of hindwing strongly convex and nearer the base, postmedial of forewing usually concave between inner margin and M_2 and convex from there to costa, resulting in a slightly S-shaped curve, although it may be almost straight; postmedial of hindwing also nearly straight but flexed outward slightly near inner margin; costa pale luteous or tinged with pink; fringes white or tinged with pale pinkish on outer half; no discal spots. Under-side as above but somewhat paler; the lines less contrasting.

Length of forewing: males, 11-13 mm; females, 11-13 mm.

MALE GENITALIA. These apparently are indistinguishable from the male genitalia of *intensaria* and differ in only a few minor respects from those of *festaria* (see discussion under the latter species). The genitalia of *caerulescens* are also quite close to those of *leptalea* except that the basal costal processes of the valves are considerably longer, the costa much more concave, and the median ridge of the valve more prominent. I found some characters, such as the form of the transtilla and the juxta, and also to some extent the length of the costal processes, so variable that they must be regarded with caution in separating the closely related species of this group.

FEMALE GENITALIA. The ductus bursae is funnel-shaped, with a very large ostial opening almost exactly as in *leptalea* and *festaria* but less heavily sclerotized. In *caerulescens* and *intensaria* these structures appear almost exactly the same.

MATERIAL EXAMINED. 26 males, 14 females, and a colored photograph of the type; 6 male, 3 female slides.

DISTRIBUTION. TEXAS: Alpine, Brewster Co.; Pine Canyon, 5000', Guadalupe Mts., Culberson Co. NEW MEXICO: La Cueva, at about 5300', and Horseshoe Springs Camp, 2 mi. W. of La Cueva, 7900', Sandoval Co.; Jemez Springs, Jemez Mts., 6400'; White City, Eddy Co. ARIZONA: S.W. Research Station of American Museum of Natural History, 5400', Portal, Cochise Co. COLORADO: Estes Park, 7800', Larimer Co.

GEOGRAPHICAL VARIATION. Here again, as in *festaria* and probably many other species, two kinds of variation may be involved—geographical and seasonal—and because of the paucity of material, these are difficult to separate. All of the typical broad-banded form that I have seen are summer specimens. Five specimens taken at White City, N.M. on May 14, 1950 (E. C. Johnston, in CNC) are close to normal except that the white lines are distinctly narrower. A single summer female from the S.W. Research Station of the AMNH, near Portal, Ariz., July 11, 1958, is still fairly normal, although the lines are somewhat narrowed and the hindwings are as dark as the forewings. Four others from the same locality and two from the Chiricahua Monument, Cochise Co. are less normal in several respects; the color is a deeper green, without the bluish tint; the lines, although still well defined, tend to become quite narrow; the hindwings are fully as dark as the forewings and, most disconcerting of all, they show all stages in development of a red terminal line as well as weak reddish checkering of the fringes. These specimens look as though they were bridging the gap between *caerulescens* and *festaria*, but certain basic characters such as the coloring of the abdomen, color of the underside, and genitalia tend to remain as in *caerulescens*. The two specimens from the Chiricahua Monument (June 14, 1950, E. C. Johnston, in CNC) show the greatest departure in the development of very thin lines, larger abdominal spots and paler undersurface, but they show only the barest traces of red marginal scaling that mark the beginning of a terminal line. The four specimens from the S.W. Research Station (Apr. 28, May 12, June 8, June 10, in AMNH) look more richly colored than those from the Chiricahua Monument, have somewhat wider lines, and show the full development of a terminal line. The female taken Apr. 28 has a quite complete terminal line as in *festaria*, and the male taken May 12 shows it somewhat less so. The two June specimens show no sign of a terminal line.

I am not at all confident that these six Arizona specimens are *caerulescens*, nor that even they are all the same species, but there is no better place to put them for the present. At first I expected to find intergradation between *caerulescens* and *intensaria*, but at least on the basis of the material available, such is not the case.

FLIGHT PERIOD. "Mar. 1-15" (Alpine, Texas); May 9-30; June 24; July 11, 28, 29; Aug. 2. Taken in Sandoval Co., N.M., in May, June, July and Aug.; at White City, Eddy Co., N.M. on May 14, 1950 (5 specimens taken by E. C. Johnston); in the Guadalupe Mts., Aug. 28, 1967 (AMNH); in Colo., July 21, 1967 (AMNH).

EARLY STAGES. Unknown.

Nemoria intensaria (Pearsall)

Plate 15, figures 3, 3a, 3b; plate 34, figures 6, 7; plate 45, figures 17-19.

Aplodes intensaria Pearsall, 1911b, p. 251.

Nemoria intensaria Prout, 1912, p. 113. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 24. McDunnough, 1938, p. 141.

DIAGNOSIS. This is a deep green species somewhat resembling *obliqua*, with the body green above and below in the same way, and with similar abdominal markings.

However, *intensaria* may be distinguished from *obliqua* by the following characters: 1) female palpi much shorter, the third segment only about one quarter the length of the second, 2) no red terminal line, 3) legs all tinged with red, 4) hindwings often noticeably paler than forewings, and 5) size smaller than *obliqua*. The genitalia of both sexes appear to be the same as those of *caerulescens*, and not very different from those of *festaria*. *Intensaria* occurs in N.M., Ariz., Utah, Nev., and Calif.

TYPES. Pearsall stated that his types were a male and female taken by Spalding at Eureka, Utah on May 9, 1910 and May 13, 1910 respectively, although on the specimens in the AMNH these dates are reversed, the male being labeled May 13. There were 2 male cotypes from the same locality, also now in the AMNH. I hereby designate as lectotype the male type taken May 13, 1910.

SYNONYMY. None.

FURTHER DESCRIPTION. Structurally the same as *caerulescens*. Scales of antennae white near the base, becoming brownish or reddish distally; white fillet sometimes mixed with luteous scales and apparently always with a slight margin of luteous or red scales behind; front, palpi and legs pale, dull reddish to deep rose; front with or without a whitish lower border; body bright green above and below; whitish dorsal spots thinly encircled with red on abdominal segments 1, 3 and 4.

Wings above deep green, about as in *obliqua*, but finely striated and paler in some populations; hindwings slightly paler than forewings, especially towards costa (*obliqua* being essentially unstriated with its fore and hindwings colored alike). White lines as in *caerulescens* but thinner and usually straighter; no terminal line; no discal spots; costa luteous to reddish; if pale, tinged with red near base and apex; fringes white at the base, pink outwardly, with the pale basal line interrupted by diffuse pink rays opposite the veins. Underside unusually green with the white lines diffuse, again like *obliqua*.

Length of forewing: males, 12-14 mm; females, 11.5-14 mm.

MALE GENITALIA. Like those of *caerulescens*.

FEMALE GENITALIA. Like those of *caerulescens*.

MATERIAL EXAMINED. 27 males, 39 females; 4 male, 4 female slides; 1 preserved larva.

DISTRIBUTION. NEW MEXICO: Jemez Mountains, 6400'; Fort Wingate; Horseshoe Springs Camp, 7900', 2 mi. W. of La Cueva, Sandoval Co. ARIZONA: Southwestern Research Station of American Museum of Natural History, Portal, Cochise Co.; Paradise; North Rim; Walnut Canyon, 6500', 6 $\frac{1}{3}$ mi. EESE of Flagstaff, Coconino Co. UTAH: Eureka; Beaver Valley; Dividend. NEVADA: Lee Canyon, 7400', 39 mi. N.W. of Las Vegas, Clark Co.; Kyle Canyon, Mt. Charleston, Clark Co. CALIFORNIA: Argus Mountains; Smoky Valley, Tulare Co., 6200'; Ravendale, Lassen Co.; Mtn. Pass Sta., Mescal Range, San Bernardino Co.; Keystone Canyon, 5500', New York Mts., San Bernardino Co.; Wrightwood, 6100', San Gabriel Mountains.

GEOGRAPHICAL VARIATION. *Nemoria intensaria* seems quite uniform through Ariz. and Utah, but specimens from Wrightwood on the eastern slope of the San Gabriel Mts., Calif., May 10 and Aug. 4, 1964 (C. A. Hill), show a tendency toward obsolescence of the lines. The antemedial of the forewing is completely lacking and the postmedial partly so, although most other characters, including the intense green coloring, remain unchanged. Three males from Smoky Valley, Tulare Co., Calif., June 10, 1945, and June 12, 1944, also have weak lines but are unusually large and pale. The single male

from Lassen Co., Calif., resembles the Tulare Co. specimens but is very small. Specimens from the Argus Mts., New York Mts., and Mescal Range, Calif., and Clark Co., Nev., are more normal, except that in the Nevada specimens there is a distinct tendency for the hindwings to be paler. Elsewhere it is usual for most of the hindwing to be almost as intensely colored as the forewing.

FLIGHT PERIOD. Apr. 26–Sept. 5 with no apparent break, and there is not enough material from any one locality to give a clear indication of broods. There are nine specimens from Mt. Charleston, Nev., taken Apr. 26, 1950 (E. C. Johnston), and 5 from Lee Canyon in the same region taken July 24 to 29, 1966 (F. H. Rindge). Dr. Franclemont collected 8 in Walnut Canyon between Aug. 6 and 25, 1964; 10 specimens from Portal, Ariz., were taken Apr. 28, May 12, 24, 25 and 27, June 1 and 8, July 8 and 11, and Aug. 21. Two females from San Bernardino Co., Calif., were taken Aug. 30 and Sept. 5; specimens from the New York Mts. were taken Aug. 24 and Sept. 3; those from Smoky Valley, Tulare Co., June 10 and 12; the one from Ravendale, Lassen Co., Aug. 23, 1941 (W. D. Dyer).

EARLY STAGES. *Intensaria* was reared by Dr. Franclemont and Mr. R. W. Poole from a female taken in Walnut Canyon, near Flagstaff, Ariz., in 1965. The larvae fed on *Rhus trilobata*. A single preserved specimen resembles the larva of *obliqua* but has a smoother, less tuberculate integument, perhaps slightly longer dorso-lateral processes, and a much more evenly light brown, less variegated coloring.

Nemoria festaria (Hulst)

Plate 15, figures 4, 4a, 4b; plate 35, figure 1; plate 45, figures 20-21

Anaploides festaria Hulst, 1886a, p. 121. Hulst, 1896, p. 316.

Anaploides arizonaria Dyar, 1902 [1903], p. 302 (partim).

Nemoria festaria Prout, 1912, p. 112.

Racheospila festaria Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 26. McDunnough, 1938, p. 140.

Nemoria albilineata Cassino, 1927, pp. 69-70 (partim).

DIAGNOSIS. The concept of *festaria* here presented is still somewhat unsatisfactory in that it includes some unusual variation in size and in the amount of pink coloring in the fringes. Since the largest specimens mostly have spring dates in March and April, I have guessed that this variation is seasonal, although there are a few inconsistencies. The variation seems to be continuous, without a noticeable break anywhere between extremes to suggest that different species are involved, nor are any structural differences apparent between them. Well marked seasonal variation is already known in other species of *Nemoria* (e.g., *daedalea*, *bistriaria*, *biflata*).

The variation in *festaria* is from average *Nemoria* size to quite large, with the fore- and hindwings concolorous, of the usual green with characteristic fine white striation; the lines are narrow and not very prominent, the fringes whitish, variably checkered with pink, the red terminal line always present, the abdomen whitish ventrally (not green as in *caerulescens* and *intensaria*), with a row of pale spots on the dorsum surrounded by reddish, and usually including a spot on segment 2. The red shading on the abdomen may be minimal or may extend over the entire dorsal surface. The female palpi are much longer than those of the male, exceeding front by a distance about equal to the length of the second segment. The front is red or pink, with or without pale markings. The white fillet has a thin red or yellowish hind border, and the palpi and front legs are tinged with reddish. The wings are much paler beneath (unlike *intensaria* and *caerulescens* in which the underside is quite green).

Festaria occurs in Ariz. and N.M.

TYPES. *Festaria* was described from one male and five females, from "Cal. Ariz. Coll. Hy. Edwards, Neumoegen, Hulst." Of these I have found only the male, labeled "Col. B. Neumoegen," and "Coll. Brklyn. Mus." It is in the USNM. There is no locality label, and the specimen must be assumed to have come from Ariz. since the species is not known to occur in Calif. This type is in good condition except that the end of the abdomen, including the genitalia, is gone. The two abdominal spots nearest the base are visible. There is a thin red terminal line, slightly interrupted at the veins, and the fringes are ivory colored, faintly checkered with red opposite the vein endings. The size stated by Hulst, "Expands 30 mm.", is misleading because this appears to have been the length of the forewing doubled, based on his largest specimen. The type male in the USNM, which I hereby designate as the lectotype, agrees perfectly with the usual summer form as represented by a long series in the Franclemont collection from Madera Canyon, Santa Rita Mts., Ariz.

I have noted that Pearsall, 1911b, p. 252, in connection with his description of *N. intensaria*, wrote: "The type of *festaria* Hulst is in the Am. Musum of Nat. History, N.Y. City." He may have been referring to one of the female syntypes, although there seems to be no such specimen in that collection now.

SYNONYMY. Four of the paratypes of *Nemoria albilineata* Cassino are *festaria*. These were from McNary and the Baboquivari Mts., Ariz.

FURTHER DESCRIPTION. Male and female antennae and legs normal for the group; male palpi about as in *caerulescens* and *intensaria*; the female palpi slightly longer and usually with a distinctly cylindrical third segment about half as long as the second. Antennal scales white near the base, changing to reddish distally; interantennal fillet white with a thin, variable reddish hind margin, sometimes reduced to a few orange or luteous scales; front dull red with a white lower border and usually with whitish spots in the upper corners; palpi rose colored, the third segment white-tipped; front legs reddish, remaining legs cream-colored; underside of thorax and front coxae with some green scaling but otherwise with the underside of the body nearly always whitish. Occasional specimens do have some green on the underside of the abdomen. Upperside of thorax green; upperside of abdomen green with an almost complete mid-dorsal row of cream colored spots, surrounded by variable amounts of rather dull red shading. The spot on segment 2 may be reduced but is nearly always present

Upperside of wings green, paler than *intensaria* and not as blue as *caerulescens*, about the same as *glaucomarginaria* and finely striated with white in the same way. Lines white but very thin, often no wider than the red terminal line; antemedials vague, on the forewing sinuous and slightly convex, on the hindwing strongly convex and nearer the base; postmedial of forewing regular, straight or very slightly concave, not or but scarcely bending in at costa; postmedial of hindwing quite regular and slightly curved, less so than outer margin, not or but slightly flexed outward near inner margin; no discal spots; a distinct, bright red terminal line, thin and slightly interrupted at the veins, always present and characteristic of *festaria*; costa cream colored, very lightly flushed with reddish near base and apex; fringes ivory or cream colored, not usually white, with or without reddish rays opposite the veins and pink outer edging. Most specimens have fringes halfway between the two extremes. Undersurface of wings much paler than above, with the antemedials obsolete and the postmedials indistinct; costa beneath usually not flushed with red near the base but entirely whitish.

Length of forewing: spring brood males, 12-14.5 mm; spring brood females, 14-15 mm; summer males, 10.5-12.5 mm; summer females, 11-14 mm.

MALE GENITALIA. Very close to those of *caerulescens* and *intensaria*, from which they seem to differ in the following ways: 1) valve wider and with its raised, sclerotized median ridge not overlapping the costa if the valves are well spread out when mounted, 2) costa with a raised, serrated margin near the base, 3) basal costal

process tending to be distinctly longer in *festaria*, and 4) distal costal process wider. The male genitalia of *festaria* and *albilineata* appear to be the same.

FEMALE GENITALIA. These also appear to be the same as in *albilineata*, but differ from those of *caerulescens* and *intensaria* in having the area around the ostial opening more heavily sclerotized, with more prominent ridges and striations in the chitin.

MATERIAL EXAMINED. 136 males, 117 females; 6 male, 3 female slides; 4 preserved larvae.

DISTRIBUTION. ARIZONA: Prescott and Mayer, Yavapai Co.; Walnut Canyon, 6500', near Flagstaff, Coconino Co.; Phoenix; Miami and near Pine, Gila Co.; McNary, Apache Co.; Oracle, Pinal Co.; Baboquivari Mts. and Sabino Basin, Santa Catalina Mts., Pima Co.; Madera Canyon, 4880', and Peña Blanca, 3950', Santa Cruz Co.; Sierra Vista, Ramsey Canyon, Carr Canyon and Miller Canyon, Huachuca Mts., Cochise Co.; Paradise, Hereford, Cave Creek Canyon (Portal), Guadalupe Canyon, 4200', Chiricahua National Monument, and S.W. Research Station of the AMNH (near Portal), Cochise Co.; Washington Mountains. NEW MEXICO: 13 mi. N. of Silver City, Grant Co.

GEOGRAPHICAL VARIATION. The supposed spring form, which is larger, has very pink fringes and the abdomen very extensively shaded with reddish on the dorsum, is known from only a few localities. However, this may indicate a shortage of early season material in collections rather than the existence of geographic differences. Of this large spring form there are several from Mayer, Yavapai Co., and single specimens from Miami, Gila Co. and near Portal, Cochise Co. All were taken between Mar. 25 and May 4. Dr. J. G. Franclemont, collecting at Madera Canyon in 1959, 1960 and 1963, took series of at least two broods of *festaria* in the periods May 23–June 3, and July 2–Sept. 1, and these all look alike. The few specimens in the AMNH from N.M. are normal summer specimens and look just like those from Madera Canyon.

FLIGHT PERIOD. Probably because the flight times of the broods in different localities overlap, the dates appear to represent a continuous flight period from about Mar. 22 to Sept. 8. It is more likely that separate spring and summer generations would be recognizable in a given locality, and this is indicated wherever there is enough material from one place. For the early spring brood, which may usually be distinguished by its appearance, the dates are Mar. 22–May 4. Over 60 specimens from Madera Canyon fall into two later periods which are probably separate summer broods, May 23–June 3, and July 2–Sept. 1.

EARLY STAGES. *Festaria* was reared by Mr. R. W. Poole in 1965 from a female collected in Madera Canyon at 4880'. The larvae fed on *Quercus gambelii*, but the dwarfed condition of 2 reared adults suggests that this was not the right host. Several preserved larvae from this brood appear basically similar in structure and coloring to well known eastern species such as *lixaria*, *bistriaria* and *mimosaria*, but the dorsolateral processes of abdominal segments 2, 3, and 4 are unusually long, projecting outward and forward, and are tapered to points rather than truncate.

REMARKS. Since it is one of a group of closely related species, *festaria* has been rather difficult to understand and to define. There even are specimens, further discussed under *caerulescens*, that have the appearance of being intermediate between that species and *festaria*, showing the development of a red terminal line. Otherwise these specimens retain most of the basic characters of *caerulescens* or *intensaria*, rather than of *festaria*.

Nemoria albilineata Cassino

Plate 16, figures 1, 1a, 1b, 2, 2a, 2b; plate 45, figures 22, 23.

Nemoria albilineata Cassino, 1927, pp. 69-70. Prout, 1932, p. 23. McDunnough, 1938, p. 140.

DIAGNOSIS. This form, from the region of the Davis Mts. and Big Bend National Park, Texas, is very closely related to *festaria* but differs in having completely lost the red terminal line. The genitalia of both sexes seem to be exactly like those of *festaria*, and although I suspect that it may prove to be nothing more than a subspecies, the presence or absence of the terminal line within one species is unusual. *Caerulescens* and *intensaria* also have genitalia extremely similar to these but such differences as there are indicate that *albilineata* goes with *festaria*. Some *albilineata* are quite large, corresponding closely in size and appearance to the large spring brood specimens of *festaria* that occur in Ariz., except that the pale spot on abdominal segment 2 is lacking in all specimens seen (commonly present in *festaria*). The width of the white lines is variable and these may be wider than is usual in *festaria* or about the same. The fringes are pale at the base and pink outwardly, either evenly shaded or diffusely checkered. The abdominal markings and other characters appear to be about the same as in *festaria*, except as noted.

TYPES. The holotype male, from Alpine, Brewster Co., Texas, May 1 (Poling), is in the MCZ. Cassino's type material, the holotype, allotype and 19 paratypes, included three species. Three paratypes from McNary, Ariz., and one from the Baboquivari Mts., Pima Co., Ariz. show the red terminal line and are normal *festaria* (one of these in AMNH; the others in MCZ). Two of the male paratypes from Alpine, Texas, both in the CNC, appear to be *caerulescens* and this has been confirmed by a genitalia slide of one of them (the other has lost its abdomen). All remaining paratypes and the allotype agree with the holotype and hence are *albilineata*.

Cassino wrote a composite description, including mention of the red terminal line: "All the fringes are whitish, with a red line on margin of the wing, and small tufts of red scales at end of veins. Some specimens are almost devoid of red". He not only overlooked the fact that the only specimens with the "red line" were the three from Arizona, but also that any of them were from Arizona, and incorrectly stated: "All taken at Alpine, Texas" (1927, pp. 69-70). I began this investigation by studying the paratypes in the CNC (*caerulescens*) neither of which show the red terminal line indicated in the description, and for a time, before seeing the holotype and the remainder of the type material, was thoroughly confused as to the identity of *albilineata*. Had the type been lost, the problem might never have been solved.

SYNONYMY. There are no synonyms, and if *Lissochlora albilineata* Warren, 1909, *Novitates Zoologicae* Vol. 16, p. 79, from Peru, should prove congeneric, then *albilineata* Cassino would become a junior secondary homonym, leaving no name available. This possibility is suggested by Prout's placement of *albilineata* Warren in the genus *Racheospila* (1912, p. 105 and 1932, p. 32), but judgement must await a more detailed study of the Neotropical species.

FURTHER DESCRIPTION. A detailed description of *albilineata* would seem unnecessarily repetitious. It should be easily recognized by the information given in the diagnosis and by reference to the figures.

Length of forewing: males, 12.5-14 mm; females, 13-14.5 mm.

MALE GENITALIA. Like those of *festaria*.

FEMALE GENITALIA. Like those of *festaria*.

MATERIAL EXAMINED. 19 males, 5 females; 4 male, 1 female slides. I have seen the entire type series with the exception of one paratype.

DISTRIBUTION. TEXAS: Davis Mountains; Fort Davis, Jeff Davis Co.; Alpine, Brewster Co.; Basin, Big Bend National Park, Brewster Co.

GEOGRAPHICAL VARIATION. None apparent in the material available.

FLIGHT PERIOD. The old specimens are labeled with various dates covering a period from Mar. 1 to May 7, and one for July. Four recent specimens, all males, in the AMNH were taken Mar. 27, 1965 (Fort Davis), and one female Sept. 4, 1964 (Big Bend National Park), all collected by Mr. A. Blanchard.

EARLY STAGES. Unknown.

REMARKS. Much more material is needed, especially from northern Mexico, to clarify the status of this form.

Nemoria bifilata bifilata (Walker)

Plate 16, figures 3, 3a, 3b; plate 35, figure 2; plate 45, figures 24-27.

Anisodes bifilata Walker, 1862, p. 1585.

Nemoria bifilata Forbes, 1948, p. 114.

Racheospila abdominalia Barnes and McDunnough, 1917b, p. 218. Prout, 1932, p. 26. McDunnough, 1938, p. 140. Kimball, 1965, p. 161. New synonymy.

DIAGNOSIS. *Bifilata*, in the green form of its nominate subspecies, is the only known species of *Nemoria* with a distinct whitish dorsal stripe on the abdomen in place of the usual ocellate spots. It is one of only three species known to have both green and brown forms, the others being *bistriaria* (eastern) and *pulcherrima* (Californian). *Nemoria bifilata* (except in Texas) is most readily distinguished from *bistriaria* by the abdominal markings if these are visible, but unfortunately in many brown examples of both species they are obscured. One may then resort to the genitalia, which have diagnostic characters in the male, or consider the several other less satisfactory characters included in the following summary of superficial differences between the two species:

Nemoria bistriaria

1. Abdomen always spotted in green form, commonly unmarked in brown form.
2. Terminal line red or brown, often very thin, distinctly interrupted at veins.
3. Fringes distinctly paler at base.
4. Front of fore tibia nearly always with an oblique white band near middle.

Nemoria bifilata bifilata

1. Abdomen striped in green form (except in Texas subspecies); unmarked, spotted, or striped in brown form.
2. Terminal line red, often wider, sharply defined, continuous or only slightly interrupted at veins.
3. Fringes more uniformly pinkish or paler, less apt to be contrastingly paler toward base.
4. Fore tibia without white markings.

- | | |
|---|---|
| 5. Male palpi generally longer, second segment clearly exceeding front. | 5. Male palpi generally shorter, second segment reaching but scarcely exceeding front (unreliable because it depends on position of palpi). |
| 6. Color of brown form usually not reddish. | 6. Color of brown form often very decidedly reddish. |

Character number 4, the presence or absence of a white band on the fore tibia, seems to be almost 100% reliable, although in rare examples of *bistriaria* the band is reduced or wanting.

Nemoria bifilata occurs down the east coast from N.J. to Fla., and discontinuously westward to Neb. In Texas there is a peculiar subspecies with the normally diagnostic abdominal stripe replaced by spots, exactly like those of *bistriaria*.

TYPES. *Bifilata* was described from a single brown female "from Mr. Milne's collection". The type locality was not stated but may have been Georgia, as Milne obtained material from Abbot (Doubleday, in Scudder, 1869, p. 123). The type is in the BM.

Abdominaria was described from three green males from Stemper, Fla. (Aug.) and one green female from Fort Myers, Fla. (Apr. 16-23). No type designation was made in the original description, but the specimens are labeled as type male and paratypes in McDunnough's handwriting (I have not seen the female type). The three males are in the USNM, and I hereby designate as lectotype the specimen labeled by McDunnough as the male type.

SYNONYMY. Although the type of *bifilata* clearly represents the brown form of *bistriaria* or *abdominaria*, further identification has been a problem. From a colored photograph, I had at first identified it as *bistriaria*, but changed this decision following recent correspondence with Mr. D. S. Fletcher, who kindly reexamined the specimen for me. He reported that the genitalia of the type most closely resemble my figure 2, plate 35, having the same deep "pockets" in the sterigma. What is much more important however, is that the single remaining foreleg of the type does not have a white-marked tibia. The absence of this marking, as opposed to its usual presence in *bistriaria*, is so nearly diagnostic that it seems safe to conclude that *bifilata* is the same as *abdominaria*.

The three males of the type series of *abdominaria* are all unusually small (most Florida examples seen are larger), but the pale abdominal stripe is very distinct. I am confident that they are correctly associated with *bifilata* as here defined. I have made a slide of one of the paratypes and it agrees in all essential details with the many other specimens examined.

FURTHER DESCRIPTION. **Green form**—male antennae normal for the group, with longest branches equal to about twice diameter of shaft; female antennae normal; male palpi with second segment reaching but scarcely exceeding front; third segment small, conical, often decumbent; female palpi similar but a little longer; legs normal for the group.

Antennal scales white, becoming luteous distally; white interantennal fillet with its hind margin red, luteous or, not infrequently, almost entirely green with just a few red or luteous scales; front red, often a dull rusty or yellowish shade, unmarked or with cream colored spots in the lower and upper corners; palpi tinged with reddish; foreleg red anteriorly, except the coxae, which are greenish; middle tibia sometimes with a trace of reddish; legs otherwise whitish; front tibia nearly always without a pale bar across the middle; underside of body whitish; upperside of thorax and abdomen green, concolorous with wings; abdomen marked with a distinct, sharply defined, cream-colored mid-dorsal stripe that actually begins on the metathorax and runs to segment 5 or 6, where the dorsum becomes generally whitish. Along the edges of the pale stripe there may be a few reddish scales visible under magnification

Both wings above bright green, finely striated with white; lines of the wings usually very thin, less distinct than those of *bistriaria*. Antemedials often obsolescent but, if distinct, rather evenly convex and slightly waved; postmedial of forewing almost straight, regular, turning in slightly and usually fading out at the costa. Costa of forewing white, flushed with red at base and apex, and with a luteous border behind separating it from the green area of the wing as in the *extremaria* group. There is a well defined red terminal line, continuous or slightly interrupted at the veins, variable in width but commonly equal to or exceeding the width of the postmedial line. The fringe is solidly cream colored, often evenly pinkish on the outer half, very rarely pinkish in the basal half or with diffuse pink rays opposite the veins. Small blackish discal spots are normally present on both wings. The underside is the same as above but much paler, the lines indistinct, the costa luteous. **Eastern brown form**—In this form the normal green coloring of wings and body is replaced by brown, often a pinkish or reddish shade in *biflata* (compared to the duller brown of *bistriaria*), but the shade is highly variable. In some specimens all of the legs and even the antennal scales are brown, and usually the luteous hind border of the costa is overlaid with brown. The pale dorsal stripe on the abdomen tends to be compressed and broken into a series of narrow pale spots, or obliterated altogether. The lines and discal spots remain normal except that the terminal line may be a darker shade of brown rather than the usual bright red. The fringes of the brown form tend to be almost solidly pinkish, scarcely if at all paler at the base.

Intermediates appear to be very rare. I have seen no caught specimens, but a series reared by Frederick Lemmer at Lakehurst, N.J., in 1934 from a brown parent came out in the proportion of eight brown (5 male, 3 female) to seven green (3 male, 4 female), and of these, two brown specimens show a strong mixture of green scales, and one green specimen a slight mixture of brown scales.

Length of forewing: males, 10.5-13.5 mm; females, 12-14 mm.

MALE GENITALIA. Characterized by an unusually straight, parallel-sided valve, reduced distal costal process, and irregularly swollen, slightly curved basal costal process that is directed almost straight backward rather than at a pronounced lateral angle as in *bistriaria*.

FEMALE GENITALIA. Close to and commonly inseparable from those of *bistriaria*, but the sclerotized, pouch-like enclosure of the ostial opening (the sterigma) tends to be larger in *biflata*.

MATERIAL EXAMINED. Green form: 92 males, including type, 60 females; brown form: 16 males, 15 females; slides, 16 male, 5 female.

DISTRIBUTION. FLORIDA: Miami; Florida City; Stemper; St. Petersburg; Belleair; Oneco, Manatee Co.; Charlotte Harbour; Sarasota Co.; Tampa; Weekiwachee Springs; Ferdinandino; Port Sewall, Martin Co.; Daytona; Archbold Biological Station, Lake Placid, Highlands Co.; Parker Island, Highlands Co.; Cassia, Lake Co.; Orlando; Welaka, Putnam Co.; Shalimar; Apalachicola; "Ocean City". ALABAMA: Ozark. GEORGIA: Augusta. SOUTH CAROLINA: 2 mi. N. of Myrtle Beach, Horry Co.; The Wedge Plantation, South Santee R., Charleston Co. NORTH CAROLINA: Southern Pines; Maxton. NEW JERSEY: Lakehurst; Sweetwater. NEW YORK: "vicinity of New York City"; Wyandanch, Long Island. NEBRASKA: Columbus, June 5, 1963, E. A. Froemel, one male in the Brower collection, in poor condition (genitalia checked).

The two New York records are old specimens in the USNM with data labels that could be regarded as doubtful, although occurrence of the species in such a place as Long Island is not unlikely.

GEOGRAPHICAL VARIATION. Apart from a tendency for Florida specimens to be a somewhat deeper green than northern ones, the most noticeable north-south change is the

loss of the brown form toward the southern extremity of the range. Of the many specimens seen from Fla., only one male from Ocean City [Okaloosa Co.] (H. O. Hilton) represents the brown form. It looks just like those from N.J., where the forms occur in the proportion of 28% brown to 72% green (based on 53 caught specimens). The single female from Ala. is green, but the specimen from Ga., also a female, is brown. The specimens from S.C. are green but those from N.C. include both green and brown. Although it is apparent from the single record that the brown form reaches northern Fla., there is not enough material to indicate whether the transition from 72% green to all green is abrupt or gradual. It would seem that, in nature, brown adults usually result from pupae that have gone through a diapause. Only in southern Fla., where *bifilata* can fly all year round, is the brown form lacking. *Nemoria bistriaria* shows a reversal of this trend because in that species it is the northern population, subspecies *rubromarginaria*, that tends to lose the brown form. Unfortunately, a comparison cannot be made in Fla. as *bistriaria* does not seem to occur there. I am describing as a subspecies of *bifilata* a peculiar Texas population characterized by abdominal spots instead of the usual stripe. The abdomen of the single Nebraska specimen was so discolored that I was unable to tell whether it had been striped or spotted.

FLIGHT PERIOD. In Fla., Jan. 20–Apr. 12 and May 8–June 10. Taken in Ala. on Mar. 18, in S.C. on Apr. 10 and July 9–18, in N.C. on Apr. 7 and Aug. 10. At Lakehurst, N.J., dates extend from Apr. 23 to July 26, which would seem to represent two broods.

EARLY STAGES. Frederick Lemmer appears to have been the only person who has reared *bifilata*, and no description or preserved larvae are known to exist. Lemmer fed his larvae oak but the resulting specimens, most of which are in the USNM, are all somewhat dwarfed. He made the following remark on a label affixed to the parent: "Young fed on oak. I suspect sumach to be the right food". Since the foregoing was written, I reared *bifilata* from a female taken near McClellanville, S.C. in Aug., 1968. The larvae, which did well on *Rhus copallina*, are similar to those of *bistriaria*, but have longer protuberances. This brood produced 38 adults between Oct. 6 and 15, and all were green.

REMARKS. Of the 53 caught specimens examined from N.J., the 15 brown ones all appear to belong to the spring generation, which is part green and part brown. Second generation caught specimens are all green. However, the brood reared by Lemmer produced adults in late June and these were half green and half brown.

In Texas a unique problem exists because there occur what appear to be three seasonal forms in a population that I consider to represent a subspecies of *bifilata*. The following is a description of this subspecies.

***Nemoria bifilata planuscula*, new subspecies**

Plate 16, figures 4, 4a, 4b; plate 35, figure 3; plate 45, figures 28, 29.

Aplodes brunnearia Packard, 1876, p. 388 (partim).

DIAGNOSIS. This population, which occurs in eastern and central Texas, violates the rule with regard to the main superficial character of the nominotypical subspecies. Instead of the diagnostic dorsal abdominal stripe, the green form of *planuscula* has ocellate spots exactly like those of the corresponding form of *bistriaria*. The reversion of this character greatly increases the possibility of confusion with *bistriaria*, *lixaria* or *albilineata*, but the genitalia of *planuscula* clearly reveal its relationship to *bifilata*.

Like *bifilata* of the Atlantic coast, the Texas subspecies seems to be seasonally polymorphic. There is a large brown early spring form in March, corresponding to the brown diapausing form of *bifilata*, a similarly large green form in April and May, presumably the second generation, and a smaller green summer form, probably representing two or three broods flying continuously from June to September

Types. Holotype male, Welder Wildlife Foundation Refuge, San Patricio Co., Texas, Apr. 10, 1962, collected by R. O. and C. A. Kendall (my slide No. 963). Paratypes: one male, same locality and collectors, Apr. 7, 1962; one male, Bastrop State Park, Bastrop Co., Texas, May 19, 1962, same collectors; one female, same locality and collectors, May 20, 1962; two females, Huntsville, Walker Co., Texas, May 26, 1963, A. Blanchard; one female, Kerrville, Texas, May, 1908, H. Lacy. All specimens in the AMNH except the last, which is in the USNM.

Since actual proof of relationships of the supposed seasonal forms is lacking, I am limiting the type material to the large green spring form. Because the difference in abdominal markings shows clearly only in green specimens (brown examples normally having spots in both subspecies), use of a brown specimen as type would seem a poor choice.

SYNONYMY. In the description of *brunnearia*, Packard mentioned having only two specimens but listed three localities, including Dallas, Texas. His Dallas specimen would have been the brown form of this Texas population, although I have found no type. Had I found such a specimen labeled as a type, I would have restricted the name *brunnearia* to the Texas subspecies.

FURTHER DESCRIPTION. First spring generation (brown form)—Closely resembling the brown form of the nominotypical subspecies but generally larger, a duskier shade of brown, and with less of the reddish tint; abdomen usually with a row of distinct pale spots, apparently never fused to form a stripe; discal spots small, blackish. One male from Burnet Co., Texas apparently melanic, being a darker smoky brown, with the subterminal dark brown instead of reddish. Length of forewing: males (7), 13-14 mm; females (4), 14-15 mm., except for one dwarfed specimen of only 12 mm.

Second spring generation (type form)—Similar to the eastern green form of *bifilata* except for the following differences: 1) Larger size, especially in females, 2) abdomen with cream colored dorsal spots, thinly encircled with dull red, on segments 1, 3 and 4, instead of the pale dorsal stripe of *bifilata*, these spots being almost exactly as in *bistriaria*, but smaller and with less red than is usual in *festaria* or *albilineata*, 3) discal spots obsolete or distinctly reddish brown rather than blackish, 4) red shade of front, palpi and legs somewhat paler, but bright red terminal line about the same as in eastern *bifilata*. Length of forewing: holotype male, 12.5 mm; other males (2), 12-12.5 mm; females (6), 13.5-15 mm.

Summer generations—Exactly like the large green spring form but much smaller, and with a tendency to be more intensely colored. Length of forewing: males (28), 10-11 mm; females (7), 11.5-12.5 mm.

MALE GENITALIA. Like those of *bifilata*.

FEMALE GENITALIA. Like those of *bifilata*.

MATERIAL EXAMINED. First spring brood (brown): 18 males, 5 females; second spring brood (type form): 3 males, 6 females; summer broods: 28 males, 7 females; slides: 6 male, 8 female.

DISTRIBUTION. TEXAS: Brown spring brood—Dallas; Tennessee Colony, Anderson Co.; Kerrville, Kerr Co.; Bastrop State Park, Bastrop Co.; Garner State Park, Uvalde Co.;

"Burnett Co." Green spring brood (type form)—Welder Wildlife Refuge, San Patricio Co.; Huntsville, Walker Co.; Bastrop State Park, Bastrop Co.; Kerrville, Kerr Co.; College Station, Brazos Co. Summer broods—Lake Brownwood State Park, Brown Co.; Kerrville State Park, Kerr Co.; Forestburg, Montague Co.; College Station, Brazos Co.

GEOGRAPHICAL VARIATION. None apparent in the material available.

FLIGHT PERIOD. First spring brood (brown): Mar. 4-22; second spring brood (green): Apr. 7-May 26; summer broods: June 1-Sept. 9.

EARLY STAGES. UNKNOWN.

REMARKS. One other green specimen, a large, worn female from Coldspring, San Jacinto Co., June 1, 1963, I tentatively place here, although its interrupted subterminal, slightly checkered fringes and white marked fore tibiae suggest that it may be *bistriaria*. It should be noted that *bistriaria* does reach eastern Texas, and although the male genitalia can always be distinguished, those of the females cannot.

It appears that *planuscula* represents a disconnected Texas population as there are no known records of *bifilata* from a large region between Florida and Texas. It may be there but uncollected. Whether the change in abdominal markings is an abrupt or gradual one thus remains to be worked out. The brown form from Texas has generally been misidentified in collections as *bistriaria* or *brunnearia*.

I had difficulty in choosing the holotype of *planuscula* because of inadequate material. To show the best combination of characters it needed to be a green male, and none of these were in especially good condition.

Nemoria bistriaria *bistriaria* Hübner

Plate 2, figure 6; plate 17, figures 1, 1a, 1b; plate 35, figure 4; plate 45, figures 30-32; plate 46, figure 1.

Terpne bistrigaria Hübner, 1808, p. 6. **Nomen nudum.**

Nemoria bistriaria Hübner, 1818, p. 25, pl. [24], figs. 139, 140. Prout, 1912, p. 111. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 22. McDunnough, 1938, p. 140.

Aplodes bistriaria Hulst, 1896, p. 315. Dyar, 1902 [1903], p. 302.

Aplodes rubrolinearia Packard, 1873, p. 74; 1876, p. 390. **New synonymy.**

Synchlora rubrolinearia Gumpfenberg, 1895, p. 498.

Racheospila rubrolinearia Prout, 1912, p. 104. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 26. McDunnough, 1938, p. 140.

Nemoria rubrolinearia Forbes, 1948, p. 113.

Aplodes brunnearia Packard, 1876, p. 388 (partim), pl. 10, fig. 88. **New synonymy.**

Nemoria brunnearia Barnes and McDunnough, 1916b, p. 170; 1917a, p. 99. Prout, 1932, p. 22. McDunnough, 1938, p. 140. Forbes, 1948, p. 114.

DIAGNOSIS. This is one of the two eastern species with green and brown forms, the spring generation being mostly brown (except in race *rubromarginaria*), the summer generation green. It closely resembles *bifilata* in size and coloring, except that the abdomen is marked with spots instead of a stripe in the green form, and unmarked or only faintly spotted in the brown form (see table of differences under *bifilata*). The white lines are regular or slightly sinuous, the terminal line thin, red in green specimens, often dark brown in brown ones, interrupted at the veins. The fringes are whitish in green specimens, pale brown in brown ones, with or without pinkish rays opposite the veins. The abdomen has whitish spots bordered by red on abdominal segments 1, 3 and 4, but these may be obsolete in the brown form. Dark discal spots may be present or absent. The front of the fore tibia nearly always has an oblique white band across the middle (lacking in *bifilata*).

The genitalia of both sexes quite readily distinguish *bistriaria* from all other sympatric species. The range is from eastern Texas to Georgia and north to Pennsylvania, with subspecies *rubromarginaria* extending from the mountains of Pennsylvania to Montreal, Quebec. In the southeast, green specimens of *bistriaria* may be confused with *lixaria*, although the female palpi are not as long. Males in which the tip of the uncus happens to be visible are readily distinguished without making a genitalia slide. North of the range of *lixaria*, *bistriaria* is the only species with both red terminal line and abdominal spots.

Types. The type of *bistriaria* came from Georgia, as stated by Hübner in the text of the *Zuträge*, p. 25: "Aus Georgien in Florida. Durch Herrn Dr. Andersch erlangt". Its present location, if it still exists, is unknown to me. Hübner's figures 139 and 140 show what is quite certainly a brown *Nemoria*, with white lines that seem unusually wide for *bistriaria* from that far south, although I have seen few specimens from Ga. Lines of that width occur not infrequently in the northern race *rubromarginaria*, but never in *bifilata*—the only other species with a brown form in Ga. On the basis of our present knowledge of the fauna and assuming that the locality stated is correct, *bistriaria* has to be one of these two species. The width of the lines almost certainly rules out *bifilata* which, in addition, seems to be rarer and the one less likely to fall into a collector's hands. The figures in the *Zuträge* are not good enough to show finer distinctions such as the color of the terminal line or the character of the abdominal marking. The shade of brown on the wings does look more like that of what I am calling *bistriaria*. I have seen a few northern specimens (e.g., from Ithaca, N.Y.) that are a better match for Hübner's figures than are any southern specimens available, but the latter are still so few that they do not provide sufficient justification for regarding the type locality, Georgia, as incorrect.

Rubrolinearia was based on one male from "Philadelphia, Pa. (Coll. Amer. Ent. Soc.)", and its present location is uncertain. It is not in the MCZ.

Packard's description of *brunnearia* is confusing but he had at least three specimens, two of which I have found. I hereby designate as lectotype the female from West Virginia in the MCZ, stated in the description to have been taken April 18 by T. L. Mead. It is a very rubbed specimen but the abdomen is there to confirm the determination if necessary. There is another female type in the USNM, labeled "Capt. May 7/73", "Aplodes brunnearia Packard, Type", and "Type No. 328, U.S.N.M." It has no abdomen and no front legs. Judging by the date, this is the specimen Packard mentioned from "Central Missouri (Riley)". He also included with the above types a specimen, or specimens, from "Dallas, Texas (Boll, Mus. Peab. Acad. Sc.)", and although there are three such specimens (all females) in the MCZ, none bears a type label. The Dallas specimens, although also brown, are not *bistriaria*, but represent the Texas form of *bifilata*. Packard was not specific about the sex of each specimen for which he gave locality data, but indicated that the description was that of two males, while basing the measurements given only on an unstated number of females. My guess is that his use of male sex symbols in the description was an error or misprint.

SYNONYMY. Although I have not seen the type of *rubrolinearia*, it appears to have been a green summer brood specimen (fringe pale). If one chooses to regard the northern, transition zone population as a subspecies, *rubrolinearia* (1873) is one of two Packard names that must be considered, the other being *rubromarginaria* (1876) from Montreal, Quebec. Since Philadelphia, the type locality of *rubrolinearia*, is within or perhaps even south of the boundary zone between the northern and southern populations, I prefer to assign *rubrolinearia* to the synonymy of *bistriaria* and use for the subspecies the unambiguous name *rubromarginaria*. As the more obvious subspecific differences occur in the spring broods, racial determination of the type of *rubrolinearia per se* may be difficult or impossible. Specimens examined from Washington, D.C., Wilmington, Del. and southern N.J. are quite normal southern *bistriaria*;

those from New Brighton, Pa., the vicinity of New York City, and southern Conn. seem to be intermediate, with brown still the dominant color of the spring generation.

The lectotype of *brunnearia*, from W. Va., and the syntype from Mo. are quite certainly brown spring specimens of *bistriaria*, but the specimens from Dallas, Texas, are something else, which I refer, at least for the present, to *bifilata*. I had thought of restricting the name *brunnearia* to the latter form by designating a Texas example as lectotype, but have found no such specimens that can definitely be regarded as part of Packard's original type lot. Identification of Packard's material is further complicated by the knowledge that true *bistriaria* also occurs in eastern Texas. Barnes and McDunnough (1916b, p. 170) also failed to find any type of *brunnearia* from Texas, and considered that it had been described only from the two females mentioned.

FURTHER DESCRIPTION. Green form (summer brood)—Structure of antennae, palpi and legs as in *bifilata*. Male antenna with ventral branches 10-15 (the longest) equal to twice the diameter of the shaft; male palpi exceeding front by about half the length of the second segment; third segment small, set well in among the scales of the second, somewhat rounded, slightly decumbent; female palpi longer, exceeding front by a distance almost equal to the length of the second segment; third segment half the length of the second, subcylindrical.

Antennal shaft with white scales near the base, luteous distally; white inter-antennal fillet with a narrow yellowish or reddish border behind; front pale, dull red to deep brick red with a white lower border and usually a pair of whitish spots or bars in the upper corners; palpi white, outwardly tinged with the same shade of red as the front; legs cream colored except for the front tibiae, which are pale reddish brown, marked with a white band across the middle of the anterior side; underside of body whitish; upperside of thorax and basal half of abdomen green, concolorous with wings, caudal half of abdomen mostly whitish; abdominal segments 1, 3 and 4 with whitish dorsal spots narrowly bordered with red or yellowish.

Upperside of wings green, about the same shade as *rubrifrontaria*, a little paler than *bifilata*, very finely and faintly striated with white; lines thin; antemedials evenly convex, that of the forewing slightly waved; postmedial of forewing regular, slightly convex, almost parallel to outer margin; postmedial of hindwing slightly waved, curved parallel to outer margin, sometimes angled at Cu; discal spots lacking or indicated only as spots of darker green (rarely red or brown); costa white, yellowish or faintly reddish at base and apex, with a weak luteous edging along its full length behind, separating the white from the green; terminal line bright red, usually a little narrower and more distinctly interrupted at the veins than in *bifilata*; fringes white in basal half, luteous outwardly, usually with weak reddish rays opposite the veins. Underside much paler with the lines obsolete and the entire costa luteous.

Length of forewing: males, 10.5-12 mm; females, 12-13 mm. **Brown form** (spring brood)—Green coloring of wings and body entirely replaced by brown as in brown form of *bifilata*. Shade of brown generally less reddish than in *bifilata*, although occasional specimens pinkish. Brown specimens variably striated with whitish, often much more coarsely so than green ones, and antemedial and postmedial lines with tendency to be wider. Terminal line either reddish or a darker shade of brown. Except for a pale line near base, fringes almost completely suffused with pinkish brown; the reddish rays, although still there, diffuse and not contrasting. The small discal spots, if present, red or brown. Thorax and front concolorous with wings; front may retain whitish markings of green form although these often reduced or lost. Palpi tinged with either red or brown. Fore tibiae brown anteriorly, retaining the oblique white band across middle, often helpful in distinguishing *bistriaria* from *bifilata*. Dorsum of abdomen normally solid brown, except for the whitish caudal tufts, only rarely showing vestiges of the abdominal spots characteristic in the green form. Underside as above but much paler, the lines less distinct and the costa brownish.

Length of forewing: males, 11-11.5 mm; females, 11.5-12.5 mm.

The separation into brown spring form and green summer form is not invariable.

From the vicinity of Washington, D.C. I have seen one green male taken May 11 (USNM) and one brown male (dwarfed) taken Sept. 2 (JGF). I have also seen a spring female from Montgomery Co., Va., that is intermediate. The green spring form of subspecies *rubromarginaria*, together with a full range of intermediates, begins to appear commonly in Pa.

MALE GENITALIA. Close to those of *bifilata* but easily distinguished by several characters. Uncus long, slender, only slightly expanded at tip (stouter in subspecies *rubromarginaria*); socii broad and rounded; anellus forming an almost square opening through which passes the aedeagus (in *bifilata* this being more often rounded or irregularly V-shaped, and the transtilla wider); valve with a more elevated, sharper-edged mesial ridge than in *bifilata*, and with the costa more concave, terminating in a very prominent, pointed distal process; basal costal processes of the same length as in *bifilata* but almost perfectly straight and evenly tapered to sharp points, diverging rather strongly (as mounted on a slide), whereas those of *bifilata* are directed almost straight backward; aedeagus commonly with a row of 5-8 small teeth on its distal half, smaller and less developed than those in *bifilata*.

FEMALE GENITALIA. Here the differences between *bistriaria* and *bifilata* are much less satisfactory and I have found none that are really consistent. The sclerotized, pouch-like structure that encloses the ostial opening is always quite wide in *bifilata*; in *bistriaria* it may be the same width or somewhat smaller, retaining the same shape. There also seems to be a tendency for the lip of this structure to be strongly concave in *bistriaria*, more nearly straight across in *bifilata*.

MATERIAL EXAMINED. Green form, 33 males, 13 females; brown form, 44 males, 24 females. Slides: green form, 4 males, 2 females; brown form, 6 males, 2 females.

DISTRIBUTION. TEXAS: Town Bluff, Tyler Co. (DCF Slide No. 899, AMNH); Spring, Harris Co. MISSISSIPPI: Pearl, Rankin Co.; Clinton, Hinds Co. ALABAMA: Ozark, Dale Co.; Anniston. GEORGIA: Augusta (Slide No. 5330, AMNH). SOUTH CAROLINA: Wedge Plantation, South Santee River, Charleston Co.; Cherry Hill Recreation Area, 2000', Oconee Co. NORTH CAROLINA: Tryon; Brevard; Highlands, 3865', Macon Co. TENNESSEE: Johnson City. KENTUCKY: Morehead. MISSOURI: Warsaw, Benton Co. ARKANSAS: Washington Co. ILLINOIS: Decatur. OHIO: Fairfield Co. WEST VIRGINIA: "W. Va." VIRGINIA: Black Mountain; Blacksburg and Brush Mountain, Montgomery Co.; Arlington. DISTRICT OF COLUMBIA: Washington. MARYLAND: Plummer's Island (Cabin John). DELAWARE: Wilmington, New Castle Co. NEW JERSEY: Lakehurst.

The following show, by an increasing frequency of green in the spring brood, a condition intermediate between *bistriaria* and subspecies *rubromarginaria*—NEW JERSEY: Essex County Park; Ft. Lee District; Greenwood Lake; PENNSYLVANIA: Adamstown, Lancaster Co.; New Brighton, Beaver Co.; NEW YORK: Riverhead, L.I.; Bronx Park; Bear Mts.; New Windsor; CONNECTICUT: Greenwich, Fairfield Co.; Shelton; near Middletown.

I have seen no records for Fla. although it would be expected to reach the northern part of that state. A few that I thought might be Floridian *bistriaria* proved to be *lixaria* when the genitalia were examined.

GEOGRAPHICAL VARIATION. There appears to be little variation throughout the range except for the increasing tendency for green specimens to appear in the spring generation toward the northeastern boundary. This boundary is actually an extensive zone of overlap that seems to extend from about Washington, D.C., to New Haven, Conn., but it requires further investigation. The most southerly record of a pure green spring specimen is from Washington, D.C., but even in southern Conn. the spring form is still predominantly brown. Although the material examined has hardly been adequate, I believe that in the hills of northern Conn. the spring form is

predominantly green, as it certainly is at Ithaca, N.Y. (*rubromarginaria*). Two spring females from Montgomery Co., Va., are intermediate (green, heavily suffused with brown). In S.C., the early spring generation (Mar.) seems to be entirely brown. I have seen only two Texas examples, a male and a female, both normal looking brown spring specimens.

FLIGHT PERIOD. In Texas, Mar. 10, 23; Miss., May 18, June 11 (green, second brood); Ala., Mar. 24, 26 (brown, first brood), June 27 (green, second brood); S.C., N.C., Va., Md., Del., Ky., Mo., Ark., Ill., Mar. 16–May 21 (brown) and June 25–Aug. 10 (green); Pa., N.J., N.Y., Conn., Apr. 15–May 31 and July 9–31, with one record for Aug. 21 (Middletown, Conn.) and one for Sept. 15 (Bear Mt., N.Y.). In the Franclemont collection there is one brown male taken at Arlington, Va., Sept. 2, presumably a third generation emergence.

EARLY STAGES. I reared *bistriaria* from a brown spring female taken at the Wedge Plantation, near McClellanville, S.C., Mar. 27, 1968. The larvae fed on oak (various species). The resulting brood, which emerged between May 22 and June 12, consisted of 7 green males and 3 brown males, and 6 green females. One of the 7 green males was somewhat intermediate, being tinged with brown. The larva is basically similar to that of *lixaria*, and to others of the *bistriaria* group such as *mimosaria* and *rubrifrontaria*, but differs in numerous minor details. The processes on abdominal segments 3 and 4 are conspicuously longer than the others, and each terminates in a pair of subequal spines. The processes on A3 are contrastingly dark in color. The dorsal pair of processes on A8 are long. The numerous setose tubercles are unusually well developed and the integument is more heavily pilose than in any other species of *Nemoria* examined. The larva seems to differ somewhat from that of subspecies *rubromarginaria*, the processes on A2, A3 and A8 being distinctly longer.

Abbot manuscript drawings of a larva and pupa, reproduced by Packard (1876, pl. 13, figs. 28, 28a) were thought by Packard to represent his *brunnearia* [= *bistriaria*]. Abbot gave as the food plant *Juglans nigra*, and associated the larvae with both brown and green adults. The fact that Abbot had two color forms puzzled Packard, but we now know this to be correct.

Comstock (1960, pp. 436, 439) gives *Prunus* as a food plant, but when I checked his reference, a paper by D. S. Kellicott (1885, *Canad. Ent.* 17: 32–33), I found that Kellicott was not referring to a species of *Nemoria*, but to *Eumacaria brunnearia* [*brunneata*] Packard (= *Itame latiferrugata* (Wlk.)). Hulst (1887, p. 72) described a larva, as *rubrolinearia*, feeding on *Myrica* on Long Island, N.Y., but I believe that this was *rubrifrontaria*. In the USNM there are 2 summer generation females of *bistriaria*, without locality, reared from *Betula nigra* by C. V. Riley

***Nemoria bistriaria rubromarginaria* (Packard), new status**

Plate 17, figures 2, 2a, 2b; plate 46, figures 2–5.

Aplodes rubromarginaria Packard, 1876, pp. 389–390.

Anaplodes rubromarginaria Dyar, 1902 [1903], p. 302.

Racheospila rubrolinearia Prout, 1912, p. 104 (partim). Barnes and McDunnough, 1917a, p. 99 (partim). McDunnough, 1938, p. 140 (partim).

Racheospila rubromarginaria Barnes and McDunnough, 1916b, p. 170; 1917a, p. 99. Prout, 1932, p. 25. McDunnough, 1938, p. 140.

Nemoria rubrolinearia Forbes, 1948, p. 113 (summer brood).

Nemoria rubromarginaria Forbes, 1948, p. 114; p. 112, fig. 122 (spring brood)

DIAGNOSIS. This is the northern population of *bistriaria*, occurring approximately from Pennsylvania to southern Quebec and Ontario, and distinguished mainly by having a

predominantly green, rather than brown, spring generation. Although the spring and summer broods are both green, they look quite different and were considered different species until Forbes (1948, p. 114) pointed out that they were almost certainly seasonal forms of the same species. He used the name *rubrolinearia* for the summer brood, but for reasons already explained I have referred that name to the synonymy of *bistriaria*. The summer generation of *rubromarginaria* looks just like that of *bistriaria*; the spring generation may be about 15% brown or intermediate but those that are green tend to differ from summer specimens in being subhyaline and fragile looking, with wider white lines and often much more red suffusion in the fringes and on the abdomen. The brown form differs from that of *bistriaria* in being unstriated, or almost so. Throughout all or nearly all of its range, *rubromarginaria* is the only representative of the genus with a red terminal line.

TYPES. The type is a female from Montreal, Quebec in the MCZ. It is labeled "Type 2219", and a slide has been made of the genitalia (J. F. Gates Clarke slide No. 1162). The type is a specimen of the spring generation.

SYNONYMY. None.

FURTHER DESCRIPTION. Spring brood—Structure of antennae, palpi and legs as in *bistriaria*. White interantennal fillet with the usual red hind border well developed, followed by a diffuse pale brown collar separating the head from the green thorax; front pale dull red or brownish, with or without the usual pale markings; palpi heavily tinged with the same shade, the third segment whitish at the tip; fore tibia red or brownish with the white band across the middle as in *bistriaria*; legs otherwise whitish or faintly tinged with brown; thorax and basal half of abdomen green above; abdominal segments 1, 3 and 4 normally with pale spots encircled with light brown, but the brown shading is sometimes exaggerated, covering much of the dorsum, in which case the pale spots may be obliterated.

Wings normally green instead of brown, unstriated but pale, thinly scaled and almost subhyaline; white lines with a tendency to be almost as wide as the fringes and variable in position (e.g., often coming unusually close together at the inner margins); antemedial of forewing normally convex but not infrequently straight or nearly so; costa white with its luteous posterior margin not well defined, flushed with red towards base and apex; red terminal line present but often feeble and widely interrupted at the veins; fringes basally whitish, variably suffused with pinkish brown. The fringes tend to have diffuse pinkish rays opposite the vein endings and these may be discrete and well defined (as in the summer brood), or so exaggerated and confluent that the entire fringe appears reddish. The fringes, when thus wholly suffused, are much the same as in the brown form of *bistriaria*, although the wings otherwise remain green. Minute dark green or brown discal spots may be present or absent.

A small proportion of brown specimens occur in the spring generation at least as far north as Ithaca, N.Y., where about 15% of the spring brood is brown or intermediate. These look much like the southern spring form of *bistriaria* but have a tendency to be smaller, paler, unstriated, and subhyaline. Many are not entirely brown but, at least under magnification, prove to have a mixture of green and brown scales that may occur in any degree of intergradation.

I should emphasize again the extreme variability of the lines in the spring brood. In some specimens examined, both green and brown, these are so diffuse as to be almost obsolete; in others the lines are wide, pure white and sharply defined. The extreme variability in the course and position of these lines has been mentioned, as has the unusual variation in the amount of reddish brown on the abdomen and in the fringes.

Length of forewing; males, 10-12 mm; females, 11-13 mm.

Summer brood—This is probably indistinguishable from the summer brood of *bistriaria*. The wings are slightly darker green and much more opaque than in the

spring brood, and the fringes may be solidly whitish, without red markings. No brown summer specimens of *rubromarginaria* are known.

Length of forewing: males, 9.5-12 mm; females, 11-12 mm.

MALE GENITALIA. Several definite trends are apparent in the genitalia of *rubromarginaria*, revealing a south to north divergence from typical *bistriaria*. This trend is in the direction of shorter and stouter genitalic components. There is even a noticeable difference, for example, between specimens from Ontario and those from Ithaca, N.Y., with evidence that this is a clinal continuum throughout what I define as the range of *rubromarginaria*. The uncus becomes shorter and stouter, the tip often more expanded and nearly spatulate, the valve noticeably shorter and wider, with the costa more concave, the distal process of costa not quite so long and pointed, and the basal process slightly stouter and with a tendency for the outer half to be bent or curved outward.

These are trends only, not necessarily apparent in any one specimen, but obvious when a fair number are examined. Of the characters mentioned, the thickened uncus is the most consistent, being nearly always evident where the spring form is mostly green. There appear to be no genitalic differences between the spring and summer forms.

FEMALE GENITALIA. Similar to and possibly indistinguishable from those of *bistriaria* and *biflata*.

MATERIAL EXAMINED. Total of 461 males, 53 females, the various forms represented as follows: spring form, green: 230 males, 19 females; spring form, brown: 20 males, 2 females; spring form, intermediate (green-brown): 19 males, 1 female; summer form: 192 males, 31 females. Slides: 20 male, 4 female. Larvae: one brood reared.

DISTRIBUTION. NEW YORK: Horseheads, Chemung Co.; Ithaca, Tompkins Co.; Picton Island, Clayton. CONNECTICUT: Washington, Litchfield Co.; Mansfield, Tolland Co.; Putnam, Windham Co.; Norwich. ONTARIO: Marmora; Ottawa; South March; Chaffey's Locks [near Kingston]; Renfrew; Easton's Corners. QUEBEC: Montreal; Isle Jesu; Norway Bay.

GEOGRAPHICAL VARIATION. Most of the variation in *rubromarginaria* is not geographical, although the frequency of brown in the spring form apparently changes from south to north (see also discussion under *bistriaria*), as does to some extent the form of the male genitalia, already discussed. Most of the transition from *bistriaria* to *rubromarginaria* seems to occur across a surprisingly narrow zone of 50 miles or even less, although this distance is difficult to measure because too few localities are represented, and because the zone swings northward up the coast from Philadelphia to Long Island Sound. The few specimens available suggest that the boundary passes from east to west through the middle of Connecticut.

Of the 251 spring brood specimens examined from the vicinity of Ithaca, N.Y., the color proportions are as follows:

<i>Males</i>	<i>Females</i>
85% green	89% green
7% brown	11% brown
8% intermediate	0% intermediate

In these proportions there is a possibility of two different kinds of sampling errors. First, the available females are so few (18) that there is a chance of those figures being statistically unreliable. Second, there is a possibility of selectivity on the part of collectors in saving a higher proportion of the rarer brown specimens than actually occurs in nature.

I have not seen brown specimens from anywhere north of Ithaca, and very few spring specimens at all from other localities. Of approximately 125 specimens seen

from Ontario and Quebec, 115 are of the summer form. In addition to the type, I have seen only two other specimens from the vicinity of Montreal, a female taken May 8, 1949 and a male labeled July 15-31, 1932, both in the collection of Mr. A. C. Sheppard. A series of summer generation specimens reared at South March, Ont. (see below) are somewhat unusual in having the red terminal line and red fringe markings reduced, at least in part of the specimens, almost to the point of obsolescence. The fringes are almost pure white. Other Canadian specimens are normal.

FLIGHT PERIOD. Spring brood, Apr. 23-June 10; summer brood, July 1-Aug. 10. The brood reared by Dr. McDunnough from a female taken at South March, Ont., May 20, 1943, produced four males and seven females between June 26 and July 6.

EARLY STAGES. The brood mentioned above, reared by Dr. McDunnough, provides the only actual proof I have seen that we are dealing with seasonal forms of one species. His eleven specimens, reared *ex ovo* on oak (species not specified) from a spring female, are the summer form, with darker, more opaque wings. In the spring of 1965 I reared larvae from two females taken in May at Ithaca, N.Y. These were fed white oak, on which they did quite well; they pupated but did not produce a second generation. The following December these pupae still appeared to be alive, but they did not survive the winter.

Prentice (1963, p. 305) reports on several specimens of this species (as *rubrolinearia* Pack.) reared on white oak in the vicinity of Renfrew and Prescott in southeastern Ontario. I have examined adults in the CNC that I believe represent three of these Forest Insect Survey specimens, and they are spring specimens that emerged (in the laboratory) in February and March.

In the USNM there are two summer generation females reared from *Betula nigra* (ex collection C. V. Riley). The locality is not given and I have assumed that they are *bistriaria*, although they look exactly like the Ontario *rubromarginaria* reared by McDunnough.

The larva is much like that of *bistriaria*, *mimosaria*, *rubrifrontaria* or *lixaria* but is more slender, with the lateral processes on segments A2-A4 somewhat smaller and more distinctly notched between the spines at the tips. The processes on A2, A3 and A4 are more uniform in size than in *bistriaria*, and those on A8 are short. Abdominal segments 2, 3 and 4 each have dark dorsal spots like *bistriaria*, *mimosaria* and *rubrifrontaria*, but there are no stripes. As in *bistriaria*, the darkest markings (dark brown on a paler brown ground) occur beneath the lateral processes, and this dark mottled area is sharply differentiated from the unmarked venter along a straight ventro-lateral line. This line, dividing a pigmented from an unpigmented area, is not so defined in any other species examined and perhaps could serve as a key character. Also as in *bistriaria*, the integument tends to be heavily pilose, but the processes on A2 are not contrastingly darker than those on A3 to A4.

REMARKS. One of the odd things about *rubromarginaria* is that it is known from relatively few localities. It must be more generally distributed within this region than the records indicate, but the vast bulk of specimens in collections are from Ithaca, N.Y., mostly collected by Dr. Franclemont. There is also a large series of over one hundred summer brood specimens in the AMNH, collected by the Rev. J. C. E. Riotte at Chaffey's Locks, Ont.

I have considered the possibility of *rubromarginaria* being a species distinct from *bistriaria*, partly because of its very distinctive looking spring generation and the slight differences in the genitalia. However, these changes are not abrupt, and with important aspects of distribution and biology still not known in detail, such a division at present would seem untenable.

Nemoria rubrifrontaria (Packard)

Plate 17, figures 3, 3a, 3b; plate 35, figure 6; plate 46, figures 9, 10.

Racheospila rubrifrontaria Packard, 1873, p. 76. Prout, 1912, p. 104.

Aplodes rubrifrontaria Packard, 1876, p. 386. Dyar, 1902 [1903], p. 302.

Nemoria rubrifrontaria Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 23. McDunnough, 1938, p. 140. Dethier, 1942, p. 233 and pl. XVI (larva). Forbes, 1948, p. 113.

Aplodes packardaria Grote, 1882, p. 46.

Aplodes rubrolinearia Hulst, 1887, p. 72 (described larva, probably of *rubrifrontaria*).

DIAGNOSIS. *Rubrifrontaria* is the only northeastern species of *Nemoria* with the following combination of characters: fringes pink, paler at the base (appearing almost white in worn specimens), only faintly checkered, near the apex, if at all; no red terminal line; abdomen with three or four white dorsal spots encircled with red. Apart from the abdominal markings and pink fringes, *rubrifrontaria* closely resembles *mimosaria*, but in genitalia and host plant preferences they are also distinct. The genitalia appear closest to those of the *festaria-intensaria* complex. *Rubrifrontaria* ranges from N.S. to N.C., and west to S.D. and Kans. It gets north at least to Smoky Falls on the Mattagami River, Ont.

TYPES. The type of *rubrifrontaria* was a male from Mass. (Sanborn). On a recent visit to the MCZ, I was unable to find it, but Packard's description leaves virtually no doubt as to its identity. The type of *packardaria* Grote would have been the same specimen.

SYNONYMY. *Packardaria* was proposed as a substitute name for *rubrifrontaria*, which Grote considered to be preoccupied.

FURTHER DESCRIPTION. Antennae and legs normal for the group; palpi of male somewhat pointed, shorter than those of *mimosaria*, exceeding front only by the length of the very small third segment; palpi of female longer, exceeding front by half the length of the second segment; third segment more prominent than that of the male, rounded; antennal scales whitish at the base, luteous distally; interantennal fillet white with a rather wide reddish hind margin; front red, usually of a somewhat rusty shade, not rose or pink, the lower margin rather narrowly white or luteous; luteous spots in upper corners of front present only rarely; palpi tinged with rose, the third segment white-tipped; femora and tibiae of the front legs and sometimes also the middle legs heavily tinged with deep rose; legs otherwise whitish or luteous. Underside of body whitish except for some green thoracic vestiture just behind the head, and traces of green on the undersides of the mid-abdominal segments, apparent in very fresh specimens. Upper side of thorax green like the wings; upper side of abdomen with green shading to segment 3 or 4, white beyond; abdomen with moderately well developed dorsal markings consisting of cream colored to whitish spots on segments 1, 3 and 4, encircled with variable amounts of a rather rusty shade of red like the coloring of the front; vestiges of similar markings may be present on segments 2 and 5.

Fore- and hindwings uniformly green, of a decidedly darker shade than *mimosaria*, very faintly striated with whitish. The usual lines white, fairly distinct but not wide, almost exactly as in *mimosaria*; antemedials convex, that of the forewing quite sinuous; postmedials regular or slightly sinuous, subparallel to outer margin; no terminal line; no discal spots; costa whitish, slightly shaded with red near the base; fringes with basal half whitish, outer half light pink; fringe coloring normally uniform, occasionally variegated with weak rays of darker pink on forewings. Pink distal half of fringe commonly faded or lost in worn specimens, but these may always be distinguished from *mimosaria* by the abdominal markings and from *bistriaria* by the lack of a red terminal line. Underside slightly paler with the lines indistinct.

Length of forewing: males, 12-13.5 mm; females, 12-14 mm.

MALE GENITALIA. Closest to those of the *festaria-intensaria* complex but differing in the following ways; uncus dilated at the tip; valve narrower, with a pointed, serrated prominence at the base of the costa (present as a vestige in *Ariz. festaria*); the usual basal costal process longer.

FEMALE GENITALIA. Also basically similar to those of the *festaria* complex but with the funnel-shaped ductus bursae of somewhat different form, as indicated by the figure

MATERIAL EXAMINED. 201 males, 112 females; 9 male, 5 female slides; numerous larvae, alive, in alcohol and inflated; one brood reared *ex ovo*.

DISTRIBUTION. NOVA SCOTIA: Pictou; Debert and Truro, Colchester Co.; New Harbour, Guysborough Co.; Mt. Uniacke, Hants Co.; Armdale, West Dover, bog on Prospect Road at Goodwood, bog east of Big Indian Lake in Halifax Watershed area, Purcell's Cove, and Halifax, Halifax Co.; Petite Riviere and Green Bay, Lunenburg Co.; Caledonia, Lake Kejimikujik, and White Point Beach, Queens Co.; Wolfville, Auburn and near Aylesford, Kings Co.; Annapolis Royal and South Milford, Annapolis Co. NEW BRUNSWICK: Caraquet, Gloucester Co. QUEBEC: Kazubazua. ONTARIO: Ottawa; Constance Bay; Severn; Sparrow Lake; Bobcageon; Biscotasing; Sudbury; Sault Ste. Marie; Smoky Falls, Mattagami River. MAINE: Bar Harbor; Passadumkeag; Thomaston, Knox Co.; Augusta; Gardiner; Sebec Lake. NEW HAMPSHIRE: Webster; Franconia. MASSACHUSETTS: Springfield; Cohasset; Weston; Amherst; Barnstable; Martha's Vineyard. CONNECTICUT: Putnam; Mansfield, Tolland Co.; Mystic; Guilford; New Haven; New Canaan; Greenwich, Fairfield Co.; Litchfield; Washington. NEW YORK: Maspeth, L.I.; Orient, L.I.; Yaphank, L.I.; Central Park, L.I.; near Amityville and near Patchogue, Suffolk Co.; West Farms, N.Y. City; Bear Mountain; Horseheads. NEW JERSEY: Edgewater Heights; Fort Lee District; Orange Mt.; Smithville, Atlantic Co.; Lebanon State Forest; South Amboy; Elizabeth; Jerseyville, 3 mi. E. of Freehold; Freehold; Atsion, Burlington Co.; Lakehurst; Whitebog. PENNSYLVANIA: Sinking Spring, Berks Co.; Scranton. VIRGINIA: Arlington. NORTH CAROLINA: Southern Pines. OHIO: Jackson Co. INDIANA: Millers. WISCONSIN: Lake Katherine, Oneida Co. MISSOURI: Willard. KANSAS: Mears Park, Franklin Co. SOUTH DAKOTA: Terry Peak, Black Hills, June 28, 1939 (A. C. Frederick), one male, one female in Brower collection, determined by genitalic examination.

GEOGRAPHICAL VARIATION. There is little indication of consistent geographical variation. Specimens from Mass. to N.J. in the central coastal region have the white lines a little wider than do the Canadian ones. The series reared on *Rhus copallina* at Arlington, Va. seemed unusually large and dark.

FLIGHT PERIOD. May 31–July 20 in N.S., with only one generation. Two or more generations southward; e.g., May 7–June 29 (one on Apr. 26 at Horseheads, N.Y.) and July 17–Aug. 29 in the region from Mass. to Pa.; Apr. 26–May 20 and July 17–29 at Arlington, Va. The one Kans. record was a female taken Aug. 7, 1965 by Mr. Wm. H. Howe (AMNH).

EARLY STAGES. The larva was first described by Packard (1876, p. 387) from notes made by Scudder. Hulst (1887, p. 72) described a larva, as *rubrolinearia*, found feeding on Bayberry, *Myrica cerifera* [*pennsylvanica*] at the eastern end of Long Island, but this was probably *rubrifrontaria*. It has since been redescribed and figured in excellent detail by Dethier (1942, p. 233, pls. 15, 16). The commonest, or at least best known, host plant is sweet fern, *Comptonia peregrina*. I have found and reared to maturity many larvae on *Comptonia*, and also reared a brood from eggs on this plant in Nova Scotia. I have also reared adults from larvae on *Myrica gale* and one from a larva found on *Kalmia angustifolia*. The last food plant should be verified although it is not entirely unlikely. In the CNC there is a male and a female reared from *Ceanothus* at

Bobcageon, Ont., by McDunnough, and another series reared on *Comptonia* at Kazubazua, Que. Dr. J. G. Franclemont reared it from eggs on *Rhus copallina* at Arlington, Va.

REMARKS. Packard, in his monograph of 1876, p. 386, erroneously included specimens from several western localities under *rubrifrontaria*. Part of these would have been *darviniata*.

Nemoria mimosaria (Guenée)

Plate 17, figures 4, 4a, 4b; plate 35, figure 5; plate 46, figures 6-8.

Aplodes mimosaria Guenée, 1857, p. 377. Walker, 1861, p. 586. Packard, 1876, pp. 388-389, pl. 10, fig. 89. Hulst, 1886b, pp. 139-141. Hulst, 1896, p. 315. Dyar, 1899a, pp. 310-311 (early stages); 1902 [1903], p. 302.

Nemoria mimosaria Prout, 1912, p. 111. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 22. McDunnough, 1938, p. 140. Forbes, 1948, p. 113, figs. 116, 120.

Iodis tractaria Walker, 1861, p. 540.

Hipparchiscus venustus Walsh, 1864, p. 301.

Aplodes latiaria Packard, 1873, p. 74; 1876, p. 391. Hulst, 1886b, p. 139.

Aplodes coniferaria Packard, 1884, p. 933.

Synchlora mimosaria and *latiaria* Gumpfenberg, 1895, pp. 497-498.

DIAGNOSIS. A pale green northeastern species entirely without red markings on the wings and abdomen; in size and lines of the wings very similar to *rubrifrontaria*; abdomen marked with a small, pure white dorsal spot at the base which is diagnostic; fringes white; front rose colored with a white lower border; vertex without a red posterior margin. Genitalia of both sexes distinctive and readily distinguished from those of all other species. *Mimosaria* ranges from N.S. to Sask., about as far north as Kapuskasing, Ont., and The Pas, Man., and south to Ill. and Va.

TYPES. *Mimosaria* was described from one male and two females from "Géorgie américaine," and "Canada." The surviving type is a female in the USNM labeled "Canada. Ex Musaeo Achille Guenée. Ex typicalibus speciminibus. Oberthur Coll. *Aplodes mimosaria*, Guenée, Sp. G. No. 605. Type." This specimen has lost its original abdomen and has been repaired with a female abdomen of some altogether different species, probably *bifilata* (it has a cream-colored dorsal stripe). A careful comparison of the specimen with *rubrifrontaria* and others convinced me that it definitely represents the species that has generally been called *mimosaria*. The type is still green and in fair condition except for the loss of its abdomen. The specimen or specimens from Georgia included in the species by Guenée must either have had a false locality or have been something else, as the species herein defined as *mimosaria* almost certainly does not reach Georgia. Guenée's description fits this species exactly, mentioning even the white dorsal spot at the base of the abdomen.

Tractaria was based on seven specimens in the BM from Trenton Falls, N.Y., "Orilla, West Canada" and N.S. *Venustus* was from Rock Island, Ill., but the present location of Walsh's material is unknown to me. *Latiaria* was described from one male from Albany, N.Y., and is probably at the New York State Museum, Albany. *Coniferaria* was based on six reared specimens from larvae on "fir and hemlock." The locality was not stated but the original description mentions that they "issued from the chrysalids in the breeding box, in Providence [Rhode Island], between April 20th and 25th." I have found four specimens labeled as types of *coniferaria*, one in the MCZ (unspread), one in the AMNH ex Hulst collection, labeled "Me.," and two in the USNM ex collection C. V. Riley.

SYNONYMY. There seem to be no reasons to doubt that the names *tractaria*, *venustus*, *latiaria* and *coniferaria* are anything other than *mimosaria*. However, *approximaria* Packard (1873, p. 73), which has been included in the synonymy of *mimosaria* since Dyar put it there in 1903, is almost certainly something else, but I am unable to identify it, even from Packard's figure. The reddish-brown front and legs, white-striped abdomen, green fringes and somewhat different wing shape mentioned in the description remove it from association with *mimosaria*. The present location of the type of *approximaria*, supposedly from Albany, N.Y., is unknown to me. *Coniferaria* was described mainly on the basis of having a different host plant, but it has since become apparent that *mimosaria* has an exceedingly wide range of food plants.

FURTHER DESCRIPTION. Antennae and legs normal for the group; male palpi moderate, exceeding front by just slightly more than the length of the third segment; third segment small, rather conical, arising conspicuously from the much wider, truncated end of the second segment; female palpi a little longer, exceeding front by half the length of the second segment; third segment elongated, subcylindrical.

Antennal scales pure white; head behind the white fillet entirely green; front deep rose with a white lower border of variable width and often with small white spots in the upper corners; palpi white, lightly tinged with rose on the second and third segments; front coxa and femur greenish anteriorly, tibia red; legs otherwise whitish; underside of body entirely whitish; upperside of thorax green like the wings; upperside of abdomen white except for the first three segments which are green; abdomen with a small but distinct pure white dorsal spot on the first segment, and a suggestion of a similar spot on the third segment where the green dorsal shading ends.

Upperside of wings a light, delicate shade of green, usually unstriated, paler than *rubrifrontaria* but with the lines about the same. Lines narrow but distinct, the antemedials occasionally vague; antemedials wavy, especially that of the forewing, evenly convex, closer to the base on the hindwing in the usual way; postmedial of forewing almost straight, quite regular, usually bent in slightly near costa; postmedial of hindwing bent on vein Cu, almost parallel to outer margin, which tends to be very slightly angled at M_3 ; costa white, green at the base and with or without a few faintly reddish scales near the base; fringes pure white, except that very fresh specimens often have a faint tinge of pink at the extreme apex of the forewing; no discal spots. Underside as above but considerably paler, darkening gradually towards the costa of the forewing, the lines indistinct, and the costa sometimes heavily flushed with pink toward the base. The pink ventral shading of the costa may be present or absent in offspring of the same parent.

Length of forewing: males, 10.5-14 mm; females 12-14 mm; largest in the southern portions of the range.

MALE GENITALIA. These are distinguished by the very long, pointed basal costal processes, and also by the abrupt 90° curve toward the end of the sclerotized costa, terminating in a very prominent, pointed distal costal process. In the development of the basal and distal processes of the costa of the valve, *mimosaria* is the most extreme species of the *bistriaria* group.

FEMALE GENITALIA. In *mimosaria* the sclerotized, funnel-shaped structure connecting the ductus bursae and ostium is further exaggerated, more so than in any other species, with its sides marked by coarse folds and striations.

MATERIAL EXAMINED. 333 males, 125 females, including types of *mimosaria* and *coniferaria*. Slides: 8 males, 6 females. Early stages: numerous larvae, alive and in alcohol; one brood reared *ex ovo*.

DISTRIBUTION. NOVA SCOTIA: Cheticamp, Inverness Co.; Baddeck, Victoria Co.; Pictou; Amherst and Parrsboro, Cumberland Co.; Waverley, Sackville, Armdale, Purcell's Cove,

and near Big Indian Lake, Halifax Co.; Mount Uniacke, Hants Co.; Centreville, Aldershot and near Aylesford, Kings Co.; Isle Haute, Bay of Fundy; Lake Kejimikujik, Queens Co.; Annapolis Royal, Annapolis Co.; Argyle, Yarmouth Co.; Digby. NEW BRUNSWICK: Caraquet, Gloucester Co. QUEBEC: Knowlton. ONTARIO: Ottawa; Trenton; Port Colborne; Miner's Bay; Lindsay; Stayner; Kearney; Leamington; Mer Bleue; Neebing; Hymers. MANITOBA: Birtle; Beulah; Transcona; Ninette; McCreary; Aweme; Red Rock Lake, Whiteshell Provincial Park. MAINE: Sebec Lake; Rangeley; Enfield. NEW HAMPSHIRE: Franconia; Randolph. VERMONT: West Sandgate, Bennington Co. MASSACHUSETTS: Boston. CONNECTICUT: Mystic; Storrs; Torrington; Litchfield; Washington; New Canaan; Greenwich, Fairfield Co. NEW YORK: West Farms, N.Y. City; Bronx Park; Yaphank, L.I.; Riverhead, L. I.; Bear Mountain; Big Indian Valley, Catskill Mountains; Albany; Ithaca; McLean; Buffalo. NEW JERSEY: Lakehurst; Lake Hopatcong; Paterson; Lee District; Jerseyville, 3 mi. E. of Freehold. PENNSYLVANIA: New Brighton; Adamstown; Scranton; Delaware Water Gap. VIRGINIA: Brush Mountain and Blacksburg, Montgomery Co. WISCONSIN: Lake Katherine, Oneida Co.; Bailey's Harbour, Door Co. ILLINOIS: Palos Park; Decatur. IOWA: Iowa City.

Prentice, 1963, p. 302, gives a distribution map for larval collections in Canada, indicating the northern and western limits that I mentioned in the diagnosis. Jones and Kimball, 1943, p. 107, report it from the island of Nantucket, Mass., but not from Martha's Vineyard. I have not seen these. There are three specimens in the USNM labeled "Colo., Bruce," probably in error.

GEOGRAPHICAL VARIATION. Specimens from Conn. southward tend to be larger than northern ones. The three examples taken in Va. (Covell) were all large, with the green unusually striated.

FLIGHT PERIOD. May 31–July 9 in N.S.; May 24–July 4 in Man.; May 20–June 24 in New England, but as early as May 9 at Ithaca, in central N.Y.; May 9–June 17 from New York City southward. The Virginia specimens were taken May 9 and 17.

It is interesting to note that throughout the entire range there is evidence of only one generation per season.

EARLY STAGES. These have been described by Walsh, 1864, pp. 300-302; Packard, 1881, p. 49, 1844, pp. 933-934, 1890, p. 189; Dyar, 1899a, pp. 310-311, and Forbes, 1948, p. 113. The larva is exceedingly close to that of *rubrifrontaria*, with only minor differences in pattern and coloring, and in the size of some of the setal tubercles. The integument in general is not quite as rough as that of *rubrifrontaria*. Prentice, 1963, p. 306, provides a long list of host plant species from which larvae have been collected by the Canadian Forest Insect Survey. I quote this as follows, with the number of records indicated in each case:

White birch	31	Speckled alder	2
Balsam fir	21	Red oak	2
Eastern hemlock	6	Green ash	2
Tamarack	6	Yellow birch	2
White elm	5	Mountain ash	1
Willow	5	Hawthorn	1
White spruce	5	Choke cherry	1
Basswood	4	Sugar maple	1
White Oak	4	Blue beech	1
Ironwood	2	Trembling aspen	1

In Nova Scotia I reared *mimosaria* from single larvae found on alder, willow and sweet fern (*Comptonia*), and reared a large brood ex ovo on white birch (*Betula papyrifera*). All of these emerged the following spring, but in the CNC there are eight specimens reared ex ovo on alder at Parrsboro, N.S. (McDunnough) which apparently emerged as a second generation the same season, as the dates are Aug. 3–Sept. 17, 1944.

***Nemoria glaucomarginaria* (Barnes and McDunnough), new combination**

Plate 18, figures 1, 1a, 1b; plate 36, figure 1; plate 46, figures 11, 12.

Racheospila glaucomarginaria Barnes and McDunnough, 1917c, p. 224. Prout, 1932, p. 25. McDunnough, 1938, p. 140.

DIAGNOSIS. A large, usually light green species, superficially almost exactly like *darwiniata* but with larger abdominal spots encircled by a pale, dull shade of red, the discal spots always wanting, no terminal line and the fringes white or ivory, unmarked or variably irrorated with red. Male genitalia differing from those of all other North American species in the large, bifurcate basal costal process of the valve. Female genitalia close to those of *leptalea* and the *intensaria-festaria* complex, but with ostial opening distinctly wider than in any of these; very different from those of *darwiniata*. *Glaucomarginaria* occurs in the region of the Cascades, Coast Ranges and Sierra Nevadas from the Okanagan Valley, B.C., to San Diego Co., Calif.

TYPES. *Glaucomarginaria* was described from a male from Laguna Beach [Orange Co.] and a female from Palo Alto, Calif. I hereby designate as lectotype the male, in the USNM (ex Barnes collection). The left wings are somewhat torn but the specimen is otherwise intact.

SYNONYMY. None.

FURTHER DESCRIPTION. Antennae, palpi, and legs normal for the group; male palpi exceeding front by twice the length of the small, rounded third segment; female palpi longer, exceeding front by a distance equal to about two-thirds the length of the second segment, the third segment subcylindrical.

Antennal scales whitish near the base, becoming luteous or reddish distally; white interantennal fillet with a red border behind; front dull to deep red, with or without a weak yellowish lower margin and small spots of the same shade in the upper corners; palpi heavily tinged with pale, dull red to deep rose; first pair of legs, and sometimes tibia of the second pair of legs reddish; legs otherwise ivory; front coxae and underside of thorax with some green vestiture but underside of body otherwise whitish. Upper side of thorax and abdomen green except for the large cream colored or whitish abdominal spots encircled with dull red on segments 1, 3 and 4. Vestiges of similar spots may also occur on segments 2 and 5 (that on 2 sometimes fully developed), and a small dorsal wedge of red is commonly present on the metathorax adjacent to the spot on segment A1.

Wings light green, sometimes darker, finely and faintly striated, almost exactly as in *darwiniata*; lines white, the postmedials usually distinct, the antemedials less so; antemedials convex, that of the forewing slightly sinuous, that of the hindwing strongly curved and nearer the base; postmedial of forewing almost straight, parallel to outer margin or diverging from it toward costa; postmedial of hindwing evenly curved or angled slightly at Cu₁; no discal spots; costa of forewing whitish or ivory, faintly tinged with red near base and apex; fringes plain ivory or yellowish, or variably marked with red. Most commonly the fringes have some traces of red rays opposite the veins on the forewing or both wings, but these markings are sometimes intensified and quite prominent, or (rarely) even confluent, forming a continuous crenulate red outer border on the fringes. The underside is similar but paler, the lines indistinct, and the costa with more reddish shading than above.

The white streak along the outer end of the cell on the hindwing, mentioned as a character by Barnes and McDunnough, is usually present but is unreliable, as *darwiniata* may also have it.

Length of forewing: male, 15-18 mm; female, 13.5-18.5 mm.

MALE GENITALIA. Although these show a clear relationship to the *bistriaria* group, they are unusual in several respects. The valve has a strongly sclerotized, concave costa with a large and prominent, obtusely pointed distal process, and a heavily sclerotized elevated median ridge. The large, heavy, basal costal processes are unique in being bifurcate. The uncus is linear or slightly expanded at the tip. The vinculum is very wide, with the sides almost parallel, and the juxta has an unusually elongated papiliform process.

FEMALE GENITALIA. These are less distinctive and indicate a close relationship to other species of the group. The ductus bursae is much enlarged in the usual funnel-shaped fashion, terminating in a very wide, quite rigidly sclerotized ostial opening larger than that of any of the closely related species.

The form of the sclerotized structures associated with the ostium in *darwiniata* is altogether different, and hence the genitalia of females as well as males of the two species are immediately distinguishable.

MATERIAL EXAMINED. 51 males, 51 females, including type; 11 male, 6 female slides.

DISTRIBUTION. BRITISH COLUMBIA: Oliver; WASHINGTON: Brewster, Okanogan Co.; Kusshi Canyon, Yakima Co. OREGON: S. Fork Umpqua River, 14 mi. N. of Tiller, Douglas Co. CALIFORNIA: Dunsmuir, Siskiyou Co.; Mt. Lassen, Shasta Co.; Orleans, Humboldt Co.; Mt. San Hedrin and Laytonville, Mendocino Co.; Anderson Springs, Cobb Mountain, Lake Co.; Spring Mountain and Mt. St. Helena, Napa Co.; Petaluma and Trinity P.O., Sonoma Co.; Walnut Creek, Lafayette, foot Shell Ridge and Martinez, Contra Costa Co.; Palo Alto, San Mateo Co.; Smoky Valley, Tulare Co.; Atascadero, San Luis Obispo Co.; Los Gatos, Santa Clara Co.; Glendora and Cloudburst Canyon, Angeles Crest, Los Angeles Co.; Laguna Beach, Orange Co.; Arlington, Idyllwild and Riverside, Riverside Co.; Upper Santa Ana River and Forest Home, San Bernardino Co.; Pine Valley, Descanso and San Diego, San Diego Co.; Alma; Eldridge.

GEOGRAPHICAL VARIATION. No consistent geographical trends apparent in the material available.

FLIGHT PERIOD. Mar. 8–July 5, with single records for July 19, Aug. 3 and Sept. 1. The three specimens from Wash. were taken May 3 and 27; the one from B.C., May 19. The records indicate that it usually begins flying in April in northern and central Calif.; in March in southern Calif.

EARLY STAGES. Unknown.

REMARKS. Perhaps the most notable feature of this species is its striking similarity to *darwiniata*, while not really being that closely related. The greatest resemblance is to northern *darwiniata*; whereas in Calif., where about half of the overlap occurs, the dark discal spots and more intense abdominal markings that distinguish *darwiniata* subspecies *punctularia* also serve to separate this subspecies from *glaucomarginaria*.

The specimen from Martinez, Calif., in the USNM, is labeled as a cotype of *darwiniata*, although Dyar's original description of that species does not mention such a specimen. The specimen from Oliver, B.C., May 19, 1953, D. F. Hardwick (CNC), female genitalia slide No. 1051 (D. C. Ferguson), is the only Canadian record.

