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A Revision of the Moth Genus *Xanthotype* (Lepidoptera, Geometridae)

FREDERICK H. RINDGE[1]

ABSTRACT

The genus *Xanthotype* is revised for the first time since Swett's initial work (1918). Five species are included; they occur in the continental United States and southern Canada. The following changes in synonymy are made: *vagaria* Swett and *turbidaria* Swett are placed in the synonymy of *urticaria* Swett; *manitobensis* Swett and *marylandensis* Swett are now synonyms of *sospeta* (Drury). All species are fully described; keys to the genitalia are given for the first time. All the species and their genitalia are illustrated; distributional maps are included. Taxonomic problems within the genus are discussed, including geographic and seasonal variation within certain species.

INTRODUCTION

The genus *Xanthotype* has not been revised since Swett's paper of 1918, although McDunnough (1926, 1938) made some nomenclatural changes. A preliminary survey of the members of this distinctive genus showed that additional changes were needed. The purpose of the present paper is to revise *Xanthotype*, to propose keys to the genitalia of both sexes for the first time, to redescribe the included species, and to discuss the problems within the genus.

Warren described *Xanthotype* in 1894, designating *Phalaena crocataria* Fabricius, 1798, as the type species. This specific name was used to include all species in the genus until 1918, when Swett revised the group. It should be noted that he retained *crocataria* as a valid species; *sospeta* Drury, 1773, was used by McDunnough in 1926 to replace the Fabrician name. Two other names antedate Swett's revision; they are *citrinaria* Hübner, 1824, and *caelaria* Hulst, 1886. Swett based his study basically on the genitalia of the males, and named nine taxa; six of these were on the specific level, two as "var." (presumably meaning subspecies), and one as a "form." Swett's revision appeared in four parts, accompanied by two color plates and six genitalic drawings; the last section ends with "To be continued," but no further parts were ever published. Written descriptions were given for four taxa; the adults of three of these were illustrated. The five remaining names were validated by the figures on the color plates, accompanied by their names and the type localities. McDunnough (1926) published an excellent review of Swett's work, based primarily

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on Canadian material, which resulted in some synonymies. Additional changes were published by McDunnough (1938); no other changes have been made since then.

The adults of *Xanthotype* are easy to recognize, with their bright yellow wings, brownish spotting, and relatively large size. Adults were illustrated by early authors, usually under the name *crocataria* Fabricius; some of these include Packard (1869, pl. 8, fig. 5 [male]; 1876, pl. 11, fig. 52 [male]), Saunders (1883, fig. 362 [female]), Lugger (1898, fig. 180 [male]), and Holland (1919, pl. 44, figs. 39 [male], 40 [*caelaria* female]). I have purposely omitted the figures given by Drury and Hübner in the above list to avoid duplication; references to these earlier figures are given in the bibliography of *sospeta*.

The adults of all species included in this genus are, for practical purposes, externally indistinguishable from one another, as they are almost identical in color, maculation, and size. Within a given population there is often considerable variation in the extent of the larger spots that indicate the cross lines, and the amount of brown scaling and speckling on the wings. In some instances a single population may have specimens that run the gamut from heavily spotted to almost immaculate. There does not seem to be any noticeable north-south variation in size or maculation. This is not the case, however, when series of specimens from east to west are studied. Two species, *urticaria* and *sospeta*, extend from the Atlantic Ocean to the Rocky Mountains across southern Canada and the northern United States, and then south in the Rockies. Both species exhibit parallel variation, going from east to west, as they gradually tend to become larger in size and to have progressively reduced maculation; this is apparently a clinal variation, as no discernible breaks in the characters have been found. Swett apparently did not realize that he was dealing with clinal variation, and so he named several subspecies, as well as one heavily spotted form. I am not using any subspecific names in this paper, as I believe that the evidence will not substantiate such categories in this genus.

In addition to the individual and geographic variation, there is often a seasonal one; this can be rather subtle in its expression. Moths caught early in the year (usually in the early spring months, depending on the locality) tend to be slightly larger and to have less brown scaling on the upper surface than do moths caught later in the flight period. This could be an indication of either two generations per year, or a succession of broods during that period.