Nemoria rindgei, new species

Plate 18, figures 2, 2a, 2b; plate 36, figure 2; plate 46, figures 13, 14.

DIAGNOSIS. A peculiar New Mexican species known from only four specimens. Forewing of the one male very pointed for *Nemoria*, with outer margin almost straight; forewing

of female more rounded. Color an intense shade of green, with hindwings contrastingly paler, antemedials of both wings obsolete, the postmedial of the forewing weak, arising at middle of inner margin, and straight, oblique; postmedial of the hindwing, although indistinct, also oblique, meeting inner margin at or before the middle. Fringes pinkish, pale at base, front and forelegs reddish, the body solid green, above and below, the abdomen unmarked. The lines, although less distinct, very reminiscent of *Chlorosea*, especially *C. margaretaria*.

Male genitalia normal for *bistriaria* group and close to those of *glaucomarginaria*, except that the basal costal process is not bifurcate. Aedeagus with a ventral hump not seen in any other species. Female genitalia unusual only in having a discrete pair of sclerotized plates in the wall of the funnel-shaped structure that leads to the ostial opening.

Rindgei and *caerulescens* are the only species of the *bistriaria* group in which the hindwings are distinctly paler than the forewings.

TYPES. Holotype male, Sitting Bull Falls, 4800', 42 mi. S.W. of Carlsbad, Eddy Co., N.M., June 26, 1964 (F., P., and M. Rindge), DCF slide No. 789. Paratypes, two females, same locality and collectors, June 26 and June 29, 1964; one female, Lordsburg, N.M., June 8[?], 1940 (Hill), ex Sperry collection. All four specimens of the type series are in the AMNH.

FURTHER DESCRIPTION. Antennae, palpi and legs essentially normal for the group; male palpi exceeding front by about twice the length of the small, rounded third segment; female palpi much longer, rather slender, exceeding front by almost half their length, third segment subcylindrical, about one-quarter the length of the second. Legs unusually slender when compared to others of the group (e.g. *bistriaria*, *rubrifrontaria*), but hind tibia of male moderately dilated and bearing the usual two pairs of spurs.

Antennal scales luteous; interantennal fillet whitish mixed with luteous scales, with a feeble, irregularly delimited buff or dull reddish hind margin; front uniformly dull red without pale markings; palpi variably tinged with the same or a rosier shade; coxae and femora of all legs green, except for the front and middle femora having some red shading distally, just before the point of articulation with the tibiae; front tibia red anteriorly, the same shade as the front or brighter. The hind tibia of the holotype is partly green but in the other specimens it is all whitish or luteous. The middle tibia and all tarsi are luteous. The body above and below is entirely green except for the very tip of the abdomen, which is whitish; the abdomen is unmarked.

Forewing with apex unusually acute; upperside a rather intense shade of green but not as dark as *intensaria*, unstriated; hindwings contrastingly paler except near outer margin and anal angle, becoming almost white toward costa; antemedial lines of both wings lacking; postmedial of forewing not strongly defined, straight, oblique, running from inner margin near middle to costa near apex; postmedial of hindwing indistinct, visible only in greener portion of wing, also oblique but curved, meeting inner margin near the middle; no discal spots; costa yellowish, darkening slightly but not flushed with red until it meets the fringe; fringe of forewing uniformly pink on outer half, cream colored on basal half; fringe of hindwing cream colored with the pink outer shading only near anal angle. Underside of forewing paler, hindwing about as above; the lines less distinct.

Length of forewing: holotype male, 12.5 mm; paratypes females, 12-13.5 mm.

MALE GENITALIA. Closest to those of *glaucomarginaria* but with the basal costal process of the valve undivided, the papilliform process of the juxta short and stubby, the sides of the vinculum more convergent toward the saccus, and a prominent mid-ventral hump on the aedeagus unlike any other species examined.

FEMALE GENITALIA. These too are of the *glaucomarginaria* type, and may be distinguished mainly by the two separated triangular areas of brown sclerotization at the ostial

opening. There is also what appears to be a partially sclerotized, tube-like structure farther down within the ductus bursae.

MATERIAL EXAMINED. One male, 3 females; 1 male, 1 female slide.

DISTRIBUTION. NEW MEXICO: Sitting Bull Falls, 4800', 42 mi. S.W. of Carlsbad, Eddy Co.; Lordsburg, Hidalgo Co.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. June 8 [?]-29.

EARLY STAGES. Unknown.

REMARKS. This distinctive species is named for Dr. Frederick H. Rindge of the AMNH who, with members of his family, collected three of the four specimens, and who kindly loaned these to me for study.

Unidentified Species

Aplodes approximaria Packard, 1873, p. 73. Hulst, 1886b, p. 140.

Type locality: Albany, N.Y.

Previous authors have referred this name to the synonymy of *mimosaria*, but it seems to me that Packard's description neither fits *mimosaria* nor any other known species. *Approximaria* will have to remain a *nomen dubium* until the type is located (see discussion under *mimosaria*).

PHRUDOCENTRA Warren

Phrudocentra Warren, 1895, p. 90, 1897, p. 429.

Melochlora Warren, 1901, p. 445.

Nesipola Warren, 1909, p. 82.

TYPE SPECIES. Of *Phrudocentra*, *pupillata* Warren, designated by Warren in 1895, p. 90, although the species was not described until 1897, p. 429; of *Melochlora*, *neis* Druce, designated by Warren, 1901, p. 445; of *Nesipola*, *impunctata* Warren, 1909 = *Phrudocentra impunctata* (Warren), designated by Warren, 1909, p. 82.

ADULT CHARACTERS. Moths medium sized to quite large, length of forewing 11-18 mm; wings broad, apex of forewing right angled in *centrifugaria* but usually more acute and produced; hindwing varying from slightly angulate to almost tailed; color bright green, scarcely striated, markings variable; antemedials commonly very weak or wanting; postmedials indistinct and convex (*Nesipola*), or often, as in *Dichorda*, almost straight (*Phrudocentra*), and well defined in whitish or brown; costa with or without a pale margin; brown discal spots usually present; terminal line present or absent; fringes mostly concolorous; abdomen commonly marked with a dorsal row of minute white spots. Characteristic dark brown shading may occur on both the upperside and underside in certain species of the *neis* group, and the species of the *centrifugaria* group

(*Nesipola*) may be marked by peculiar ocellate spots on each wing, with or without white filling.

It is doubtful if the venation provides any characters that differ consistently from those of *Nemoria*, although in three species examined (*pupillata*, *neis*, *centrifugaria*), Cu_1 of the hindwing always seems to arise before the end of the cell as in *Chlorosea*. Also in the hindwing (*centrifugaria*), Sc and R are separate or just barely touching, and the third anal is indicated only as a fold. *Centrifugaria* has a peculiar character in the cell formed by the second and third anals at the base of the forewing. This cell is so expanded that it almost forms a fovea. The frenulum of the male is normal, of the female wanting.

Male antenna bipectinate with longest branches longer than twice thickness of shaft, antenna tapering gradually from base to apex, becoming simple toward the tip; female antenna usually simple but in some species bipectinate like that of the male, or with pectinations even longer (e.g., in *neis* Druce and *eccentrica* Prout); palpi of male with second segment rather wide and compressed, truncate, third segment small and rounded; female palpi long to very long, in *centrifugaria* extending well beyond the head and with the third segment nearly as long as the second, and cylindrical or clavate; eyes normal, those of the male slightly larger and the front narrower; tongue normal, well developed; hind tibia of male moderately dilated and with no terminal process (*neis*) to fully dilated with a very long terminal process (*centrifugaria*), always with all spurs in both sexes; outer spurs less than half the length of inner spurs, and the distance between the two pairs generally less than the length of the longest spur

Male genitalia closest to those of *Dichorda* but with highly characteristic differences in the shape of some components. Tegumen and vinculum more slender and delicate than in either *Nemoria* or *Dichorda*; sides of vinculum much distended laterally so that the unit comprised of uncus, tegumen and vinculum is pear-shaped; in *Dichorda* this is spindle-shaped, in *Nemoria* variable but never as distinctly pear-shaped; saccus reduced to a knob or spine, or obsolete; uncus normal and long as in *Dichorda*, or short and stout as in the genotype, *Phrudocentra pupillata*; socii and gnathos essentially of the *Nemoria* and *Dichorda* type; valves basically like those of *Dichorda*, without a differentiated costa or other sclerotized elaborations, but with the coremata, lacking in *Dichorda*, enormously developed; aedeagus with a pair of sclerotized internal elements as in *Dichorda*; eighth sternite emarginate as in most species of *Nemoria*.

The female genitalia of the only species examined, *centrifugaria*, are very simple and offer little in the way of distinguishing characters. They are mostly membranous, with the bursa and ductus bursae both elongate, with no signum, and without special structures associated with the ostium.

LARVAL CHARACTERS. Larva of *Phrudocentra* unknown, but that of *pigraria* Wichers and Scheller, a species of uncertain identity that Prout first assigned to *Phrudocentra* (1912) and later (1932) to the related genus *Tachyphyle* Butler, was figured by Christian Sepp in 1848 (*Surinaamsche Vlinders*, Amsterdam, p. 39, fig. 16). It was "brown, protectively assimilated to withered leaf, the first five abdominal segments apparently with enormously extended dorsolateral protuberances, forming, from the dorsal view, a continuous plate" (Prout, 1912, p. 121; 1932, p. 45).

DISTRIBUTION. Neotropical, with one species entering southern Florida and another known from a single record from Pharr, Hidalgo Co., Texas. The two or three species of the *centrifugaria* group seem to be localized in the Antillean region.

REMARKS. This generic definition is unsatisfactory since it has not been possible to consider all of the Neotropical species. I have examined the male genitalia of *centrifugaria*, *neis* and *pupillata*, representing three diverse groups within *Phrudocentra*, as understood by Prout, and find that they form a natural group with basically similar genitalia. The structural differences are mostly those of size and proportion only, and although there is some diversity in the non-genitalic characters such as antennae and

male hind tibiae, I have little hesitation in regarding at least the three species examined as congeneric. Compared to the others, *pupillata* has a much shortened uncus, a larger tooth on the gnathos, and one of the two sclerotized elements of the aedeagus replaced by a cluster of cornuti, but otherwise its genitalia are close to those of *neis* and *centrifugaria*.

Phrudocentra centrifugaria (Herrich-Schaeffer)

Plate 3, figure 1; plate 18, figures 3, 3a, 3b; plate 36, figure 3; plate 46, figures 15-18.

- Geometra centrifugaria* Herrich-Schaeffer, 1870, p. 182; 1871, p. 46. Gundlach, 1881, p. 385.
 Anonymous, 1895, p. 69.
Racheospila centrifugaria Dyar, 1908a, p. 171; 1908b, p. 35.
Nesipola centrifugaria Warren, 1909, p. 82.
Phrudocentra centrifugaria Prout, 1912, p. 123. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 49. McDunnough, 1938, p. 141.
Phrudocentra centrifugaria (sic) Kimball, 1965, p. 163.
Geometra protractaria Herrich-Schaeffer, 1870, p. 182; 1871, p. 47. Gundlach, 1881, p. 386.
 Anonymous, 1895, p. 79.
Eucrostis hollandaria Hulst, 1886a, p. 122.
Racheospila hollandaria Hulst, 1896, p. 314. Dyar, 1902 [1903], p. 300.
Eucrostis jaspidiaria Hulst, 1886a, p. 122.
Racheospila jaspidiaria Hulst, 1896, p. 314. Dyar, 1902 [1903], p. 300.
Synchlora viridipurpurea Hulst, 1898, pp. 159-160.
Racheospila viridipurpurea Dyar, 1902 [1903], p. 300.
Racheospila anomalaria Moeschler, 1890, p. 243.
Nesipola anomalaria Warren, 1909, p. 82.
Phrudocentra anomalaria Prout, 1912, p. 124.
Euchloris heterospila Hampson, 1904, p. 178.
Nesipola heterospila Warren, 1909, p. 82.
Phrudocentra heterospila Prout, 1912, p. 124.

DIAGNOSIS. Within the region covered, this is a distinctive species unlikely to be confused with any other. It is one of a small group of closely related Antillean species but, of these, only *centrifugaria* reaches Florida. It also occurs in Cuba, the Bahamas and Puerto Rico. *Centrifugaria* is about the same size as *Nemoria lixaria*, bright green, unstriated, with a broken reddish brown terminal line and pinkish fringes; the lines of the wings, especially the postmedials, are indicated as series of small brown dots. Most females have large spots which may be whitish with brown borders or solidly brown. There is one such spot on the forewing near the anal angle, and another on the inner margin of the hindwing. The palpi are rose colored, extremely long, those of the female equal in length to the forecoxa; the front is green with a thin white border at bottom and sides, the body whitish below, green above; the abdomen has a series of small dorsal spots that are either white or brown and white.

The large spots of the females are extremely variable, ranging from total absence to conspicuous brown circles filled with white, or even multiple spots (two or three). Males apparently always lack the spots. The sexual dimorphism and variability has resulted in an extensive synonymy. Both Herrich-Schaeffer and Hulst described the two sexes as different species.

TYPES. *Centrifugaria* and *protractaria* were described from Havana, Cuba. I do not know the present location of the types. *Hollandaria* was based on one female from Florida, "Coll. Holland". It should be in the Carnegie Museum, Pittsburgh, Pa. *Jaspidiaria* was based on two males from Fla., both now in the AMNH, although there is a third labeled type in the USNM, from Indian River, Fla. One of the specimens in the AMNH bears a red type label and I designate this as the lectotype. *Viridipurpurea* was described from an unstated number of specimens, all females, from Charlotte

Harbor, Indian River, and Lake Worth, Fla. Two of the types, both from Charlotte Harbor, are in the AMNH, and a third, from Indian River, is in the USNM. I hereby designate as lectotype the specimen in the AMNH labeled Collection G. D. Hulst. *Anomalaria* was from Puerto Rico but its present location is unknown to me. *Heterospila* was from the Bahamas and I presume that the type is in the BM.

SYNONYMY. Dyar (1908a) first referred the Floridian population (*hollandaria*, *jaspidiaria*, *viridipurpurea*), to *centrifugaria*, but did not indicate how he identified Herrich-Schaeffer's Cuban specimens of *centrifugaria* and *protractaria*. *Anomalaria* Moeschler was placed in the synonymy by Prout (1932, p. 49). The type material of *heterospila* Hampson was undoubtedly available to Prout and he considered that this form, from the Bahamas, originally described as a species, could perhaps not even be regarded as a race. *Hollandaria* was a female with large whitish spots, and *jaspidiaria*, described at the same time, was based on males. Hulst remarked that they might be male and female of the same species but named both anyway. He later acquired females in which the spots were not filled with white but were entirely purplish brown and exaggerated in size, and named this form as another new species, *viridipurpurea*. These forms fall within the normal range of variation. *Stellataria* Moeschler, from Jamaica, is very close to *centrifugaria* but the male genitalia show slight differences in several characters. There are names for a number of other Antillean populations or forms (see Prout, 1932, p. 49) but I have not investigated these.

FURTHER DESCRIPTION. Antenna of male broadly bipectinate to near the tip, the length of the longest branches at least equal to five times the diameter of the shaft; antenna of female ciliate as in *Nemoria*; male palpi long, exceeding front by over half their length, with segment 3 about half the length of segment 2, slender, clavate; female palpi extremely long, slender, exceeding front by about two-thirds of their length, with segment 3 equal in length to segment 2, slender, slightly clavate. Other external structural characters as given for the genus.

Scales of antennal shaft and branches white dorsally near the base, yellowish distally; interantennal fillet pure white with a few red scales behind; front solidly deep green, smoothly scaled, with a thin white margin at sides and bottom, and with a few red scales just above the white ventral margin; palpi heavily tinged with deep rose, segments 2 and 3 white-tipped; legs white or yellowish except that the fore tibia and femur are tinged with brown; underside of body whitish; upperside of thorax and abdomen green, concolorous with wings, except that the abdomen has a row of small dorsal spots. These spots may be pure white or they may be partly encircled with deep reddish brown, and most of the dorsal surface of segment 7 may be brown.

Upper surface of wings bright green, unstriated; costa thinly edged with white, turning yellow at base, and with a yellow shade posteriorly for its full length; ante-medial indicated only by a series of 3 or 4 minute reddish brown dots on the forewing, wanting on the hindwing; postmedial indicated by a similar series of dots on both wings, one dot on each vein; discal spots of the same reddish brown color usually present, that of the hindwing being the larger. Females usually have a large spot toward the anal angle of the forewing, not quite reaching the margin, and a similar spot toward the anal angle of the hindwing but touching the inner margin. These spots are commonly large enough to occupy the space between M_3 and the second anal on the forewing, and Cu_3 and the inner margin on the hindwing, but they may be even larger or reduced to the point of being vestigial. These large spots may be solidly brown, or purplish brown, or they may be conspicuously filled with white or pinkish scaling, encircled with a dark border. The spot on the hindwing is almost centered on the postmedial but that of the forewing lies just beyond it. Apparently such markings do not occur in the male. Both sexes have a dark reddish brown terminal line, interrupted at the veins, and pink fringes with yellow rays opposite the vein endings. The underside is much paler, quite yellowish, with the markings of the upperside hardly indicated.

Length of forewing: male, 11-13 mm; female, 12-13 mm.

MALE GENITALIA. As discussed under the generic heading and figured on pl. 18, fig. 3.

FEMALE GENITALIA. As discussed under the generic heading and figured on pl. 36, fig. 3.

MATERIAL EXAMINED. 41 males, 24 females; 4 male, 3 female slides.

DISTRIBUTION. FLORIDA: Miami; Homestead; Paradise Key; Tavernier; Bradenton; Fort Meade; Florida City; Royal Palm State Park; Lake Worth; Marco; Vero Beach; Port Sewall, Martin Co.; Charlotte Harbour; Indian River; Oneco, Manatee Co.; Siesta Key, Sarasota Co.; St. Petersburg; Archbold Biological Station, Lake Placid, Highlands Co.; Gainesville. Also in the Bahamas, the Greater Antilles to Puerto Rico, and perhaps the Virgin Islands.

GEOGRAPHICAL VARIATION. None within the continental region.

FLIGHT PERIOD. The records are distributed through every month of the year, indicating that the species flies almost continuously.

EARLY STAGES. Unknown.

REMARKS. Kimball (1965, p. 163), gives numerous additional records that I do not quote as I have not seen the specimens.

Phrudocentra neis affinis (Warren)

Plate 46, figures 21, 22.

Melochlora affinis Warren, 1906, p. 417.

Phrudocentra affinis Prout, 1912, p. 122.

Phrudocentra neis affinis Prout, 1932, p. 49.

In the AMNH there is a single female (ex Buchholz Collection) from Pharr, Texas (H. A. Freeman) that seems closer to *affinis* than to any other known form. The label does not give the date of capture. A comparison with specimens believed to be the true *affinis* from Brazil and French Guiana shows that the wings of the Texas specimen are less angulate and the underside less heavily marked with brown. Therefore, the determination is somewhat uncertain and will no doubt remain so until more material is available. I searched several large Mexican collections (AMNH, USNM, and a quantity of material from Yucatan in the YPM) looking for additional specimens but have found none.

A startling peculiarity of this species and some of its near relatives is that the female antennae are pectinate with branches even longer than those of the male. This was noted by Prout in *Phrudocentra eccentrica* Prout and *P. neis* Druce (1932, p. 48), but at first I mistook the Texas specimen for a male because of its wide antennae, even considering that it might have been repaired with the head from a different specimen.

Druce (1892, p. 93) reported *neis* from Coatepec, Mexico (near Jalapa, Veracruz), but that is the only Mexican record I have found for any species in this group. *Neis* was described from Chiriqui, Panama (type in BM), and *affinis* from French Guiana (type in USNM). Specimens of the former from Columbia, and of the latter from French Guiana and Brazil (in the USNM, ex Dognin collection) agree with this suggested pattern of distribution, but the single Texas specimen would seem to violate it, since the reduction in the brown pattern of the underside is even more extreme than in *affinis*. *Neis* has the most extensive brown clouding beneath, with a characteristic

proximal extension of the brown area on the forewing along the inner margin almost to the base. The apparent reversal of this geographic trend seen in the Texas specimen supports the notion that it may represent another species, but it should not be named until more Mexican material is available.

DICHORDA Warren

Dichorda Warren, 1900, p. 132.

TYPE SPECIES. *Geometra iridaria* Guenée, 1858 = *Dichorda iridaria* (Guenée), designated by Warren, 1900, p. 132.

ADULT CHARACTERS. Relatively large species, forewing length 11-22 mm; wings of characteristic shape, with the apex of the forewing produced, and the hindwing somewhat lengthened from base to anal angle, the latter forming an angle of 90° or less; color bright green as in most other *Nemoriini*, often with a bluish cast, with or without pale clouding but never coarsely striated; costa pale, heavily irrorated with purplish brown; lines highly characteristic, whitish, almost straight, all usually present and well defined except the antemedial of the hindwing, which is wanting; antemedial of forewing often erect, postmedials oblique, tending to form a continuous straight line from anal angle of hindwing to near apex of forewing; small dark discal spots usually present; no terminal line; fringes green or shaded with white; abdomen unmarked or with minute white dorsal spots; palpi and legs characteristically spotted with dark brown.

Venation not really different in any significant way from that of *Nemoria*. $M_3 + Cu_1$ of hindwing unstalked; third anal of hindwing present; frenulum of male present but very small, of female completely wanting.

Antennae of male bipectinate, tapering gradually, outer third simple, length of longest pectinations greater than twice thickness of shaft in the species studied; female antennae simple or slightly dentate, ciliate beneath; palpi of the sexes similar, quite long, exceeding front by almost half their total length, third segment twice as long as wide, or less, rounded; eyes of male slightly larger than those of female, front narrower and almost square; front flat except for a somewhat raised transverse ridge across the bottom; tongue normally developed; hind tibia of male almost undilated, with no terminal process, and with two pairs of spurs separated by a distance less than the length of the longest spur; hind tibia of female undilated, also with both pairs of spurs; hind tarsus of both sexes approximately as long as tibia.

Male genitalia characteristic and varying little from species to species. Uncus, tegumen and vinculum comprise a spindle-shaped unit, with an elongate and somewhat pointed saccus. Uncus, socii and gnathos much as in *Nemoria* and *Phrudocentra*; transtillata well developed; valve simple as in *Phrudocentra*, with an essentially undifferentiated costa; coremata obsolete; aedeagus very long and containing a pair of longitudinal, pointed, sclerotized processes, one terminating apically and the other subapically; eighth sternite distinctive in having its posterior margin extruded to form a very convex, rounded process, entire or but feebly emarginate, quite sclerotized and with a roughened, finely spinulose surface.

A diagnostic character of the female genitalia, at least in the species examined, is that the bursa copulatrix is twisted about sideways with sufficient rigidity that it cannot be straightened without rupture or distortion, although it appears membranous. Ostium simple; ductus bursae elongate and somewhat sclerotized; ductus seminalis entering just between this sclerotized region and the beginning of the bursa; no signum.

LARVAL CHARACTERS. The larva is quite like that of *Nemoria* except that the peculiar lateral protuberances show even more exaggerated development. These are outwardly truncate, with setae at the corners, and adjoin the body in such a way as to form large quadrate dorsal segmental plates on the thoracic and first five abdominal segments. The thoracic plates are smallest, that of abdominal segment 3 widest, forming a transverse rectangle about three times as wide as long. Abdominal segments 6 to 8 have the lateral processes reduced to small humps, but segment 8 bears a pair of erect, dorsal, horn-like processes. The head, like that of *Nemoria*, is rounded and unadorned, without specialized lobes or processes. The three species that have been reared all fed on species of *Rhus* (Sumach).

DISTRIBUTION. Mainly southern Nearctic, northern Neotropical. There are four species in the United States, and supposedly four others in South or Central America and one in Jamaica.

REMARKS. *Dichorda* is a small, compact and quite distinctive genus of which the North American members are closely related and mostly allopatric. Of the taxa treated here, four are clearly good species, with subtle but consistent genitalic differences. Subspecies *latipennis* does not differ structurally from *iridaria*, and they appear to intergrade in a narrow blend zone. Otherwise *latipennis* looks distinct enough to be regarded as a species, its Floridian distribution following the pattern of mutual exclusion commonly found among closely related species in the Geometrinae.

In relationship, *Dichorda* is well isolated from *Nemoria* and *Chlorosea*, but probably close to *Phrudocentra*. Some of the Neotropical species that Prout assigned to *Phrudocentra* have lines like those of *Dichorda*, but I have not examined their genitalia.

Key to the Species of *Dichorda*

1. Antemedial of forewing and postmedial of hindwing slightly convex; eastern 2
 All lines nearly straight; western, including Tex. 3
2. White lines wide, green areas more or less clouded with white, veins in postmedial space usually outlined with white; eastern except where replaced by *latipennis* *iridaria iridaria*
 White lines rather narrow, green areas only faintly clouded with white, veins in postmedial space faintly outlined with bluish but not white; peninsular Fla., coastal Ga., S.C. *iridaria latipennis*
3. Coloring similar to *iridaria*, postmedials somewhat diffuse outwardly (as in *iridaria*), green areas with or without whitish clouding, including veins of postmedial space; S. Ariz., Mexico, Central America *consequaria*
 Coloring more bluish than *iridaria*, postmedials thin, sharply defined, no white clouding, veins not outlined with white 4
4. Shade usually only faintly bluish, almost pure green, discal spots distinct, small patch of dark scales on underside of hindwing between discal spot and inner margin (as in the preceding species), a larger species than *iridaria*; Calif. *illustraria*
 Shade distinctly bluer than any of the preceding, discal spots weak or wanting, patch of dark scales on underside of hindwing between discal spot and inner margin nearly always lacking, a species the size of *iridaria* or smaller 5

5. Size of *iridaria*; Tex. and Ariz. to N.D. and Mont. *rectaria rectaria*
 Smaller than *iridaria*; desert areas of S. Calif. *rectaria cockerelli*

Dichorda iridaria iridaria (Guenée)

Plate 3, figure 2; plate 18, figures 4, 4a, 4b; plate 19, figures 1, 1a, 1b, 1c; plate 36, figure 5; plate 46, figures 23, 24.

Geometra iridaria Guenée, 1858, p. 344. Walker, 1861, p. 508. Packard, 1876, p. 394 (partim). Oberthür, 1916, p. 77.

Holothalassis iridaria Gumpfenberg, 1895, p. 510.

Anaploides iridaria Hulst, 1896, p. 316.

Dichorda iridaria Warren, 1900, p. 132. Prout, 1912, p. 127. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 51. McDunnough, 1938, p. 141. Forbes, 1948, p. 114.

Geometra remotaria Walker, 1861, p. 530. Hulst, 1895, p. 71.

Anaploides remotaria Hulst, 1896, p. 316. Dyar, 1902 [1903], p. 302.

DIAGNOSIS. This is the only named *Dichorda* in the eastern half of North America except for *latipennis* in Fla. and Ga. and *rectaria* in Tex. *Iridaria* ranges from the Gulf states to southern Canada. It differs from *consequaria* and *rectaria* in (1) the more rounded shape of the wings, with more convex outer margins, (2) the tendency to have much more white in the lines, as shading in the median space and outwardly along the veins, and (3) in having almost always a slight convexity in the postmedial of the hindwing. *Latipennis* is similar in wing-shape but is smaller, more intensely green and with the amount of white much reduced; it lacks the white shading on the veins beyond the postmedial line. True *consequaria* has wide lines and sometimes well developed white shading but is mostly Mexican. Genitalic differences are slight but *iridaria* tends to have a narrower valve and more produced saccus than most other species.

TYPES. *Iridaria* was described from "un ex[emplaire] mutilé. Coll. Bdv.," from "Amérique septentrionale." According to Oberthür, 1916, p. 77, the type is lost. *Remotaria* was described from one male without locality, but stated by Walker to be from Mr. Milne's collection. In a letter to T. W. Harris, dated June 4, 1839, Edward Doubleday remarked "the late Mr. Milne's collection will soon be for sale, and he purchased many things of Abbot" (Entomological Correspondence of Thaddeus William Harris, M.D., edited by Samuel H. Scudder, Occasional Papers of the Boston Society of Natural History 1:123. 1869). It would therefore seem quite likely that the type of *remotaria* is an Abbot specimen and came from Georgia (but see below).

SYNONYMY. There is still some uncertainty as to the identity of *iridaria*. Being one of Boisduval's specimens, it could have come from almost anywhere—perhaps California, in which case it could be the same as either *illustraria* or *rectaria*. Hulst stated that *iridaria* was the same species as *rectaria*, and that *remotaria* should be used for the well known species of the eastern states (1895, p. 71). Prout (1912, p. 127) disregarded Hulst's identification and reassigned the name *iridaria* to the eastern species, without giving any reason or any indication of whether he had seen Guenée's type. The original description, based on one poor specimen, mentions none of the more obvious distinguishing characters of the eastern species, but does contain two fragments of evidence that indeed suggest that this is what Guenée had. These are as follows: "les lignes ordinaires très-distinctes, . . . précédées de vert plus jaunâtre, fondu, suivies d'un vert plus bleu," and "Un petit point cellulaire noir, un peu cerclé de blanchâtre." The bluish shade following the postmedials and the faint whitish ring around the discal spots are diagnostic for distinguishing *iridaria* from

latipennis, *rectaria* and *illustraria*, but not from *consequaria*. However, since the place of origin was stated to be North America, it seems much less likely that Guenée would have been describing *consequaria*.

Remotaria is possibly the same as *iridaria*, and appears to have the same rounded wing shape. I have a colored photograph of the type in the BM and, although the specimen is still green and in fair condition (no abdomen), the crucial characters are just not clear. The outer third of the forewing is so worn that the white shading on the veins, if it was present, does not show. The white shading on the antemedial and postmedial lines is not very wide, and the postmedial of the hindwing is perfectly straight. The antemedial of the forewing is also straight, and the postmedial of the forewing is bent in slightly on approaching the costa. These are characters of *latipennis*, from Florida, and I have a strong suspicion that this is what *remotaria* might be. It also much resembles *consequaria* except for the more convex outer margins.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs as given for the genus. Antennal shaft white, sometimes with an admixture of brown scales; interantennal space and vertex white, usually with some pale brownish scales mixed in; front white, traversed by an irregular band of light brown; palpi heavily tinged with smoky brown; legs whitish, contrastingly ringed or spotted with dark gray-brown, mostly at the apices of the tibiae; underside of body whitish; upperside of body whitish; upperside of thorax and abdomen green, concolorous with wings; abdomen unmarked.

Wings above deep, pure green, often heavily shaded with white; costa partly white, broadly and heavily dusted with chocolate brown before antemedial, narrowly and faintly so beyond; antemedial of forewing evenly convex, white, narrower than postmedial, usually with yellowish outer edging; hindwing with antemedial wanting; postmedials broad, white, preceded by a cream colored or olivaceous edging, and outwardly diffuse, giving the appearance of bluishness along the outer side; postmedial of forewing almost straight, just slightly concave in lower half; postmedial of hindwing usually somewhat convex but occasionally straight; veins diffusely shaded with white beyond the postmedials on both wings, but especially the forewing, forming characteristic whitish rays between the postmedials and the outer margins that distinguish *iridaria* from all the other species discussed except *consequaria*. Median space, especially of forewing, variably shaded with bluish-white; discal spots on both wings small, blackish, often thinly encircled with whitish, that on the forewing situated closer to the antemedial than in the other species; fringes green, but varying from almost white to a shade nearly concolorous with wings. Underside paler except toward costal area of forewing, which is all green; lines faint and diffuse; shading of veins and median space not repeated below; discal spots stronger than above; hindwing with an irregular blackish patch between discal spot and inner margin, this being part of a diffuse and mostly obsolescent blackish band occupying approximately the position of an antemedial line.

Length of forewing: male, 11.2-15 mm; female, 15-16 mm.

MALE GENITALIA. Uncus more slender than in *consequaria*, *illustraria* or *rectaria*, about as in *latipennis*; valve slightly narrower than is usual in the western species; saccus with an extruded process, rounded or knob-like at the tip. The characters are variable in all the species and perhaps not consistent.

FEMALE GENITALIA. Doubtfully distinguishable from those of the other species. The ductus bursae seems shorter and stouter and the bursa copulatrix more rounded than in *rectaria*, but similar to those of the other species.

MATERIAL EXAMINED. 190 males, 71 females; 8 male, 5 female slides.

DISTRIBUTION. NOVA SCOTIA: Green Bay, near Petite Riviere, Lunenburg Co. QUEBEC: Norway Bay; Montreal. ONTARIO: Marmora; Port Colborne; Point Pelee; Barry's

Bay. MASSACHUSETTS: Cohasset; Weston; Melrose; Martha's Vineyard. CONNECTICUT: Putnam, Windham Co.; Washington, Litchfield Co.; Greenwich, Fairfield Co.; West Rock Park, New Haven; East River; Mystic; New Canaan; Middletown. NEW YORK: Clayton, Picton Island; Katonah; New Windsor; Catskill Mountains; Bear Mountain; Valley Cottage, Rockland Co.; West Farms, New York City; South Shore, Long Island; Orient, Long Island. NEW JERSEY: Mendham; Chester; Mt. Holly; Bayonne; Plainfield; Oakland; Lakehurst; Jerseyville, 3 miles east of Freehold. PENNSYLVANIA: New Brighton; Adamstown; Delaware Water Gap; Sinking Spring, Berks Co. OHIO: Granville; Goodhope Tp., Hocking Co. MICHIGAN: Oakland Co.; Branch Co.; Gull Lake Biological Station, Kalamazoo Co. INDIANA: Fremont. ILLINOIS: Putnam Co.; Carbondale. DELAWARE: Wilmington, New Castle Co. MARYLAND: Plummer's Island, Cabin John. VIRGINIA: Arlington; Blacksburg; Luray. NORTH CAROLINA: Maxton; Raleigh; Southern Pines. SOUTH CAROLINA: Beaufort; McClellanville. TENNESSEE: Monteagle; Burrville. MISSOURI: St. Louis Co.; Warsaw; Williamsville. GEORGIA: Screven Co.; Burton. ALABAMA: Ozark. MISSISSIPPI: Jackson, Hinds Co.; Agricultural College. TEXAS: Town Bluff, Tyler Co. FLORIDA: Tallahassee; Torreya State Park, Liberty Co. UTAH: Logan, one male taken July 12, 1955 by S. L. Wood (CNC); determination checked by genitalic dissection but locality should be verified.

GEOGRAPHICAL VARIATION. Specimens from Screven Co., Ga., Tallahassee, Fla. (AMNH), and from Ala. and Miss. have heavy white markings and are normal *iridaria*; a male from Torreya State Park, Fla., is the color and size of *iridaria* but does have the white shading reduced, suggesting a transition to *latipennis*; 5 specimens from The Wedge plantation, near McClellanville, S.C. (YPM) appear intermediate between *iridaria* and *latipennis*; two specimens examined from the Okefenokee Swamp, Ga. (AMNH) are definitely *latipennis* and show no sign of intergradation. The single specimen from Texas (AMNH) has the lines a little narrowed, but is probably within the normal range of variation for *iridaria*. The specimen from Utah has the white lines and rays reduced but is otherwise quite normal.

FLIGHT PERIOD. Two well defined generations are indicated throughout the range. In Ont. and Que., June 3–July 9, and July 31–Aug. 11 (the single N.S. record taken by me June 30, 1955); northern states to Del., Md. and Mo., May 7–July 2, and July 12–Aug. 27 (one N.J. record for Sept. 15); Va., N.C. and Tenn., Apr. 16–June 5 and July 19–Aug. 31; S.C., Ga., Ala., Miss., Mar. 29–Apr. 16, and June 9–Aug. 7. The Texas record was taken Mar. 27.

EARLY STAGES. *Dichorda iridaria* was reared by Dimmock on *Rhus* (sumach). His reared adults and empty pupal shells are in the USNM, and his manuscript notes are supposed to be there although I could not find them. There is also a drawing by F. Knab, presumably of one of Dimmock's larvae. In 1967 I reared *iridaria* from a female taken at Hamden, Conn. in June, and this brood produced adults as a second generation in late July. I fed the larvae on *Rhus typhina*. The larva is much like that of *illustraria* except that the paired caudal processes are longer and not bifurcate at the tips.

Dichorda iridaria latipennis (Hulst)

Plate 19, figs. 2, 2a, 2b; plate 46, figures 25, 26.

Slossonia latipennis Hulst, 1898, p. 217. Dyar, 1902 [1903], p. 335.

Anaploides remotaria Grossbeck, 1909, p. 354.

Dichorda iridaria (partim) Prout, 1912, p. 127. Barnes and McDunnough, 1917a, p. 100. Prout 1932, p. 51. McDunnough, 1938, p. 141.

Dichorda iridaria consequaria Forbes, 1948, p. 114.

Dichorda iridaria latipennis Kimball, 1965, p. 164.

DIAGNOSIS. *Latipennis* is a smaller, greener form that replaces nominate *iridaria* in the Floridian fauna. In peninsular Fla. it looks almost distinct enough to be regarded as a species, but there appears to be a narrow clinal zone through Ga. and S.C. The postmedials of *latipennis* are discrete lines with almost no outward diffusion, and there are no boldly contrasting white rays in the outer area. The postmedial of the forewing is quite straight except for a slight inward bend at R_5 , so that it tends to meet the costa a little farther from the apex than in *iridaria*. The postmedial of the hindwing and antemedial of the forewing are straighter than in *iridaria*. The olivaceous inner shade along the lines is often more evident than in *iridaria*, and there is almost no whitish overlay in the median space or near the costa. The fringes are entirely deep blue-green in *latipennis*, almost concolorous with the wings and with no pale basal line; they are mostly whitish in *iridaria*.

TYPES. Described from one specimen from "Cocoanut Grove, S. Fla." [Dade Co.], type No. 3956 in the USNM. The type is a completely discolored, yellowish specimen, which probably explains why Hulst did not recognize it as belonging in the Geometrinae.

SYNONYMY. None. The names *consequaria* Hy. Edw. and *perpendicularata* Warr., included here by some authors (e.g. Forbes, 1948), refer to a different species. The name *remotaria* Wlk., discussed under *iridaria*, possibly refers to *latipennis*, and would have priority.

FURTHER DESCRIPTION. Subspecies *latipennis* resembles *iridaria* except for the differences mentioned in the diagnosis. The larger gap on the costa between the postmedial and the apex is perhaps more apparent than real because of the thinness of the line and the green color of the fringes. However, the outer margin of the hindwing in *latipennis* looks even more convex, and the straighter postmedial bisects the hindwing into basal and distal portions of almost equal area. In *iridaria*, the basal portion almost always looks the larger. *Latipennis* seems to average distinctly smaller than nominate *iridaria*.

Length of forewing: males, 12-14 mm; females, 14-15.5 mm.

MALE GENITALIA. Like those of nominate *iridaria*.

FEMALE GENITALIA. Like those of nominate *iridaria*.

MATERIAL EXAMINED. 62 males, 26 females; 3 male, 1 female slides.

DISTRIBUTION. FLORIDA: Biscayne Bay; St. Petersburg; Charlotte Harbour; Florida City; Port Sewall, Martin Co.; Orlando; Siesta Key, Sarasota Co.; Oneco, Manatee Co.; Miami; Vero Beach; Punta Gorda; Archbold Biological Station, near Lake Placid, Highlands Co. GEORGIA: Chesser's Island, Okefenokee Swamp, Charlton Co. SOUTH CAROLINA: McClellanville, Charleston Co. (This record also listed under *iridaria* to draw attention to the existence of specimens that are intermediate).

GEOGRAPHICAL VARIATION. See comments above on intergradation to nominate *iridaria*.

FLIGHT PERIOD. Jan. 8, 30; Feb. 5, 12, 16; Mar. 1-30; Apr. 1, 4, 18; May 8-29; July 5, 21, 27; Sept. 17.

EARLY STAGES. After this paper was written, I reared a brood on *Rhus copallina* from a female taken at the Wedge Plantation, McClellanville, S.C. in Aug., 1968. The 46 resulting offspring, which emerged between Sept. 16 and 21, are closer to *latipennis* than to the nominate subspecies.

Dichorda consequaria (Henry Edwards), new status

Plate 20, figures 1, 1a, 1b; plate 36, figure 7; plate 46, figures 19, 20.

Geometra iridaria var. *consequaria* Henry Edwards, 1884, p. 19.

Geometra iridaria Druce, 1900, p. 83, pl. 49, fig. 5.

Anaploides remotaria consequaria Dyar, 1902 [1903], p. 302.

Dichorda perpendicularata Warren, 1904b, p. 503. New synonymy.

Dichorda iridaria perpendicularata Prout, 1932, p. 51.

DIAGNOSIS. *Consequaria* is a handsome species of Central America, Mexico, and extreme southern Arizona, closely resembling *iridaria* but distinguished by several good characters, as follows: outer margins less convex, resulting in the fore- and hindwing appearing more pointed towards the apex and anal angle respectively; all lines, including the antemedial of the forewing, almost perfectly straight and not quite as wide as in *iridaria*; postmedial on underside of forewing usually double in *consequaria*, single in *iridaria*. The veins beyond the postmedial lines are often marked by white rays as in *iridaria* but these tend to be less developed.

Despite the close superficial resemblance to *iridaria*, *consequaria* is more closely related to the Californian *illustraria*. This view is supported by the genitalia, which in *consequaria* and *illustraria* are almost identical, but in *iridaria* (and *latipennis*) clearly differ in several characters.

TYPES. The type of *consequaria* is a male in the USNM labeled Jalapa [Veracruz], Mexico, "Coll. Brkln. Mus." In the original description, no precise locality was designated, but in the introduction to his paper (1884, p. 11) Edwards mentioned that the material of this and other species he was describing was "captured chiefly in the State of Vera Cruz, Mexico, by Mr. William Schaus, Jr." The type is good enough to be easily recognized and looks exactly like specimens from Madera Canyon, Santa Cruz Co., Ariz.

The type of *perpendicularata* is a male in the BM from Huatuxco, Veracruz, Mexico.

SYNONYMY. I have not seen the type of *perpendicularata*, but the original description, together with Prout's association of the name with *iridaria*, would seem to leave little doubt as to its identity. The *iridaria* that Druce reported from Mexico was of course also *consequaria*, or almost certainly so. In the original description of *consequaria*, Henry Edwards mentioned having also received this from Georgia and Florida, thus initiating an erroneous identification that has been passed on from author to author up to Forbes (1948). The Florida *Dichorda* is *latipennis*, probably conspecific with *iridaria* but certainly not with *consequaria*. Prout (1932, p. 51), in using the junior synonym *perpendicularata* for the Mexican form, seems to have overlooked the fact that Edwards' type of *consequaria* also came from Veracruz.

FURTHER DESCRIPTION. Structure and coloring of antennae, front, palpi, and legs as in *iridaria*; thorax and abdomen whitish below, green above; no dorsal abdominal markings; wings above deep green, about the same shade as *iridaria*, but usually with less white shading. The median space of the forewing may be faintly frosted with white or pale bluish, or it may be pure green. Beyond the postmedials the veins are often unmarked, or they may be outlined with white as in *iridaria*. If so, this white shading is rarely as extreme as in well marked examples of *iridaria*. Lines white, distinctly narrower than those of *iridaria* and the postmedials less diffuse outwardly; usually narrowly shaded on the side of the median space with solid green, which may be faintly olivaceous; antemedial of forewing almost straight and erect, inclined just slightly inward from the inner margin; antemedial of hindwing wanting; postmedials of both wings straight, well defined right to costa; costa speckled with purplish brown

in the usual way but with less white than in *iridaria*; discal spots small, blackish, sometimes feebly encircled with whitish; fringes quite uniformly green, concolorous with the wings or paler, with a pale line at the base. Underside paler, especially the hindwing, thinly dusted with blackish scales; lines showing faintly, antemedial of forewing usually double (single in *iridaria*); discal spots larger than above, and hindwing, between base and discal spot, marked by the usual diffuse, incomplete blackish band occupying approximately the position of the antemedial.

Length of forewing: males, 13-17 mm; females, 17-18.5 mm.

MALE GENITALIA. Uncus rather slender, only slightly dilated toward tip as in *iridaria*; valve moderately slender but variable; saccus rather obtusely pointed, not ending in a knob-like process as is common in *iridaria*; rounded process of eighth sternite conspicuously longer, darker in color and more chitinous than that of *iridaria*, weakly notched.

FEMALE GENITALIA. About the same as in other species of *Dichorda*.

MATERIAL EXAMINED. 62 males, 17 females, including type of *consequaria*; 3 male, 1 female slides.

DISTRIBUTION. ARIZONA: Hereford and Palmerlee, Cochise Co.; Sierra Vista and Ramsey Canyon, Huachuca Mountains, Cochise Co.; S.W. Research Station of AMNH, Chiricahua Mts., near Portal, Cochise Co.; Madera Canyon, 4880', Santa Rita Mountains, Santa Cruz Co.; Peña Blanca, 3950', Santa Cruz Co.; Baboquivari Mountains, Pima Co. MEXICO: Jalapa, Veracruz; Orizaba; S. Angel, D.F.; Tehuacán, Puebla; Puebla, Pue.

Druce (1900, pl. 49, fig. 5) figured a male from Dueñas, without further data, and in the USNM collection there are specimens from Guatemala and Honduras.

GEOGRAPHICAL VARIATION. Not apparent in the material available, but there is some seasonal variation. Forty-six males and seven females taken by Dr. Franclemont at Madera Canyon and Peña Blanca, Ariz., show that spring specimens, taken Apr. 12 to May 21, average larger and greener than those taken in summer and fall.

FLIGHT PERIOD. Material taken throughout the season in Santa Cruz Co. (JGF) indicates a discrete spring generation and a prolonged, fairly continuous flight through the summer and fall, probably representing at least two additional generations. The few other records available also fit this pattern. Apr. 12 to May 31; June 23 to Oct. 12.

EARLY STAGES. Unknown.

Dichorda illustraria (Hulst)

Plate 19, figures 3, 3a, 3b, 3c, 3d; plate 36, figure 6; plate 46, figures 27, 28.

Geometra iridaria Packard, 1876, p. 394 (partim).

Geometra illustraria Hulst, 1886a, p. 121.

Anaploides illustraria Hulst, 1896, p. 316. Dyar, 1902 [1903], p. 303.

Dichorda illustraria Prout, 1912, p. 128. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 51. Comstock, 1960, pp. 426-430, figs. 4-6 (early stages).

DIAGNOSIS. This is the common *Dichorda* of California, distinguished from *rectaria* and *cockerelli* by its larger size and greener coloring, and also by good larval characters. *Illustraria* does not normally have the distinctive blue-green hue of *rectaria* but there do

occur occasional bluish individuals that may be misdetermined in collections. Conversely, many examples of *rectaria* from Texas and Arizona could be mistaken for it (see discussion of genus). *Illustraria* lacks the broader white lines and rays of *Dichorda iridaria* and *consequaria*, and the wing shape is like that of *consequaria* and *rectaria*, without the strongly convex outer margins of *iridaria*. The male genitalia average larger than those of *rectaria* or *cockerelli*, the aedeagus longer, the saccus usually more produced, the tip of the uncus more dilated, and the rounded posterior process of the eighth sternite is consistently much wider and but feebly emarginate. The shape of the eighth sternite is perhaps the most reliable character for distinguishing this species from *rectaria*. As far as is known, *rectaria* is represented in California only by the dwarfed southern race, *cockerelli*, which is rather easily distinguished from *illustraria*.

TYPES. *Illustraria* was described from two specimens, a male and female, from Calif., without further locality data. They are in the AMNH. Both specimens are intact, with abdomens, but the male is completely discolored. The female, which is in fairly good condition and quite unmistakable, I hereby designate as the lectotype. It is labeled California, No. 12632 Collection Hy. Edwards, *Geometra illustraria* Type Hulst.

SYNONYMY. None.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs as in *iridaria*. Antennal shaft and fillet white; head behind fillet green; front dark brown with white dorsal and ventral borders; palpi marked with dark brown laterally and distally, but with a sharply defined white area ventrally; legs whitish, spotted with dark brown as in *iridaria* but with the markings darker and more contrasting; underside of body whitish; upperside of thorax green; abdomen with a green dorsal shade that narrows posteriorly, often leaving the last three or four segments entirely white in males, almost so in females; segments 2 and 3 with small white dorsal spots, a character shared with *rectaria* and *consequaria*, but not *iridaria*.

Upperside of wings bright green, usually becoming bluish only in worn or faded specimens, but occasional bluish specimens occur that appear fresh. Green areas finely striated with olive; white lines distinct but not wide, variable, usually as narrow as in *rectaria* but wider in some females; antemedial of forewing straight or slightly convex, almost erect but inclined inward slightly toward costa; antemedial of hindwing wanting; postmedials straight, that of forewing tending to fade out on approaching costa. The antemedial is followed, and the postmedials preceded by a thin olivaceous shade that may encroach halfway across the white lines and make them appear yellowish, much as in the other species. The postmedial transects the hindwing near the middle as in *iridaria* and *rectaria*. Costa white, heavily mottled with dark purplish brown in the usual way; discal spots small, blackish, usually not encircled with whitish; fringes green, concolorous with wings. Underside with hindwing almost white, forewing greener, both sparsely dusted with black scales; lines as on upperside but less distinct; postmedials single, not preceded by a parallel ghost line as in *consequaria*; patch of black scales on hindwing midway between discal spot and inner margin reduced but commonly present (normally lacking in *rectaria*, present in *consequaria* and *iridaria*).

The wing shape in *illustraria* and *rectaria* is about the same; *iridaria* differs in having the outer margins more convex, that of the forewing almost angulate; *consequaria* differs in having the outer margins, especially that of the hindwing, considerably less convex.

Length of forewing: males, 14-18 mm; females, 18-22 mm.

MALE GENITALIA. Uncus broadly dilated at the tip; saccus moderately extended, the sides of the vinculum converging quite evenly to a bluntly pointed apex; saccus

longer than in *rectaria* or *consequaria*, and without the narrowed apical extension of *iridaria*; valves a little wider and less tapered than those of *rectaria*; aedeagus appears disproportionately longer than that of *rectaria* but this largely coincides with the larger overall genitalic size; aedeagus with a slightly better developed hook at the tip than in the other species; posterior process of the eighth sternite broad, evenly rounded, with or without a slight marginal notch or depression, extensively chitinous and brown in color.

FEMALE GENITALIA. Indistinguishable from those of *rectaria*. These two species differ from *iridaria* and *consequaria* in having a more slender bursa copulatrix.

MATERIAL EXAMINED. 191 males, 81 females; 10 male, 3 female slides; 7 preserved larvae.

DISTRIBUTION. CALIFORNIA: Shasta Retreat, Siskiyou Co.; Mendocino and Laytonville, Mendocino Co.; Anderson Springs, Lake Co.; Petaluma, The Geysers, Cazadero, and San Antonio Creek, Sonoma Co.; Mill Valley, Marin Co.; Berkeley; Oakland; Palo Alto; Mission San Jose; San Jose; San Francisco; Los Gatos, Santa Clara Co.; Santa Cruz Mountains, Santa Cruz Co.; Santa Barbara; Wheeler Hot Springs, Ventura Co.; Newhall, Sunland, Burbank, Glendale, Azusa, Alhambra, Claremont, Santa Monica and Glendora, Los Angeles Co.; Singing Spring, Angeles Crest, Los Angeles Co.; Avalon, Santa Catalina Island, Los Angeles Co.; Laguna Beach and San Clemente, Orange Co.; Loma Linda and Wrightwood, San Bernardino Co.; Riverside, Arlington, Idyllwild, Palm Springs and Rancho La Sierra, Riverside Co.; Mt. Palomar State Park, San Diego Co.; Julian, Descanso, Pine Valley, San Diego, Borrego, and La Mesa, San Diego Co.; Boquet Canyon; Hayward; Glen Ivy; La Puerta; Padua Hills. BAJA CALIFORNIA: Santo Tomas, 11 mi. E. of Ensenada.

GEOGRAPHICAL VARIATION. No apparent geographical variation. The specimens from Baja California, in the AMNH, are normal *illustraria*.

FLIGHT PERIOD. Mar. 6–Nov. 28, with a few records for Dec., Jan. and Feb. from the vicinity of Los Angeles. The records for the southern half of Calif. suggest two peaks of abundance in July and Sept. In the northern counties the records mostly fall within the period from June to Sept., but the specimen from Anderson Springs, Lake Co. was taken Oct. 25, 1947 (W. R. Bauer).

EARLY STAGES. These have been elegantly described and figured by Comstock (1960, pp. 426-430, figs. 4-6). I have some larvae in alcohol from Burbank, Los Angeles Co.; and these confirm Comstock's description in most details. However, the tips of the horn-like processes on the eighth abdominal segment are very noticeably bifurcate in these; whereas Comstock described them as being blunted at the tips. Those of *rectaria*, and probably *iridaria*, are more pointed. The quadrate dorsal plates are wider from front to back in *illustraria* than in *rectaria*, and that of the third thoracic segment is not toothed on the outer margin as in the latter species. The larva of *illustraria* is entirely brown, apparently quite dark. The preserved larvae of *rectaria* look as though they had originally been a shade of brown much paler than *illustraria*, perhaps with some green. It would seem that these two species are more distinct as larvae than they are as adults. The only reported food plant for *illustraria* is *Rhus laurina* Nuttall.

Dichorda rectaria rectaria (Grote)

Plate 20, figures 2, 2a, 2b, 3, 3a, 3b, 3c; plate 36, figure 4; plate 47, figures 1-4.

Geometra rectaria Grote, 1877, p. 157. Hulst, 1886b, p. 139.

Geometra iridaria (partim) Packard, 1876, p. 394 (nec Guenée). Hulst, 1895, p. 71 (nec Guenée).

Anaploides iridaria Hulst, 1896, p. 316. Dyar, 1902 [1903], p. 303 (nec Guenée).

Dichorda rectoria Prout, 1912, p. 127. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 51, pl. 6e. McDunnough, 1938, p. 141.

DIAGNOSIS. *Dichorda rectoria* is a western species, occurring in the nominate form from Texas and Arizona north to Montana and North Dakota, superficially almost exactly like *illustraria* but generally of a more bluish coloring and averaging smaller in size. The shade of green is variable in both species and not always reliable. However, there are other characters, as follows: discal spots smaller (sometimes lacking); brown-mottled, whitish costal border usually narrower; brown markings of front and palpi paler; on the underside, hindwing almost as green as forewing, not as whitish as in *illustraria*; patch of blackish scales on underside of hindwing between discal spot and inner margin commonly wanting in *rectoria*, nearly always present in *illustraria*; the saccus less produced, and the process of the eighth sternite consistently narrower and with its sides more convergent. There also appear to be good larval characters.

TYPES. Described from a male collected in Texas by Belfrage and now in the BM. No exact locality was specified, but Belfrage did get material of this species at Waco (see Packard's records under *iridaria*, 1876, p. 394), and the type may have come from there. There is a very badly stained male, without locality data, labeled Type 2235 in the MCZ (ex Peabody Academy Collection).

SYNONYMY. Packard had three species, including *rectoria*, confused under the name *iridaria*, and Hulst incorrectly synonymized *iridaria* and *rectoria*, using the name *remotaria* for the eastern species now known as *iridaria*.

FURTHER DESCRIPTION. Structure of antennae, palpi and legs as in the other species of *Dichorda*. Brown markings of front, palpi and legs about as in *iridaria*, paler than in *illustraria*; underside of body whitish; upperside of thorax blue-green, concolorous with wings; upperside of abdomen shaded with blue-green almost to its extremity, and with the same minute white dorsal spots on segments two and three as in *illustraria* and *consequaria*. Wings above usually a bright blue-green, but variable from a pure green like *illustraria* almost to a real pale blue; fringes concolorous. Markings of upperside exactly as in *illustraria* except for the following minor differences: discal spots smaller, often absent; pale, brown-speckled costal border usually narrower. On the underside, the hindwing, although slightly paler, is more nearly the same shade of green as the forewing, not as whitish as that of *illustraria*, and there is scarcely any of the thin dusting of black scales characteristic of *illustraria*; also, the patch of blackish scales midway between the discal spot and inner margin is only rarely present in *rectoria*. In *illustraria*, the latter marking is commonly present, although not as well developed as in *consequaria* and *iridaria*. The lines are rather faintly reproduced beneath and are single; only rarely is there a suggestion of an inner "ghost line" paralleling the postmedials. Such a line is even more unusual in *illustraria* but quite characteristic of *consequaria*.

Length of forewing: males, 11.5-15.5 mm. (average about 14 mm); females, 14-17 mm.

MALE GENITALIA. Closest to those of *illustraria* but distinguished by the following characters: Uncus less abruptly dilated at tip, moderately spatulate or often just clavate; saccus produced to a blunt point in the same way but usually less extended; valve usually of somewhat stubbier form, wide at the base, then tapering; brown, chitinous posterior lobe of eighth sternite distinctly narrower with the sides inclined toward each other and the outer end emarginate. The shape of the eighth sternite readily distinguishes *rectoria* and its race *cockerelli* from *illustraria* and *iridaria*. In this character *consequaria* is closest, but still different.

FEMALE GENITALIA. Indistinguishable from those of *illustraria*, having the same relatively slender bursa. In *consequaria* and *iridaria* the corpus bursae is almost globular.

MATERIAL EXAMINED. 201 males, 108 females; 8 male, 7 female slides; 3 preserved larvae.

DISTRIBUTION. TEXAS: New Braunfels, Comal Co.; Forestburg, Montague Co.; Palo Pinto Co.; Burnett Co.; Blanco Co.; Lake Brownwood State Park, Brown Co.; Kerrville, Kerr Co.; Alpine, Brewster Co.; Big Bend National Park, 6000'; Pine Canyon and the Basin, Big Bend National Park, Brewster Co.; Fort Davis, Jeff Davis Co.; Sierra Blanca, Hudspeth Co. NEW MEXICO: Sitting Bull Falls, 42 mi. S.W. of Carlsbad, Eddy Co.; Frijoles Canyon, 6050', Bandelier National Monument; Jemez Springs, Sandoval Co. ARIZONA: 3 mi. W. of Eagar, 7100', Apache Co. (Piñon-Juniper life zone); Vernon, Apache Co.; Paradise, Cochise Co.; Portal and Cave Creek Canyon, Portal, Cochise Co.; S.W. Research Station of AMNH, 5 mi. W. of Portal, Cochise Co.; Redington; Tucson; Baboquivari Mountains, Pima Co.; Santa Catalina Mountains, Pinal Co.; Oracle, Pinal Co.; Pinal Mountains; Miami and Globe, Gila Co.; Flagstaff, Coconino Co.; Walnut Canyon, 6500', 6 mi. E. of Flagstaff, Coconino Co.; West Fork, 6500', 16 mi. S.W. of Flagstaff, Coconino Co.; Todd's Lodge, Oak Creek Canyon, Coconino Co.; Sedona, Coconino Co.; Prescott, Yavapai Co.; Mayer, Yavapai Co.; Yuma Co.; Wheeler Canyon. COLORADO: Durango; Glenwood Springs; Chimney Gulch, Golden; Rock Creek Park and Rock Creek Canyon, near Colorado Springs, El Paso Co. UTAH: American Fork; Richfield and Sevier, Sevier Co.; Salamander Lake, Timpanogos; Red Canyon Camp, 11 mi. S.E. of Panguitch, Garfield Co.; Trout Creek, Juab Co. IDAHO: "R'dale." MONTANA: Big Timber Creek, 7 mi. N. of Big Timber, Sweetgrass Co. NORTH DAKOTA: Badlands, Slope Co. KANSAS: Franklin Co. CALIFORNIA: Truckee, Nevada Co.

GEOGRAPHICAL VARIATION. Variation is slight but Ariz. and Utah specimens show a tendency to be more bluish than Texas ones. The geographical pattern of such variation is difficult to ascertain since the color also varies with age (flown specimens are bluer, fresh ones greener). Some small Utah specimens look like *cockerelli*. The single Calif. record is a female in the USNM (ex McGlashan and Barnes collection), without date. It is small (12.5 mm.) somewhat faded, and with the discal spots well developed for *rectaria*. It looks like, and could be a dwarfed example of *illustraria*, but there are no other records from east of the Sierras.

FLIGHT PERIOD. In Tex., May 19–Sept. 4; in Ariz., Mar. 7–Aug. 29, with apparent peaks in Apr. and July; in N.M., Colo., Utah, May 29 (Utah), June 11 (Colo.), July 21–Aug. 22. The single Idaho record is a male taken Sept. 1, 1934 (C. F. Smith), and is in the USNM. The N.D. record is based on two males in the AMNH taken July 29, 1959 (J. Oberfoell). The Mont. record was a single male taken July 4, 1966 (DCF); the Kans. record one male taken May 21, 1961 (AMNH).

EARLY STAGES. *Rectaria* has been reared by Mr. Robert W. Poole from a female taken at Walnut Canyon, Coconino Co., Ariz., on June 20, 1965. Three last instar larvae and the parent, as well as colored photographs, were kindly made available to me for examination. The larva differs from that of *illustraria* in several characters and it would seem that these might provide more positive means of identification than any characters found in the adult. It is pale in color, light brown with a greenish tinge, and with a thin dark mid-dorsal line; the larvae of *illustraria* are a much darker brown. The quadrate dorsal plates in *rectaria* are not quite as large, and both the anterior and posterior corners of each plate are angled and bear a slight tooth; in *illustraria* the hind corner tends to be acutely angled, the front corner rounded off. The pair of dorsal horn-like processes on abdominal segment 8 are

sharply pointed in *rectaria*, blunted or with the tips cleft in *illustraria*. The food plant of *rectaria* was *Rhus trilobata*. Eighteen adults of this brood emerged Sept. 15–Nov. 13, 1965.

Dichorda rectaria cockerelli (Sperry), new status

Plate 20, figures 4, 4a, 4b; plate 47, figures 5, 6.

Dichorda cockerelli Sperry, 1939b, p. 262.

DIAGNOSIS. This is a very small, light blue-green form of doubtful status, mostly from San Bernardino Co., Calif. Although described as a species, *cockerelli* may be distinguished from *rectaria* by little more than the difference in size, which is considerable. The color is even bluer than that of normal *rectaria*, and the discal spots are further reduced, usually to the point of obsolescence. Most of the material examined came from the Ivanpah and the New York Mts.

TYPES. The holotype is a male in the CNC (Type No. 4554) from Mexican Wells, San Bernardino Co., Calif., collected July 12, 1938 by J. L. Sperry. The allotype, same locality, July 7, 1937, is in the AMNH. There are single paratypes in the AMNH, USNM and Los Angeles County Museum.

SYNONYMY. None.

FURTHER DESCRIPTION. In pattern and coloring *cockerelli* differs from *rectaria* only as already noted in the diagnosis.

Length of forewing: males, 11-13 mm. (average about 12 mm); females, 13.5-15 mm.

MALE GENITALIA. Exactly like those of *rectaria* but smaller, in proportion to the smaller size of the moth, and with the brown, chitinous posterior lobe of the eighth sternite not emarginate or but feebly so.

FEMALE GENITALIA. Like those of *rectaria*.

MATERIAL EXAMINED. 31 males, 7 females, including holotype and allotype; 8 male, 2 female slides.

DISTRIBUTION. CALIFORNIA: Mexican Wells and Granite Wells, San Bernardino Co.; Essex, San Bernardino Co.; Split Rock Tank, Mojave Desert; Keystone Canyon, 5500', New York Mountains, San Bernardino Co.; Mountain Pass Station; Ivanpah Mountains, San Bernardino Co.; Tub Canyon, Borrego [San Diego Co.].

GEOGRAPHICAL VARIATION. Not apparent in the material available.

FLIGHT PERIOD. Apr. 18, 21; May 21, 24; July 7, 27; Aug. 25; Sept. 3, 8, 24; "Dec." I have a series of 11 taken by Mr. Frank P. Sala in Keystone Canyon on Aug. 25, and 9 on Sept. 3, 1959.

EARLY STAGES. Unknown.

REMARKS. *Rectaria* from Utah comes closest in appearance to *cockerelli* and in some collections has been determined as such.

4. SYSTEMATIC ACCOUNT OF THE TRIBE DICHORDOPHORINI

Since only the one genus and two very closely related species are known, the generic characters serve also as the tribal characters. The unique genitalia and complete loss of the frenulum in both sexes provide the most important distinguishing features.

DICHORDOPHORA Prout

Dichordophora Prout, 1913b, p. 437.

TYPE SPECIES. *Dichorda* (?) *phoenix* Prout, 1912, p. 128 = *Dichordophora phoenix* Prout, 1913b, p. 437, monobasic.

ADULT CHARACTERS. Size like that of a small *Dichorda*, length of forewing 10.5 to 16.5 mm; wings hardly produced, shape nearly as in *Nemoria*; color bright green with the pale costa heavily irrorated with purplish brown as in *Dichorda*; antemedial of hindwing wanting but other lines normal, whitish, well defined, almost straight but postmedials not as oblique as in *Dichorda*, that of forewing almost parallel with outer margin; antemedial of forewing almost erect; discal spots blackish, weak, or wanting; terminal line wanting; fringes green, unmarked; palpi and legs tinged with pink only, not spotted with dark brown as in *Dichorda*.

Venation as in the *Nemoriini*, almost exactly matching *Dichorda*, but frenulum completely wanting in both sexes.

Male antennae like those of *Dichorda*, bipectinate, tapering gradually, outer third simple, length of longest pectinations more than three times thickness of shaft; female antennae also pectinate, with branches one half to two thirds as long as those of the male; palpi of the sexes similar in form but those of the male only slightly exceeding the front, those of the female exceeding it by almost half their length; third palpal segment small, slender, rounded or conical, in the female a little more elongated; eyes of the sexes similar; front flat, wider than high; tongue developed but a little smaller than in the *Nemoriini*; hind tibia of male undilated, slender, with no terminal process and with either one pair of spurs (*phoenix*), or both pairs (*aplagaria*); hind tibia of female similar, also with one pair of spurs in *phoenix* and both pairs in *aplagaria*.

Male genitalia peculiar and unique among the North American Geometrinae. Uncus divided into two separate prongs, flanked by the similarly sclerotized and rigid socii; gnathos forming a complete ring with its distal edge much extended to form a large, recurved, flattened plate that is notched at the end; saccus extremely elongated; valve with simple costa but a complex of sclerotized structures basally towards the sacculus; ventral margin of valve with a U-shaped emargination; aedeagus as in *Dichorda*; eighth sternite with posterior margin almost straight, simple.

Female genitalia with bursa copulatrix membranous, simple, elongate but dis-

proportionately small; no signum; ductus bursae leading into a peculiar, heavily sclerotized, tubular genital plate that extends the ostial opening well back in the eighth segment near the papillae anales. In no other North American genus of this subfamily does the ostium occur farther back than the anterior margin of the eighth sternite. There is a characteristic bend in the ductus bursae just before it meets the tubular genital plate. The latter structure is almost certainly derived from the preostial fold, or pouch, of less specialized forms, since an almost complete sequence of intermediate stages may be seen in the genus *Nemoria*.

LARVAL CHARACTERS. Unknown.

DISTRIBUTION. Southwestern United States and Mexico.

REMARKS. Apart from the species discussed here, only one other is known, *aplagaria* Dyar from Mexico. For the characters distinguishing these two species, see the paper by Todd, 1955. The two are very similar except for differences in the genitalia, and *aplagaria* has two pairs of spurs on the hind tibia in both sexes.

Looking at the superficial characters of this genus, including even the venation, it is easy to see how Prout was led to associate it closely with *Dichorda*, but the bizarre genitalia at once belie such a relationship. The similarity in appearance must be due to convergence. The male genitalia of the Neotropical genus *Oospila* have two pairs of processes corresponding in position to the socii and divided uncus of *Dichordophora*, but they are of different homology. The mesial pair are the socii and the outer pair are horn-like processes derived from the gnathos; *Oospila* has lost the uncus and the distal part of the gnathos that ordinarily completes the ring.

The larva, when it is known, may help in clarifying the relationships of *Dichordophora*, but at present I know of no other forms that could be considered closely related.

Dichordophora phoenix (Prout)

Plate 3, figure 3; plate 21, figures 1, 1a, 1b; plate 37, figure 1; plate 47, figures 7, 8.

Dichorda (?) *phoenix* Prout, 1912, p. 128.

Dichordophora phoenix Prout, 1913b, p. 437. Barnes and McDunnough, 1917a, p. 101. Prout, 1933, p. 70, McDunnough, 1938, p. 142. Todd, 1955, p. 118-120; figs. 1, 5.

DIAGNOSIS. See the discussion of the genus. There is only one other species, *aplagaria* Dyar, which occurs in Mexico and Guatemala. *Phoenix* and *aplagaria* are very close both in facies and genitalia, but *aplagaria*, like the species of *Dichorda*, has two pairs of spurs on the hind tibia in both sexes. *Phoenix* lacks the terminal spurs on the hind tibia and may always be distinguished by this character. Also, it is the only species of *Dichordophora* known to occur in the United States, ranging from the Mexican border at least to Colorado and Nevada.

TYPES. *Phoenix* was described from two females taken at Phoenix, Ariz., Sept. 13, 1904 (R. E. Kunze). Prout designated these type and cotype. Both are in the BM.

FURTHER DESCRIPTION. Male antenna broadly bipectinate for basal two-thirds, narrowing abruptly toward tip, longest branches 4 to 6 times diameter of shaft; female antenna also bipectinate but with much shorter branches, the longest being only about twice the diameter of the shaft; male palpi moderate, exceeding front by a distance equal to one half the length of the second segment, obtusely pointed, with the small third segment so concealed by the terminal scales of the second that only

the tip is evident; female palpi slightly longer, more slender, not so evenly tapered, with the third segment arising more obviously from the somewhat truncated apex of the second; legs rather slender, third pair with terminal spurs only in both sexes, spurs variable in length.

Scales of antennal shaft white, branches yellowish; interantennal fillet white with a small patch of pink scales next to the inner side of the scape; head behind fillet green; front rose, with white spots in the four corners which may be confluent, especially the lower pair, limiting the rose color to a transverse band across the middle of the front; palpi with outer two segments heavily tinged with rose; legs with coxae green, femora and tibiae partly rose colored, especially those of the first pair which are solidly rose colored inwardly; tarsi whitish or cream colored; thorax green above and below; abdomen green above and below in fresh males; mostly whitish in females except for some green on basal half of dorsum.

Wings above bright green, not especially bluish, almost unstriated, hindwing slightly paler towards costa; markings almost exactly like those of *Dichorda*; lines cream colored to white, even, almost as wide as the fringe, sharply defined. Antemedial of forewing erect or leaning inward, straight or slightly convex, often feebly excurved near inner margin; antemedial of hindwing lacking; postmedial of forewing straight or evenly convex (tending to parallel outer margin) for most of its length, usually bending inward on approaching costa; postmedial of hindwing sometimes straight but more commonly with a slight convexity; costa white, heavily speckled with pinkish or purplish brown; fringes with basal half green, outer half white; dark discal spots usually present but minute. Underside as above but paler.

Length of forewing: male, 12.5-14.5 mm, but occasionally as small as 10.5 mm; female, 12-16.5 mm.

MALE GENITALIA. The very peculiar genitalia have already been described in the discussion of the genus *Dichordophora*. Genitalic figures for both species were published by Todd (1955, p. 119). In *phoenix* the socii are smaller, the sacculus more pointed, and the semi-circular excavations on the ventral margin of the valve larger than in *aplagaria*.

FEMALE GENITALIA. The females of both species were also figured by Todd. These are very similar but the sclerotized portions of the ductus bursae and ostium are of more delicate structure in *phoenix* than in *aplagaria*.

MATERIAL EXAMINED. 121 males, 98 females; 7 male, 5 female slides

DISTRIBUTION. TEXAS: Chisos Basin, Big Bend National Park, Brewster Co. (4 specimens); ARIZONA: Portal, Cochise Co.; Guadalupe Canyon, 4200', Cochise Co.; Redington; Aguila; Tucson; Phoenix; Wickenburg; Waterman Mountains; Madera Canyon (4880') and Peña Blanca (3950'), Santa Cruz Co.; Kits Peak Rincon, Brown's Canyon and Sabino Canyon, Baboquivari Mountains, Pima Co.; Organ Pipe National Monument, and Mt. Lemmon, Pima Co.; between Dewey and Salome; Kingman; New River, Maricopa Co.; Montezuma Well, Rimrock; Prescott and Mayer (4300'), Yavapai Co.; Mojave Co. CALIFORNIA: Borrego; Morongo Valley; Providence Mountains, San Bernardino Co.; Vidal; Riverside; Palm Springs and Palm Desert, Riverside Co.; Perris, Riverside Co.; Split Rock Tank, Mojave Desert; Yermo and 12 mi. S.E. of Ivanpah, San Bernardino Co.; Joshua; Hidden Valley; Julian. NEVADA: Valley of Fire. COLORADO: Glenwood Springs (see remarks under flight period below). WASHINGTON: Brewster, Okanogan Co.

There are two specimens that I have seen from Nev., both taken by J. L. Sperry (CNC and AMNH), and one each from Colo. (in CNC) and Wash. (YPM). The last record is a female from Brewster, Wash., received with material from John C. Hopfinger, and although it represents a surprising range extension there seems to be no other reason to doubt its authenticity.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. In Tex. and Ariz., Apr. 22–Nov. 7; in Calif., Dec. 21–May 19, very few in June and July, none in Sept., but more Oct. 1–Nov. 8. The Nev. specimens were taken May 27, 1938; the Wash. specimen May 30, 1956; the Colo. record is an old Oslar specimen without date and the locality should be verified (see similar remarks regarding certain Oslar specimens under *Synchlora frondaria* and *Cheteoscelis pectinaria*).

EARLY STAGES. Unknown.

5. SYSTEMATIC ACCOUNT OF THE TRIBE SYNCHLORINI

Small to medium sized species; wings broad and rounded (*Synchlora*), or somewhat lengthened, with forewing bluntly pointed and costa almost straight (*Cheteoscelis*, *Merochlora*); green pigment bright, apparently the same as in the Nemoriini, unlike that of the Hemitheini. Venation of costal area of forewing unusually well spaced for the following reasons: 1) Sc and R₁, or R₁ and R₂ often unite so that only four instead of five veins are left to meet costa, 2) Sc—R₄ bend toward costa sooner than they do in other tribes, 3) space separating C from R slightly wider than usual. Hindwing with Sc and R fused where they come together (joined for at least half length of cell in *Cheteoscelis* and *Merochlora*); third anal of hindwing nearly always entirely wanting; frenulum present in male, replaced by a tuft of bristles or wanting in female.

In male genitalia, uncus without the usual long process, having only the small basal portion to which are articulated the pointed, sclerotized but usually moveable socii; gnathos a normal, toothed ring in most species but sometimes incomplete (e.g., in *S. cupedinaria*); valve simple; aedeagus sclerotized in a manner diagnostic for the tribe: viewed dorsally or ventrally, it is seen to consist of two slender, rigid prongs arising from a short proximal stem, the shape suggesting that of a musician's tuning fork; prongs commonly simple, sometimes dentate; eighth sternite simple, shallowly emarginate. Female genitalia very simple, with or without slight sclerotization of ductus bursae; signum present or wanting.

Larva characteristic in structure and habits, with little variation among the three genera. The dorsolateral protuberances, so highly developed in the Nemoriini, are present, but are half the size or less, forming only rounded or pointed humps. They are also adapted for a different purpose. In the Synchlorini each protuberance ends in an enlarged, spine-like tubercle that bears small hooks. To these the larva attaches fragments of plant material from the host as a means of concealment. The Synchlorini, like some Hemitheini, tend to be flower feeders on Compositae.

KEY TO THE GENERA OF SYNCHLORINI

1. Wings with brown or reddish markings, at least a red terminal line, abdomen brown above with white spots; small, tropical *Synchlora*, in part

- Wings without such markings, abdomen green and white only; small to medium sized, temperate or tropical 2
2. Hind tibia of male dilated and with a terminal process, hindwings like forewings, all lines present, Sc and R of hindwing fused for a short distance only ..*Synchlora* (*aerata* group)
- Hind tibia of male undilated and without terminal process, hindwings paler than forewings, at least antemedial of hindwing wanting, Sc and R of hindwing fused for at least half the length of cell 3
3. Hind tibia with all spurs in both sexes, antemedial of forewing wanting*Merochlora*
- Hind tibia with distal pair of spurs only in both sexes, antemedial of forewing present*Cheteoscelis*

SYNCHLORA Guenée

Synchlora Guenée, 1858, p. 375.

Eunemoria Packard, 1873, p. 76.

TYPE SPECIES. Of *Synchlora*, *Synchlora liquoraria* Guenée, 1858, designated by Hulst, 1896, p. 314. Of *Eunemoria*, *Eunemoria gracilaria* Packard, 1873 = *Synchlora aerata* (Fabricius), monobasic.

ADULT CHARACTERS. Small moths, length of forewing 6 to 13 mm; wings rounded, never produced or angulate; color bright green, with various reddish or purplish brown marginal patterns in some tropical species; antemedial and postmedial lines white or pale, normal, complete if present, but all lines sometimes obsolete; costa of forewing margined with white or reddish brown; discal spots present or absent; terminal line and fringes marked or unmarked; abdomen with a white dorsal stripe in the typical group, commonly with white, raised segmental spots in the tropical species.

The main venational character distinguishing *Synchlora* from *Cheteoscelis* and *Merochlora* is that Sc and of R the hindwing are fused for a short distance only. Although there is some minor variation within *Synchlora*, as may be seen in the illustrations, the venation is otherwise essentially similar to that of the other genera.

Antenna of male broadly bipectinate for basal two thirds, tapering rather abruptly to outer third which is simple, length of longest pectinations 4 to 8 times width of shaft; female antenna simple, slender, ciliate beneath; palpi of male moderate, about as in *Nemoria*; palpi of female variable, like those of the male, or just slightly longer, to very long with a cylindrical third segment equal in length to the second; eyes of the sexes similar; front flat, about as wide across the top as high, the sides convergent ventrally in the usual way; tongue well developed; hind tibia of male moderately dilated, prismatic, with a long terminal process in all but *herbaria* and *cupedinaria*, always with both pairs of spurs; hind tibia of female undilated, also with both pairs of spurs.

Male genitalia with uncus reduced to a rounded basal sclerite, or obsolete; socii rigidly sclerotized, pointed, somewhat moveable, articulating with the vestigial uncus, if present, or fused to it and immoveable (as in *noel*); gnathos normally a toothed ring as in the *Nemoriini* but sometimes aberrant (divided into two arms in *cupedinaria*); transtilla well developed as a plate or band (also divided in *cupedinaria*); juxta a flat or concave plate, variable in shape, but without a papilliform process; saccus also variable—rounded, tapered, or with a distinct process that may be pointed (*cupedinaria*), rounded (*irregularia*), or truncate (*noel*); vestigial uncus, tegumen and

vinculum generally forming a unit that is more ovate than spindle-shaped; valve simple, rather slender, commonly without specialized structures but with a protruding triangular costa in *hulstiana*; coremata nearly always present; aedeagus of the two-pronged type characteristic of the tribe, the prongs usually smooth, but toothed in *gerularia* and *cupedinaria*; eighth sternite with a median notch or depression on its posterior margin.

Female genitalia of basically the same form as in *Cheteoscelis* and *Merochlora*, but with considerable variation. Bursa copulatrix with ductus bursae adjoining either terminally or subterminally, moderately elongate, membranous, with or without a signum; ductus bursae well differentiated from bursa, slightly to heavily sclerotized, and almost as variable in length and width as in the genus *Nemoria*; postostial plate triangular, finely scobinate, distinctive, evidently derived from the ventral membrane of the eighth segment and not homologous with the usual postostial plate. In the character of the postostial plate, *cupedinaria* is again aberrant. Apart from the more normal two-piece genital plate, *irregularia* and *noel* have a circular accessory postostial plate that may have had the same derivation as the triangular plate of *cupedinaria*. *Synchlora aerata* and its near relatives do not have a sclerotized genital plate.

LARVAL CHARACTERS. The larvae of the three genera included in the tribe Synchlorini all appear to be much alike in structure and habits, and the description given in the discussion of tribal characters would also apply here. The protuberances that bear the fragments of plant material seem to be a little less developed in the *Synchlora aerata* group than in *Cheteoscelis* or *Merochlora*, but I have not seen larvae of the more divergent southern species of *Synchlora*.

DISTRIBUTION. Mostly Neotropical and extreme southern Nearctic, but one or two species of the *aerata* complex reach southern Canada.

REMARKS. I am including in *Synchlora* a diverse and possibly heterogeneous array of species formerly divided between *Racheospila* and *Synchlora*. I recognize eight as occurring in this region but there are probably many more in the Neotropics. Although these have much in common and form a compact tribe, future study of the South American fauna may well indicate that some are better placed in separate genera. On the other hand, it may also reveal connecting forms that will add support to the present arrangement. Of the species studied, *cupedinaria* is the most aberrant, with several quite odd characters having developed in the genitalia, but it does have Neotropical relatives. *Gerularia* is more normal, despite its distinctive wing pattern.

The *aerata* group represents a widely distributed complex of closely related North American forms and perhaps some Neotropical ones. The interrelationships within this complex remain somewhat obscure. The concept presented here developed gradually during my study of over 2,000 specimens, but it is still rather arbitrary. *Aerata*, *liquoraria*, *albineata*, *frondaria* and *denticularia* are so close that there would be considerable justification for regarding all as a single species.

Key to the Species of the Genus *Synchlora*

- 1. Abdomen shaded with brown and usually with white dorsal spots; wings with brown or reddish markings, at least a red terminal line; southern 2
- Abdomen without brown shading, with or without a white dorsal stripe on a green background; wings without brown markings; no red terminal line; widespread, Canada to Mexico (*aerata* group) 6
- 2. Wings with reddish brown subterminal markings 3

- Wings with red terminal line only 4
3. Forewing with complete reddish costal margin; discal spots minute, obsolescent .. *cupedinaria*
 Forewing without complete reddish costal margin; discal spots very large, same color
 as subterminal markings *gerularia*
4. Hind tibia of male without terminal process; a very small species of Fla. and the
 Antilles *herbaria hulstiana*
 Hind tibia of male with a terminal process; somewhat larger species, Tex., Calif. 5
5. Fringes pure white in basal half, checkered with reddish in distal half; discal spots
 minute, blackish; s. Tex. *irregularia*
 Fringes checkered with full length dull reddish rays, not leaving a clear white proxi-
 mal band; discal spots quite large, light brown; s. Calif. *noel*
6. Lines sharply dentate and somewhat offset; southern 7
 Lines regular or waved, not sharply dentate, not offset; widespread 8
7. Front usually green; Gulf States *frondaria denticularia*
 Front usually red; extreme southwest *frondaria avidaria*
8. Lines waved or slightly irregular; front red; Rocky Mt. region and west
liquoraria liquoraria
 Lines regular; front red, brownish or green; eastern 9
9. Large; white lines wide; front green or red; univoltine; Canada and adjacent northern
 states *liquoraria albolineata*
 Smaller; white lines usually narrow; front usually green, sometimes brown; multi-
 voltine; most of eastern U.S. *aerata*

Note: The *aerata* group is extremely confusing and many specimens will not key satisfactorily; species descriptions should be consulted.

Synchlora liquoraria liquoraria Guenée

Plate 21, figures 2, 2a, 2b; plate 37, figure 3; plate 47, figures 9-13.

Synchlora liquoraria Guenée, 1857, p. 375. Packard, 1876, p. 383 (reproduces original description). Hulst, 1886b, p. 141; 1895, p. 71; 1896, pp. 314-315. Dyar, 1902 [1903], p. 301. Prout, 1912, p. 115. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 41, pl. 4k. Comstock and Dammers, 1937, pp. 71-74 (early stages). McDunnough, 1938, p. 141.

Eunemorina tricoloraria Packard, 1874, p. 30.

Synchlora tricoloraria Packard, 1876, p. 381, pl. 10, fig. 83. Hulst, 1895, p. 71 (synonymizes it with *liquoraria*).

Synchlora rubrifrontaria Dyar, 1904a, p. 903 (nec Packard) (corrected by Taylor, *Canad. Ent.* 40: 100, 1908).

Synchlora glaucaria Dod, 1906, p. 257 (nec Guenée).

DIAGNOSIS. This is the common *Synchlora* of the west, occurring in the typical multivoltine form from southern Calif. and Ariz. to Vancouver Island. Northward and

eastward in the Rocky Mt. region it becomes univoltine and larger, and across the plains of western Canada and the Dakotas forms a gradual cline with the northeastern *albolineata*. The existence of a clinal connection between *liquoraria* and *aerata* has not been established.

Liquoraria apparently always has a red front, and the basal half of the pale costal margin is characteristically tinged with pink. The wings are slightly bluer than those of *aerata* or *albolineata*, but as a character this color difference is subtle and intangible because of fading and discoloration. The postmedials tend to be quite evenly dentate, or at least waved and the lines are characteristically thinner and more delicate than those of either *aerata* or *albolineata*. The bluish shade of green and pinkish costa are lost in the intergradation to *albolineata*; the dentate lines and red front are partly so. In the southwest, where *liquoraria* becomes very small, there is some difficulty distinguishing it from *avidaria*, but I believe they are distinct species. *Avidaria* has the denticulate lines more offset as in *denticularia*, and apparently lacks the pink costal shading, both above and below

TYPES. *Liquoraria* was described from one female from Calif. (Boisduval collection), the exact locality not specified. The present location of the type is unknown to me. It is neither at the USNM, the BM nor, according to Viette (1950), in the National Museum of Natural History at Paris. *Tricoloraria* was described from one male from Calif. collected by Henry Edwards, but Packard later acquired a female and included this in his description in the Geometrid Monograph (1876, p. 381, pl. 10, fig. 83). He figured the female. In the MCZ there are two specimens that are probably the ones Packard discussed in 1876. The female is a large specimen, still intact but without an abdomen, labeled "Type 2223" on red paper. Unfortunately this specimen cannot be made a lectotype since it was not mentioned in the original description. The second specimen, labeled California, "*Synchlora tricoloraria* Pack. Type," but without a red type label, has one hind wing only and the head glued on paper. It is probably the true type.

SYNONYMY. Even with the type unavailable, one can be quite certain about the identity of *liquoraria* from Guenée's description. The same is true of *tricoloraria*. It is unlikely that there is any other species in that region to which such a description might apply

FURTHER DESCRIPTION. It is not necessary to add much to what has already been said in the diagnosis. *Liquoraria* looks very much like *aerata* except for the differences noted. Californian examples look most like *aerata* and northern ones from B.C., Alta. and Sask. look more like *albolineata*. This is further discussed under geographic variation.

Length of forewing: males, 8-12.5 mm; females, 10-13 mm. The smallest specimens are from the southern half of Calif.; more northern ones are generally larger.

MALE GENITALIA. Like those of *aerata*.

FEMALE GENITALIA. Like those of *aerata*.

MATERIAL EXAMINED. 437 males including type of *tricoloraria*, 289 females; 2 male, 3 female slides.

DISTRIBUTION. CALIFORNIA: Hornbrook, Siskiyou Co.; Childs Meadows, Mt. Lassen; Laytonville and Ukiah, Mendocino Co.; Anderson Springs and Kelseyville, Lake Co.; Petaluma, Sebastopol, and the Geysers, Sonoma Co.; Napa; Coleville, Mono Co.; 4 mi. W. of Pinecrest, Tuolumne Co.; El Portal and Miami Ranger Station, Mariposa Co.; San Leandro, Alameda Co.; Palo Alto; San Jose; Walnut Creek and Lafayette,

Contra Costa Co.; Santa Cruz; Big Sur, Monterey Co.; Morro Bay, San Luis Obispo Co.; Walker Pass and near Lebec, Kern Co; Santa Barbara; Wheeler Hot Springs and Oxnard, Ventura Co.; Burbank, Newhall, Glendale, Pasadena, Temple City, Malibou, Glendora, Long Beach, Mint Canyon, and Acton Junction, Los Angeles Co.; Clear Creek Camp, Los Angeles Co.; Angeles Crest Highway, Los Angeles Co.; Avalon, Santa Catalina Island; Laguna Beach and San Clemente, Orange Co.; Lytle Creek, Loma Linda, Vidal, Needles, Calico Mountains, and Providence Mountains, San Bernardino Co.; Camp Baldy, San Bernardino Mountains; Split Rock Tank, Mojave Desert; Riverside, Arlington, Palm Springs, Palm Village, La Quinta, Hemet, and Rancho La Sierra, Riverside Co.; San Diego, Julian, Descanso, La Mesa and Borrego, San Diego Co.; Boquet Canyon; Glen Ivy; Sunland; Cajon Valley; Ft. Yuma; Gavlion; Phelan; Apple Valley; Castro Valley; Tujunga; Sausalito. BAJA CALIFORNIA: Santo Tomás; 11 mi. E. of Ensenada (4 specimens in poor condition, identification somewhat doubtful). ARIZONA: Gila Co. (O. C. Poling); Flagstaff; Walnut Canyon, 6500', near Flagstaff, Coconino Co.; Prescott; Lake Mountain, Apache Co.; White Mountains, Apache Res[ervation]. NEW MEXICO: Albuquerque; Frijoles; 6 mi. N.E. of Santa Fe, 8000', Santa Fe Co.; Jemez Springs; McGaffey, Zuni Mountains, McKinley Co. NEVADA: Kyle Canyon, Mt. Charleston, Clark Co., Pyramid, Washoe Co.; Kingston Camp, 7300', 30 mi S. of Austin, Lander Co.; Lye Creek Camp, 7500', 18 mi. N. of Paradise Valley, Humboldt Co. UTAH: Eureka; Stockton; South of Tropic; Beaver River, Beaver; near Service; Timpanagos Cave; Vineyard; Red Canyon Camp. 11 mi. S.E. of Panguitch, 7200', Garfield Co. COLORADO: Estes Park; Denver; Colorado Springs; Hall Valley; Clear Creek; Platte Canyon; Maysville; Valley View Lodge, 7600', 10 mi. S. of Steamboat Springs, Routt Co.; Harding; Glenwood Springs; Boulder; Como, Park Co.; Saguache; Great Sand Dunes National Monument, Alamosa Co. WYOMING: Moran; Jenny Lake. OREGON: Baker; Biggs; Warm Springs, Jefferson Co.; Cold Springs Junction, Umatilla Co. WASHINGTON: Walla Walla; Pullman; Wallula; Trout Lodge, Tieton River, 2200', Yakima Co.; Satus Creek and Kusshi Canyon, Yakima Co.; Leavenworth; Brewster, 900', Okanagan Co.; Omak; Orcas Island. IDAHO: Pocatello; Twin Falls; Wallace; near mouth of Wildhorse River; Adams Co. MONTANA: Big Timber Creek, 7 mi. N. of Big Timber, Sweetgrass Co. NEBRASKA: Thedford. SOUTH DAKOTA: Hill City, Pennington Co.; Joe Dollar Gulch, near Hill City; Slate Creek, 6000', 9 mi. N.W. of Hill City. NORTH DAKOTA: Ransom Co.; Dunn Co.; Bowman, Slope Co. BRITISH COLUMBIA: Robson; Kaslo; Rolla; Princeton; Vernon; Goldstream; Oliver; Keremeos; Peachland; Summerland; Lillooet; Diamond Head Trail, 3200', Garibaldi Park, near Squamish; New Westminster; Wellington, V.I. ALBERTA: Crowsnest Pass, ca. 4500'; Head of Pine Creek, Calgary; Edmonton; Dominion Range Station, Manyberries. SASKATCHEWAN: Lloydminster; Attons Lake, Cut Knife; Swift Current; Waskesiu Lake.

GEOGRAPHICAL VARIATION. There are geographic changes in several characters eastward and northward until ultimately, across Alta., Sask., Man. and the Dakotas, the gap is bridged between *liquoraria* of the west and *albolineata* of the northeast. The characters that change are as follows: 1) Size. Smallest in southern Calif., larger in the Rocky Mt. region from Colo. northward, and in B.C. For example, specimens from Glenwood Springs, Colo., the Black Hills, S.D., Idaho and B.C. look about the same and are consistently large (average wing length, males, about 11.5 mm.). Some Californian material, even from as far south as Los Angeles and San Bernardino Counties also looks like this but the size is inconsistent; most are smaller (average wing length for Californian males, about 9.5 mm.). The size variation in Calif. might be seasonal, with the spring brood being larger. 2) Number of broods. *Liquoraria* is multivoltine from Calif. to Vancouver Is. and the Okanagan Valley, B.C. It is probably univoltine through most of the Rocky Mt. region, and certainly occurs only as a single mid-summer generation in the Black Hills, S.D. and northward. 3) General coloring. When good series of *albolineata* from eastern Canada and of *liquoraria* from west of the continental divide are compared, a difference in color is quite apparent; *liquoraria* is bluish, *albolineata* a pure green. The bluish shade persists northward into B.C. and eastward to the Black Hills,

although in my sample of 32 S.D. specimens it does appear to be slightly diminished. A change from bluish to pure green occurs somewhere between B.C. and Sask., as examples from the latter area are just as green as eastern ones. 4) Costa. The pink tinge on the costa disappears in about the same region. In Vancouver Is. specimens it is quite well marked but appears much reduced in examples from the interior of B.C. Sask. specimens have the pink reduced to the minimum, and specimens from the Black Hills, S.D. are intermediate. 5) Lines. Typical *liquoraria* has antemedial and postmedial lines that are rather delicate and not strongly contrasting. The thickness and contrast of these lines increases in the cline towards *albolineata*, coincident with the transition from dentate to the more regular lines. The dentate character of the lines diminishes across Alta. and Sask. but is never entirely lost, as occasional specimens of *albolineata* even from as far east as N.S. still show dentate lines. Specimens from Sask. show almost the full range of variation from one extreme to the other, although dentate lines in the majority of specimens persist into Man. In the thickness and contrast of the lines, Sask. specimens are already quite like eastern ones, and Man. specimens even more so. In these characters, my material from the Black Hills, S.D., is more like true *liquoraria*, with the lines more delicate and more consistently dentate.

In summary, concordance in the characters that one might use to separate *liquoraria* and *albolineata* is approximate, not precise, and any sharp line drawn between them has to be a somewhat arbitrary one. Partly for convenience I have treated the line between Sask. and Man. (presumably extending southward through the middle of N.D.) as such a boundary, but emphasize that some *liquoraria* characters are lost well to the west of this and others persist eastward of it. West to east, the characters seem to change in the following order: 1) multivoltine to univoltine, 2) small average size to larger, 3) general coloring from bluish green to green, with reduction of pink costa, 4) white lines become wider, and 5) lines change from distinctly dentate to regular.

FLIGHT PERIOD. The dates from Calif. appear so continuous that it is difficult to recognize discrete generations. However, for Ore., Wash. and southern B.C., two generations are clearly indicated. The same is probably true for Ariz. and Utah, although the data for those areas are less adequate. Unusually late dates for other localities, such as the two specimens from Thedford, Nebr., Aug. 31, 1960 (both quite fresh), and one from Swift Current, Sask., Sept. 11, 1940, suggest that partial second generations may occur farther north in the plains region.

The flight periods for various regions, based on the material available, are as follows: Calif., Mar. 20–Nov. 21; Ore., Wash., Vancouver Is. and the Okanagan Valley, B.C., Apr. 5–July 4 and July 21–Sept. 15; Ariz., "1-15-VI," July 6–Aug. 28, Sept. 5; N.M., July 30, Aug. 2; Utah, July 4–Sept. 6; Colo., Wyo., Idaho, June 7–Aug. 28; Neb., Aug. 31, 1960; S.D., N.D., June 14–Aug. 14; Alta., Sask., July 4–Aug. 30, Sept. 11.

EARLY STAGES: These were described by Comstock and Dammers (1937, pp. 71-74), with figures of larvae and pupae. In gross morphology the larva appears to be similar to that of *aerata*, but since I do not have specimens available for detailed examination it is not possible to say whether there are subtle characters that would distinguish the two species. Comstock and Dammers described it as follows:

This larva, when mature, measures approximately 14 mm. It ranges in color from a pale buff with various areas laved with maroon, to a deep buff heavily marked and striped with reddish brown. The pale type may be briefly described as follows: Body, pale buff. A thin mid-dorsal maroon band showing on the segmental junctures, and center of each segment (this band occasionally continuous and conspicuous). A line of maroon spots on the segmental junctures in line with the spiracle. A third line of similar spots midway between these and the mid-dorsal area. The segmental joints show a maroon shading. The dorsal surface of each segment is irregularly flattened and bears a number of spiculiferous white processes. Similar processes occur laterally and also are numerous along the lower edge of the

body. Under magnification, the body is seen to be completely covered with numerous minute raised pale buff punctae. Abdomen, legs and prolegs concolorous with body. Spiracles brown. Head, pale buff. Mouth parts brown. In every case it feeds only on the flower. Small parts of the blossoms are bitten off and placed over its back, each particle being very carefully attached to a spiculiferous process. If this covering is removed the larva immediately begins again to complete its camouflage. While resting the larva holds only by its caudal prolegs, and arches its body. . . . Thus its posture and covering both tend to heighten the illusion that it is a part of the plant.

The locality and season of the brood described were not given, nor was it stated whether the pupae went into diapause.

The food plants listed by Comstock and Dammers (1937, p. 72) and Comstock (1960, p. 436) were: *Artemisia californica* Lessing; buds and flowers of *Chilopsis linearis* DeCandolle; *Coreopsis* sp.; *Eriogonum fasciculatum* Bentham. Goldenrod was also mentioned in the earlier paper but omitted in the later one. It is interesting to note that among these plants there are two departures from the common synchloline habit of feeding on Compositae. *Chilopsis* (Desert Willow) is in the Bignoniaceae; *Eriogonum* is in the Polygonaceae.

***Synchlora liquoraria albolineata* (Packard), new status**

Plate 3, figure 5; plate 21, figures 3, 3a, 3b; plate 37, figure 4; plate 47, figures 14-18.

Synchlora albolineata Packard, 1873, p. 75 (partim)

Synchlora albolinearia Packard, 1876, pl. 10, fig. 84.

Synchlora rubrifrontaria Auct. (partim) including Forbes, 1948, p. 115, and Ferguson, 1954, p. 289; *nec* Packard, 1873.

DIAGNOSIS. This is a large single brooded northern form of the Hudsonian and Canadian zones in eastern Canada and adjacent states from Nfld. to Man., intergrading westward with *liquoraria* in a cline across the northern plains. In addition to being larger than *aerata*, it is greener and more opaque, with white lines that are consequently more contrasting and more inclined to be sinuous or even dentate. An average of about half have a red front like *liquoraria*, the shade varying from dull brick red to rose red; the remainder have the front green like *aerata*, except for a few intermediates (6%) in which the front shows a mosaic of red and green scales. It should be emphasized that some *aerata* have a dull brownish front, and this has caused much confusion. The boundary between *albolineata* and the more southern *aerata* is relatively abrupt and seems to coincide with the change from a univoltine to a multivoltine population.

TYPES. *Albolineata* was described from four females from Me., and Boston and Natick, Mass. A female from Me. in the MCZ, labeled Type 2224 is hereby designated the lectotype. It is in poor condition with the abdomen gone and only the front wings and one detached hindwing surviving. The other three types are presumed to have been *aerata*, but now appear to be lost. All four were stated to have green fronts.

SYNONYMY. None. *Rubrifrontaria* of Packard, a name that has been commonly used for red-fronted specimens, mainly of *albolineata*, is here referred to the synonymy of *aerata*.

FURTHER DESCRIPTION. Very similar to *aerata* except for the differences noted in the diagnosis. From *liquoraria* it differs in having the white lines wider and not so distinctly dentate, the pale costa without a pink flush near the base, and the general coloration pure green without a bluish tint. Also, the true western *liquoraria* always has a red front.

Length of forewing: male, 9-12 mm; average (104 specimens), 10.38 mm; female, 12-13.5 mm; average (26 specimens), 12.67 mm.

MALE GENITALIA. Like those of *aerata*.

FEMALE GENITALIA. Like those of *aerata*.

MATERIAL EXAMINED. 224 males, 65 females; 3 male, 2 female slides.

DISTRIBUTION. ALBERTA: Edmonton; Lloydminster. MANITOBA: Beulah; Miniota; Aweme; Brandon; Winnipeg; McCreary; Cartwright; Riding Mountain National Park; Red Rock Lake, Whiteshell Provincial Park. ONTARIO: Nipigon; Geraldton; Batchawana Bay, Lake Superior; Larsson's Camp, One Sided Lake; Simcoe; Hymers; Sudbury; Constance Bay; Lake Constance, 17 mi. W. of Ottawa; Chaffey's Locks [near Kingston]. QUEBEC: Chelsea; Meach Lake, near Ottawa; Kazubazua; Norway Bay; Alcove. NEW BRUNSWICK: Bathurst, Caraquet and Inkerman, Gloucester Co.; Dorchester, Westmoreland Co. NOVA SCOTIA: Glenville, Cumberland Co.; Debert, Colchester Co.; Three Brooks, Pictou Co.; Baddeck, Victoria Co.; St. Paul Island, Cabot Strait, Victoria Co.; Mount Uniacke, Hants Co.; Halifax, Armdale, Purcell's Cove, West Dover and Echo Lake, Halifax Co.; Auburn, Kings Co.; South Milford, Annapolis Co.; Petite Rivere, Green Bay, Broad Cove and Dublin Shore, Lunenburg Co.; Caledonia, Lake Kejimikujik and White Point Beach, Queens Co. NEWFOUNDLAND: Doyles and Millville, Codroy River Valley. MINNESOTA: Long Prairie, Todd Co. WISCONSIN: Lake Katherine, Oneida Co. MICHIGAN: Ice Lake, Iron Co. NEW YORK: McLean Bogs Reserve, Tompkins Co.; Boreas River. MAINE: Lincoln; Sebec Lake; Rangeley; Dennysville; Bar Harbor. NEW HAMPSHIRE: Jefferson; Franconia; Concord. MASSACHUSETTS: Newton Highlands. CONNECTICUT: Lakeside; Putnam, Windham Co.; Washington and Pleasant Valley, Litchfield Co.

GEOGRAPHICAL VARIATION. Variation is slight except for a gradual development of the more dentate lines and pinkish costa of *liquoraria* westward across the plains region of western Canada. Most Man. specimens are still like eastern *albolineata*, but most seen from southern Sask. and Alta. are clearly of the *liquoraria* type. Specimens seen from Lloydminster and Edmonton, farther to the north, still retain the appearance of the eastern form. Virtually all specimens examined from Man. westward had red fronts, but in most of eastern Canada the incidence of green fronts approaches 50%. This tendency appears to reach its maximum in Nfld. where, in a sample of 52 specimens, the green front occurs in 30, or 57.7%.

FLIGHT PERIOD. June 29 to Aug. 7, but single records for June 9 at Simcoe, Ont. (possibly *aerata*), June 16 in Conn., and June 23 at Aweme, Man.

EARLY STAGES. Apparently similar to those of *aerata*, but *albolineata* is always univoltine, overwintering as a partly grown larva. I have attempted to rear it on raspberry and *Rudbeckia*, but the larvae cease feeding and go into diapause when about half grown. At Halifax, N.S., Dr. J. McDunnough found a larva in the spring of 1950 feeding on *Gaylussacia baccata*, and reared from it an adult female on July 20.

REMARKS. It now seems clear that *liquoraria* and *albolineata* are connected in an east-west clinal relationship; a corresponding north-south connection between *albolineata* and *aerata* in the east is not so clear. The change from one to two annual generations seems to coincide with a rather abrupt boundary, but not without some geographical overlap. Among the several records that indicate a zone of overlap, there is a single example from the McLean Bogs, Tompkins Co., N.Y. and five from Litchfield Co., Conn., that appear to be good *albolineata*. These are rather cool areas with strong Canadian zone faunal and floral elements, but the more abundant multivoltine *aerata* occurs in

apparent contact with *albolineata* in both places, flying from May to late September. If *albolineata* were to be regarded as a northern univoltine population of *aerata*, one would expect that the earliest spring specimens of *aerata* would most resemble it. Although early *aerata* are somewhat larger than the late summer ones, the very large examples determined as *albolineata* from N.Y. and Conn. are summer specimens, taken within the normal flight period of *albolineata* (Washington, Conn., July 1, 3, 1958; Pleasant Valley, Conn., Aug. 1; McLean Bogs, N.Y., July 19, 1946).

The green front, an *aerata* character, is common in *albolineata* from the Atlantic Provinces (exceeding 50% in Nfld.). The red front, a *liquoraria* character, occurs much less frequently in *aerata* south at least to Mass. and perhaps very rarely throughout the range of this species. A pale brownish front is not unusual in *aerata*, but this is not the same as the true red or brick red coloring found in *liquoraria* and *albolineata*. There has thus been some exchange of characters, at least in the Atlantic coastal region. A plausible explanation that seems to account for this is provided by the supposition that introgressive hybridization has occurred, or perhaps is still going on, in the zone where the two species come together.

Synchlora aerata (Fabricius)

Plate 21, figures 4, 4a, 4b; plate 37, figure 2; plate 47, figures 19-21.

Phalaena aerata Fabricius, 1798, p. 456. Aurivillius, 1897 [1898], p. 166.

Synchlora aerata Dyar, 1902 [1903], p. 301. Prout, 1912, p. 115. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 41, pl. 4, row K. McDunnough, 1938, p. 141. Forbes, 1948, p. 115.

Aplodes glaucaria Guenée, 1857, p. 377. Packard, 1876, p. 392 (reproduces original description). Hulst, 1895, p. 71.

Synchlora glaucaria Hulst, 1886b, p. 141; 1896, p. 315. Dyar, 1900, p. 93 (early stages).

Geometra mimicata Walker, 1866, p. 1600. Packard, 1876, p. 395 (reproduces original description). Hulst, 1895, p. 71 (refers it to synonymy of *glaucaria*).

Aplodes rubivora Riley, 1869, p. 139, pl. 2, fig. 25. Anonymous, 1890, p. 352 (food plant and parasite).

Synchlora rubivora Hulst, 1895, p. 71 (refers it to synonymy of *glaucaria* and *mimicata*)

Synchlora rubivoraria Packard, 1876, p. 382, pl. 10, fig. 86. Saunders, 1883, p. 316

Synchlora rubrifrontaria Packard, 1873, p. 75, 1876, p. 383. Hulst, 1896, p. 315. Dyar, 1902 [1903], p. 301. Prout, 1912, p. 115. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 41, pl. 4, row I. McDunnough, 1938, p. 141.

Aplodes rubrifrontaria Anonymous, 1890, p. 352 (food plant and parasite)

Synchlora rubivoraria var. *rufifrontaria* Gumpfenberg, 1895, p. 500 (in error for var. *rubrifrontaria*).

Eunemoria gracilaria Packard, 1873, p. 77.

DIAGNOSIS. This is the only species of *Synchlora* in most of the eastern United States, but it is replaced northward in Maine and eastern Canada by *albolineata*, southward in the Gulf strip by *denticularia*, and west of the great plains by *liquoraria*, all of which are doubtfully distinct except as races. The coloring of the front is usually green but may also be light brown or reddish, apparently not as a result of discoloration; hence this is useful as a statistical rather than as a key character. The red front is very rare south of Mass. but the pale brown front is widespread in about 15% of the population. *Aerata* has at least two and perhaps three generations annually and is highly variable in size, late summer specimens being smaller than the earlier ones. The larva is a flower feeder on various Compositae, and on raspberry.

TYPES. The type of *aerata* is at Copenhagen, Denmark. The only locality information given by Fabricius was: "Habitat in America boreali Dom. v. Rohr." However, Aurivillius (1896 [1898], p. 166) stated that it came from Boston according to the label on the specimen ("Das Stück stammt nach dem Zettel aus Boston"). *Glaucaria* was

based on two males from "Géorgie américaine. . . Coll. Mus. et Lefebvre." In the USNM I found a male of *aerata* (without abdomen) labeled as follows: Georgie; Ex Museo Ach. Guenée; Ex Typicalibus Speciminibus; Aplodes glaucaria Guenée, Sp. G. No. 606 type; Oberthür Collection; Glaucaria Gn., Am. bor; Barnes Collection. It seems certain that this specimen is one of the two types, although the original description did not indicate that they were in Guenée's collection. Viette (1950, pp. 201-206) did not include this name in his list of Guenée types now in the Muséum National d'Histoire Naturelle. The type of *mimicata* was one female stated to be from "North America. From Mr. Carter's collection." It should be in the BM but now appears to be lost (D. S. Fletcher, *in litt.* Dec. 18, 1964). Riley described *rubivora* from one reared female from South Pass, Illinois. He reared it on raspberry and the original description includes his account of the life history. I have not found this specimen, although in the USNM there are several "bred" specimens of *aerata* from the Riley collection; also an inflated larva and some pupal shells labeled *Aplodes rubivora* or *rubivoraria*. There is one adult labeled: C. Mo. [Central Missouri]; Sep; *Synchlora rubivoraria* (Riley); Type No. 330, U.S.N.M. This cannot be regarded as the true type since the original specimen was stated to have come from Illinois. In the MCZ, there is a male of *aerata* labeled "*Synchlora rubivoraria* Type (Riley) Pack.," but this cannot be the type either, since it is a male. *Rubrifrontaria* was described from two females from West Farms in the vicinity of New York City. I did not find these at the MCZ and their present location is unknown. The name *gracilaria* was based on a male from "Mass., Aug. 5 (Harris Coll. Bost. Soc. N. H.)." It should be in the MCZ, but I could not find it there.

SYNONYMY. The doubtful type of *glaucaria* in the USNM has the lines fairly even and is normal *aerata*, not *denticularia*, even although it is from Georgia. Guenée's comment that the lines were almost dentate also suggests *aerata*, since the lines in *denticularia* are nearly always decidedly dentate. In identifying Walker's *mimicata*, which is lost, I have little evidence other than the opinion of Hulst (1895, p. 71), who probably saw it. He said that it was the same as *rubivora* Riley and also a synonym of *glaucaria* Gn. Prout (1912, p. 115), who placed *mimicata* in the synonymy of *aerata*, may also have had the opportunity of studying the type although he gives no indication of this. The identification of *rubivora*, also apparently lost, is reasonably certain because the type locality is known, the description included an account of the life history that at once eliminates all other possibilities for that area, and several specimens, reared and determined by Riley, still survive. The spelling *rubivoraria* was just an emendation by Packard. My listing of the *rubrifrontaria* of various authors in the synonymy of *aerata* records the long standing misconception that specimens with red fronts and those with green fronts were always different species, an error that was prevalent at least up to the time of the McDunnough check list (1938). Forbes (1948) first correctly segregated the larger, single brooded northern population as a different taxon and applied the name *rubrifrontaria* to it, perhaps because a higher proportion of these northern specimens do indeed have a red front. However, Packard's types of *rubrifrontaria* came from New York City, somewhat south of the range of the large northern form, and must be regarded as representing those occasional individuals of *aerata* with reddish fronts. Actually the front was stated to be ochreous brown, not red, and this is more in agreement with *aerata*. For the northern form, the name *albolineata* Packard is available, based on an unambiguous specimen from Maine. The types of *rubrifrontaria* evidently were very large females (wing length given as .50 inch), but smaller than *albolineata* (.54 inch). Packard's half inch measurement exceeds my largest female *aerata* by .5 mm., and my supposition is that he measured from the center of the thorax. The type of *gracilaria* Packard, which I have been unable to find, was almost certainly a male of *aerata* ("Front dull green; palpi pale, tips slightly fuscus. Length of forewing .36 inch"), and the name was soon synonymized by Packard himself (1876, p. 382).

FURTHER DESCRIPTION. Male antennae bipectinate, broad near the base and tapering towards the outer third, which is simple; longest branches equal to 4-5 times the width

of the shaft; female antennae slender, ciliate beneath; male palpi moderate, exceeding front by a distance about equal to the width of front at lower margin; third segment short, rounded, about one third the length of the second; female palpi much longer, third segment slender, cylindrical, about equal in length to the second; hind tibia of male quite dilated, with an apical extension reaching to the end of the first tarsal segment, and bearing two pairs of spurs and a well developed, recessed hair pencil; hind tibia of female hardly dilated, with two pairs of spurs but no apical extension or hair pencil.

Scales of antennal shaft white, branches luteous; interantennal fillet white, sometimes with a trace of reddish or luteous scales along its hind margin; head behind fillet green; front commonly green (about 85%), with or without an irregular white lower border; front in some specimens pale brown or, very rarely, reddish. From about the latitude of Massachusetts northward the red front becomes more frequent. Palpi mostly whitish, lightly tinged with green, luteous or reddish dorsally and towards the end; front legs with coxae and often also the femora greenish, tibiae and first two or three tarsal joints pale reddish dorsally; legs otherwise whitish or cream colored; underside of body whitish; upperside of thorax green; upperside of abdomen shaded with green which diminishes posteriorly, and marked for most of its length with a fairly well defined mid-dorsal white stripe that actually begins on the mesothorax.

Upperside of wings light green, fore and hindwings colored alike; antemedials and postmedials white, not wide but quite well defined on both wings, commonly quite regular and evenly convex, sometimes slightly sinuous or almost dentate; postmedials subparallel with outer margins, antemedials more convex; space beyond postmedials often lightly clouded with whitish between the veins; discal spots obsolete but replaced by vague white streaks marking distal ends of cells; costa white with a dull yellowish hind border of similar width separating it from the green area of the wing; fringes green like the wings, with a paler distal half and a thin white line at the base marking the end of each vein with a small white point. Underside much paler with the lines indistinct; greenest just behind costa of forewing, palest on hindwing, which is uniformly almost white, including fringes.

Length of forewing: males, 7-10.5 mm; females, 8.5-12 mm. Mean wing length of 61 males (excluding reared specimens, which tend to be dwarfed): 8.67 mm; mean wing length of 37 females: 10.51 mm.

MALE GENITALIA. Apparently indistinguishable in *aerata*, *albolineata*, *liquoraria* and *denticularia*, as reference to the figures will show. In this group the socii and gnathos are normal, the latter bearing a sharp tooth. The sides of the vinculum meet in an evenly rounded loop that virtually eliminates the saccus as a distinct structure. The aedeagus is typical of the Synchronini and simple, without accessory spines or teeth.

FEMALE GENITALIA. The several forms mentioned above are also similar in the female genitalia. The bursa copulatrix is elongated and somewhat vaguely S-shaped. The signum is quite large and subcircular, with a pair of wing-like processes projecting towards the interior of the bursa. The ductus bursae is somewhat stout but well differentiated from the bursa, with a slightly thickened wall, and is finely scobinate.

MATERIAL EXAMINED. 309 males, 171 females; 4 male, 4 female slides; several larvae, alive and preserved.

DISTRIBUTION. ONTARIO: Simcoe; Point Pelee; Port Colborne. VERMONT: Swanton. MASSACHUSETTS: Amherst; Cohasset; Framingham; Lee; Newton Highlands; Norton; Springfield; West Barnstable; Martha's Vineyard. RHODE ISLAND: Kingston. CONNECTICUT: Greenwich, Fairfield Co.; Litchfield; Mystic; New Canaan; New Haven; North Haven; Putnam; Washington; Willimantic. NEW YORK: Lake George; Monroe Co.; Ithaca and McLean, Tompkins Co.; Katonah; Bear Mountain; Bardonia and Valley Cottage, Rockland Co.; New York; Yonkers, Westchester Co.; Montauk; near Amityville, Suffolk Co.; South Shore, L.I.; Babylon, Port Washington, East Hampton, Riverhead, Oyster Bay,

Bellport and Orient, L.I. NEW JERSEY: Newark; Elizabeth; West Englewood, Bergen Co.; Ramsey; Dayton; Freehold; Jerseyville, 3 mi. E. of Freehold; Lower Squankum, Monmouth Co.; Oakland; Cranford; Anglesea; Irvington; Mendham; New Brunswick; Lakehurst; Cape May. PENNSYLVANIA: Scranton; Delaware Water Gap; Adamstown; Jeanette; Oak Station, Allegheny Co.; New Brighton; Washington Co. DELAWARE: Wilmington; New Castle Co. MARYLAND: Cecil Co.; Silver Spring; Plummer's Island, Cabin John. DISTRICT OF COLUMBIA: Washington. VIRGINIA: Arlington; Fairfax; Suffolk; Blacksburg; Brush Mountain; Eggleston. NORTH CAROLINA: Vade Mecum; Niagara, Moore Co.; Southern Pines; Tryon; Valley of Black Mountains; Highlands, 3865', Macon Co. OHIO: Green Twp., Adams Co.; Granville; Hocking Co.; Marion; Ft. Ancient, Warren Co. KENTUCKY: Harrod's Creek. TENNESSEE: Chattanooga. MICHIGAN: Detroit; Highland Park; Sturgis; South Haven; Port Huron; George Reserve, Livingston Co.; East Lansing; Gull Lake Biological Station, Kalamazoo Co.; Midland Co. WISCONSIN: Sayner. ILLINOIS: Lacon; Decatur; Carbondale. INDIANA: Terre Haute, Vigo Co. MISSOURI: St. Louis; St. James; Warsaw; Independence; Barnhart, Jefferson Co.; Springfield, Green Co. KANSAS: Lawrence; Ottawa. ARKANSAS: Sulphur City, Washington Co. OKLAHOMA: Norman. GEORGIA: "Géorgie." ALABAMA: Birmingham, Jefferson Co.; Elmore. MISSISSIPPI: Hattiesburg; Clinton, Hinds Co.; Jackson, Hinds Co.; Pearl, Rankin Co. TEXAS: Kerrville; Forestburg, Montague Co.; Menard, Menard Co.

GEOGRAPHICAL VARIATION. Although there is some seasonal variation (spring specimens large, summer ones smaller), there appears to be very little geographical variation. Although it seems that there should be blend zones where *aerata* meets *albolineata* to the north, *denticularia* to the south, and *liquoraria* to the west, there is not enough material from most of the crucial areas to permit any sort of analysis. Nearly all the material of *aerata* in collections is from the central portions of its range. The boundary between *aerata* and *albolineata* runs through southern Wis., central Mich. and the Niagara Peninsula of Ont. Farther east it is confused by the local topography of the Appalachians. I have seen normal looking *albolineata* from the McLean Bogs Reserve, Tompkins Co., N.Y. and from Washington, Litchfield Co. Conn., but a specimen from Swanton, Vt., on Lake Champlain near the Quebec border, appears to be *aerata*. Such records suggest an extensive overlap zone in N.Y. and New England.

Similarly, the southern boundary seems to cover a wide zone and here there is considerably more evidence of introgression. I have seen normal looking *aerata* from Ga., Ala., Miss. and Tex., yet *denticularia* extends northward to N.C. and Tenn. Of 5 specimens collected by Dr. J. G. Franclemont at Highlands, N.C., Aug. 6-21, 1958, three are normal *aerata*, one looks quite normal for *denticularia*, and the fifth appears to be intermediate. A female from Suffolk, Va. also clearly shows the strongly dentate lines of *denticularia*. The best evidence of a blend zone is a series of 49 males and 78 females from Miss. in the AMNH. Variation in this large sample is extreme; the specimens range from very small to very large, and from those with the even lines of *aerata* to those that are seemingly pure *denticularia*. Only about 5% of the Miss. sample look like pure *aerata*, but every degree of intergradation is present. The specimens from Tex. represent the most westerly records seen for *aerata*, and it was my impression when I examined those from Forestburg and Menard (AMNH) that they were normal. Two specimens from Kerrville, Tex. (USNM) have more dentate lines but fall within the expected range of variation. A female from Norman, Okla., is also normal *aerata*, with green front and only slightly irregular lines.

The exact location of the boundary where *aerata* and *liquoraria* meet is not known, but it must be somewhere in the plains region. *Aerata* reaches eastern Kans., but the form that is present at the western edge of the plains is *liquoraria*, or at least not *aerata*. A series of 32 that I collected in the Black Hills, S.D., in 1964 are *liquoraria* of the large northwestern type.

FLIGHT PERIOD. Northern states south to the latitude of New York City: May 17-Sept. 30 (earliest record of many taken at Ithaca, N.Y. is June 3); central states

from N.J. and Ill. to N.C. and Tenn.: May 11–Oct. 14; Ala., Miss.: Mar. 29–Oct. 15. The Texas records were taken May 12, July 5 and Sept. 18. Most records, at least for the northern and central regions, are for July and Aug. There are also many for Sept., but spring records are relatively few. There are probably two or three generations per year in the north, and four or more farther south. The large series in the Franclemont collection from the vicinity of Ithaca, N.Y. shows peaks of abundance for June and Aug., suggesting two broods in that area.

EARLY STAGES. The early stages of *aerata* are relatively well known and have been described in varying detail by several authors (Saunders, French, Riley, Dyar). The larva seems to have been figured only by Saunders (1883, p. 316). In the last instar it is light brown or greenish, with thin stripes and mottled markings of a darker shade, including a thin and somewhat interrupted mid-dorsal line. With magnification, the surface of the head and the integument of the body appears finely and densely granulated. The conspicuous lateral processes characteristic of *Nemoria* and *Dichorda* are undeveloped, appearing only as low dorso-lateral humps, each bearing a slender setose tubercle that terminates in the usual long seta. These spinelike tubercles, with their numerous accessory setae, are in effect barbed, although the small setae on the sides are not recurved. It is to these specialized tubercles that the larva attaches bits of plant debris to cover itself in the manner characteristic of the tribe Synchronini. Only the abdominal tubercles are specialized in this way and the larva does not attach plant fragments to the thoracic segments. The dorso-lateral humps on the thorax are smaller and bear only the usual low setiferous tubercles. Moderately large abdominal setiferous tubercles also occur subventrally.

The reported host plants are as follows: *Rubus* (raspberry) (Riley, 1869; Saunders, 1883; a specimen in the AMNH reared from raspberry at Englewood, N.J.); *Rudbeckia* (reared specimen in AMNH, from Bardonia, N.Y., which also fed on *Chrysanthemum*); *Rudbeckia hirta* (reared specimen in USNM, and also reared by me on this plant at New Haven in 1964); *Aster* (Dyar, 1900); *Aster ericoides* (reared specimens in USNM); *Ambrosia* (reared specimen in USNM); *Coreopsis* (series in USNM, including two inflated larvae, reared by McDunnough at Decatur, Ill.); *Erigeron canadensis* (an inflated larva, without locality, and one reared adult from "D.C.," in USNM); *Eupatorium* (Anonymous, 1890, as *rubrifrontaria*, at St. Louis, Mo. in 1871); *Ageratum* (Anonymous, 1890, as *rubivora*, at St. Louis, Mo. in 1881).

Riley stated that the larva fed on the "fruit of the raspberry," and the species has even been treated in the literature as a potential pest of raspberry (Saunders). It is interesting to note that Dyar's larvae, reared from eggs obtained at Washington, D.C., Sept. 21, hibernated in the fourth instar. Similarly, my unsuccessful attempt to rear the single brooded *albolineata* suggested that the larvae of that form are hibernators. The annual number of generations of *aerata* from north to south probably varies from two to about four. A braconid parasite identified as *Rhogas melleus* Cresson, was reared from *aerata* larvae feeding on *Eupatorium* and *Ageratum* at St. Louis, Mo., in 1871 and 1881 (Anonymous, 1890, p. 352).

Synchlora frondaria Guenée

Synchlora frondaria Guenée, 1858, p. 376. Prout, 1912, p. 115. Prout, 1932, p. 41

Geometra frondaria Hampson, 1895, p. 332.

Aplodes frondaria Prout, 1910, p. 210.

Thalera minuata Walker, 1866, p. 1613.

DIAGNOSIS. A very small species, common and supposedly widespread in the American tropics from Mexico and the West Indies to Argentina, entering the United States in the extreme southwest (*avidaria*) and in the southeast (*denticularia*). Specimens

I have examined from Brazil, French Guiana, Puerto Rico, Haiti, Cuba and Florida all look so much alike that it seems doubtful at this stage if the name *denticularia* should be retained even in a subspecific sense. The green front, prevalent in the Florida population, may have been derived through introgression with *aerata*, as has apparently happened in the case of *liquoraria albolineata*. Specimens from the south-western United States differ slightly and for these the name *avidaria* is available. A form occurs in Central America (Panama, Costa Rica, Guatemala) with wider and more prominent white lines and white shading between the veins beyond the postmedial. This has a distinctly different appearance and may not be the same species.

TYPES. *Fronitaria* was based on one male and one female in the Guenée collection from Cayenne, French Guiana. These are now in the BM. *Minuata* was described from one female from Santa Marta [Colombia?], "from Mr. Bouchard's collection." It is also in the BM.

SYNONYMY. I have not seen the type of *minuata* Walker, and I am accepting Prout's assignment of this name to the synonymy of *fronitaria*. In the USNM there is a specimen from Brazil (ex Dognin collection) identified by Warren as *minuata*, and this specimen looks the same as what I determine as *fronitaria*. Also, the original description of *minuata* seems to fit this species. It is not improbable that two other names, *albicostaria* Herrich-Schäffer (Cuba) and *pallida* Warren (Bonaire, Netherlands Antilles) also belong in this synonymy.

Synchlora fronitaria avidaria Pearsall

Plate 21, figures 6, 6a, 6b; plate 37, figure 6; plate 47, figures 26, 27.

Synchlora avidaria Pearsall, 1917, p. 34.

Synchlora fronitaria avidaria Prout, 1932, p. 41. McDunnough, 1938, p. 141.

DIAGNOSIS. *Avidaria* is a very small form of the desert areas in southern Calif., Ariz., and extreme southern Texas. It usually has a reddish front and is otherwise also similar to *liquoraria* except for its smaller size, more strongly dentate and offset lines, and somewhat more intense green coloring. There are no significant differences in the genitalia.

TYPES. The type of *avidaria* is a male from Palmerlee, Cochise Co., Ariz., (June) in the AMNH. This collection also contains the allotype female, an Oslar specimen from Oracle, Ariz. (June 30, 1904).

SYNONYMY. None.

FURTHER DESCRIPTION. Male antenna bipectinate, broad near the base and tapering toward the outer third, which becomes simple; longest branches equal to 4.5 times the diameter of the shaft; female antenna slender, ciliate beneath; male palpi moderate, exceeding front by a distance subequal to the width of front at lower margin; third segment short, rounded, about one third the length of the second; female palpi much longer, third segment slender, subcylindrical, almost as long as the second; hind tibia of male slightly dilated, with the apical extension extending as far as the end of the first tarsal segment, and bearing two pairs of spurs and a recessed hair pencil; hind tibia of female undilated, with the usual two pairs of spurs but no apical extension or hair pencil.

Scales of antennal shaft white, branches luteous; interantennal fillet white; head

behind fillet green; front brown or reddish (rarely green) with an irregular white band along its lower margin, the white scales often heavily interspersed with rose colored ones; palpi of both sexes whitish, outwardly tinged with pink; front legs with coxae and sometimes the inner sides of the femora greenish, tibiae and tarsi faintly shaded with pink or brownish; legs otherwise whitish; underside of body whitish; upperside of thorax green; upperside of abdomen green almost to the end; middorsal abdominal white stripe present but weak, usually broken into a series of segmental spots.

Upperside bright green, in fresh specimens evidently a little more intense than in *liquoraria*; fore- and hindwings colored alike; antemedials and postmedials white, thin, delicate, ill-defined except in very good specimens, denticulate, often prominently offset outwardly in the space between M_2 and Cu_2 on both wings; general course of postmedials subparallel with outer margins; antemedials more convex; postmedial space sometimes faintly clouded with white between the veins; a single broken row of white scales marking the outer end of the cell on both wings, and single white scales occurring here and there on the veins; forewing costa white, sometimes weakly tinted with pinkish at the base, and with the usual luteous hind border separating it from the green portion of the wing; fringes green, concolorous with wings in basal half but with a paler distal half, and a vague whitish line at the base (actually at the termen), dilated to form small wedge-shaped spots at the veins. Underside much paler, almost white on the hindwing, with all lines indistinct.

Length of forewing: males, 6-8 mm; females, 7-11 mm. Mean wing length: males (25 specimens), 6.90 mm; females (25 specimens), 9.22 mm

MALE GENITALIA. These are apparently indistinguishable from the genitalia of nominate *frondaria*, *frondaria denticularia*, *liquoraria* and *aerata*.

FEMALE GENITALIA. The above remarks also apply here.

MATERIAL EXAMINED. 248 males, 164 females, including types; 2 male, 2 female slides; 4 preserved larvae.

DISTRIBUTION. CALIFORNIA: Ft. Yuma; Borrego; Needles, San Bernardino Co. ARIZONA: Yuma; Organ Pipe Cactus National Monument; Hualapai Mountains, Mojave Co.; New River, Maricopa Co.; Mayer, Yavapai Co.; Tucson, Pima Co.; Santa Cruz Village, ca. 3100', Cobabi Mountains, Pima Co.; Coyote Mountains, ca. 3500'; Baboquivari Mountains, Pima Co.; Kits Peak Rincon, Baboquivari Mountains, Pima Co.; Saguaro National Monument, Pima Co.; Madera Canyon, 3800' and 4400', Santa Rita Mountains; Peña Blanca, 3950', Santa Cruz Co.; Phoenix; Oracle, Pinal Co.; Globe, Gila Co.; S.W. Research Station of the AMNH, Chiricahua Mountains, Cochise Co.; Paradise, Palmerlee, Sierra Vista, and Chiricahua Monument, Cochise Co.; Silver Creek Wash, 4880', near Portal, Cochise Co.; Ramsey Canyon and Miller Canyon, Huachuca Mountains; Redington; Tempe; Aguila; Superior; Fairview; Apache. TEXAS: Santa Elena Canyon, Brewster Co.; Mercedes and Pharr, Hidalgo Co.; Brownsville and San Benito, Cameron Co.

All records from north and east of the Edwards Plateau and the arid plain south of the Nueces River in Texas I refer, somewhat arbitrarily, to subspecies *denticularia*. I have seen no material from New Mexico. In the CNC there are four specimens labeled "Plate Canon, Col. Oslar" that appear to be this, but as with some other Oslar specimens (see *Cheteoscelis pectinaria*), the locality is suspect.

GEOGRAPHICAL VARIATION. There is no obvious geographical variation except in the coloring of the front. In Ariz. a reddish front prevails and only two specimens of approximately 200 examined for this character had a green front, or 1%. In the vicinity of Brownsville, Tex., the proportion seems close to 50%, and of the three

specimens seen from Santa Elena Canyon in the Big Bend Region, two have green fronts. Subspecies *denticularia* normally has a green front but the reddish front, with an incidence of over 6% in Fla., occurs with greater frequency there than does the green front in Ariz. The available evidence suggests that the Texas form is intermediate between these two extremes.

FLIGHT PERIOD. The data for all localities in Ariz. and Calif. combined gives the impression of a continuous flight period from Apr. to Oct., but the Franclemont material collected during several seasons in the Santa Rita Mts., Santa Cruz Co., Ariz. (mostly in Madera Canyon) seems to fall into two separate periods, suggesting two discrete generations: May 14 to July 9, and Aug. 9 to Sept. 9. There are Texas records for Jan., Mar., May, July, Aug., Oct., and Dec.

EARLY STAGES. This form was reared by Mr. Robert W. Poole from a female taken in Madera Canyon in 1965. The larvae fed on *Senecio* flowers. I have examined preserved specimens from this brood, and the larva is apparently very similar in both structure and habits to that of *aerata*. It has the lateral protuberances a little better developed on the thoracic segments, with three or four lateral tubercles on each segment unified to form a single, more prominent hump. However, this difference is very subtle and may prove not to be consistent when more material is studied.

***Synchlora frondaria denticularia* (Walker), new status**

Plate 21, figures 5, 5a, 5b; plate 37, figure 5; plate 47, figures 22-25.

Nemoria? denticularia Walker, 1861, p. 536. Hulst, 1895, p. 71.

Synchlora denticulata Hulst, 1896, p. 315. Dyar, 1902 [1903], p. 301.

Synchlora denticularia Prout, 1912, p. 115. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 41. McDunnough, 1933, p. 141. Forbes, 1948, p. 115. Kimball, 1965, p. 163

Synchlora excurvaria Packard, 1873, p. 76; 1876, pp. 380, 381, pl. 10, fig. 85. Dyar, 1894, p. 62.

DIAGNOSIS. This is a form found in the southeastern United States, Cuba, the Bahamas and Bermuda, differing from *frondaria* in little other than the coloring of the front, which is nearly always green as in *aerata*. *Denticularia* differs from *aerata* mainly in its smaller size and in its strongly dentate and offset lines. Most material in collections is from Florida but the range extends from there to central Texas and north to Arkansas and North Carolina. There is some evidence of introgression between *denticularia* and *aerata*, especially in Mississippi, but elsewhere in the contact zone they seem to remain more distinct.

TYPES. *Denticularia* was described from two females from the Milne collection and I designate as lectotype one of these specimens now in the BM. It is so labeled. I have a colored photograph of this specimen and its identity seems reasonably certain. The type locality was not given by Walker ("Country unknown"), but it is not unlikely that the specimens came from John Abbott in Georgia, from whom Milne purchased material (Doubleday, in Scudder, 1869, p. 123). In the AMNH there are specimens collected by the late Otto Buchholz in Screven Co., Ga., where Abbot lived.

The types of *excurvaria* were two females from "Waco, Texas, Oct. 10 (Bel-frage)". One of these specimens, labeled Type 2225, still survives in the MCZ, and I designate this the lectotype.

SYNONYMY. The lectotype of *excurvaria* is a rather large specimen and on examining it about a year ago I thought that it might be *liquoraria*. However, subsequent study has indicated that *liquoraria* does not occur in Texas.

FURTHER DESCRIPTION. The description of *avidaria* applies equally well here except that *denticularia* averages slightly larger (although individual size variation covers a wide range), and normally has a green front. In a sample of 79 Florida specimens of *denticularia* examined for the latter character, 6 individuals, or 7.6%, have a reddish front. On that basis this character difference is reliable for only 92.4% of the population. There is also a minor difference in the coloring of the forewing costa. In *avidaria*, as in *liquoraria*, there is commonly a rosy flush at the base of the costa; in *denticularia* this appears much less frequently.

Length of forewing: males, 6.5-10 mm; females, 8-11.5 mm. Mean wing length: males, 8.03 mm. (42 specimens); females, 9.94 mm. (35 specimens).

MALE GENITALIA. Like those of *avidaria*, *liquoraria* and *aerata*.

FEMALE GENITALIA. Like those of *avidaria*, *liquoraria* and *aerata*.

MATERIAL EXAMINED. 197 males, 265 females; 2 male, 2 female slides.

DISTRIBUTION. TEXAS: Corpus Christi; Victoria; Welder Wildlife Foundation Refuge, San Patricio Co.; Bexar Co.; Blanco Co.; Cold Spring, San Jacinto Co.; Waco; Dallas; Forestburg, Montague Co.; Town Bluff, Tyler Co. LOUISIANA: Schriever; Covington; Shreveport; Lafayette; Cypremont; Weeks Island, Iberia Parish. ARKANSAS: Hope. MISSISSIPPI: Biloxi, Harrison Co.; Greenville; University; Pascagoula, Jackson Co.; Pearl and Camp Wahi, Rankin Co.; Bolton, Clinton, and Jackson, Hinds Co.; Hattiesburg and Camp Shelby, near Hattiesburg. ALABAMA: Ozark; Anniston. TENNESSEE: East Ridge; Gatlinburg, Sevier Co. NORTH CAROLINA: Raleigh, Wake Co.; New Bern, Craven Co.; Leland; Vade Mecum. SOUTH CAROLINA: Charleston; The Wedge Plantation, South Santee R., Charleston Co.; Myrtle Beach; Ocean Drive. GEORGIA: Screven Co.; Clark Co.; Savannah; Okefenokee Swamp. FLORIDA: Fernandina; St. Johns Bluff, Duval Co.; De Funiac Springs, Walton Co.; Gainesville; Welaka, Putnam Co.; Old Town, Dixie Co.; DeLand; New Smyrna; Leesburg, Lake Co.; Orlando; Winter Park, Orange Co.; Anclote River, Elfers, Pasco Co.; Tampa; St. Petersburg; Oneco, Manatee Co.; Siesta Key, Sarasota Co.; Archbold Biological Station, Lake Placid, Highlands Co.; Hicoria, Highlands Co.; Charlotte Harbour; Vero Beach; Port Sewall, Martin Co.; Bonita Springs, Lake Co.; Fort Lauderdale; Miami; Homestead, Dade Co.; Florida City; Biscayne Bay; Everglades; Tavernier, Monroe Co.; Big Pine Key, South Florida Keys; Key West; Dry Tortugas; Stemper; Modello.

I have also seen normal looking *denticularia* from North and South Bimini Islands in the Bahamas, Havana, Cuba, and Bermuda.

GEOGRAPHICAL VARIATION. It is to be expected that westward, in eastern Texas, there will be a decrease in average size and increasing frequency of the red-fronted character in clinal fashion, forming a blend zone between *denticularia* and *frondaria*. The few specimens I have been able to examine do suggest that this situation occurs. A reverse trend with respect to size occurs in Fla., where the specimens tend to be smaller than those from farther north in Ga., Ala., Miss. and the Carolinas. Nearly all of the extremely small specimens are from Fla.

A large sample of 49 males and 78 females from Miss. (Bryant Mather) in the AMNH provides the only good evidence of intergradation between this species and *aerata*. Variation in this series is extreme; size varies from very small to very large, and pattern varies from the even lines of *aerata* to the highly dentate and offset lines of true *denticularia*. Only about 5% have lines as regular as normal *aerata*, but intergradation seems to be complete. The single specimen from Gatlinburg, Tenn., and two from Highlands, N.C. (under *aerata*) also look intermediate. Those from S.C. are pure *denticularia*.

FLIGHT PERIOD. There are Fla. records covering every month of the year but northward there is a break during the winter. The records for Miss. indicate a continuous flight period from Mar. 24 to Oct. 15, and those for S.C. suggest a similar pattern.

EARLY STAGES. Dyar (1894, p. 62) described a larva from Lake Worth, Fla., as follows: "Head pale brown, minutely pilose. Body with the segments projecting laterally in points, the dorsum roughened. On these lateral processes the larva attaches various objects, which gives it a strange appearance. Body light brown with black shades and an interrupted dorsal line. Two reddish points anteriorly on joints 3-9 and 13; other elevated reddish spots laterally and fine hairs; the skin granular. On joints 5-9 are curious structures composed of pieces of dead leaves, etc. After moulting the larva applied several pieces of green leaf to itself, which subsequently withered, and also some pieces of paper from its label. Length about 12 mm.; width of head 1 mm." This reads very much like a description of the larva of *aerata*, as would be expected.

Dyar neglected to mention the food plant, but in the USNM I found three reared specimens with host plant data; one from *Stillingia* sp. (Euphorbiaceae) at Ocean Drive, S.C.; one from *Pluchea odorata* (Compositae) at Key West, Fla.; and one from *Bidens* (Compositae) at Everglade, Fla. Kimball (1965, p. 163) mentions also *Chrysanthemum* and blackberry.

Synchlora gerularia (Hübner), new combination

Plate 3, figure 4; plate 22, figures 1, 1a, 1b; plate 37, figure 7; plate 47, figures 28, 29.

Phalaena Geometra ocellata Stoll, 1791, pp. 156, 184, pl. 34, fig. 9 (nec Linnaeus, 1758, p. 258).

Primary homonym

Comibaena ocellata Walker, 1861, p. 570.

Phorodesma ocellata Möschler, 1881, p. 402.

Geometra ocellata Möschler, 1890, p. 244.

Comibaena gerularia Hübner, 1823, p. 284.

Racheospila gerularia Prout, 1912, p. 109. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 38, pl. 4d. McDunnough, 1938, p. 140. Bourquin, 1945, pp. 29-30. Kimball, 1965, p. 162, pl. 5, fig. 31.

Phorodesma stollaria Guenée, 1858, p. 370.

Geometra stollaria Herrich-Schäffer, 1870, p. 182. Gundlach, 1881, p. 384

Racheospila marginiplaga Walker, 1861, p. 583.

Racheospila rufidorsaria Snellen, 1874, p. 41, pl. 3, fig. 4.

Racheospila jucunda Felder, 1875, pl. 127, fig. 18.

Racheospila xysteraria Hulst, 1886a, p. 121; 1896, p. 314.

Synchlora xysteraria Dyar, 1902 [1903], p. 301.

DIAGNOSIS. This is an ornate little species of a delicate, pale yellowish-green color, with the usual lines indistinct and with brown-checked fringes, large brown discal spots and distinctive purplish brown patches in the terminal area—two on the forewing and three on the hindwing. The abdomen is brown on the dorsum with white, raised spots. The genitalia are very close to those of the *aerata* group, much more so than are the genitalia of *herbaria*, *irregularia*, *noel* or *cupedinaria*. About the only distinctive features are the hook-like processes on the aedeagus in the male and large U-shaped signum and large ostium in the female.

Gerularia is supposed to be widely distributed through the American tropics from Florida to Argentina, and although specimens from widely scattered localities within this vast area appear to be similar, it remains for future investigation to determine how many species are actually involved. If it is all one species, this would represent the widest geographical distribution known for any American species of the subfamily with the exception of *Synchlora frondaria*.

TYPES. *Ocellata* Stoll was based on material from Netherlands Guiana ("On la trouve á Suriname"). I have not determined whether a type now exists but it was figured. Hübner realized that *ocellata* was preoccupied and proposed the substitute name *gerularia*, which would have the same type and type locality. The same is true with respect to *stollaria* Guenée. *Marginiplaga* Walker was described from one female from Brazil (ex Saunders collection). The specimen that is supposed to be the type, now in the University Museum at Oxford, England, is a male. *Rufidorsaria* Snellen was based on a specimen (the figure is that of a male) taken Jan. 18, 1871, by Baron Von Nolcken on the Rio Magdalena, presumably in northern Colombia. *Jucunda* Felder was a female from Brazil. I have made no effort to locate the types of *rufidorsaria* and *jucunda*. *Xysteraria* Hulst was described from one female from Florida (exact locality not specified), and the type is in the AMNH.

SYNONYMY. Final decisions on synonymy must await detailed investigation of the Neotropical fauna. All that I can say at present is that the specimens examined from Surinam (*ocellata* Stoll, *gerularia* Hübner, *stollaria* Guenée) appeared to be extremely close to the form that occurs in Florida (*xysteraria* Hulst). A colored photograph of the supposed type of *marginiplaga* (a male, not a female as Walker stated), kindly made available to me by the authorities at the BM, shows that it is the same sort of thing, although the discal spots are much smaller than is usual in Floridian examples. The figure of *rufidorsaria* (Snellen, 1874, pl. 3, fig. 4) is uncolored but the markings appear to be exactly right for *gerularia*. The figure of *jucunda* (Felder, 1875, pl. 127, fig. 18), colored in the Cornell copy but not in the Yale one, is not very good but obviously represents the same or a similar species. I have examined the type of *xysteraria* and there is no doubt about its identity. This is the only synonym based on North American material.

FURTHER DESCRIPTION. (based on Florida specimens). Antennae typical of *Synchlora*; those of the male broadly bipectinate for basal two-thirds, tapering and becoming simple in outer third, longest branches equal to 4-5 times diameter of shaft; female antennae slender, ciliate beneath; male palpi moderate, exceeding front by about half the length of the second segment, third segment short, rounded, one quarter the length of the second; female palpi very long, second and third segments of similar length, each subequal to width of eye; hind tibia of male only slightly dilated but with a long terminal extension three quarters the length of the first tarsal joint; hind tibia of female compressed but hardly dilated, truncate at the end, without an extension.

Antennal shaft white, branches yellowish; head behind white fillet broadly reddish or brown, forming a collar; front red with an irregular luteous lower margin and small lateral maculae of a similar shade near upper corners; palpi red with the second segment whitish beneath; legs whitish with red anterior shading on the first pair, especially on the tibia; underside of body whitish; thorax above with the front quarter and the patagia green, the remainder brown with some deep red scales anteriorly and a large, circular light brown dorsal spot occupying the posterior lobe of the mesothorax; upperside of abdomen brown with pure white raised spots somewhat variable in size and number, usually one or two in male, three in female, each narrowly encircled with reddish.

Upper surface of wings yellowish green with the antemedials and postmedials very faintly indicated as sinuous lines of a paler shade; discal spots, costal and marginal markings all of a prominent and contrasting purplish brown; discal spots large, round or slightly compressed, with a cluster of white scales at the center; costa margined with white, followed by a cream colored band, becoming red towards the apex, and expanding at the base to form a well defined reddish brown patch at the humeral angle. There is a somewhat crenulate reddish or purplish brown terminal line which expands inward to form two prominent, submarginal lobes of the same color on the forewing and three on the hindwing. On the forewing these are

rounded; one lies just beyond the middle of the outer margin and the other in the tornus. There is often a much smaller wedge of the same brown coloring between them. On the hindwing, the median submarginal patch is a lobe, those in the anterior and anal angles somewhat flattened; that of the anal angle extends more than halfway up the inner margin as a thin border. These brown submarginal markings each enclose one or two greenish yellow marginal spots, and the brown areas have a dusting of white scales, visible only under magnification. The green scaling of the wings changes to yellow where it meets the brown marginal markings. The fringes are pale brown to yellowish, with a weak and interrupted white line at the base and diffuse reddish brown rays opposite the veins. Underside much paler, almost white, with the brown markings repeated less distinctly.

Length of forewing: males, 8.5-10 mm; females, 10-12 mm.

MALE GENITALIA. Similar to those of the *Synchlora aerata* group but with the following differences: socii and gnathos more heavily developed, the latter with a rather large tooth; valve more slender with the sides parallel and with the elevated mesial ridge overlapping the costa; transtilla forming a wider band; juxta much wider laterally; saccus terminating in a knob-like process. The aedeagus is especially distinctive, with the two chitinous prongs each bearing one or two large, hook-like lateral teeth. *Cupedinaria* is the only other *Synchlora* in this region with teeth on the aedeagus but they are smaller, more numerous and different in shape.

FEMALE GENITALIA. These are quite distinctive, with a relatively large bursa, a large U-shaped signum with its ends divergent, and with the ductus bursae shortened, thickened, somewhat sclerotized and opening into a much larger ostium than is usual at least in the North American *Synchlorini*.

MATERIAL EXAMINED. 42 males, 57 females, including type of *xysteraria*; 5 male, 4 female slides.

DISTRIBUTION. FLORIDA: Key Largo; Florida City and Homestead, Dade Co.; Biscayne Bay; Miami; Port Sewall, Martin Co.; Vero Beach, Indian River Co.; Bonita Springs, Lee Co.; Fort Myers; Marco; Sarasota; Siesta Key, Sarasota Co.; Oneco, Manatee Co.; St. Petersburg; Hicoria, Highlands Co.; Winter Park, Orange Co.; Titusville, Brevard Co.; Welaka, Putnam Co. TEXAS: Brownsville, Cameron Co., one male in the USNM taken November 10, 1928, by F. H. Benjamin.

A female that I collected at the University of Florida Conservation Reserve, Welaka, Putnam Co. on March 11, 1962, is the most northerly record examined, but Kimball (1965, p. 162) reports *gerularia* from Warrington (near Pensacola, Escambia Co.). South of the United States, *gerularia* has been reported from numerous localities through Central America, the West Indies and South America to the estuary of the Rio de la Plata between Uruguay and Argentina. In the Cornell University collection there are series from British and Dutch Guiana, and the USNM has two of Bourquin's specimens labeled Tigre, Argentina [mouth of the La Plata]. The extent of its distribution through the Antilles is unknown.

GEOGRAPHICAL VARIATION: Not studied.

FLIGHT PERIOD: There are Florida records for every month of the year

EARLY STAGES: Kimball (1965, p. 162) mentions as food plants mango and lychee, on the authority of the Division of Plant Industry, Florida Department of Agriculture. An interesting account of the larva and its habits has been published (Bourquin, 1945, pp. 29-30), based on observations made in Argentina. Although there is no certainty that this is the same species that occurs in North America, the adults certainly

look alike, and the larvae would be similar. Bourquin's description and figures reveal that the larva is typically *Synchlora* in structure and habits. It fed on *Baccharis salicifolia* (Compositae). The following is my translation (from Spanish) of the major portion of his description:

At my country house, "La Tacuarita" (Islas del Tigre, F.C.C.A.) in January, 1936, I noticed a curious irregular clump of the remains of flowers and fruit on a leaf of the milk tree, *Sapium aucuparium* Jacq. More careful examination revealed a caterpillar underneath, completely concealed. A month later there emerged a *Racheospila gerularia*, which I kept for my collection. In March of the following year I caught another example of the same species at the light of a lantern. It had suffered considerable deterioration. I put it in a jar and, fortunately, during the night, it laid ten eggs. These were of ovoid form, agate-like, and appeared as if they had been embossed on their surfaces. They measured 0.65 mm. by 0.55 mm., and were of a yellowish white color gilded with metallic reflections. In five days the first caterpillars hatched and were 1.44 mm. in length. Three hours later they tasted the leaves of the milk tree that I gave them to eat, but quickly ceased feeding and from then on refused this food. I therefore concluded that the caterpillar of the previous year, discovered on a leaf of the milk tree, had just by chance pupated on it, and that one would be able to find its foodplant in the area. I obtained various herbs that grew around this tree and from among these they chose *Baccharis salicifolia* Pers. At first they skeletonized a leaf but then fed ravenously upon the flowers, especially the bases of the pistils and stamens. The next day, upon looking for my little caterpillars, I found them changed into little lumps, and with surprise admired the skill with which they could hide themselves. They covered the body with plant fragments in a genuine "camouflage." With suitable forceps I carefully removed these adherences from one larva 1.50 mm. in length. Uncovered, it chewed again on the stamens and pistils. With its mouth it took hold of the pieces, attached them over some little finger-like horns it has on its dorsum and, turning its head to the rear, covered them with silken filaments from silk glands beneath the head. After several hours the caterpillar was found to be covered again by the protective mantle. During growth it changed its food. After the stamens it ate the corolla of the flowers, then the leaves; thus, with the change of food, the "camouflage" changed. They could be seen covered successively with flower petals, full-blown flowers, dry flowers, remains of the capitulum and pieces of leaves. At maximum development the caterpillar is 16.25 mm. long; its color varies from true yellow to reddish brown, striated with white lines. The skin is granulated like that of a toad, distinctly angulate, and wrinkled as though it were too large.

In order to pupate it spins a platform on a leaf with crossed threads of silk. It weaves an irregular fleecy net over which it attaches pieces of the capitulum of the flower and remains of fruit. Thus protected under this final "camouflage" the chrysalis, which is brownish colored with darker lines and spots, can peacefully pass its pupal period of about ten days.

Synchlora herbaria (Fabricius)

- Phalaena herbaria* Fabricius, 1794, p. 162.
Microloxia herbaria Warren, 1906b, p. 82.
Synchlora herbaria Prout, 1912, p. 115.
Racheospila herbaria Prout, 1932, p. 39.
Racheospila sitellaria Guenée, 1858, p. 374.
Geometra congruata Walker, 1861, p. 511.

TYPE LOCALITIES. *Herbaria*, "Habitat in Americae meridionalis Insulis Dr. Pflug" (presumably the West Indies); *sitellaria*, Haiti; *congruata*, "St. Domingo."

REMARKS. There are also a number of other names for this species or complex (see Prout, 1932, pp. 39-40), based on material from various islands. It would not be surprising if some of these proved to be distinct. Until the Antillean fauna has been properly studied I am in no position to say whether the names equal *hulstiana* or whether they equal one another. In the present revision I treat only the Florida population, which seems homogeneous and for which the name *hulstiana* is available, if needed.

Synchlora herbaria hulstiana (Dyar)

Plate 3, figure 6; plate 21, figures 7, 7a, 7b; plate 38, figure 4; plate 47, figures 30, 31.

Synchlora louisiana Hulst, 1898, p. 159, *partim*.

Synchlora louisiana var (?) *hulstiana* Dyar, 1901b, p. 457.

Synchlora hulstiana Dyar, 1902, [1903], p. 300.

Racheospila sitellaria Dyar, 1908a, p. 171 (*nec* Guenée, 1858). Prout, 1912, p. 109. Barnes and McDunnough, 1917a, p. 99.

Racheospila herbaria hulstiana Prout, 1932, p. 39. McDunnough, 1938, p. 140. Comstock, 1960, pp. 436, 438. Kimball, 1965, p. 162, pl. 5, fig. 32.

Eucrostis dominicaria Hulst, 1895, p. 71 (*nec* Guenée, 1858, p. 367).

Racheospila tenuimargo Guedet, 1939, p. 29 (*nec* Warren, 1905, p. 319).

DIAGNOSIS. *Herbaria* is a very small, plain, bright green species of the Caribbean region that enters our area as subspecies *hulstiana* in southern Florida. It probably has many close Neotropical relatives but none within the United States. *Synchlora irregularia* of Texas is superficially similar but has distinctly different genitalia. *Hulstiana* has a whitish costa, a red terminal line, red and white checkered fringes, small blackish discal spots, and it has the lines of the wings indicated only as series of faint white dots. There are no other markings on the wings. Both *gerularia* and *cupedinaria* have obvious lobes of color encroaching inward from the reddish brown outer margin, and *cupedinaria* has a red costa. All three have conspicuous white dorsal abdominal spots. In *hulstiana* these are best developed in the female, much reduced or lacking in the male, and the brown dorsal shade surrounding them is much paler and less extensive than in the other species.

TYPES. The description was evidently based on one male reared from a larva on a flower head of *Lantana camara* at Palm Beach, Fla. The type should be in the USNM but there is nothing labeled as such. There is one of Dyar's specimens from Palm Beach, Fla., crudely labeled as *Synchlora louisiana* var. *hulstiana* and bearing the number 15499.

SYNONYMY. The type material of *Synchlora louisiana* consisted of a male *cupedinaria* and a female *hulstiana*, but the name was restricted to the male type by Barnes and McDunnough (1916b, p. 170).

Hulst's report of the occurrence of *Eucrostes dominicaria* (Gn.) in the United States was based on a misdetermination of specimens collected at Key West, Fla. by C. V. Riley. One of these still survives in the USNM and a careful examination discloses that it is nothing other than *hulstiana*. This specimen bears a note by Foster Benjamin correcting the determination to *sitellaria* Gn., but the original report of *dominicaria* in Fla. has continued to be passed on from author to author.

Guedet's published record of the occurrence of "*Racheospila*" *tenuimargo* Warren in Fla. was the result of another complete misidentification. His original specimens

from Florida City were kindly sent to me by Dr. C. Don MacNeill, on loan from the California Academy of Sciences, and I was thus able to confirm that they are perfectly normal examples of *S. herbaria hulstiana*.

FURTHER DESCRIPTION. Male antennae bipectinate with long branches on basal half, then tapering so that the distal third is ciliate only; longest branches equal to about 6 times the diameter of the shaft; female antennae simple, ciliate beneath; male palpi moderate, exceeding front by a distance equal to width of front at lower edge; female palpi very long, the joints almost cylindrical, exceeding front by about one-quarter the length of the antennae; third palpal joint of female three times longer than that of the male; hind tibia of both sexes with the usual two pairs of spurs and no terminal process; hind tibia of male but slightly dilated, that of female, undilated and longer.

Shaft of antenna white, branches luteous; interantennal fillet white with a red band behind, front red with a filling of green scales and a pair of white spots or lobes at the bottom; palpi red; legs mostly whitish but with the femur and tibia of the first pair tinged with red; underside of thorax and abdomen whitish; upperside of thorax green, of abdomen green near the base but otherwise variably shaded with reddish brown, and with or without two or three pure white, raised dorsal spots; such spots usually prominent on segments 2, 3 and 5 in females, with the first two confluent, sometimes much reduced or obsolete in males.

Upperside of wings bright green with the lines only faintly indicated as series of small white dots; small dark brown discal spots present; costa of forewing narrowly edged with white and margined behind with luteous, shading to reddish near base and apex; both wings with a well developed red terminal line, interrupted at the veins; fringes white at the base but with pink rays opposite the vein endings that expand and become confluent outwardly. Underside paler with the costa more generally reddish.

Length of forewing: males, 6-8 mm; females, 8-9.5 mm.

MALE GENITALIA. Essentially characteristic of the genus but distinguished from all other species in this region by a large triangular expansion on the costa of the valve.

FEMALE GENITALIA. Normal for the genus but with a distinctive genital plate consisting of a thin, even, sclerotized ring encircling the ostium; no signum.

MATERIAL EXAMINED. 84 males, 33 females; 4 male, 1 female slides.

DISTRIBUTION: FLORIDA: Key West; Big Pine Key; Paradise Key; W. Summerland Key; Key Largo; Tavernier, Monroe Co.; Everglade; Cocoanut Grove [Dade Co.]; Florida City; Homestead; Miami; Biscayne Bay; Palm Beach; Port Sewall, Martin Co.; Vero Beach; Chokoloskee; Siesta Key, Sarasota Co.

GEOGRAPHICAL VARIATION. None apparent within this region.

FLIGHT PERIOD. There are records for every month of the year but the data indicate a peak in Oct. and Nov. Otherwise there are quite numerous records for Sept. and Mar., but relatively few for the remaining months.

EARLY STAGES. Dyar (1901b, p. 457) described the larva, which he found on the flower head of *Lantana camara* L. at Palm Beach, Fla. His description indicates a larva that conforms closely in structure and habits to all known species in the tribe Synchronini.

***Synchlora irregularia* (Barnes and McDunnough), new combination**

Plate 22, figures 2, 2a, 2b; plate 38, figure 1; plate 47, figures 32, 33

Racheospila irregularia Barnes and McDunnough, 1918, p. 134. Prout, 1932, p. 38. McDunnough, 1938, p. 140.

DIAGNOSIS. *Irregularia* is similar in appearance to *hulstiana* but distinctly larger, with the white lines of the wings complete and irregularly sinuous. The general coloring, costa, terminal line, fringes, discal spots and abdominal markings are as in *hulstiana*, but the male genitalia are very distinct in several characters. The exaggerated costal expansion on the valve of *hulstiana* is lacking, the socii are slender and the saccus is developed as an almost bulbous process. *Irregularia* is still extremely rare in collections. It is known from only four specimens, all from Cameron and Hidalgo Counties, Texas.

TYPES. Described from two females from Brownsville, Texas (Geo. Dorner), without published holotype designation but the specimens, both in the USNM, are labeled type ♀ and Paratype ♀ in McDunnough's handwriting. These are labeled with the dates 5-11 and 6-11 respectively, which I would interpret either as November or as February 5 and 6, but not May and June as McDunnough stated in the description. The paratype looks as though it may have been repaired with an abdomen that does not belong to it. I hereby designate the specimen labeled type ♀ as the lectotype.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae bipectinate with very long branches for basal two-thirds, outer third simple; longest branches equal to 6-8 times the diameter of the shaft. Female antennae simple, rough-scaled, ciliate beneath; male palpi moderate, exceeding front by at least one-third their length, a little stouter than those of *hulstiana*, tapering evenly from the second to the rounded third segment which is one-third the length of the second; hind tibia of male slightly dilated, with the usual two pairs of spurs; terminal process present and about the same length as the smaller of the two distal spurs; hind tibia of female less dilated and without the terminal process.

Antennal shaft white, branches luteous; fillet white with a red band behind; front red, solid in the female, filled with green in the male, and with spots or lobes of white in the lower corners in both sexes; palpi reddish, tipped with white; fore coxa greenish; fore tibia red inwardly; legs otherwise whitish; entire body whitish below; upperside of thorax green with a minute white spot on the metathorax; abdomen shaded with brown dorsally and marked with pure white, slightly raised spots on segments 2 and 3 in the male, and 2, 3 and 4 in the female. In the female the three spots are nearly equal in size and equidistant, not confluent. The abdominal markings of the single male were discolored and indistinct, although spots were visible.

Upperside of wings green, about the same shade as in *hulstiana*; antemedials and postmedials present on both wings, white, very thin but distinct, almost continuous, irregularly sinuous, undulating between the veins, postmedials approaching outer margin more closely on veins M_3 , Cu_1 and Cu_2 than elsewhere; discal spots dark brown, distinct; costa white, bordered behind with yellowish or pink, the white edging becoming suffused with red at the very base; terminal line strong, deep red, interrupted with white at the veins; fringes white with rays of pink opposite the vein endings. Underside much paler with costa more generally pinkish.

Length of forewing: male, 7.5 mm.; females, 9 mm.

MALE GENITALIA. Socii rather long and slender, curved ventrally toward tips; gnathos ribbon-like with a long, straight tooth; saccus a well developed clavate process, almost bulbous; valve narrowing abruptly near base, thence long and slender, without a large costal expansion as in *hulstiana*; aedeagus normal for the group, prongs not toothed.

FEMALE GENITALIA. Bursa, ductus bursae, ductus seminalis normal for the genus; no signum; genital plate comprised of a shallow, membranous, preostial pouch-like fold, and two separate but overlapping, sclerotized postostial plates; first postostial plate elongated laterally, almost as wide as preostial fold, rounded; second postostial plate much smaller, circular.

MATERIAL EXAMINED. 1 male, 3 females, including the two types; 1 male, 2 female slides. The male is in the USNM; the third female in the AMNH.

DISTRIBUTION. TEXAS: Brownsville, Cameron Co.; Mercedes, Hidalgo Co.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. Types probably taken November 5 and 6; the Brownsville male taken November 10, 1928 by F. H. Benjamin; the Mercedes female taken December 13, 1958 by H. Schmalzried.

EARLY STAGES. Unknown.

REMARKS. The relationship of the single known male to the three females is of course only a guess, but this specimen is so obviously similar that the guess seems a reasonable one.

Synchlora noel (Sperry), new combination

Plate 22, figures 3, 3a, 3b; plate 38, figures 2 (*indecora*), 3; plate 47, figure 34.

Racheospila diaphana Coolidge, 1923, p. 16 (*nec* Warren). McDunnough, 1938, p. 140.
Racheospila noel Sperry, 1949, p. 42.

DIAGNOSIS. This species may be recognized by its synchlorine male antennae (broadly pectinate for basal two thirds, then tapering and becoming simple towards the tip), long female palpi, light yellowish green coloring, sharply dentate postmedial lines, reddish brown discal spots, red terminal line interrupted at the veins, checkered fringes, and abdominal markings consisting of three or more round white dorsal spots on a brown background. The size is large for a *Synchlora*: wing expanse of males about 18 mm., of females 20-24 mm. I have seen specimens only from the vicinity of Palm Springs, Riverside Co. and Borrego [San Diego Co.], Calif., and it is the only species in Calif. that will fit the above description. *Noel* is extremely close to *Synchlora indecora* (Prout) from near Mexico City and the state of Veracruz, but differs in some minor genitalic details in both sexes.

TYPES. The holotype male and allotype female are from Borrego [San Diego Co.], Calif., May 6, 1946, and now in the AMNH (ex Sperry Collection). There were also 15 paratypes which were distributed to various collections as indicated in the original description.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae broadly bipectinate for the basal two thirds, tapering towards the outer third, which is simple; longest branches equal to about 8 times the width of the shaft; female antennae slender, ciliate and slightly dentate beneath; male palpi moderate, exceeding front by a distance about equal to the width of front at lower margin; third segment short, rounded, about one third the length of the second; female palpi much longer, third segment slender, cylindrical, almost as long as the second; hind tibia of male somewhat dilated, with an apical process extending as far as the middle of the first tarsal segment, and bearing the usual two pairs of spurs; hind tibia of female with the same two pairs of spurs but undilated and without the apical process.

Scales of antennal shaft white, branches brownish; interantennal fillet white; head behind fillet reddish; front with lower third white, upper two thirds dull red; palpi rose colored, often intermixed with a few white scales, and with segments two and three in the female and three in the male tipped with white; legs whitish except for some green on the fore coxae and dull red on the fore tibiae; underside of body whitish; upperside of thorax green with a small white spot surrounded by brown on the metathorax; abdomen with some dorsolateral green shading scarcely extending beyond segment one, otherwise shaded with pale brown or dull reddish brown dorsally, and bearing round white dorsal spots on the first two or three segments.

Upperside of wings a rather light yellowish shade of green, unstriated, the fore and hindwings colored alike except that the hindwing has a paler area immediately behind the costa; lines thin, white, delicate but usually distinct except in worn specimens; antemedial waved; postmedial strongly dentate with teeth on M_3 and Cu_1 being the longest, approximately parallel to outer margin; discal spots reddish brown, distinct on both wings but not as large as in *Synchlora indecora*; costa white with a rosy flush at the base, and with a pinkish to luteous border behind exceeding in width the white costal margin; terminal line deep to dull red shading to paler reddish inwardly, and interrupted by white at the veins; fringes pale pinkish but with prominent white semicircular basal patches between the ends of the veins, giving them a checkered appearance. Underside much paler with lines obsolete and with more prominent reddish shading behind the costa of the forewing.

Length of forewing: males, 10-11.5 mm; females, 11.5-12.5 mm.

MALE GENITALIA. These are very close to those of *indecora*, but differ in the somewhat longer valve, more curved toward the end, and in the form of the costal margin of the valve. In *indecora* the costa is prominently convex; in *noel* it appears concave except for a triangular costal flange just before the middle. This flange may be folded under in some preparations so that it is not apparent; this is the case in the example illustrated. The recurved teeth on the prongs of the aedeagus are not as large as in *indecora*, nor is the eighth sternite as deeply notched. *Noel* and *indecora* are peculiar in having the strongly chitinous socii and the basal sclerite of the uncus fused together as a solid unit.

FEMALE GENITALIA. In these *noel* and *indecora* seem to differ only in the form of a subquadrate, sclerotized postgenital plate on the eighth sternite, lying just caudad of the ostium or perhaps actually forming a specialized dorsal element of the ostial opening. In *noel* this plate is almost rectangular; in *indecora* its sides are convergent towards the ostial end resulting in a rounded cone shape.

MATERIAL EXAMINED. 33 males, 7 females, including holotype; 3 male, 1 female slides.

DISTRIBUTION. CALIFORNIA: Borrego and Tub Canyon, Borrego [San Diego Co.]; Palm Springs, Riverside Co.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. This species seems to have an almost year round flight as there are records for every month except June, Aug., and Sept. Most specimens have been taken in the period from Dec. to May.

EARLY STAGES. Unknown.

REMARKS. *Noel* and *indecora* are so very closely related that they could belong to one continuous population, but evidence in the form of specimens from the intervening region in northern Mexico is as yet unavailable.

Synchlora cupedinaria (Grote)

Plate 3, figure 7; plate 22, figures 4, 4a, 4b; plate 37, figure 8; plate 47, figures 35, 36.

Racheospila cupedinaria Grote, 1880, p. 218. Prout, 1912, p. 109. Barnes and McDunnough, 1917a, p. 99. Prout, 1932, p. 39, pl. 5f. McDunnough, 1938, p. 140. Kimball 1965, p. 162, pl. 5, fig. 33.

Geometra cupedinaria Hampson, 1904, p. 178.

Racheospila cupidenaria (sic) Dyar, 1908a, p. 171.

Synchlora cupidenaria (sic) Dyar, 1908b, p. 34.

Synchlora louisa Hulst, 1898, p. 159 (partim). Dyar, 1902 [1903], p. 301. Rindge, 1955, p. 147.

Racheospila louisa Barnes and McDunnough, 1916b, p. 169.

Racheospila atripes (sic) Haimbach, 1916, p. 143 (nec *atrapes* Druce, 1900, p. 91).

DIAGNOSIS. *Cupedinaria* is another small Floridian species, about the same size as *hulstiana*, but of the same yellowish green coloring as *gerularia*. The purplish brown outer margins on both wings, with thickenings near apex and anal angles, also suggest *gerularia*, but the thickenings are not developed into prominent spots. Also, the discal spots are minute, not large as in *gerularia*. The superficial character that best distinguishes *cupedinaria* from all other Geometrinae in the southeast, however, is the solid purplish brown costa that forms an uninterrupted continuation of the outer border of the forewing.

The genitalia of both sexes are distinctive and unlike those of any other species within the region covered by this revision. Beyond Florida, *cupedinaria* has been reported from the Bahamas, but the full extent of its range in the Antilles is not known. Judging from material seen from elsewhere in the West Indies and from the mainland of South America, I would guess that *cupedinaria* is one of a group of several closely related Neotropical species.

TYPES. The type of *cupedinaria* is a male from Enterprise, Fla., "May 24 (Schwarz)." It went with the Grote collection to the BM. The type of *louisa* is a male from "Cocoanut Grove, S. Florida," labeled Type No. 3918 in the USNM.

SYNONYMY. Although I have not been able to examine the type of *cupedinaria*, various authors since Dyar have consistently associated the name with the present species. The type was undoubtedly available to Prout and his colored figure, if based on a Fla. specimen, is unmistakable (1932, pl. 5f). Hulst (1895, p. 71) considered that it equaled *lixaria* Guenée, but even after seeing the types, he included no less than five different species in the synonymy of *lixaria*. I have examined the type of *louisa* and feel that there is no doubt about its identity. Hulst based *louisa* on two specimens, the other being a female of *hulstiana*, but the name was restricted to the male by Barnes and McDunnough (1916, pp. 169-170).

FURTHER DESCRIPTION: Male antennae broadly bipectinate, tapering, outer third simple; longest branches about five times diameter of shaft; female antennae slender, ciliate

beneath; male palpi moderate, exceeding front by the length of the third segment or by about one-third their total length; female palpi very long, slender, cylindrical, straight, exceeding front by more than half their total length, third segment longer than second; hind tibia of male hardly dilated and without a terminal process; that of female undilated.

Fillet and antennal shafts white, branches pale brownish; head behind fillet deep purplish red-brown; front solidly red; palpi, front femora and tibiae tinged with deep rose; legs otherwise whitish except for a few red scales on the second pair; underside of body entirely whitish; upperside of thorax deep reddish brown except for the patagia and the areas covered by them, which are green, and a large white spot on the posterior dorsal lobe of the mesothorax; upperside of thorax also deep brown, with white raised spots on segments 2, 3 and 4, that on 2 being subequal in size to the thoracic spot.

Uppersurface of wings bright yellowish green with a simplified, brown-bordered pattern. Antemedials and postmedials virtually obsolete; costa rather broadly margined with deep purplish brown, this continuing as an uninterrupted border around the outer margins of both wings, usually preceded by a thin yellow shade between the brown and the green, and terminating more than halfway up the inner margin of the hindwing. In many specimens the brown costal margin has two very slight posterior thickenings or lobes, and the brown outer border always has distinct thickenings near the anterior and anal angles of both wings. The fringes are a mixture of red and white scales in the basal half and pale brownish distally. The discal spots are reddish brown and small. Underside as above but much paler.

Length of forewing: males, 7-8.5 mm; females, 8-10 mm.

MALE GENITALIA. These are very peculiar in several respects. The basal portion of the uncus to which the socii normally articulate in *Synchlora* appears to be completely missing, and instead the socii are partly fused to each other. The tips of the socii are strongly recurved and hook-like. The gnathos is completely divided into two arms, which are expanded and lobate towards the ends, and of course the usual tooth-like process of the gnathos is not there. The valve is stout with a concave costa, and the saccus is a rather long, pointed process. The apical processes of the aedeagus each bear a row of about four stout, sharp, lateral teeth, uniform in size and evenly spaced.

FEMALE GENITALIA. These are also unusual for *Synchlora*. The walls of the ductus bursae and ostium are thickened and moderately rigid, and there is a distinctive, triangular, thinly sclerotized and finely scobinate postostial plate on the eighth sternite. The apophyses of the eighth segment are very reduced, and the bursa seems to have no signum.

MATERIAL EXAMINED. 70 males, 23 females, including type of *louisa*; 4 male, 3 female slides.

DISTRIBUTION, FLORIDA: Dry Tortugas; Tavernier and Key Largo, Monroe Co.; Coconut Grove, Florida City, and Miami, Dade Co.; Everglades; Royal Palm State Park; Chokoloskee; Fort Lauderdale; Port Sewall, Martin Co.; Vero Beach, Indian River Co.; Bonita Springs, Lee Co.; Siesta Key, Sarasota Co.; Oneco, Manatee Co.; St. Petersburg; Archbold Biological Station and Parker Island, near Lake Placid, Highlands Co.; Enterprise (type of *cupedinaria*).

Prout (1932, p. 39) reports it from the Bahamas, and in the Cornell University collection there is a series from St. Croix, Virgin Islands, that I thought belonged here when I examined them.

GEOGRAPHICAL VARIATION. Not studied.

FLIGHT PERIOD. Records available for every month of the year except August.

EARLY STAGES. Unknown.

CHETEOSCELIS Prout

Cheteoscelis Prout, 1912, p. 117.

TYPE SPECIES. *Chlorosea bistrisaria* Packard, 1876 = *Cheteoscelis bistrisaria* (Packard), designated by Prout, 1912, p. 117.

ADULT CHARACTERS. Medium sized species, length of forewing 10.5 to 16.5 mm; forewing with apex somewhat produced, bluntly pointed, costa almost straight, outer margins of both wings evenly convex; wing shape similar to that of *Merochlora*, but forewing distinctly longer and more pointed than in *Synchlora*; color of forewing bright green, finely striated, hindwing contrastingly paler, becoming white or nearly so towards costa; lines of forewing white, regular, very oblique, subparallel; antemedial usually distinct, convex, running from inner margin near base to near middle of costa; postmedial straight or but slightly convex, from two-thirds of the way out inner margin to costa just before apex; on the pale hindwing, antemedial wanting and only part of the postmedial visible, and that not always so; costa very thinly margined with whitish; discal spots wanting; termen and fringes concolorous, unmarked; abdomen mostly white, unmarked.

Venation almost exactly as in *Merochlora* except that Sc and R of the hindwing are fused about to the middle of the cell in *Cheteoscelis*, beyond the middle of the cell in *Merochlora*. The long anastomosis of these two veins is a diagnostic feature of *Cheteoscelis* and *Merochlora*, separating them from *Synchlora*, in which the fusion of Sc and R is short and normal.

Male antenna bipectinate with very long branches near the base, their length 6-8 times the thickness of the shaft, tapering uniformly almost to the tip, which is simple; female antenna dentate to bipectinate, with branches half as long as those of the male; palpi of male normal, moderate, third segment very short, rounded, of female just slightly longer; eyes of the sexes similar or nearly so; front almost flat, normal; tongue somewhat reduced, not as large as that of *Synchlora*, but better developed than in *Merochlora*; hind tibiae of both sexes undilated, slender, with only one pair of spurs and no terminal process.

Male genitalia virtually without characters to distinguish them from the typical group of *Synchlora* except that the valve is broad and rounded, and the coremata are vestigial; saccus large and rounded or quite pointed; aedeagus exactly as in the *Synchlora aerata-liquoraria* group except that the separation of the two prongs occurs nearer the proximal end; eighth sternite only very feebly emarginate. *Merochlora* is also similar in male genitalia.

Female genitalia close to those of *Synchlora*, with bursa copulatrix large, long and quite stout, characteristically bent near the middle unlike that of *Merochlora*; bursa membranous except for a colorless, semi-rigid thickening of the wall in the distal third, which is slightly ribbed; no signum; ductus bursae short and membranous, meeting bursa subterminally; ostium simple, without sclerotized structures.

LARVAL CHARACTERS. I have had available for examination only two half grown larvae of *bistrisaria* kindly supplied by Mr. Robert W. Poole, who reared them on *Helianthus* flowers near Flagstaff, Arizona in 1965. These are like the larvae of the *Synchlora aerata* complex except that the integument is more coarsely folded and rugose, and the lateral protuberances are larger. The latter are more like those of *Merochlora*

(as figured by Comstock, 1960, p. 433), but rounded rather than sharply triangular, each bearing a long tapered tubercle at the top. As in all known members of the tribe, these spine-like tubercles are specially modified with small hooks for holding fragments of plant material as a means of concealment, and this material still adheres to the preserved larvae. The paired dorsal protuberances of segment eight are low, rounded humps, without large setose tubercles. The head and body are densely granulated, more so than in *Synchlora*.

DISTRIBUTION. Western North America, including Mexico, north to southern Saskatchewan and British Columbia.

REMARKS. *Cheteoscelis* is a small genus of only four recognized species—the two discussed here plus *orthogramma* Dyar and *naenia* Druce, both of Mexico. It is very closely related to *Merochlora* but may be distinguished easily by the single pair of hind tibial spurs, the presence of a distinct antemedial line on the forewing, and by certain differences in the genitalia of both sexes.

Cheteoscelis bistriaria (Packard)

Plate 4, figure 3; plate 23, figures 1, 1a, 1b, 2, 2a, 2b, 3, 3a, 3b; plate 38, figure 5; plate 48, figures 1-7.

Chlorosea bistriaria Packard, 1876, pp. 378-379, pl. 13, fig. 55. Hulst, 1886b, p. 140; 1888, pp. 193-194.

Annemoria bistriaria Hulst, 1896, p. 312. Dyar, 1902 [1903], p. 298.

Thetidia bistriaria Gumpfenberg, 1895, p. 505.

Cheteoscelis bistriaria Prout, 1912, p. 117. Barnes and McDunnough, 1917a, p. 100. Prout, 1932, p. 42. McDunnough, 1938, p. 141. Comstock, 1960, p. 435.

Aplodes undinaria Strecker, 1878, p. 1862.

Cheteoscelis clarkei Sperry, 1939a, p. 124. **New Synonymy.**

DIAGNOSIS. This is a widely distributed and variable western species occurring from Canada to southern Calif., northern Ariz., N.M. and western Tex., and from the central Great Plains to the Cascade, Sierra Nevada and San Gabriel Mts., apparently not quite reaching the Pacific coast. Throughout most of this range *bistriaria* should not be confused with any other species since the well defined, evenly curved, oblique white lines of the forewing, and much paler hindwing at once identify it. *Chlorosea*, which also has only one pair of hind tibial spurs, may have a similarly oblique postmedial line (in *margaretaria*) but entirely lacks the antemedial. *Cheteoscelis pectinaria*, of southern Ariz., is greener and has very narrow lines (as do some southern populations of *bistriaria*), and may be distinguished structurally by the pectinate female antennae.

Cheteoscelis bistriaria breaks up into a number of geographical variants that could be regarded as subspecies. Under geographical variation I discuss these but do not name them.

TYPES. The type of *bistriaria*, from "Nevada" (Henry Edwards), is a male in the MCZ. Although this specimen has no head, an abdomen that has been glued on, and the right forewing missing, it is still recognizable. The exact type locality is unknown but the type is a large, well marked specimen that agrees well with a series of five males and four females taken at Kingston Camp, 7300', 30 mi. S. of Austin, Lander Co., Nev., July 12 to 18, 1966, by Dr. F. H. Rindge (AMNH). Very few Nevada specimens have been available for study.

The type of *undinaria* is presumably at the Chicago Natural History Museum (ex Strecker collection). This name was based on "One example, [taken] July 13,

at the Rio Navajo." The locality was near the boundary between Colo. and N.M., but over the line in N.M.; Lat. 36° 59', Long. 106° 52'.

The holotype of *Cheteoscelis clarkei* was from Split Rock Tank, Mojave Desert, Calif., and is in the USNM.

The type series also included specimens from Granite Wells and Morongo Valley in the same arid region of Calif.

SYNONYMY. I have not seen the type of *undinaria* but Strecker's description is good enough so that it may be determined with reasonable certainty. *Clarkei* is an unusually deep green desert form with no structural differences that I have been able to find. When one examines sufficient material it becomes apparent that there is complete and continuous intergradation between this form and normal *bistriaria*, without satisfactory geographic separation. Consequently, I here relegate *clarkei* to the synonymy, although there would be much justification for regarding it as a subspecies of the Mojave Desert region.

FURTHER DESCRIPTION. Male antennae bipectinate with very long branches, tapering beyond the middle to the apical fifth, which is simple; longest branches equal to 6-8 times diameter of shaft; female antennae dentate and ciliate beneath, rather rough scaled; male palpi small, exceeding front by a distance equal to half the width of front at lower margin; third palpal segment of male small, rounded, one fourth the length of the second, the terminal scales of which partly conceal it; female palpi similar in length to those of the male but more slender; hind tibiae of male and female similar, undilated, bearing one pair of spurs.

Antennae yellowish brown with whitish scales; interantennal fillet white, green behind; front dull reddish to pale brown, often with some white scales along the lower edge; palpi whitish with the tips colored like the front; legs with coxae and femora greenish, front tibiae dull reddish, otherwise white or luteous. Underside of thorax and abdomen white with usually some light green shading; upperside of thorax green, concolorous with wings; upperside of abdomen white with some light green shading near the base.

Upperside of forewing bright green, minutely striated or dusted with white, marked only by the thin white costa and the usual two white lines, which are typically quite wide and well defined, usually somewhat convex, oblique, subparallel or slightly divergent towards the costa. Antemedial evenly convex (rarely straight), oblique from basal third of inner margin to middle of costa; postmedial begins two thirds of the way out inner margin and meets costa very near apex; postmedial may be straight but is more often slightly convex, although less so than outer margin; costa thinly edged with white; fringes green. Hindwing mostly white for basal two thirds, shaded with green towards anal angle only; antemedial wanting; postmedial vaguely apparent where it separates green outer portion from white basal portion, disappearing towards costa; discal spot wanting. Underside as above but forewing becoming whitish towards inner margin; hindwing greener with postmedial distinct towards costa, obsolete near inner margin.

Length of forewing: male, 11-16.5 mm; female, 13-16 mm.

MALE GENITALIA. These are essentially as described in the definition of the genus. There is considerable variation in the width of the valve, in the size of its raised median ventral ridge, and in the shape of the saccus, even among specimens from the same locality.

FEMALE GENITALIA. These are also as described in the generic definition. The females show relatively little variation.

MATERIAL EXAMINED. 362 males, 107 females, including types of *bistriaria* and *clarkei*. Slides: 18 male, 6 female, including paratypes of *clarkei*. Larvae: two specimens in alcohol, Franclemont collection.