No one has found a reliable way to recognize the species as yet except by genitalia. Swett (1918) was the first to realize the value of the genitalic structures; McDunnough (1926, p. 120) pointed out that the male genitalia can be studied without dissection, by removing some of the scales ventrally at the end of the abdomen. The species can be separated into two groups based on the form of the aedeagus; the latter is nearly always visible for study. One group has a slender organ with a sclerotized, often dark brown, flat, bilobed apex (*urticaria*, *barnesi*, and *rufaria*; see figs. 14-16); the other has a larger, curved, bluntly pointed organ that is broadly swollen medially (*sospeta* and *attenuaria*; see figs. 17, 18). With a little experience, the great majority of males can be determined without dissection, using the technique outlined by McDunnough. With the species of the first group, *rufaria* has both sides of the aedeagus prominently serrate, while the other two have smooth margins; *barnesi* is known only from California, whereas *urticaria* occurs in eastern North America and the Rocky Mountains. With the second group, the best specific character (without dissection) is the process of the sacculus; in *attenuaria* it is elongate and strongly spinose, and is usually easily seen, whereas in *sospeta* this structure is small and inconspicuous. Unfortunately, no such easily available characters have been found for the females; dissections are necessary, and the characters are not so obvious as in the males.

In the present paper I am deviating from my usual bibliographical style in that I am not attempting to give all the citations to be found for each name. The reason for this is the aforementioned difficulties in correctly identifying the species; references prior to the 1918 revision were usually given as *crocataria*, and this name was applied to all our species. Without examining the adults upon which these early references were made (and these specific moths

are nearly always impossible to locate with certainty), one cannot be confident of the correct present-day terminology; hence the citations are not given. The only citations and distribution records given in this paper, outside of those of the original descriptions, new combinations, and synonymies, are those that I have been able to verify personally.

The same problem arises when working with the early stage and food plant references; articles on these subjects go back more than 100 years in the literature. Once again it is impossible to tell to which species these refer. One result of these early articles is to have produced a considerable amount of confusion as to the food plants of the various species. Because subsequent authors have cited previous references without checking them thoroughly, early errors have been perpetuated. In the generic descriptions for Early Stages and Food Plants I give a summary of the literature. For the individual species, the only citations are those that I have verified. A number of reared specimens have been examined that had only the date of emergence for the moth, or indicated that the adult was reared from the egg. Practically none of these had any food plant information on the pin labels; consequently, this valuable information has been lost. I urge, as strongly as possible, that the host record always be included in the labeling of every reared specimen.

All the photographs in this revision were taken by me. Every extant holotype and allotype are illustrated in this paper with the exception of *marylandensis* Swett, which was never spread.

During the course of this study I have examined 1886 specimens (1441 males, 445 females) and 261 genitalic dissections (183 males, 78 females). The majority of the dissections were prepared by me; in addition, I made slide mounts of the antennae and legs of both sexes when sufficient specimens were available. All specimens studied by me at the American Museum of Natural History have had identification labels placed on their pins (with the exception of primary types). The majority of specimens (1205) and slides (131) are in the collection of that institution.

The following abbreviations have been used:
AMNH, the American Museum of Natural History
CNC, the Canadian National Collection
EQ, Eric Quinter, Department of Entomology, the American Museum of Natural History
LAM, Natural History Museum of Los Angeles County
USNM, National Museum of Natural History, Smithsonian Institution

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I acknowledge with thanks the cooperation and aid of the following colleagues who have allowed me to study the types and specimens in their charge, who have furnished me with specimens and data, and who have been kind enough to answer many questions: Dr. F. Martin Brown, Colorado Springs, Colorado; Mr. Julian P. Donahue for the Natural History Museum of Los Angeles County; Dr. D. C. Ferguson for the National Museum of Natural History, Smithsonian Institution; Mr. Ira Heller for Adelphi University; Dr. W. C. McGuffin for the Canadian National Collection; Dr. Alfred F. Newton, Jr., for the Museum of Comparative Zoology; Dr. J. A. Powell for the California Insect Survey Collection, University of California, Berkeley; and Mr. Eric Quinter, Department of Entomology, the American Museum of Natural History. I am also indebted to Mrs. Marjorie Favreau for the preparation of the maps.