DISTRIBUTION. BRITISH COLUMBIA: Oliver, 2500'; 28 mi. S. of Radium Hot Springs, 2600'. ALBERTA: Red Deer River; Scandia; Horseshoe Canyon, Drumheller, 2750'; Lethbridge. SASKATCHEWAN: Saskatoon; Indian Head. WASHINGTON: Entiat; Vantage Ferry. OREGON: Bend. IDAHO: Rupert, Minidoka Co.; Malta, Cassia Co. MONTANA: Big Timber Creek, 7 mi. N. of Big Timber, Sweetgrass Co. SOUTH DAKOTA: Big Buffalo Creek, N. of Cedar Pass, Jackson Co. WYOMING: Camp Roosevelt and Mammoth, Yellowstone National Park; Medicine Bow; Bates' Hole; Old Ford on Green River, Sweetwater Co. COLORADO: Salida; Glenwood Springs; Durango; Maybell; West Cliff; Fort Garland, 8300'; near Almont, Gunnison Co., 8050'; Great Sand Dunes National Monument, Alamosa Co. UTAH: Bryce; Eureka; Stockton; Vineyard; Beaver Valley; Nebo Jct.; Bellevue, Washington Co., 2000'; Red Canyon Camp, 12 mi. S.E. of Panguitch, Garfield Co., 7200'. NEVADA: Railroad Canyon, White Pine Co.; Baker; Kingston Camp, 7300', 30 mi. S. of Austin, Lander Co.; 40 mi. S.W. of Denio, Humboldt Co. CALIFORNIA: Lassen Creek, N. of Davis Creek, Modoc Co.; Lava Beds National Monument, Siskiyou Co.; Smoky Valley, Tulare Co.; Walker Pass [Kern Co.]; Darwin and Lone Pine, Inyo Co.; Wrightwood, 6100', and Apple Valley, San Bernardino Co.; 12 mi. S.E. of Ivanpah, San Bernardino Co.; Mountain Pass Station and Wheaton Springs, Ivanpah Mountains, San Bernardino Co.; Keystone Canyon, New York Mountains, 5500', San Bernardino Co.; Split Rock Tank, Mojave Desert (type of *clarkei*); Morongo Valley and Granite Wells [San Bernardino Co.]; Upper Santa Ana River, San Bernardino Co. ARIZONA: Williams; Fort Defiance; Pinyon and Vernon, Apache Co.; Concho; Showlow and Joseph City, Navajo Co.; Lake Mary, Tuba City, and Flagstaff, Coconino Co.; Mile 252, Route 180, 6600', near Ebert Mt., Coconino Co.; Walnut Canyon, 6500', near Flagstaff; Vail Lake Road, 6500', 9½ mi. S.E. of Flagstaff; Slate Mt. Loop Road, 6900', 20 mi. N.W. Flagstaff. NEW MEXICO: Fort Wingate; Jemez Springs; Frijoles Canyon; Albuquerque; McGaffey, 7500', Zuni Mts., McKinley Co.; Filmas Canyon. TEXAS: Fort Davis, Jeff Davis Co.; Brewster Co. (Poling); Alpine, Brewster Co.; Basin, Big Bend National Park, Brewster Co.

GEOGRAPHICAL VARIATION. In size, width of lines, shade of green and amount of green on the hindwings, *bistriaria* is extremely variable from one area to another, but my efforts to sort these into more than one species have not been successful. It appears that integration between these variant populations may always be found if one examines enough material. The following is a discussion of those forms that may, with some justification, be considered to represent recognizable subspecies. Only one of these, *clarkei* Sperry, has been named.

1). Sierra Nevada and San Gabriel Mts., Calif. Specimens from Walker Pass [Kern Co., 5250'] (CNC) and Wrightwood, 6100', San Gabriel Mountains (YPM) are very large (length of forewing about 16 mm) The coloring is normal but the lines of the forewing are unusually wide and tend to be curved more than usual. Nine specimens from Walker Pass and 11 from Wrightwood are so similar in these characters and so different from neighboring populations in San Bernardino and Inyo Counties that they appear to represent colonies of the same race. The male genitalia of Walker Pass specimens (2 examined) seem disproportionately large, being almost twice the size of those in normal *bistriaria*, but scarcely different otherwise.

2). The Mojave Desert of Calif. and adjacent arid regions, mostly at low elevations, are occupied by the small, intensely colored form named *clarkei* by Sperry. The pattern and the genitalia seem normal, but the forewing and area enclosed by the anal of the hindwing tend to be a much deeper shade of green than is usual. Specimens with this coloring from the Ivanpah and New York Mts., San Bernardino Co., are the smallest *bistriaria* seen, but the type material of *clarkei* is actually intermediate in size. Specimens with the deep green *clarkei* coloring are also found farther north, in Inyo Co.; I have seen examples from Lone Pine and Darwin, in the Owens Valley. There are also numerous *clarkei*-like specimens from Utah and Colo. (AMNH), with complete integration to normal *bistriaria*. Thus I have found it impossible to define *clarkei*

as a species, but should not be very surprised if future study reveals that it is one. Its geography lacks something of the discreteness usually required of a subspecies.

3). In the San Bernardino Mts., Calif., there is a population characterized by moths of very large size, like those of the San Gabriels or even larger, but in contrast to the latter, the San Bernardino specimens have the lines of the forewing so reduced in width that the moths have a strong superficial resemblance to *Cheteoscelis pectinaria*. The female antennae, however, are clearly of the *bistriaria* type, as are the pale hindwings. The genitalia are normal. In the AMNH there are 27 males and 4 females of this form from the Upper Santa Ana River and Barton Flats, June 26 to July 12, 1946, 1948 (ex Sperry collection).

4). In the Big Bend region of Texas there is a small form (wing length of male 11-12 mm.) that also has narrow lines like *pectinaria*, but the pale hindwings and dentate female antennae associate it with *bistriaria*. The few Texas specimens seen have been exclusively of this form. Such specimens also occur in N.M. (Filmas Canyon; Jemez Springs) in apparent contact with normal *bistriaria*, which I have also seen from Jemez Springs [Sandoval Co.]. Too few specimens are available to allow a guess as to what the relationship might be between these two forms in that area.

Examples of *bistriaria* from northern Ariz. tend to be small with the lines somewhat narrowed, suggesting a cline in the direction of the Texas form. What happens at the precise boundary in Ariz. where *bistriaria* meets *pectinaria* remains to be established. In all the material I have seen the character of the female antennae has been diagnostic, with no hint of intergradation.

Within the confines of San Bernardino Co., Calif., where three rather strikingly divergent forms occur in a pattern that suggests ecological isolation, there is still a need for discriminating field work to determine the true relationships.

FLIGHT PERIOD. In western Canada, June 26–July 31; northwestern states, June 6–Aug. 11, but two records from Entiat, Wash. for May 9, 1934 (CNC); Colo., July 3–Aug. 4; Walker Pass, Calif., May 5; San Gabriel Mts., Calif., July 7–Aug. 4; San Bernardino Mts., Calif., June 26–July 12; Ariz., June 3–Aug. 31; N.M., June 18–July 25; Texas, May 19, 25, Aug. 30. Dates for the *clarkei* form from s. Calif., Apr. 19–May 31, with a few taken in the Ivanpah Mts., Aug. 21, and one taken in the New York Mts., Sept. 3. In collections there are a number of Utah specimens collected by Tom Spalding bearing dates as early as May 7 and as late as Sept. 2. At first I considered that such dates should be verified, but since some of the Utah specimens are of the *clarkei* form, which has a similar flight period in Calif., the dates may be correct.

EARLY STAGES. The only published description of the larva is by Hulst (1888, pp. 193-194). He obtained the larvae from Bruce, presumably from Colo., although the locality is not stated. They fed on the flowers of *Solidago*. In 1965, larvae of *bistriaria* were reared from eggs by Mr. Robert W. Poole, who kindly supplied for examination two of his specimens in alcohol (also the parent moth), now in the Franclemont collection. This material came from Walnut Canyon, near Flagstaff, Ariz., and the larvae fed on *Helianthus* flowers. These Ariz. larvae, although somewhat faded by the alcohol, fit Hulst's description, part of which I reproduce, as follows:

Head rounded, somewhat furrowed between the eyes. Color clay green, with scattered dark flecks. All parts heavily rugose. Body considerably swollen just behind the head, then the segments continuing nearly of the same size to the last. Ground color of the whole, a dirty clay white; somewhat russet anteriorly on dorsum, with dusky, irregular and broken markings below. The segments are . . . very rugose and as well ridged and tubercled. First there is on each a raised ridge on each side of the dorsal line, not very distinctly marked with a small tubercle and hair point, on the anterior portion of each segment. Then a supra-lateral ridge of tubercles, one on each segment, angular, and somewhat extended backward, much after the ordinary pattern of the larvae of *Aplodes* [*Nemoria*]. Each of these tubercles is

surmounted at the point by a smaller cylindrical tubercle, somewhat spiny haired on sides, and with a single prominent spine on the summit. Laterally there are two oblique ridges on each segment. The spiracles are marked by black points. The [thoracic] legs are dusky in color, the [prolegs] are of the color of the body.

The larva has at the same time a very remarkable habit. After eating the scales of the involucre of the flowers, it places the flowers upon the spines which surmount the body on each side of the dorsum [at the tips of the dorsolateral processes]. These soon drying, become distended, and thus the larva is thoroughly hidden, as it absolutely resembles the ripening flower heads, for about all that is visible is composed of them.

Neither Hulst nor Poole succeeded in getting their larvae to reach maturity as these stopped feeding while not yet full grown. This indicates that they hibernate as larvae, as do some of the species of *Synchlora*. Although of paler coloring, and with a more heavily rugose and furrowed integument, the larva is extremely close in both structure and habits to that of *Synchlora* (*aerata* group). The dorsolateral processes, or humps, in *Cheteoscelis* are perhaps more prominent and triangular.

After the above was written I found a specimen in the YPM reared by Dr. C. L. Remington in 1957 from a larva collected at Almont, Gunnison Co., Colo. It was in a nest of the leaves of a *Rosa* species, pupated July 7, and produced an adult Aug. 7.

REMARKS. I have personally collected *bistriaria* in only two places: Big Buffalo Creek, at the northern edge of the White River Badlands, S.D., and near Big Timber, Mont., both plains habitats. The locality in S.D. was dry, rough, treeless prairie; that in Mont. was in a rather lush growth of willow and cottonwood on Big Timber Creek. *Helianthus* and various similar Compositae were abundant in both areas.

Cheteoscelis pectinaria (Grossbeck)

Plate 23, figures 4, 4a, 4b; plate 38, figure 6; plate 48, figures 8,9.

Anemoria pectinaria Grossbeck, 1910, p. 202.

Cheteoscelis pectinaria Prout, 1912, p. 117. Barnes and McDunnough, 1912, pl. 24, fig. 21 (type); 1917a, p. 100. Prout, 1932, p. 42, McDunnough, 1938, p. 141.

DIAGNOSIS. *Cheteoscelis pectinaria* is a greener looking species with the usual lines much reduced in width; it replaces *bistriaria* in southern Ariz. Although there are no other structural characters that I have been able to find, this species may at once be distinguished from *bistriaria* by the pectinate antennae of the female. The branches are much shorter than those of the male, but still the antennae are decidedly pectinate, not just dentate or serrate as in the female of *bistriaria*. There are populations of *bistriaria* in the San Bernardino Mts., Calif., in N.M. and western Texas that also have very narrow lines and which have been commonly misidentified as *pectinaria*, although the character of the female antennae at once removes them from association with that species.

TYPES. The name was based on one female type from Redington [Pima Co.], Ariz., now in the USNM (ex Barnes Collection). The type is in excellent condition.

SYNONYMY. None.

FURTHER DESCRIPTION. Most of the description of *bistriaria* also applies to *pectinaria* except that the antemedial and postmedial lines of the forewing are thinner and the general coloring somewhat greener. The lines of the forewing are very narrow, often

slightly sinuous, usually distinct but the antemedial especially may be almost obsolete. The costa shows less of a white margin than in *bistriaria*. The hindwing has darker green shading towards the anal angle and this shading also extensively invades the median space, which in *bistriaria* is nearly all white except for just a trace of green before the postmedial. In *pectinaria* the underside, including the body, is also more generally green, and the postmedial of the hindwing beneath is less distinct

Length of forewing: male, 10.5-14 mm; female, 12-15mm.

MALE GENITALIA. Like those of *bistriaria*.

FEMALE GENITALIA. Like those of *bistriaria*.

MATERIAL EXAMINED. 57 males, 42 females, including type; 4 male, 2 female slides.

DISTRIBUTION. ARIZONA: Planet Mine, Bill Williams River, Yuma Co.; "Mojave Co."; Mayer, Yavapai Co.; Bloody Basin, Yavapai Co.; Oracle, Pinal Co.; Redington, Pima Co.; Huachuca Mountains, Cochise Co.; Sierra Vista and Paradise, Cochise Co.; S.W. Research Station of the AMNH, Chiricahua Mountains, Cochise Co.; Cave Creek Canyon, 5400', Chiricahua Mts., Cochise Co.; Madera Canyon, Santa Rita Mountain, Santa Cruz Co.; Peña Blanca, 3950', Santa Cruz Co.

There are specimens labeled Glenwood Springs, Colo., Oslar (in CNC and AMNH) but this locality needs to be verified (see similar remarks under *Synchlora frondaria* and *Dichordophora phoenix*). I am certain that these specimens of *pectinaria* actually came from Ariz. but were mislabeled, perhaps not by Oslar but by someone who later acquired them.

GEOGRAPHICAL VARIATION. None in the material studied.

FLIGHT PERIOD. Apr. 13 to May 29, June 15, and July 12 to Oct. 27.

EARLY STAGES. Unknown.

MEROCHLORA Prout

Merochlora Prout, 1912, p. 221.

TYPE SPECIES. *Nemoria* (?) *faseolaria* Guenée, 1858 = *Merochlora faseolaria* (Guenée), designated by Prout, 1912, p. 222.

ADULT CHARACTERS. Medium sized moths, length of forewing 9 to 16 mm.; forewing somewhat produced, longer than that of *Synchlora*, almost as pointed as in *Cheteoscelis* and general shape very similar; color of forewing bright, deep green (*faseolaria*) or pale green (*graeffaria*), lightly striated; hindwing contrastingly paler, becoming white or nearly so toward costa; antemedials of both wings wanting; postmedial of forewing whitish, not strong, regular, approximately parallel to outer margin or but slightly oblique; postmedial of hindwing, if visible, curved subparallel to outer margin, costa thinly margined with whitish or pink; discal spots wanting or faintly indicated in green; termen and fringes concolorous and unmarked; abdomen mostly white, unmarked.

Venation as in *Cheteoscelis* except that the anastomosis of Sc and R in the hindwing is even longer, continuing beyond the middle of the cell, whereas these veins separate just about opposite the mid point of the cell in *Cheteoscelis*.

Male antennae broadly bipectinate exactly as in *Cheteoscelis*, tapering uniformly almost to the tips, which are simple; female antennae slender, slightly dentate or serrate, roughly scaled; palpi of the sexes similar, of short to moderate length but slender, with the third segment small and cylindrical, one quarter to one third as long as segment two; eyes of male slightly larger than those of female, and the front correspondingly narrower; front flat, quite strongly trapezoidal; tongue very slender, not as well developed as in *Synchlora* or *Cheteoscelis*; hind tibiae of both sexes undilated, slender, with both pairs of spurs, no terminal process.

Male genitalia almost exactly like those of *Cheteoscelis* but with the saccus less enlarged and the coremata better developed. *Faseolaria* has a rounded valve like that of *Cheteoscelis*, but *gaseolaria* has a slender valve with concave costa, like that of most *Synchlora* species.

Female genitalia with bursa copulatrix elongate, slender, delicately membranous, not ribbed, straight, not bent at the middle as in *Cheteoscelis*; no signum; ductus bursae short, meeting bursa just slightly subterminally; ostium simple, without sclerotized structure.

LARVAL CHARACTERS. I have not seen a larva of *Merochlora*, but a long description of *faseolaria*, with figures of egg, larva and pupa, was published by Comstock (1960, pp. 431-435). The larva is evidently much like that of *Synchlora* and *Cheteoscelis* but has the lateral protuberances better developed and sharply triangular. The food plant was *Artemisia californica* Lessing.

DISTRIBUTION. *Merochlora* is known only from limited areas in the west and southwest, from extreme southern Idaho to northern Baja California.

REMARKS. Only the two species are known and they are not especially close, differing markedly in wing shape, coloring and male genitalia. However, certain characters in the venation, palpi, legs and genitalia tie them together. *Merochlora* may always be distinguished from *Cheteoscelis* by the two pairs of hind tibial spurs in both sexes.

Merochlora faseolaria (Guenée)

Plate 4, figure 1; plate 22, figures 5, 5a, 5b; plate 38, figure 7; plate 48, figures 10, 11.

Nemoria? faseolaria Guenée, 1858, p. 351. Packard, 1876, p. 375.

Chlorosea fasciolaria Hulst, 1886b, p. 141.

Annemoria faseolaria Hulst, 1896, p. 312. Dyar, 1902 [1903], p. 299.

Merochlora faseolaria Prout, 1912, p. 222. Barnes and McDunnough, 1917a, p. 101. Prout, 1933, p. 71. McDunnough, 1938, p. 142.

Merochlora fasiolaria Comstock, 1960, pp. 431-435, figs. 7-9.

Chlorosea perviridaria Packard, 1876, p. 379, pl. 10, fig. 82.

DIAGNOSIS. This is a species found only in the coastal region of Calif. from Sonoma Co. southward. Superficially it much resembles *Cheteoscelis pectinaria* but of course has two pairs of hind tibial spurs in both sexes, and the female does not have pectinate antennae. The forewing is bright green, usually marked only by a thin postmedial, the hindwing white with green shading towards anal angle, the fringes concolorous, the front, fore tibiae and frequently also the costa pinkish, and the abdomen without red markings. *Faseolaria* is the only green geometrid in Calif. that will fit this description.

TYPES. *Faseolaria* was described from one female from Calif. in the Boisduval collection. I have been unable to determine its present location. *Perviridaria* was based on two males and an unstated number of females (perhaps one) from Sanzalito [Sausalito,

Marin Co.?), Cal[ifornia], June 27 to July 10 (Behrens)." Of these, a single specimen, rubbed and without an abdomen, survives in the MCZ. It is still recognizable and I designate it the lectotype.

SYNONYMY. *Perviridaria* Packard is the only synonym and, as indicated above, I have examined the type and consider it to be readily identifiable. *Faseolaria* I have not seen but the present species is the only one known from Calif. that exactly fits Guenée's description.

FURTHER DESCRIPTION. Male antennae bipectinate with long branches, tapering beyond the middle to the apical fifth, which is almost simple (slightly serrate); longest branches equal to 6-7 times the diameter of shaft; female antennae slightly serrate and ciliate beneath, rough scaled; male palpi small, somewhat variable in length (but this is partly dependent upon their attitude in individual specimens), exceeding front up to a distance equal in length to the lower margin of front; female palpi also variable but generally a little longer than those of the male; hind tibiae of male and female similar, undilated, bearing two pairs of spurs.

Antennal scales white, occasionally pink and white; interantennal fillet white, often interspersed with luteous scales, green behind; front dull red to brownish; palpi similar or tinged with rose (rarely green); legs with coxae and femora partly green, front and middle femora with rose scaling on anterior edge, and fore and middle tibiae strongly shaded with rose; legs otherwise whitish; underside of body whitish with some weak green shading on ventral surface of abdomen near middle; upperside of thorax green, concolorous with wings; upperside of abdomen white with some light green shading near base.

Upperside of wing bright pea green, finely striated with white; the shade being much more intense than in *graeffaria* and not as bluish as in *Cheteoscelis*. Antemedial wanting or indicated only by a few isolated white scales (only two of the specimens examined had a more complete antemedial, and it was broadly dentate); postmedial thin, white, slightly and evenly convex, often slightly dentate outwardly at the veins, meeting inner margin at one half to two thirds the distance from base, and meeting costa at three fourths to four fifths the distance from base; costa very thinly edged with pink or with white, or sometimes green with no such edging; fringes green in basal half, white outwardly; hindwing white with some greenish shading usually confined to region near anal angle; both lines wanting or the postmedial indicated only as a vague boundary separating the white proximal two thirds from the green shaded distal third; fringes of hindwing faintly greenish. Some specimens have disconnected traces of a green terminal line on the hindwing, and some have weak green discal spots on both wings. Underside as above but hindwing with more extensive green scaling and forewing turning pale towards inner margin.

Length of forewing: male, 9-13.5 mm; female 10-14 mm.

MALE GENITALIA. Very close to those of *Cheteoscelis bistriaria*, the main distinction being the much less distended saccus. They differ from the genitalia of *M. graeffaria* in several minor characters such as the shape of the valve and saccus, as references to the figures will show.

FEMALE GENITALIA. Apparently indistinguishable from the female genitalia of *M. graeffaria*.

MATERIAL EXAMINED. 176 males, 46 females, including the type of *perviridaria*; 4 male, 2 female slides.

DISTRIBUTION. CALIFORNIA: Petaluma, Sonoma Co.; Inverness, Marin Co.; San Leandro, Alameda Co.; Oakland; Berkeley; Palo Alto; Half Moon Bay, San Mateo Co.; Carmel;

Monterey; Morro Bay; San Luis Obispo; Grover City; 2 mi. S. of Painted Cave, Santa Barbara Co.; Santa Barbara; Ventura, Ventura Co.; Avalon, Santa Catalina Island, Anacapa Island, and Santa Rosa Island, Channel Islands; Live Oak Park; Los Angeles; Pasadena; Beverly Hills; Santa Monica; Essex; Long Beach; Laguna Beach, Orange Co.; Riverside; San Clemente; Del Mar; La Jolla; San Diego; La Mesa and Pine Valley, San Diego Co. BAJA CALIFORNIA: 7 mi. N. of Colonia Guerrero, November 3, 1953, 1 male (AMNH).

GEOGRAPHICAL VARIATION. The north-south variation in several characters is such that I was at first led to suspect that two species were involved. However, more detailed study indicates that this is continuous variation from one end of the range to the other. Southern specimens tend to be small, northern ones larger. Long series available from San Diego show a preponderance of very small specimens with a wing length scarcely exceeding 10 mm. Specimens from the region of San Francisco commonly have a wing length of 12 mm. or more in both sexes. A pink costa is more prevalent in northern specimens from the San Francisco Bay area. In most San Diego Co. specimens the costa is edged with whitish only; in some it is tinged with pink, in others entirely green. Palpal length also varies, northern specimens of both sexes having slightly longer palpi than southern ones. When two extremes are compared, this difference can be quite impressive. Nine specimens from Santa Catalina Island, Sept. 20–Oct. 18, Feb. 17–May 1, 1929–33, collected by Don Meadows (USNM) appear similar in every way to those from the nearby mainland.

FLIGHT PERIOD. The data for southern Calif. indicate a flight period extending over most of the year from Jan to Nov. with records for all months except Dec. Farther north, in Marin Co., I have seen records only for the period from June 10 to July 4.

EARLY STAGES. The egg, larva and pupa of *faseolaria* were described and figured by Comstock (1960, pp. 431–435). The larva, although basically *Synchlora*-like in structure, manner of feeding, and in the habit of concealing itself by attaching fragments of plant material to the spines of its dorsolateral protuberances, is nevertheless more distinctive in form and markings than any other species of the tribe. The protuberances, described by Comstock as triangular plates, are prominent and pointed, and are developed more after the fashion of the processes found in *Nemoria* than are those of *Synchlora* or *Cheteoscelis*. Also, the dorsolateral processes “are margined with light yellow bands which are bordered by a fine brown stripe,” and laterally, on abdominal segments 1 to 5, there are contrasting oblique white dashes. Such markings are not like anything I have seen in other geometrine larvae and would seem to be characteristic of *Merochlora*.

Merochlora graefiaria (Hulst)

Plate 4, figure 2; plate 22, figures 6, 6a, 6b; plate 38, figure 8; plate 48, figures 12–15.

Chlorosea graefiaria Hulst, 1886a, p. 123.

Annemoria graefiaria Hulst, 1896, p. 312. Dyar, 1902 [1903], p. 299.

Cheteoscelis graefiaria Prout, 1912, p. 117.

Merochlora graefiaria Barnes and McDunnough, 1916b, p. 171; pl. 15, fig. 17; 1917a, p. 101.

Prout, 1933, p. 71. McDunnough, 1938, p. 142.

Merochlora eutrappes Prout, 1912, p. 222.

DIAGNOSIS. *Merochlora graefiaria* is a southwestern species similar in structure and pattern to *faseolaria* but much paler green, and in size averaging somewhat larger. Also, in *graefiaria* the antemedial of the forewing is more often present (broadly dentate), and the postmedial is quite wide, distinct, and regular, not dentate. The lines are variable in width, however, and even the postmedial may be obsolete. The fore tibiae,

conspicuously rose colored in *faseolaria*, have only the faintest tinge of pink in *graeffaria*. In contrast to *faseolaria*, which has mainly a coastal Californian distribution, *graeffaria* seems confined to the interior, being known only from the San Gabriels (one record), the San Bernardinos and the Sierra Nevadas in Calif., "Nevada" (types only), Utah, Colo., and Idaho.

TYPES. The types of *graeffaria* were two females from "Nevada, Coll. Graef. Tepper." One of these, which I hereby designate as the lectotype, is in the USNM (ex collections Graef, Neumoegen), and is the specimen examined by Barnes and McDunnough (1916b, p. 171). The second type is in the collection of the Department of Entomology, Michigan State University, East Lansing, Michigan, and I am indebted to Mr. Julian P. Donahue for photographs of this specimen, which somehow had been mislabeled as *Eucrostis saltusaria*, "Nevada," "Type." Like the lectotype, it is discolored and no longer green, but I had no difficulty recognizing it from Mr. Donahue's photographs.

The type of *eutraphes*, from Stockton, Utah, Aug. 2, 1907 (Spalding), is a male in the BM (ex Prout collection). Prout designated an unstated number of cotypes in the Grossbeck collection. I obtained a colored photograph of the holotype through the courtesy of Mr. D. S. Fletcher and Mr. J. D. Bradley of the BM and have been able to confirm its identity with reasonable certainty. It is still green and in good condition. The type of *eutraphes* is one of those specimens in which the postmedial is not well defined, but I have examined 17 other specimens from Stockton, Utah, including the one figured by Barnes and McDunnough, and they show the normal variation.

SYNONYMY. *Eutraphes* Prout, discussed above, is the only synonym.

FURTHER DESCRIPTION. A detailed description seems unnecessary since *graeffaria* differs from the much better known *faseolaria* mainly as indicated in the diagnosis. However, the genitalia provide a sound structural basis for distinguishing the two as separate species.

Length of forewing: male, 12-16 mm; female, 14.5-16 mm.

MALE GENITALIA. Usually distinguishable from the genitalia of *faseolaria* by the narrower valve with its concave costa appearing well recessed beneath the swollen median ventral valvular ridge (if the valves are spread well apart in preparation). *Graeffaria* also with a better developed saccus which may be broadly rounded or somewhat pointed.

FEMALE GENITALIA. No apparent differences between *graeffaria* and *faseolaria*.

MATERIAL EXAMINED. 267 males, 26 females, including lectotype of *graeffaria*; 4 male, 2 female slides.

DISTRIBUTION. CALIFORNIA: Wrightwood, 6000', San Gabriel Mountains, San Bernardino Co. (a single male specimen, in the AMNH); Upper Santa Ana River and Barton Flats, San Bernardino Mountains, San Bernardino Co. (230 specimens); Coleville and Mono Lake, Mono Co.; Smoky Valley, Tulare Co., 6500'; Spaldings, Lassen Co. NEVADA: types of *graeffaria* only, locality unknown. UTAH: Stockton; Vineyard; Eureka (all collected by Tom Spalding). COLORADO: State Bridge, near Bond, 7000', Eagle Co., June 23, 1961, 4 males (M. R. MacKay). IDAHO: Twin Falls, June 10, 1943, one male (J. R. Douglass).

GEOGRAPHICAL VARIATION. None apparent in the material studied.

FLIGHT PERIOD. June 17 to Sept. 13 in San Bernardino Co., Calif.; June 20 at Mono Lake; June 19 to 29 in Tulare Co.; June 27 in Lassen Co.; May 31 to July 12 in Utah; June 23 in Colo.; June 10 in Idaho.

EARLY STAGES. Unknown.

REMARKS. The only really large sample of this species that I have seen, and perhaps the only large series ever collected, is the material that John L. Sperry collected in the San Bernardino Mts. This is now mostly in the AMNH. *Graefiaria* seems to have a peculiarly discontinuous distribution. Although it is in southern Calif., Utah, and even reaches Colo., it is not known from Ariz. In recent years Dr. F. H. Rindge has collected geometrids intensively in many localities in Utah and Nevada, but in all of his material there is not a single example of *graeffaria* from either state. All the Utah records are old Spalding specimens taken in the period from 1907 to 1914.

6. SYSTEMATIC ACCOUNT OF THE TRIBE LOPHOCHORISTINI

Small to large species, wings rounded, not angulate but hindwing margin somewhat scalloped in the larger species of *Lophochorista*. Green pigment not as readily fading as that of the Hemitheini, intensely colored, apparently similar to that of the Nemoriini; wings generally with complex patterns of white and brown. Venation and frenulum as in the Hemitheini, although a vestige of the third anal is present in the hindwing of *Lophochorista*. Antennae bipectinate in male, simple or bipectinate in female; abdomen tufted or untufted; hind tibia of male strongly and abruptly swollen toward distal end.

Male genitalia compact, rather strongly sclerotized, with the valves rounded, each bearing a strong mesial sclerite that varies in form and provides a good character for distinguishing the species; uncus well developed, stout, pointed; socii as long or longer than uncus, slender, semi-rigid; gnathos highly characteristic, entire, strongly developed, the distal tooth long, blunt, curved posteriorly almost parallel to uncus; transtilla a large thin plate; juxta variable; saccus produced, rounded; aedeagus variable, of the slender hemitheine type in *Eueana*, short, stout, and containing a large spine in *Lophochorista*; eighth sternite with one or two posterior marginal processes (*Lophochorista*) or unmodified (*Eueana*).

Female genitalia without any unusual characters and suggesting those of the Hemitheini more than anything else, those of *Eueana* almost as in *Chlorochlamys*. Bursa stout, subglobose or pear-shaped, with a small signum; genital plate consisting of the usual two elements—a preostial pouch and a postostial plate, well sclerotized in *Lophochorista* (*ockendeni*) but not in *Eueana*.

The larva is known only for *Eueana* and it is clearly of the hemitheine type, not at all as in the Nemoriini or Synchlorini.

LOPHOCHORISTA Warren

Lophochorista Warren, 1904a, p. 22.

TYPE SPECIES: *Racheospila calliope* Druce, 1892 = *Lophochorista calliope* (Druce), designated by Warren, 1904, p. 22.

ADULT CHARACTERS. Size small (*lesteraria*) to rather large (*ockendeni*); wing shape normal, rounded, but with a tendency for the outer margin of the hindwing to be scalloped, or at least shallowly emarginate between veins M_1 and M_3 ; wings rather

thinly scaled, quickly turning subhyaline as the moths become worn, unlike *Eueana*; color bright, pure green or bluish green, often with elaborate markings of white, and light and dark brown, derived from exaggeration of the antemedial and postmedial lines; antemedials of both wings very wide, whitish or pale brown; postmedials irregular or sinuous, whitish, followed by a brown shade that is basically a dark brown patch in the tornus (both wings but strongest on the forewing), but may extend as a more diffuse or patchy brown postmedian shade all the way to the costa; subterminal area variable, often with much white shading; discal spots weak, whitish, or wanting; costa pale, often with some green; terminal line weak, interrupted, green or brown; fringes variable, in general concolorous with adjacent parts of the wing; dorsal side of thorax brown with green and white tegulae, metathorax tufted; dorsal side of abdomen also shaded with brown and with prominent crests on segments two, three, and four.

Forewing with R_1 arising exactly opposite end of cell in specimen examined (*calliope*), $R + M_1$ stalked, $M_3 + Cu_1$ arising separately, third anal very weak; hindwing with Sc and R fused for a short distance, $R + M_1$ with a long stalk, $M_3 + Cu_1$ with a very short stalk, third anal present but vestigial.

Antennae of both sexes bipectinate with very long branches, tapering and becoming merely ciliate in the outer third; palpi slender, in male very short, not exceeding front, third joint small, in female third joint greatly elongated, longer than joint two, cylindrical; eyes large, similar in the two sexes; front about as wide as high at the top, but with the sides converging ventrally; tongue variable, moderate in some species, well developed in others; hind tibia of male as in *Eueana*, clavate, abruptly and strongly dilated in distal half, produced somewhat beyond articulation of tarsus, with the distal spurs only, and heavily clothed with long scales on the inner side of the dilated end in the genotype, but not in *lesteraria* or *diversata*; hind tibia of female undilated or but slightly so, also with only the distal pair of spurs, which are quite short and stout; hind tarsus of male just slightly more than half the total length of the adjoining tibia, of the female almost as long as tibia in the species examined.

Male genitalia hardly differing from those of *Eueana*. Uncus, tegumen, and vinculum forming a spindle-shaped unit; uncus stout, pointed; socii semimembranous but rigid, about as long as uncus; gnathos entire, heavy, terminating in a long blunt process directed backward almost parallel to uncus; transtilla a very large, subquadrate plate occupying nearly all of the space between the sides of the tegumen, its posterior margin convex or but slightly emarginate; juxta shallowly cup-shaped (*calliope*) or with a papilliform process (*lesteraria*, etc.); saccus quite produced, rounded; valve short, rounded, with a prominent mesial sclerite that may be in the form of a long, curved spine (*lesteraria*, *diversata*), or an obliquely transverse, bilobed plate with dentate outer margin (*calliope*); aedeagus short, stout, containing a large, tooth-like spine; eighth sternite with a pair of posterior marginal processes or a single large one.

For representative material of the female genitalia of *Lophochorista*, I have had available only a specimen of *ockendeni* Druce from Venezuela. These proved to be of the same basic type as in the Hemitheini, with a pear-shaped bursa narrowing to a rather extended, heavily sclerotized "neck region" but, as in *Eueana*, there is a small signum; ductus bursae entering bursa terminally, short, stout, lying behind a large overlapping fold in the intersegmental membrane; well developed preostial pouch also present and covered by the intersegmental fold; postostial plate small, subquadrate, sclerotized; eighth sternite with an unusually strong pair of brush-like pads (of scales) flanking the postostial plate, similar to those found in *Xerochlora*, these usually removed in dissection.

LARVAL CHARACTERS. Unknown.

DISTRIBUTION. Neotropical and Mexican, with one species known from Arizona.

REMARKS. *Lophochorista* is a small but seemingly well differentiated genus, to which I assign six recognized species, as follows:

1. *Racheospila calliope* Druce, 1892 = *Lophochorista calliope* (Druce). Mexico, Guatemala.

2. *Racheospila ockendeni* Druce, 1911 = *Lophochorista ockendeni* (Druce). Northern South America (including *klagesi* Prout and *orthorisma* Prout, 1933, described as subspecies, which I have not examined).
3. *Lophochorista* sp., undescribed. Mexico.
4. *Progonodes diversata* Dyar, 1912 = *Lophochorista diversata* (Dyar). **New combination.** Mexico.
5. *Synchlora lesteraria* Grossbeck, 1910 = *Lophochorista lesteraria* (Grossbeck). **New combination.** Arizona.

Lophochorista lesteraria (Grossbeck), new combination

Plate 24, figures 1, 1a, 1b, 1c; plate 48, figures 16, 17.

Synchlora lesteraria Grossbeck, 1910, p. 203. Barnes and McDunnough, 1912, pl. 23, fig. 11.

Racheospila lesteraria Prout, 1912, pp. 110, 114.

Oospila lesteraria Barnes and McDunnough, 1916b, p. 171; 1917a, p. 100. Prout, 1932, p. 55. McDunnough, 1938, p. 141.

DIAGNOSIS. This is a rare species of which only 4 specimens are known, all from Arizona. The only other species in the United States that looks like this is *Eueana niveociliaria* from Florida, but *lesteraria* has close congeneric relatives in Mexico. One of these, *Lophochorista diversata* (Dyar) is so close that it could easily be confused with *lesteraria*, but there are distinguishing characters in the male genitalia that may be seen in the accompanying genitalic figures of the types. *Lesteraria* also is somewhat less heavily marked with white and brown than *diversata*, and much less so than the generotype, *calliope*. The postmedial line is indistinct, almost obsolete, in *lesteraria*, thin but complete in *diversata*. The species of *Lophochorista*, unlike *Eueana*, have an antemedial line on both wings, and it is a wide whitish or pale brown band, occupying most of the basal area.

TYPES. Described from two males from "South Arizona, May 1-15 and Santa Catalina Mts., Pinal Co., Arizona." I hereby designate as lectotype the former, figured by Barnes and McDunnough (1912, pl. 23, fig. 11) and now in the USNM (ex Barnes Collection). The specimen from the Santa Catalina Mts. is in the AMNH.

SYNONYMY. None.

FURTHER DESCRIPTION. (based on male only, female unknown). Antenna broadly bipectinate, widest at segments 6-10, then narrowing gradually to tip; longest branches equal to 3-4 times diameter of shaft, which is heavily scaled above and looks thicker than it is; front level with eyes, flat; palpi minute, slender, not exceeding front; legs as described for genus.

Antennal scales whitish, branches yellowish; interantennal fillet and entire top of head white to cream colored; front with a mixture of whitish and smoky brown scales; palpi tinged with pinkish brown; legs cream colored to light brown; most of the first pair and femora of the second and third pairs dusted with a few pink scales; underside of thorax and abdomen whitish; upperside of thorax green with a broad median longitudinal stripe of brown, as wide as the head, palest anteriorly and at the edges, becoming crested on the metathorax, and projected backwards to segment 4 of the abdomen; abdominal segments 2, 3 and 4 with prominent brown dorsal tufts, caudad of which the abdomen is whitish.

Wings above bright green of a somewhat bluish hue, unstriated; postmedial lines faint and incomplete, waved, whitish where visible; antemedial almost erect and slightly concave; space between basal and antemedial lines of both wings occupied by a much expanded pale brown antemedial band that fades out before costa. The postmedial

curves well inward in the inner third of both wings to accommodate large brown patches in the anal angles. These patches are pale brown but each contains an irregular spot or band of blackish brown scales toward the outer edge. Similar but much smaller brown patches are repeated on both wings at the intersections of the postmedial and vein M_2 . The entire median space is clear green without discal spots or other markings. Costa feebly margined with pale brownish, almost white; middle of outer margin of forewing with a few indistinct subterminal rows of white scales; fringes green with a mixture of white scales. Underside paler, most markings obsolete but with a pale basal area before the antemedial of the hindwing, and a less intense repetition of the brown patch in the tornus of the forewing.

Length of forewing: male, 12 mm.

MALE GENITALIA. These differ from the genitalia of *diversata* mainly in the smaller size of the big spines on the valve and in the aedeagus, and in the form of the process on the eighth sternite. In *lesteraria* this process is pointed; in *diversata* it is rather broadly truncated, with the tip slightly incised. The genitalia of *diversata* and *lesteraria* both differ from those of *calliope* in the shape of the large valvular sclerite and the eighth sternite, the latter bearing a pair of short pointed processes in *calliope*.

FEMALE GENITALIA. Not examined (female unknown).

MATERIAL EXAMINED. 4 males; 2 male slides, including lectotype. In addition to the type, there are two unspread specimens in the USNM, one without locality, the other labeled Baboquivari Mts.

DISTRIBUTION. ARIZONA: "South Arizona" (lectotype); Santa Catalina Mountains, Pinal Co.; Baboquivari Mountains, Pima Co.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. The only information available is on the label of the specimen from the Baboquivari Mts. This states: "1-15 June, 1924. O.C. Poling, Coll."

EARLY STAGES. Unknown.

EUEANA Prout

Eueana Prout, 1912, p. 202.

TYPE SPECIES. *Eucrostis niveociliaria* Herrich-Schäffer, 1870 = *Eueana niveociliaria* (Herrich-Schäffer), monobasic.

ADULT CHARACTERS. Small moths, length of forewing 8.5 to 12.5 mm., females considerably larger than males; wings broad and rounded, shaped as in *Synchlora aerata*, opaque; color bright, intense, bluish-green; lines white, thin, well defined, irregular, antemedial of hindwing wanting; costa and subterminal area variably marked with whitish and pinkish brown, with diffuse concentrations of brown scales in the anal angles of both wings, the general pattern of markings suggesting that of *Lophochorista* except for the reduction of the antemedial; discal spots thin, white; terminal line weak, dark, interrupted; fringes whitish; thorax and first abdominal segment green with a broad whitish dorsal stripe, abdomen otherwise mostly white; metathorax and abdomen not tufted or crested.

Venation as in the Hemitheini except that R_1 branches off well beyond the end of the cell in the forewing; $R + M_1$ of forewing short stalked, M_3 and Cu_1 branching just before end of cell, third anal obsolete; in hindwing Sc and R fused for a short distance, $R + M_1$ with a very long stalk, M_3 and Cu_1 branching before end of cell, third anal completely wanting; frenulum present in male, wanting in female.

Antenna of male stout, broadly bipectinate almost to the tip, which is merely ciliate; antenna of female simple but rather stout, compressed, ciliate beneath in the usual way; palpi of male short, only slightly exceeding front, joint three conical; palpi of female much elongated, joint three one and one-half times as long as joint two, cylindrical; eyes of male slightly larger than those of female, and the sides of the front more convergent ventrally; width of front at the top only slightly less than its height; tongue rather small; hind tibia of male abruptly and strongly dilated in distal half as in *Lophochorista*, produced well beyond base of tarsus, bearing only the apical spurs, of which the anterior one is slender, the posterior one stouter; hind tibia of female undilated, normal, also bearing only the apical spurs, which are equal in thickness although the anterior one is shorter; hind tarsus of male about one half the total length of the adjoining tibia; of the female, longer than one half the length of the tibia.

Male genitalia similar to those of *Lophochorista*; uncus stout, pointed; socii are semimembranous flaps, longer than uncus; gnathos quite heavy, often erect, with a rounded distal process; transtilla very large, thin and delicate, prominently bilobate posteriorly; juxta a semi-circular plate, almost flat, not conical or cup-shaped; saccus quite distended, rounded; valve rather simple except for a distinctive, transverse, comb-like, dentate sclerite just beyond the middle; aedeagus elongate, simple, of the hemitheine type; eighth sternite unmodified, shallowly emarginate.

Female genitalia as in the Hemitheini, rather simplified, very close to those of *Chlorochlamys* or *Xerochlora*.

LARVAL CHARACTERS. Larva of the same type as in the Hemitheini, slender and twig-like, with the same conical processes on head and prothorax as in *Chlorissa*, *Mesothea* and *Hethemia*. It scarcely differs from that of *Hethemia* except in having a lateral pair of large, double, granulated humps on abdominal segment two. Further description is given under the species.

DISTRIBUTION. The single included species is known only from Cuba and southern Florida.

REMARKS. *Eueana* is apparently an isolated Antillean derivative from the same stock that gave rise to *Lophochorista*. The two genera hardly differ except in certain minor characters such as those of the venation, wing pattern, thoracic and abdominal tufting and the female antennae. Earlier, I had thought that the male genitalia were more distinct, but an investigation of various species of *Lophochorista* revealed that the true *calliope* (Druce) also possesses, in somewhat different form, an obliquely transverse sclerite in the middle of the valve almost certainly homologous to that of *Eueana*.

The most obvious superficial difference between *Eueana* and *Lophochorista* is found in the character of the antemedial line. *Eueana* has this line on the forewing only, and it is thin and normal; *Lophochorista* apparently always has the antemedial on both wings and it is very wide, occupying most of the basal area.

Prout (1933) included in *Eueana* a second species, *euclines* Prout, from Bolivia, but I suspect that it belongs elsewhere.

Eueana niveociliaria (Herrich-Schäffer)

Plate 4, figure 4; plate 24, figures 3, 3a, 3b; plate 39, figure 1; plate 48, figures 18-20.

Eucrostis niveociliaria Herrich-Schäffer, 1870, p. 182; 1871, p. 46. Gundlach, 1881, p. 384.

Eucrostes niveo-ciliaria Anonymous, 1895, p. 77.

Racheospila niveociliaria Dyar, 1908a, p. 171.

Phorodesma niveociliaria Dyar, 1908b, p. 35.

Eueana niveociliaria Prout, 1912, p. 202. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 69. McDunnough, 1938, p. 142. Kimball, 1965, p. 165.

Eucrostis saltusaria Hulst, 1886a, p. 122.

Racheospila saltusaria Hulst, 1896, p. 314. Dyar, 1900b, p. 118, (larva and food plant); 1902 [1903], p. 300. Holland, 1903, p. 336, pl. 43, fig. 20.

DIAGNOSIS. *Eueana niveociliaria* is a small to medium sized species of southern Florida and the West Indies, of a slightly bluish, deep green shade with white or pinkish white markings. An irregular pale terminal band on both wings, inwardly dentate, usually expanding into a large patch in the anal angles, is perhaps the most characteristic feature. Lines distinct or obsolete, almost dentate, postmedials nearer margin at middle than at either end; antemedial of hindwing wanting; costa white dusted with pink; discal spots white, compressed, that of forewing connected with costa; male genitalia with a transverse comb-like structure on the valve that is diagnostic; female genitalia as in *Chlorochlamys*; larva typical of the tribe Hemitheini. Although *niveociliaria* resembles certain species of *Lophochorista* that occur in Mexico and Arizona, there are no known sympatric species with which it might be confused.

TYPES. *Niveociliaria* was described from Havana, Cuba. I do not know whether the type material still exists. *Saltusaria* was described from two males and two females from Fla. (no locality specified), "Coll. Hy. Edwards, Neumoegen, Hulst." Holland (1903, p. 336) said that he collected the type of *saltusaria* on the upper waters of the St. Johns River, and figured a male stated to be the type. This is open to question as his name was not mentioned in the original description as it was in connection with *Eucrostis hollandaria* Hulst. I do not know the present location of the male figured by Holland, although it may be at the Carnegie Museum. In the AMNH there are two female types of *saltusaria* from Indian River, Fla. One is labeled "Collection G. D. Hulst," the other, "Collection Henry Edwards." The latter is in better condition and bears an AMNH "Type" label. I hereby designate this specimen as the lectotype.

SYNONYMY. Since a recognizable lectotype exists there is now no doubt about the identity of *saltusaria*. Any uncertainty that might exist relates to the identification of *niveociliaria*, as the type of this is unavailable. When I read the original description I found no reason to doubt that Herrich-Schäffer's species and *saltusaria* were the same. There are Cuban specimens in the USNM and although these look a little different from Floridian ones, they have the same genitalia. The differences are presumably subspecific.

FURTHER DESCRIPTION (see also generic definition). Scales of antennal shaft entirely white or cream colored in male, marked with intersegmental bands of red in female; interantennal fillet and collar (post-antennal space) white with a thin row of mixed red and green scales separating them; front bright green with a pale edging at the bottom; palpi reddish dorsally, pale ventrally; first pair of legs with femur, tibia and tarsi dull rose or pale reddish brown anteriorly, second pair with a suggestion of the same coloring; legs otherwise whitish; underside of thorax and abdomen cream colored; upperside of thorax and first abdominal segment green, with a longitudinal spindle-shaped whitish mesial configuration matching in color the pinkish white markings of the wings; remaining abdominal segments whitish but usually with paired subdorsal green spots on segments 2-4, not cristate.

Wings above deep green, with a bluish shade in most Florida specimens; markings white, partly dusted with pinkish scales but with the usual lines pure white. Near the base of the forewing with a straight, erect basal line between inner margin and costa; antemedial of forewing almost erect at inner margin but undulating at Cu and R; basal line and antemedial wanting on hindwing; postmedials of both wings angled quite sharply at the veins, almost dentate, approaching closest to outer margins be-

tween veins M_3 and Cu_1 , then turning quite abruptly inward above and below to meet costa and inner margin about two-thirds of the distance from the base; discal spots very compressed, crescentic, that of the forewing adjoining the pale costal zone; outer area of both wings with an irregularly delimited, inwardly dentate white margin, widest between R_5 and M_3 , and beyond this a thin, interrupted dark red or green terminal line. The anal angle of both wings, between the postmedial and outer margin, may be occupied by a large patch of white, variably dusted or mottled with darker shades including pink, red, green, light brown and dark brown. The dark colors predominate in Cuban examples but Florida specimens tend to have the anal patches pinkish, or lacking altogether. Veins beyond the postmedials often outlined with white; costa very broadly margined with white and dusted with pink and dark red scales; fringes with basal half pure white, distal half grayish. Underside very pale, almost white, with little contrast between white and green areas; costa of forewing broadly shaded with pink.

Length of forewing: males, 8.5-10 mm; females 12.5 mm.

MALE GENITALIA. Characterized by a toothed, transverse sclerite across the middle of the valve. For further detail refer to generic description.

FEMALE GENITALIA. Similar to those of *Chlorochlamys* (see generic description).

MATERIAL EXAMINED. 17 males, 6 females from Fla.; 3 males from Cuba. Slides: 5 male, 1 female. Larvae: 1 inflated specimen.

DISTRIBUTION. FLORIDA: Big Pine Key; Key Largo and Key Vaca, Monroe Co.; Tavernier, Monroe Co.; Matheson Hammock, Dade Co.; Miami; Palm Beach; Lake Worth (more correctly, Palm Beach, according to Kimball, 1965, p. 12); Indian River. CUBA: Baracoa; Santiago de Cuba.

I have seen specimens from all the Florida localities that have been reported and there seem to be no recent records from anywhere north of Dade Co. It would seem to be well established and perhaps locally common in the region of Monroe Co. and the Florida Keys.

GEOGRAPHICAL VARIATION. Florida specimens appear slightly more bluish and have less of a tendency to show well developed brown patches in the anal angles than the nominate form from Cuba. There is probably much variation in both populations that should be better understood before the name *saltusaria* is applied in a sub-specific sense. Floridian examples range all the way from those that are extremely well marked with the characteristic pinkish white maculation to those that are almost immaculate.

FLIGHT PERIOD. Jan. 5; Feb. 4; Apr. "4-9"; Aug. 16; Sept. 17, 21; Oct. 6, 12; Nov. 4-19; "Dec., 1898". The five records for Nov. are more than for any other month.

EARLY STAGES. Dyar described these in detail from material he collected at Palm Beach, Fla., (as *Racheospila saltusaria*, 1900b, p. 118). He found and reared larvae on *Krugidendron ferreum* (as *Condalia ferreum*), and an inflated larva that he prepared still survives in good condition in the USNM. The larva is long and slender, without the lateral protuberances that characterize the *Nemoriini* and *Synchlorini*. In form it is strikingly similar to the larva of *Hethemia pistasciaria*, having the head deeply cleft with two high conical points and matching prothoracic humps. The latter are closely appressed and appear as one, except toward the extreme apex; in *Hethemia* the prothoracic humps are separated. The larva of *Eueana* is further distinguished by double lateral humps, blackish and rough textured, on the second abdominal segment. A very minute suggestion of similar markings is repeated on

segment 6, which also has a subdorsal pair of blackish conical tubercles, none of which are present in *Hethemia*. Dyar stated that the larva was "leaf green, minutely white frosted with dense granules, part of them green; a series of small dorsal intersegmental black-vinous streaks with whitish frosted edges". He said that it is a remarkable mimic of the young twigs of the food plant, the same kind of observation that impressed me when I reared *Hethemia pistasciaria*.

7. SYSTEMATIC ACCOUNT OF THE TRIBE HEMITHEINI

Generally small species, with a trend in most genera toward pointed forewings and angulate hindwings; green pigment unstable, readily fading or discoloring, color not as bright as in other tribes, often olivaceous. Venation without distinctive features and almost exactly as in the Nemoriini except that the third anal of the hindwing appears to be always lacking; hindwing with Sc and R touching at a point only, fused or unfused; frenulum present in male, wanting in female.

Male genitalia with uncus well developed, usually long and pointed; socii unusually well developed in the American species, often as large or larger than uncus and of similar form, rigidly sclerotized but usually somewhat moveable; gnathos weak, often incomplete, without a distal tooth; aedeagus simple, linear, without special internal structures but frequently with small marginal teeth toward distal end; eighth sternite simple, or with posterior margin produced to form a pointed process that may be single or double. Female genitalia with characteristic development of the structures comprising the genital plate, either of which may be delicately membranous, thickened and semi-rigid, or sclerotized; no signum.

Larva simple, linear, twig-like, with no suggestion of the dorso-lateral protuberances of the Nemoriini and Synchronini; head commonly bifid, produced dorsally as two conical points. *Mesothea* and *Hethemia* are foliage feeders; the species of *Chlorochlamys*, like the Synchronini, are flower feeders, mostly on Compositae.

KEY TO GENERA OF THE TRIBE HEMITHEINI

1. Male antennae simple; distribution eastern *Hethemia*
 Male antennae bipectinate or at least appearing heavily serrate; widely distributed 2
2. Male antennae not bipectinate in the usual way, but with very short, stubby, ciliate or pubescent branches; Canada, northern states, Rocky Mts. only; diurnal *Mesothea*
 Male antennae bipectinate with normal branches; mostly more southern or widespread; nocturnal 3
3. Fringes and termen marked with brown; hindwing strongly angulate .. *Chloropteryx*, in part
 Fringes and termen not so marked; hindwing rounded or but slightly angulate 4

4. Male antennae with short pectinations, their length not exceeding twice thickness of shaft; pale costal border with or without fine sprinkling of brown scales; desert regions of the southwest *Xerochlora*
 Male antennae with long pectinations, the longest at least equal to 4 times thickness of shaft; pale costal border never with sprinkling of brown scales; widespread 5
5. Postmedial of forewing weak, interrupted, offset; female palpi exceeding front by three quarters of their total length; S. Fla. and Antilles *Chloropteryx paularia*
 Postmedial of forewing strong, complete, well defined, often nearly straight, regular or at least not offset; female palpi exceeding front by half their total length or less; widespread; some polymorphism in the southwest, with green, brown and whitish forms *Chlorochlamys*

CHLOROCHLAMYS Hulst

Chlorochlamys Hulst, 1896, p. 312.

TYPE SPECIES. *Nemoria chloroleucaria* Guenée, 1858 = *Chlorochlamys chloroleucaria* (Guenée), designated by Hulst, 1896, p. 312.

ADULT CHARACTERS. Rather small moths, forewing length 7-11.5 mm., females only slightly larger than males; wings quite rounded, not produced at the apices, not angulate, outer margin of forewing never concave below apex; wings opaque, scales very wide, especially near base of forewing; color dull bluish green, olivaceous, or yellowish green, pinkish brown, or cream, readily fading, with or without whitish striation; costa pale, not irrorated with dark scales as in *Chloropteryx* or *Xerochlora*; lines whitish or yellowish, normal, complete except that antemedial of hindwing is wanting; discal spots wanting; terminal line usually wanting; fringes essentially concolorous, unmarked; abdomen with a vague pale dorsal stripe or unmarked.

Veins Sc and R₁ of forewing united for part of their length; R + M₁ of forewing slightly stalked; third anal of forewing lost; venation otherwise as in allied genera; frenulum well developed in male, wanting in female.

Antenna of male broadly bipectinate for basal three quarters, tapering and becoming simple towards the tip; length of longest pectinations 4 to 6 times thickness of shaft; antenna of female simple, slender, ciliate beneath; palpi normal, those of female either as in male (*phyllinaria*) or distinctly longer with the third segment cylindrical; eyes of the sexes similar or nearly so; front about as wide across the top as it is high, with the sides convergent towards the bottom; tongue smaller than in *Chloropteryx* or *Xerochlora*; hind tibia of male moderately dilated, flattened or somewhat prismatic, with a large hair pencil (commonly recessed), the apical spurs only, and a well developed apical process; hind tarsus not as abbreviated as in *Chloropteryx*; hind tibia of female undilated and with two pairs of spurs.

Male genitalia with gnathos completely fused to tegumen at bases of socii; trans-tilla with a large cone- or funnel-shaped structure which may overlie the juxta or be caudad of it; juxta shallowly pouch- or cup-shaped; female genitalia with or without a sclerotized postostial plate and preostial pouch, the latter appearing bowl- or crescent-shaped; these structures often connected or encircled by folds in the integument; ductus bursae does not adjoin exactly at the apex of the bursa copulatrix but slightly to one side.

LARVAL CHARACTERS. *Chlorochlamys* has a simple green larva with the conical processes of the head and prothorax present but much less developed than in *Hethemia pistasciaria* or *Mesothea*. The shape of the body is also different, being shorter,

stouter, and tapering from the posterior end forward, without the highly developed protective resemblance to twigs of the food plant. Like the Synchronini, the species of *Chlorochlamys* are often flower feeders, but do not conceal themselves with attached pieces of plant debris.

DISTRIBUTION. *Chlorochlamys* is distinctly North American, with no known species elsewhere. The generotype, *chloroleucaria*, probably has the distinction of being distributed through more biotic zones than any other American geometrine, occurring from Cape Breton Island to southern Mexico. *Triangularis* is a corresponding western species, mainly west of the continental divide, and the two others occur across the southern part of the continent from California to the Gulf of Mexico.

REMARKS. I restrict *Chlorochlamys* to a small group of four closely related species, three of which are extremely similar and the fourth (*phyllinaria*) somewhat different. One species, *appellaria*, is regularly polymorphic, with green and brown forms. These four species had been treated as ten in the previous literature, so it is not surprising that identifications in virtually all collections have been hopelessly confused. *Chloroleucaria* had been described under no less than seven different names and *phyllinaria* under five.

Key to the Species of *Chlorochlamys*

1. Postmedials usually quite convex, slightly waved; ground color not distinctly striated or irrorated with whitish; female palpi short, normally exceeding front by only one third their total length; mostly southern, Gulf States and Mo. to Calif. *phyllinaria*
 Postmedials straight or but slightly convex, regular; ground color striated or irrorated with whitish; female palpi longer, normally exceeding front by one half their total length; widespread, Canada to Mexico *chloroleucaria*, *triangularis*, *appellaria* (see tables)

Chlorochlamys chloroleucaria (Guenée)

Plate 5, figure 1; plate 24, figures 4, 4a, 4b, 5, 5a, 5b; plate 25, figures 1, 1a, 1b; plate 39, figure 2; plate 48, figures 21-26.

Nemoria chloroleucaria Guenée, 1858, p. 351. Walker, 1861, p. 534. Hulst, 1880a, p. 78 (larva); 1886b, p. 141; 1895, p. 71

Eucrostes chloroleucaria Packard, 1876, p. 370; pl. 10, fig. 77. Goodell, 1880, p. 235. Hulst, *in* Smith, 1891, p. 67.

Eucrostes chloroleucaria Gumpfenberg, 1895, p. 488.

Chlorochlamys chloroleucaria Hulst, 1896, p. 312. Dyar, 1902 [1903], p. 299. Hulst, *in* Smith, 1903, p. 71. Prout, 1912, p. 177. Barnes and McDunnough, 1917a, p. 100. Prout 1933, p. 62. McDunnough, 1938, p. 142. Dethier, 1942, pp. 231-233, pls. 15, 17. Jones and Kimball, 1943, p. 108. Forbes, 1948, p. 115. Sperry, 1951, p. 51. Ferguson, 1954, p. 290. Comstock, 1960, p. 435 (partim).

Nemoria indiscriminata Walker, 1862, p. 1556. Packard, 1876, p. 375 (reproduced original description). Hulst, 1886b, p. 141; 1895, p. 71 (as synonym of *chloroleucaria*).

Eucrostis indiscriminata Hulst, *in* Smith, 1891, p. 67.

Chlorochlamys indiscriminata McDunnough, 1938, p. 142. Kimball, 1965, p. 164.

Nemoria ? *densaria* Walker, 1862, p. 1557. Packard, 1876, p. 375 (reproduced original description).

Nemoria densaria Hulst, 1886b, p. 141; 1895, p. 71 (as synonym of *chloroleucaria*).

Eucrostis densaria Hulst, *in* Smith, 1891, p. 67.

Chlorochlamys densaria Prout, 1933, p. 62.

TABLE 1. Superficial characters in the *Chlorochlamys chloroleucaria* complex.

	<i>chloroleucaria</i>	<i>triangularis</i>	<i>appellaria</i>
Distribution	East of Rocky Mts., Canada to the tropics	West of Rocky Mts., B.C. to Mexican border	Calif., Nev., Utah, Ariz., N.M., Texas, Mexico
Size (forewing length)	Males 8 to 11 mm. Females 9 to 11.5 mm.	Males 8 to 10 mm. Females 9 to 10.5 mm.	Males 7 to 10 mm. Females 7.5 to 10 mm.
Shape of forewing	Broad and rounded in both sexes	Intermediate	Slightly longer, more pointed in male, less so in female.
Color of wings	Green (except when faded)	Green (except when faded). Also a rare cream colored form.	Green, brown, or, in a rare form, cream colored with dark lines.
Lines	Wide, usually bent subparallel to margins; without dark shading	Usually thin; curved without dark shading	Usually thin, often nearly straight; forewing postmedial often erect, twice as far from apex as from inner margin; lines frequently edged with a shade darker than the ground
Front	Light yellow-brown, orange, or dull orange-red; never deep red, gray or greenish	As in <i>chloroleucaria</i> or redder; usually uniform but reddish examples sometimes with mixture of yellowish scales	In Calif. and Nev. like <i>triangularis</i> but inclined to be redder and mixed with yellowish; from Ariz. eastward commonly dark olive to slate gray
3rd palpal segment of female	Almost as long as second, very slender, cylindrical	Same length but stouter, cylindrical; thickness intermediate between the other two	Same length but with tendency to be very stout, almost as large as second; slightly compressed

TABLE 2. Genital characters in the *Chlorochlamys chloroleucaria* complex.

	<i>chloroleucaria</i>	<i>triangularis</i>	<i>appellaria</i>
Socii	Very large, much stouter than uncus, each with a recurved hook at the tip. Socii and uncus subequal in length to tegumen.	More slender, about equal in stoutness to uncus, with recurved hooks as in <i>chloroleucaria</i> . Socii and uncus much shorter than tegumen.	Slender as in <i>triangularis</i> , nearly always without apical hooks. Socii and uncus much shorter than tegumen.
Gnathos	Partly fused to tegumen but otherwise distinctly visible, complete.	More delicate than that of <i>chloroleucaria</i> but still complete.	Nearly obsolete; disconnected or membranous across middle.
Juxta	Typically almost as wide as transtilla, like shallow bowl in profile or squarish.	$\frac{1}{2}$ to $\frac{4}{5}$ as wide as transtilla, deeper, often squarish, quite variable	Usually smaller, roundly cup-shaped; quite variable.
Saccus	Stout; length equal to twice the width or less.	More slender; length usually greater than twice the width.	Very short, small; length and width often about equal.
Median ridge of valve	With usually 6—8 bristles, few hairs.	As in <i>chloroleucaria</i> ,	With few if any bristles, many hairs.
Female genitalia	Genital plate with one large sclerotized unit—the postostial plate; preostial pouch unsclerotized.	Genital plate usually all membranous; weakly sclerotized areas sometimes present.	Genital plate with two separate sclerotized units—a postostial plate and preostial pouch.

- Thalassodes deprivata* Walker, 1862, p. 1559. Packard, 1876, p. 396 (reproduces original description).
- Nemoria deprivata* Hulst, 1886b, p. 141; in Smith, 1891, p. 67; 1895, p. 71 (in synonymy of *chloroleucaria*).
- Geometra desolataria* Herrich-Schäffer, 1870, p. 182; 1871, p. 46. Gundlach, 1881, p. 385. Anonymous, 1895, p. 68. **New synonymy.**
- Chlorochlamys desolataria* Prout, 1933, p. 62 (as synonym of *densaria*).
- Eucrostis rectilinea* Zeller, 1872, p. 480. Prout, 1912, p. 177 (as synonym of *chloroleucaria*).
- Aplodes flavilineata* Riley, 1870, p. 205. **New synonymy.**
- Synchlora aerata flavilineata* Prout, 1932, p. 41.

DIAGNOSIS. *Chlorochlamys chloroleucaria* may be distinguished from other eastern Geometrinae by the gray-green coloring that quickly fades to yellowish, the wide cream colored lines and costa, pale terminal line and fringes, rusty orange or yellowish front, and broadly pectinate male antennae. The size and wing shape are about like *Synchlora aerata* but the shade of green is not nearly so bright, the lines are much wider, more nearly straight, and cream colored rather than white, and the male has only one pair of spurs on the hind tibia. *Chloroleucaria* has no antemedial on the hindwing, no discal spots, and no distinctive abdominal markings. It is the only species of *Chlorochlamys* east of the Rocky Mts. except where it overlaps with *phyllinaria* across the southern states and with *appellaria* in southern Texas. For further detail consult the character tables provided for the genus *Chlorochlamys*.

TYPES. Of *chloroleucaria*, "Amérique septentrionale. Deux ♂, deux ♀. Coll. Mus. et Gn." I have not determined whether any of these four specimens still exist. There appears to be no type material in the USNM, and according to Viette (1950) there is nothing considered to be a type at Paris. Guenée's description clearly fits this species and his types were probably Abbot specimens from Georgia.

The type of *indiscriminata* is a female in the BM, collected by Doubleday in East Florida, presumably at St. Johns Bluff, Duval Co. It is still intact and in fairly good condition. The types of *densaria* and *deprivata* are males, also in the BM and collected by Doubleday in East Florida, with St. Johns Bluff actually specified as the locality in the case of *deprivata*. These specimens are still quite recognizable, although both have lost their abdomens. *Desolataria* was described from Cuba and the type material, if it still exists, should be with the Gundlach collection at Havana. This collection originally contained specimens on which Herrich-Schäffer based his descriptions of Cuban species, and such specimens may be regarded as types. The name was listed in the catalogue of the Gundlach collection (Anonymous, 1895, p. 68). *Rectilinea* was described from material collected by Boll in Texas, but Zeller did not state the sex or number of specimens. The surviving type is a male from the Zeller collection in the BM.

SYNONYMY. The Florida population (*indiscriminata*, *densaria*, *deprivata*) was treated by Prout (1933, p. 62) as a separate species, mainly on the basis of the male antennae, in which he thought the pectinations were longer than normal. He chose to use the name *densaria* because the type was a male. McDunnough (1938) followed Prout but used the name *indiscriminata* because of its page priority. I have examined a large number of Florida specimens, as well as colored photographs of the types of the above three names, and consider that the differences, if any, between these and northern specimens are negligible. I have seen specimens of *chloroleucaria* from Cuba and the Bahamas, and believe that *desolataria*, described from Cuba, also represents this same species. Prout, who did not have Cuban material, decided that *desolataria* was the same as what he was calling *densaria*. *Chloroleucaria* seems quite common through much of Texas, and it seems reasonably certain that this is what Zeller had when he described *rectilinea*. *Flavilineata* Riley, of which I have thus far been unable to find the type, was associated with *Synchlora aerata* by Prout (1933, p. 41) who quoted part of the description. From the characters mentioned, it seems to me almost

certain that *flavilineata* was misplaced in *Synchlora*, and actually equals *Chlorochlamys chloroleucaria*.

FURTHER DESCRIPTION. Male antenna broadly bipectinate for basal three quarters, tapering towards the apical quarter, which is simple; branches slightly clavate, the longest equal to about 6 times the diameter of the shaft; female antenna simple, slender, finely ciliate beneath; male palpi moderately long, exceeding front by a distance almost equal to its average width, third segment cylindrical, about half as long as second; female palpi distinctly longer, exceeding front by a distance equal to or greater than its average width, third segment thinner than that of the male, cylindrical, almost as long as second; male hind tibia quite swollen, with an apical process equal in length to the shorter of the two spurs; female hind tibia undilated, with two pairs of spurs but no apical process.

Scales of antennal shaft and branches cream colored, those of the inner branches sometimes reddish (Florida specimens); interantennal fillet cream colored or luteous, occupying all of the space on top of the head except sometimes for a narrow green border at the back; front rusty orange-yellow or dull rust-red, often darkest at the top; palpi luteous, tinged with red; front legs and femora of middle pair reddish brown inwardly; legs otherwise whitish; underside of body whitish; upperside of thorax and abdomen green like the wings except for a cream colored collar behind the head and an ill defined mid-dorsal stripe of the same color extending from the middle of the thorax almost to the end of the abdomen. These pale dorsal markings are quite vague and can usually be seen only in fresh specimens.

Upperside of wings yellowish green or bluish green, quite bright when fresh, but readily fading to pale olivaceous yellow-green or gray-green, and ultimately becoming almost colorless (cream colored); green areas variably striated or dusted with yellowish, sometimes heavily, sometimes almost clear of yellowish scaling, fore and hindwings colored alike; lines, costa, and narrow terminal line all similarly yellowish; postmedials rather wide, sharply defined and distinct in fresh specimens, straight or convex, that of the forewing tending to parallel outer margin, that of the hindwing often slightly angled near the middle; antemedial of forewing narrower than postmedial, convex, slightly waved, usually inclined outward at inner margin and angled sharply inward near costa; antemedial of hindwing obsolete; no discal spots; costa with a wide but rather diffuse pale margin; terminal line very thin, pale; fringes green, concolorous with wings, sometimes checkered with cream colored rays between vein endings. Underside much paler, darkest towards costa of forewing; lines indistinct.

Length of forewing: males, 8-11 mm; females, 9-11.5 mm.

MALE GENITALIA. See identification table and figures. *Chloroleucaria* may be recognized easily by the very large socii and uncus, which are about equal in length to the tegumen.

FEMALE GENITALIA. The genital plate consists of a single large sclerotized element which is the postostial plate; the preostial portion is unsclerotized. See identification table and figures.

MATERIAL EXAMINED. 627 males, 311 females; 31 male, 19 female slides; 5 larvae in alcohol, 3 inflated.

DISTRIBUTION. NOVA SCOTIA: Cheticamp River, Inverness Co.; Brierly Brook, Antigonish Co.; Three Brooks, Pictou Co. QUEBEC: Norway Bay; Montreal. ONTARIO: Ottawa; Mer Bleue, near Ottawa; Kitchener; Dunnville; Sudbury; Marmora; Simcoe; Constance Bay; Palmer Rapids; Point Pelee; Larsson's Camp, One Sided Lake. MANITOBA: Aweme; Ninette; McCreary; Red Rock Lake, Whiteshell Provincial Park. MAINE: Norway; Enfield, Penobscot Co.; Bar Harbor. NEW HAMPSHIRE: Franconia; Randolph; Jefferson, Coos Co.; Canobie Lake. VERMONT: West Sandgate, Bennington Co.; Swanton;

Charlotte. MASSACHUSETTS: Martha's Vineyard; Barnstable; Cohasset; Manchester; Holliston; Tyringham, Berkshire Co.; Boston; Framingham. CONNECTICUT: Washington, Litchfield Co.; Litchfield; Putnam, Windham Co.; Mystic; East River; N. end of Higby Mountain, 4 mi. W. of Middletown, Middlesex Co.; New Canaan; Greenwich, Fairfield Co. NEW YORK: Picton Island, Jefferson Co.; Ithaca and Varna, Tompkins Co.; Horseheads; Sardinia; Tuxedo; New Windsor; Millbrook, Dutchess Co.; Sloansville; Shokan; Catskill Mountains; Monroe Co.; Valley Cottage, Rockland Co.; Yonkers, Westchester Co.; 3-mile Harbor, Coram, Oyster Bay, Orient, Riverhead, Forest Park, Port Washington, and Montauk, Long Island. NEW JERSEY: Elizabeth; Newark; Paterson; Passaic; Anglesea; Atsion, Burlington Co.; Chester; Freehold; Jerseyville, 3 mi. E. of Freehold; Irvington; Mendham; Oakland; Cranford; Orange Mountains; Lake Hopatcong; Lakehurst; New Brunswick; Cape May Co. PENNSYLVANIA: Adamstown; Scranton; New Brighton. DELAWARE: Wilmington. MARYLAND: Cecil Co.; Patuxent Ref., Bowie. OHIO: Granville; Portsmouth; Green Twp., Adams Co. MICHIGAN: Ice Lake, Iron Co.; Ecorse, Wayne Co.; Utica Woods, Macomb Co.; Midland Co.; Shiawassee Co.; George Reserve, Livingstone Co.; Birmingham; Detroit; Gull Lake Biological Station, Kalamazoo Co. INDIANA: Hessville. ILLINOIS: Chicago; Elgin; Decatur. WISCONSIN: Madison; Harrisville, Marquette Co. MINNESOTA: Long Prairie, Todd Co. IOWA: Ames; Iowa City. MISSOURI: Willow Spring, Howell Co.; Ranken, St. Louis Co.; Barnhart, Jefferson Co. KENTUCKY: Harrod's Cr. ARKANSAS: Arkadelphia, Clark Co. VIRGINIA: Arlington; Falls Church; Suffolk; Eggleston; Christchurch, Middlesex Co.; Blacksburg; Brush Mountain and Price's Fork, Montgomery Co. NORTH CAROLINA: Raleigh, Wake Co.; Leland; Southern Pines. SOUTH CAROLINA: The Wedge Plantation, South Santee River, Charleston Co. GEORGIA: Waycross; Chesser's Island, Okefenokee Swamp, Charleton Co.; Thomasville. FLORIDA: Fernandina; Gainesville; St. Johns Bluff, Duval Co.; Welaka, Putnam Co.; Torreya State Park; Brooksville, Hernando Co.; Orlando; Hastings; New Smyrna; Lake Lucy and Cassia, Lake Co.; Archbold Biological Station, Lake Placid, Highlands Co.; Oneco, Manatee Co.; Elfers; Siesta Key, Sarasota Co.; Port Sewall, Martin Co.; Charlotte Harbor; Tampa; Bonita Springs; Miami; Florida City; St. Petersburg; Punta Gorda; LaBelle; Paradise Key; Big Pine Key. ALABAMA: Ozark. MISSISSIPPI: Camp Shelby, near Hattiesburg; University; Clinton, Bolton and Jackson, Hinds Co.; Pearl, Rankin Co.; Biloxi, Harrison Co. NORTH DAKOTA: Grand Fork Co. SOUTH DAKOTA: Joe Dollar Gulch, E. of Hill City; Slate Creek, 6000', 9 mi. N.W. of Hill City; Spring Creek, 4300', about 10 mi. S.W. of Hill City, Black Hills, Pennington Co. NEBRASKA: Omaha. WYOMING: Reuter Canyon Camp, 5 mi. N. Sundance, Crook Co. KANSAS: Ottawa; Big Bend; Shawnee Mission Park; University of Kansas Natural History Reserve, Douglas Co. COLORADO: Plainview; Boulder; Rock Creek Canyon. OKLAHOMA: Payne Co.; Flint; Grove. TEXAS: Forestburg, Montague Co.; Dallas; Town Bluff, Tyler Co.; College Station; Irving; Georgetown; Victoria; Welder Wildlife Refuge, San Patricio Co.; Brownsville; Mercedes; Lake Brownwood State Park, Brown Co.; Garner State Park, Uvalde Co.; Ballinger, Runnels Co.; Fort Davis. BAHAMAS: North Bimini Island. CUBA: Matanzas. MEXICO: Jalapa, Orizaba, and "Cerro tzul," Veracruz; Tehuacán, Puebla.

GEOGRAPHICAL VARIATION. Hardly any variation is apparent in *chloroleucaria* throughout its vast range from Man. and Cape Breton Is. to Cuba and southern Mexico. The longer antennal pectinations of the male, continued nearer to the tip, Prout's main justification for treating the Florida population as a different species, possibly represents a geographical trend. However, I have found this a very subtle character, difficult to measure, and somewhat inconsistent. I regard such slight variation as well within the expected limits for such a widely distributed species.

FLIGHT PERIOD. Canada to N.J. and Pa., northern Midwest, mostly May 30 to Sept. 19, but records as early as May 8 in Conn., May 7 at Ithaca, N.Y., Apr. 25 in Ohio; south-eastern region except Fla., Mar. 25–Oct. 4; Fla., records for every month from Jan. to

Oct.; Texas, Feb. 5 to Sept. 3. The species is multivoltine except near the northern edge of its range.

The available dates for N.S. are June 28 to July 25, and for Man., June 10 to July 13, suggesting single broods. In southern Ont., with dates from June 10 to Sept. 4, there are obviously two generations at least. There are two broods at Montreal, as indicated by specimens in Mr. A. C. Sheppard's collection with dates from June 3 to July 7, and July 31 to Aug. 20. A large sample in the Franclemont collection from Ithaca, N.Y. clearly shows the pattern of two generations: May 7 to June 23, and July 13 to Sept. 12. I have taken very fresh specimens at Ithaca as late as Sept. 19, suggesting that even that far north there is a partial third brood.

EARLY STAGES. *Chloroleucaria* has been reared many times on a variety of host plants. According to Packard (1876, p. 372) there exists an Abbot manuscript drawing of the larva of this species which fed on *Helenium autumnale* L. (Compositae). Packard also mentions that Goodell reared it on red raspberry, but when Goodell published a description of the larva four years later (1880, p. 235), based on 44 specimens, he made no mention of raspberry, instead listing as food plants the flowers of *Eupatorium perfoliatum* L., *Achillea millefolium* L., and various species of *Helianthus* and *Aster* (all Compositae). Hulst (1880a, p. 78) published a brief description of a larva "feeding upon the petals of the clustered flowers of the common oxeye daisy, *Leucanthemum vulgare*" [*Chrysanthemum leucanthemum* L.]. Dethier (1942, pp. 231-233, pl. 15, figs. 1-3, pl. 17, fig. 4) gave a much more detailed description, providing even a setal map. Dethier's larvae fed on the leaves of *Apocynum androsaemifolium* L. (Apocynaceae) and on the flowers of a species of *Zinnia* (Compositae). Forbes (1948, p. 115-116) mentions only "Larva on blackberry, preferring the berries" (*Rubus* sp., Rosaceae), and calls *chloroleucaria* the Blackberry Looper.

In my study of material in various museums I found five adults reared by McDunnough at Ottawa, Ont., on *Rudbeckia* (CNC); one reared on *Ceanothus* at Constance Bay, Ont., by Dr. T. N. Freeman (CNC); single specimens from Marmora, Ont., (G. S. Walley) and Palmer Rapids, Ont. (F. A. Urquhart), both on *Rudbeckia* (CNC); several reared on ironweed [*Vernonia*] at East River, Conn., by Charles R. Ely (USNM); several reared by Dimmock at Canobie Lake, N.H., on *Rudbeckia hirta*, *Aster* sp., pink petals of carnation, and *Myrica asplenifolia* [*Comptonia peregrina* Coult.] (USNM). The single specimen from *Comptonia* is quite dwarfed. I have also seen a series reared by Grossbeck from larvae on ragweed [*Ambrosia*] on Long Island in 1898 (AMNH), and specimens reared from "flowers of Goldenrod" [*Solidago*] in the Catskill Mountains, N.Y. (AMNH). Dr. W. C. McGuffin of the Canada Department of Forestry loaned to me several preserved larvae that had been found on yarrow (*Achillea*) in Quebec.

Comstock and Dammers (1934, pp. 29-30) figured, as *chloroleucaria*, the larva and pupa of a species that I believe was *Chlorochlamys appellaria*, as their material presumably came from southern Calif.

Chloroleucaria apparently has a simple green larva, shaped much like that of *Hethemia* but a little stouter, and with the pointed processes of the head and prothorax less developed. It comes with or without a dorsal stripe that has been variously described as red, brown, or purple. In two inflated examples before me from East River, Conn., this stripe appears quite red. For more detailed information on the structure of the larva refer to Dethier's paper (1942).

Chlorochlamys triangularis Prout

Plate 25, figures 2, 2a, 2b; plate 39, figure 3; plate 48, figures 27-30.

Chlorochlamys triangularis Prout, 1912, p. 77. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 62. McDunnough, 1938, p. 142. Sperry, 1951, p. 51.

DIAGNOSIS. *Chlorochlamys triangularis* is a Pacific coast and Rocky Mt. species generally replacing *chloroleucaria* west of the continental divide from B.C. to southern Calif. and Ariz., but overlapping broadly with a third closely related species, *appellaria*, in southern portions of the range. *Triangularis* has been almost universally misidentified as *chloroleucaria*, which it closely resembles, but may be recognized immediately by characters in both the male and female genitalia. The moths are always green (except for an aberrant whitish form known only from the New York Mts., Calif., and the Spring Mts., Clark Co., Nev.); the frontal coloring is orange red as in *chloroleucaria*; the wings tend to be more acute than in the other two species and the lines thinner. The postmedials tend to parallel the outer margins more closely than in *appellaria*. However, there are no really clear cut superficial characters for determining this species and it is often necessary to examine the genitalia.

TYPES. Described from one female from "Head of Noyo," Mendocino Co., Calif., "June 8-11, 1871." Noyo Creek flows from near the vicinity of Willits to Fort Bragg, Mendocino Co. The type is in the BM and I have a colored photograph of it. The type locality is near the middle of the range of the species to which I here apply the name *triangularis*, and in a region where neither *appellaria* nor *chloroleucaria* seem to occur.

SYNONYMY. None.

FURTHER DESCRIPTION. *Triangularis* is so similar to *chloroleucaria* that a detailed description would be repetitious. The main differences were discussed in the diagnosis.

Length of forewing: males, 8-10 mm; females, 9-10.5 mm.

MALE GENITALIA. Socii and uncus much smaller than in *chloroleucaria*, distinctly shorter than tegumen, as in *appellaria*; socii and uncus of about equal thickness; each socius with a recurved hook at the tip as in *chloroleucaria*; gnathos more delicate than that of *chloroleucaria* but still entire; juxta one half to four fifths as wide as transtilla, often squarish but quite variable; saccus long, length usually greater than twice the width; median ridge of valve with about 6 to 8 stout bristles in basal half, few hairs.

FEMALE GENITALIA. In *triangularis*, the strongly sclerotized structures characteristic of the genital plate in *chloroleucaria* and *appellaria* are lacking, and the area comprising the genital plate, before and after the ostium, is almost entirely membranous. Sometimes there are small sclerotic remnants but these are never developed as in the other species.

MATERIAL EXAMINED. 58 males, 40 females; 15 male, 11 female slides; 1 larva in alcohol.

DISTRIBUTION. BRITISH COLUMBIA: Seton Lake, near Lillooet. OREGON: Baker and Spring Creek, Baker Co.; Biggs. CALIFORNIA: Hat Creek P.O., Shasta Co.; Alturas, Modoc Co.; Anderson Springs, Lake Co.; Head of Noyo Creek, Mendocino Co.; Coleville and Leevining, Mono Co.; Smoky Valley, Tulare Co.; San Luis Obispo; Angeles Crest Highway, Los Angeles Co.; Upper Santa Ana River and Barton Flats, San Bernardino Co.; Keystone Canyon, 5500', New York Mountains, San Bernardino Co. NEVADA: Elko; Baker; Kingston Camp, 7300', 30 mi. S. of Austin, Lander Co.; Lee Canyon, 7400', 39 mi. N.W. of Las Vegas, Clark Co. UTAH: Eureka; Stockton; Tooele; Bonanza, Uintah Co.; Red Canyon Camp, 7200', 11 mi. S.E. of Panguitch, Garfield Co. ARIZONA: Flagstaff and Walnut Canyon, 6500', near Flagstaff, Coconino Co.; Vail Lake Road, 6500', 9½ mi. S.E. of Flagstaff; Little Colorado Canyon, Coconino Co.; Prescott, Yavapai Co.; S.W. Research Station of the AMNH, 5400', near Portal, Cochise Co.; Madera Canyon, 4400', 4880', and 5800', Santa Rita Mountains, Santa Cruz Co.; Peña Blanca, 3950', Santa Cruz Co. NEW MEXICO: Frijoles; Artesia, Eddy Co. TEXAS: Fort Davis, Jeff Davis Co.

GEOGRAPHICAL VARIATION. There is little variation except for a pale, cream-colored form that occurs along with normal specimens at Lee Canyon, Clark Co., Nev., and Keystone Canyon, New York Mts., Calif. This pale form is unicolorous except that the usual lines may be yellowish and vaguely outlined with blackish scaling. A rare form almost exactly corresponding to this also occurs in *appellaria* and can be distinguished only by the genitalia.

FLIGHT PERIOD. May 13 to Sept. 8 in s. Calif., Ariz. and N.M., presumably with a shorter season northward. Records from May to Aug. suggest two broods at least as far up as n. Calif., but spring records are scarce everywhere. It may well be that the species is multivoltine throughout its range, and that the available dates from Ore. and B.C., July 24 to Aug. 23, represent only the summer generation.

EARLY STAGES. Comstock and Dammers (1934, pp. 29-32) figured a larva and pupa from Calif. (as *chloroleucaria*) that may have been either *triangularis* or *appellaria*. The food plant was *Eriogonum fasciculatum* Benth. Two adults in the AMNH, from the Angeles Crest Highway, Los Angeles Co., Calif., were reared from larvae on flowers of *Ericameria parashii*. Genitalic examination of one of them, a male, shows conclusively that it is *triangularis*. In Aug., 1965, Mr. R. W. Poole reared *triangularis* from a female taken at Walnut Canyon, Ariz. The larvae fed on the flowers of a species of yellow Compositae, possibly *Helianthus*. One male emerged Oct. 29, 1965. A preserved larva from this brood appears similar to *chloroleucaria*, but shows no red markings.

Chlorochlamys appellaria Pearsall

Plate 25, figures 3, 3a, 3b, 4, 4a, 4b, 5, 5a, 5b; plate 39, figure 4; plate 48, figures 31-36; plate 49, figures 1-3.

Chlorochlamys appellaria Pearsall, 1911a, p. 206. Prout, 1912, p. 177. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 62. McDunnough, 1938, p. 142. Rindge, 1955, p. 137.

Chlorochlamys rubromediaria Cassino and Swett, 1925, p. 36. McDunnough, 1938, p. 142. **New synonymy.**

Chlorochlamys appellaria rubromediaria Prout, 1933, p. 62.

Chlorochlamys chloroleucaria Comstock and Dammers, 1934, pp. 29-30, pls. 8, 9.

Chlorochlamys hesperia Sperry, 1951, p. 51. **New synonymy.**

DIAGNOSIS. This is a common species of the southwestern states east to Texas, and has both green and brown forms. Before Sperry described it (as *hesperia*, 1951), the green form was commonly mistaken for *chloroleucaria*, which it closely resembles except for its smaller size, slightly different shade of green, and quite well developed differences in the genitalia of both sexes (see table). The true *chloroleucaria* apparently is not sympatric with *appellaria* except in Texas and Mexico, although *appellaria* and *triangularis* overlap widely in the southwest, the latter probably at higher elevations. *Phyllinaria* also occurs throughout much of the range of *appellaria*, but is more easily identified than the other three.

TYPES. *Appellaria* was described from two brown males taken in Yuma Co., Ariz., Aug. 19, and both are now in the AMNH (ex collections Pearsall and Rutgers University). In the original description neither specimen was restricted as the type, but Rindge (1955, p. 137) designated the specimen from the Pearsall collection as the lectotype. It is complete and in fair condition.

Rubromediaria was described from a holotype, allotype, 64 male and 32 female paratypes, all from Eureka [Juab-Utah County line], Utah (collected by Tom Spalding). The holotype, allotype and most of the paratypes are in the MCZ (ex Cassino collection). A few paratypes are in the USNM.

Hesperia was described from a holotype, allotype, 143 male and 29 female paratypes from various localities in the Colorado and Mojave deserts, southern Calif. The holotype male, in the AMNH (ex Sperry collection), was taken at Borrego, Calif. February 27, 1950.

SYNONYMY. The types of *appellaria* and *rubromediaria* represent the brown form, and *hesperia* the commoner green form of the same species. *Rubromediaria* is actually a somewhat aberrant local population in Utah that averages larger and tends to have a rather pinkish brown coloring with contrastingly darker median space. I considered that it might be a distinct species or even a brown form of *triangularis*, but it appears to blend completely with *appellaria*. Genitalic characters of *rubromediaria* are normal except that one of the male paratypes examined has genitalia that could pass for those of *triangularis*.

FURTHER DESCRIPTION. The green form "*hesperia*" so closely resembles *chloroleucaria* and *triangularis* that there is little one can say to supplement the table of characters. The smaller size and generally yellower appearance, including yellow rather than whitish lines and costa, are the most obvious differences that distinguish *appellaria* from the other two species. The postmedial of the forewing tends to be almost straight, as in *triangularis*, but is more often nearly erect and farther from the outer margin than in that species.

Unlike all other species of *Chlorochlamys*, *appellaria* has a brown form. Brown specimens occur throughout most of its range with varying frequency, although there may be areas where these are absent. The green form seems to be considerably commoner. The brown form differs only in that the usual green coloring is replaced by light brown, often of a pinkish shade, and an intermediate condition in which green and brown scales are mixed is not infrequent. There is also a very rare cream colored form with dark lines, corresponding to a similar form in *triangularis*. I have a single male of this before me from Sierra Blanca, Hudspeth Co., Texas, June 5, 1950, collected by E. C. Johnston (CNC) and determined by genitalia.

Length of forewing: males, 7-10 mm; females 7.5-10 mm.

MALE GENITALIA. Socii and uncus distinctly shorter in length than tegumen; socii slender, about equal in thickness to uncus, without apical hooks; gnathos nearly obsolete; juxta usually small, roundly cup-shaped, but quite variable; median ridge of valve with few if any bristles, many hairs; saccus short and small, length and width often nearly equal.

FEMALE GENITALIA. The genital plate consists of two separated sclerotized parts—a post-ostial plate and a preostial pouch.

MATERIAL EXAMINED. 314 males, 191 females, of which about 102 males and 66 females were brown or intermediate; 46 male, 21 female slides.

DISTRIBUTION. OREGON: Warm Springs, Jefferson Co., one male collected June 14, 1963, by S. G. Jewett, Jr. (AMNH, D. C. Ferguson genitalia slide No. 1007. Locality should be verified). CALIFORNIA: The Geysers, Sonoma Co.; Kelseyville, Lake Co.; Pinnacles National Monument, San Benito Co.; Bishop, Inyo Co.; Surprise Canyon, Panamint Mountains, Inyo Co.; Panamint Valley; Walker Pass, Kern Co.; Burbank; Santa Catalina Island; Los Angeles; Glendale; Mint Canyon, Los Angeles Co.; Apple Valley; Borrego; Split Rock Tank and Rock Springs, Mojave Desert; 12 mi. S. Cave Spring, Mojave Desert; Morongo Valley; Mexican Well, Ivanpah Mountains, San Bernardino Co.; Keystone Canyon, 5500', New York Mountains, San Bernardino Co.; Clark Mountain; Providence Mountains; Calico Mountains, San Bernardino Co.; Barton Flats and Upper Santa Ana River, San Bernardino Co.; Indio; 29 Palms, San Bernardino Co.; Riverside;

Palm Springs and Chino Canyon, Palm Springs; Hemet, Riverside Co.; Arlington, Riverside Co.; Snow Creek, Riverside Co.; Gavilan; Glen Ivy; Essex; Cajon Valley; La Puerta Valley; Hidden Valley, Joshua; San Diego; Julian; Descanso; Split Mountain Canyon, San Diego Co.; Guatay and San Felipe Valley, San Diego Co. NEVADA: Valley of Fire; Lee Canyon, 38 mi. N. of Las Vegas, Clark Co.; Kyle Canyon, Spring Mountains, Clark Co. UTAH: Eureka; Moab, Grand Co.; Monument Valley. ARIZONA: Mojave Co.; Yuma Co.; Kingman; North Rim; New River and Wickenburg, Maricopa Co.; Mayer and Prescott, Yavapai Co.; Phoenix; Oracle, Pinal Co.; Gila-Pinal Co. line; Tucson; Baboquivari Mountains, Pima Co.; Patagonia Mountains; Madera Canyon, 4400' and 4880', Santa Rita Mountains, Santa Cruz Co.; Peña Blanca, 3950', Santa Cruz Co.; Fairview; Golden Age; Portal, Cochise Co. NEW MEXICO: Sitting Bull Falls, 4800', 42 mi. S.W. of Carlsbad, Eddy Co.; White City, Eddy Co. TEXAS: Sierra Blanca, Hudspeth Co.; Fort Davis, Jeff Davis Co.; Welder Wildlife Refuge, San Patricio Co. MEXICO: 5 mi. S. of Monterrey, Nuevo Leon; Tehuacán, Puebla

GEOGRAPHICAL VARIATION. I have made little attempt to determine whether the proportions of green and brown specimens vary geographically, but my impression is that they do. In a sample of 30 specimens collected by Franclemont at Madera Canyon and Peña Blanca, Santa Cruz Co., Ariz., 20 specimens are green, 5 are brown, and 5 could be described as intermediate. This agrees well with the overall ratio, which is about two thirds green to one third brown or intermediate. This dimorphism seems to be neither sexual nor seasonal. The brown form is at least almost as widely distributed as the green form as I have seen both from most of the localities where the species has been collected in fair numbers, although the specimens available from the extremities of the distribution in Ore., northern Calif., N.M., Texas, and southern Mexico happen to be green. One male from Sierra Blanca, Hudspeth Co., Texas, is of a cream colored form with thin dark lines (see remarks under Further Description).

The one character that most obviously varies geographically is the color of the front. In Calif. and Nev. the front is much like that of *triangularis*—dull orange to red, often with pale luteous scales mixed in. In most specimens from Ariz. eastward the frontal coloring is quite different, being dark grayish olive or almost slate gray, shades that never seem to occur in California specimens. This change takes place somewhere in Ariz. and is seen in brown specimens as well as green ones. It can be an exasperating character to work with because so many specimens in collections are found to have been almost completely denuded of their frontal scales.

The record for San Patricio Co., on the Gulf coast of Texas, is based on two males taken Feb. 24 and Sept. 2, 1962 by R. O. and C. A. Kendall (AMNH). These are dull green with gray fronts and are normal in every respect except for their rather small size. The two Mexican examples at present available (I have seen several) have grayish brown fronts but otherwise look just like the green "*hesperia*" form from Calif. The genitalia are also normal.

There is some genitalic variation. Two females examined from the Upper Santa Ana River, San Bernardino Co., Calif. (AMNH) have the poststomial portion of the genital plate almost wholly unsclerotized, although the well sclerotized preostial pouch is still there. These are fairly large green specimens and I had difficulty deciding whether they were *appellaria* or *triangularis*. The only male available from that region is from Barton Flats, and turned out to be *triangularis*. However, I am inclined to believe, from their appearance, that the females with the peculiarly intermediate genitalia are actually *appellaria*, if not hybrids.

FLIGHT PERIOD. In southern Calif., Feb. 28 to Nov. 4; in Ariz., Apr. 3 to Oct. 5.

EARLY STAGES. The larva and pupa figured as *chloroleucaria* by Comstock and Dammers (1934) were probably of this species, but may have been *triangularis*. They did not record the locality, which presumably was in southern Calif., but the food plant was *Eriogonum fasciculatum* Benth.

Chlorochlamys phyllinaria (Zeller)

Plate 26, figures 1, 1a, 1b; plate 39, figure 5; plate 49, figures 4-8.

Eucrostis phyllinaria Zeller, 1872, p. 479. Hulst, 1886b, p. 141.

Nemoria phyllinaria Hulst, in Smith, 1891, p. 67. Hulst, 1895, p. 71.

Chlorochlamys phyllinaria Hulst, 1896, p. 313. Dyar 1902 [1903], p. 299. Hulst, in Smith, 1903, p. 71. Prout, 1912, p. 177. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 62. McDunnough, 1938, p. 142. Forbes, 1948, p. 116.

Eucrostis zelleraria Packard, 1876, p. 307; pl. 10, fig. 76. Hulst, 1886b, p. 141 (as synonym).

Chlorochlamys zelleraria Prout, 1912, p. 177. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 62. McDunnough, 1938, p. 142. **New synonymy.**

Chlorochlamys vertaria Pearsall, 1908, p. 197. Prout, 1912, p. 177 (as synonym).

Chlorochlamys curvifera Prout, 1912, p. 177. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 62. McDunnough, 1938, p. 142. **New synonymy.**

Chlorochlamys fletcheraria Sperry, 1949, p. 43. **New synonymy.**

DIAGNOSIS. *Chlorochlamys phyllinaria* is a southwestern and southern species found from Calif. to Ga., northward in the central states to Mo. and Nebr., and southward into Mexico. It may be recognized by its small size, olive green ground color almost without pale striation, and thin, sharp whitish lines, of which the postmedials tend to be quite roundly convex, and either regular or slightly waved. The front may be brown or olive green. The male genitalia readily distinguish *phyllinaria* from allied species, but those of the female, being closely similar in structure of the genital plate to *appellaria* and *triangularis*, are less distinctive. Fortunately the short female palpi, hardly longer than those of the male, provide the needed structural character, so that even very worn or faded females may be identified without difficulty. Prout considered that there were two species, *phyllinaria* and *zelleraria*, mainly on the basis of the front being green or brown, and was followed by McDunnough and others. It now seems reasonably certain that such differences are within the range of infraspecific variation.

TYPES. *Phyllinaria* was described from three males from Texas, collected by Boll. There are now 2 male syntypes in the BM (ex Zeller and Walsingham collections). I have had no chance to examine these, but there is probably no other species in Texas with which this one need be confused. The specimen Prout regarded as the type (1933, p. 62) had a reddish brown front.

Zelleraria was based on six males and one female from Waco, Texas, August 8-21, collected by Belfrage. In the MCZ, I found one specimen labeled type and three as cotypes. These are now faded but quite recognizable, and I designate the one labeled type as the lectotype. According to Packard they had green fronts.

Vertaria was described from a type male and type female from Phoenix, Ariz., taken Sept. 18 and 16, 1907 and three male cotypes, presumably from the same locality (collected by Dr. R. E. Kunze). The type male and type female are in the AMNH (ex Pearsall collection). The male, taken Sept. 18, 1907, is a good and complete specimen and I designate it the lectotype.

The type of *curvifera* is a female from Phoenix, Ariz., taken Sept. 7, 1904, by R. E. Kunze. It is in the BM.

Fletcheraria was described from a holotype male from Organ Pipe Cactus National Monument [Pima Co.], Ariz., Apr. 14, 1948 (Grace H. and J. L. Sperry), an allotype female from Mexican Wells, Calif., July 7, 1937, and 55 male and 7 female paratypes from various localities in Pima and Santa Cruz Counties, Ariz. The holotype is in the AMNH.

SYNONYMY. Examination of the type material of *zelleraria* convinced me that this represents the same species as *phyllinaria*, especially since both were from Texas. *Vertaria* also, according to the type, is what I consider to be the same species, but from Ariz.

Identification of *curvifera* seemed somewhat more of a problem at first, but the

combination of green front, short palpi, and general appearance, based on a colored photograph of the type, fits no known species except *phyllinaria*. The wing expanse, 20 mm., seems large but there is great size variation in females of *phyllinaria*. I have before me a female from Madera Canyon, Ariz., that measures exactly that size, and also happens to have a green front like *curvifera*. It appears to be almost an exact match for the type. I have seen other similar females from elsewhere. In its color, the type of *curvifera* does suggest two other species, *Xerochlora viridipallens* and the new one I am describing as *mesotheides*, but structurally it is neither of these.

Fletcheraria was based on Arizona and California specimens with green fronts, and the supposed genitalic differences mentioned by Sperry fall within the normal range of variation of *phyllinaria*. The size of *phyllinaria* varies everywhere, but in arid regions the moths tend to be very small. I believe this contributed to the idea that *fletcheraria* was different.

FURTHER DESCRIPTION. Male antennae bipectinate, tapering gradually toward the tips, which are simple; longest pectinations equal to 4-5 times diameter of shaft; female antennae slender, simple, ciliate beneath, the scaling rather rough; male palpi exceeding front by little more than the length of the short, rounded third segment, which appears to be about one third the length of the second; female palpi not much longer than those of the male, with the third segment only half as long as in *chloroleucaria*, *triangularis*, and *appellaria*; hind tibia of male conspicuously dilated, more so than in *chloroleucaria*, with a similar long hair pencil (usually recessed), and a long apical process that reaches halfway between the tip of the longer apical spur and the end of the first tarsal joint; hind tibia of female undilated but very slender proximally, usually somewhat thickened distally, no apical process.

Scales of antennal shaft and interantennal fillet cream colored to pale brown; fillet covering most of head behind antennae but with a contrasting green posterior border; front green, reddish or brown, often a mosaic; palpi pale brown, usually slightly reddish toward the tips; first pair of legs light reddish brown inwardly, legs otherwise mostly cream colored, underside of body whitish; upperside of thorax and abdomen green, the latter becoming whitish towards the end; no indication of a pale middorsal stripe as in the preceding species.

Upperside of wings olive green, the coloring relatively intense because of the near absence of whitish irroration characteristic of the other species; fore- and hindwings colored alike; lines whitish or yellowish, thin but sharply defined, rarely obsolescent and then only partly so, frequently widening abruptly at the costa of the forewing; antemedial of hindwing always lacking; antemedial of forewing convex, even or slightly irregular, turning inward toward costa; postmedials curved subparallel to outer margins, even or slightly irregular, that of the hindwing slightly angled at the middle; costa yellowish, immediately followed by some white scales mixed with the green; a very weak yellowish terminal line or none; no discal spots; fringes green, concolorous or with a few paler scales mixed in. Underside much paler except near costa of forewing; lines indistinct; costa yellower than above.

Length of forewing; males, 6-9 mm; females, 7-10.5 mm.

MALE GENITALIA. Valve much longer than that of the three preceding species; uncus usually swollen in the middle; socii stouter and each with a hook at the tip; gnathos about as in *chloroleucaria*; saccus much reduced.

FEMALE GENITALIA. Precoastal pouch and postcostal plate both lightly sclerotized and quite similar to those of *appellaria*.

MATERIAL EXAMINED. 289 males, 163 females; 6 male, 4 female slides.

DISTRIBUTION. GEORGIA: Screven Co. (11 specimens in AMNH collected by Otto Buchholz). MISSISSIPPI: Agricultural College; Bolton and Clinton, Hinds Co. LOUISIANA: Winn-

field. MISSOURI: Barnhart, Jefferson Co.; Osceola, St. Clair Co.; Boonville; Williamsville. NEBRASKA: Plattsmouth (4 specimens in AMNH). KANSAS: Ottawa; Pittsburg; Eureka; Big Bend; McPherson; Winfield; Hackney, Cowley Co. OKLAHOMA: Cleo Springs; Norman; Snyder; Stillwater; Thomas; Payne Co. TEXAS: Alpine, Davis Mountains, Brewster Co.; Blanco Co.; Brownsville, Cameron Co.; Corpus Christi; Cotulla; Forestburg, Montague Co.; Irving; Kerrville; Laredo; Mercedes, Hidalgo Co.; New Braunfels; Palo Duro Canyon, near Canyon, Randall Co.; Pharr; Plano; Sabinal, Uvalde Co.; Shamrock. NEW MEXICO: 16 mi. N. Las Cruces; 18 mi. N. Rodeo, Hidalgo Co.; Deming, 4325', Luna Co.; Lordsburg. ARIZONA: Research Station of the AMNH, and Silver Creek Wash, 4880', near Portal, Cochise Co.; Sierra Vista, Cochise Co.; Ramsey Canyon, Huachuca Mountains, Cochise Co.; Redington; Oracle; Tucson; Madera Canyon, 4880', Santa Rita Mountains, Santa Cruz Co.; Peña Blanca, 3950', Santa Cruz Co.; 5 mi. S.W. Patagonia, 3700', Santa Cruz Co.; Nogales; Brown's Canyon, Baboquivari Mountains, Pima Co.; Alamo Canyon, Ajo Mountains; Organ Pipe Cactus National Monument; Christmas, Gila Co.; Phoenix; Tempe; Yavapai Co.; Fort Grant; Kingman, Mojave Co. CALIFORNIA: Needles, San Bernardino Co.; Keystone Canyon, 5500', New York Mountains, San Bernardino Co.; Mexican Wells; Borrego. MEXICO: 18 mi. W. Cananea, Sonora; Manzanillo, Colima; Balsas, Guerrero.

GEOGRAPHICAL VARIATION. No geographical variation is especially evident. The differences in the color of the front seem to occur both in the east and in the west with similar frequency. The smallest specimens seen are from Ariz. and I suspect these are associated with arid conditions.

FLIGHT PERIOD. Ga., June 27–Aug. 26; Miss., La., June 16–Sept. 21; Mo., Kans., Okla., June 3–Sept. 22; Neb., Aug. 2, 22, Sept. 22; Texas, Mar. 27–Nov. 10, and one record for Dec. 10 from Mercedes, Hidalgo Co.; N.M., Ariz., Calif., Apr. 11–Oct. 4. *Phyllinaria* is obviously multivoltine throughout its range.

EARLY STAGES. Unknown.

CHLOROPTERYX Hulst

Chloropteryx Hulst, 1896, p. 314.

TYPE SPECIES: *Nemoria tepperaria* Hulst, 1886 = *Chloropteryx tepperaria* (Hulst), designated by Hulst, 1896, p. 314.

ADULT CHARACTERS. Moths small to medium sized, females larger than males, typically with the forewing produced and pointed at the apex, and with the outer margin of hindwing sharply angled, almost tailed, at M_3 , except for *Chloropteryx paularia*, in which both wings are almost rounded; scales in basal half of wing narrower than in *Chlorochlamys* and mostly lying flat, not arched as in that genus; color largely dull olivaceous green, brown, or whitish, readily discoloring from green to yellowish shades or buff, opaque (thinly scaled in some Neotropical species); lines white, thin, incomplete, usually appearing only as series of vein dots, the postmedials offset; antemedial of forewing convex, irregular, of hindwing, wanting; ground color essentially unstriated; discal spots present or absent. The generotype and most other species have a brown terminal line, and have the fringes, costa, and abdomen marked with brown, but the one abnormal species, *paularia*, lacks such markings.

Veins Sc and R_1 of forewing typically separate, and $R + M_1$ of forewing unstalked, but in the atypical species, *paularia*, Sc and R_1 are united for part of their length and $R + M_1$ of forewing are slightly stalked exactly as in *Chlorochlamys*; third anal of

forewing almost lost; venation otherwise as in allied genera; frenulum well developed in male, wanting in female.

Antennae of male bipectinate, tapering gradually toward tips, which are simple; length of branches variable and useful as a character for distinguishing species; female antennae very slender, simple, ciliate beneath; palpi of both sexes generally longer than in *Chlorochlamys* or *Xerochlora*, those of the female with the third segment equal to or longer than segment two; eyes noticeably larger in the male than in the female, and the front correspondingly narrower; interantennal fillet typically protruding forward as a sharp ledge above the front (in *paularia* less prominent); tongue a little larger than in *Chlorochlamys*, apparently about the same as in *Xerochlora*; hind tibia of male dilated, prismatic, distinctly flattened towards the end where it is produced in an unusually long terminal process exceeding in length the longer apical spur; only the apical spurs present; the usual full length hair pencil present but nearly always recessed; hind tarsus abbreviated, distinctly shorter than half the total length of the adjoining tibia; hind tibia of female undilated, with both pairs of spurs well developed; hind tarsus of female not abbreviated.

Male genitalia with gnathos completely fused to tegumen or obsolete at bases of socii; transtilla situated caudad of juxta, shape variable but not cone- or funnel-shaped (asymmetrical in *tepperaria*), length usually exceeding width; juxta inconspicuous, cup-shaped or just appearing as a small V-shaped sclerite. Female genitalia with at least the large outer ring of the large genital plate sclerotized, and typically with a U-shaped sclerite supporting the preostial pouch (but not in *paularia*); bursa copulatrix pear-shaped, with ductus bursae typically entering slightly to one side of the narrow end as in *Chlorochlamys*, but in *paularia* entering apically as in *Xerochlora*.

LARVAL CHARACTERS. See *tepperaria*.

DISTRIBUTION. The genus is mostly Neotropical but three species occur in the United States: *tepperaria* in the southeast as far north as Virginia, *paularia* in southern Florida, and *nordicaria* just barely crossing the Rio Grande in southernmost Texas.

REMARKS. Except for the atypical Antillean and Floridian species, *paularia*, which should perhaps go in a genus by itself, *Chloropteryx* forms a reasonably compact natural group, characterized superficially by angulate wings, and better by genitalic characters. There are over two dozen species, centered in northern South America, of which relatively few have filtered across the Central American isthmus or the Antilles. Only one species, *tepperaria*, is exclusively Nearctic, and presumably has been derived from a Floridian relict of some ancient northward invasion from the Neotropics. *Nordicaria* is a Mexican and perhaps Central American species. Both have close relatives in South America. Although correctly identified many years ago by Prout (1933), *tepperaria* and *nordicaria* have continued to be confused in virtually all collections. They are not as closely related as they look and, most conveniently for determination purposes, are widely allopatric.

Chlorochlamys, *Chloropteryx* and *Xerochlora* could be more easily defined as genera were it not for the existence of *paularia*, which seems to be a composite of characters from all three. As such, it is approximately what one might imagine the ancestral form of this group of genera to have been like. It is interesting to note also that *paularia* is an island form, known to reach a continental mainland only in southern Florida, which it has apparently colonized from Cuba.

Discovery of a form such as *paularia* poses a nomenclatural problem for which the taxonomist has three alternatives: 1) to combine the three genera that the species appear to link, 2) to erect a new genus to accommodate it, and 3) to include it in one of the existing genera where it fits best. For the present I have chosen the last, partly because this does not change anything, and partly because the male genitalia have turned out to be essentially like those of *Chloropteryx*. Future study of the little known

Neotropical fauna may well clarify its position, but there is as yet no known relative with which *paularia* is likely to be confused.

Key to the Species of *Chloropteryx*

- 1. Hindwing strongly angulate, terminal line and fringes marked with dark brown 2
 Hindwing quite rounded, no brown terminal line or markings on the fringes. Fla., Antilles *paularia*
- 2. No blackish discal spots; abdomen with a dark brown dorsal spot on segment 2 only.
 Southeastern, La. to Fla., north to Va. *tepperaria*
 Blackish discal spots distinct; abdomen with dorsal brown shading more diffuse, not confined to segment 2 but usually extending almost the full length to segment 8.
 Southern Texas, Mexico *nordicaria*

Chloropteryx tepperaria (Hulst)

Plate 5, figure 3; plate 28, figs. 3, 3a, 3b; plate 41, fig. 1; plate 49, figure 1.

Nemoria tepperaria Hulst, 1886a, p. 122. Hulst, in Smith, 1891, p. 67.

Chloropteryx tepperaria Hulst, 1896, p. 314. Dyar, 1902 [1903], p. 300. Hulst, in Smith, 1903, p. 72. Prout, 1912, p. 178. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 64. McDunnough, 1938, p. 142. Forbes, 1948, p. 117. Kimball, 1965, p. 164, pl. 21, fig. 19.

DIAGNOSIS. This is the only species of *Chloropteryx* in the southeastern United States and is easily recognized. It is a small, dull, gray-green moth most resembling *Hethemia pistasciaria* and *Chloropteryx paularia* in that region but distinguished by the following combination of characters: outer margin of hindwing very strongly angled at M_3 , tending to be almost tailed; wings with dark brown terminal line and checkered fringes; costa of forewing yellowish, irregularly speckled with clusters of dark scales; abdomen very distinctively marked with a dark brown dorsal spot on the second segment. This description would also apply to *nordicaria*, the species of southern Texas and Mexico, which differs from *tepperaria* mainly in having prominent discal spots and a more diffuse and extensive brown patch on the abdomen. *Nordicaria* also has shorter antennal pectinations. *Tepperaria* is known from Va. to Fla., and west along the Gulf Coast to La.

TYPES. Described from "1 male, 1 female, Ga. N. Car. Coll. Edwards, Tepper." The male, from Ga., is in the collection of the Department of Entomology, Michigan State University, East Lansing, Michigan. The female, from N.C., is in the USNM. In the AMNH there is another female labeled: "Fla.," "Collection G. D. Hulst," "Nemoria tepperaria Type, Hulst," but since this specimen was not mentioned in the original description it must be regarded as a spurious type. I hereby designate as lectotype the female from N.C. in the USNM, labeled Type No. 34191. This specimen has no head but is otherwise reasonably complete and recognizable. Its genitalia have been mounted (slide No. 1371, Hahn W. Capps).

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae bipectinate, gradually tapering toward the tips, which are simple; longest branches equal to 5-6 times the width of the shaft; female

antennae slender, simple, ciliate beneath; male palpi quite long, slender, tapering, exceeding front by almost half their length, third segment slender, cylindrical, rounded at the end, two-fifths as long as the second; female palpi longer, exceeding front by about two-thirds their length, very slender, third segment cylindrical, about half the length of the second; hind tibia of male twice as long as tarsus, evenly dilated for most of its length, with one pair of spurs and a short apical process; hind tibia of female undilated, very slender, one and one half times as long as tarsus, with two pairs of spurs and no apical process.

Scales of antennal shaft and interantennal fillet whitish, lustrous; antennal branches brown; collar and head behind fillet dull green, concolorous with wings; front brown, often with a grayish or greenish tint, unmarked; palpi whitish or luteous, tinged with red dorsally; legs ivory, the scaling lustrous, tibiae and tarsi of at least the first pair shaded with brown; underside of body ivory; upperside of thorax and most of abdomen dull gray green, but second abdominal segment with a sharply contrasting dark brown spot occupying most of the tergite. This dark spot is flanked laterally and posteriorly by patches of pale brown scales, and its anterior margin is deeply incised along the middorsal line by a slightly raised tuft of pale brown scales.

Upperside of wings dull gray green, perhaps when very fresh almost sage green, but not as bright as *Mesothea* nor as olivaceous as *Hethemia*, very close to the coloring found in species of *Xerochlora*; fore- and hindwings colored alike; antemedials and postmedials white, indistinct and mostly broken into a series of spots, somewhat waved, the latter noticeably indented at M_2 ; in some specimens the antemedial is followed and postmedial preceded by a slightly darker shade; discal spots very faint or wanting; costa yellowish, irregularly speckled with patches of dark purplish gray scales; outer margins of both wings with a terminal line of the same dark purplish gray or purplish brown shade, interrupted with a yellowish spot marking the end of each vein; fringes pale yellowish, heavily checkered with rays of dark cinereous gray opposite the veins. Underside much paler, lustrous, with all lines except the terminal lacking and the costa mostly clear yellowish.

Length of forewing: males, 9-10.5 mm; females, 9.5-12 mm.

MALE GENITALIA. These are larger than in *nordicaria*, with the valve generally wider and less tapering, and with the uncus and socii distinctly longer. The transtilla is remarkably different in shape and distinctly asymmetrical in all specimens examined. It has a large pointed caudad extension and smaller pointed cephalad process, both lacking in *nordicaria*. The juxta is rather obscure and is represented mainly by a small V-shaped sclerite. The aedeagus is similar to that of *nordicaria* but more dilated in the distal half. The posterior margin of the eighth sternite is usually straight or convex; if concave, very slightly so.

FEMALE GENITALIA. These are more heavily sclerotized than in *nordicaria*, with the bursa copulatrix larger. The postgenital plate is sclerotized in the middle and has a deep fold in its posterior margin, making this structure, together with the prominent U-shaped pregenital plate, appear as a heart-shaped unit. There is also a brown sclerotized patch in the left ventral wall of the ductus bursae where it adjoins the bursa.

MATERIAL EXAMINED. 69 males, 47 females, including lectotype; 4 male, 2 female slides.

DISTRIBUTION. VIRGINIA: Accomac, Accomack Co.; Christchurch, Middlesex Co.; Arlington. NORTH CAROLINA: Raleigh; Tryon, Brevard. SOUTH CAROLINA: Wedge Plantation, South Santee R., Charleston Co.; Bull Island, Cape Romain National Wildlife Refuge. GEORGIA: Screven Co. (Otto Buchholz). MISSISSIPPI: Camp Shelby, near Hattiesburg. LOUISIANA: Vermilion River, Vermilion Parish. FLORIDA: Gainesville; Welaka, Putnam Co.; Orlando; Archbold Biological Station, Lake Placid, Highlands Co.; Oneco, Manatee Co.; Siesta Key, Sarasota Co.; Arcadia; Bonita Springs; Keystone Heights; St. Petersburg.

GEOGRAPHICAL VARIATION. Florida specimens tend to be smaller and darker than those from the northern end of the range, but the only good basis for comparison is a series of four males and sixteen females from Arlington, Va. in the Franclemont collection. These are a much lighter shade of green than the specimens from Fla., where most material has been collected. I have seen few specimens from the intervening region, but several from S. C. and the Gulf States resemble the Florida specimens.

FLIGHT PERIOD. Two generations in Va., June 3–July 9, and Aug. 8–Sept. 3. For Fla., there are records for every month of the year except Sept. Taken in S.C. July 12–Aug. 11, in Ga. Aug. 5 and Oct. 11, in Miss. in late Sept., and in La. June 7.

EARLY STAGES. In 1968 I reared a brood of *tepperaria* from a female taken at the Wedge Plantation, McClellanville, S.C. in Aug., and the adults emerged in Oct. The larvae did well on *Taxodium* but in the last instar would also eat *Tsuga*. Mature larva 25 mm long, slender, twig-like, closely resembling that of *Hethemia* and *Mesothea*, but with a more produced, conical supra-anal plate. Color greenish, tinged with brown mainly towards each end; head dark brown; metathoracic segment with pair of contrasting blackish dorsolateral spots, these sometimes confluent dorsally.

Chloropteryx nordicaria (Schaus)

Plate 28, figures 4, 4a, 4b; plate 41, figure 2; plate 49, fig. 23.

Gelasma nordicaria Schaus, 1901, p. 253.

Chloropteryx nordicaria Prout, 1912, p. 179. Prout, 1933, p. 64. McDunnough, 1938, p. 142.

DIAGNOSIS. This is a Mexican species known to enter the United States only in the lower Rio Grande Valley near Brownsville, Texas. All Texas specimens of *Chloropteryx* examined seem to belong to this species rather than to *tepperaria*. *Nordicaria* looks like *tepperaria* except that it has distinct discal spots, shorter antennal pectinations, and rather diffuse dark brown dorsal abdominal scaling from segments 2 to 8 which, in *tepperaria*, is usually localized as a distinct dark spot on segment 2 only.

TYPES. Described from Orizaba, Mexico, but neither the number of specimens nor the sex was mentioned in the description. Type should be in the USNM.

SYNONYMY. I should not be surprised if *nordicaria* proved to be the same as *munda* Warren (1897, *Novit. Zool.* 4:425), described from "La Plata" [Colombia, Lat. 2.33 N., Long. 75.55 W.]. The Neotropical species of *Chloropteryx*, as of virtually all the other genera, need to be completely reinvestigated, as Prout had little material of most species and did not study the genitalia.

FURTHER DESCRIPTION. A detailed description of *nordicaria* seems unnecessary. Since it so closely resembles *tepperaria*, such a description would be largely repetitious and I shall discuss only those characters in which the two species differ. 1) Antennae. The longest pectinations in *nordicaria* are equal to 3 or 4 times the thickness of the shaft; in *tepperaria* 5 to 6 times. 2) Palpi. These are similar in form but are tinged with dark brown in *nordicaria*, with red in *tepperaria*. 3) Discal spots. These are dark brown and distinct in *nordicaria*, lacking in *tepperaria*. 4) Abdominal markings. In *nordicaria* the upperside of the abdomen is extensively shaded with dark brown scales, intermixed in part with light brown scales, from segments 2 to 8; in *tepperaria* nearly all of the dark brown abdominal scaling is concentrated in a single spot on the second segment.

Length of forewing: males, 8-9 mm; females, 10-10.5 mm.

MALE GENITALIA. Smaller than those of *tepperaria* with the valve usually narrower and more tapered; uncus and socii shorter; transtilla symmetrical, roughly quadrate but

with a deep, rounded excavation cephalad, and sometimes rounded rather than truncate caudad; juxta a rounded, pouch-like structure, cup-shaped, without the obvious V-shaped sclerite of *tepperaria*; aedeagus slender; posterior margin of eighth sternite distinctly concave.

FEMALE GENITALIA. Less heavily sclerotized than those of *tepperaria*, and with a smaller ductus bursae; central portion of postgenital plate almost membranous so that its sclerotized margin appears as a ring-like structure, fused to the U-shaped pregenital plate as a solid unit (pregenital plate in *tepperaria*, although larger and stronger, is separated by unsclerotized connections); sclerotized patch where ductus bursae adjoins bursa feeble or obsolete.

MATERIAL EXAMINED. 55 males, 6 females from Texas, several specimens from Mexico; 5 male, 3 female slides.

DISTRIBUTION. TEXAS: Brownsville, Cameron Co.; Mercedes and Pharr, Hidalgo Co. MEXICO: Orizaba, Veracruz.

GEOGRAPHICAL VARIATION. None in the material available.

FLIGHT PERIOD. Sept. 15 to May 29, almost continuously. No records for June, July or August.

EARLY STAGES. Unknown.

Chloropteryx paularia (Möschler)

Plate 5, figure 4; plate 28, figures 2, 2a, 2b; plate 41, figure 3; plate 49, figures 24-26.

Nemoria paularia Möschler, 1886, p. 68.

Chloropteryx paularia Prout, 1912, p. 178; 1933, p. 63.

Chlorochlamys paularia Sperry, 1951, p. 53. Kimball, 1965, p. 164.

?*Aplodes punctata* Warren, 1904a, p. 19.

Chloropteryx punctata (= *paularia*) Prout, 1912, p. 178.

DIAGNOSIS. A small, plain, tropical species of the West Indies and southern Fla., aberrant in several respects and seemingly a relict connecting *Chloropteryx*, *Xerochlora* and *Chlorochlamys*. The color is dull gray-green, and the lines are offset and usually broken into a series of white dots as in *Chloropteryx*; the fringes and abdomen are unmarked; the interantennal fillet is roughly clothed with large scales as in *Chlorochlamys* and *Xerochlora*, not as smooth as in *Chloropteryx*. The wings are not angulate but rounded, and the venation is exactly as in *Chlorochlamys*. The male genitalia are like those of *Chloropteryx*. The female genitalia are quite unique but perhaps more suggestive of *Xerochlora* than anything else. The color and general appearance of the moths also is most like *Xerochlora*.

TYPES. *Paularia* was described from Jamaica and Möschler's type material should be in the Zoological Museum of Humboldt University, Berlin. The number of specimens in the type series was not stated but he mentioned that he had both sexes. *Punctata* was based on two males from Upper Park, Jamaica, now in the BM.

SYNONYMY. The types of *punctata* had been labeled as *paularia* but Warren thought they were different. Prout showed no hesitation in placing *punctata* in the synonymy, and since there seem to be no other species with which this one would be easily confused, I consider that Prout's identification of both *punctata* and *paularia* are probably correct.

FURTHER DESCRIPTION. Male antennae broadly bipectinate for proximal three quarters, then tapering abruptly and becoming simple or merely dentate toward the tips; longest branches equal to 4-6 times thickness of shaft; female antennae slender, simple, finely ciliate beneath in the usual way; male palpi quite long, exceeding front by about half their length, third segment cylindrical, about half as long as second; female palpi very long, exceeding front by three quarters of their total length, third segment cylindrical, becoming prismatic towards tip; subequal in length to second; eyes of male slightly larger than those of female and the front narrower; hind tibia of male dilated, somewhat compressed, with one pair of spurs and a very long apical process exceeding the longer spur and half as long as tarsus; male hind tarsus more abbreviated and tibial extension longer than in *Chloropteryx tepperaria*; hind tibia of female not dilated, with the usual two pairs of spurs and no apical process.

Scales of antennal shaft white proximally, cream colored to pale brownish distally; interantennal fillet white, space behind fillet green; top of head about equally divided between white and green; front light greenish brown, somewhat as in *tepperaria* but paler; palpi pale beneath, tinged with reddish dorsally; forelegs pale brown or reddish inwardly, legs otherwise cream colored; underside of body whitish; upperside of thorax concolorous with wings; upperside of abdomen like the thorax, paler, or slightly brownish, unmarked.

Wings not angulate, rounded as in *Chlorochlamys*, upperside light gray-green, less intensely colored than *tepperaria*, and not turning yellow with age or discoloration, unstriated, fore and hindwings colored alike; lines as in *tepperaria*, weak, mostly reduced to series of white vein dots, but shaded with darker green on the side towards median space; antemedial of hindwing wanting; postmedials of both wings offset outwardly between M_3 and Cu_1 ; discal spots wanting except for a faint green bar or crescent across the end of the cell on the hindwing; costa yellowish, not irrorated with dark scales; terminal line indicated only as a series of faint white dots marking the vein endings; fringes concolorous with wings, unmarked. Underside much paler, lines obsolete, costa yellowish.

Length of forewing: males, 7-8 mm; females, 8-11 mm.

MALE GENITALIA. Similar to those of *nordicaria* and *tepperaria* but with the socii thicker and bent near the middle, the valve slightly different in shape and, in the aedeagus, instead of merely a row of marginal serrations near the tip there is a subterminal cluster of 8-10 well developed spines.

FEMALE GENITALIA. In the pattern of sclerotization in the genital plate region these are actually quite unique and show no clearer affinity for *Chloropteryx* than for any of the other allied genera. The shape of the bursa and its relationship to the ductus bursae suggests *Xerochlora*.

MATERIAL EXAMINED. 74 males, 21 females, including examples from all of the Caribbean islands from which it is known. Slides: 4 male, 2 female, including males from Fla., Cuba and Jamaica.

DISTRIBUTION. FLORIDA: Oneco, Manatee Co.; Siesta Key, Sarasota Co.; Port Sewall, Martin Co.; Biscayne Bay; Royal Palm State Park; Florida City; Coconut Grove; Key Largo; Big Pine Key, South Florida Keys. Kimball (1965, p. 164) also reported it from Weekiwachee Springs, St. Petersburg, Bradenton, the Archbold Biological Station near Lake Placid, Highlands Co., Homestead, Paradise Key, and Tavernier, but I have not seen these specimens. CUBA: Baracoa; Santiago de Cuba. JAMAICA: "Jamaica"; Hardwar Gap, 4800'; Christiana, 3000'. HISPANIOLA: "Dominican Republic." PUERTO RICO: San Germán. MARTINIQUE: Morne Rouge. The Antillean specimens examined are in the AMNH and the USNM.

GEOGRAPHICAL VARIATION. There is no variation that is especially apparent.

FLIGHT PERIOD. There are Florida records for every month of the year.

EARLY STAGES. Unknown.

REMARKS. This is a difficult species to place because of its strange mixture of characters showing relationship to *Chloropteryx*, *Chlorochlamys* and *Xerochlora*. It may have descended separately from the common ancestral form of all three, remaining relatively unmodified in the isolated and stable environment of the Antilles. If so, it is a relict of considerable antiquity. The *Chloropteryx* type of genitalia in the male supports Prout's rather hesitant assignment of *paularia* to that genus, and I have left it there. Other alternatives would be to combine the three genera into one, which would have the effect of suppressing the knowledge that the three lines are otherwise distinct, or, to erect a monotypical genus for *paularia*. I prefer to let this decision wait until the Neotropical fauna is better known.

Paularia was first identified from the United States in 1933 by Foster H. Benjamin of the USNM, this first record being based on two males taken by Frank Morton Jones in Royal Palm State Park (now included in the Dade Co. part of Everglades National Park). Benjamin made genitalia slides of males from Fla. and Cuba, correctly labeling these as *paularia* (in USNM), but apparently never published the record. A report of the occurrence of this species in Fla. did not appear in the literature until 1951 (Sperry, 1951, p. 53). *Paularia* has established little more than a toe hold on the North American continent, and presumably colonized the southern end of Fla. from neighbouring Cuba as have many other tropical species.

XEROCHLORA, new genus

TYPE SPECIES. *Synchlora viridipallens* Hulst, 1896 = *Xerochlora viridipallens* (Hulst).

ADULT CHARACTERS. Rather small to medium sized species, forewing length 9 to 15 mm; females often conspicuously larger than males; wings longer than in *Chlorochlamys* or *Chloropteryx*, the forewing more produced and sometimes with the outer margin concave below the apex, the hindwings often slightly angled at M_3 ; wings thinly scaled, especially in the larger species, the scales generally narrower than in *Chlorochlamys*; color drab olivaceous to about the same bluish green shade as *Mesothea*, fading to yellowish or grayish green, finely striated with whitish; costa yellow, commonly irrorated with purplish brown scales as in *Chloropteryx*; lines vague, whitish, incomplete, often irregular, shaded with darker green on the side towards the median space, on the hindwings obsolete or nearly so; position of lines as in allied genera; faint green discal spots present or absent; fringes concolorous, unmarked in the known species; abdomen usually unmarked, but may have some brown shading containing pale dorsal spots (*masonaria*).

Venation as in *Chloropteryx* but with $R + M_1$ of forewing stalked as in *Chlorochlamys*, the third anal present and complete, and $R + M_1$ and $M_3 + Cu_1$ of the hindwing with fairly long stalks of subequal length; Sc and R_1 of forewing remaining separate; frenulum well developed in male, wanting in female.

Antennae of male bipectinate for proximal three quarters, becoming simple or merely dentate toward tip; branches rather short and stout, the longest not exceeding twice the diameter of the shaft in the known species; female antennae simple, slender, ciliate beneath; palpi as in related species, those of the female variable in length and with the third joint cylindrical; eyes of the sexes similar; front narrower than in *Chlorochlamys* and with the sides less divergent dorsally; tongue better developed than in *Chlorochlamys*, about as in *Chloropteryx*; hind tibia of male moderately and quite uniformly dilated, prismatic, with apical spurs only, with a terminal process and a thin

but full length hair pencil; hind tarsus of male as in *Chlorochlamys*, not as abbreviated as in *Chloropteryx*; hind tibia of female undilated and with one or two pairs of spurs (apical pair only in the genotype; other species with both pairs, or the first pair present but rudimentary).

Male genitalia with the gnathos not fused to tegumen at bases of socii, but appearing distinctly at that position as a loop on each side; transtilla of characteristic shape with two lobate cephalad processes, width generally exceeding length, overlying juxta; juxta quite prominent, form variable but often deeply cone shaped; coremata tending to be reduced or even wanting; female genitalia not differing in any consistent way from those of allied genera, except for the ductus bursae adjoining the bursa copulatrix directly at the apex, not slightly to one side as in *Chlorochlamys* or usually in *Chloropteryx*.

LARVAL CHARACTERS. Unknown.

DISTRIBUTION. This appears to be mainly a genus of the Sonoran zone with at least one species reaching Costa Rica to the south and another (*viridipallens*) reaching Colo. to the north. All of the known species occur in southern Ariz. except the new one I describe, which is found in N.M. and western Texas.

REMARKS. *Xerochlora* is a compact group of six extremely similar species, some of which may be distinguished only by genitalic characters, and it would be surprising if there were not still some undiscovered ones in Mexico or Central America. In appearance the moths rather closely resemble certain Old World species of *Hemithea* or *Gelasma*, but the genitalia show them to be something quite different. I had originally thought of including them in *Chloropteryx*, but more careful analysis of the characters revealed that they fit no better there than in *Chlorochlamys*. Although the relationships to *Chlorochlamys* and *Chloropteryx* are obviously close, the species of *Xerochlora* form a visibly distinct group with no definite connecting forms. The best way of calling attention to this is to treat them as a genus.

Key to the Species of *Xerochlora*

1. Pale costal border of forewing ill defined, not contrasting, mostly suffused with green, without mixture of brown scales 2
 Pale costal border of forewing yellow, contrasting, with or without a sprinkling of brown scales 3
2. Small, intensely green species, lines obscure but postmedials quite regular in both sexes, hindwing slightly paler towards costa; length of longest antennal pectinations in male less than twice thickness of shaft. N.M. and Texas only *mesotheides*
 Moths larger, size and color normal for genus; lines more evident, postmedials usually regular in female only; hindwing not noticeably paler towards costa; length of longest antennal pectinations in male about equal to twice thickness of shaft. Colo., N.M., Ariz., Calif., Texas *viridipallens*, in part
3. Female palpi very long, segments 2 and 3 about equal; forewing pointed, outer margin usually concave below apex; outer margin of hindwing distinctly emarginate between M₁ and M₃; yellow costa nearly always with sprinkling of brown scales; dorsal abdominal markings usually discernible although rudimentary in Arizona specimens. Ariz., N.M., Mexico *masonaria*

Female palpi never as long as described above; forewing less pointed, outer margin straight or convex, rarely concave below apex; hindwing margin between M_1 and M_3 straight or but slightly concave; yellow costa with or without sprinkling of brown scales; abdomen unmarked. Ariz. *martinaria*, *inveterascaria*, *viridipallens*,
in part (these cannot be satisfactorily distinguished except by genitalia)

Xerochlora viridipallens (Hulst), new combination

Plate 26, figures 2, 2a, 3, 3a, 3b, 4, 4a, 5; plate 39, figure 6; plate 49, figures 9, 10.

Synchlora viridipallens Hulst, 1896, p. 315. Dyar, 1902 [1903], p. 301, Hulst, *in* Smith, 1903, p. 72. Prout, 1912, p. 115 ("huj. gen.?").
Chlorochlamys viridipallens Barnes and McDunnough, 1916b, p. 171; 1917a, p. 100. Prout, 1933, p. 62. McDunnough, 1938, p. 142. Sperry, 1951, p. 50-51.
Chlorochlamys volantara Pearsall, 1906, pp. 206, 214. McDunnough, 1938, p. 142. Sperry, 1951, pp. 50-51. **New synonymy.**
Mesothea viridipennata Wright, 1920, p. 484.

DIAGNOSIS. This is one of the more widespread species of *Xerochlora*, occurring in Colo., N.M., Ariz., Texas and Calif. Apart from the male genitalia, which are distinctive, the moths may often be recognized by their appearance, at least the females, when the post-medial lines are regular and evenly curved. Unfortunately, the lines may be somewhat irregular, especially in males, and such specimens are generally indistinguishable from *inveterascaria* or *martinaria*. However, the yellowish costal border is weakly developed with little contrast in *viridipallens*, and is often actually green as in *mesotheides*. It is apparently never irrorated with dark scales as in *masonaria* or as it may be in *martinaria* or *inveterascaria*. The dorsal side of the abdomen is solidly greenish, with no suggestion of paler spots or dark brown scales. All specimens of *Xerochlora* seen from Colo. and Calif. have belonged to this species.

TYPES. *Viridipallens* was described from an unstated number of specimens from "Colorado; Arizona," but I base my identification on a male type from Colo. in the AMNH. I hereby designate this specimen as the lectotype, in accord with an informal type restriction published by Barnes and McDunnough (1916b, p. 171). Positive identification of *viridipallens* has been made possible by examination of the genitalia of the type, and I provide a figure of the male genitalia of another Colorado specimen that match them closely. Since only the one species seems to reach Colo., restriction of the type locality to that region furnished additional support for this determination.

Volantara was described from a "male Type," which I regard as the holotype, and several cotypes, all from "Palmerly" [Palmerlee], Cochise Co., Ariz. The holotype is type No. 34189 in the USNM, with its genitalia on Slide No. 1056 (J.F.G.C.). Two male cotypes of *volantara* in the AMNH are also *viridipallens*, but of two female cotypes in the same collection, one is *masonaria* and the other *martinaria*.

SYNONYMY. The genitalia of the type of *volantara* show it to be the same species as *viridipallens*, but, as discussed above, the cotypes include 3 species. The determination of *inveterascaria* is uncertain as the type has lost its abdomen, and although I am using the name for another species there is a possibility that the type is the same as *viridipallens*.

FURTHER DESCRIPTION. Male antennae bipectinate, tapering in outer third and becoming simple at tip, longest branches at least equal in length to twice thickness of shaft; female antennae slender, simple or at most dentate, ciliate beneath, roughly scaled above; male palpi as in related species, rather short, often little more than exceeding front; female palpi longer than those of male, exceeding front by twice as much, third segment half as

long as second; hind tibia of male as in other species of the genus; hind tibia of female apparently always with one pair of spurs only.

Antennal scales cream colored; interantennal fillet white, cream, or sometimes suffused with green, broad with a narrow and diffuse green margin behind; front reddish brown, sometimes quite reddish; palpi tinged with red; forelegs quite red on inner sides, middle legs somewhat less so, legs otherwise cream colored; underside of body whitish; upperside of thorax and abdomen green, concolorous with wings, the abdomen becoming whitish towards the end, unmarked.

Wings with tendency to be more rounded than in other species of *Xerochlora*; upperside light sage green when perfectly fresh, a shade paler and less bluish than fresh *masonaria*, about the same as *inveterascaria* and *martinaria*; green color soon fading to a more yellowish shade, as in the other species, tending not to be as boldly striated as in *masonaria*, but instead with whitish or almost colorless scales more evenly intermixed with the green ones; fore- and hindwings colored alike; lines pale, whitish, weak but usually complete, bordered with solid green on side towards median space; antemedial of hindwing wanting except for a vague partial continuation of the darker green shade; antemedial of forewing almost erect, slightly convex, turning in abruptly near costa; postmedials almost parallel with outer margins, slightly irregular in male but more regular and evenly convex in female, bending inward and expanding slightly just before costa; discal spots wanting or faintly indicated in darker green; costa usually with a thin yellow or cream colored margin but this may be suffused with green; costa not marked with dark brown scales; fringes completely concolorous with wings, unmarked; no terminal line. Underside paler, darkest near costa of forewing which may be bordered with yellowish as above, lines obsolete.

Length of forewing: males, 9-11.5 mm; females, 11-12 mm.

MALE GENITALIA. These are easily recognized by the large, almost bulbous saccus, the relatively flat valve with sides almost parallel, and the evenly curved socii like those of *masonaria*. The coremata are vestigial or wanting. Unlike *martinaria* and *inveterascaria*, the valves in *viridipallens* and *masonaria* may be spread widely apart without tearing the membranous connection at the juxta.

FEMALE GENITALIA. Postostial plate large, circular, of semisclerotized thickened integument; preostial plate developed as a large semicircular pouch of similarly thickened integument, prominent, wider than postostial plate; bursa copulatrix almost globular, ribbed near ductus bursae, which is short, thick and only about half as long as in *masonaria*; ductus seminalis entering bursa on right side just before its juncture with ductus bursae.

MATERIAL EXAMINED. 51 males, 19 females, including types of *viridipallens* and *volantaria*; 14 male, 8 female slides.

DISTRIBUTION. COLORADO: Rock Creek Canyon [El Paso Co.]. NEW MEXICO: Cimarron Canyon, 7900', Sangre de Cristo Mountains, Colfax Co.; Bear Trap Camp, 8500', 28 mi. S.W. of Magdalena, Socorro Co.; McMillan Camp, 6800', 13 mi. N. of Silver City, Grant Co. TEXAS: Alpine [Brewster Co.]. ARIZONA: Greer, 8500', White Mountains, Apache Co.; 3 mi. W. of Eagar, 7100', Apache Co.; Beaver Creek, S. of Alpine, Greenlee Co.; Redington [Pinal Co.]; Palmerlee [Cochise Co.]; Sabino Basin, Santa Catalina Mountains; Madera Canyon, 4880', Santa Rita Mountains, Santa Cruz Co.; Flagstaff; Walnut Canyon, near Flagstaff, Coconino Co. CALIFORNIA: "New York Mountains"; Keystone Canyon, 5500', New York Mountains, San Bernardino Co.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. The five specimens from Rock Creek Canyon, Colo., were taken Aug. 14, 1957, by Margot May (AMNH); in N.M., the Socorra Co. specimen was taken

July 21, 1964, and the Grant Co. specimens July 24, 1961, both by F., P., and J. Rindge (AMNH), and the Colfax Co. specimen on July 13, 1962 by E. and I. Munroe (CNC); the two Texas records are labeled Aug. 1-7 (MCZ); the dates for Ariz. are Aug. 2-28; for Calif., Aug. 25-Sept. 3

EARLY STAGES. Unknown.

REMARKS. All locality records given have been verified by genitalia slides.

Xerochlora inveterascaria (Swett), new combination

Plate 27, figures 2, 2a, 2b; plate 40, figure 3; plate 49, figures 13-16.

Chlorochlamys inveterascaria Swett, 1907, p. 379. Prout, 1912, p. 177. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 62. McDunnough, 1938, p. 142.

DIAGNOSIS. This species is known only from the southeastern quarter of Ariz., where it is apparently at times common. *Inveterascaria* is similar in size, wing shape and coloring to *viridipallens*, but the postmedials in the female are less regular and the wings tend to have a more striated appearance. It is superficially indistinguishable from *martinaria*, but as yet the latter is definitely known only from Cochise and Santa Cruz Counties. *Inveterascaria* is best identified by the male genitalia, in which the socii are neither straight and sharp as in *martinaria* or *mesotheides*, nor evenly curved as in *viridipallens* or *masonaria*, but are distinctly angled at about 90°, forming an elbow just beyond the middle. Otherwise the male genitalia are closest to those of *martinaria*. In the female, the bursa copulatrix has a more elongated and more plicated neck region than in *martinaria* or *viridipallens*, in both of which the bursa is more nearly globular. The angulate socii are so distinctive and invariable that males may be identified without dissection. This is accomplished merely by brushing away some of the long vestiture that overlies the uncus and socii, using a fine stiff brush (No. 000 sable hair) and a stereoscopic microscope.

TYPES. Described from one male from Tucson, Ariz., May 11, 1905, Type No. 2236 in the MCZ. When I examined the type, a rather poor and faded specimen, I found that it had lost its abdomen, and so it is virtually impossible to be certain of the identification until other characters are found. In associating *inveterascaria* with this species, I am resorting to guesswork in an effort to conserve the name, at least until it can be shown to belong elsewhere. The present species is evidently commoner and more widely distributed than *martinaria*. It extends northward beyond Tucson, whereas it is less certain that *martinaria* does so. When I examined the type, however, I also considered that it might be *viridipallens*.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae bipectinate, tapering in outer third and becoming simple at tip, longest branches about equal in length to twice thickness of shaft; female antennae slender, simple or at most slightly dentate, ciliate beneath; male palpi as in related species, rather short, often little more than exceeding front; female palpi longer and slightly more slender than those of the male, exceeding front by twice as much; third palpal segment of female actually almost as long as second, but with its base often so concealed by scales that it may appear only half as long; hind tibia of male as in other species of the genus; hind tibia of female with apical spurs normal, but of the preapical pair only one spur commonly present and often much reduced in size.

Antennal scales and interantennal fillet whitish or cream colored, the latter not as

large as in *viridipallens* but still occupying over half of the space on top of the head, and with a more sharply defined boundary where it meets the green border behind; front dusky brown, with or without a slightly greenish tint, rarely reddish; palpi cream colored, usually lightly tinged with red; forelegs dull reddish inwardly, second pair faintly tinged with reddish or pale brown; legs otherwise cream colored; underside of body whitish; upperside of thorax and abdomen green, concolorous with wings, the abdomen becoming whitish at the tip, unmarked.

Forewing with apex moderately pointed, on the average probably a little more so than in *viridipallens*, at least in females, although the latter species has a longer and narrower wing; apex of forewing not produced as in *masonaria*, outer margin evenly convex; hindwing rounded. Color of upperside dull sage green fading to olive, almost exactly as in *viridipallens* but less bluish than in fresh *masonaria*; wings finely and densely striated with whitish or colorless scales, more so than in *viridipallens*; both wings colored alike; lines weak, antemedial wanting on the hindwing, as in related species, and very nearly obsolete on the forewing; postmedials consisting mainly of a series of whitish vein dots, usually emphasized by some solid green shading on the side towards median space, on the forewing almost erect, waved, with a rounded convexity near the middle preceded and followed by shallow concavities, bending in slightly at costa; postmedial of hindwing generally vague but, if visible, subparallel to margin, slightly irregular; discal spots wanting or faintly indicated in darker green; costal margin of forewing solid, deep yellow or sometimes with a few weak brownish scales mixed in (in *martinaria* the brown scales tend to be dark and contrasting, almost as in *masonaria*); no terminal line but there are usually minute, yellowish marginal vein dots; fringes concolorous with wings, unmarked. Underside paler, all markings obsolete except the yellow costa, which is somewhat exaggerated.

Length of forewing: males, 9.5-10.5 mm; females, 11-13 mm.

MALE GENITALIA. These have already been discussed to some extent in the diagnosis. When properly spread apart for mounting, the valves are not divergent in the usual way, but are directed more nearly caudad, a peculiarity of both *inveterascaria* and *martinaria*. The saccus tends to be more slender than that of *martinaria*, the valves are differently shaped, and the socii strongly elbowed at about 90° just beyond the middle. The bent socii provide the most obvious and useful character for recognition of the species, especially since they may be seen without dissection (see diagnosis).

FEMALE GENITALIA. Ductus bursae very short as in *martinaria*, but bursa copulatrix more pear-shaped, with narrowed end quite distinctly ribbed (plicated); tapered end of bursa narrowing gradually until it becomes the ductus bursae; membranous folds encircling postostial plate less inclined to be sclerotized; anterior apophyses (8th segment) aborted, usually appearing as though cut off, or sometimes just bent.

MATERIAL EXAMINED. 52 males, 12 females, including type; 12 male, 7 female slides.

DISTRIBUTION. ARIZONA: S.W. Research Station of the AMNH, near Portal, Cochise Co.; Palmerlee and Paradise, Cochise Co.; Hereford [Cochise Co.]; Ramsey Canyon and Miller Canyon, Huachuca Mountains, Cochise Co.; near Miami, Gila Co.; Desert Arboretum, Superior, Pinal Co.; Madera Canyon, 4880', Santa Rita Mountains, Santa Cruz Co.; Peña Blanca, 3950', Santa Cruz Co.; Sonoita Creek, 10 mi. S. of Patagonia, and Hidden Spring Canyon, 9 mi. E. of Sonoita, Santa Cruz Co.; Baboquivari Mountains, Pima Co.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. Mostly July to Aug. 29, but taken Feb. 24, and Mar. 4 and 13 at Sonoita Creek by Mr. R. F. Sternitzky (in AMNH).

EARLY STAGES. Unknown.

Xerochlora martinaria (Sperry), new combination

Plate 27, figures 3, 3a, 3b; plate 40, figures 4, 5; plate 49, figures 17-19.

Chlorochlamys martinaria Sperry, 1948, p. 6; 1951, p. 51.

DIAGNOSIS. This species, superficially indistinguishable from *inveterascaria*, is known only from a few localities in Cochise and Santa Cruz Counties, Ariz., except for one old specimen labeled White Mts., Ariz. [Apache Co.] (USNM, ex Barnes collection), a locality that may be incorrect. Most of the material seen is from the type locality, Madera Canyon, Santa Cruz Co. *Martinaria* is most easily identified by the male genitalia, which are distinctive. The socii are straight, pointed, and blade-like, and may be seen without dissection by brushing away some of the vestiture from the tip of the abdomen.

TYPES. Holotype male from Madera Canyon, Santa Rita Mountains, Santa Cruz Co., Ariz., Aug. 15, 1947 (J. A. Comstock and Lloyd Martin), D. C. Ferguson Genitalia slide No. 967, deposited in the Los Angeles County Museum, Los Angeles, Calif. The original allotype was from the White Mountains, Ariz., but later (1951, p. 51) Sperry decided that this specimen was *volantaria* (actually it is *masonaria*), and designated a new allotype from Madera Canyon. He also had 37 male and 20 female paratypes, all from Madera Canyon, now distributed in various collections. I have not checked the entire type series, but 4 males and 1 female of the paratype series in the AMNH are definitely *martinaria*, and preparations of single male paratypes in the CNC and USNM have shown that these also are this species. Two female paratypes of *martinaria* in the AMNH are *masonaria*, and one female cotype of *volantaria* from Palmerlee, Ariz., slide No. 1376 (AMNH), is *martinaria*.

SYNONYMY. None.

FURTHER DESCRIPTION. *Martinaria* fits the description of *inveterascaria* in almost every detail. However, it shows more of a tendency for the yellow costa to be dusted with contrasting, dark purplish brown scales. *Inveterascaria* either lacks these dark scales or they are weak and pale; *masonaria* tends to have them clustered in larger aggregations. Another point that I have noted in the few females available is that the first pair of hind tibial spurs are better developed than in *inveterascaria*, with both spurs of the pair present and more nearly the size of the apical ones.

Length of forewing: males, 9-11 mm; females, 11-12 mm.

MALE GENITALIA. Valves rather flattened, expanded; when spread apart for mounting, valves directed almost straight caudad; uncus straight, slender, evenly tapered, very pointed; socii straight, blade-like, pointed, slightly shorter than uncus; juxta and transstilla as in *inveterascaria*, the latter perhaps more evenly sclerotized and with a narrower, more evenly rounded cephalad emargination; saccus generally larger, or at least wider than that of *inveterascaria*; hairy coremata of sacculus similar, moderately developed.

FEMALE GENITALIA. Closest to those of *inveterascaria* but bursa copulatrix usually subglobular rather than pear-shaped, and only faintly ribbed where it rather abruptly narrows to meet the ductus bursae; ductus longer than in *inveterascaria* and more distinct from the bursa; membranous folds encircling postostial plate with a tendency to be more extensively sclerotized and rigid than in *inveterascaria*; anterior apophyses small but normal, straight, not bent or aborted.

MATERIAL EXAMINED. 23 males, 8 females, including type; 8 male, 7 female slides, including type.

DISTRIBUTION. ARIZONA: Madera Canyon, 4880' and 5800', Santa Rita Mountains, Santa Cruz Co.; Hereford and Palmerlee, Cochise Co.; "White Mts." [Apache Co.] (should be verified, see diagnosis).

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. July 3 to August 31.

EARLY STAGES. Unknown.

Xerochlora masonaria (Schaus), new combination

Plate 5, figure 2; plate 27, figures 1, 1a, 1b; plate 40, figures 1, 2; plate 49, figures 11, 12.

Nemoria masonaria Schaus, 1897, p. 161.

Gelasma masonaria Dyar, 1908b, p. 34.

Chlorochlamys masonaria Prout, 1912, p. 177. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 62. Sperry, 1951, p. 51.

Chlorochlamys masonaria form *hyperalla* Prout, 1933, p. 62.

Chlorochlamys volantara Prout, 1912, p. 177, (= *masonaria* Schaus); 1933, p. 62.

DIAGNOSIS. This is the largest and perhaps most easily recognized species of *Xerochlora*, with very long female palpi in which the third segment is as long or even longer than the second. The apex of the forewing tends to be more produced and pointed and the hindwing more angulate than in other species; the lines are irregular, pure white but fragmentary, and usually closely followed by solid green shading; the yellow costa is nearly always irrorated with patches of brown scales. In Mexican material the dorsal side of the abdomen is characteristically marked with small whitish or pinkish spots on a brown shaded background; in United States specimens such markings are rudimentary, although traces of them are still apparent with magnification, especially on the second segment. *Masonaria* tends more than any other species of the genus to have both pairs of hind tibial spurs in the female, although of the first pair only one spur is commonly present. The females are much larger than the males and in size alone are quite conspicuously different from those of allied species. *Masonaria* occurs from Ariz. and N.M. to Costa Rica.

TYPES. The type of *masonaria* is a female in the USNM from Jalapa, Veracruz, Mexico. A genitalia slide of this specimen was prepared for me by Dr. Ronald W. Hodges, and a drawing that I made from it is figured (Pl. 40, fig. 1). The type of *hyperalla* is a male from Juan Vinas, Costa Rica, now in the BM. One of the female cotypes of *volantara* from Palmerlee, Ariz., slide No. 1375 (AMNH), is *masonaria*, and two female paratypes of *martinaria* from Madera Canyon (AMNH) are also *masonaria*.

SYNONYMY. The identity of *hyperalla* is not certain but a single specimen that I examined from Cachi, Costa Rica (USNM) is the same as Mexican ones, showing at least that *masonaria* occurs there. The species is variable and it would not be surprising if Prout's form fitted within the present concept.

FURTHER DESCRIPTION. Male antenna bipectinate, tapering in outer third and becoming simple at tip, longest branches about equal in length to twice thickness of shaft; female antenna slender, simple or slightly dentate, ciliate beneath, roughly scaled above; male palpi as in allied species; female palpi much longer than those of male and longer than in any other species of the genus, third segment slender, cylindrical, at least as long as second; hind tibia of male normal for the genus; hind tibia of female variable, usually

with both pairs of spurs or with one spur of the proximal pair missing or rudimentary, sometimes with both spurs of the proximal pair obsolete or nearly so.

Antennal scales whitish; interantennal fillet white, apparently more constant than that of *viridipallens*, narrowly bordered with green behind; front dusky brown, rarely reddish brown; palpi reddish above, pale below; first pair, and to a lesser extent second pair of legs dull reddish on inner sides; legs otherwise whitish; underside of body whitish; upperside of thorax and abdomen green, concolorous with wings, the abdomen variably marked with whitish or rose red segmental spots surrounded by dark brown shading. The pale spots, the brown shading, or both may be obsolescent as is the case in Arizona and New Mexico specimens, occurring only as vestiges on segments two or three. Rose shading associated with the abdominal markings seems to develop only in Mexico and Central America, and there as a variation expressed only in some specimens.

Forewing produced, usually pointed and with the outer margin nearly always slightly concave below apex; hindwing with outer margin more noticeably angled at M_3 and emarginate between M_1 and M_3 than in allied species. The wings are less opaque than in the other species so that worn specimens look more translucent. Upperside of wings, when fresh, delicate sage green in United States specimens, distinctly more bluish than *viridipallens*; shade uncertain in Mexican specimens because no fresh material is available. Most museum specimens have faded to the more yellowish or olivaceous green characteristic of the group; some specimens in nature fade to a slightly violaceous light gray-green, a color not seen in other species. The thinly scaled look is partly a result of colorless scales mixed with the green; these may be arranged as fine striations or as dense uniform irroration. Fore- and hindwings colored alike; lines pure white but fragmentary, often obscure, especially the antemedial, followed by a weak or distinct solid green shade on side towards median space; antemedial of forewing, if visible, erect or convex, irregular, on hindwing wanting; postmedials subparallel to margins, irregular, that of the forewing usually with a shallow concavity between Cu_1 and inner margin, turning in slightly but not expanding at costa; discal spots usually indicated as markings of solid green; costa yellowish, heavily to very lightly irrorated with groups of purplish brown scales; position of terminal line marked by a series of small white dots at the veins and sometimes by a faint edging of solid green; fringes concolorous with wings; unmarked. Underside much paler, all markings obsolete except yellow costa, which tends to be less irrorated than above.

Length of forewing: males, 11-13 mm; females, 12-14 mm, but one very large female from Purulha, Guatemala, measures 16 mm.

MALE GENITALIA. Uncus narrow, evenly tapered to a point; socii curved but not sharply elbowed, bluntly rounded at the ends; transtilla with two rather large lobes; valve with a high, setose median ridge at base, broadly overlying costa; valve widest at middle, where there is a large, rounded costal convexity, narrowing toward base and apex; saccus intermediate between that of *viridipallens* and *martinaria*; coremata quite well developed; aedeagus longer and with the row of marginal teeth near apex better developed than in the other species.

FEMALE GENITALIA. Easily recognized by the length of the ductus bursae, this being about twice as long as in other species of the genus.

MATERIAL EXAMINED. 62 males, 34 females, including type; 10 male, 7 female slides.

DISTRIBUTION. ARIZONA: Walnut Canyon, 6500', near Flagstaff, Coconino Co.; South Fork Camp, White Mts.; Hereford; Palmerlee; Paradise; Redington; Carr Canyon and Ash Canyon, Huachuca Mts., Cochise Co.; S.W. Research Station of the AMNH, 5400', 5 mi. W. of Portal, Cochise Co.; Onion Saddle, 7600', and Pinery Canyon, 7000', Chirichaua Mts., Cochise Co.; Madera Canyon, 4880' and 5800', Santa Rita Mts., Santa Cruz Co. NEW MEXICO: Lordsburg; McMillan Camp, 7000', 14 mi. N. of Silver City, Grant Co.

MEXICO: Zacualpan; Sn. Angel, D.F.; Jalapa and Orizaba, Veracruz; Tehuacán, Puebla.
GUATEMALA: Purulha; Volcan Sta. Maria (identification doubtful). COSTA RICA: Cachi.

GEOGRAPHICAL VARIATION. The tendency toward loss of the brown abdominal shading northward has already been mentioned. Whether this is a gradual change has not been established because no material is available from northern Mexico, but some specimens from southern Mexico already have this shading reduced. It is even possible that the form with reduced markings is not conspecific with *masonaria*, although it has the same kind of genitalia and seems about the same in other characters, including size. Two males from Volcan Sta. Maria, Guatemala (USNM) look greener, have the pink and brown abdominal shading unusually well developed, have lost all white scaling from the lines, which are strongly indicated in green, and appear to have slightly different genitalia, with a longer, narrower valve. These may represent another species.

FLIGHT PERIOD. In Ariz. and N.M., June 25, 27; July 11–Aug. 28.

EARLY STAGES. Unknown.

Xerochlora mesotheides, new species

Plate 28, figures 1, 1a, 1b; plate 40, figure 6; plate 49, figures 20, 21.

DIAGNOSIS. This is the smallest and greenest species of *Xerochlora*, superficially resembling *Mesothea incertata viridipennata*, with which it has been confused. However, the wing shape, vestiture and male antennal structure are different, and *mesotheides* is peculiar, even within its own genus, in having the hindwings slightly paler than the forewings. It occurs in New Mexico and western Texas and is nowhere sympatric with *Mesothea* as far as known. In *Xerochlora*, only the range of *viridipallens* seems to overlap that of *mesotheides*. As in other species of the genus, females tend to be much larger than males.

TYPES. Holotype male, Sierra Blanca, Hudspeth Co., Texas, June 5, 1950, E. C. Johnston, DCF slide No. 1038, in the CNC. Paratypes, 3 females, same data; one male, Marathon, Brewster Co., Texas, May 23, 1950, E. C. Johnston; one female, Big Bend National Park, 6000', Brewster Co., Texas, April 25, 1959, E. W. Smalzried; 4 males, 4 females, White City, Eddy Co., N.M., May 14, 1950, E. C. Johnston; 4 males, 6 females, Sitting Bull Falls, 4800', 42 mi. S.W. of Carlsbad, Eddy Co., N.M., June 26, 28, 29, 1964, F., P., and M. Rindge. All of the paratypes collected by E. C. Johnston are in the CNC except two, which are in the collection of the author. The Rindge specimens are all in the AMNH.

SYNONYMY. None.

FURTHER DESCRIPTION. Male antennae bipectinate, tapering gradually to tips, which are simple, length of longest branches less than twice thickness of shaft; female antennae slender, slightly dentate, ciliate beneath; male palpi short, usually not exceeding front, third segment small, somewhat conical; female palpi hardly longer than those of the male and with the third segment similar; male hind tibia quite dilated, prismatic, with the apical spurs only and a slight apical process; female hind tibia undilated, with the apical spurs only.

Scales of antennal shaft and interantennal fillet whitish, the latter sometimes greenish; head behind fillet green, forming a border about half the width of the fillet; front, palpi, and inner surfaces of first and second pairs of legs dull red or reddish

brown; legs otherwise cream colored; underside of body cream colored; upperside of thorax and abdomen green, concolorous with wings, the abdomen becoming paler posteriorly, unmarked.

Forewing rather long, apex produced but not pointed, costa almost perfectly straight, especially in males, outer margin evenly convex; hindwings rounded, outer margin not angulate; color of wings pure green or slightly olivaceous, not as blue as *Mesothea*; coloring fairly intense, opaque, unstriated, the hindwings noticeably paler than forewings, especially towards costa; antemedial of forewing very vague; postmedial more distinct but still weak, paler green with whitish vein dots, subparallel to outer margin but curving inward just before costa, slightly irregular in male, more evenly convex in female; antemedial of hindwing wanting; postmedial of hindwing as on forewing or less distinct, sometimes obsolete, with an outward bulge near the middle in both sexes; discal spots wanting or very faintly indicated in darker green; costa with or without a weak yellowish margin in the male, all green in the female; no terminal line but with a tendency to have small white marginal vein dots on the forewing; fringes solid green, concolorous with wings. Underside paler, yellow costa on the forewing of the male more distinct than on the upperside, pale terminal vein dots usually present, lines obsolete.

Length of forewing: holotype, 8.5 mm; other males, 8-9 mm; females, 9.5-11 mm.

MALE GENITALIA. These most closely resemble the genitalia of *martinaria* in the slender, pointed uncus and straight, blade-like socii. However, the valve is not flattened and expanded like that of *martinaria*, and the saccus is much abbreviated, more so than in any other species of the genus. The transtilla is very prominently bilobed, and the aedeagus unusually short. The hairy coremata are present but small.

FEMALE GENITALIA. The genital plate is an almost circular structure, the postostial part of which consists mainly of a semicircular area of weak sclerotization, and the preostial part the usual rounded pouch-like invagination of thickened, semi-rigid membrane. The ductus bursae is very short, and the bursa itself rather small and ovate.

MATERIAL EXAMINED. 10 males, 14 females; 3 male, 4 female slides. Only the types are known.

DISTRIBUTION. The data given for the type series include all known localities.

GEOGRAPHICAL VARIATION. None.

FLIGHT PERIOD. See data given for type series.

EARLY STAGES. Unknown.

REMARKS. I have subsequently seen 7 specimens of *mesotheides* collected in Coahuila, Mexico, by Dr. C. L. Remington. These are from 3 mi. S. of Gloria, July 28, 1959, and from 4000' in the Sierra de la Gavia, July 29, 1959.

HETHEMIA, new genus

Chlorissa Prout, 1912, 1933. Barnes and McDunnough, 1917a. Forbes, 1924, 1948. McDunnough, 1938, (nec Stephens, 1831, p. 315; nec Westwood, 1840, p. 100).

TYPE SPECIES: *Nemoria* ? *pistasciaria* Guenée, 1857 = *Hethemia pistasciaria* (Guenée), monobasic.

ADULT CHARACTERS. Small moths, similar in size to *Mesothea* and *Chloropteryx*, females distinctly larger than males; wing shape as in the Old World genera *Hemithea* and *Diplodesma*, with forewing somewhat pointed and hindwing angled, but not as angulate as in the typical group of *Chloropteryx*; wings opaque, densely scaled, especially in males; color olivaceous green or reddish brown, clouded with orange-yellow beneath in males but not in females, the green discoloring to yellowish or buff; costa of forewing with a broad brown margin, not irrorated with dark scales as is common in *Chloropteryx* and *Xerochlora*; lines pale, normal but weak, fairly regular; discal spots green, indistinct, or wanting; no terminal line; fringes concolorous or brownish, unmarked; abdomen uncrested, unmarked, except with some general brownish shading.

Venation with Sc and R₁ of forewing fused for a short distance, R₁ and R₂ separate; R + M₁ and M₃ + Cu₁ of forewing unstalked, separate; third anal of forewing present; frenulum present in male, slender; frenulum wanting in female.

Antenna of male as in *Chlorissa*, simple, ciliate beneath; of female, similar but more slender; palpi similarly short in both sexes, hardly exceeding front, third joint short, conical; eyes of the sexes similar, normally developed, not reduced as in *Mesothea*; front almost square, slightly narrowing ventrally; tongue well developed; hind tibia of male as in *Mesothea*, hardly dilated, flattened towards the end, with the distal pair of spurs only, no terminal process, and apparently no hair pencil; hind tibia of female with both pairs of spurs, a character that conveniently distinguishes it from *Mesothea*; vestiture of front, palpi and thorax normal, not hairy as in *Mesothea*.

The genitalia of both sexes show a relationship closer to *Chlorissa* than to anything else, but in the male at least there are several important differences. In the male genitalia, *Mesothea* appears closer to *Chlorissa* than does *Hethemia*, but in the female, the last two are almost identical, and *Mesothea* differs most. In *Hethemia*, the form of the tegumen, vinculum, uncus, socii, juxta, transtilla, and aedeagus are all very much as in *Chlorissa viridata* (the generotype), except that no sclerotized parts are deep brown in color as they tend to be in *Chlorissa* and *Mesothea*. In the valve, the prominent and partly free costal sclerite, characteristic of *Chlorissa* and *Mesothea*, is nearly lost, having become completely fused with the valve, leaving only a rounded, dentate, costal bulge. The knob-like median basal process of the valve of *Chlorissa*, which also persists in *Mesothea*, is reduced to an elongated, low ridge, somewhat pointed at the distal end. The gnathos is complete, as in *Chlorissa*, but very weak. The eighth sternite, bearing a single process in *Chlorissa* and *Mesothea*, is bifid in *Hethemia*, ending in two long, sharp processes, dentate on the outer sides.

The female genitalia are very close to those of *Chlorissa*, with the same extremely elongated bursa copulatrix.

LARVAL CHARACTERS. The larva differs in no apparent way from that of *Chlorissa* or *Mesothea*. A description is given in the discussion of *pistasciaria*.

DISTRIBUTION. Eastern North America from N.S. and southern Ont. to Fla., westward to Man., N.D., and Mo.

REMARKS. In many respects this taxon hardly differs from *Chlorissa*, and before investigating the Old World genera in detail, I had not thought that a new genus would be required for *pistasciaria*. *Chlorissa*, *Hethemia*, and *Mesothea* are clearly more closely related than any one of them is to *Hemithea* or to any other allied form, but each is distinctive in certain respects. Especially in its unique sexual dimorphism, loss of the dark coloring of sclerotized parts, simplified valve, and peculiar double process on the eighth sternite, *Hethemia* seems as far removed from *Chlorissa* as is *Mesothea*, so that in recognizing one as generically distinct, one is obliged to do likewise with the other.

Geographically too, *Hethemia* is far removed from the Palaearctic *Chlorissa*, being completely isolated in eastern North America, south of the boreal forest and east of the Great Plains. This distribution contrasts with that of *Mesothea*, which crosses the entire continent to Alaska as though it were holarctic.

The name is an anagram of *Hemithea*.

Hethemia pistasciaria (Guenée), new combination

Plate 5, figure 5; plate 29, figures 1, 1a, 1b, 2, 2a, 2b; plate 41, figure 4; plate 49, figures 27-30.

Nemoria ? *pistasciaria* Guenée, 1857, p. 348. Walker, 1861, p. 534.

Nemoria pistacearia Hulst, 1895, p. 71.

Nemoria pistaciata Packard, 1876, p. 374. Hulst, 1896, p. 313.

Nemoria pistaceata Hulst, in Smith, 1891, p. 67. Dyar, 1902 [1903], p. 299. Hulst, in Smith, 1903, p. 72.

Chlorochroma pistaceata Gumpfenberg, 1895, p. 495.

Chlorissa pistasciaria Prout, 1912, p. 175. Barnes and McDunnough, 1917a, p. 100. Forbes, 1924, p. 284. Prout, 1933, p. 61. McDunnough, 1938, p. 141. Kimball and Jones, 1943, p. 108. Kimball, 1965, p. 164.

Chlorissa pistaciaria Forbes, 1948, p. 116. Ferguson, 1954, p. 289.

[?] *Iodis euchloraria* Guenée, 1857, p. 355.

Nemoria euchloria (sic) Hulst, 1896, p. 313.

Nemoria euchloraria Dyar, 1902 [1903], p. 299.

Chlorissa (?) *euchloraria* Prout, 1912, p. 175; 1933, p. 61.

Chlorissa euchloraria Barnes and McDunnough, 1917a, p. 100. McDunnough, 1938, p. 141.

Nemoria subcroceata Walker, 1862, p. 1557. Packard, 1876, p. 372. Hulst, 1886b, p. 141. Hulst, in Smith, 1891, p. 67. Hulst, 1896, p. 313. Dyar, 1899b, p. 386; 1902 [1903], p. 299. Hulst, in Smith, 1903, p. 72.

Chlorochroma incertata var. *subcroceata* Gumpfenberg, 1895, p. 495.

Chlorissa subcroceata Prout, 1912, p. 175. Forbes, 1924, p. 284 (synonymy). Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 61. McDunnough, 1938, p. 141.

Acidalia ? *insecutata* Walker, 1862, p. 1613.

Thalera superata Walker, 1866, p. 1612. Hulst, 1895, p. 71 (synonymy).

Nemoria gratata Packard, 1876, p. 373; pl. 10, fig. 79. Hulst, in Smith, 1891, p. 67. **New synonymy.**

Chlorochroma gratata Gumpfenberg, 1895, p. 494.

Nemoria auranticolorata Strecker, 1899, p. 8. Dyar, 1902 [1903], p. 72. Prout, 1912, p. 175 (synonymy).

Nemoria yarii Hulst, 1900, p. 105. Dyar, 1902 [1903], p. 299. Hulst, in Smith, 1903, p. 72. Prout, 1912, p. 175 (synonymy).

DIAGNOSIS. This is a small eastern species often confused with *Mesothea incertata*, but easily recognized by a number of distinctive characters. It has simple antennae in both sexes, slightly angulate hindwings, and a yellow, orange or brown collar behind the head. The coloring of the wings is quite deep green in freshly emerged specimens; in the female almost sage green like *Mesothea* but darker, in the male more olivaceous. The female is usually green beneath, but the male is always much yellower on the underside. The color of both sexes quickly fades through various shades of olive green to yellowish green or even pale brown, and specimens of an intense orange yellow shade are not uncommon in collections. I suspect that the most extreme of these are the result of discoloration in relaxing, but it is not unlikely that similar discoloration may occur in nature. The fringes may be green, pinkish, or brown.

Pistasciaria occurs from southern Ont., Que. and N.S. to Fla., and seems commonest in bogs, blueberry barrens and other acid soil habitats. The extreme instability of the green pigment in this species, as well as its polymorphism, sexual and otherwise, has long confounded lepidopterists and has led to the complex synonymy.

Pistasciaria and *subcroceata* are different color forms but not green and orange-yellow as thought by former authors. Both are green when fresh, but *pistasciaria* has reddish or brown fringes, *subcroceata* has green fringes.

TYPES. *Pistasciaria* was described from one female "en mauvais état", from "Amérique septentrionale. Coll. Bdv." The type is believed to be lost (Prout, 1933, p. 61), but Guenée's description seems to fit the present species very well. It was a specimen with reddish brown fringes. 27 mm. seems large, but if one doubles the distance from the

center of the thorax to the apex of the forewing, as was the custom, it is found that large females measure just about this size.

Euchloraria was based on one example from the Boisduval collection, supposedly from North America. The sex was not stated and the type appears to be lost. It is not in the USNM.

Subcroceata was based on one specimen, described in Latin as a male and in English as a female. Walker stated that it was from New York, but the label states only U.S. Prout (1933, p. 61) said that it was from East Florida [St. Johns Bluff, Duval Co., Doubleday], evidently at the suggestion of Warren, according to Prout's notebook in the BM. The specimen bears the BM registration number 46-110, indicating collection number 110 acquired in the year 1846. This collection contained all the nocturnal Lepidoptera collected by Edward Doubleday in North America in 1837-38. It further bears, on separate labels, the numbers 19 and 736, evidently referring to lists that now seem to be lost (Fletcher, *in litt.*). A colored photograph of the type sent to me from the BM is that of a male, clearly the same species as *pistasciaria*. As far as one can tell it is the form with green fringes, indicating a northern specimen, and so Trenton Falls, N.Y. is most probably the type locality.

Insecutata was described from one female with no locality given. The type in the BM appears to represent the true brown form known only from Fla., Ga. and S.C. (see discussion of geographical variation). Consequently, I believe that the type locality of *insecutata* is St. Johns Bluff, Duval Co., Fla., and that it is one of the specimens collected there by Edward Doubleday in 1838.

Superata was also described from one female, from "North America. From Mr. Carter's collection." The locality is not known, but the type, which is in the BM, again clearly represents the same species as *pistasciaria*. Like *subcroceata*, it appears to represent the form with green fringes.

Gratata, supposed to be a Walker manuscript name published by Packard, was based (by Packard) on four males and four females from Brunswick, Me.; London, Ont.; Salem, Boston and Amherst, Mass.; Albany, N.Y.; Lansing, Mich.; Philadelphia, Pa. At the MCZ, where much of Packard's material should be, I did not find any specimens marked as types.

The type of *auranticolorata* is a specimen in the Strecker collection at the Field Museum of Natural History, Chicago, labeled "Fla. 1896." I have not determined whether it is male or female. Strecker described it from "One example, taken by Whitfield in Florida." It has been suggested that this was an erroneous spelling of Wittfeld, one of the early collectors in Florida (Kimball, 1965, p. 164).

Dyarii was described "either from L.I., N.Y., or from Dist. Colum.; collection of Dr. H. G. Dyar." "National Museum, type No. 4700." The specimen labeled as the type in the USNM is a male, without locality data.

SYNONYMY. As mentioned above, my examination of type specimens or photographs of them has made it clear that the names *subcroceata*, *superata*, and *dyarii* are synonyms of *pistasciaria*, as here understood. Although I have found no types of *gratata*, Packard's description of this form unquestionably refers to the present species and not to *Mesothea incertata*, in whose synonymy it has been listed by all previous authors from Hulst (1895) to Forbes (1948). Packard's statements about the fringes being either reddish or green in *gratata*, the deep rusty-ochreous prothorax (the "collar"), and the dates of flight, May 28 to June 17, point quite conclusively to *pistasciaria*, although of course he may have had a mixed series. Also, he included in the type lot a specimen from Philadelphia, well south of the range of *incertata*. Judging from a colored photograph of the type, it seems quite certain that *insecutata* is the rare brown form so far known only from northeastern Fla., from Waycross, Ga., and from Charleston Co., S.C. The type is the right shade of brown, although considerably faded, and what is more important, the upperside of the abdomen is heavily shaded with reddish brown to an extent probably never found in normal green *pistasciaria* and which is not a result of discoloration. In the event that it should later seem advantageous to regard this form

as a different species or subspecies, the name *insecutata* of Walker is available for it. I had expected that *auranticolorata*, also from Fla., would be the same as the true brown form, *insecutata*, but according to Strecker's description it is not. I have not seen the type. *Auranticolorata* apparently is a normal green specimen of *pistasciaria*, faded or discolored to the bright orange yellow shade so characteristic of this species. The type of *euchloraria* Guenée has never been found and its identity has always been in doubt. Forbes (1948, p. 117) expressed the opinion that "it may have been an exotic with false locality," but I think it equally possible that it was a female of *Hethemia pistasciaria*.

FURTHER DESCRIPTION. Male and female antennae simple, ciliate beneath; antennae of male slightly stouter than those of the female; male and female palpi similar, rather short, exceeding front by no more than the length of the small, conical third segment; hind tibia in both sexes about $1\frac{1}{2}$ times the length of tarsus, without an apical process, undilated, in the male with only the apical spurs, in the female with both pairs of spurs but the first pair smaller and sometimes inconspicuous.

Interantennal fillet, scape, and antennal scales near base cream colored or ivory, not white; antennal scaling for distal four-fifths usually gray; head behind fillet brown, followed by a collar of lighter brown or yellowish, contrasting sharply with the green thorax in fresh specimens but almost colorless in discolored ones; front brown, varying from deep chestnut to grayish brown; palpi brown, usually paler than front; legs luteous, shaded with brown, the front tibiae with a grayish or purplish tint; underside of body ivory or luteous; upperside of thorax concolorous with wings; upperside of abdomen the same or brownish.

Upperside of wings in fresh specimens deep olive green (pistachio) in males, sage green in females, the latter almost the same color as *Mesothea incertata*; fore- and hindwings colored alike; lines white, very thin, usually discontinuous and broken into a series of delicate dots or bars, often edged with a faint green shade darker than the ground color; antemedial of forewing obscure, roundly convex, of hindwing wanting; postmedial of forewing erect, slightly irregular, bending inward at costa and usually with a slight concavity at Cu_2 ; postmedial of hindwing convex, slightly irregular, and also with a concavity at Cu_2 , postmedials of both wings approximately parallel to outer margins and marking off outer thirds of the wings at costal and inner margins; discal spots wanting or indicated only as vague markings of darker green; costa pinkish or purplish brown in males, green or brown in females; no terminal line; fringes nearly always purplish brown in males (rarely green), either purplish brown or green in females in proportions that probably vary geographically; underside of male bright orange yellow, sometimes clouded with green but always yellower than above, no markings; underside of female green like the upperside but paler, (occasionally orange as in the male) costa brown, other markings obsolete.

As mentioned in the diagnosis, the green coloring, especially of males, is very unstable and readily fades or discolors through lighter shades of olive green, greenish yellow, and ultimately to a completely bleached pale brown. In discolored males, the shade of the upperside not infrequently matches the orange yellow hue of the underside. A few females, especially from the New Jersey pine barrens, are bright orange beneath like the males and appear to have been so when fresh. In addition to those specimens that have become brown through discoloration, there is a real brown form (*insecutata* Walker), further discussed under geographical variation.

Length of forewing: males, 8.5-10.5 mm; females, 10-13 mm. Females conspicuously larger than males.

MALE GENITALIA. See discussion under genus *Hethemia*. Readily distinguished from all other American species by the form of the valve and the distinctively bifurcate ventral plate of the eighth segment. Neither sex has the dark brown coloring of sclerotized parts seen in *Mesothea*.

FEMALE GENITALIA. These also are distinctive in the much elongated bursa and the pair of setose papillae within the sclerotized ring of the postgenital plate.

MATERIAL EXAMINED. 173 males, 301 females, including the type of *dyarii* and colored photographs of the types of *subcroceata*, *insecutata*, and *superata*. Slides: 3 male, 4 female. Larvae: 2 broods reared.

DISTRIBUTION. NOVA SCOTIA: Annapolis Royal, Annapolis Co.; Lake Kejimikujik, Queens Co.; Auburn and Aylesford, Kings Co.; Mt. Uniacke, Hants Co.; Armdale, Halifax Co.; Bogs in Halifax Watershed Area, Halifax Co.; Mt. Thom, Pictou Co.; Brierly Brook, Antigonish Co. QUEBEC: Lanoraie; Nominuingue. ONTARIO: Ottawa and Mer Bleue, near Ottawa; Merivale, near Ottawa; Dunnville; Charleton; Black Rapids; Parry Sound District; Point Pelee; Waubamie. MANITOBA: Winnipeg; Aweme. MAINE: Enfield and Passadumkeag, Penobscot Co.; Bangor; Bar Harbor. NEW HAMPSHIRE: Franconia. MASSACHUSETTS: Sharon; Newton Highlands; Framingham; Amherst; E. Wareham; Barnstable; Martha's Vineyard. CONNECTICUT: Storrs. NEW YORK: Amagansett, Forest Park, Bellport, Yaphank, and Riverhead, Long Island; Nassau-Suffolk Border, south shore Long Island; West Farms, New York City; New Windsor; Ithaca, Tompkins Co.; Picton Island, near Clayton, Jefferson Co. NEW JERSEY: Freehold; Jerseyville; Newark; Elizabeth; Mt. Holly; Plainfield; Chester; Lakehurst; Milltown; Sweetwater; New Lisbon; Jamesburg; Atsion, Burlington Co.; 7 mi. N.W. New Gretna, Burlington Co. PENNSYLVANIA: Scranton; Philadelphia; Sinking Spring, Berks Co.; New Brighton. MARYLAND: Montgomery Co. DELAWARE: New Castle Co. MICHIGAN: Ramona; Grayling; Manistique, Schoolcraft Co. WISCONSIN: Lake Katherine, Oneida Co. MINNESOTA: Potroit Lake, Becker Co. NORTH DAKOTA: Red River north of Fargo, Cass Co. VIRGINIA: Mountain Lake; Eggleston. NORTH CAROLINA: Highlands, Macon Co.; Black Mountains; New Bern. TENNESSEE: Johnson City. MISSOURI: Adair Park, Independence. ALABAMA: Camp Rucker, Ozark. SOUTH CAROLINA: The Wedge Plantation, S. Santee River, Charleston Co. (form "*insecutata*"). GEORGIA: Waycross (form "*insecutata*"). FLORIDA: University Conservation Preserve, Welaka, Putnam Co. (form "*insecutata*").

GEOGRAPHICAL VARIATION. The peculiar color problems in this species, as well as its diversity of host plants and habitats, at first led me to anticipate confusing trends in geographical variation, if not an actual sibling species complex. I have not been able to find characters by which to recognize more than one species, although this by no means precludes the possibility that such may be the case. Analysis of much good material has revealed that most of the apparent variation is just sexual dimorphism plus rather dramatic alteration of the green pigment through ordinary environmental agencies such as sunlight and moisture. Fortunately the species is univoltine, or matters might have been further complicated by seasonal forms. Once the above characteristics are understood, the remaining variation mostly falls into place in a natural north-south sequence.

Males show little change from Canada to N.C. The large number examined from this region had brownish fringes almost without exception, and those from Ga. and Ala. probably do, although from there I have seen only females. Two males from Man. had greener fringes. Northern females, such as those from the Canadian provinces, are apparently always green on the underside and nearly always have green fringes, although a few from southern Ont. have faintly pinkish fringes. Two geographical changes begin to appear in females from central portions of the range, as in the N.J. pine barrens. In this population a higher proportion of females, apparently at least 50%, have pinkish brown fringes like those of the male, and a few are even more unusual in having the underside of the wings bright orange, also like the male. I have seen the orange underside in quite fresh green specimens and doubt if it could be a result of discoloration. Since there is relatively little material available from anywhere south of N.J., the southward extent of these trends is uncertain. I have seen one female from Highlands, N.C., that is orange beneath, but other southern specimens examined are green beneath, and with or without brown fringes. Females with brownish fringes tend also to have some brown

dorsal shading on the abdomen, but the brown fringes and orange undersurface are not necessarily concomitant. Some of the best examples of the latter form have green fringes. The most southerly record I have seen of a green *pistasciaria* with authentic locality data is a female from Ozark, Ala., Mar. 31, 1943 (Franclemont collection). It is a normal specimen with faintly pinkish fringes. A female from Fargo, N.D., June 6 (AMNH) and a male from Independence, Mo., May 4, 1962 (Charles Covell Collection), near the western limits of distribution, also seem to be normal.