GENUS *XANTHOTYPE* WARREN

Angerona of authors, not Duponchel: Packard, 1876, p. 474. Anon., 1882, p. 25. Grote, 1882, p. 45. Smith, 1891, p. 66.

Xanthotype Warren, 1894, p. 463. Hulst, 1896, p. 372. Dyar, "1902" [1903], p. 336. Smith, 1903, p. 79. Barnes and McDunnough, 1917, p. 120. McDunnough, 1938, p. 167. Forbes, 1948, p. 79.

DIAGNOSIS: The moths can be easily recognized by their large size and bright yellow wings, the latter having a variable amount of brown maculation. Antennae of the males are pectinate, and very shortly pectinate in the females. Male genitalia are recognized by the elongate, complex valves, each costa having a basal arm, a raised, sclerotized median process, a swollen sacculus with a small to elongate digitate process; the vesica is without spines. Female genitalia have a wide, sclerotized

lamella postvaginalis, a relatively large ductus bursae, and a large elliptical signum.

ADULT: Head with eyes of both sexes large, round, wider than front; front slightly convex; tongue present; palpi moderate, extending slightly beyond front, not rising to middle of eyes; antenna with from about 43 to 51 segments, pectinate in male, partly pectinate in female; males with pectinations arising in basal half of segments, with terminal five or six segments simple, pectinations about 6 times as long as basal segments, 1.1 to 1.2 mm. in length, each pectination with double row of slender setae below and with one or two larger, thicker setae at apex; females with short pectinations on basal two-thirds of segments, each pectination occupying most of length of each segment, pectination on distal side of antenna longer than one on basal side, longest pectinations shorter than their basal segments. Thorax slender, without tufts; fore tibia unarmed, with process of male arising one-third distance from base of segment and extending slightly beyond apex, of female shorter, arising about three-fifths distance from base of segment; hind tibia with two pairs of spurs in both sexes, males without groove and hair pencil. Abdomen slender, elongate, without dorsal tufts; males with ventral surface of third segment without row of setae and last segment without modification.

Forewings broad, apex angulate, outer margin rounded; 12 veins present; with or without one accessory cell; R uniting with Sc; R_{1+2} stalked, R_4 going to costa just before apex; mdc and ldc of about equal length, angled basad; Cu_1 from shortly before lower angle; fovea absent. Hind wings broad, weakly projecting at R, concave to M_3, then rounded; frenulum strong in both sexes; Sc paralleling R for less than half length of cell; R and M_1 separating before upper angle of cell; m and ldc angled; M_3 from lower angle; cell moderate, extending one-half or less length of wing; Cu_1 arising nearer angle than to Cu_2.

Upper surface of all wings yellow, variably marked with brown, grayish brown, or lilac-brown spots and scaling, more or less concentrated in areas of t. a., t. p., and extradiscal lines, maculation sometimes reduced or absent. Under surface similar to upper surface but with somewhat reduced maculation. Females tending to be slightly larger than males, to be slightly paler in color, and to have less prominent maculation.

MALE GENITALIA: Uncus heavily sclerotized, broad, rounded apically, curved ventrally, with weakly defined single or double apical projection on ventral surface; socius small, inconspicuous, located adjacent to apical projection; gnathos prominent, heavily sclerotized, U-shaped, widened medially, posteroventral margin bluntly pointed; valves elongate, complex; costa with short to elongate, flattened, basal arm, setose distally; distal portion of valve slender, inner face setose; median process of valve sclerotized, raised, apically pointed; sacculus lightly sclerotized, swollen, extending partially or completely to middle of valve, more or less setose, and with small to elongate, simple or setose digitate process; transtilla broad laterally, very slender medially, weakly sclerotized; anellus large, flat, anterior portion semicircular or elliptical, posterior portion larger, tending to be slightly more heavily sclerotized, widened posteriorly; cristae and furca absent; tegumen large, broad, thick dorsoventrally; saccus large, broad, anterior end with two lateral lobes; aedeagus simple, either with sides more or less parallel or becoming broadly swollen posteriorly, ventral surface sclerotized, margins with or without small teethlike projections, posterior end truncate, weakly concave, or sharply bifurcate. in length about equal to combined lengths of tegumen and saccus; vesica relatively small when everted, extending dorsally as simple tube, with or without weakly sclerotized area.

FEMALE GENITALIA. Sterigma with lamella postvaginalis heavily sclerotized, flaplike, wider than long, lamella antevaginalis in form of narrow rim around edge of ductus bursae; ductus bursae sclerotized, with length about equal to width; ductus seminalis arising medioventrally, anteriad of ductus bursae; corpus bursae elongate, membranous, posterior portion slender, with or without swollen, lightly sclerotized area extending anteriorly from ductus bursae, anterior portion swollen; signum large, more or less elliptical, with raised rim all

around. Apophyses posteriores 1.5 to 2.3 mm. in length. Segment 8 with curved depression just posteriad of lamella postvaginalis, with or without prominent posteroventral ridge on each side near end of segment.

EARLY STAGES: As discussed in the Introduction, a number of papers have been published on the early stages, but it is almost impossible to tell to which species these refer. It is probable that most of them pertain to *urticaria* and *sospeta*, as the rearings were done primarily in the northern United States and southern Canada, and these are the only two species occurring in that area. The following is a chronological list of many of the papers pertaining to *Xanthotype*; it is not complete, as I have been unable to examine some additional references.

Angerona crocataria: Packard, 1869, p. 319, pl. 8, fig. 5a (caterpillar; larval description); 1876, p. 475, pl. 13, fig. 9 (caterpillar; larval description). French, 1878, p. 243 (larval description, based on Packard, 1869). Saunders, 1883, p. 348, fig. 361 (caterpillar; larval description). Gumppenberg, 1887, p. 396 (larval description). Dyar, 1894, p. 62 (larval notes); 1901, p. 226 (description of eggs, larvae, pupae). Lugger, 1898, p. 233 (description of larvae, pupae). Mosher, 1916, pp. 129, 131 (pupal description).

Angeronia [*sic*] *crocaotaria* [*sic*]: Bowles, 1871, p. 9 (description of eggs, larvae, pupae).

Xanthotype sospeta: Forbes, 1945, p. 195 (description of larvae, pupae); 1948, p. 79 (description of eggs, larvae, pupae). Peterson, 1962, p. 118, fig. 29 (description, photograph of eggs).

Xanthotype urticaria: McDunnough, 1933, p. 125, fig. 4 (cremaster; larval description). Forbes, 1948, p. 80 (larval note).

Swett (1918, pp. 39, 41, 43) claimed to have life history information, but this was never published.

FOOD PLANTS: The same precautionary words given in the Introduction and Early Stages apply here.

Angerona crocataria: Packard, 1869, p. 319 (cultivated strawberries); 1876, p. 475 (strawberries, currants). Saunders, 1883, p. 348 ("gooseberry, strawberry, and other plants besides"). Bruce, 1887, p. 48 (currants). Lugger, 1898, p. 233 (a general feeder, especially currants). Dyar, 1901, p. 227 (Polygonum). Grossbeck, 1917, p. 101 (Polygonum, red currant, "wild currant," strawberry, gooseberry, and mint).

Angeronia [*sic*] *crocaotaria* [*sic*]; Bowles, 1871, p. 9 (red currant).

Xanthotype sospeta: McDunnough, 1933, p. 125 (*Cornus*, *Thalictrum*). Forbes, 1948, p. 79 (a general feeder on low plants, also on *Cornus*). Prentice, 1963, p. 477 (basswood, red maple, bitternut hickory, white elm).

Xanthotype urticaria: McDunnough, 1933, p. 125 (*Cornus*; pupae between leaves of *Myrica*). Forbes, 1948, p. 80 (*Cornus*). Wood, 1951, p. 243 (blueberries). Prentice, 1963, p. 478 (mountain maple). Ferguson, 1975, p. 27 (*Glechoma*, *Rhododendron*; a pupa found on *Alnus*).

Summarizing the above, the caterpillars have been reported as feeding on (or their pupae found on) members of the following families of plants; Aceraceae, Betulaceae, Cornaceae, Ericaceae, Juglandaceae, Labiatae, Myricaceae, Polygonaceae, Ranunculaceae, Rosaceae, Saxifragaceae, Tiliaceae, and Urticaceae.

Food plants verified during the course of this study include members of the Betulaceae, Caprifoliaceae, Compositae, Ericaceae, Iridaceae, Labiatae, Rosaceae, and Saxifragaceae.