Although there are a few reports of *Hethemia pistasciaria* from Fla. that may refer to the normal form (e.g., the type of *auranticolorata*, and others mentioned by Kimball, 1965, p. 164), three males and three females that I collected at Welaka, Putnam Co. on March 11, 15 and 20, 1962 are strikingly unusual. These are entirely a deep, rich reddish brown with concolorous fringes. The underside is similar but slightly paler, except for one female which is contrastingly paler and slightly greenish beneath. In one very fresh male the wings have a purplish sheen. The deep brown coloring evidently fades and becomes somewhat paler in old specimens, but it is likely that these could always be distinguished from specimens that had originally been green. Three other specimens of this brown form subsequently turned up. There is a female in the CNC taken at Waycross, Ga., March 22, 1952, by G. S. Walley, and on March 29, 1967, I collected another male and female at light near the bank of the South Santee River, Charleston Co., S.C., in an area where the biota is very similar to that of northern Fla. The South Carolina examples are not quite as dark as most of the others and show a slight tinge of green, suggesting that there may be a blend zone between the green and brown forms. The genitalia of the brown form hardly differ from those of normal *pistasciaria*, but the former may prove to be a distinctive subspecies of the extreme southeast. As mentioned previously, the type of *insecutata* Walker, probably from St. Johns Bluff, Fla., apparently represents this form, and provides a name if one is required. I am deterred from formally treating *insecutata* as a species or subspecies because of inadequate material and also because of the knowledge of other similarly distinctive brown forms among the North American Geometrinae (e.g., in *Nemoria bistriaria*, *bifilata*, and *pulcherrima*, and *Chlorochlamys appellaria*).

FLIGHT PERIOD. N.S., June 5–July 11; Ont. and Que., May 22–June 11; Man., June 9–July 4; New England States, May 21–June 28; N.Y., May 28–June 15; Mich., May 28–June 19; Wis., June 3–24; Minn., June 7 (one record); N.J. to Va., May 6–June 30, except for one record from Mountain Lake, Va., for July 8; N.C., Apr. 10–June 24; Mo., May 4 (one record); S.C., Ga., Ala., Fla., Mar. 11–31. Apparently only one generation everywhere.

EARLY STAGES. The egg and larva were described by Dyar (1899b, p. 386), who reared them on a species of oak that he identified as *Quercus coccinea*. His material came from Brookhaven, Long Island, N.Y. In the CNC there are four adults also reared on oak, in 1959, presumably from Ont., although the locality is not on the label, and one female reared from white birch near Parry Sound, Ont., in 1948. Prentice (1963, p. 308), in giving host plant records from the Canadian Forest Insect Survey, lists white birch, yellow birch, ironwood and basswood. I reared *pistasciaria* through two generations from eggs laid by a female collected at Aylesford, Kings Co., N.S., on June 20, 1963. These were fed on *Vaccinium* (blueberry) and seemed to do so well that I suspect it is a favored food plant, at least in that region. In form and coloring, the larvae bore a striking resemblance to the branches of the blueberry, their pointed heads simulating the terminal buds and leaf scars of the twigs. The following is a description of the last instar based on my larvae, and seems to agree with Hulst's description except for some minor differences in coloring.

Body long (24 mm.), straight, rather slender, tapering slightly from the posterior abdominal segments to the thorax; integument densely granular, the granules of the dorsal area exaggerated and arranged as about six somewhat irregular longitudinal ridges, brownish in color; ventral granules also arranged in longitudinal rows but

smaller and more concolorous with body; the head, also finely rough-textured and bearing short setae, deeply cleft at the top into two conical points that exceed the adjoining thorax by a distance equal to almost half the total height of the head; prothoracic segment with a matching but smaller pair of pointed dorsal processes; supranal plate produced posteriorly, bluntly conical; color green to yellowish brown, greenest beneath, brownish above; three last abdominal segments and prolegs quite brown; intersegmental folds of integument appearing as paler rings; head brown, thoracic legs and prothoracic processes tipped with brown. Thoracic legs usually held tightly together beneath head. Thoracic and abdominal setae small and inconspicuous, although anus is surrounded by four setiferous tubercles bearing longer setae, the lateral pair of tubercles being larger than the dorsoventral pair. Proleg crochets arranged in separate anterior and posterior groups of five strong hooks, each group consisting of an outer row of three long hooks, and two short inner hooks.

REMARKS. Unlike *Mesothea*, *Hethemia pistasciaria* is definitely nocturnal and comes to light. In its favored habitats of low heath vegetation, such as the bogs in eastern Canada and northern New England, it is readily flushed in the daytime, and I have collected many specimens in that way. In N.S. it occurs most commonly in exactly the same bog and heath habitats as *Mesothea*, but beginning almost a month later. *Hethemia* seems less restricted to this kind of environment, however, and may appear at light in almost any kind of woodland in that region. Whether it is limited to acid soil areas elsewhere I do not know.

MESOTHEA Warren

Mesothea Warren, 1901, p. 446.

TYPE SPECIES: *Nemoria incertata* Walker, 1862 = *Mesothea incertata* (Walker), designated by Warren, 1901, p. 446.

ADULT CHARACTERS. Small moths, forewing length 9-12 mm; females generally about the same size as males; wings quite rounded, hindwing only sometimes very slightly angulate; wings opaque, scaling dense, many of the scales near base of forewing narrow, linear; color bright sage green, discoloring to buff, unstriated; lines pale, weak, convex, even or only slightly irregular; costa of forewing with a brown margin; no discal spots; no terminal line; fringes unmarked, concolorous with wings or tipped with whitish; abdomen green, unmarked; front, palpi and interantennal fillet green and hairy, the latter actually whitish but mostly concealed beneath a covering of long hair-like green scales; thorax also quite hairy, above and below, this general hairiness being a unique character, as far as known.

In the forewing, veins R_1 and R_2 fused for part of their length, Sc and R_1 either separate or fused for a short distance; $R_{2-5} + M_1$ with a long stalk; M_3 and Cu_1 of the forewing diverging before the end of the cell; third anal well developed. In the hindwing, Sc and R touching only, not actually fused; $R + M_1$ with a much longer stalk than $M_3 + Cu_1$. Frenulum of male fully developed but rather small, of female wanting.

The male antennae are peculiar and could either be described as heavily serrate, with pubescent teeth, or as bipectinate with short, stubby, ciliate or pubescent branches, no longer than the width of the shaft. Male antennae tapering gradually, becoming simple at the tips; antennal shaft rather stout; female antennae much more slender, simple or feebly dentate; palpi of both sexes short, not exceeding the densely clothed, rather protruding front; eyes very small, those of the male about two-thirds as wide as front, of the female hardly half as wide as front; front very wide with sides nearly parallel, almost square in male, wider than high in female; tongue well developed; hind tibia of male hardly dilated, not prismatic but somewhat compressed towards the end,

no terminal extension, only the apical spurs present, apparently without a hair pencil; hind tibia of female undilated, only the apical spurs present; hind tarsus almost as long as adjoining tibia in male, about three-quarters as long in female.

The male genitalia show an obviously close relationship to *Chlorissa* (i.e., the genotype *viridata*), and if it were not for other distinctive characters I would regard them congeneric. Socii rigid and tapering, resembling uncus in shape and size as in *Chlorissa*; gnathos weakly sclerotized, divided into two arms with the ends free or nearly so; transtilla also divided into two parts; juxta small, crescentic, without a process; vinculum strong; saccus rather extended, tapering; valve with a well differentiated, sclerotized costal region consisting of a small basal process and a large costal sclerite extending from the base to the middle of the costa, where it terminates in a rounded, partially free end, these features evidently homologous with similar structures in *Chlorissa*; coremata vestigial; aedeagus elongate, simple, normal for the tribe; posterior margin of eighth sternite with a heavily chitinized, pointed spine as in *Chlorissa*, smooth or serrate. The male genitalia, as well as the integument of the whole body in both sexes, are strongly pigmented with dark brown to an unusual degree. Elsewhere I have seen this character only in *Chlorissa viridata* and *Nemoria pulcherrima*, but in these it is not as extreme as in *Mesothea*.

Female genitalia basically characteristic of the tribe and less modified than those of the male. Genital plate partially sclerotized, with a rigid semicircular preostial pouch, and sometimes with rudiments of the two setose papillae found on the postostial plate of *Hethemia*, *Chlorissa* and other allied genera; bursa copulatrix normal, only moderately elongated to one and one-third times the length of the posterior apophyses, not extremely long as in *Chlorissa*.

LARVAL CHARACTERS. The larva is slender, twig-like, quite smooth, with the head bifid, and very closely resembles that of *Hethemia*.

DISTRIBUTION. Hudsonian and Canadian Zones in North America, from Nfld. to Alaska, southward to Mass. and N.Y. in the east and to Colo. and northern Calif. in the west. Only the one species is known, occurring as two subspecies that differ mainly in size.

REMARKS. *Mesothea* is of particular interest because it represents the only species of the subfamily in North America with an exclusively boreal distribution, occurring closer to the Arctic than any other geometrine, and not south of about Latitude 41° except at high elevations in the mountains. Presumably in correlation with its boreal habitat, it is impressively modified in several ways, as in the hairy vestiture of head and thorax, the small eyes, and diurnal habits. Other unusual features include the dark pigmented integument and almost undilated male hind tibia, apparently without a hair pencil.

Considering the wide coast to coast boreal distribution of *Mesothea*, it is surprising that it is not holarctic, but apparently the closest relatives are Palearctic species of *Chlorissa*.

Mesothea incertata incertata (Walker)

Plate 29, figures 4, 4a, 4b; plate 41, figure 5; plate 49, figures 31-34.

Nemoria incertata Walker, 1862, p. 1557, Hulst, 1895, p. 71.

Nemoria subcroceata incertata Hulst, in Smith, 1891, p. 67.

Eucrostis incertata Hulst, 1896, p. 313. Dyar, 1902 [1903], p. 300. Hulst, in Smith, 1903, p. 72. Holland, 1903, p. 336, pl. 43, fig. 18.

Chlorochroma incertata Gumpfenberg, 1895, p. 495.

Mesothea incertata Warren, 1901, p. 446. Prout, 1912, p. 176. Barnes and McDunnough, 1917a, p. 100. Prout, 1933, p. 61. McDunnough, 1938, p. 141. Jones and Kimball, 1943, p. 108. Forbes, 1948, p. 116. Ferguson, 1954, p. 290. Prentice, 1963, p. 308.

Nemorina oporaria Zeller, 1872, p. 481. Hulst, in Smith, 1891, p. 67. Hulst, 1895, p. 71 (as synonym of *incertata*).

Nemorina gratata Hulst, 1895, p. 71, as synonym of *incertata* (nec *gratata* Packard, 1876).

DIAGNOSIS. *Mesothea incertata* is a small, dull, sage green species of the Canadian and Hudsonian zones across the continent, with the larger subspecies *viridipennata* in the Rocky Mts. and north Pacific coastal region. It is the only American geometrine with an exclusively northern distribution and the only species that reaches as far north as Labrador and the Yukon Territory. *Incertata* flies early in the season, appearing in May through most of its range and in June in the far north. It is at least semi-diurnal and is most often found flying on bogs or blueberry barrens where it has been assumed that the larval food would be *Vaccinium*. However, the few that have been reared were found feeding on other plants. Freshly emerged moths are always sage green but flown ones commonly fade to dull olive, pale brownish, or yellowish. Very old ones become bleached almost to off white. Improper relaxing of fresh specimens produces similar discoloration.

In collections, *incertata* and *Hethemia pistasciaria* have often been confused, but even the most dilapidated specimens may at once be recognized by the following structural differences: *incertata* has small eyes, decidedly narrower than the frontal space between them, whereas in *pistasciaria* the eye and front are subequal in width; the male of *incertata* has heavily serrate antennae, that of *pistasciaria* simple antennae; the female of *incertata* has one pair of hind tibial spurs, the female of *pistasciaria* two pairs of spurs. In color, the males of *incertata* are green beneath but those of *pistasciaria* are usually deep yellow on the underside. *Pistasciaria* has in both sexes a whitish interantennal fillet and brown front; in *incertata* these are green and concolorous with body and wings. Also, *incertata* has hairy vestiture on head and thorax, unlike any other geometrine species examined.

TYPES: *Incertata* was described from five specimens from St. Martin's Falls, Albany River, Hudson Bay, Ont. (Barnston). Of these, a female, photographed for me by Mr. J. D. Bradley, is hereby designated as the lectotype. It is in the BM and although the wings are somewhat torn and discolored to yellowish, the body and antennae are intact.

Oporaria was from "Die nördlichen Staaten Nordamerika's. 2 males durch Dr. Packard in meiner Sammlung." Since Lord Walsingham bought the Zeller collection, these are now in the BM, and have been examined for me by Mr. D. S. Fletcher. One of these, labeled with the word "Type," presumably by Zeller, I hereby designate as the lectotype.

SYNONYMY. The identity of *oporaria* Zeller has been verified by Mr. Fletcher, who reports (*in litt.*) that both types have the serrate antennae and small eyes of *Mesothea incertata*. *Gratata* Packard has been listed in the synonymy of *incertata* by all authors since Hulst (1895), but several points in Packard's description make it clear that what he really had was *Hethemia pistasciaria*. I have not been able to find the types and Packard may have had the two species mixed, but his description undoubtedly refers to *pistasciaria*.

FURTHER DESCRIPTION. Male antennae heavily serrate, almost pectinate, tapering gradually toward the tips, the teeth ciliate at the ends; female antennae simple, very slender, not ciliate beneath; male palpi short, hardly exceeding front, clothed with hair-like scales; female palpi similar but more slender; hind tibia of male only slightly longer than tarsus, slightly dilated distally but with no apical process, with one pair of spurs; female hind tibia similar, a little longer but undilated; vestiture of head and thorax hairy.

Scales of antennal shaft brown, sometimes with a few white scales mixed in, especially near base; interantennal fillet green and undifferentiated, or sometimes

marked by a few white scales largely covered by green ones, but never solidly pale and sharply defined as in *Hethemia*; head behind fillet concolorous with thorax; front densely and evenly covered with hairy scales, greenish or dull gray-brown; palpi pale near the base, becoming concolorous with front apically; legs gray green to whitish, with or without a tinge of pinkish brown on the fore tibiae; underside of body whitish; faintly tinted with luteous or greenish gray; upperside of thorax and abdomen green, concolorous with wings, anal tufting slightly paler.

Upperside of wings deep sage green when fresh, readily fading to a more olivaceous hue and ultimately to pale whitish brown (as discussed under Diagnosis); fore- and hindwings colored alike; antemedial of forewing very weak or missing; if present, quite evenly convex; antemedial of hindwing obsolete; postmedials of both wings weak but usually visible, thin, whitish, regular or slightly waved, subparallel to outer margins, on forewing usually disappearing just before costa; discal spots wanting or faintly indicated as dots of darker green; costa of forewing with a variable brown margin that may be well defined or obscure; fringes green, basal half concolorous with wings, outer half paler, especially on hindwing. Underside as above but without lines, coloring paler and a little more bluish, brown costal border of forewing sometimes wider.

Length of forewing: males, 9-10 mm; females, 9-10.5 mm.

MALE GENITALIA. One of the conspicuous features of the genitalia in *Mesothea* is the dark brown coloration of certain sclerotized parts; namely the tegumen, saccus, vinculum, and parts of the valve, although not the heavy costal sclerite. The ventral and dorsal plates and basal sclerites of the abdomen are also darkly colored, but not the pointed process of the eighth sternite. Structural details have been described in the discussion of the genus. The process of the eighth sternite is quite variable but most commonly acuminate and pointed.

FEMALE GENITALIA. The female also shows the dark brown coloring in the abdominal plates and apophyses, but not in the genitalia proper. The rather elaborate rigid structure associated with the ostium is not darkly colored. The ductus bursae and bursa copulatrix are both rather short, the latter elongate, membranous, plicated in the posterior third, and without a signum.

MATERIAL EXAMINED. 185 males, 80 females; 5 male, 1 female slides; 2 larvae in alcohol.

DISTRIBUTION. NEWFOUNDLAND: St. John's, Cape Broyle and Holyrood, S.E. Nfld; Table Mountain, W. Nfld; Grand Bruit, Cinq Cerf River, Burgeo, Grandy Brook, and Port Aux Basques, S. Nfld. (the foregoing not examined but based on Krogerus, 1954, p. 61); Doyles Station [Codroy Valley]; Table Mountain Plateau, near Cape Ray, 1700'; Cartwright, Labrador. NOVA SCOTIA: near Cap Rouge, Inverness Co.; Three Brooks, Pictou Co.; Springhill, Cumberland Co.; Mount Uniacke, Hants Co.; Wolfville, Coldbrook and Aylesford, Kings Co.; Waverley, Fall River, Armdale, Purcell's Cove, Halifax Watershed Area, Sackville, MacNab's Island and West Dover, Halifax Co.; Digby Co. QUEBEC: Aylmer; Perkins' Mills; St. Hilaire; Lanoraie; Rawdon; Le Gite, Laurentides Park. ONTARIO: Ottawa; Mer Bleue; "S. March"; Toronto; Geraldton. MANITOBA: Red Rock Lake, Whiteshell Provincial Park; Winnipeg; Riding Mountain National Park; Aweme; Miniota; McCreary; Kelwood. SASKATCHEWAN: Oxbow. ALBERTA: Edmonton; Sunnydale, Lloydminster. NORTHWEST TERRITORIES: Norman Wells; Fort McPherson. YUKON TERRITORY: Rampart House. ALASKA: Big Delta; College, near Fairbanks; Badger Road, 4 mi. N. of North Pole; Mile 32, Steese Highway, N.E. of Fairbanks; Moose Pass, Kenai Peninsula. MAINE: Bangor; Orono; Enfield; Lincoln; Passadumkeag Bog; Sebec Lake; Wilson's Mills; Bar Harbor; Southwest Harbor, Mt. Desert Island. NEW HAMPSHIRE: Franconia; Surprise Mountain, North Conway. VERMONT: West Sandgate, Bennington Co. CONNECTICUT: "Conn." (no data, one female in AMNH). MASSACHUSETTS: Bedford; Framingham; East Wareham; Princeton; Nantucket. NEW YORK: Albany; Colonie, Albany Co.; Big Indian Valley, Catskill Mountains; West Farms, New York

City; Centre; Connecticut Hill, Trumbull Corner; Oswego; McLean Bogs Reserve, Tompkins Co.; Clayton, Jefferson Co. MICHIGAN: Bog near Manistique, Schoolcraft Co.; Cecil Bay; Lakeville; Midland Co.; Crawford Co.; Mackinac Co.; Delta Co.; Charlevoix Co.; Oscoda Co. WISCONSIN: Cranmoor, Wood Co. ILLINOIS: N.E. Lake Co.

GEOGRAPHICAL VARIATION. No variation is especially apparent. The trend toward the larger size of subspecies *viridipennata* begins near the eastern edge of the Canadian Rockies. Specimens from Calgary are intermediate to large, and are referred to the subspecies. Most examples available from the far north are discolored, presumably from relaxation. Their size is normal and there is no reason to think that their original color was not normal. Some Alaskan specimens are green and Newfoundland specimens also seem to be the same as those from the mainland.

FLIGHT PERIOD. In the northeastern United States and southern Canada generally, May 8 to June 18; in Maine, May 16 to June 16; on the Mainland of N.S., May 9 to June 13, but a single specimen that I took near Cap Rouge, Cape Breton Is. on June 18, 1953, is fresh; on the island of Nfld., May 26 to July 8; in Labr., June 29, 30, July 7; in the Yukon and N.W.T., June 2 to 27; in Alaska, May 24 to June 9.

EARLY STAGES. The four recorded food plants are *Salix*, *Fragaria*, *Comptonia*, and *Betula populifolia*. Prentice (1963, p. 308) reported willow and wire birch [*B. populifolia*]. In the CNC there are six adults reared by McDunnough from Strawberry at Aylmer, Que., and one reared by the Canadian Forest Insect Survey on willow in Man. Dr. W. C. McGuffin of the Canada Department of Forestry kindly loaned me two preserved larvae obtained from willow at Laniel, Que. In N.S. I reared adults from larvae found on willow near Pictou, and on *Comptonia* at Wolfville.

The preserved larvae are completely discolored but were probably originally green. It seems unlikely that the larva differs to any extent from that of subspecies *viridipennata*, which is better known. As mentioned in the generic description, the larva of *Mesothea* is hardly distinguishable structurally from that of *Hethemia pistasciaria*.

REMARKS. *Incertata* occurs most commonly in quite characteristic habitats that do not always correlate well with the habitats of the known food plants. This suggests that there are other hosts. In N.S., where I lived and collected for many years, *incertata* is a characteristic species of sphagnum bogs, heaths and blueberry barrens, and I have seen it commonly in bogs where none of the recorded hosts were growing, at least not in the immediate vicinity. I guessed that the common host plant would prove to be *Vaccinium*, but this has never been verified. *Hethemia pistasciaria* from the same habitats is easily reared on *Vaccinium*. *Incertata* is usually flushed from the low heathy vegetation in the daytime and I do not remember ever seeing one come to light. Like so many moths of the bog and heath environment, it seems to have assumed a semi-diurnal or perhaps crepuscular habit, and is the only known nearctic species of the subfamily to have done so.

Krogerus (1954, p. 62) says that *incertata* is "One of the commonest moths in Newfoundland in June. It occurred very frequently in tundra-like habitats; near St. John's on the summits of the hills, in all the higher mountains visited in the Avalon Peninsula, and on the coastal tundra along the south coast. The last, very worn specimens were seen in the first days of July. . . ." This species and *Synchlora liquoraria albolineata* seem to be the only Geometrinae present in Nfld., but the latter species is strictly nocturnal.

Mesothea incertata viridipennata (Hulst), new status

Plate 5, figure 6; plate 29, figures 3, 3a, 3b; plate 41, figure 6; plate 49, figures 35, 36.

- Eucrostis viridipennata* Hulst, 1896, p. 314. Dyar, 1901a, p. 287 (life history); Dyar, 1902 [1903], p. 300; Hulst, in Smith, 1903, p. 72; Barnes and McDunnough, 1912, pl. 23, fig. 9.
- Mesothea viridipennata* Prout, 1912, p. 176. Barnes and McDunnough, 1917a, p. 100; Prout, 1933, p. 61. McDunnough, 1938, p. 141. Prentice, 1963, p. 309. Hardy, 1965 [1966], p. 19 (early stages).
- Thamnonoma marinaria* Strecker, 1899, p. 9.
- Cymatophora marinaria* Hulst, in Smith, 1903, p. 74; Dyar, 1902 [1903], p. 314.

DIAGNOSIS. This is a western subspecies much larger than eastern *incertata* but otherwise similar. It occurs in the Rocky Mt. region from Alta. to Colo., and westward to the Pacific coast.

TYPES. In describing *viridipennata*, Hulst gave no indication of the number of specimens that he had, but since both sexes were mentioned he must have had more than one. Ordinarily one would be inclined to choose as lectotype the specimen from the Hulst collection in the AMNH, but this is a badly discolored specimen (female), without an abdomen. In the USNM there are a male and female labeled "Type," and these are in somewhat better condition, although the male has lost its antennae. The female is labeled Golden, Colorado, May 15, 1897, D. Bruce, Type No. 34190, but this date is eight months after the original description was published. However, I believe that the other specimen in the USNM, labeled "Type male," "Col.," "Type No. 3894" is one of Hulst's original specimens and designate it as the lectotype.

Marinaria was based on one completely faded, grayish yellow specimen, sex not stated, from Seattle, Wash. I have not seen the type, which presumably is in the Chicago Natural History Museum, nor have I determined who was responsible for identifying it as *viridipennata* (between 1912 and 1917). The description is extremely brief, but there is no reason to doubt that the name belongs here.

SYNONYMY. *Marinaria* Strecker, discussed above, is the only synonym.

FURTHER DESCRIPTION. *Viridipennata* differs from the nominate subspecies in little other than its larger size. The shade of green is perhaps a little bluer and the lines less distinct. The lines are often obsolete or nearly so.

Length of forewing: males, 10-12 mm; females, 10-12 mm.

MALE GENITALIA. These are quite variable in the shape of the saccus, the length of the costal sclerite, the form of the juxta and basal costal process, and in other minor characters in both *incertata* and *viridipennata*, and there seem to be no consistent differences. The pointed process of the eighth sternite is also variable, and in one example from Stimson Creek, Mason Co.; Wash., it is heavily serrate on the sides.

FEMALE GENITALIA. Similar to those of *incertata*.

MATERIAL EXAMINED. 75 males, 30 females, including types. Slides: 5 male, 1 female. Larvae: 1 inflated, 10 in alcohol.

DISTRIBUTION. ALBERTA: Calgary; Banff; Jasper National Park; Waterton Lakes National Park. BRITISH COLUMBIA: Robson; Trinity Valley; Bon Accord; Vancouver; Royal Oak; Victoria; Wellington; Duncans. MONTANA: Coeur d'Alene Mountains, 3500'. IDAHO: Priest River; near Clark Fork. WASHINGTON: Brewster, 900', Okanagan Co.; Bellingham; Chehalis; Pullman; Easton; Garfield; Stimson Creek, Mason Co.; Seattle. OREGON: Baker; Reed. WYOMING: Jenny Lake. COLORADO: Rock Creek, El Paso Co., 8500'-8700' and 9100'; Boulder Canyon, Boulder; Gothic, Gunnison Co.; Coal Creek, Jefferson Co.; Chimney Gulch, Golden; Wind River, Rocky Mountain National Park; West

Fork Camp, 7800', 20 mi. N.W. of Dolores, Dolores Co. UTAH; PROVO, CALIFORNIA: Dunsmuir, Bartle, Mt. Shasta, Harris Springs and Soda Springs, all in Siskiyou Co.; Truckee, Nevada Co. Wright (1920, p. 484) reported it from Arizona, but I checked his specimens and found them to be *Xerochlora viridipallens*.

GEOGRAPHICAL VARIATION. Throughout the range given here there is little variation. The transition from the eastern form to subspecies *viridipennata* seems to occur rather abruptly in the Rocky Mt. foothills of Alta., and the only material available that provides any evidence of a blend zone is that from the neighborhood of Calgary. A few specimens from this locality are small like eastern *incertata*, but most are decidedly larger. As far as one can ascertain from scanty material, *incertata* from eastern Alta. (Lloydminster), and from the N.W.T. through the Y.T. to Alaska still resembles the eastern population.

FLIGHT PERIOD. In the northwest, mostly Apr. 22 to June 11, but individual records as early as Apr. 3 at Victoria, B.C., and Apr. 17 at Stimson Creek, Wash.; in Colo., May 15 to July 2. The single Utah record, June 25, seems late, but may have been taken at a high elevation. The record for Harris Springs, Calif., is an E. C. Johnston specimen (CNC) labeled July 16, 1936, the latest date recorded and possibly an error.

EARLY STAGES. Dyar (1901a) described the egg and the different larval instars, based on material reared from a female taken at Boulder, Colo., June 4. Since the coloring is very much faded in the preserved larvae available to me, I quote Dyar's description of the last instar, based on living material: "Head granular, the high, erect, pointed lobes projecting as far as half the height of the head; whitish green on face, lobes and sides brown shaded, with a few blackish dots; width 1.4 mm. Body slender, green, angular at the joints when bent, the cones on joint 2 smaller and slenderer than the head lobes, but resembling them, brown shaded. Dorsum slightly yellowish between the obscure, slightly raised subdorsal lines of granules with a red-brown diffuse dorsal line. Anal plate produced into a cone behind, brownish at the sides. Thoracic feet brownish, appressed and touching the head at rest, the whole looking like one piece. A faint, pale, stigmatal shade. A dark red-brown mark subventrally on joints 12-13. Abdominal feet brownish shaded. Surface all finely pale granular. Spiracles reddish; no perceptible tubercles." I have checked this description against specimens from Alta. in alcohol and Dyar's inflated larva (USNM) and find that it agrees exactly as far as one can tell, except that I would describe the "red-brown mark" as being sublateral and on abdominal segments 7-9, ending above the first pair of legs. It is not apparent in alcoholic specimens but shows clearly in the inflated one.

Dyar stated that his larvae ate wild cherry, gooseberry and cottonwood, but refused several herbaceous plants. Ten larvae loaned to me by Dr. W. C. McGuffin of the Canada Department of Forestry, were all found on *Ribes* near Kananaskis, Alta. Prentice (1963, p. 309) reports as host plants buffalo berry [*Shepherdia*], alder, willow, and white birch, but a few of his records from eastern Alta. fall within the range of the nominate subspecies and may refer to it rather than to what I am calling *viridipennata*. Hardy (1965 [1966]) described the early stages based on material from southern Vancouver Is., and reported *Amelanchier florida* and *Geum macrophyllum* as food plants.

8. LIST OF THE GENERA AND SPECIES OF GEOMETRINAE
OF THE UNITED STATES AND CANADA WITH
THEIR KNOWN DISTRIBUTION

(Subspecies preceded by lower case letters; synonymic names in italics)

Tribe NEMORIINI

CHLOROSEA Pack.

- | | |
|----------------------------|--|
| 1. nevadaria Pack. | Rocky Mt. region from B.C. to Ariz. and N. M. |
| <i>proutaria</i> Pears. | |
| 2. banksaria Sperry | Pacific coast region from B.C. to cent. Calif. |
| a. <i>gracearia</i> Sperry | S. Calif. |
| 3. margaretaria Sperry | Sierra Nevada Mts., Calif., Utah. |
| 4. roseitacta Prout | Utah, Ariz., N. M., s. Colo. |

NEMORIA Hbn.

I. The unitaria group.

- | | |
|-------------------------------|---|
| 5. pulcherrima (B. & McD.) | Calif. |
| <i>naidaria</i> (Swett) | |
| 6. mutaticolor Prout | Ariz., Mexico (Nayarit) |
| 7. unitaria (Pack.) | Rocky Mt. region from Canada to Ariz. and N. M. |
| <i>junctolinearia</i> (Graef) | |
| <i>hudsonaria</i> (Tayl.) | |
| <i>unilinearia</i> (Tayl.) | |

II. The arizonaria group.

- | | |
|--------------------------|--------------|
| 8. latirosaria (Pears.) | Utah, Ariz. |
| 9. aemularia B. & McD. | Ariz., N. M. |
| 10. arizonaria (Grt.) | Ariz. |
| <i>olivearia</i> Cassino | |
| 11. daedalea Ferguson | Ariz. |
| 12. viridicaria (Hlst.) | Colo., Utah |
| 13. subsequens Ferguson | N. M. |
| 14. diamesa Ferguson | Ariz., N. M. |
| 15. albaria (Grt.) | Ariz. |

III. The pistacearia group.

- | | |
|----------------------------|-----------------------------|
| 16. pistacearia (Pack.) | Coastal Calif., Baja Calif. |
| <i>unistrigata</i> (Gump.) | |

IV. The extremaria group.

17. *extremaria* (Wlk.) Fla., Miss.
 18. *elfa* Ferguson Fla., S. C., N. C., Texas
 19. *tuscarora* Ferguson Va., W. Va., N. C.
 20. *catachloa* (Hlst.) Fla.
 21. *outina* Ferguson Fla.

V. The lixaria group.

22. *lixaria* (Gn.) S.e. from N. C. to Fla., w. to Ark. and Texas
 inclusaria (Wlk.)
 texana (Hlst.)
 associaria (B. & McD.)
 knobelaria (Cassino)
 23. *saturiba* Ferguson N. C., S. C., Ga., Fla., Ala., Miss.

VI. The obliqua group.

24. *darwiniata* (Dyar) W. North Amer. from B. C. to San Francisco Bay, e. to Rocky Mts.
 oregonensis Cassino
 mentastii Guedet
 a. *punctularia* B. & McD. S. Calif., Ariz.
 californica Prout
 25. *zelotes* Ferguson Ariz., N. M.
 26. *obliqua* (Hlst.) Colo., N. M., Ariz.
 bellonaria (Streck.)
 a. *hennei* Sperry Calif., Nev.

VII. The splendidaria group.

27. *splendidaria* (Grossb.) Ariz. (Cochise Co.), Mexico (Chihuahua, Durango)
 28. *strigataria* (Grossb.) Ariz., N. M.

VIII. The bistriaria group.

29. *zygotaria* (Hlst.) Texas
 30. *leptalea* Ferguson Pacific coast region from San Francisco Bay to Baja Calif.
 delicataria (Dyar), Homonym
 31. *caerulescens* Prout Texas, N. M., Ariz.
 32. *intensaria* (Pears.) N. M., Ariz., Utah, Nev., Calif.
 33. *festaria* (Hlst.) Ariz., N. M.
 34. *albilineata* Cassino W. Texas
 35. *bifilata* (Wlk.) E. U. S. from N. J. to Fla.
 a. *planuscula* Ferguson Texas
 36. *bistriaria* Hbn. Southeastern; from N. J. to n. Fla., w. to Mo. and e. Texas
 rubrolinearia (Pack.)
 brunnearia (Pack.)
 bifilata (Wlk.)
 a. *rubromarginaria* (Pack.) Northeastern; extreme s. Que. and Ont. to Conn.
 37. *rubrifrontaria* (Pack.) Eastern: Nova Scotia to N. C., w. to Kans. and S. D.
 packardaria (Grt.)
 38. *mimosaria* (Gn.) Nova Scotia to Sask., s. to Ill. and Va.
 tractaria (Wlk.)
 venustus (Walsh)
 latiaria (Pack.)
 coniferaria (Pack.)
 39. *glaucomarginaria* (B. & McD.) Wash., Ore., Calif.
 40. *rindgei* Ferguson N. M.

PHRUDOCENTRA Warren

41. centrifugaria (H.-S.) S. Fla., Antilles
protractaria (H.-S.)
hollandaria (Hlst.)
jaspidiaria (Hlst.)
viridipurpurea (Hlst.)
anomalaria (Mösch.)
heterospila (Hamp.)
- 42a. *neis affinis* (Warren) Neotropical; one record from Hidalgo Co., Texas

DICHORDA Warren

43. *iridaria* (Gn.) E. North Amer.
remotaria (Wlk.)
 a. *latipennis* (Hlst.) Fla. to s. S. C.
44. *consequaria* (Hy. Edw.) S. Ariz., Mexico, Central Amer.
perpendicularata Warren Calif., Baja Calif.
45. *illustraria* (Hlst.) W. U. S. from Texas and Ariz. to Mont.
 46. *rectaria* (Grt.) and N. D.
 a. *cockerelli* Sperry S.e. Calif.

Tribe DICHORDOPHORINI

DICHORDOPHORA Prout

47. *phoenix* (Prout) Texas, Ariz., Calif., Colo., Nev., Wash.

Tribe SYNCHLORINI

SYNCHLORA Gn.

48. *liquoraria* Gn. W. North Amer.; B. C. and Alta. to s. Calif. and Ariz.
tricoloraria (Pack.) Canadian zone from Nfld. and Me. to cent. Alta.
 a. *albolineata* Pack. E. U. S.
49. *aerata* (Fabr.)
glaucaria (Gn.)
mimicata (Wlk.)
rubivora (Riley)
rubivoraria Pack.
rubrifrontaria Pack.
rufofrontaria Gump.
gracilaria (Pack.)
- 50a. *frondaria avidaria* Pears. W. Texas, Ariz., s. Calif.
 b. *frondaria denticularia* (Wlk.) Southeastern; N. C. and Ark. to Fla. and Texas
excurvaria Pack. Fla., Neotropics
51. *gerularia* (Hbn.)
ocellata (Stoll). Homonym
stollaria (Gn.)
marginiplaga (Wlk.)
rufidorsaria (Snellen)
jucunda (Felder)
xysteraria (Hlst.)

- 52a. *herbaria hultiana* Dyar
 53. *irregularia* (B. & McD.)
 54. *noel* (Sperry)
 55. *cupedinaria* (Grt.)
 louisa Hlst.
- CHETEOSCELIS Prout
56. *bistriaria* (Pack.)
 undinaria (Strecker)
 clarkei Sperry
 57. *pectinaria* (Grossb.)
- MEROCHLORA Prout
58. *faseolaria* (Gn.)
 perviridaria (Pack.)
 59. *graefiaria* (Hlst.)
 eutraphes Prout

Tribe LOPHOCHORISTINI

- LOPHOCHORISTA Warren
60. *lesteraria* (Grossb.)
- EUEANA Prout
61. *niveociliaria* (H.-S.)
 saltusaria (Hlst.)

Tribe HEMITHEINI

- CHLOROCHLAMYS Hlst.
62. *chloroleucaria* (Gn.)
 indiscriminata (Wlk.)
 densaria (Wlk.)
 deprivata (Wlk.)
 desolataria (H.-S.)
 rectilinea (Zell.)
 flavilineata (Riley)
 63. *triangularis* Prout
 64. *appellaria* Pears.
 rubromediaria C. & S.
 hesperia Sperry
 65. *phyllinaria* (Zell.)
 zelleraria (Pack.)
 vertaria Pears.
 curvifera Prout
 fletcheraria Sperry

XEROCHLORA Ferguson

66. *viridipallens* (Hlst.)
volantaria (Pears.)
 67. *masonaria* (Schaus)
hyperalla (Prout)
 68. *inveterascaria* (Swett)
 69. *martinaria* (Sperry)
 70. *mesotheides* Ferguson

Colo., w. Texas, N. M., Ariz., s.e. Calif.

Ariz. and N. M. to Costa Rica

S.e. Ariz.

S. Ariz.

N. M., w. Texas

CHLOROPTERYX Hlst.

71. *tepperaria* (Hlst.)
 72. *nordicaria* (Schaus)
 73. *paularia* (Mösch.)

Va. to Fla., w. to La.

Mexico and extreme s. Texas

S. Fla., Antilles

HETHEMIA Ferguson

74. *pistasciaria* (Gn.)
subcroceata (Wlk.)
insecutata (Wlk.)
superata (Wlk.)
gratata (Pack.)
auranticolorata (Stkr.)
dyarii (Hlst.)

E. North America from Nova Scotia and
 Ont. to Fla., w. to N. D. and Mo.

MESOTHEA Warren

75. *incertata* (Wlk.)
oporaria (Zell.)
 a. *viridipennata* (Hlst.)
marinaria (Stkr.)

Northern; Nfld. and Labrador to Alaska, s.
 in bogs and heaths to Mass., N. Y., Mich.,
 Wisc.

Rocky Mt. region from Alta. to Colo., w.
 to Pacific coast

9. ACKNOWLEDGEMENTS

The work on this revision has extended over a period of several years, during which time I have received valuable assistance in many forms from many institutions and individuals. I have been a frequent visitor at the American Museum of Natural History, New York City, which possesses the largest representation of North American Geometridae, and owe special thanks to Dr. Frederick H. Rindge of that institution for making available their facilities, and for lending specimens for dissection and photography. This great collection has contributed more information than any other. Of great importance too have been the national collections of both the United States and Canada. I have visited Washington three times and Ottawa twice during the course of the present investigation, and was kindly granted loans of much important material by both institutions. I am especially indebted to Dr. E. L. Todd and Dr. Ronald W. Hodges of the United States National Museum, to Dr. E. G. Munroe of the Entomology Research Institute, Ottawa, and to Dr. W. C. McGuffin of the Canada Department of Forestry, Ottawa.

Free access to the material in these three institutions, plus the type-rich collection of the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, meant that I was able to study the majority of the North American types of this subfamily, and thus resolve in a satisfactory way most of the synonymic problems. Nearly all of the remaining types, those of Walker, Zeller, Grote, and Prout, are at the British Museum (Natural History), and the problem of identifying these had to be approached in a different way. In this endeavor, the assistance of Mr. D. S. Fletcher of the British Museum has been indispensable. In addition to answering my queries and making slides and comparisons of types, he arranged to have many of the specimens photographed for me by Mr. J. D. Bradley. The resulting set of color transparencies has been of immense value, especially in rechecking the identifications of the Walker types.

This monograph is modified from a thesis accepted by the Graduate School of Cornell University in partial fulfillment of the requirements for the degree of Doctor of Philosophy. My indebtedness to Dr. John G. Franclemont, chairman of my Special Committee while I was a graduate student is of a multiple nature. It perhaps may be summarized best with the comment that, as an authority on the Lepidoptera, as a teacher and adviser on matters pertaining to the taxonomy, morphology, and general biology of this group, as well as a

field collector and preparator of phenomenal capabilities, he has few rivals, perhaps none. Excepting the lack of types, the elegant material in Dr. Franclemont's private collection has contributed fully as much to the present study as have either the national collections of the United States or Canada. I also received assistance in many forms from Dr. Charles L. Remington of Yale University, with whom I have been associated for five years.

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Knowledge of the early stages of the North American Geometrinae has come from many different sources, acknowledged in the text, but I would like to make a special point of mentioning the excellent descriptive papers of Dr. John Adams Comstock of Del Mar, California. His valuable and superbly illustrated work has filled a number of gaps in our knowledge of this group. Unpublished host plant data and preserved larvae were kindly made available to me by Dr. Franclemont, by one of his students, Mr. Robert W. Poole, and by Dr. W. C. McGuffin of the Canada Department of Forestry, Ottawa. I have myself reared fifteen of the species.

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INDEX OF SCIENTIFIC NAMES

Synonyms, preoccupied names and nomina nuda in *italics*; new names in **boldface** type.

- abdominaria*, Nemoria, 98
aemularia, Nemoria, 43
aerata, Synchrona, 150
affinis, Phrudocentra neis, 123
albaria, Nemoria, 53
albicostaria, Synchrona, 155
albilineata, Nemoria, 97
albolineata, Synchrona liquoraria, 148
Anaplodes, 28
Annemoria, 28
anomalaria, Phrudocentra, 121
aplagaria, Dichordophora, 137, 138
Aplodes, 28
appellaria, Chlorochlamys, 200
approximaria, *Aplodes*, 119
arizonaria, Nemoria, 45
associaria, Nemoria, 66
atripes, "*Racheospila*", 168
auranticolorata, **Hethemia**, 224
avidaria, Synchrona frondaria, 155
- banksaria*, Chlorosea, 21
bellonaria, Nemoria, 80
bifilata, Nemoria, 98
bistriaria, Cheteoscelis, 171
bistriaria, Nemoria, 103
bistrigaria, *Terpne*, 103
brunnearia, Nemoria, 103
- caerulescens*, Nemoria, 90
californica, Nemoria, 76
calliope, Lophochorista, 182, 183
catachloa, Nemoria, 62
centrifugaria, Phrudocentra, 121
Cheteoscelis, 170
Chlorissa, 222, 223, 230
Chlorochlamys, 191
chloroleucaria, Chlorochlamys, 192
Chloropteryx, 205
Chlorosea, 17
clarkei, Cheteoscelis, 171
cockerelli, Dichorda rectaria, 136
congruata, Synchrona, 162
coniferaria, Nemoria, 113
consequaria, Dichorda, 130
coruscula, Nemoria, 37, 38, 55
cosmeta, Nemoria, 66, 79
cupedinaria, Synchrona, 168
curvifera, Chlorochlamys, 203
- daedalea**, Nemoria, 46
darwiniata, Nemoria, 72
delicataria Dyar, Nemoria, 89
delicataria Moeschler, Nemoria, 89
- densaria*, Chlorochlamys, 192
denticularia, Synchrona frondaria, 157
deprivata, Chlorochlamys, 195
desolataria, Chlorochlamys, 195
diamesa, Nemoria, 51
diaphana, "*Racheospila*", 166
Dichorda, 124
Dichordophora, 137
Dichordophorini, 137
diversata, Lophochorista, 183, 184
dominicaria, Eucrostes, 5, 6, 163
dyarii, **Hethemia**, 224
- eccentrica*, Phrudocentra, 120, 123
elfa, Nemoria, 59
euchloraria, "Iodis", 224
Eueana, 185
Eunemoria, 142
eutraphes, Merochlora, 179
excurvaria, Synchrona, 157
extremaria, Nemoria, 57
- faseolaria*, Merochlora, 177
festaria, Nemoria, 94
flavilineata, Chlorochlamys, 195
fletcheraria, Chlorochlamys, 203
frondaria, Synchrona, 154
- Geometra*, 5
gerularia, Synchrona, 159
glaucaria, Synchrona, 150
glaucomarginaria, Nemoria, 116
gracearia, Chlorosea banksaria, 23
gracilaria, Synchrona, 150
graefiaria, Merochlora, 179
gratata, **Hethemia**, 224
- Hemithea*, 223
Hemitheini, 190
hennei, Nemoria obliqua, 82
herbaria, Synchrona, 162
hesperia, Chlorochlamys, 200
heterospila, Phrudocentra, 121
Hethemia, 222
Hipparchiscus, 28
hollandaria, Phrudocentra, 121
hudsonaria, Nemoria, 38
hulstiana, Synchrona herbaria, 163
hyperalla, **Xerochlora**, 219
- illustraria*, Dichorda, 131
impunctata, Phrudocentra, 119
incertata, Mesothea, 230
inclusaria, Nemoria, 65

- indecora*, *Synchlora*, 166, 167
indiscriminata, *Chlorochlamys*, 192
insecutata, **Hethemia**, 224
integra, *Nemoria*, 70
intensaria, *Nemoria*, 92
inveterascaria, **Xerochlora**, 216
iridaria, *Dichorda*, 126
irregularia, *Synchlora*, 165

jaspidiaria, *Phrudocentra*, 121
jucunda, *Synchlora*, 159
junctionealinea, *Nemoria*, 38

knobelaria, *Nemoria*, 66

latiaria, *Nemoria*, 113
latipennis, *Dichorda* *iridaria*, 128
latirosaria, *Nemoria*, 42
leptalea, *Nemoria*, 89
lesteraria, *Lophochorista*, 184
liquoraria, *Synchlora*, 144
lixaria, *Nemoria*, 65
Lophochorista, 182
Lophochoristini, 182
louisa, *Synchlora*, 168

margaretaria, *Chlorosea*, 25
marginiplaga, *Synchlora*, 159
marinaria, *Mesotheta*, 234
martinaria, **Xerochlora**, 218
masonaria, **Xerochlora**, 219
Melochlora, 119
mentastii, *Nemoria*, 72
Merochlora, 176
Mesotheta, 229
mesotheides, **Xerochlora**, 221
mimicata, *Synchlora*, 150
mimosaria, *Nemoria*, 113
minuata, *Synchlora*, 154
munda, *Chloropteryx*, 209
mutaticolor, *Nemoria*, 36

naenia, *Cheteoscelis*, 171
naidaria, *Nemoria*, 35
neis, *Phrudocentra*, 119, 120, 123
Nemoria, 28
Nemoriini, 16
Nesipola, 119
nevadaria, *Chlorosea*, 19
niveociliaria, *Eueana*, 186
noel, *Synchlora*, 166
nordicaria, *Chloropteryx*, 209

obliqua, *Nemoria*, 80
ocellata, *Synchlora*, 159
ockendeni, *Lophochorista*, 183, 184
olivearia, *Nemoria*, 45
Oospila, 138, 184
oporaria, *Mesotheta*, 231
oregonensis, *Nemoria*, 72
orthogramma, *Cheteoscelis*, 171
outina, *Nemoria*, 64

packardaria, *Nemoria*, 111
pallida, *Synchlora*, 155
papilionaria, *Geometra*, 5
paularia, *Chloropteryx*, 210
pectinaria, *Cheteoscelis*, 175
perpendicularata, *Dichorda*, 130
perviridaria, *Merochlora*, 177
phoenix, *Dichordophora*, 138
Phrudocentra, 119
phyllinaria, *Chlorochlamys*, 203
pigraria, *Tachyphyle*, 120
pistacearia, *Nemoria*, 55
pistasciaria, **Hethemia**, 224
planuscula, *Nemoria* *bifilata*, 101
protractaria, *Phrudocentra*, 121
proutaria, *Chlorosea*, 19, 25
pulcherrima, *Nemoria*, 34
punctata, *Chloropteryx*, 210
punctularia, *Nemoria* *darwiniata*, 76
pupillata, *Phrudocentra*, 119, 120, 121

Racheospila, 6, 28
rectaria, *Dichorda*, 133
rectilinea, *Chlorochlamys*, 195
remotaria, *Dichorda*, 126
rindgei, *Nemoria*, 117
roseitacta, *Chlorosea*, 26
rubivora, *Synchlora*, 150
rubivorararia, *Synchlora*, 150
rubrifrontaria, *Nemoria*, 111
rubrifrontaria, *Synchlora*, 150
rubrolinearia, *Nemoria*, 103
rubromarginaria, *Nemoria* *bistriaria*, 107
rubromediaria, *Chlorochlamys*, 200
rufidorsaria, *Synchlora*, 159
rufofrontaria, *Synchlora*, 150

saltusaria, *Eueana*, 187
saturiba, *Nemoria*, 70
sitellaria, *Synchlora*, 162
splendidaria, *Nemoria*, 83
stellataria, *Phrudocentra*, 122
stollaria, *Synchlora*, 159
strigataria, *Nemoria*, 85
subcroceata, **Hethemia**, 224
subsequens, *Nemoria*, 50
superata, **Hethemia**, 224
Synchlora, 142
Synchlorini, 141

tenuimargo, "*Racheospila*", 163
tepperaria, *Chloropteryx*, 207
texana, *Nemoria*, 65
texaria, *Nemoria*, 77
toxeres, *Nemoria*, 66, 78, 79
tractaria, *Nemoria*, 113
triangularis, *Chlorochlamys*, 198
tricoloraria, *Synchlora*, 144
tuscarora, *Nemoria*, 61

undinaria, *Cheteoscelis*, 171
unilinearia, *Nemoria*, 38
unistrigata, *Nemoria*, 55

unitaria, *Nemoria*, 38

venustus, *Nemoria*, 113

vertaria, *Chlorochlamys*, 203

viridata, *Chlorissa*, 223

viridicaria, *Nemoria*, 48

viridipallens, *Xerochlora*, 214

viridipennata, *Mesothea incertata*, 233

viridipurpurea, *Phrudocentra*, 121

volantaria, *Xerochlora*, 214

Xerochlora, 212

xysteraria, *Synchlora*, 159

zelleraria, *Chlorochlamys*, 203

zelotes, *Nemoria*, 77

zygotaria, *Nemoria*, 87

PLATES

PLATE I

VENATION

1. *Chlorosea banksaria*, ♂ . Wellington, Vancouver Is., B.C.
2. *Nemoria diamesa*, ♂ . Cedar Creek, near Ruidoso, Lincoln Co., N.M.
3. *Nemoria unitaria*, ♂ . Beulah, N.M., 8000'. Mid-costal portion of forewing enlarged to show details of venation. Note connate condition of $R_{2-5} + M_1$ at base.
4. *Nemoria unitaria*, ♂ . Mt. Washburn, 9000', Yellowstone National Park, Wyo. Mid-costal portion of forewing enlarged as above.
5. *Nemoria unitaria*, ♂ . Hill City, Black Hills, S.D. Note that $R_{2-5} + M_1$ are separated at base.

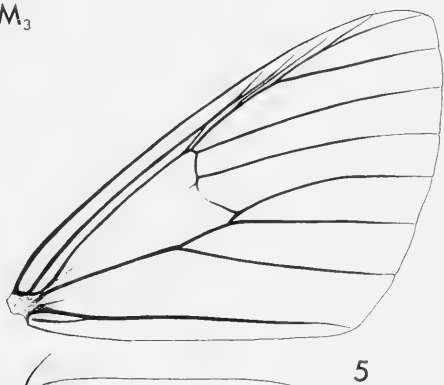
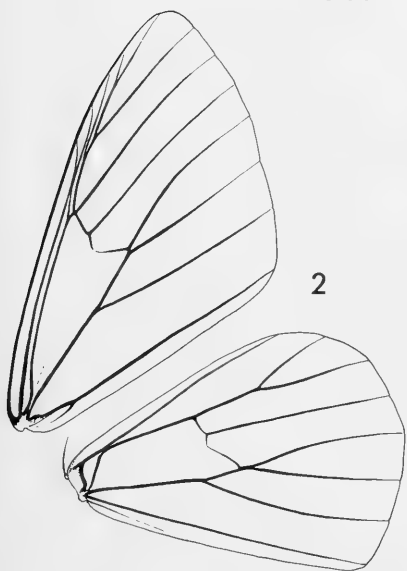
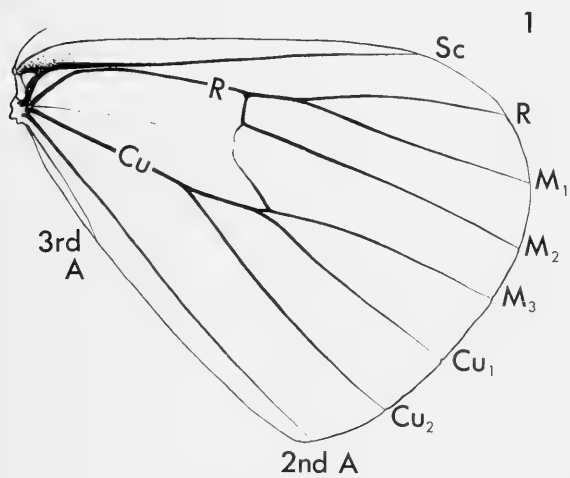
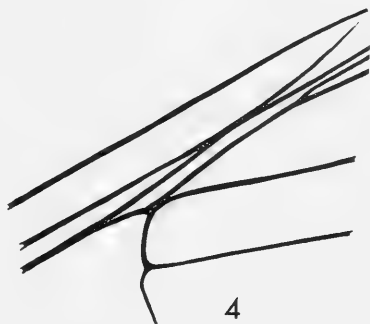
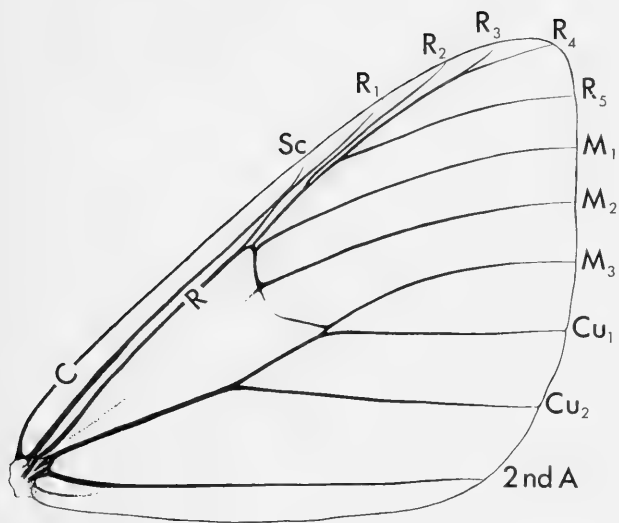


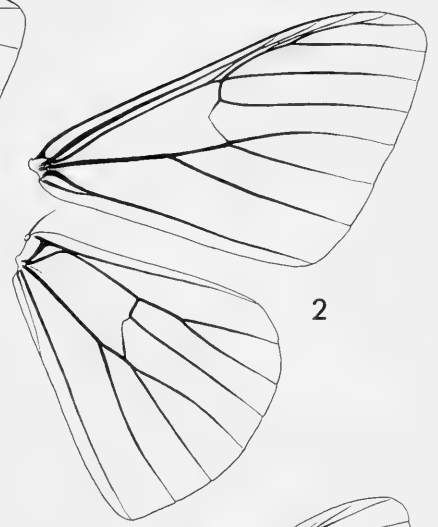
PLATE 2

VENATION

1. *Nemoria pulcherrima*, ♂ . Tujunga, Calif.
2. *Nemoria aemularia*, ♂ . Madera Canyon, Santa Cruz Co., Ariz.
3. *Nemoria pistacearia*, ♂ . San Diego, Calif.
4. *Nemoria lixaria*, ♂ . Lake Placid, Highlands Co., Fla.
5. *Nemoria strigataria*, ♂ . Madera Canyon, Santa Cruz Co., Ariz.
6. *Nemoria bistriaria*, ♂ . Arlington, Va.



1



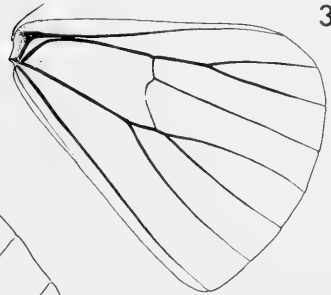
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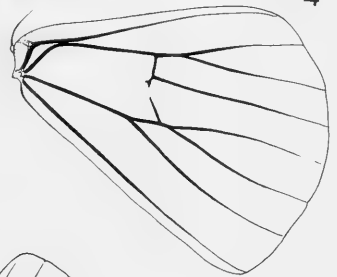
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4



5



6

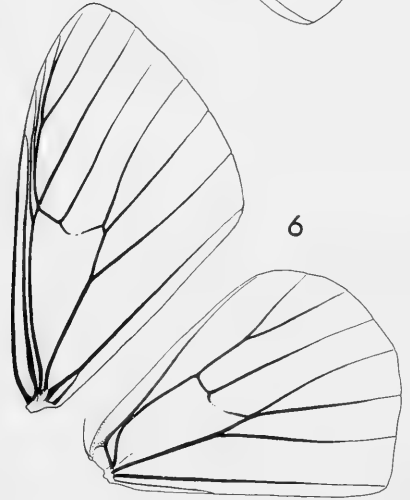
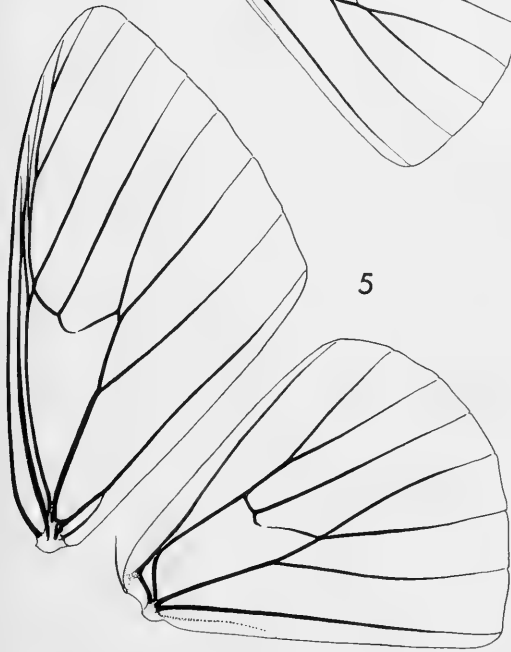


PLATE 3

VENATION

1. *Phrudocentra centrifugaria*, ♂ . Lake Placid, Highlands Co., Fla.
2. *Dichorda iridaria*, ♂ . Oakland, N.J.
3. *Dichordophora phoenix*, ♂ . Baboquivari Mts., Pima Co., Ariz.
4. *Synchlora gerularia*, ♂ . Sarasota, Fla.
5. *Synchlora liquoraria albolineata*, ♂ . Petite Riviere, Lunenburg Co., N.S.
6. *Synchlora herbaria hulstiana*, ♂ . Vero Beach, Fla.
7. *Synchlora cupedinaria*, ♂ . Miami, Fla.

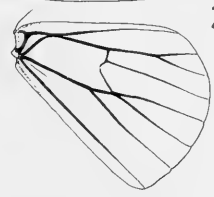
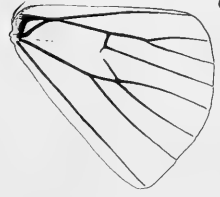
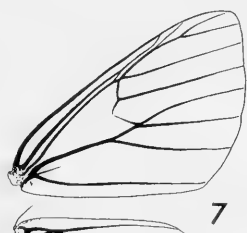
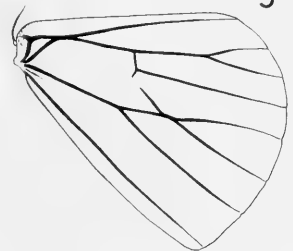
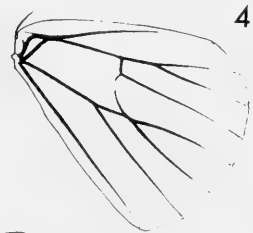
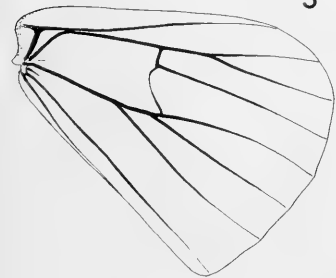
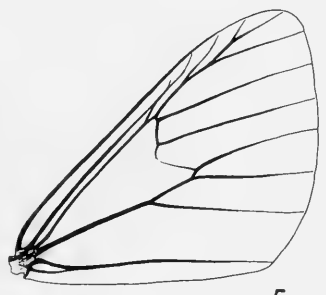
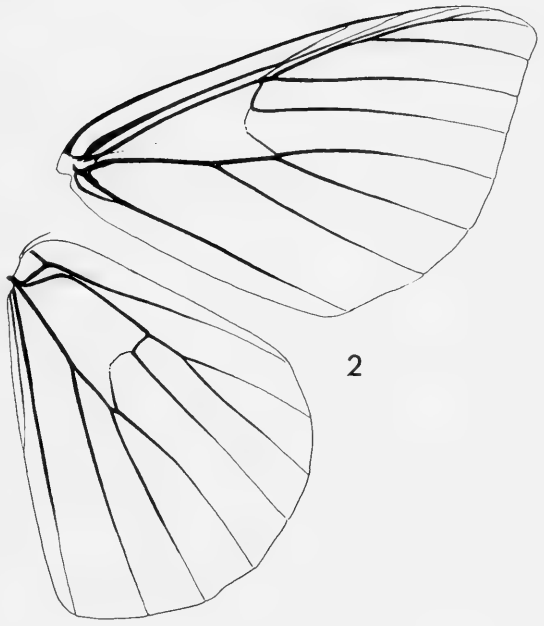


PLATE 4

VENATION

1. *Merochlora faseolaria*, ♂ . Berkeley, Calif.
2. *Merochlora graefiaria*, ♂ . Upper Santa Ana River, San Bernardino Co., Calif.
3. *Cheteoscelis bistriaria*, ♂ . Pineyon, Apache Co., Ariz.
4. *Eueana niveociliaria*, ♂ . Key Largo, Fla.
5. *Lophochorista calliope*, ♂ . Jalapa, Mexico.

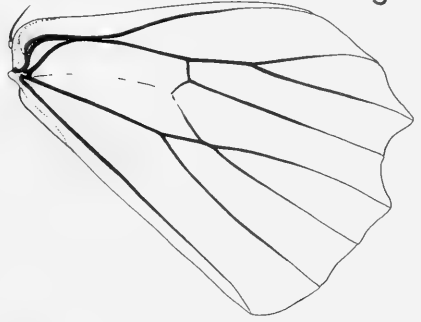
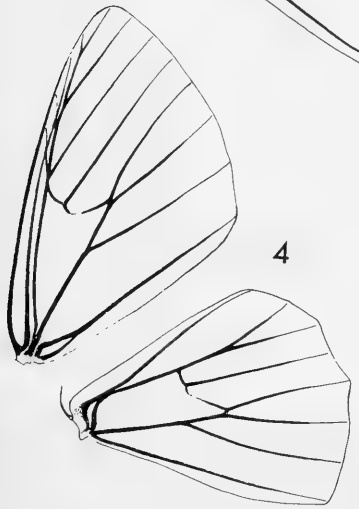
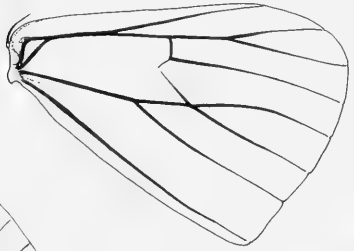
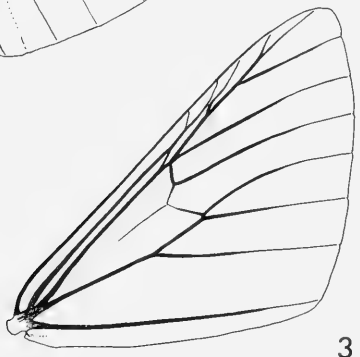
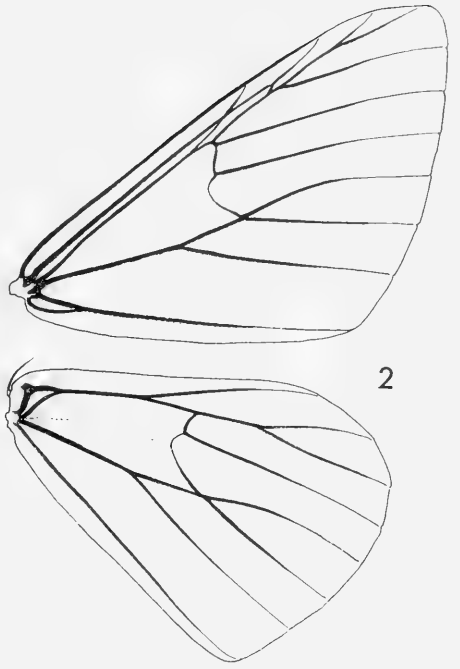


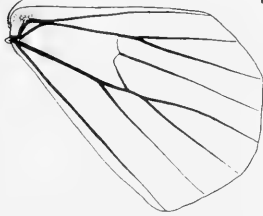
PLATE 5

VENATION

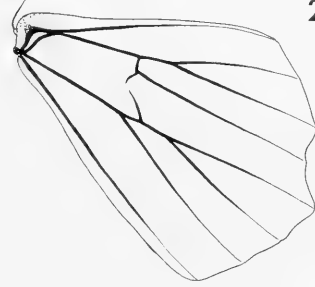
1. *Chlorochlamys chloroleucaria*, ♂ . Freehold, N.J.
2. *Xerochlora masonaria*, ♂ . White Mts., Ariz.
3. *Chloropteryx tepperaria*, ♂ . Lake Placid, Highlands Co., Fla.
4. *Chloropteryx paularia*, ♂ . Siesta Key, Sarasota Co., Fla.
5. *Hethemia pistasciaria*, ♂ . Bog on Prospect Road, Halifax Co., N.S.
6. *Mesothea incertata viridipennata*, ♂ . Brewster, Wash.



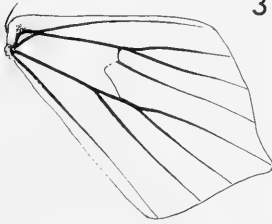
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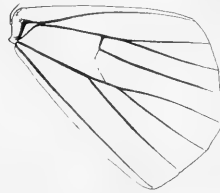
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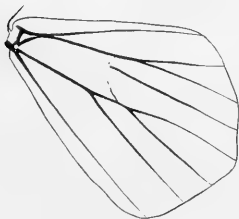
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4



5



6

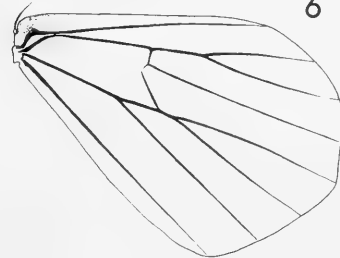
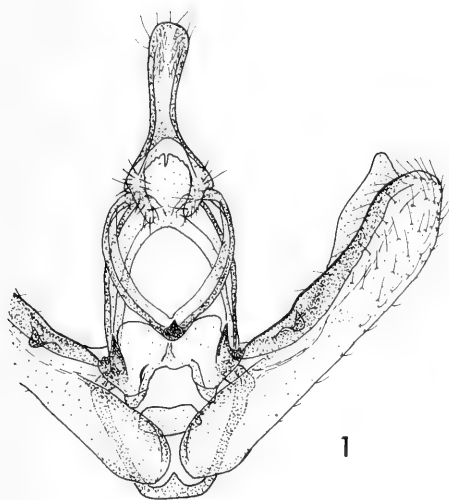


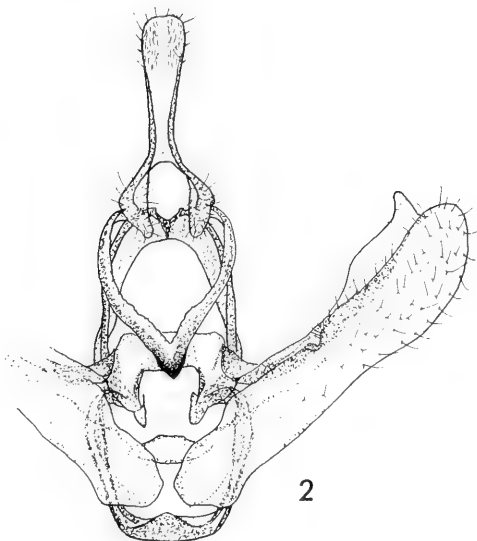
PLATE 6

MALE GENITALIA

1. *Chlorosea margaretaria*. Argus Mts., Calif. (USNM). a) aedeagus. b) 8th sternite.
2. *Chlorosea banksaria*. Wellington, B.C. a) aedeagus. b) 8th sternite. c) 8th sternite of another specimen; Shasta Retreat, Calif.; slide JFGC 1293 (USNM).
3. *Chlorosea nevadaria*. Reno, Nev. Slide JFGC 1292 (USNM). a) aedeagus. b) 8th sternite.



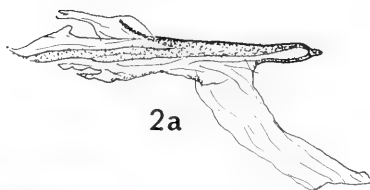
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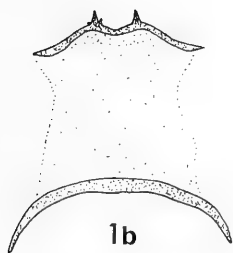
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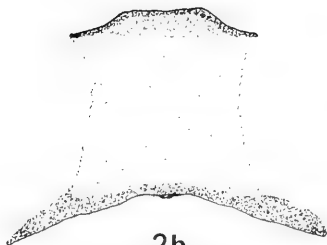
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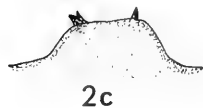
2a



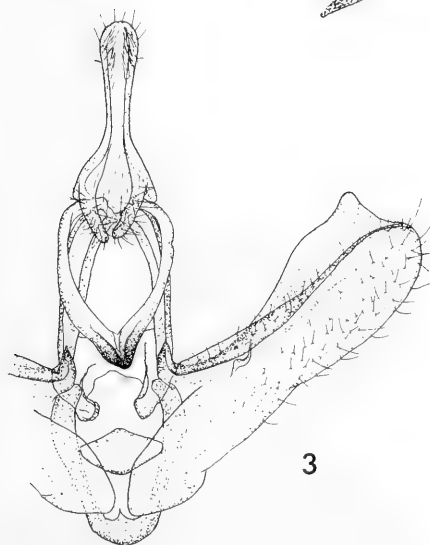
1b



2b



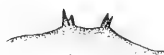
2c



3



3a

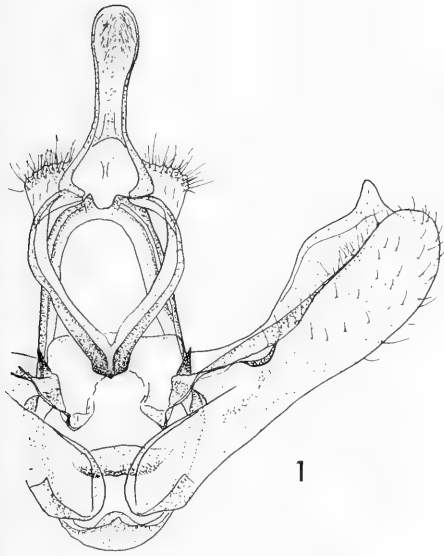


3b

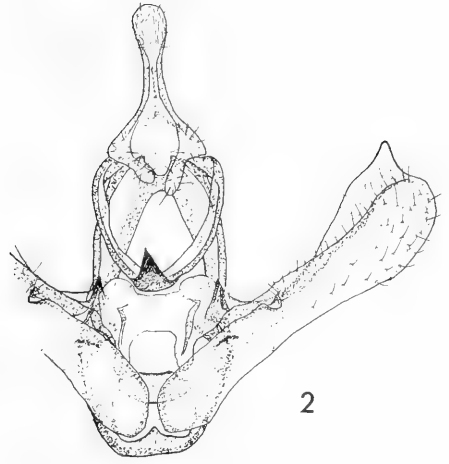
PLATE 7

MALE GENITALIA

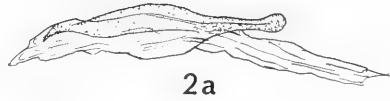
1. *Chlorosea banksaria gracearia*. Cloudburst Canyon, Los Angeles Co., Calif. a) San Gabriel Mts., Calif. Left valve. b) Charleton Flat, Los Angeles Co., Calif. Left valve. c) aedeagus of No. 1. d) 8th sternite of No. 1.
2. *Chlorosea roseitacta*. White Mts., Ariz. Slide HWC 1639 (USNM). a) aedeagus. b) 8th sternite.
3. *Nemoria pulcherrima*. Spring Mt., Napa Co., Calif. a) aedeagus. b) 8th sternite.



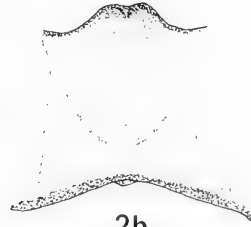
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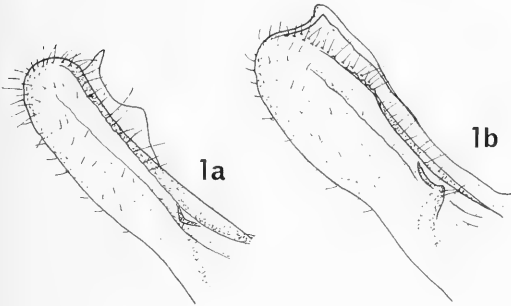
2



2a



2b



1a

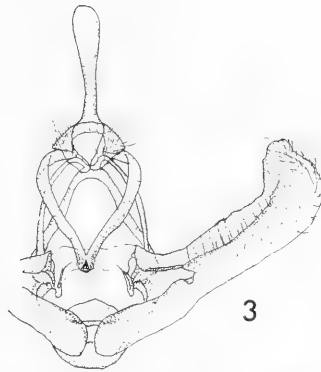
1b



1c



1d



3



3a

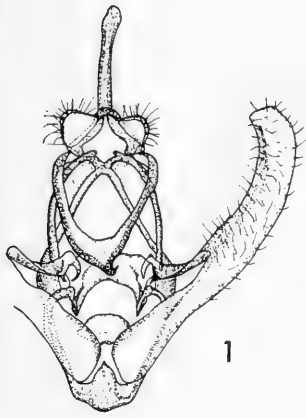


3b

PLATE 8

MALE GENITALIA

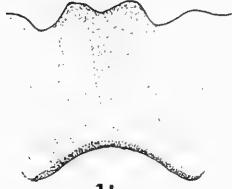
1. *Nemoria muticolor*. Madera Canyon, Santa Rita Mts., Santa Cruz Co., Ariz. a) aedeagus. b) 8th sternite.
2. *Nemoria unitaria*. Joe Dollar Gulch, near Hill City, Black Hills, S.D. a) aedeagus. b) 8th sternite.
3. *Nemoria latirosaria*. Turkey Creek, White Mts., Ariz. a) aedeagus. b) 8th sternite.
4. *Nemoria aemularia*. Madera Canyon, Santa Cruz Co., Ariz. a) aedeagus. b) 8th sternite.



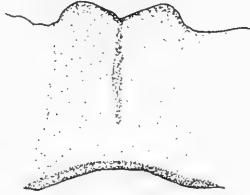
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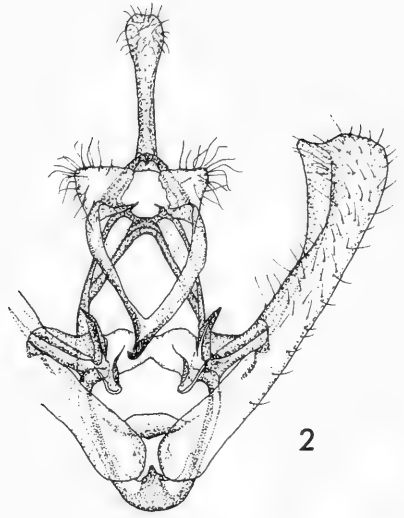
1a



1b



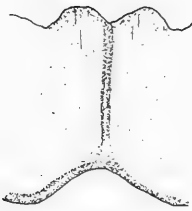
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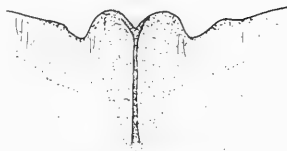
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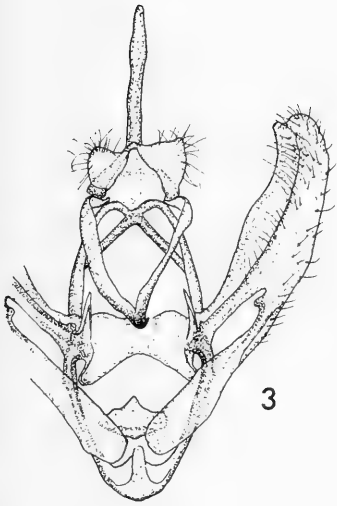
2a



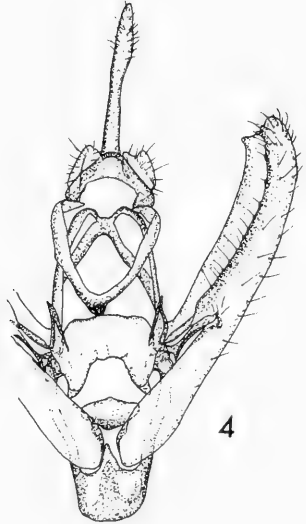
3b



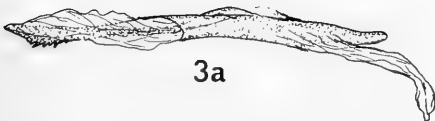
4b



3



4



3a

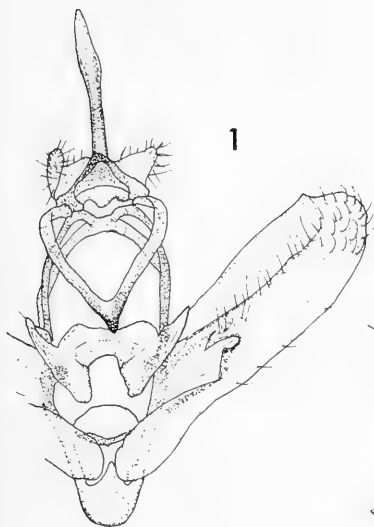


4a

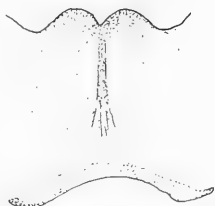
PLATE 9

MALE GENITALIA

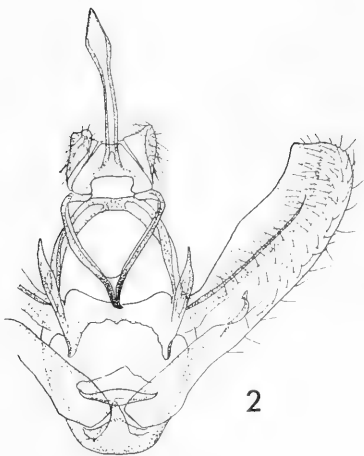
1. *Nemoria arizonaria*. Palmerlee, Ariz. a) aedeagus. b) 8th sternite.
2. *Nemoria daedalea*, holotype. a) aedeagus. b) 8th sternite.
3. *Nemoria viridicaria*. Glenwood Springs, Colo. a) aedeagus. b) 8th sternite.
4. *Nemoria subsequens*, paratype. Pine Camp, near Cloudcroft, Otero Co., N.M. a) aedeagus. b) 8th sternite.



1



1b



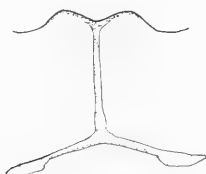
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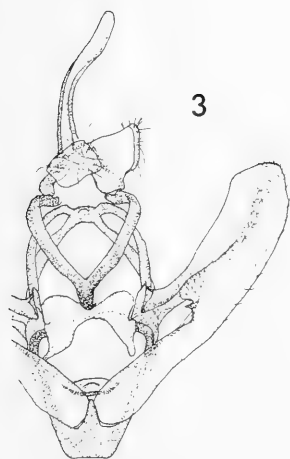
1a



2a



2b



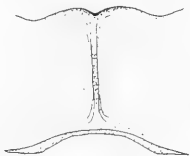
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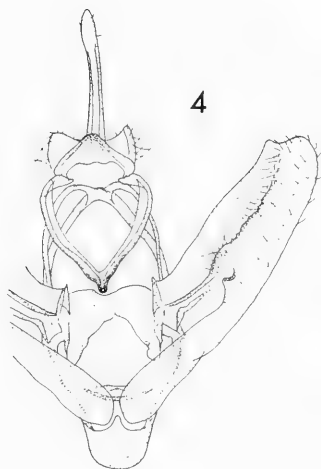
3b



3a



4b



4

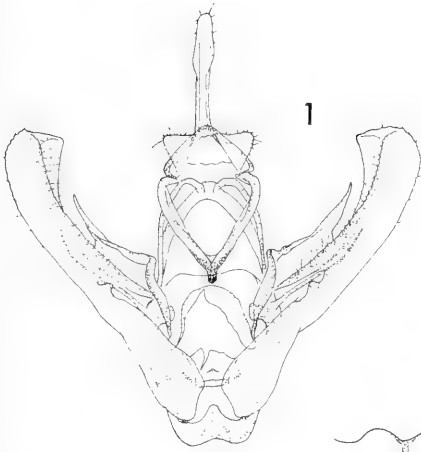


4a

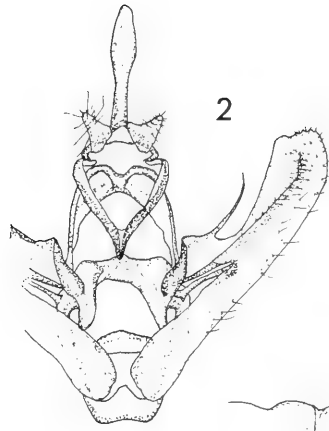
PLATE 10

MALE GENITALIA

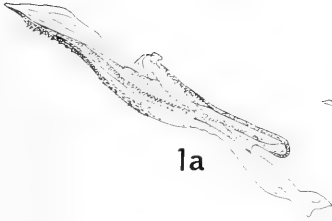
1. *Nemoria diamesa*, holotype. a) aedeagus. b) 8th sternite.
2. *Nemoria albaria*. Pine Crest, Mt. Graham, Ariz. a) aedeagus. b) 8th sternite.
3. *Nemoria pistacearia*. Mill Valley, Marin Co., Calif. a) aedeagus. b) 8th sternite.
4. *Nemoria extremaria*. Orlando, Fla. a) aedeagus. b) 8th sternite.



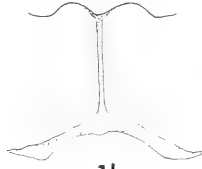
1



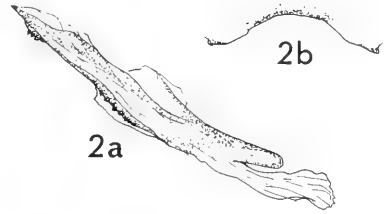
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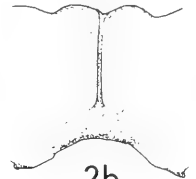
1a



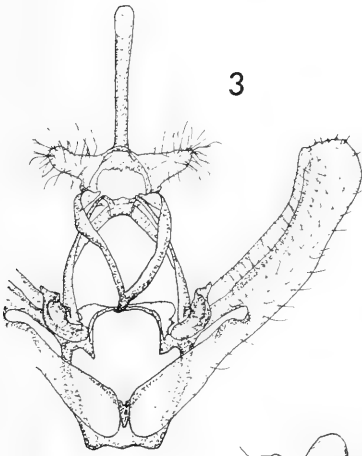
1b



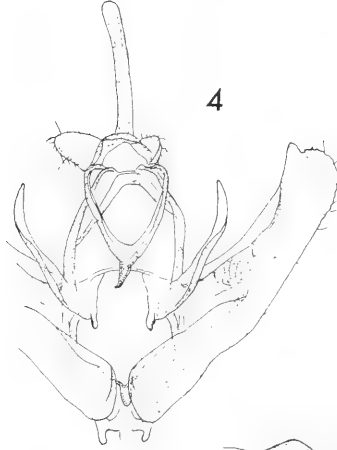
2a



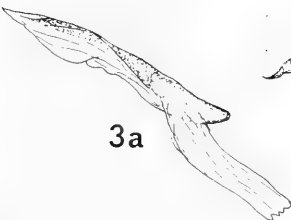
2b



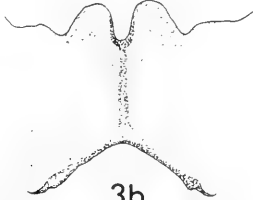
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4



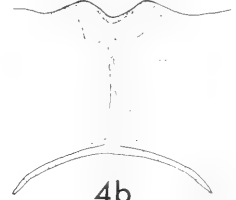
3a



3b



4a

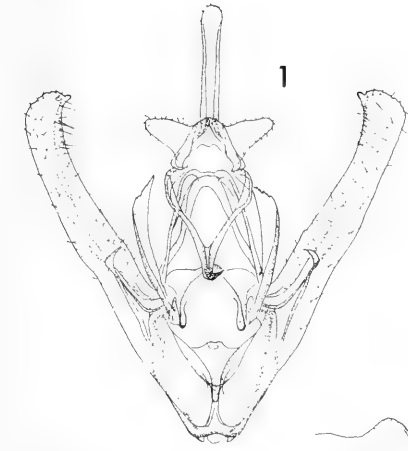


4b

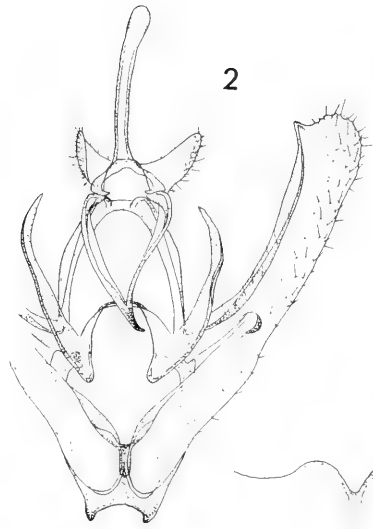
PLATE 11

MALE GENITALIA

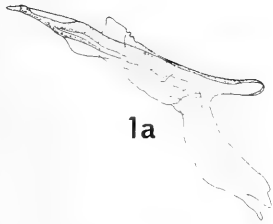
1. *Nemoria elfa*, holotype. a) aedeagus. b) 8th sternite.
2. *Nemoria tuscarora*, paratype. Mountain Lake, Va. a) aedeagus. b) 8th sternite.
3. *Nemoria catachloa*. Lake Placid, Highlands Co., Fla. a) aedeagus. b) 8th sternite.
4. *Nemoria outina*, holotype. a) aedeagus. b) sternite.



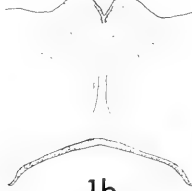
1



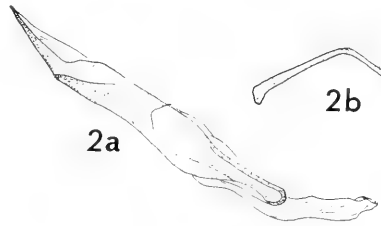
2



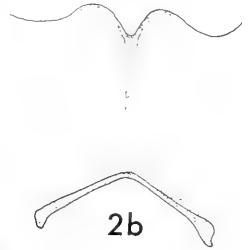
1a



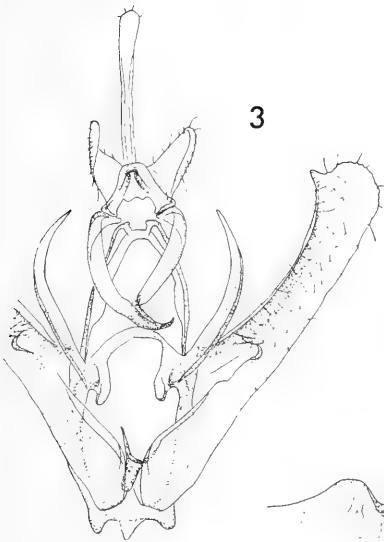
1b



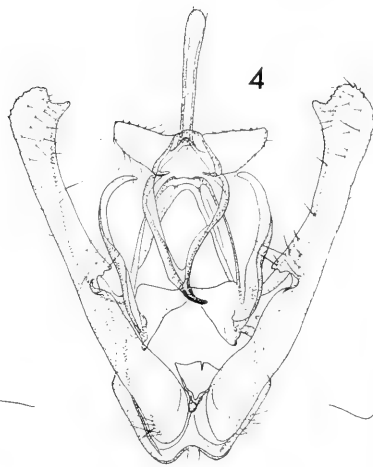
2a



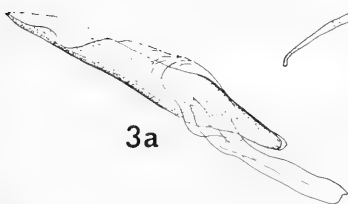
2b



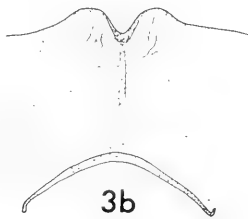
3



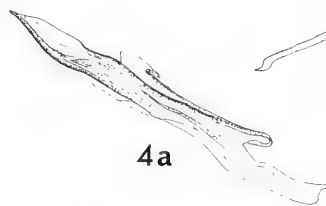
4



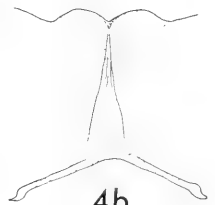
3a



3b



4a

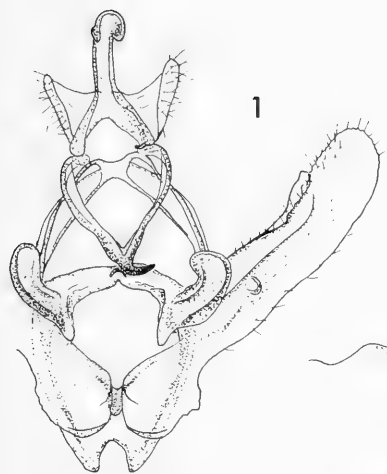


4b

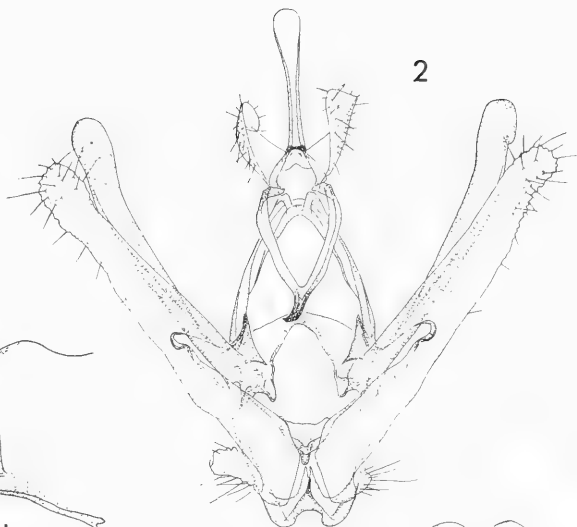
PLATE 12

MALE GENITALIA

1. *Nemoria lixaria*. Welaka, Putnam Co., Fla. a) aedeagus. b) 8th sternite.
2. *Nemoria saturiba*, holotype. a) aedeagus. b) 8th sternite.
3. *Nemoria darwiniata*. Wellington, B.C. a) aedeagus. b) 8th sternite.
4. *Nemoria darwiniata*, lectotype. Kaslo Creek, B.C. (USNM). a) aedeagus. b) 8th sternite.



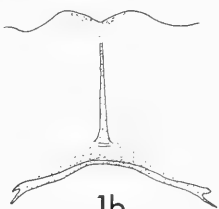
1



2



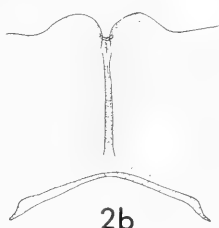
1a



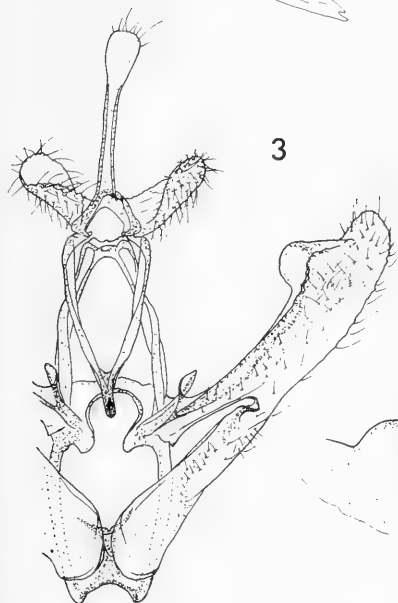
1b



2a



2b



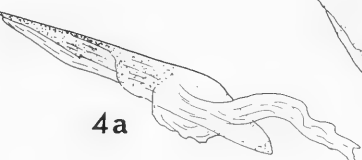
3



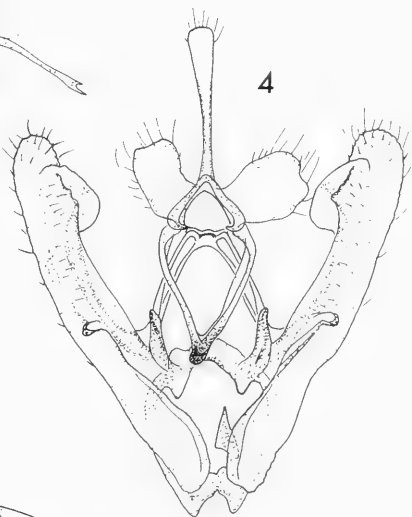
3b



3a



4a



4



4b

PLATE 13

MALE GENITALIA

1. *Nemoria darwiniata*. The holotype of *oregonensis* (MCZ), Corvallis, Ore. a. aedeagus. b. 8th sternite.
2. *Nemoria darwiniata punctularia*. La Mesa, San Diego Co., Calif. a. aedeagus. b. 8th sternite.
3. *Nemoria zelotes*, holotype. a. aedeagus. b. 8th sternite.
4. *Nemoria obliqua*. Glenwood Springs, Colo. a. aedeagus. b. 8th sternite.

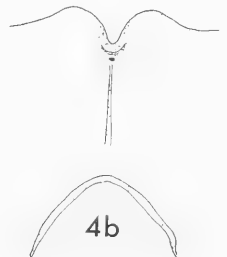
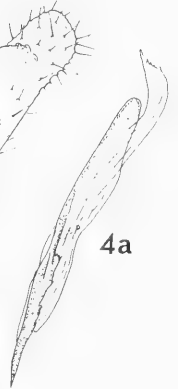
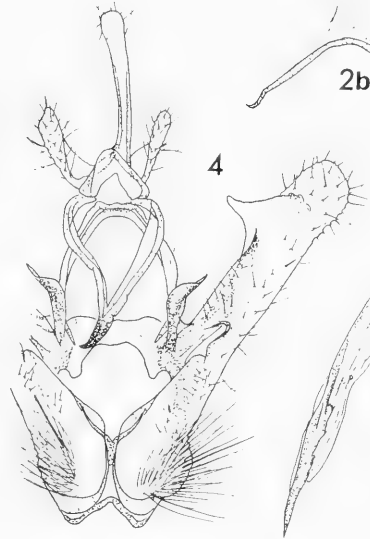
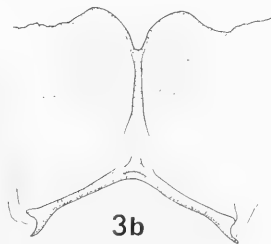
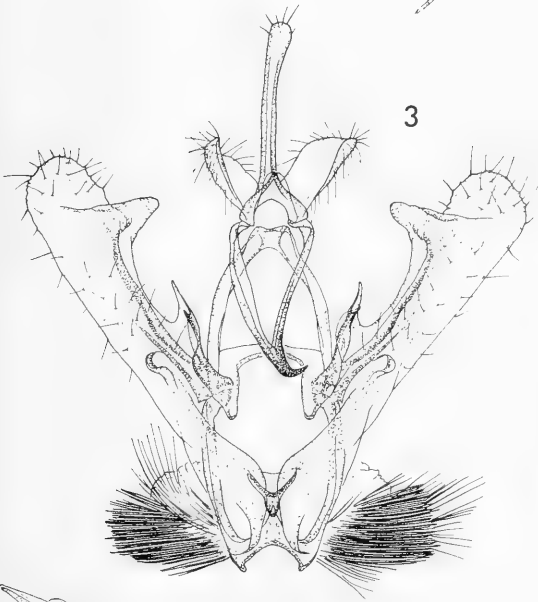
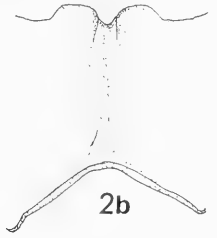
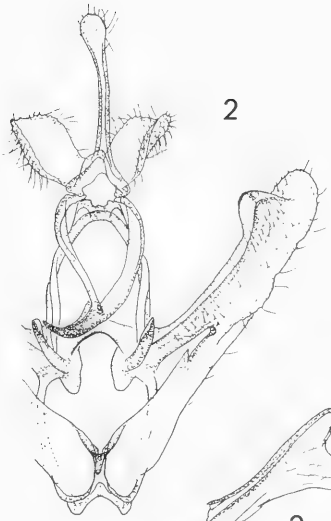
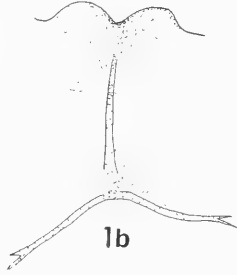
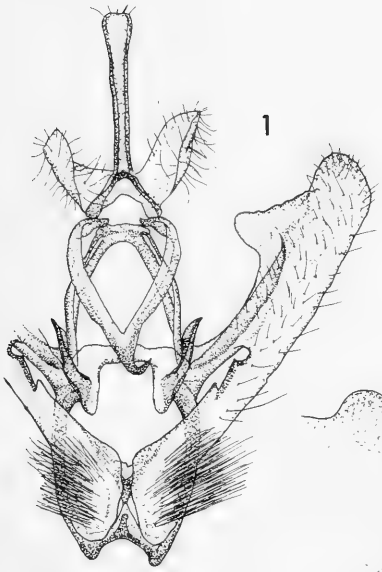


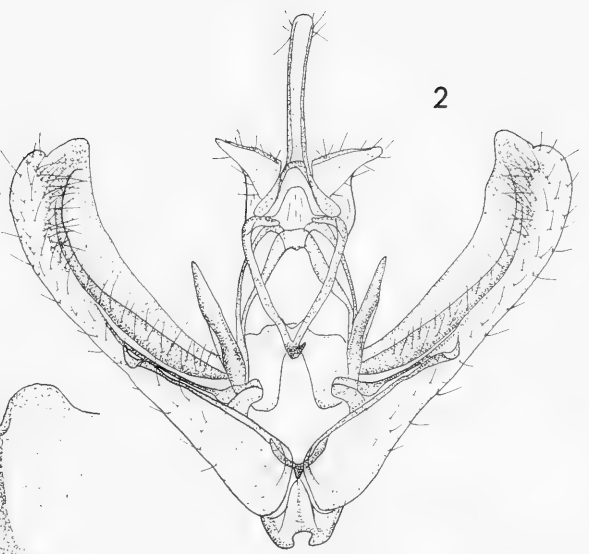
PLATE 14

MALE GENITALIA

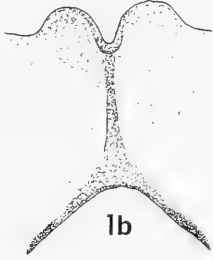
1. *Nemoria obliqua hennei*, paratype. Smoky Valley, Tulare Co., Calif. a. aedeagus. b. 8th sternite.
2. *Nemoria splendidaria*, holotype. a. aedeagus. b. 8th sternite.
3. *Nemoria strigataria*. Madera Canyon, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.
4. *Nemoria zygotaria*. San Benito, Texas. a. aedeagus. b. 8th sternite.



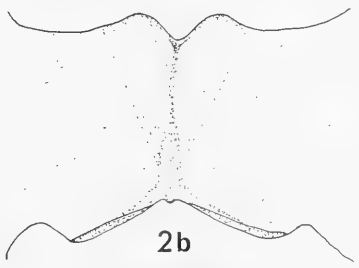
1



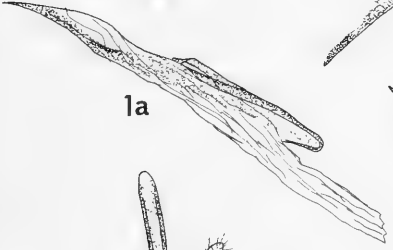
2



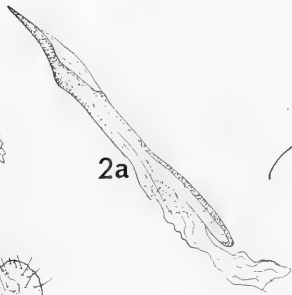
1b



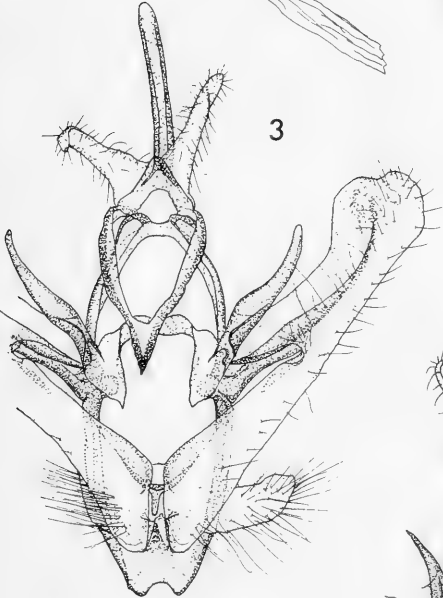
2b



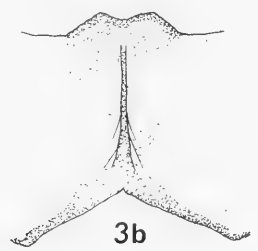
1a



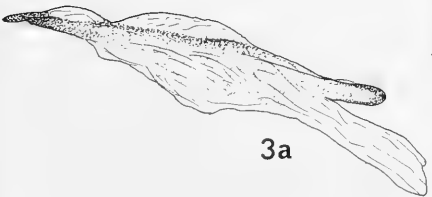
2a



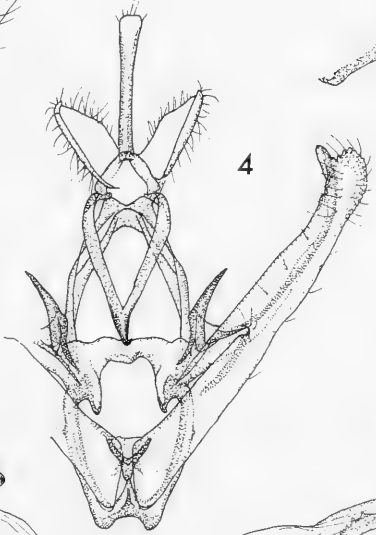
3



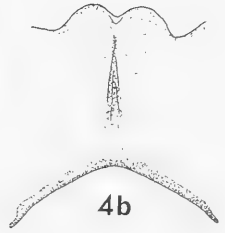
3b



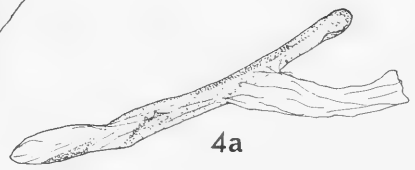
3a



4



4b



4a

PLATE 15

MALE GENITALIA

1. *Nemoria leptalea*. Roscoe, Calif. a. aedeagus. b. 8th sternite.
2. *Nemoria caerulescens*. Jemez Springs, N.M. a. aedeagus. b. 8th sternite.
3. *Nemoria intensaria*. Walnut Canyon, near Flagstaff, Ariz. a. aedeagus. b. 8th sternite.
4. *Nemoria festaria*. Madera Canyon, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.

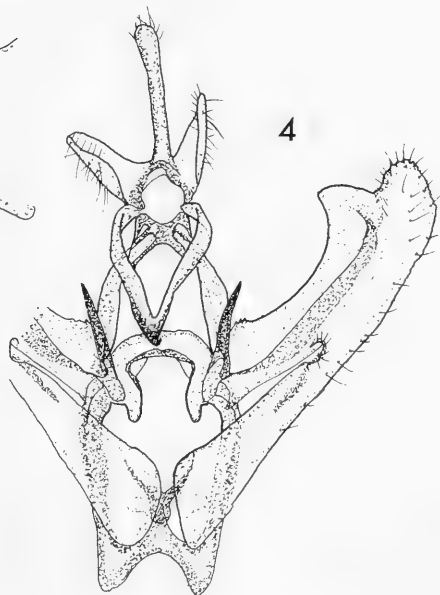
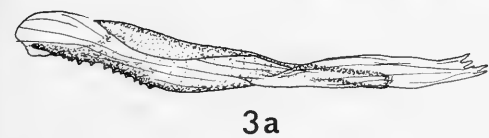
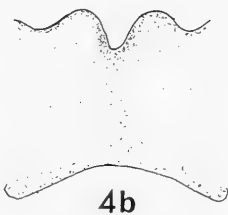
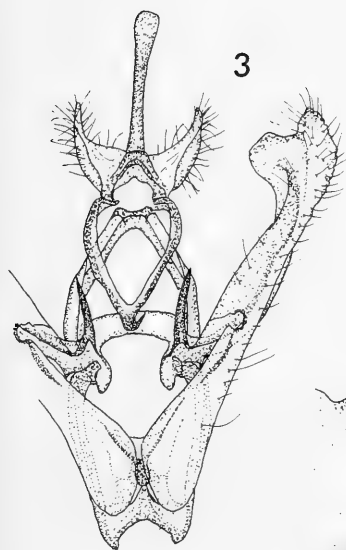
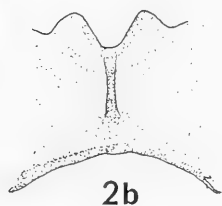
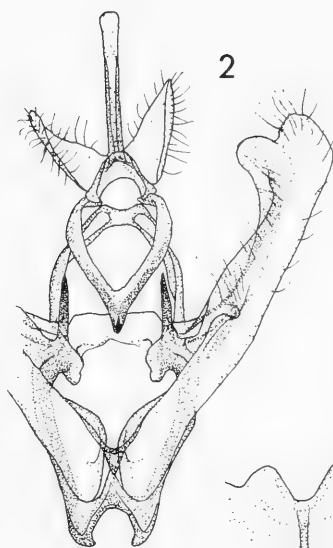
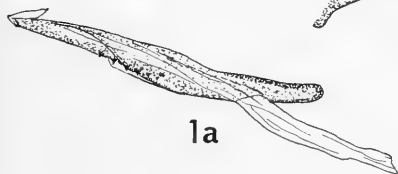
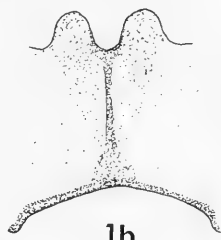
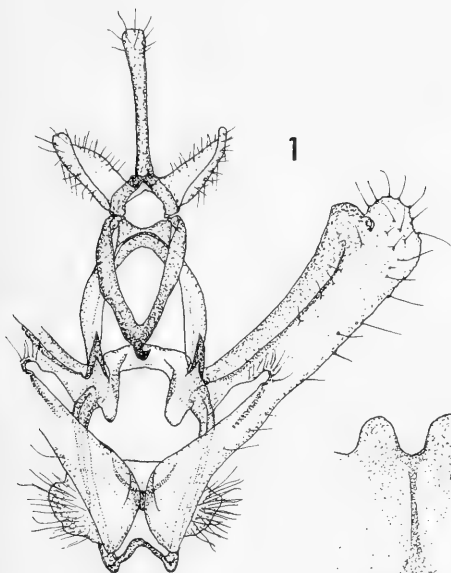


PLATE 16

MALE GENITALIA

1. *Nemoria albilineata*, paratype. Alpine, Texas. a. aedeagus. b. 8th sternite.
2. *Nemoria albilineata*. Fort Davis, Texas. a. aedeagus. b. 8th sternite.
3. *Nemoria bifilata*. Lake Placid, Highlands Co., Fla. a. aedeagus. b. 8th sternite.
4. *Nemoria bifilata planuscula*, a brown specimen. Bastrop State Park, Bastrop Co., Texas. a. aedeagus. b. 8th sternite.

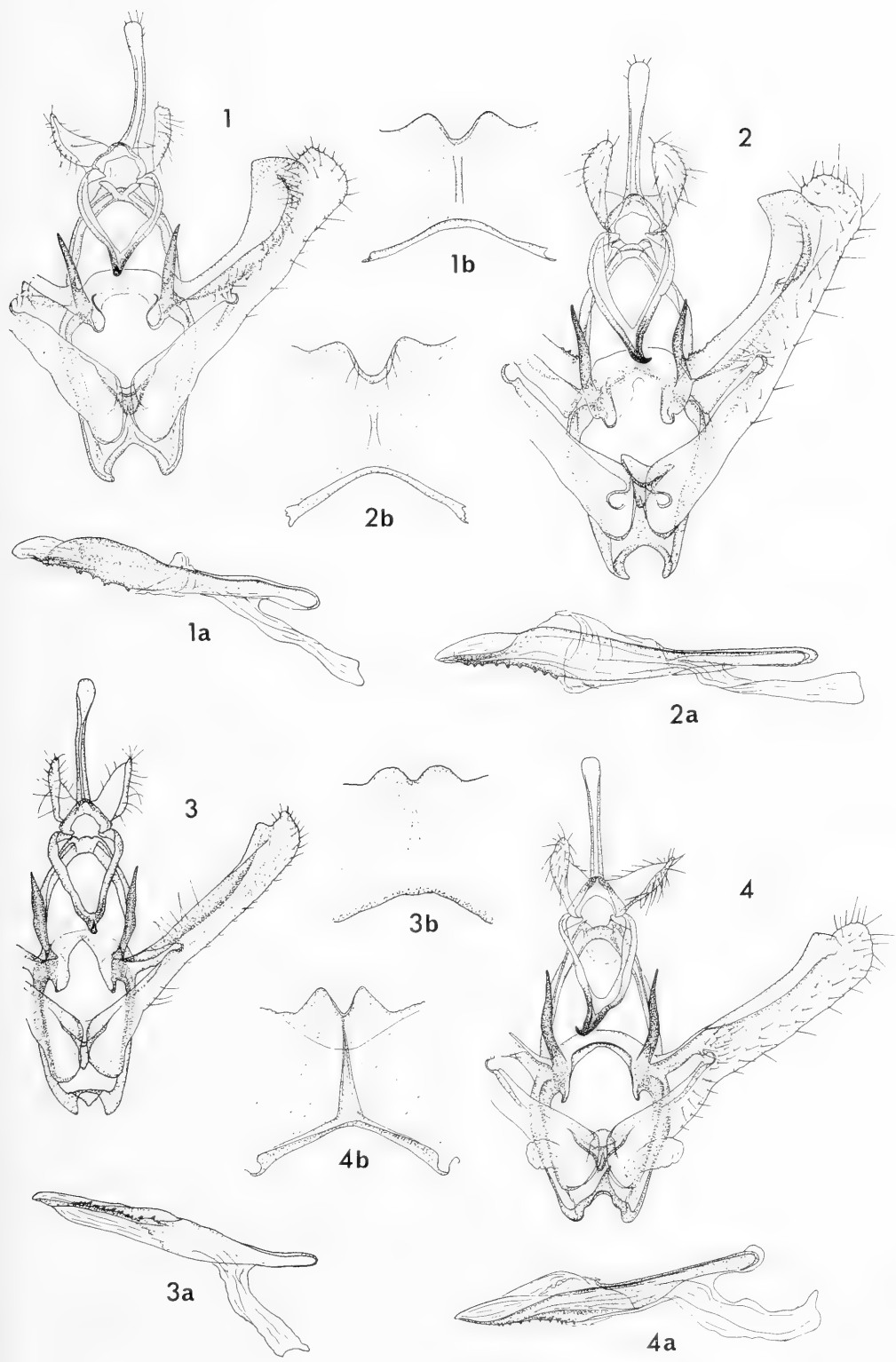
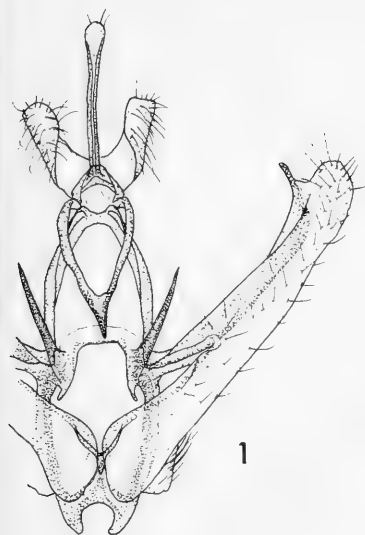


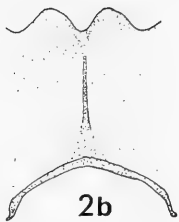
PLATE 17

MALE GENITALIA

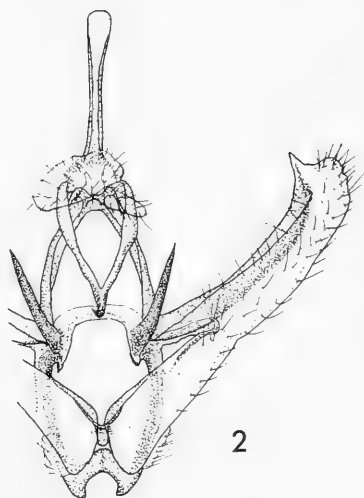
1. *Nemoria bistrifaria*. Camp Rucker, Ozark, Ala. Slide JGF 2633 (Franclemont collection). a. aedeagus. b. 8th sternite.
2. *Nemoria bistrifaria rubromarginaria*. Ithaca, N.Y. Slide JGF 290 (Franclemont collection). a. aedeagus. b. 8th sternite.
3. *Nemoria rubrifrontaria*. Aylesford, Kings Co., N.S. a. aedeagus. b. 8th sternite.
4. *Nemoria mimosaria*. Mount Uniacke, Hants Co., N.S. a. aedeagus. b. 8th sternite.



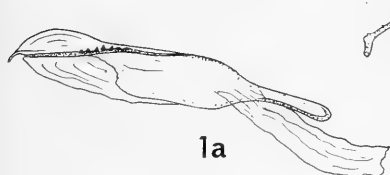
1



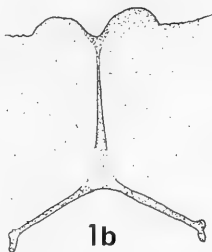
2b



2



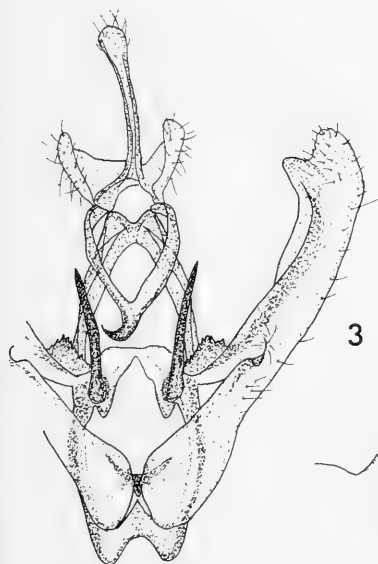
1a



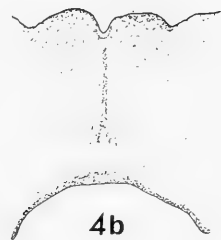
1b



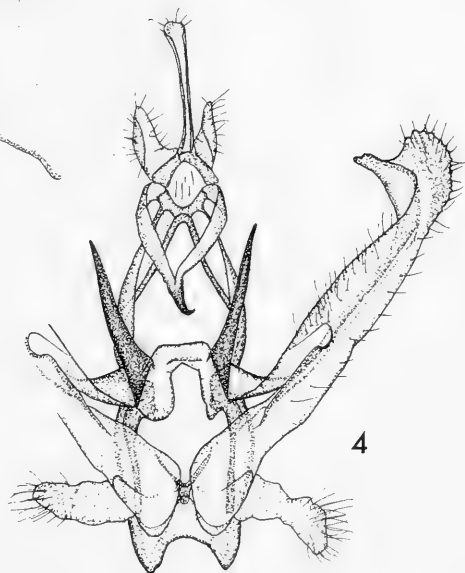
2a



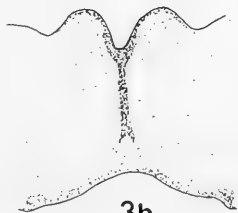
3



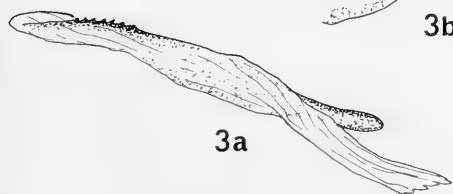
4b



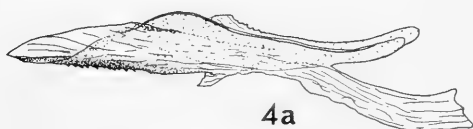
4



3b



3a

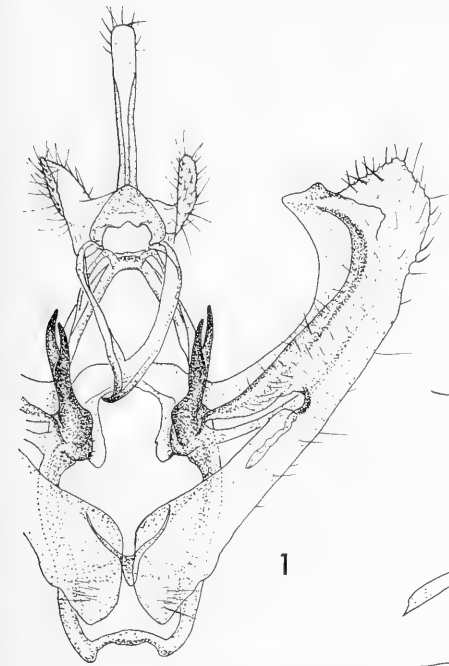


4a

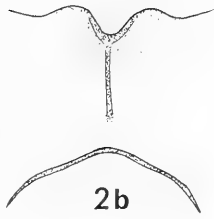
PLATE 18

MALE GENITALIA

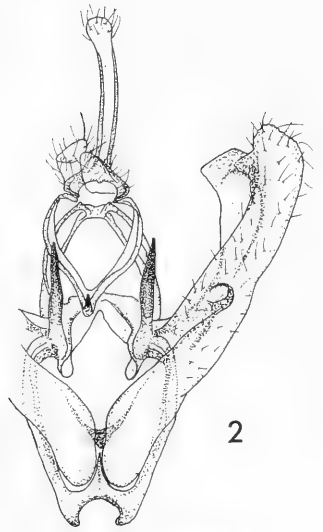
1. *Nemoria glaucomarginaria*. Anderson Springs, Lake Co., Calif. a. aedeagus. b. 8th sternite.
2. *Nemoria rindgei*, holotype. a. aedeagus. b. 8th sternite.
3. *Phrudocentra centrifugaria*. Fla. a. aedeagus. b. 8th sternite.
4. *Dichorda iridaria*. Arlington, Va. Slide 3132 (Franclemont collection). a. aedeagus. b. 8th sternite.



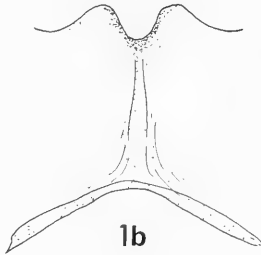
1



2b



2



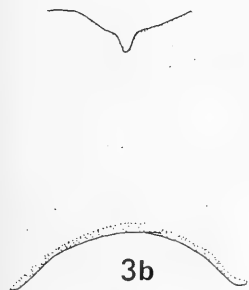
1b



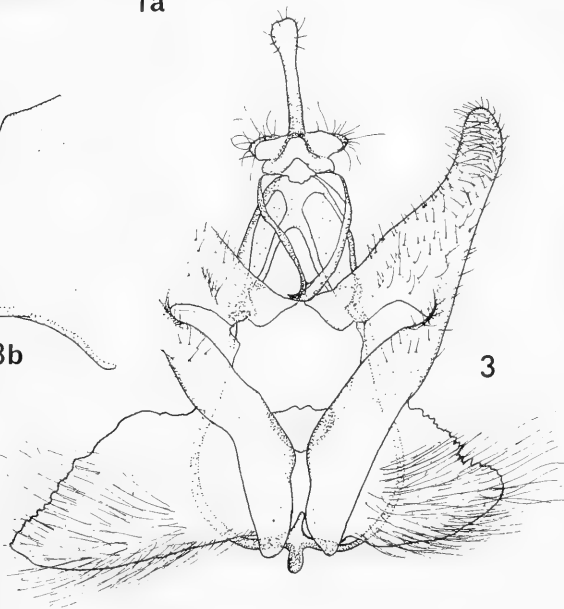
1a



2a



3b



3



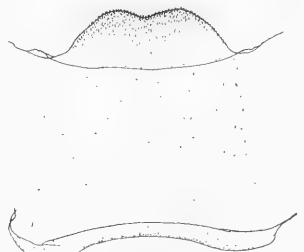
4



3a



4a

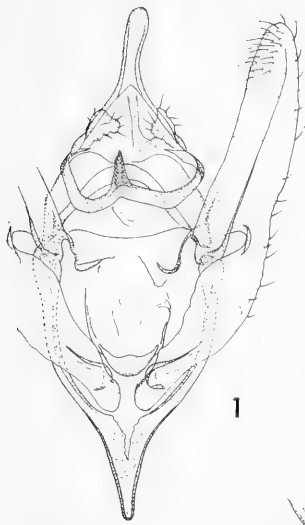


4b

PLATE 19

MALE GENITALIA

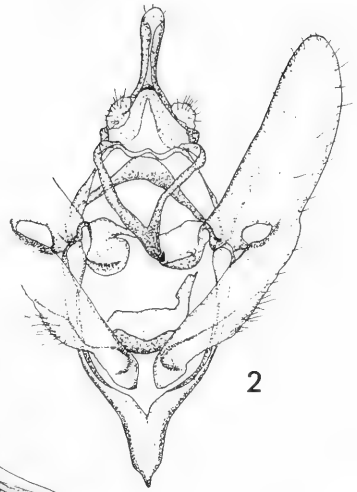
1. *Dichorda iridaria*. Logan, Utah. a. 8th sternite.
- b. *Dichorda iridaria*. Oakland, N.J. Right valve. c. Saccus.
2. *Dichorda iridaria latipennis*. Lake Placid, Highlands Co., Fla. a. aedeagus. b. 8th sternite.
3. *Dichorda illustraria*. Burbank, Calif. a. aedeagus. b. 8th sternite.
- c. Laytonville, Mendocino Co., Calif. Right valve. d. 8th sternite of 3c.



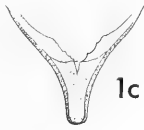
1



1b



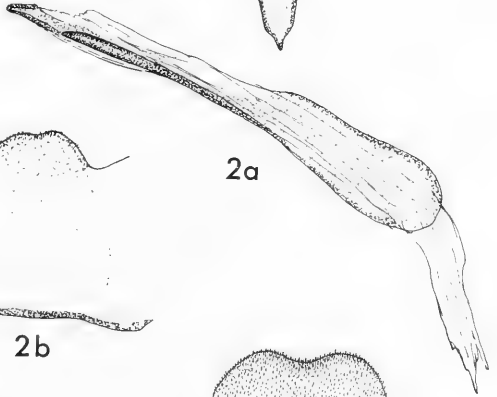
2



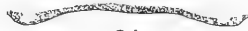
1c



2a



1a



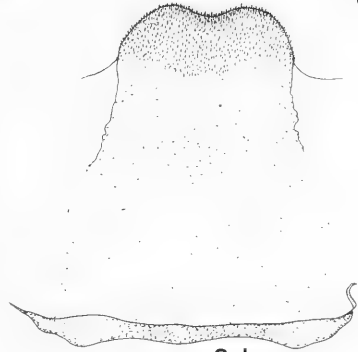
2b



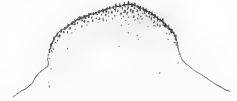
3



3c



3d



3b

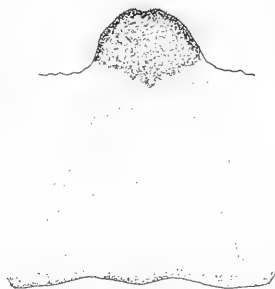
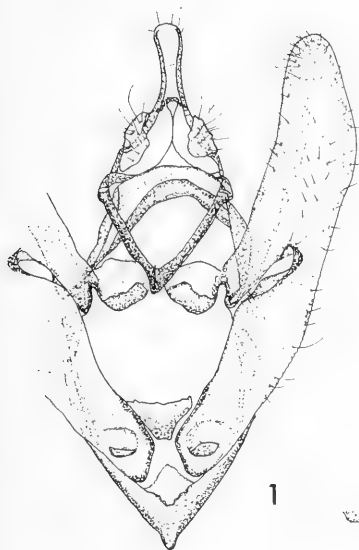


3a

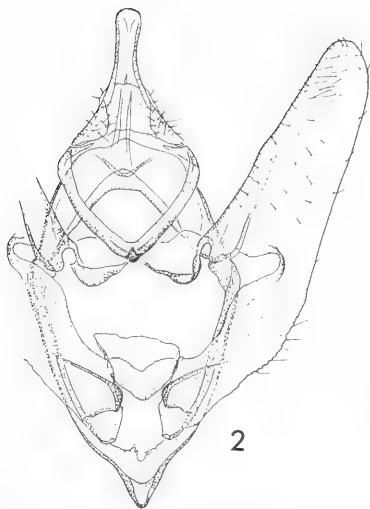
PLATE 20

MALE GENITALIA

1. *Dichorda consequaria*. Madera Canyon, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.
2. *Dichorda rectaria*. Brewster Co., Texas. a. aedeagus. b. 8th sternite.
3. *Dichorda rectaria*. Prescott, Ariz. a. 8th sternite. b. Kerrville, Texas; 8th sternite.
c. Little Colorado Canyon, Ariz.; uncus and socii.
4. *Dichorda rectaria cockerelli*. Keystone Canyon, New York Mts., Calif. a. aedeagus. b. 8th sternite.



1b



2



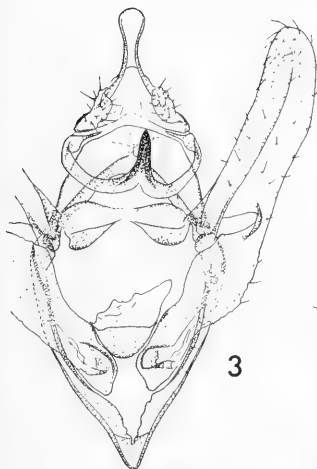
1a



2b



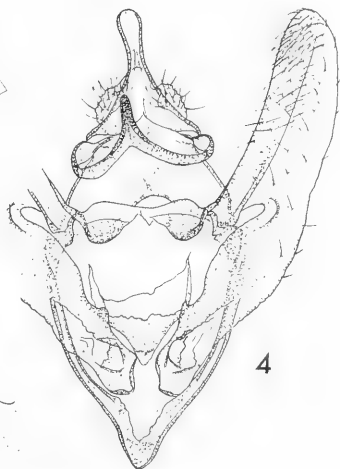
2a



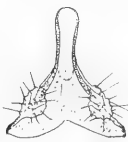
3



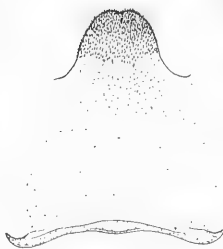
3a



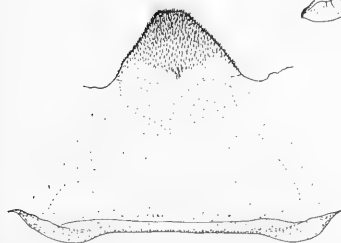
4



3c



4b



3b

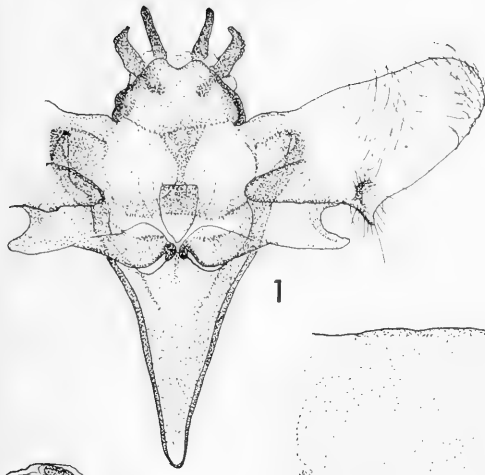


4a

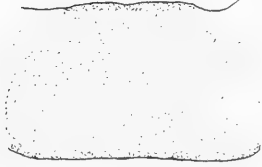
PLATE 21

MALE GENITALIA

1. *Dichordophora phoenix*. Madera Canyon, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.
2. *Synchlora liquoraria*. Anderson Springs, Lake Co., Calif. a. aedeagus. b. 8th sternite.
3. *Synchlora liquoraria albolineata*. Doyles, Nfld. a. aedeagus. b. 8th sternite.
4. *Synchlora aerata*. Ithaca, N.Y. a. aedeagus. b. 8th sternite.
5. *Synchlora frondaria denticularia*. Welaka, Putnam Co., Fla. a. aedeagus. b. 8th sternite.
6. *Synchlora frondaria avidaria*. Chiricahua Monument, Ariz. a. aedeagus. b. 8th sternite.
7. *Synchlora herbaria hulstiana*. Tavernier, Fla. a. aedeagus. b. 8th sternite.



1



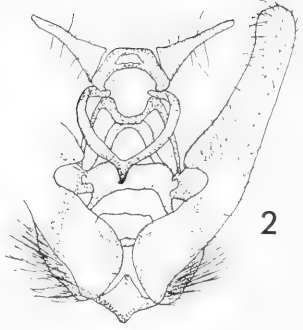
1b



1a



2b



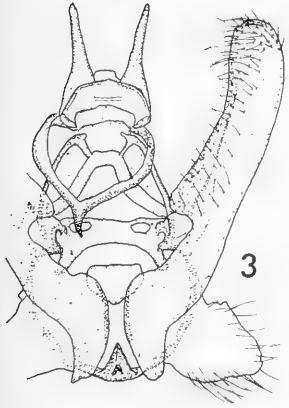
2



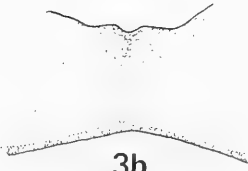
2a



4b



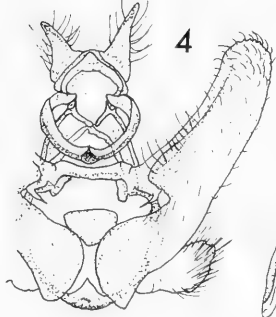
3



3b



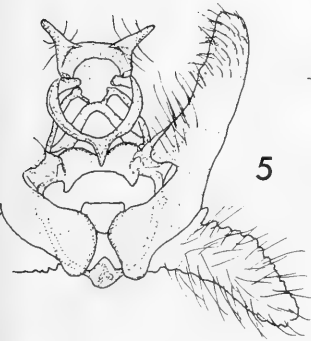
3a



4



4a



5



5b



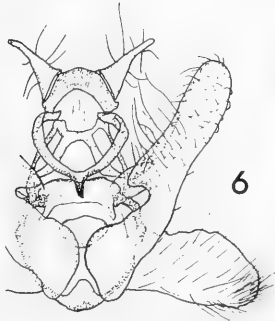
6b



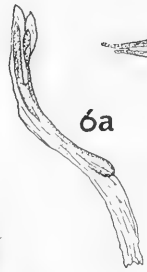
7



5a



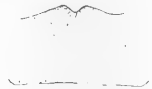
6



6a



7a

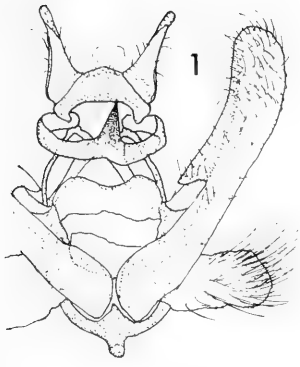


7b

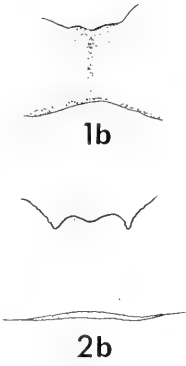
PLATE 22

MALE GENITALIA

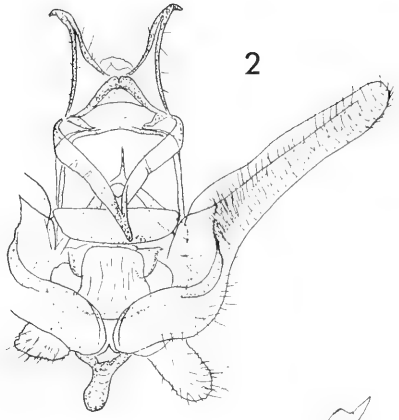
1. *Synchlora gerularia*. Lake Placid, Highlands Co., Fla. a. aedeagus. b. 8th sternite.
2. *Synchlora irregularia*. Brownsville, Texas. a. aedeagus. b. 8th sternite.
3. *Synchlora noel*. Palm Springs, Calif. a. aedeagus. b. 8th sternite.
4. *Synchlora cupedinaria*. Tavernier, Fla. a. aedeagus. b. 8th sternite.
5. *Merochlora faseolaria*. San Luis Obispo, Calif. a. aedeagus. b. 8th sternite.
6. *Merochlora graefaria*. Upper Santa Ana River, San Bernardino Co., Calif. a. aedeagus. b. 8th sternite.



1



1b



2



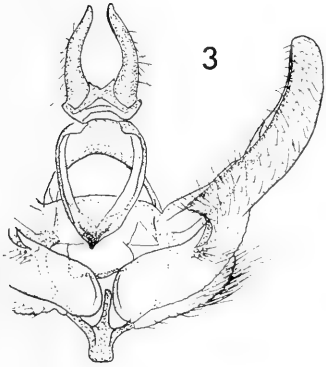
2a



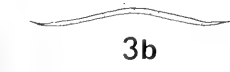
1a



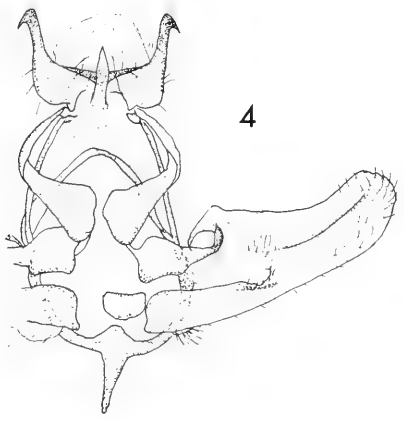
2b



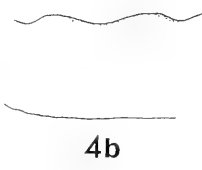
3



3b



4



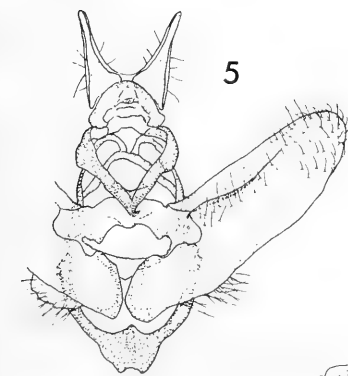
4b



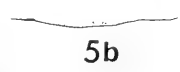
3a



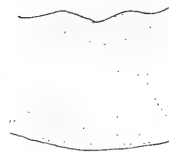
4a



5



5b



6b



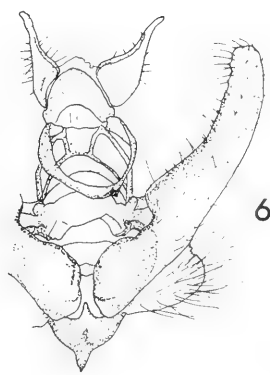
4a



5a



6a



6

PLATE 23

MALE GENITALIA

1. *Cheteoscelis bistriaria*. Walker Pass, Calif. a. aedeagus. b. 8th sternite.
2. *Cheteoscelis bistriaria*. Railroad Canyon, White Pine Co., Nev. a. aedeagus. b. 8th sternite.
3. *Cheteoscelis bistriaria*, a paratype of *clarkei*. Split Rock Tank, Mohave Desert, Calif. a. aedeagus. b. 8th sternite.
4. *Cheteoscelis pectinaria*. Madera Canyon, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.

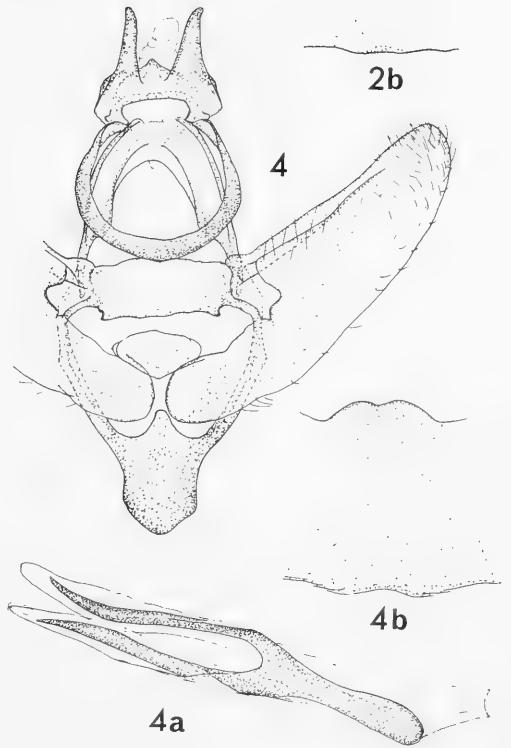
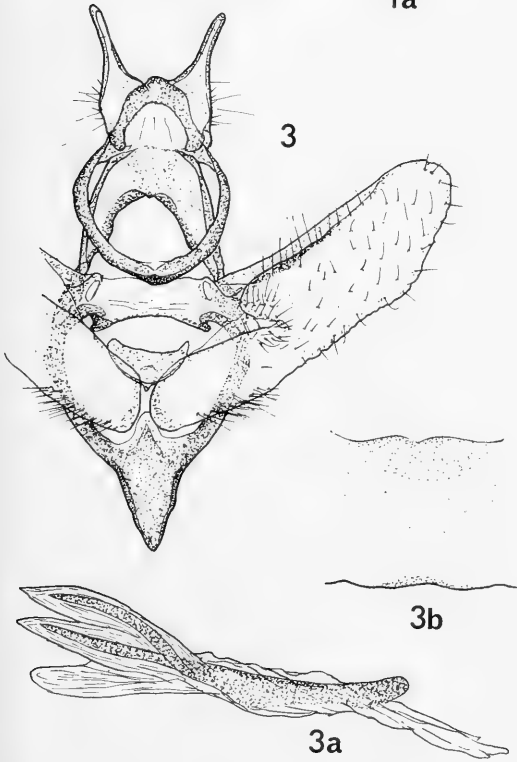
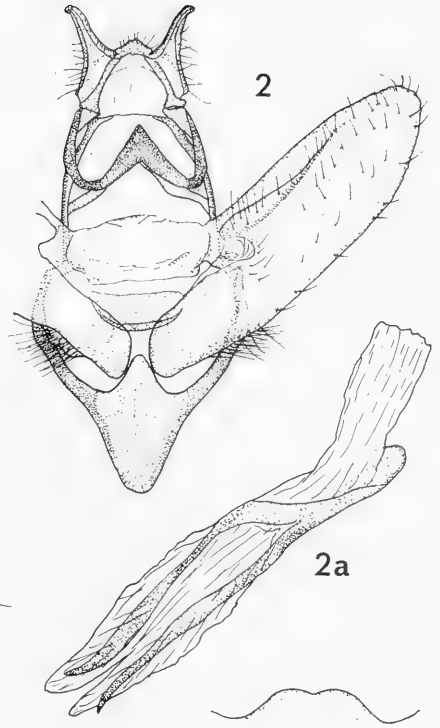
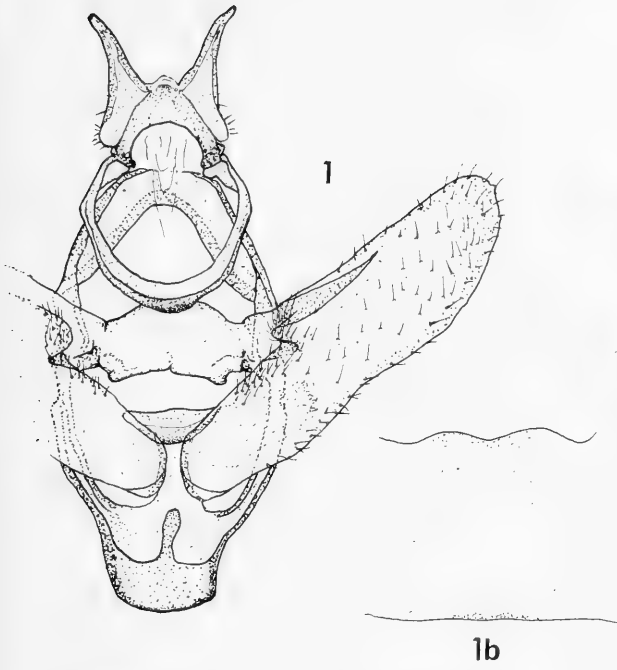
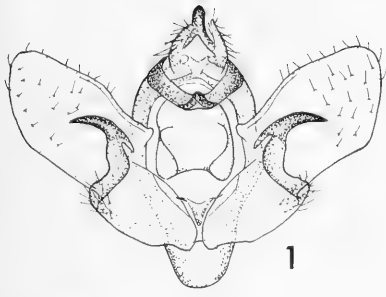


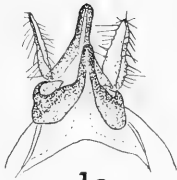
PLATE 24

MALE GENITALIA

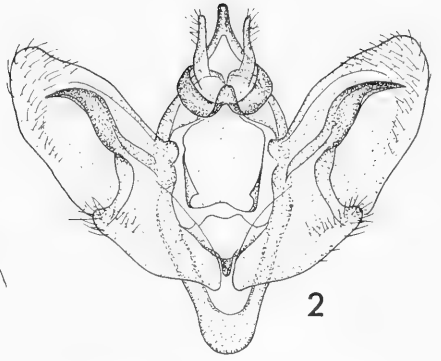
1. *Lophochorista lesteraria*, lectotype. a. aedeagus. b. 8th sternite. c. Baboquivari Mts., Ariz.; uncus, gnathos, socii.
2. *Lophochorista diversata*, type. a. aedeagus. b. 8th sternite.
3. *Eueana niveociliaria*. Miami, Fla. a. aedeagus. b. 8th sternite.
4. *Chlorochlamys chloroleucaria*. Brierly Brook, Antigonish Co., N.S. a. aedeagus. b. 8th sternite.
5. *Chlorochlamys chloroleucaria*. Welaka, Putnam Co., Fla. a. aedeagus. b. 8th sternite.



1



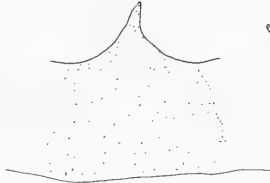
1c



2



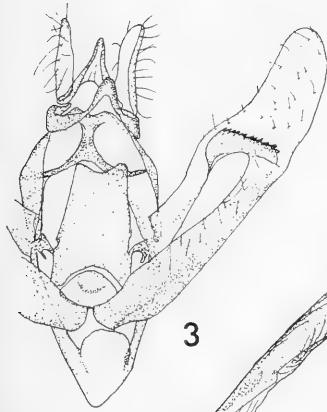
1a



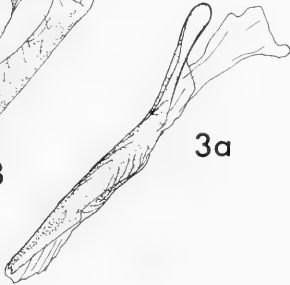
1b



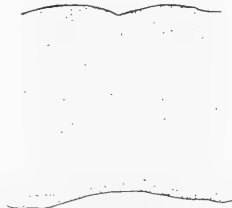
2a



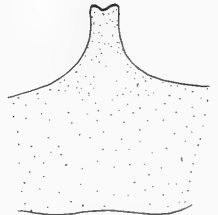
3



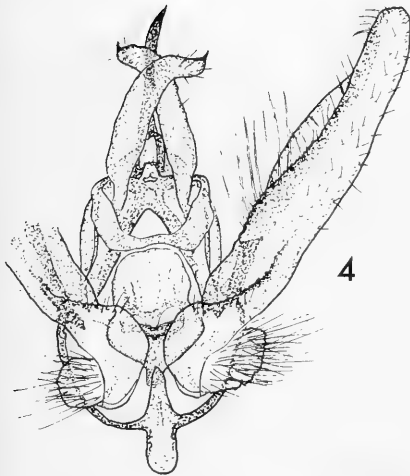
3a



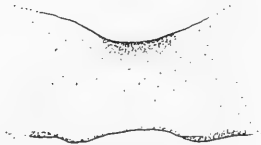
3b



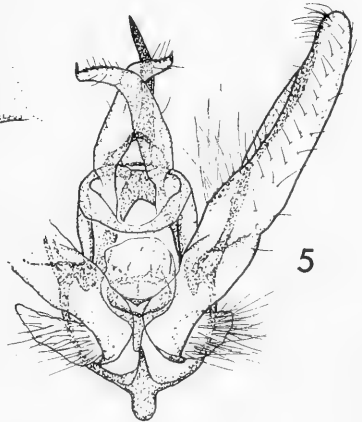
2b



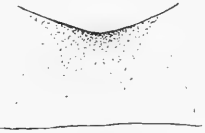
4



4b



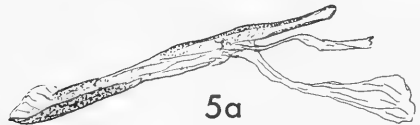
5



5b



4a



5a

PLATE 25

MALE GENITALIA

1. *Chlorochlamys chloroleucaria*. Boulder, Colo. a. aedeagus. b. 8th sternite.
2. *Chlorochlamys triangularis*. Spring Creek, Baker, Ore. a. aedeagus. b. 8th sternite.
3. *Chlorochlamys appellaria*, a paratype of *hesperia*. Borrego, Calif. a. aedeagus. b. 8th sternite.
4. *Chlorochlamys appellaria*, a paratype of *rubromediaria*. Eureka, Utah. a. aedeagus. b. 8th sternite.
5. *Chlorochlamys appellaria*. San Patricio Co., Texas. a. aedeagus. b. 8th sternite.

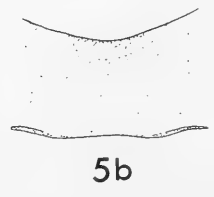
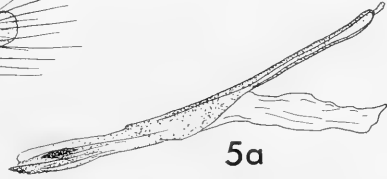
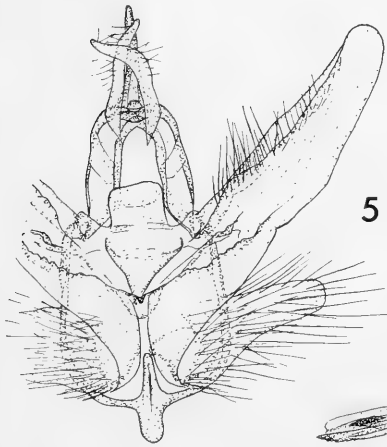
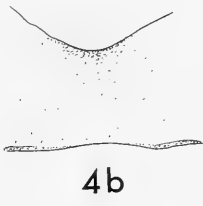
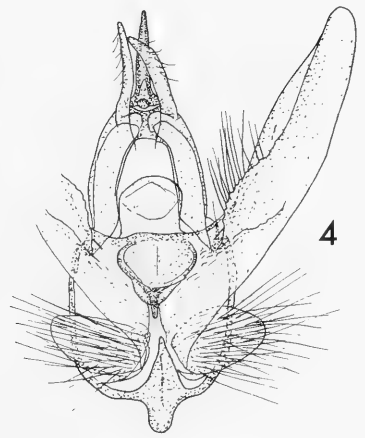
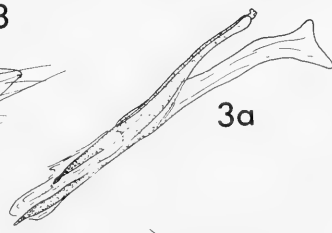
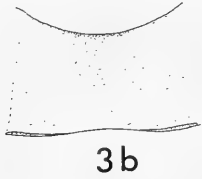
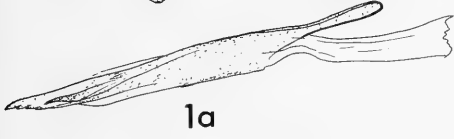
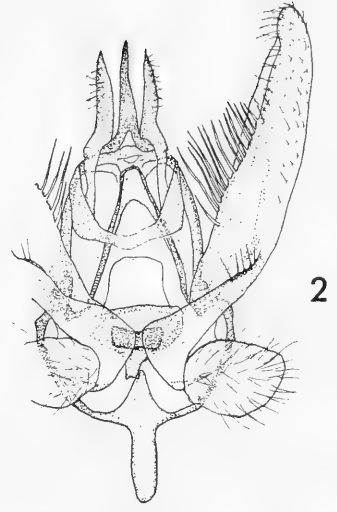
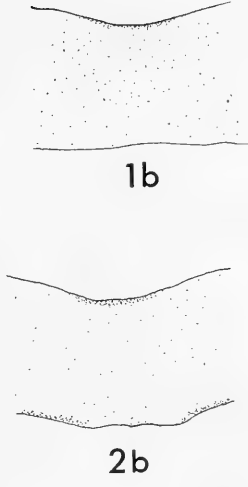
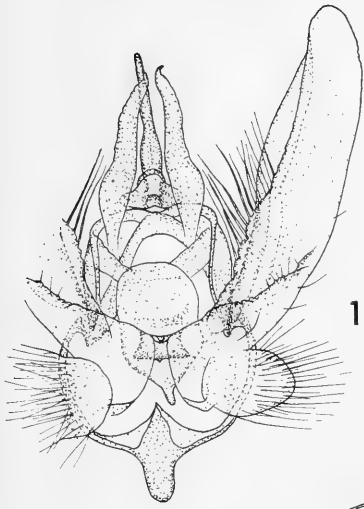


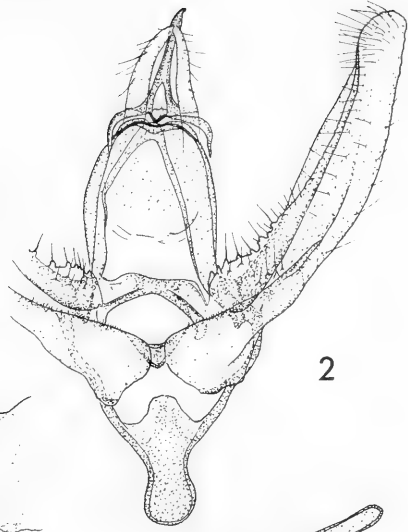
PLATE 26

MALE GENITALIA

1. *Chlorochlamys phyllinaria*. Peña Blanca, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.
2. *Xerochlora viridipallens*. Rock Creek Canyon, El Paso Co., Colo. Slide F.H. Rindge No. 8040 (AMNH) a. aedeagus.
3. *Xerochlora viridipallens*. Keystone Canyon, New York Mts., San Bernardino Co., Calif. a. aedeagus. b. 8th sternite.
4. *Xerochlora viridipallens*. Madera Canyon, Santa Cruz Co., Ariz. Vinculum, saccus, juxta, transtilla, etc. a. 8th sternite.
5. *Xerochlora viridipallens*. 18 mi N. of Silver City, N.M. Vinculum, saccus, juxta, transtilla, etc.



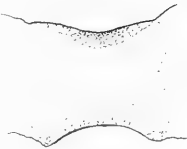
1



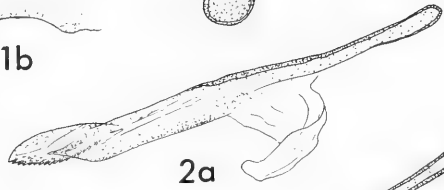
2



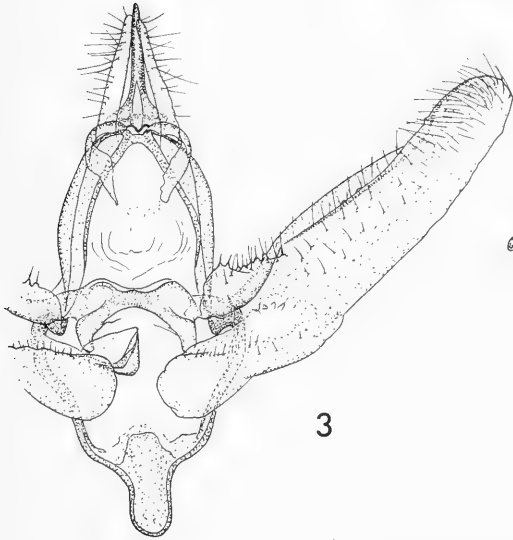
1a



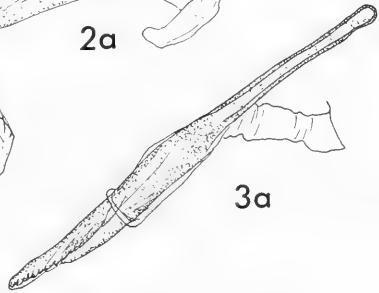
1b



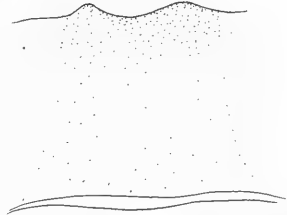
2a



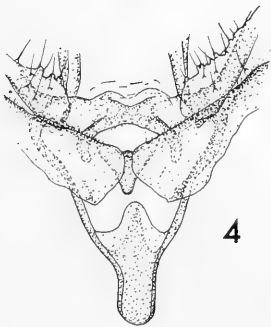
3



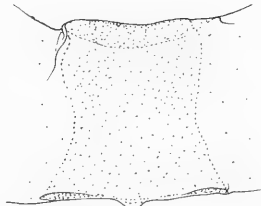
3a



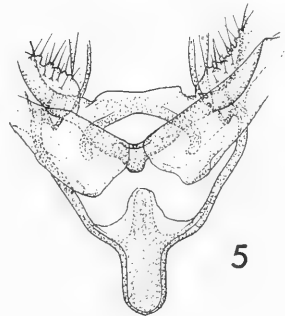
3b



4



4a

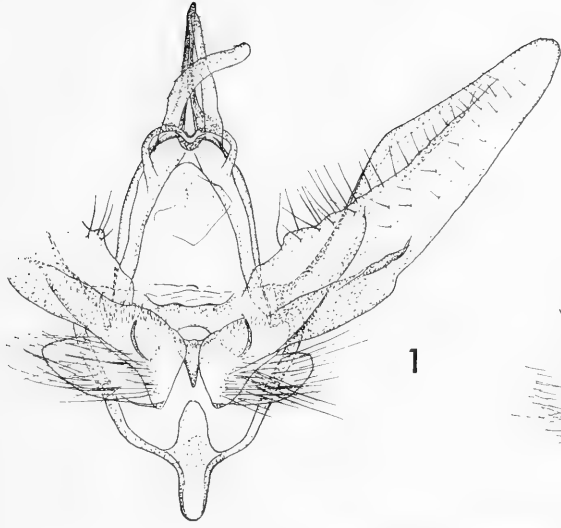


5

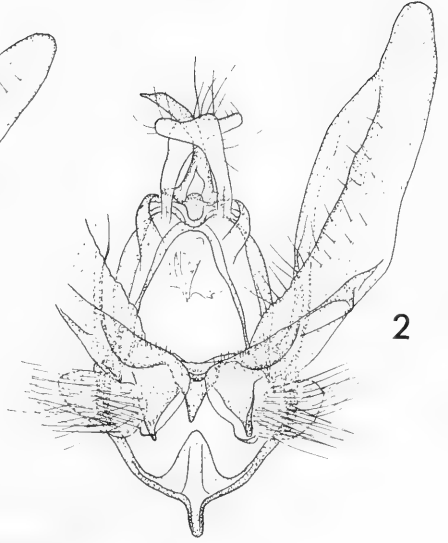
PLATE 27

MALE GENITALIA

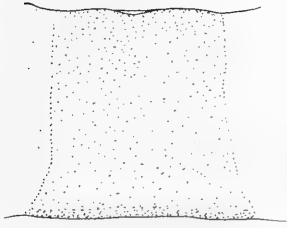
1. *Xerochlora masonaria*, Madera Canyon, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.
2. *Xerochlora inveterascaria*, Peña Blanca, Santa Cruz Co., Ariz. a. aedeagus. b. 8th sternite.
3. *Xerochlora martinaria*, holotype. a. aedeagus. b. 8th sternite.



1



2



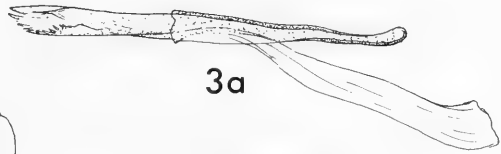
1b



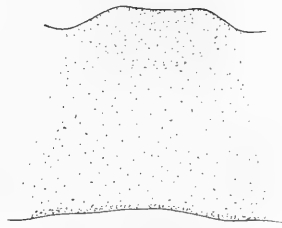
1a



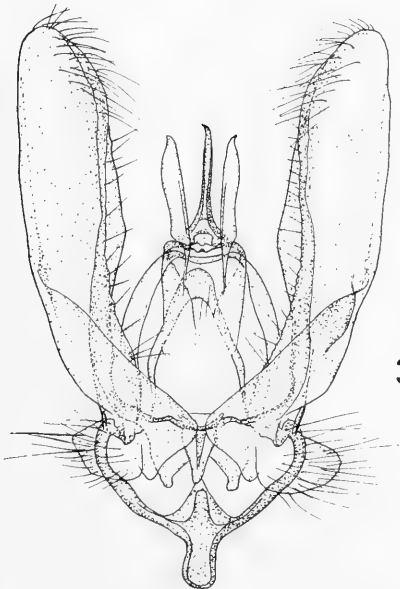
2a



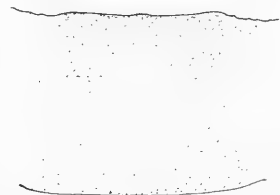
3a



2b



3

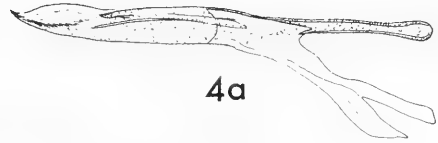
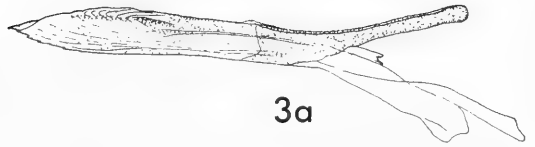
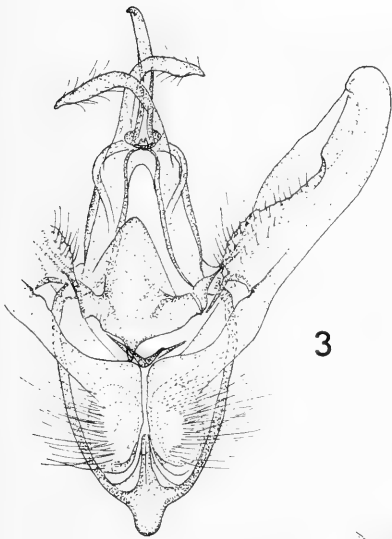
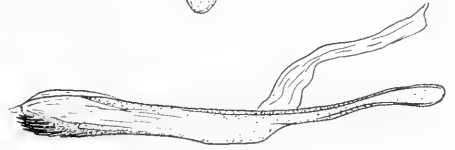
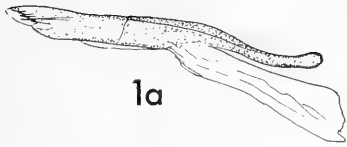
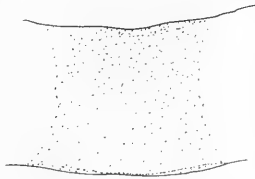
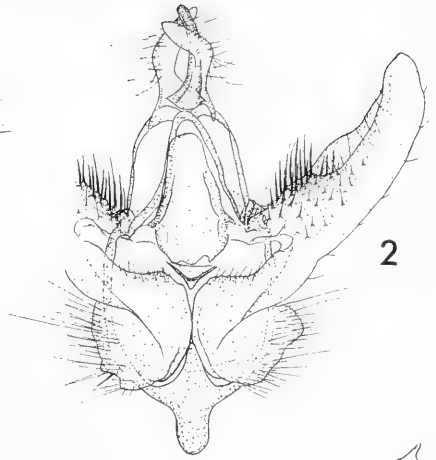
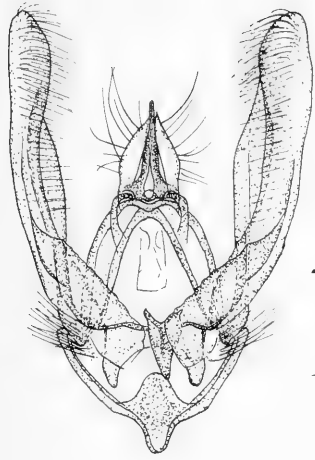


3b

PLATE 28

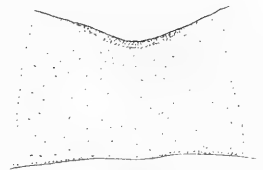
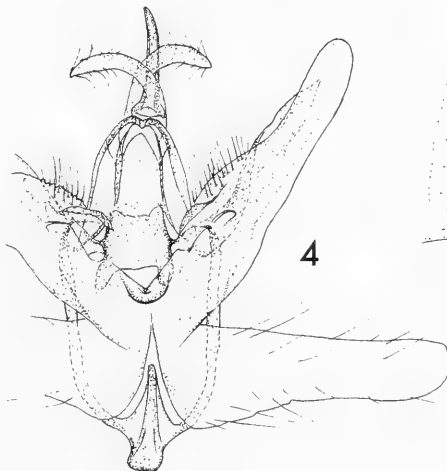
MALE GENITALIA

1. *Xerochlora mesotheides*, holotype. a. aedeagus. b. 8th sternite.
2. *Chloropteryx paularia*. Siesta Key, Sarasota Co., Fla. a. aedeagus. b. 8th sternite.
3. *Chloropteryx tepperaria*. Lake Placid, Highlands Co., Fla. a. aedeagus. b. 8th sternite.
4. *Chloropteryx nordicaria*. Mercedes, Hidalgo Co., Texas. a. aedeagus. b. 8th sternite.



4a

4a



4b

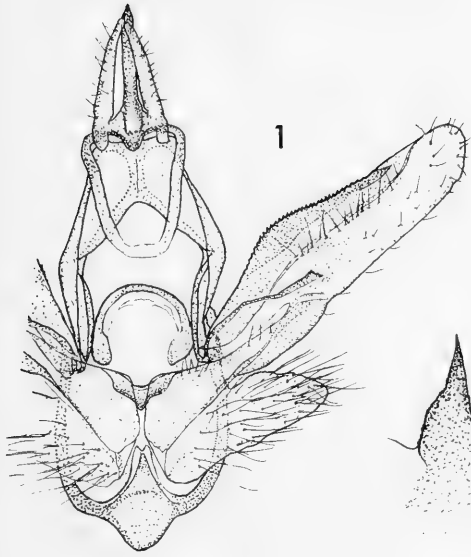
3b

3b

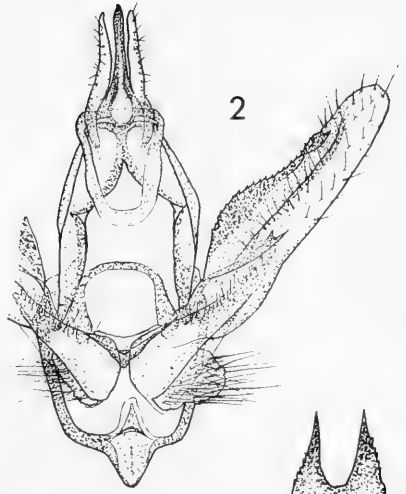
PLATE 29

MALE GENITALIA

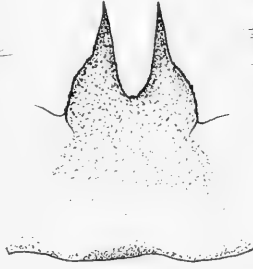
1. *Hethemia pistasciaria*. Armdale, Halifax Co., N.S. a. aedeagus. b. 8th sternite.
2. *Hethemia pistasciaria*. Welaka, Putnam Co., Fla. a. aedeagus. b. 8th sternite.
3. *Mesothea incertata viridipennata*. Stimson Creek, Mason Co., Wash. a. aedeagus. b. 8th sternite.
4. *Mesothea incertata*. Halifax Watershed Area, Halifax Co., N.S. a. aedeagus. b. 8th sternite.



1



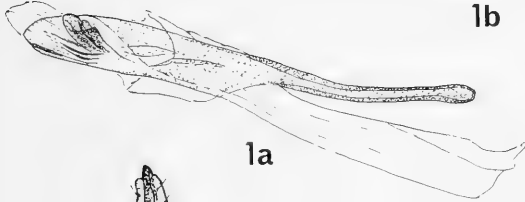
2



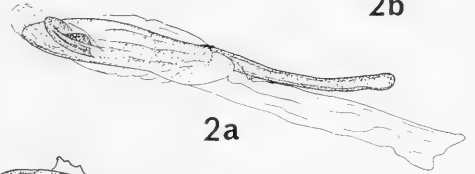
1b



2b



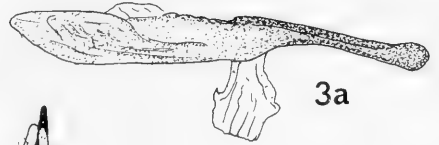
1a



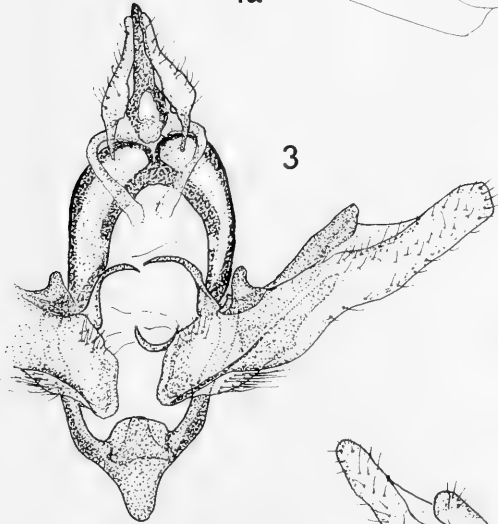
2a



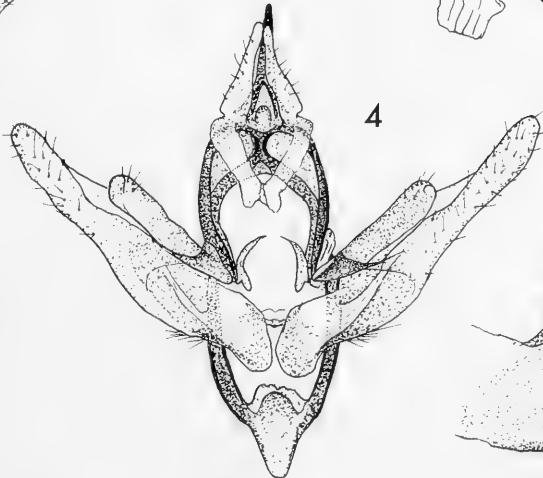
4a



3a



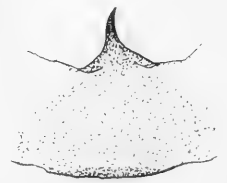
3



4



3b



4b

PLATE 30

FEMALE GENITALIA

1. *Chlorosea nevadaria*. Reno, Nev. Slide HWC 1627 (USNM).
2. *Chlorosea banksaria*. Shasta Retreat, Calif. Slide JFGC 1294 (USNM).
3. *Chlorosea margaretaria*. Mammoth Camp, Mono Co., Calif.
4. *Chlorosea roseitacta*. Manitou, Colo. Slide HWC 1629 (USNM).
5. *Nemoria pulcherrima*. Lower Mint Canyon, Los Angeles Co., Calif.
6. *Nemoria unitaria*. Joe Dollar Gulch, Hill City, S.D.
7. *Nemoria latirosaria*. Turkey Creek, White Mts., Ariz.

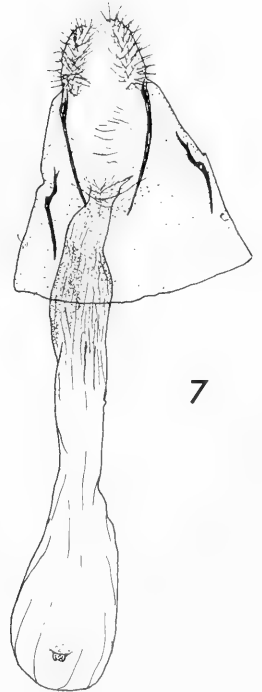
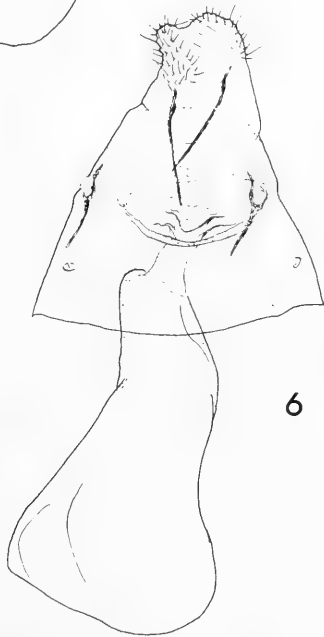
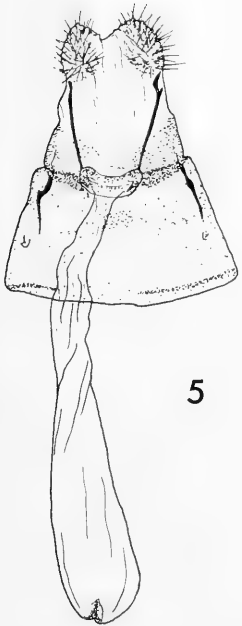
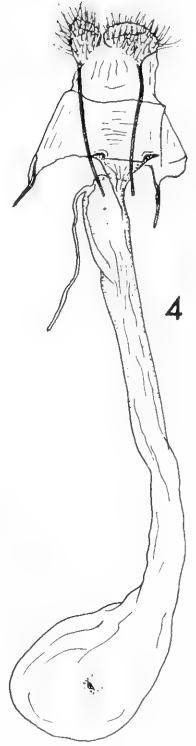
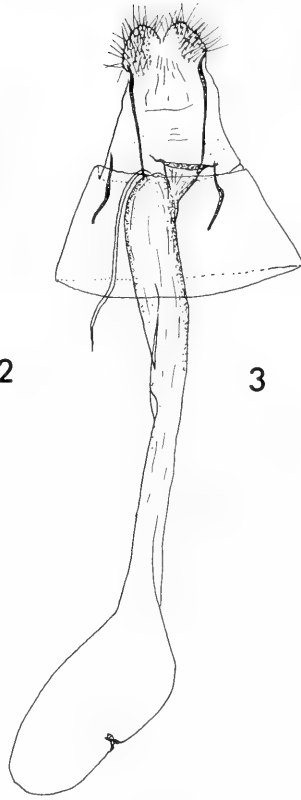
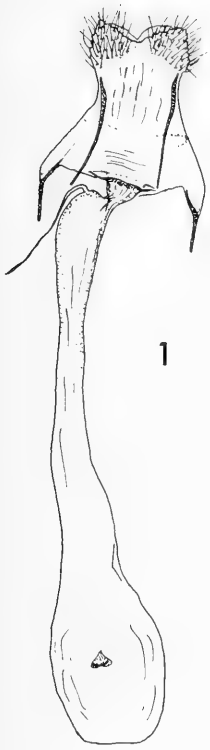


PLATE 31

FEMALE GENITALIA

1. *Nemoria aemularia*, paratype. Paradise, Ariz.
2. *Nemoria arizonaria*. Paradise, Ariz.
3. *Nemoria daedalea*, paratype. Madera Canyon, Santa Cruz Co., Ariz.
4. *Nemoria viridicaria*. Uncompahgre Plateau, 16 mi. S.W. of Montrose, Montrose Co., Colo.
5. *Nemoria diamesa*, paratype. Southwest Research Station of the AMNH, near Portal, Cochise Co., Ariz.
6. *Nemoria subsequens*, paratype. Pine Camp, near Cloudcroft, Otero Co., N.M.

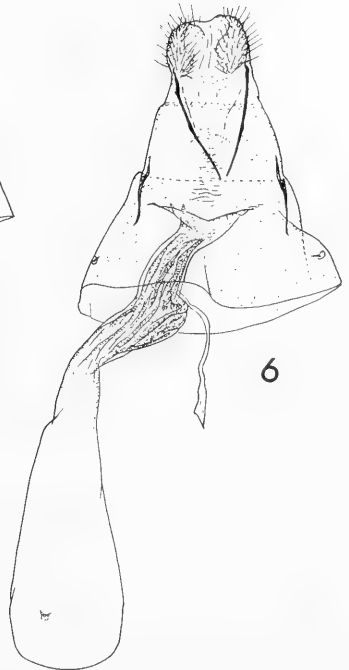
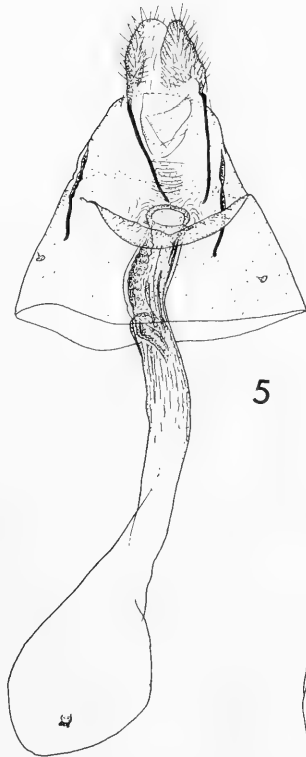
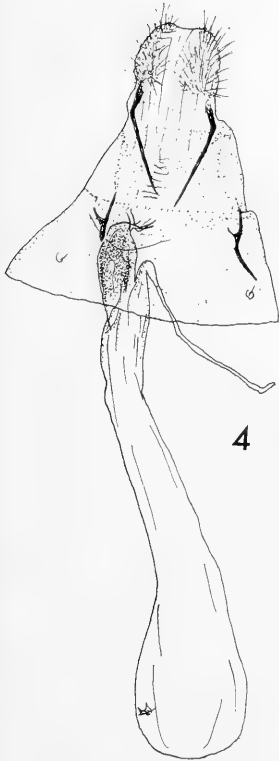
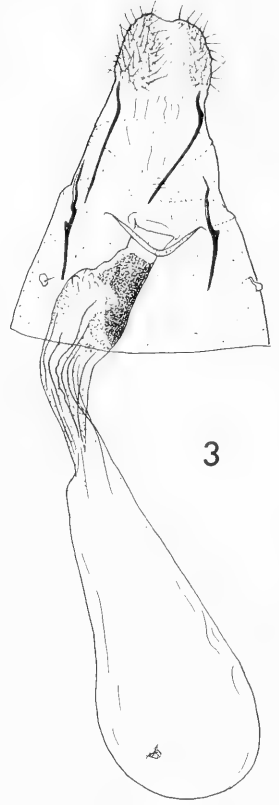
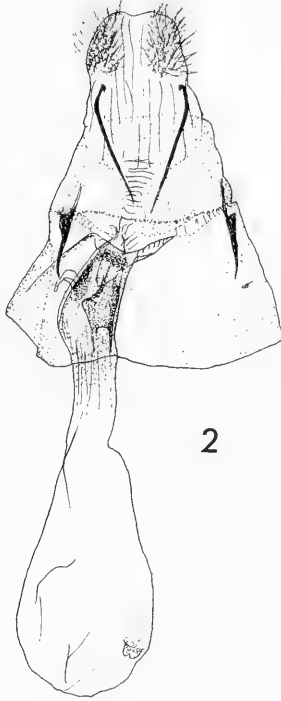
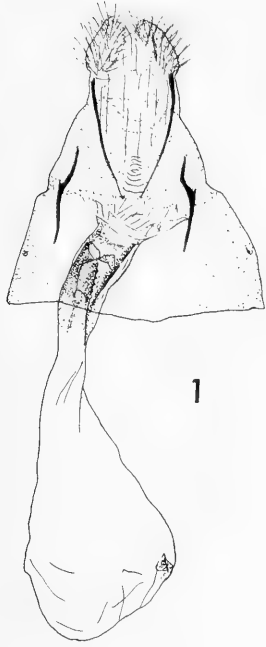


PLATE 32

FEMALE GENITALIA

1. *Nemoria albaria*. Rustler Park, Chiricahua Mts., Ariz.
2. *Nemoria pistacearia*. Bear Creek Road, Contra Costa Co., Calif.
3. *Nemoria extremaria*. Lake Placid, Highlands Co., Fla.
4. *Nemoria elfa*, paratype. Monticello, Fla.
5. *Nemoria outina*, paratype. Lake Placid, Highlands Co., Fla.
6. *Nemoria catachloa*. Lake Placid, Highlands Co., Fla.
7. *Nemoria tuscarora*, holotype.

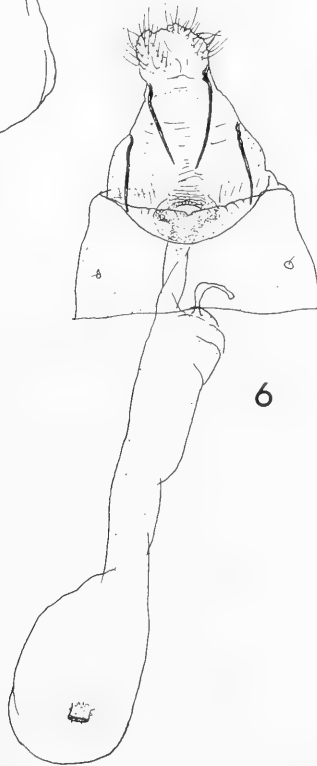
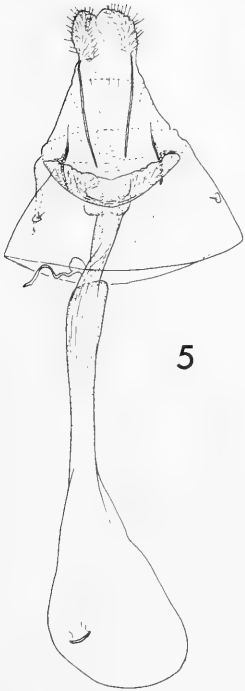
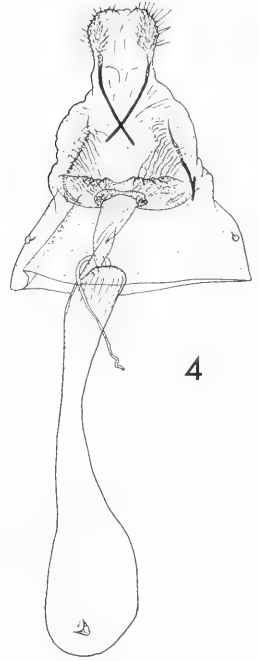
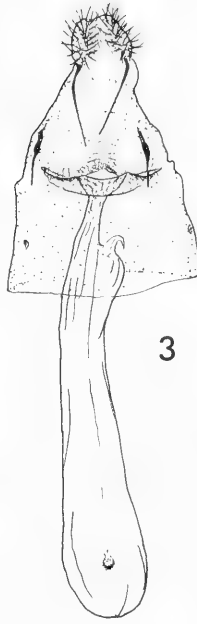
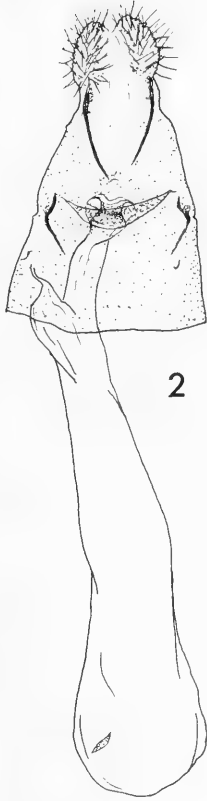
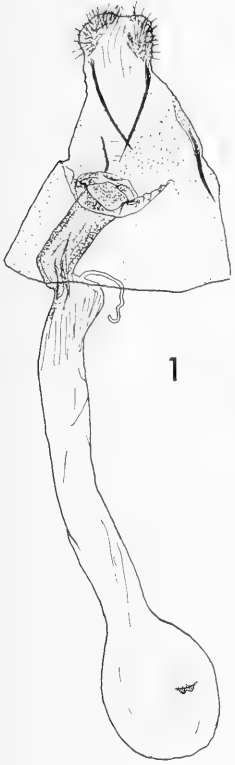


PLATE 33

FEMALE GENITALIA

1. *Nemoria lixaria*. Welaka, Putnam Co., Fla.
2. *Nemoria saturiba*, paratype. Screven Co., Ga.
3. *Nemoria darwiniata*. Wallace, Idaho.
4. *Nemoria darwiniata punctularia*. Angeles Crest, Los Angeles Co., Calif.
5. *Nemoria zelotes*, paratype. Sunnyside, west side Huachuca Mts., Ariz.
6. *Nemoria obliqua*. Glenwood Springs, Colo.

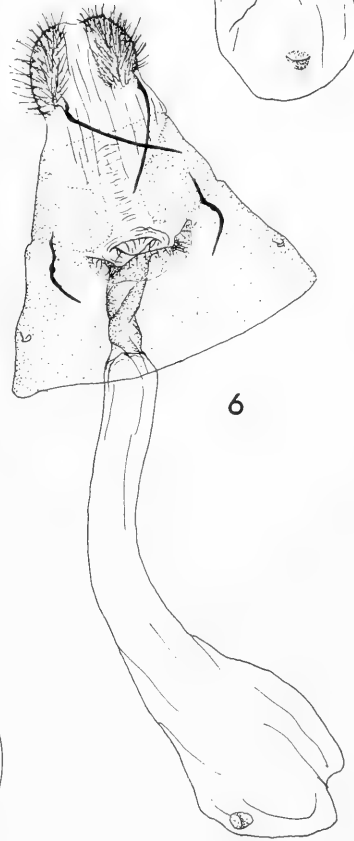
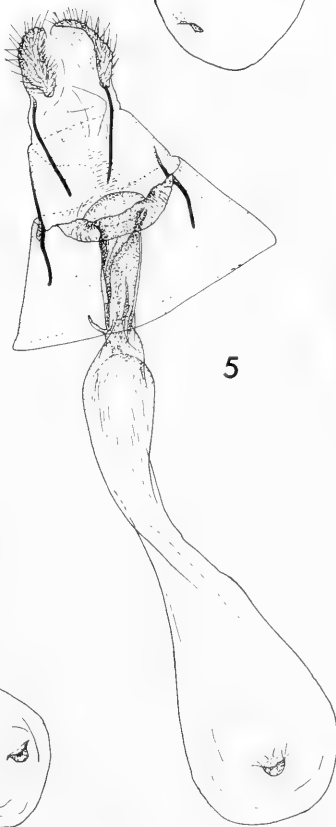
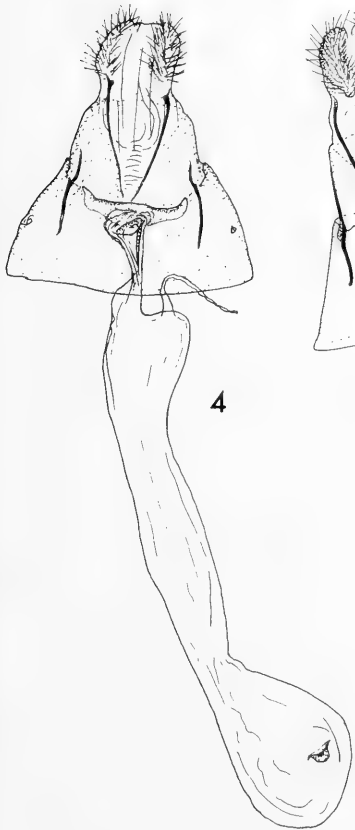
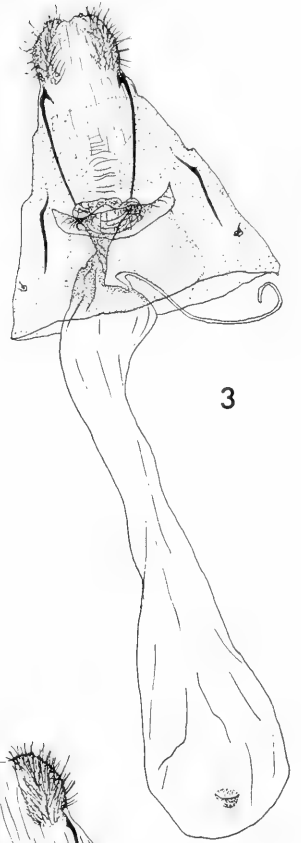
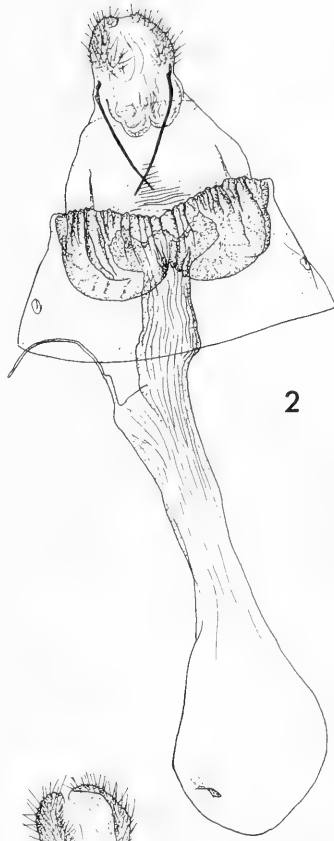
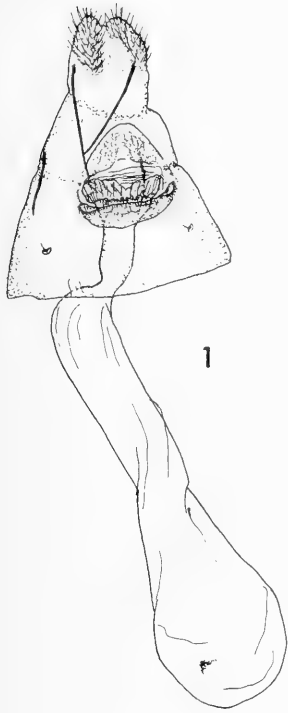
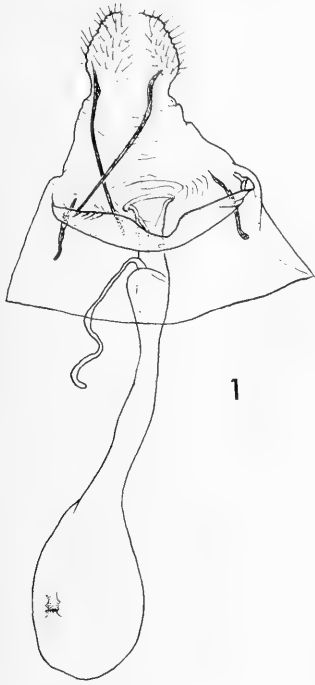


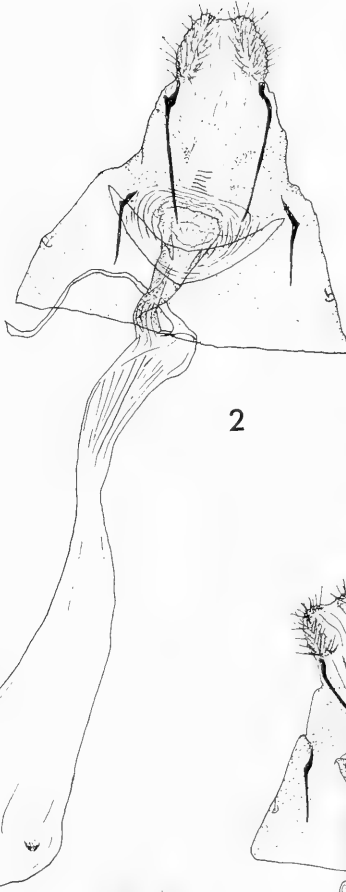
PLATE 34

FEMALE GENITALIA

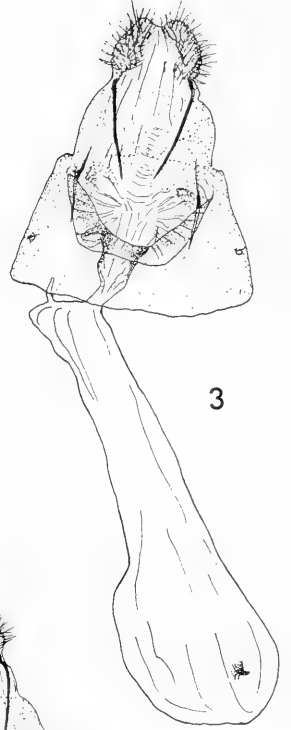
1. *Nemoria splendidaria*. 10 mi. W. of El Salto, Durango, Mexico.
2. *Nemoria strigataria*. Madera Canyon, Santa Cruz Co., Ariz.
3. *Nemoria zygotaria*. Kerrville, Texas.
4. *Nemoria leptalea*. La Mesa, San Diego Co., Calif.
5. *Nemoria caerulescens*. Jemez Springs, N.M.
6. *Nemoria intensaria*. Dividend, Utah.
7. *Nemoria intensaria*. Kyle Canyon, Mt. Charleston, Clark Co., Nev.



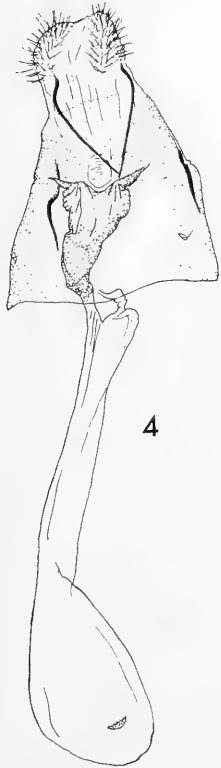
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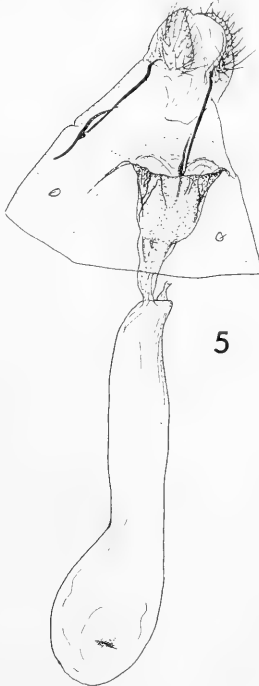
2



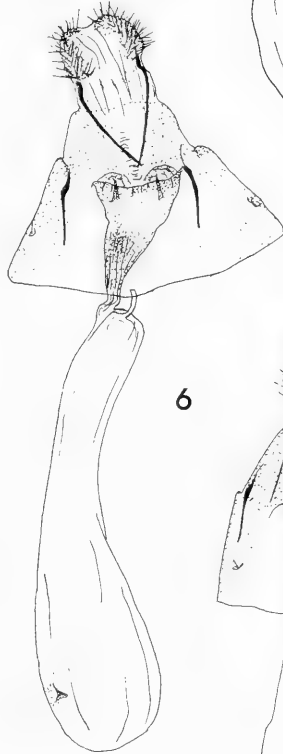
3



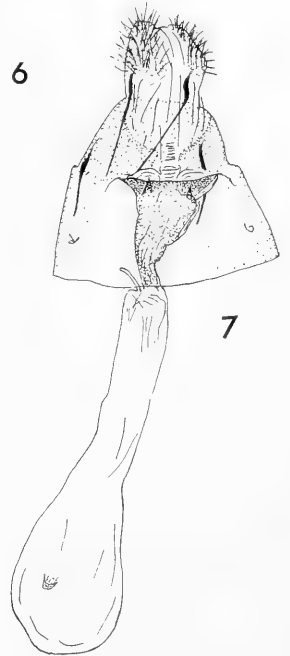
4



5



6



7

PLATE 35

FEMALE GENITALIA

1. *Nemoria festaria*: Madera Canyon, Santa Cruz Co., Ariz.
2. *Nemoria biflata*. Tampa, Fla.
3. *Nemoria biflata planuscula*, a brown specimen. Dallas, Texas.
4. *Nemoria bistriaria*. Crailhope, Ky.
5. *Nemoria mimosaria*. Halifax Watershed Area, Halifax Co., N.S.
6. *Nemoria rubrifrontaria*. Bog on Prospect Road, Halifax Co., N.S.

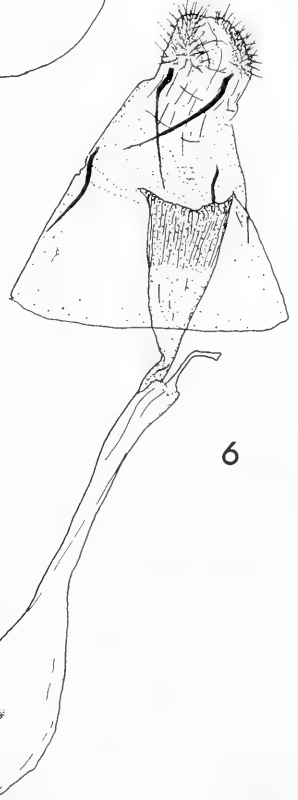
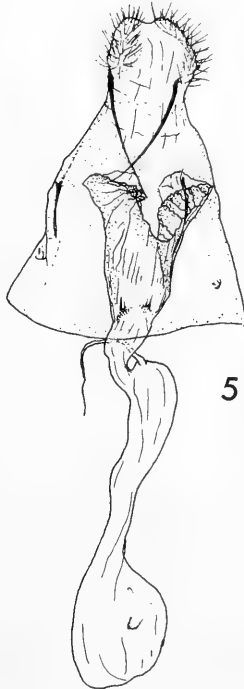
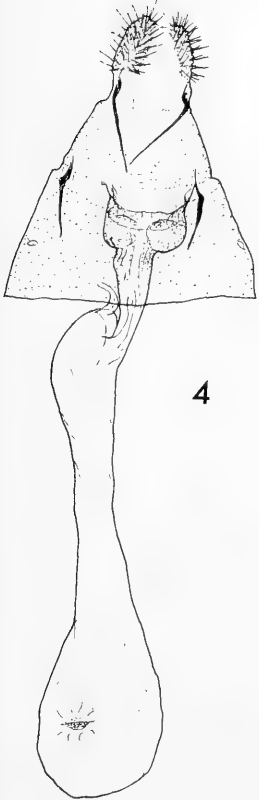
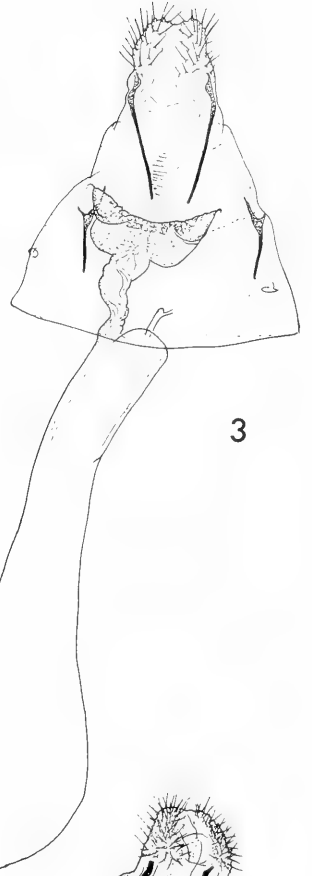
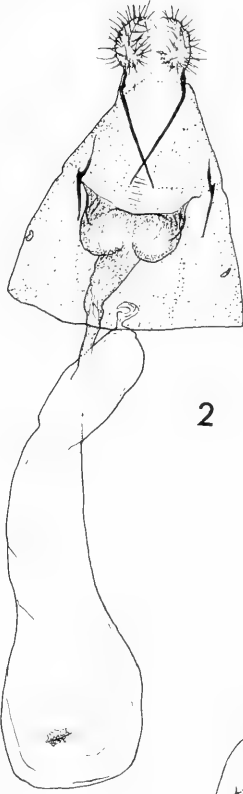
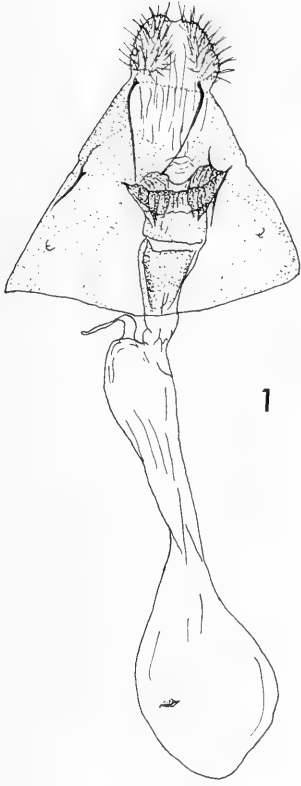


PLATE 36

FEMALE GENITALIA

1. *Nemoria glaucomarginaria*. Sonoma Co., Calif.
2. *Nemoria rindgei*, paratype. Lordsburg, N.M.
3. *Phrudocentra centrifugaria*. Lake Placid, Highlands Co., Fla.
4. *Dichorda rectaria*. Portal, Cochise Co., Ariz.
5. *Dichorda iridaria*. Valley Cottage, Rockland Co., N.Y.
6. *Dichorda illustraria*. Anderson Springs, Lake Co., Calif.
7. *Dichorda consequaria*. Madera Canyon, Santa Cruz Co., Ariz.

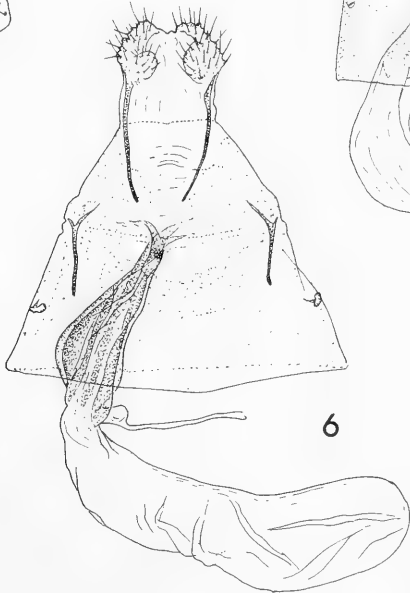
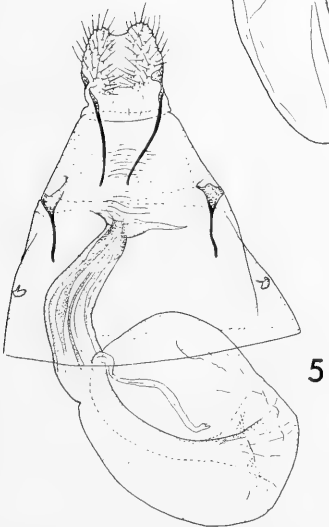
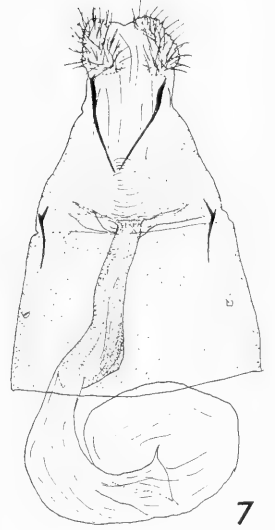
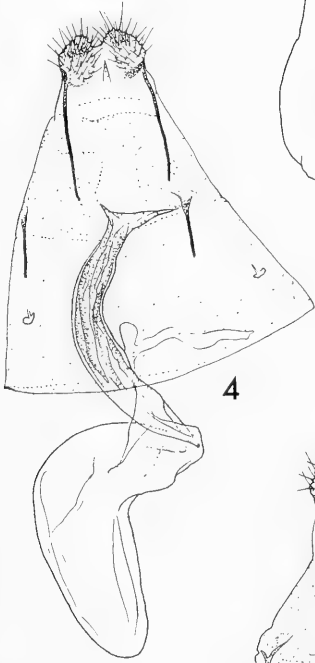
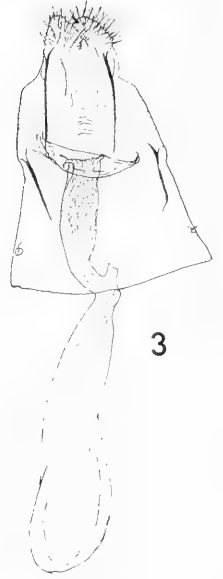
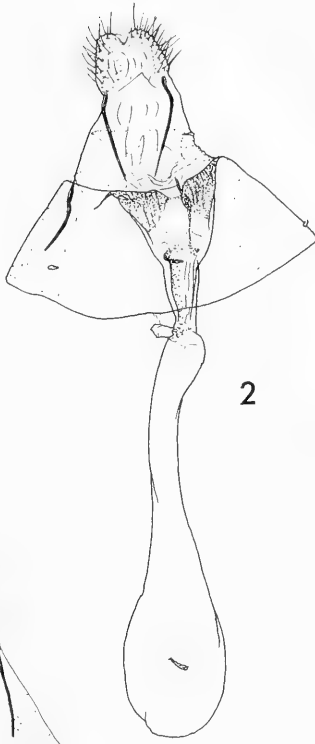
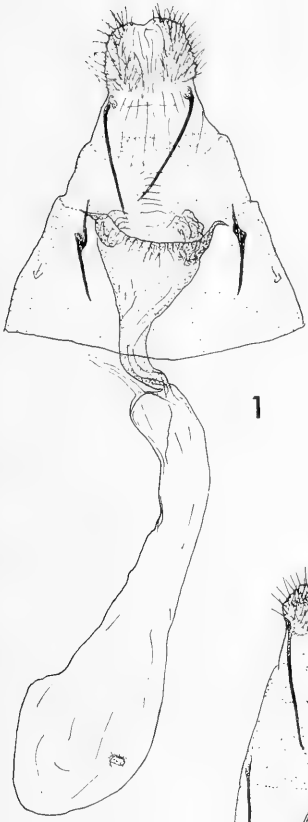
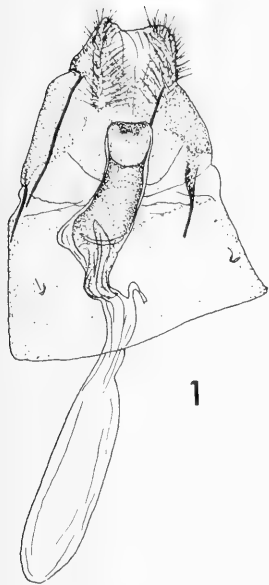


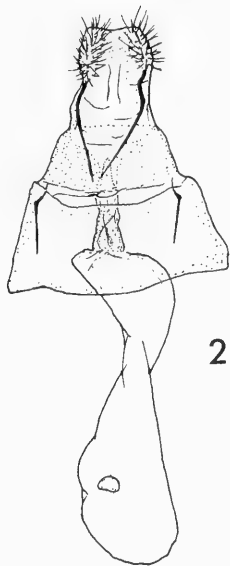
PLATE 37

FEMALE GENITALIA

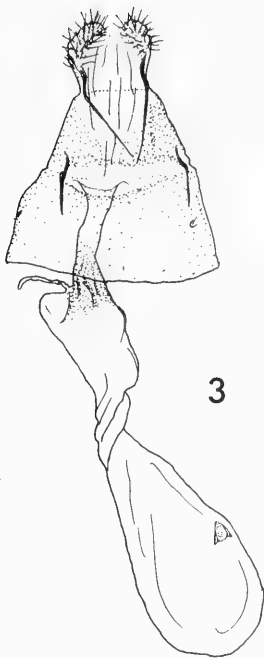
1. *Dichordophora phoenix*. Mt. Lemmon, Pima Co., Ariz.
2. *Synchlora aerata*. Freehold, N.J.
3. *Synchlora liquoraria*. Anderson Springs, Lake Co., Calif.
4. *Synchlora liquoraria albolineata*. Doyles, Nfld.
5. *Synchlora frondaria denticularia*. Lake Placid, Highlands Co., Fla.
6. *Synchlora frondaria avidaria*. Saguaro National Monument, Pima Co., Ariz.
7. *Synchlora gerularia*. Sarasota Co., Fla.
8. *Synchlora cupedinaria*. St. Petersburg, Fla.



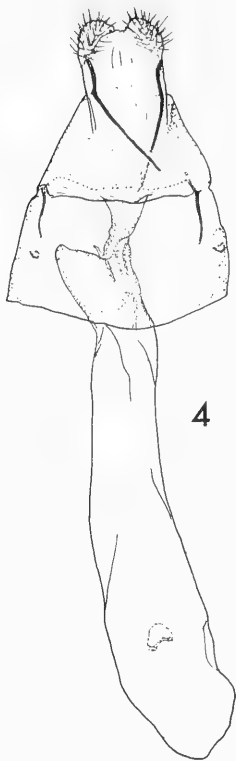
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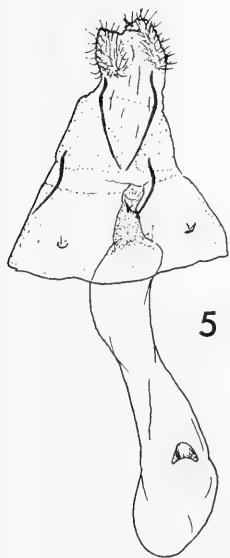
2



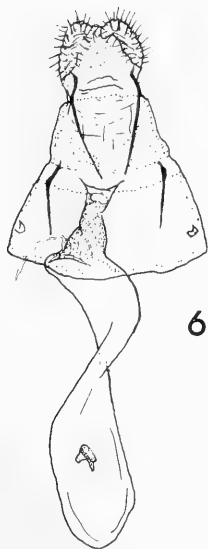
3



4



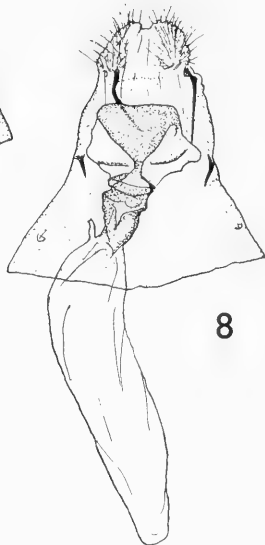
5



6



7

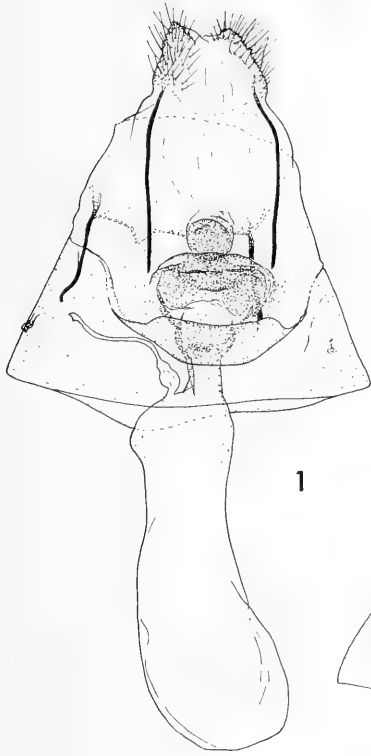


8

PLATE 38

FEMALE GENITALIA

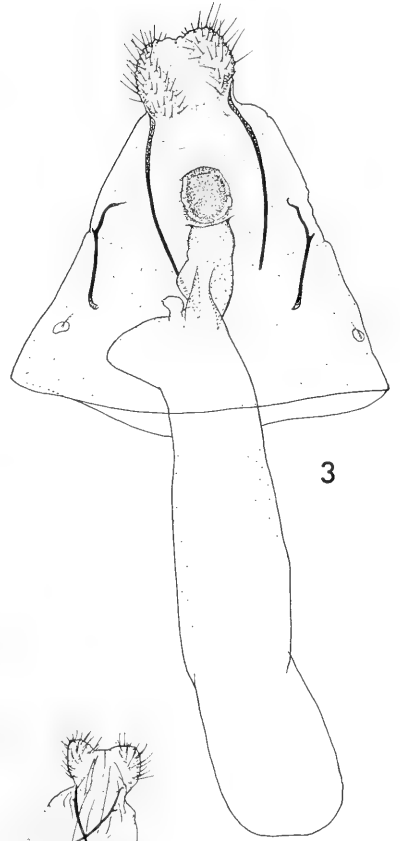
1. *Synchlora irregularia*, paratype.
2. *Synchlora indecora*. Jalapa, Mexico. Ductus bursae, ostium, postostial plate.
3. *Synchlora noel*. Borrego, Calif.
4. *Synchlora herbaria hulstiana*. Key Largo, Fla.
5. *Cheteoscelis bistrifaria*. Vineyard, Utah.
6. *Cheteoscelis pectinaria*. Paradise, Ariz.
7. *Merochlora faseolaria*. San Diego, Calif. Slide HWC 6027 (USNM).
8. *Merochlora graefiaria*. Barton Flats, San Bernardino Co., Calif.



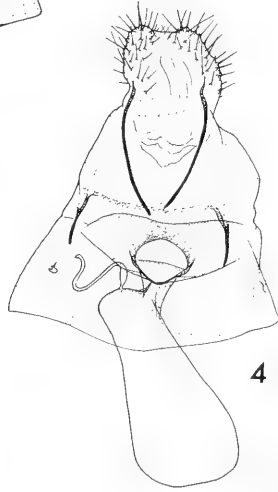
1



2



3



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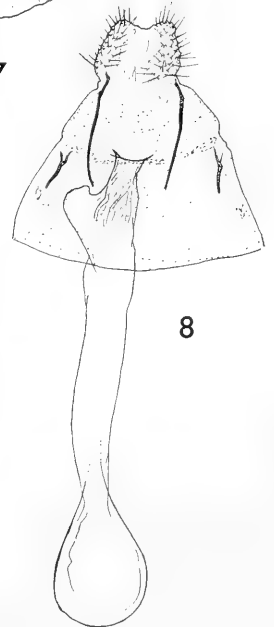
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PLATE 39

FEMALE GENITALIA

1. *Eueana niveociliaria*. Palm Beach, Fla.
2. *Chlorochlamys chloroleucaria*. Brierly Brook, Antigonish Co., N.S.
3. *Chlorochlamys triangularis*. Biggs, Ore.
4. *Chlorochlamys appellaria*. White City, Eddy Co., N.M.
5. *Chlorochlamys phyllinaria*. Winfield, La. Slide HWC 1069 (USNM).
6. *Xerochlora viridipallens*. Rock Creek Canyon, El Paso Co., Colo.

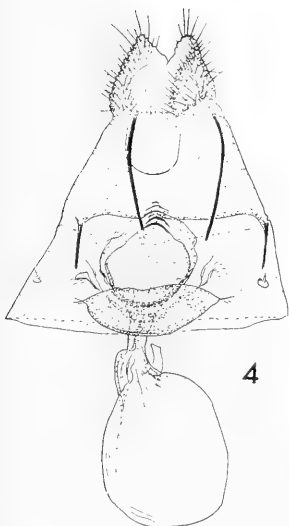
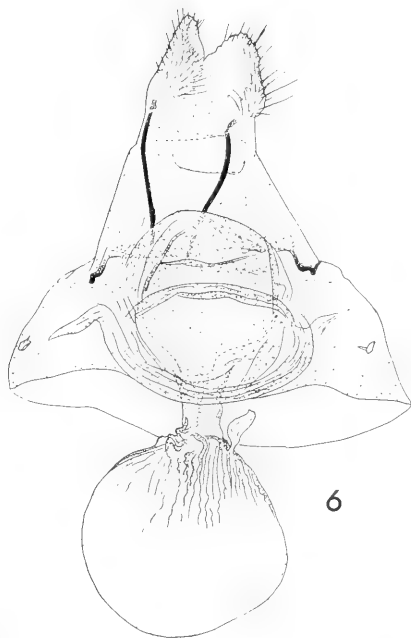
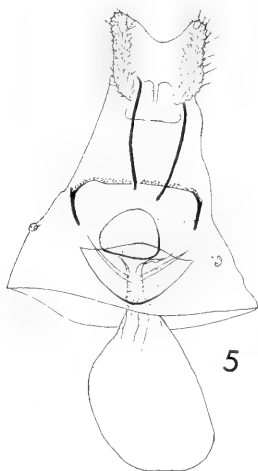
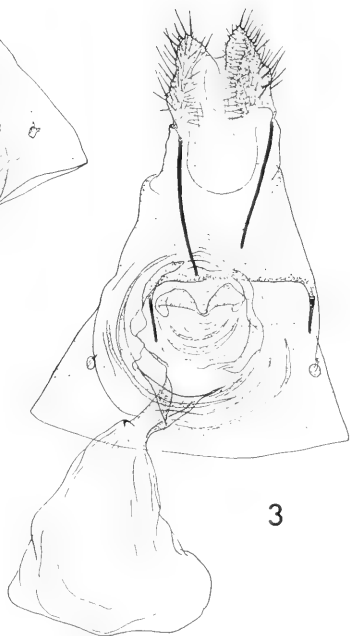
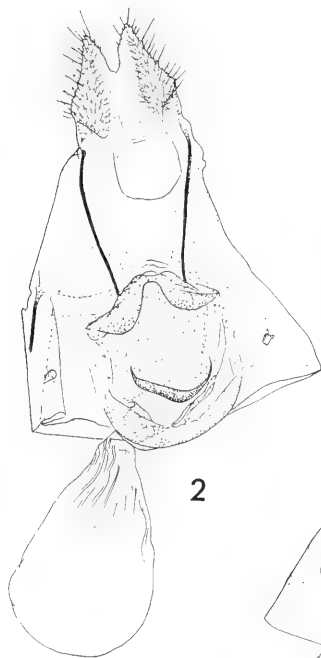
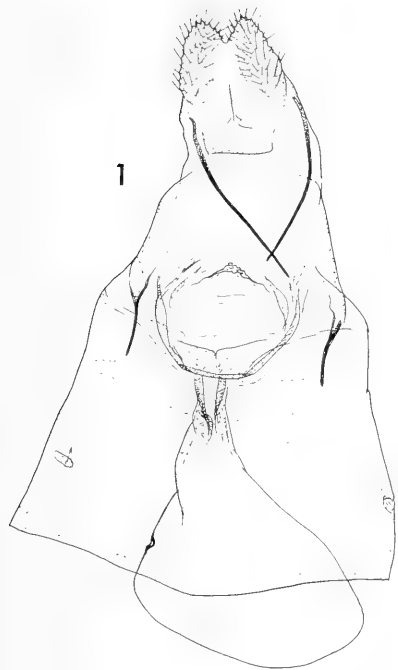
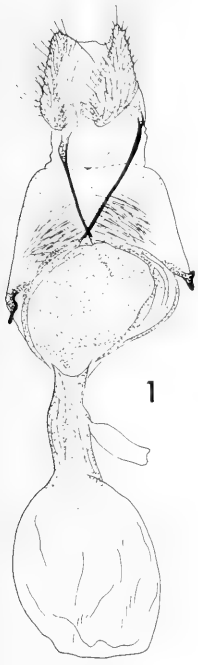


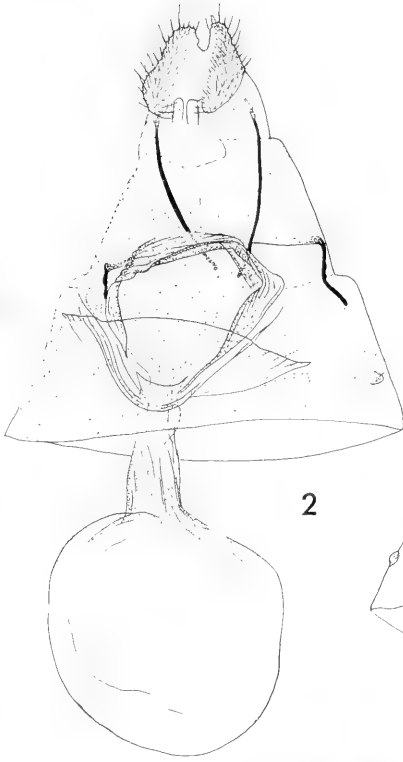
PLATE 40

FEMALE GENITALIA

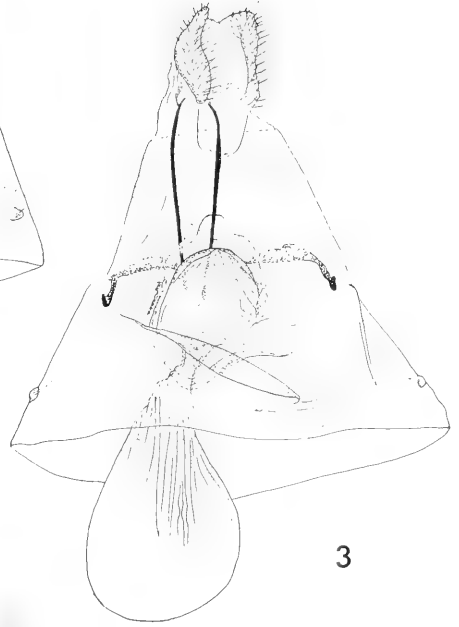
1. *Xerochloa masonaria*, holotype.
2. *Xerochloa masonaria*, McMillan Camp, near Silver City, N.M.
3. *Xerochloa inveterascaria*. Peña Blanca, Santa Cruz Co., Ariz.
4. *Xerochloa martinaria*. Madera Canyon, Santa Cruz Co., Ariz.
5. *Xerochloa martinaria*. Madera Canyon, Santa Cruz Co., Ariz. Another specimen to show variation in genital plate region.
6. *Xerochloa mesotheides*, paratype. Sierra Blanca, Texas.



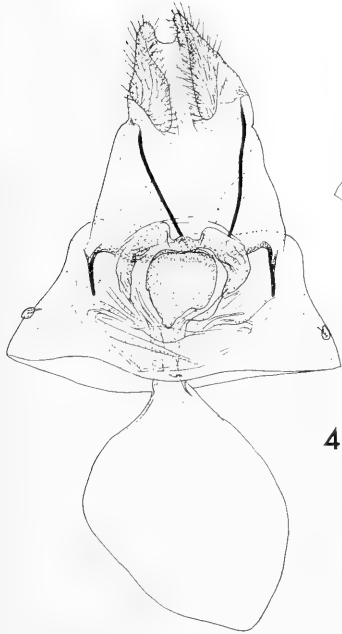
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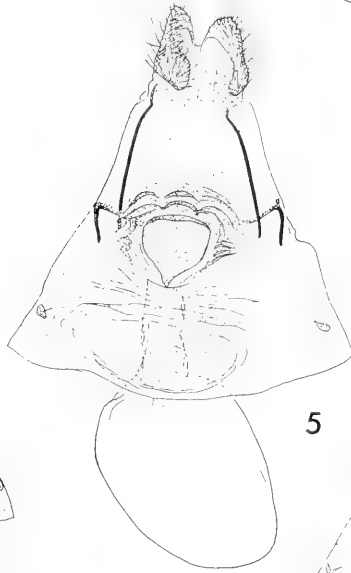
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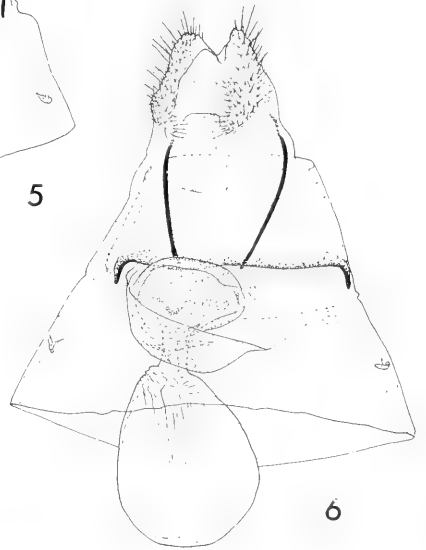
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PLATE 41

FEMALE GENITALIA

1. *Chloropteryx tepperaria*. Screven Co., Ga.
2. *Chloropteryx nordicaria*. Mercedes, Hidalgo Co., Texas.
3. *Chloropteryx paularia*. Florida City, Fla.
4. *Hethemia pistasciaria*. Lakehurst, N.J.
5. *Mesothea incertata*. Mount Uniacke, Hants Co., N.S.
6. *Mesothea incertata viridipennata*. Wellington, B.C.

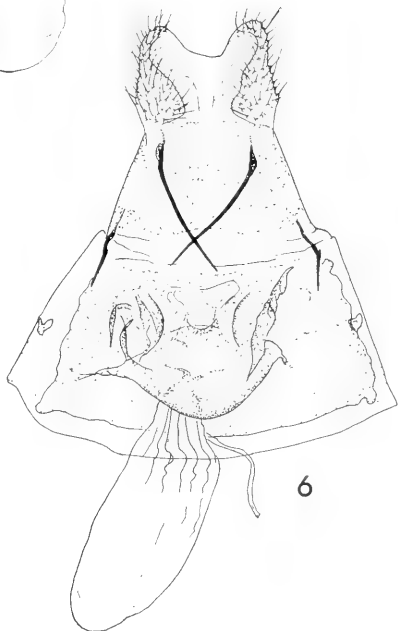
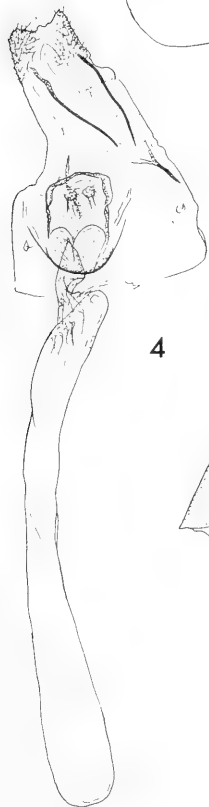
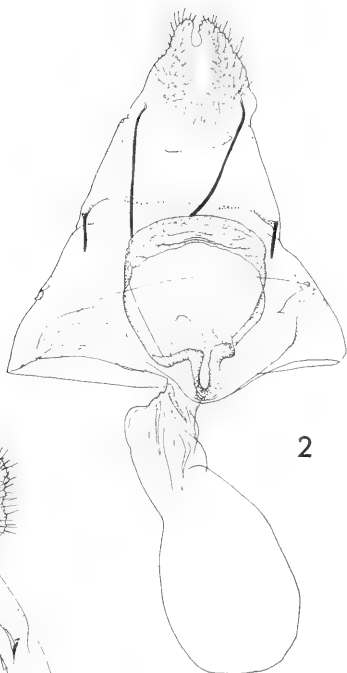
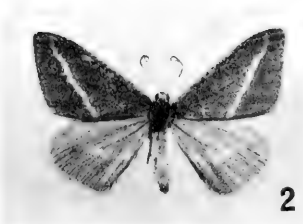


PLATE 42

1. *Chlorosea margaretaria* ♂ . Argus Mts., Calif., May 31, 1941 (collection JGF).
2. *Chlorosea margaretaria* ♂ . Paratype. Leevining, Mono Co., Calif., July 19, 1938, E.C. Johnston (CNC).
3. *Chlorosea margaretaria* ♀ . Shady Rest Campground, Mammoth Camp, Mono Co., Calif., July 13, 1965, T.W. Davies (YPM).
4. *Chlorosea nevadaria* ♂ . Kyle Canyon, 8100', Mt. Charleston, Clark Co., Nev., July 7, 1967, T.W. Davies (YPM).
5. *Chlorosea nevadaria* ♀ . Fossil Station, Lincoln Co., Wyo., July 31, 1964, C.J. Durden (YPM).
6. *Chlorosea nevadaria* ♀ . Kaslo, B.C., July 7, 1922, J.W. Cockle (CNC).
7. *Chlorosea banksaria*, ♂ paratype. Shasta Retreat, Siskiyou Co., Calif., July 1-7, Barnes collection (USNM).
8. *Chlorosea banksaria* ♂ . Wellington, V.I., B.C., June 28, 1954, Richard Guppy (collection DCF).
9. Same specimen as figure 8, enlarged to show abdominal markings.
10. *Chlorosea banksaria gracearia* ♂ . Hughes' Lake [Los Angeles Co.], Calif., "6-9-1927" (CNC).
11. *Chlorosea roseitacta* ♂ . Madera Canyon, 5600', Santa Cruz Co., Ariz., June 28, 1963, JGF (collection JGF).
12. *Chlorosea roseitacta* ♀ . Madera Canyon, 4880', Santa Cruz Co., Ariz., Oct. 23, 1959, JGF (collection JGF).
13. *Nemoria pulcherrima* ♂ , green form. Head of E. fork Piney Cr., 2200', Penon Blanco Rd. near Coulterville, Mariposa Co., Calif., Jan. 28, 1966, T.W. Davies (YPM).
14. *Nemoria pulcherrima* ♂ , green form. Petaluma, Calif., Feb. 12, 1937, E.C. Johnston (CNC).
15. *Nemoria pulcherrima* ♀ , green form. Petaluma, Calif., Feb. 5, 1940, E.C. Johnston (collection DCF).
16. *Nemoria pulcherrima* ♂ , brown form. Same data as for figure 13.
17. *Nemoria mutaticolor* ♂ . Madera Canyon, 5600', Santa Rita Mts., Santa Cruz Co., Ariz., July 1, 1963, JGF (collection JGF).
18. *Nemoria unitaria* ♂ . Hart Prairie, 8500', 10 mi. NNW of Flagstaff, Coconino Co., Ariz., July 9, 1964, JGF (collection JGF).
19. *Nemoria unitaria* ♂ , from type locality of *hudsonaria*. Red Deer River, 50 mi. NE of Gleichen, Alta., July 6, 1905, F.H. Wolley Dod (CNC).
20. *Nemoria unitaria*, ♂ paratype of *unilinearia*. Kaslo, B.C., July 7, 1907, J.W. Cockle (CNC).
21. *Nemoria unitaria* ♀ . Bucks Valley, Iron Co., Utah (USNM).



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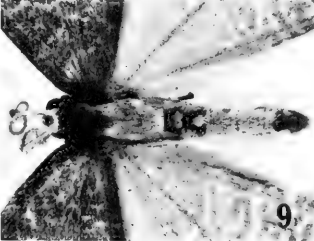
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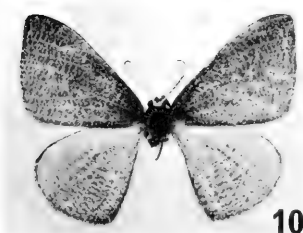
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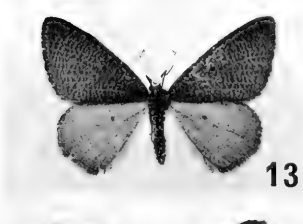
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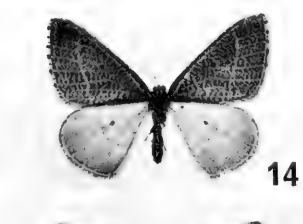
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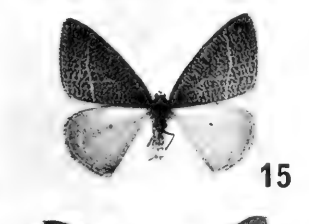
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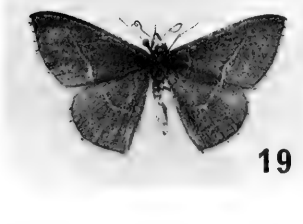
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1. *Nemoria latirosaria* ♂ . Walnut Canyon, 6500', 6-1/3 mi. EESE of Flagstaff, Coconino Co., Ariz., June 19, 1965, JGF (collection JGF).
2. *Nemoria aemularia*, ♂ paratype. Palmerlee, Cochise Co., Ariz. (USNM).
3. *Nemoria aemularia* ♂ . Madera Canyon, 5800', Santa Cruz Co., Ariz., June 29, 1960, JGF (collection JGF).
4. *Nemoria aemularia* ♀ . Madera Canyon, 4880', Santa Cruz Co., Ariz., July 24, 1959, JGF (collection JGF).
5. *Nemoria arizonaria* ♂ . Madera Canyon, 5000', Santa Cruz Co., Ariz., Mar. 21, 1961, R. Leuschner (collection JGF).
6. *Nemoria arizonaria* ♀ . Madera Canyon, 4880', Santa Cruz Co., Ariz., Mar. 29, 1963, JGF (collection JGF).
7. *Nemoria daedalea*, holotype ♂ .
8. *Nemoria daedalea* ♂ . Madera Canyon, 5600', Santa Cruz Co., Ariz., May 9, 1963, JGF (collection JGF).
9. *Nemoria daedalea* ♂ , summer generation. Madera Canyon, 5800', Santa Cruz Co., Ariz., July 13, 1960, JGF (collection JGF).
10. *Nemoria daedalea* ♀ , summer generation. Same data as the preceding.
11. *Nemoria daedalea* ♀ , summer generation. Madera Canyon, 4880', Santa Cruz Co., Ariz., Aug. 31, 1960, JGF (collection JGF).
12. *Nemoria viridicaria* ♂ . Uncompahgre Plateau, 7800—8100', 16 mi. SW of Montrose, Montrose Co., Colo., June 24, 1957, F. and P. Rindge (AMNH).
13. *Nemoria viridicaria* ♀ . Dalton Springs Camp, 8500', 5 mi. W of Monticello, San Juan Co., Utah, July 15, 1963, F., P. and M. Rindge (AMNH).
14. *Nemoria subsequens* ♂ . Pine Camp, 8600', 2 mi. NE of Cloudcroft, Otero Co., N.M., July 4, 1964, F., P. and M. Rindge (AMNH).
15. *Nemoria subsequens*, ♂ paratype from type locality, July 3, 1964, F., P. and M. Rindge (AMNH). DCF slide No. 796.
16. *Nemoria subsequens*, holotype ♀ .
17. *Nemoria subsequens*, ♀ paratype. Same locality and collectors as holotype, July 6, 1964 (AMNH).
18. *Nemoria diamesa*, holotype ♂ .
19. *Nemoria diamesa*, ♂ paratype. Same locality and collectors as holotype, July 5, 1964 (AMNH).
20. *Nemoria diamesa* ♂ . Madera Canyon, 5800', Santa Cruz Co., Ariz., June 27, 1960, JGF (collection JGF).
21. *Nemoria diamesa*, ♀ paratype. Same locality and collectors as holotype, July 1, 1964 (AMNH).
22. *Nemoria albaria* ♂ . Madera Canyon, 5800', Santa Cruz Co., Ariz., June 23, 1955, L.M. Martin (collection JGF).
23. *Nemoria albaria* ♂ . Crest Mt. Graham, 7300', Pinaleno Mts., Graham Co., Ariz., June 28, 1955, L.M. Martin (collection JGF). DCF slide No. 685.
24. *Nemoria albaria* ♀ . Same data as the preceding. DCF slide No. 877.
25. *Nemoria pistacearia* ♂ . Petaluma, Calif., June 14, 1936, E.C. Johnston (CNC).
26. *Nemoria pistacearia* ♀ . Bear Creek Rd., Contra Costa Co., Calif., June 27, 1957, T.W. Davies (collection DCF).
27. *Nemoria viridicaria* ♂ . Enlarged to show abdominal markings. Same locality as Pl. 43, fig. 12, June 25, 1957.
28. *Nemoria viridicaria* ♀ . Enlarged to show abdominal markings.
29. *Nemoria subsequens* ♂ , topotypical. Enlarged to show abdominal markings.
30. *Nemoria subsequens*, holotype ♀ . Enlarged to show abdominal markings.
31. *Nemoria diamesa* ♂ , topotypical. Enlarged to show abdominal markings.
32. *Nemoria diamesa*, ♀ paratype, same specimen as pl. 43, fig. 21. Enlarged to show abdominal markings.

PLATE 44

1. *Nemoria extremaria* ♂ . Oneco, Manatee Co., Fla., Mar. 28, 1954, JGF (collection JGF).
2. *Nemoria extremaria* ♀ . Same data as the preceding but taken Mar. 27, 1954.
3. *Nemoria elfa*, holotype ♂ .
4. *Nemoria elfa*, paratype ♂ . Wedge Plantation, South Santee R., Charleston Co., S.C., Mar. 29, 1967, DCF (YPM).
5. *Nemoria elfa*, paratype ♀ . Same data as the preceding.
6. *Nemoria tuscarora*, paratype ♂ . Highlands, 3865', Macon Co., N.C., July 27, 1958, JGF (collection JGF).
7. *Nemoria tuscarora*, holotype ♀ .
8. *Nemoria tuscarora*, paratype ♀ . Highlands, 3865', Macon Co., N.C., July 13, 1958, JGF (collection JGF).
9. *Nemoria catachloa* ♂ . Archbold Biological Station, Lake Placid, Highlands Co., Fla., Mar. 30, 1962, DCF (collection DCF).
10. *Nemoria catachloa* ♀ . Welaka, Putnam Co., Fla., Mar. 20, 1962, DCF, (collection DCF).
11. *Nemoria outina*, holotype ♂ .
12. *Nemoria outina*, paratype ♀ from type locality, Mar. 28, 1962, DCF (collection DCF).
13. *Nemoria lixaria* ♂ . Charleston, S.C., reared June 24, 1962, ex ovo on red oak, DCF (collection DCF).
14. *Nemoria lixaria* ♀ . Same data as the preceding.
15. *Nemoria lixaria* ♂ , melanic. Wedge Plantation, South Santee R., Charleston Co., S.C., Nov. 20, 1967, DCF (YPM).
16. *Nemoria lixaria* ♂ , melanic. Town Bluff, Tyler Co., Texas, Mar. 11, 1966, A. and M.E. Blanchard (AMNH).
17. *Nemoria saturiba*, holotype ♂ .
18. *Nemoria saturiba*, holotype ♂ . Enlarged to show abdominal markings.
19. *Nemoria saturiba*, paratype ♂ . Wedge Plantation, South Santee R., Charleston Co., S.C., Mar. 29, 1967 DCF (YPM).
20. *Nemoria saturiba*, paratype ♀ . Clinton, Hinds Co., Miss., May 20, 1963 Bryant Mather (AMNH).
21. *Nemoria saturiba* ♀ . Virginia Beach, Va., Apr. 30, F.M. Jones (MCZ). The most northerly record and an aberrant specimen with the usual brown abdominal patch replaced by red.
22. *Nemoria darwiniata darwiniata* ♂ , topotypical. Kaslo, B.C., June 21, 1909 (USNM).
23. *Nemoria darwiniata darwiniata* ♂ . Thetis Island, B.C., July 13, 1966, R. Guppy (YPM).
24. *Nemoria darwiniata darwiniata* ♀ . Hulcar, B.C., reared July 14, 1953 ex larva on *Salix* sp. (CNC).
25. *Nemoria darwiniata punctularia* ♂ . Mohawk, Plumas Co., Calif., July 8, 1938, W.L. Bauer (collection DCF).
26. *Nemoria darwiniata punctularia* ♂ . Trinity P.O., Sonoma Co., Calif., Apr. 9, 1940, E.C. Johnston (CNC).
27. *Nemoria zelotes*, holotype ♂ .
28. *Nemoria zelotes*, paratype ♀ . Madera Canyon, 5800', Santa Cruz Co., Ariz., June 20, 1960, JGF (collection JGF).
29. *Nemoria zelotes*, holotype ♂ . Enlarged.
30. *Nemoria obliqua obliqua* ♂ . "Colo. Bruce", ex Barnes collection (USNM). DCF slide No. 669.
31. *Nemoria obliqua obliqua* ♂ . Walnut Canyon, 6500', near Flagstaff, Ariz., Aug. 7, 1964, JGF (collection JGF).
32. *Nemoria obliqua obliqua* ♀ . Same data as the preceding.



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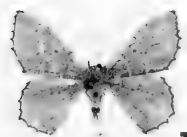
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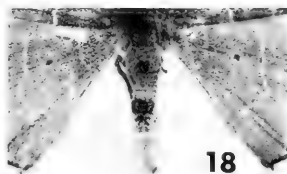
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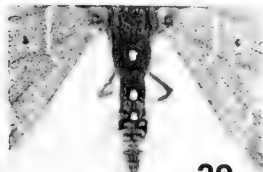
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PLATE 45

1. *Nemoria obliqua hennei*, paratype ♂ . Smoky Valley, 6300', Tulare Co., Calif., June 10, 1945 (USNM).
2. *Nemoria obliqua hennei* ♂ . Kyle Canyon, 8100', Mt. Charleston, Clark Co., Nev., July 4, 1965, T.W. Davies (YPM).
3. *Nemoria splendidaria* ♂ . 10 mi. W. of El Salto, 9000', Durango, Mexico, June 23, 1964, J.E.H. Martin (CNC).
4. *Nemoria splendidaria* ♀ . Same data as for fig. 3 but taken June 29, 1964.
5. *Nemoria splendidaria* ♂ . Sunnyside, W. side Huachuca Mts., Cochise Co., Ariz., July 7-17, 1958, T.W. Davies (LACM). The only Arizona specimen seen except for the type.
6. *Nemoria strigataria* ♂ . Madera Canyon 5600', Santa Cruz Co., Ariz., June 24, 1963, JGF (collection JGF).
7. *Nemoria strigataria* ♀ . Same data as the preceding but taken June 22, 1960.
8. *Nemoria zygataria* ♂ . San Benito, Texas, Apr. 24-30 (USNM). DCF slide No. 671.
9. *Nemoria zygataria* ♀ . Shovel Mt., Texas, Aug. 24-30 (USNM).
10. *Nemoria leptalea* ♂ . Burbank, Calif., reared "6-2-50", F.P. Sala (collection DCF).
11. *Nemoria leptalea* ♀ . Petaluma, Calif., Sept. 7, 1939, E.C. Johnston (CNC).
12. *Nemoria caerulescens* ♂ . Jemez Springs, N.M., Barnes collection (USNM).
13. *Nemoria caerulescens* ♂ . Same data as the preceding.
14. *Nemoria caerulescens* ♀ . Horseshoe Springs Camp, 7900', 2 mi. W. of La Cueva, Sandoval Co., N.M., July 29, 1961, F., P. and J. Rindge (AMNH).
15. *Nemoria caerulescens* ♂ , variant. S.W. Research Station of the AMNH, 5100', 5 mi. W. of Portal, Cochise Co., Ariz., May 12, 1956, M. Statham (AMNH).
16. *Nemoria caerulescens* ♀ , variant. Chiricahua Monument, Cochise Co., Ariz., June 14, 1950, E.C. Johnston (CNC).
17. *Nemoria intensaria* ♂ . Walnut Canyon, 6500', 6-1/3 mi. ESE of Flagstaff, Coconino Co., Ariz., Aug. 6, 1964, JGF (collection JGF).
18. *Nemoria intensaria* ♀ . Same data as the preceding but taken Aug. 25, 1964.
19. *Nemoria intensaria* ♀ . Wrightwood, 6100', San Gabriel Mts., Calif., May 10, 1964, C.A. Hill (YPM).
20. *Nemoria festaria* ♂ . Madera Canyon, 4400', Santa Rita Mts., Ariz., Sept. 7, 1960, JGF (collection JGF).
21. *Nemoria festaria* ♀ . Madera Canyon, 4880', Santa Rita Mts., Ariz., July 28, 1959, JGF (collection JGF).
22. *Nemoria albilineata* ♂ . Fort Davis, Jeff Davis Co., Texas, Mar. 27, 1965, A. and M.E. Blanchard (AMNH).
23. *Nemoria albilineata* ♀ . Big Bend National Park, Brewster Co., Texas, Sept. 4, 1964, A. and M.E. Blanchard (AMNH).
24. *Nemoria bifilata bifilata* ♂ , green form. Parker Island, near Archbold Biological Station, Highlands Co., Fla., Mar. 31, 1962, DCF (collection DCF).
25. *Nemoria bifilata bifilata* ♀ , green form. Lakehurst, N.J., July 6-8, 1940, JGF (collection JGF).
26. *Nemoria bifilata bifilata* ♂ , brown form. Ocean City, Okaloosa Co., Fla., Mar. 22, 1963, H.O. Hilton (Hilton collection).
27. *Nemoria bifilata bifilata* ♀ , brown form. Lakehurst, N.J., May 1-10, Frederick Lemmer (AMNH).
28. *Nemoria bifilata planuscula*, paratype ♀ . Huntsville, Walker Co., Texas, May 26, 1963, A. and M.E. Blanchard (AMNH). Large green form, second spring brood.
29. *Nemoria bifilata planuscula* ♀ . Garner State Park, Uvalde Co., Texas, Mar. 10, 1962, R.O. and C.A. Kendall (AMNH). Large brown form, first spring brood.
30. *Nemoria bistriaria bistriaria* ♂ , brown form. Plummer's Island, Cabin John, Md., Apr. 7, 1962, JGF (collection JGF).
31. *Nemoria bistriaria bistriaria* ♂ , brown form. New Castle Co., Del., Apr. 19, 1913, F.M. Jones (YPM).
32. *Nemoria bistriaria bistriaria* ♀ , brown form. Crailhope, Green Co., Ky., Apr. 26, 1949, Carl Cook (collection DCF).

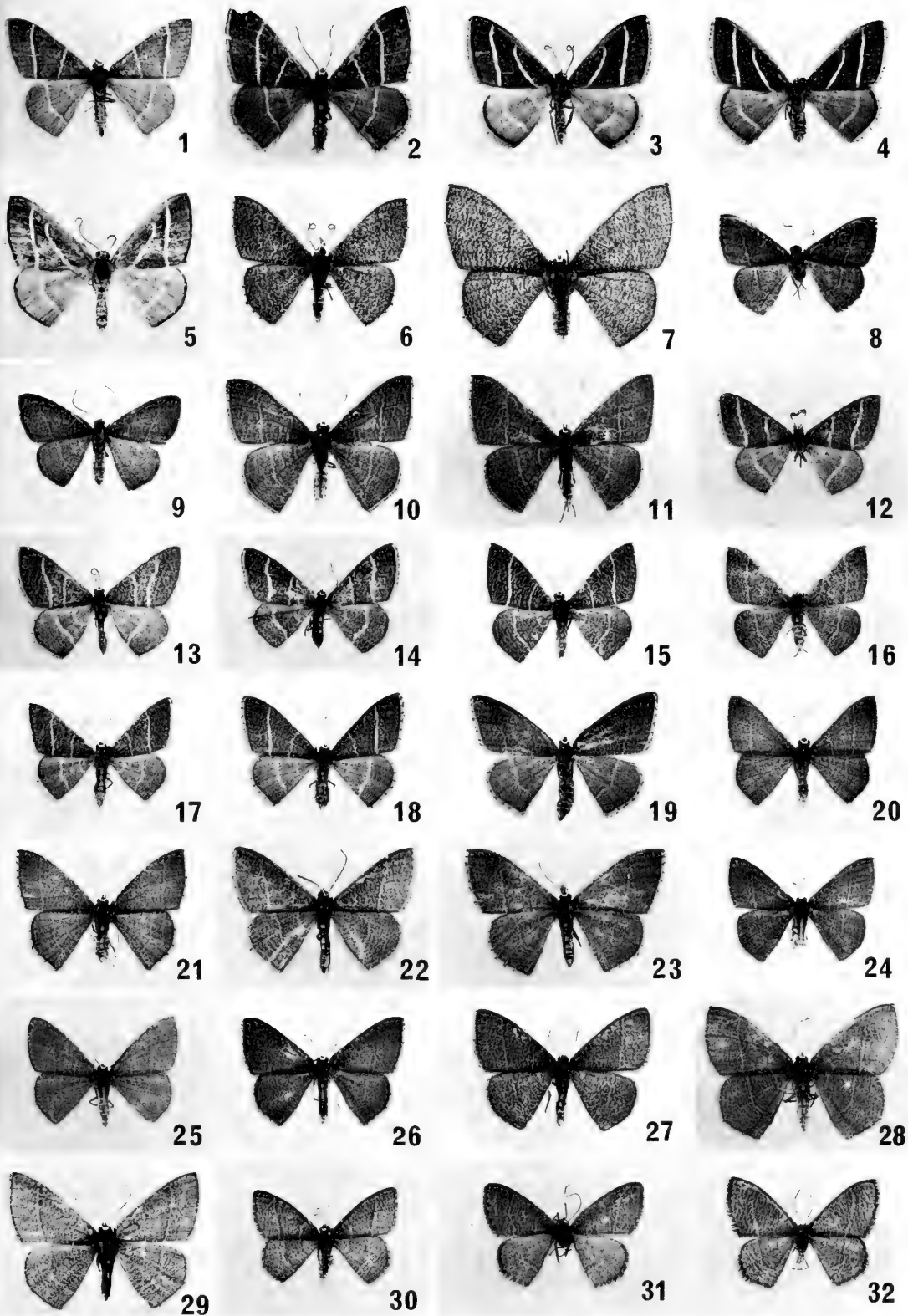


PLATE 46

1. *Nemoria bistrivaria bistrivaria* ♂ , green form. Arlington, Va., July 7, 1951, JGF (collection JGF).
2. *Nemoria bistrivaria rubromarginaria* ♂ , spring generation, green. Golf Course woods, Forest Home, Ithaca, N.Y., May 12, 1961, DCF (collection DCF).
3. *Nemoria bistrivaria rubromarginaria* ♀ , spring generation, green. Six Mile Creek, Ithaca, N.Y., May 13, 1961, JGF (collection JGF).
4. *Nemoria bistrivaria rubromarginaria* ♀ , spring generation, brown. Same data as for fig. 3.
5. *Nemoria bistrivaria rubromarginaria* ♂ , summer generation. Ithaca, N.Y., July 8, 1938, JGF (collection JGF).
6. *Nemoria mimosaria* ♂ . Near Big Indian Lake, Halifax Watershed Area, Halifax Co., N.S., reared Mar. 18, 1964 ex ovo on *Betula papyrifera*, DCF (collection DCF).
7. *Nemoria mimosaria* ♀ . Same data as for fig. 6, but emerged Mar. 20, 1964.
8. *Nemoria mimosaria* ♀ . Blacksburg, Montgomery Co., Va., May 17, 1963, C.V. Covell (collection DCF).
9. *Nemoria rubrifrontaria* ♂ . Peggy's Cove, Halifax Co., N.S., July 7, 1961, DCF (collection DCF).
10. *Nemoria rubrifrontaria* ♀ . Cat-tail swamp near Aylesford, Kings Co., N.S., reared Apr. 2, 1964 ex ovo on *Comptonia*, DCF (collection DCF).
11. *Nemoria glaucomarginaria* ♂ . Mt. St. Helena, Napa Co., Calif., Apr. 18, 1939, E.C. Johnston (CNC).
12. *Nemoria glaucomarginaria* ♀ . Same data as the preceding.
13. *Nemoria rindgei*, holotype ♂ .
14. *Nemoria rindgei*, paratype ♀ from type locality, June 26, 1964, F., P. and M. Rindge (AMNH).
15. *Phrudocentra centrifugaria* ♂ . Florida (collection DCF).
16. *Phrudocentra centrifugaria* ♀ . Oneco, Manatee Co., Fla., Mar. 21, 1954, JGF (collection JGF).
17. *Phrudocentra centrifugaria* ♀ . Same data as the preceding but taken Apr. 1, 1954.
18. *Phrudocentra centrifugaria*, ♀ form "*viridipurpurea*". Archbold Biological Station, Lake Placid, Highlands Co., Fla., Apr. 7, 1958, R.W. Pease (YPM).
19. *Dichorda consequaria* ♂ . Madera Canyon, 4880', Santa Rita Mts., Ariz., Aug. 29, 1959, JGF (collection JGF).
20. *Dichorda consequaria* ♀ . Same data as the preceding but taken July 20, 1959.
21. *Phrudocentra neis affinis*?, ♀ . Upperside. Pharr, Texas, H.A. Freeman (AMNH).
22. Same specimen, underside.
23. *Dichorda iridaria iridaria* ♂ . New Castle Co., Del., June 4, 1915, F.M. Jones (YPM).
24. *Dichorda iridaria iridaria* ♀ . Valley Cottage, Rockland Co., N.Y., June 5, 1953, M. Shulgin (YPM).
25. *Dichorda iridaria latipennis* ♂ . Archbold Biological Station, Lake Placid, Highlands Co., Fla., Feb. 12, 1958, Roger Pease (YPM).
26. *Dichorda iridaria latipennis* ♂ , from an apparently transitional population. Wedge Plantation, South Santee R., Charleston Co., S.C., Mar. 29, 1967, DCF (YPM).
27. *Dichorda illustraria* ♂ . Anderson Springs, Lake Co., Calif., Oct. 5, 1947, W.R. Bauer (collection DCF).
28. *Dichorda illustraria* ♀ . Sunland, Los Angeles Co., Calif., Oct. 19, 1946 (collection DCF).



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PLATE 47

1. *Dichorda rectoria rectoria* ♂ . Fort Davis, Jeff Davis Co., Texas, May 19, 1950, E.C. Johnston (CNC).
2. *Dichorda rectoria rectoria* ♂ . Big Timber Creek, 7 mi N. of Big Timber, Sweetgrass Co., Mont., July 4, 1966, DCF (YPM).
3. *Dichorda rectoria rectoria* ♀ . Sierra Blanca, Hudspeth Co., Texas, June 5, 1950, E.C. Johnston (CNC).
4. *Dichorda rectoria rectoria* ♀ . Walnut Canyon, 6500', near Flagstaff, Ariz., Aug. 7, 1964, JGF (collection JGF).
5. *Dichorda rectoria cockerelli*, ♂ paratype. Split Rock Tank, Mojave Desert, Calif., May 21, 1938, J.L. Sperry (USNM). E.L. Todd slide No. 154.
6. *Dichorda rectoria cockerelli* ♂ . Keystone Canyon, 5500', New York Mts., San Bernardino Co., Calif., Aug. 25, 1959, F.P. Sala (collection DCF).
7. *Dichordophora phoenix* ♂ . Split Rock Tank, Mojave Desert, Calif., May 19, 1938, J.L. Sperry (collection DCF).
8. *Dichordophora phoenix* ♀ . New River, Maricopa Co., Ariz., May 7, 1950, E.C. Johnston (CNC).
9. *Synchlora liquoraria liquoraria* ♂ . Riverside, Calif., May 9, 1935, J.L. Sperry (AMNH).
10. *Synchlora liquoraria liquoraria* ♀ . Riverside, Calif., May 30, 1939, J.L. Sperry (AMNH).
11. *Synchlora liquoraria liquoraria* ♂ . Big Timber Creek, 7 mi. N. of Big Timber, Sweetgrass Co., Mont., Aug. 9, 1966, DCF (YPM).
12. *Synchlora liquoraria liquoraria* ♂ . Crowsnest Pass, Alta., July 16, 1966, DCF (YPM).
13. *Synchlora liquoraria liquoraria* ♂ . Joe Dollar Gulch, Hill City, Black Hills, S.D., July 18, 1964, DCF (YPM).
14. *Synchlora liquoraria albolineata* ♂ . Auburn, Kings Co., N.S., June 30, 1951, DCF (collection DCF).
15. *Synchlora liquoraria albolineata* ♂ . Doyles, Codroy Valley, S.W. Nfld., Aug. 4, 1962, DCF (collection DCF).
16. *Synchlora liquoraria albolineata* ♀ . Same data as the preceding but taken Aug. 6, 1962.
17. *Synchlora liquoraria albolineata* ♀ . Dorchester, Westmorland Co., N.B., July 17, 1950, DCF (collection DCF).
18. *Synchlora liquoraria albolineata* ♀ . McLean Bogs Reserve, Tompkins Co., N.Y., July 19, 1946, JGF (collection JGF).
19. *Synchlora aerata* ♂ . McLean Bogs Reserve, Tompkins Co., N.Y., Sept. 7, 1955, DCF (collection DCF).
20. *Synchlora aerata* ♂ . Six Mile Creek, Ithaca, N.Y., Sept. 9, 1955, DCF (collection DCF).
21. *Synchlora aerata* ♀ . Highlands, 3865', Macon Co., N.C., Aug. 6, 1958, JGF (collection JGF).
22. *Synchlora frondaria denticularia* ♂ . Archbold Biological Station, Lake Placid, Highlands Co., Fla., Mar. 27, 1962, DCF (collection DCF).
23. *Synchlora frondaria denticularia* ♂ . Wedge Plantation, South Santee R., Charleston Co., S.C., Mar. 29, 1967, DCF (YPM).
24. *Synchlora frondaria denticularia* ♂ . Highlands, 3865', Macon Co., N.C., Aug. 12, 1958, JGF (collection JGF). From a locality where *aerata* also occurs (see fig. 21 above).
25. *Synchlora frondaria denticularia* ♀ . Archbold Biological Station, Lake Placid, Highlands Co., Fla., Dec. 19, 1957, Roger Pease (YPM).
26. *Synchlora frondaria avidaria* ♂ . Madera Canyon, 4400', Santa Rita Mts., Ariz., Sept. 7, 1960, JGF (collection JGF).
27. *Synchlora frondaria avidaria* ♀ . Peña Blanca, 3950', Santa Cruz Co., Ariz., Sept. 9, 1959, JGF (collection JGF).
28. *Synchlora gerularia* ♂ . Archbold Biological Station, Lake Placid, Highlands Co., Fla., Mar. 23, 1958, Roger Pease (YPM).
29. *Synchlora gerularia* ♀ . Welaka, Putnam Co., Fla., Mar. 11, 1962, DCF (collection DCF).
30. *Synchlora herbaria hulstiana* ♂ . Vero Beach, Fla., Apr., 1941, J.R. Malloch (USNM).
31. *Synchlora herbaria hulstiana* ♀ . Key Largo, Fla., Mar. 21, 1941, Mrs. Forsyth (AMNH).
32. *Synchlora irregularia* ♂ . Brownsville, Texas, Nov. 10, 1928, F.H. Benjamin (USNM). DCF slide No. 667.
33. *Synchlora irregularia* ♀ . Mercedes, Hidalgo Co., Texas, Dec. 13, 1958, H. Schmalzried (AMNH).
34. *Synchlora noel* ♀ . Tub Canyon, Borrego, Calif., Nov., 1949 (AMNH).
35. *Synchlora cupedinaria* ♂ . Oneco, Manatee Co., Fla., Mar. 23, 1955, JGF (collection JGF).
36. *Synchlora cupedinaria* ♀ . Same data as the preceding.



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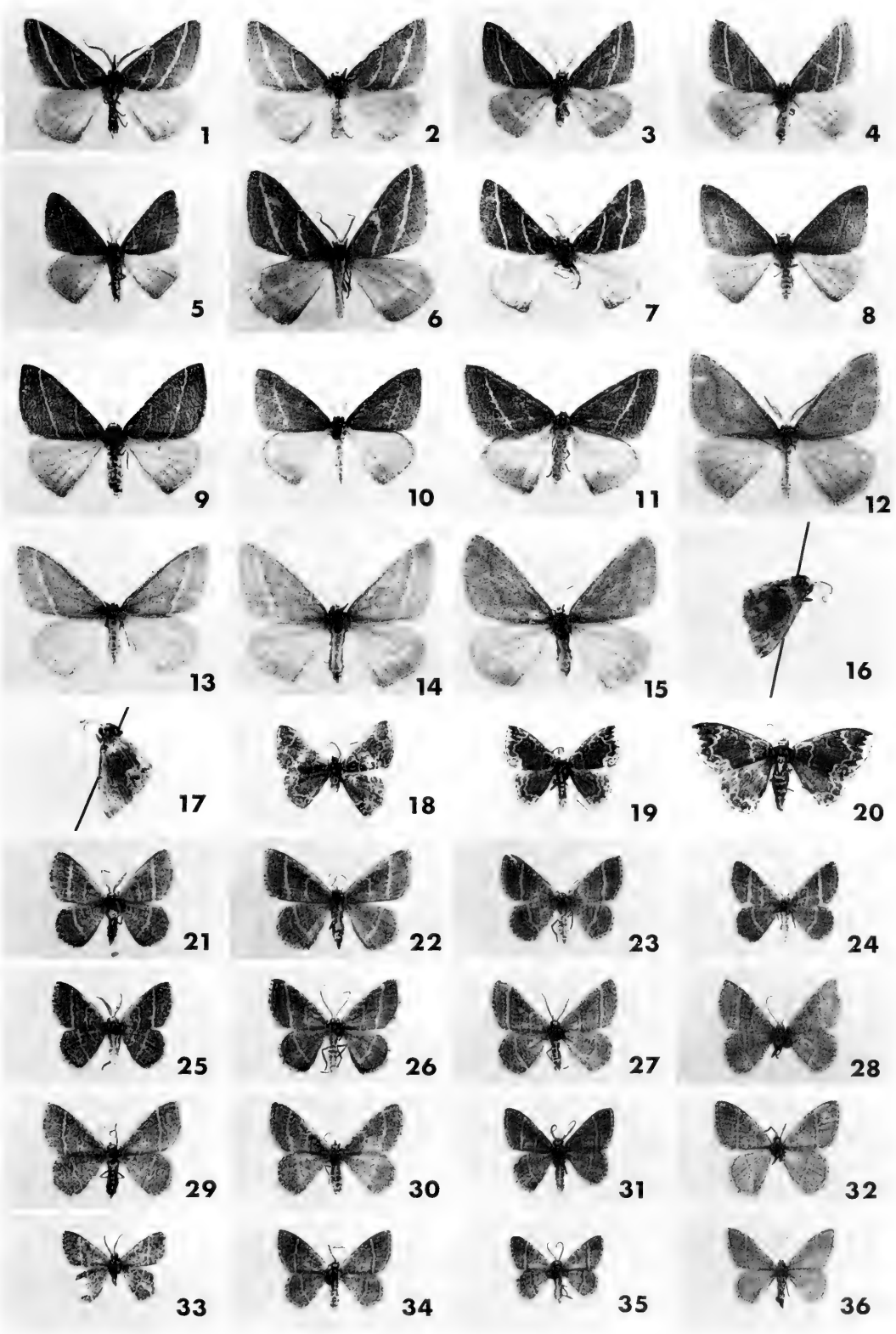
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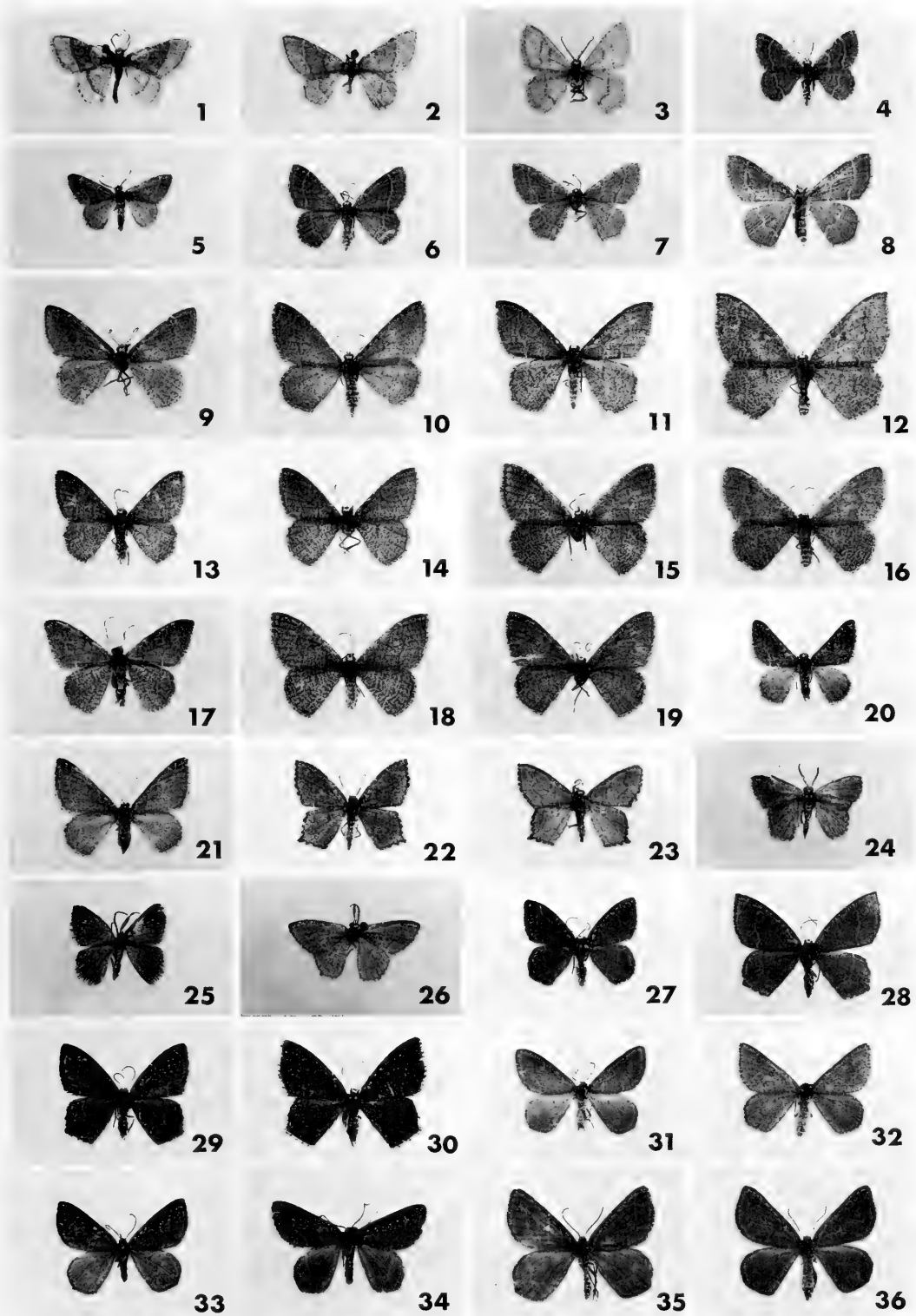
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PLATE 48

1. *Cheteoscelis bistrifaria* ♂ . Entiat, Wash., May 9, 1934, A.N. Gartrell (CNC).
2. *Cheteoscelis bistrifaria* ♀ . Big Buffalo Creek, N. of Cedar Pass, Jackson Co., S.D., July 8, 1964, DCF (YPM).
3. *Cheteoscelis bistrifaria* ♂ . Pineyon, Apache Co., Ariz., July 4, 1950, E.C. Johnston (CNC).
4. *Cheteoscelis bistrifaria* ♀ . Same data as the preceding.
5. *Cheteoscelis bistrifaria* ♂ . Ft. Davis, Jeff Davis Co., Texas, May 19, 1950, E.C. Johnston (CNC).
6. *Cheteoscelis bistrifaria* ♂ . Walker Pass, Kern Co., Calif., May 5, 1940, E.C. Johnston (CNC).
7. *Cheteoscelis bistrifaria*, ♂ paratype of *clarkei*. Split Rock Tank, Mojave Desert, Calif., May 21, 1938, J.L. Sperry (USNM). DCF slide No. 699.
8. *Cheteoscelis pectinaria* ♂ . Madera Canyon, 4880', Santa Rita Mts., Ariz., May 11, 1963, JGF (collection JGF).
9. *Cheteoscelis pectinaria* ♀ . Madera Canyon, 4400', Santa Rita Mts., Ariz., Oct. 18, 1959, JGF (collection JGF).
10. *Merochlora faseolaria* ♂ . Inverness, Marin Co., Calif., July 2, 1940, W.R. Bauer.
11. *Merochlora faseolaria* ♀ . Petaluma, Calif., June 16, 1936, E.C. Johnston (CNC).
12. *Merochlora graefiaria* ♂ . Upper Santa Ana River, San Bernardino Co., Calif., June 19, 1949, J.L. Sperry (AMNH).
13. *Merochlora graefiaria* ♀ . Barton Flats, San Bernardino Co., Calif., Aug. 16, 1945, J.L. Sperry (AMNH).
14. *Merochlora graefiaria* ♀ . Upper Santa Ana R., San Bernardino Co., Calif., July 16, 1946, J.L. Sperry (AMNH).
15. *Merochlora graefiaria* ♀ . Same data as the preceding but taken June 24, 1948.
16. *Lophochorista lesteraria* ♂ . Baboquivari Mts., Pima Co., Ariz., no date (USNM).
17. Same specimen as fig. 16 above, reverse side.
18. *Eueana niveociliaria* ♂ . Santiago de Cuba, Cuba, June, Schaus collection (USNM).
19. *Eueana niveociliaria* ♂ . Palm Beach, Fla., H.G. Dyar (USNM).
20. *Eueana niveociliaria* ♀ . Same data as the preceding.
21. *Chlorochlamys chloroleucaria* ♂ . Cheticamp R., Cape Breton Highlands National Park, Inverness Co., N.S., July 2, 1949, DCF (collection DCF).
22. *Chlorochlamys chloroleucaria* ♀ . Same data as the preceding.
23. *Chlorochlamys chloroleucaria* ♀ . E. Ottawa, Ont., reared July 26, 1937 on *Rudbeckia*, J. McDunnough (CNC).
24. *Chlorochlamys chloroleucaria* ♂ . Wedge Plantation, South Santee R., Charleston Co., S.C., Mar. 26, 1967, DCF (YPM).
25. *Chlorochlamys chloroleucaria* ♂ . Archbold Biological Station, Lake Placid, Highlands Co., Fla., Mar. 30, 1962, DCF (collection DCF).
26. *Chlorochlamys chloroleucaria* ♂ . Joe Dollar Gulch, Hill City, Black Hills, S.D., July 13, 1964, DCF (YPM).
27. *Chlorochlamys triangularis* ♂ . Leevining, Mono Co., Calif., July 25, 1950, E.C. Johnston (CNC).
28. *Chlorochlamys triangularis* ♀ . Biggs, Ore., Aug. 23, 1947, E.C. Johnston, (CNC).
29. *Chlorochlamys triangularis* ♀ . Madera Canyon, 4880', Santa Rita Mts., Ariz., Aug. 23, 1959, JGF (collection JGF).
30. *Chlorochlamys triangularis* ♀ . Vail L. Rd., 6500', 9-1/2 mi. SE of Flagstaff, Coconino Co., Ariz., July 18, 1961, JGF (collection JGF).
31. *Chlorochlamys appellaria* ♂ , green form. Peña Blanca, 3950', Santa Cruz Co., Ariz., Aug. 11, 1959, JGF (collection JGF).
32. *Chlorochlamys appellaria* ♂ , green form. Riverside, Calif., May 10, 1939, H. Buckwalter (AMNH).
33. *Chlorochlamys appellaria* ♂ , green form. Welder Wildlife Foundation Refuge, San Patricio Co., Texas, Feb. 24, 1962, R.O. and C.A. Kendall (AMNH). DCF slide No. 994.
34. *Chlorochlamys appellaria* ♀ , green form. Madera Canyon, 4880', Santa Rita Mts., Ariz., Aug. 21, 1959, JGF (collection JGF).
35. *Chlorochlamys appellaria* ♂ , brown form. Peña Blanca, 3950', Santa Cruz Co., Ariz., May 31, 1963, JGF (collection JGF).
36. *Chlorochlamys appellaria* ♀ , brown form. 29 Palms, San Bernardino Co., Calif., Apr. 20, 1950, E.C. Johnston (CNC).



1. *Chlorochlamys appellaria*, ♂ paratype of *rubromediaria*. Eureka, Utah, July 1, 1921, Tom Spalding (MCZ).
2. *Chlorochlamys appellaria*, ♀ paratype of *rubromediaria*. Eureka, Utah, July 19, 1921, Tom Spalding (USNM).
3. *Chlorochlamys appellaria* ♂, albino form. Sierra Blanca, Hudspeth Co., Texas, June 5, 1950, E.C. Johnston (CNC). DCF slide No. 756.
4. *Chlorochlamys phyllinaria* ♂. Madera Canyon, 4880', Santa Rita Mts., Ariz., Sept. 7, 1959, JGF (collection JGF).
5. *Chlorochlamys phyllinaria*, ♂ paratype of *fletcheraria*. Organ Pipe Cactus National Monument, Arizona, Apr. 11, 1947, J.L. Sperry (USNM).
6. *Chlorochlamys phyllinaria* ♀. Same data as for fig. 4 above but taken Aug. 29, 1959.
7. *Chlorochlamys phyllinaria* ♀. Kerrville, Texas, Aug., 1904, Barnes collection (USNM). J.F. Gates Clarke slide No. 1059.
8. *Chlorochlamys phyllinaria* ♀. Washington Co., Ark., Aug. 30, 1966, R.L. Brown (AMNH).
9. *Xerochlora viridipallens* ♂. McMillan Camp, 6800', 13 mi. N. of Silver City, Grant Co., N.M., July 24, 1961, F., P. and M. Rindge (AMNH). DCF slide No. 968.
10. *Xerochlora viridipallens* ♀. Walnut Canyon, 6500', near Flagstaff, Coconino Co., Ariz., Aug. 12, 1964, JGF (collection JGF).
11. *Xerochlora masonaria* ♂. McMillan Camp, 7000', 14 mi. N. Silver City, Grant Co., N.M., July 15, 1964, F., P. and M. Rindge (AMNH).
12. *Xerochlora masonaria* ♀. Madera Canyon, 4880', Santa Rita Mts., Ariz., July 29, 1959, JGF (collection JGF).
13. *Xerochlora inveterascaria* ♂. Peña Blanca, 3950', Santa Cruz Co., Ariz., Aug. 2, 1960, JGF (collection JGF).
14. *Xerochlora inveterascaria* ♂. Same data as the preceding; DCF slide No. 754.
15. *Xerochlora inveterascaria* ♀. Same data as the preceding; DCF slide No. 766.
16. *Xerochlora inveterascaria* ♀. Same data as the preceding but taken Aug. 26, 1959.
17. *Xerochlora martinaria*, holotype ♂.
18. *Xerochlora martinaria* ♀. Madera Canyon, 5800', Santa Rita Mts., Ariz., Aug. 1, 1959, JGF (collection JGF).
19. *Xerochlora martinaria* ♀. Madera Canyon, 4880', Santa Rita Mts., Ariz., Aug. 31, 1959, JGF (collection JGF). DCF slide No. 1029.
20. *Xerochlora mesotheides*, holotype ♂.
21. *Xerochlora mesotheides*, paratype ♀. Sierra Blanca, Hudspeth Co., Texas, June 5, 1950, E.C. Johnston (collection DCF).
22. *Chloropteryx tepperaria* ♂. Welaka, Putnam Co., Fla., Mar. 15, 1962, DCF (collection DCF).
23. *Chloropteryx nordicaria* ♂. Brownsville, Texas, Mar. 26, 1937, T.N. Freeman (CNC).
24. *Chloropteryx paularia* ♂. Jamaica. Schaus collection (USNM).
25. *Chloropteryx paularia* ♂. Santiago de Cuba, Cuba, Oct. Schaus collection (USNM).
26. *Chloropteryx paularia* ♂. Royal Palm State Park, Fla., no date, F.M. Jones. "♂ gen. 789, 15 Dec. 33 FHB" (USNM). Believed to be the first U. S. record.
27. *Hethemia pistasciaria* ♂. Cat-tail swamp near Aylesford, Kings Co., N.S., reared Mar. 19, 1964 ex ovo on blueberry, DCF (collection DCF).
28. *Hethemia pistasciaria* ♀. Wrangle Brook Road, Lakehurst, N.J., May 31, 1956, DCF (collection DCF).
29. *Hethemia pistasciaria* ♂, brown form. Wedge Plantation, South Santee R., Charleston Co., S.C., Mar. 29, 1967, DCF (YPM).
30. *Hethemia pistasciaria* ♀, brown form. Welaka, Putnam Co., Fla., Mar. 11, 1962, DCF (collection DCF).
31. *Mesothea incertata incertata* ♂. Purcell's Cove, Halifax Co., N.S., May 14, 1951, DCF (collection DCF).
32. *Mesothea incertata incertata* ♀. Halifax Watershed Area, Halifax Co., N.S., May 21, 1952, DCF (collection DCF).
33. *Mesothea incertata incertata* ♂. Steese Highway, NE of Fairbanks, Alaska, June 5, 1966, K.W. Philip (YPM).
34. *Mesothea incertata* ♂, apparently intermediate to subspecies *viridipennata*. Head of Pine Creek, Calgary, Alta., May 12, 1914, F.H. Wolley Dod (CNC).
35. *Mesothea incertata viridipennata* ♂. Stimson Creek, Mason Co., Wash., May 7, 1949, E.C. Johnston (CNC).
36. *Mesothea incertata viridipennata* ♀. Same data as the preceding.



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