TYPE SPECIES: *Phalaena crocataria* Fabricius, 1798; by original designation. The taxon represented by the nominal species *Phalaena crocataria* is currently treated subjectively on taxonomic grounds as the same as that represented by the older-established nominal species *Phal*[*aena*] *Noct*[*ua*] *sospeta* Drury, 1773.

DISTRIBUTION: Continental United States and southern Canada, apparently being absent from Oregon, Washington, British Columbia, and Alaska.

REMARKS: See the Introduction for a discussion of variation and the problems of separating the different species.

The adults will fly during the day if disturbed, and readily come to light at night. On two occasions I have collected *urticaria* in series; both were at the same location in the Bear Lodge Mountains, Crook County, Wyoming, at an elevation of about 6000 ft. (1830 m.). On the first trip I was assisted by Phyllis and Barbara Rindge; we collected from July 9 through 14, 1959. We netted 16 specimens during the days or at dusk. At night we caught 62 speci-

mens with only Coleman lanterns burning; when we used both Colemans and "black light," the totals were 44 and 32, respectively. The second trip was from July 2 through 11, 1962, with my assistants being Phyllis and Marguerite Rindge. We netted only four moths this time. Each night we used both Colemans and "black light"; we caught 32 and 80, respectively. As we were using the same collecting equipment, lights, and techniques at the same localities on both trips it is difficult to explain the differential response of the moths to the two types of lights on these trips. All the moths were males except for three females (one caught with a net) in 1959 and two in 1962. The disparate sex ratio is probably explained by our being in the area before the majority of the females had emerged from their pupae.

KEY TO SPECIES

Based on Male Genitalia

1. Costal arm 0.3 to 0.5 mm. in length; aedeagus broadly enlarged medially; vesica with weakly sclerotized rectangular area 4
   Costal arm less than 0.2 mm. in length; aedeagus with parallel sides or slightly enlarged medially; vesica unarmed 2
2. Sacculus with swollen, prominently spinose anterior ridge; aedeagus with posterolateral margins serrate .....*rufaria*
   Sacculus not as above; aedeagus with smooth posterolateral margins 3
3. Process of sacculus very small, 0.1 mm. in length .....*barnesi*
   Process of sacculus longer, 0.2 to 0.3 mm. in length .....*urticaria*
4. Process of sacculus thin, small, usually not spinose, 0.2 to 0.5 mm. in length .....*sospeta*
   Process of sacculus thick, elongate, spinose, 0.4 to 0.7 mm. in length .....*attenuaria*

Based on Female Genitalia and Abdomen

1. Corpus bursae with ventral surface of posterior end sclerotized; segment 8 with posterior end evenly tapering 2
   Corpus bursae with posterior end membranous; segment 8 with posterior end having deep depression and anterior flangelike lip on each side ventrally 4
2. Lamella postvaginalis 0.25 to 0.40 mm. wide; segment 8 with posterior margin rim-like .....*rufaria*
   Lamella postvaginalis 0.40 to 0.55 mm. wide; segment 8 with posterior margin simple, unmodified 3
3. Apophyses posteriores 1.7 mm. in length; combined lengths of ductus bursae and corpus bursae 2.75 mm. .....*barnesi*
   Apophyses posteriores 1.9 to 2.2 mm. in length; combined lengths of ductus bursae and corpus bursae 3.05 to 4.50 mm., averaging 3.60 mm. .....*urticaria*
4. Segment 8 with anterior depression small and membranous .....*sospeta*
   Segment 8 with anterior depression deep and sclerotized .....*attenuaria*

Xanthotype urticaria Swett

Figures 1-9, 14, 27

Angerona crocataria (in part): see listing under *sospeta*, below; most of early references refer to both *urticaria* and *sospeta*, and there is no way of distinguishing between them.

Xanthotype urticaria Swett, 1918, pl. 7, figs. 4, 5 (male holotype, female allotype). McDunnough, 1926, p. 121. Forbes, 1948, p. 80, figs. 103a, b (male valve, aedeagus).

Xanthotype urticaria form *watsoni* Swett, 1918, pl. 7, fig. 6 (male holotype). NEW SYNONYMY.

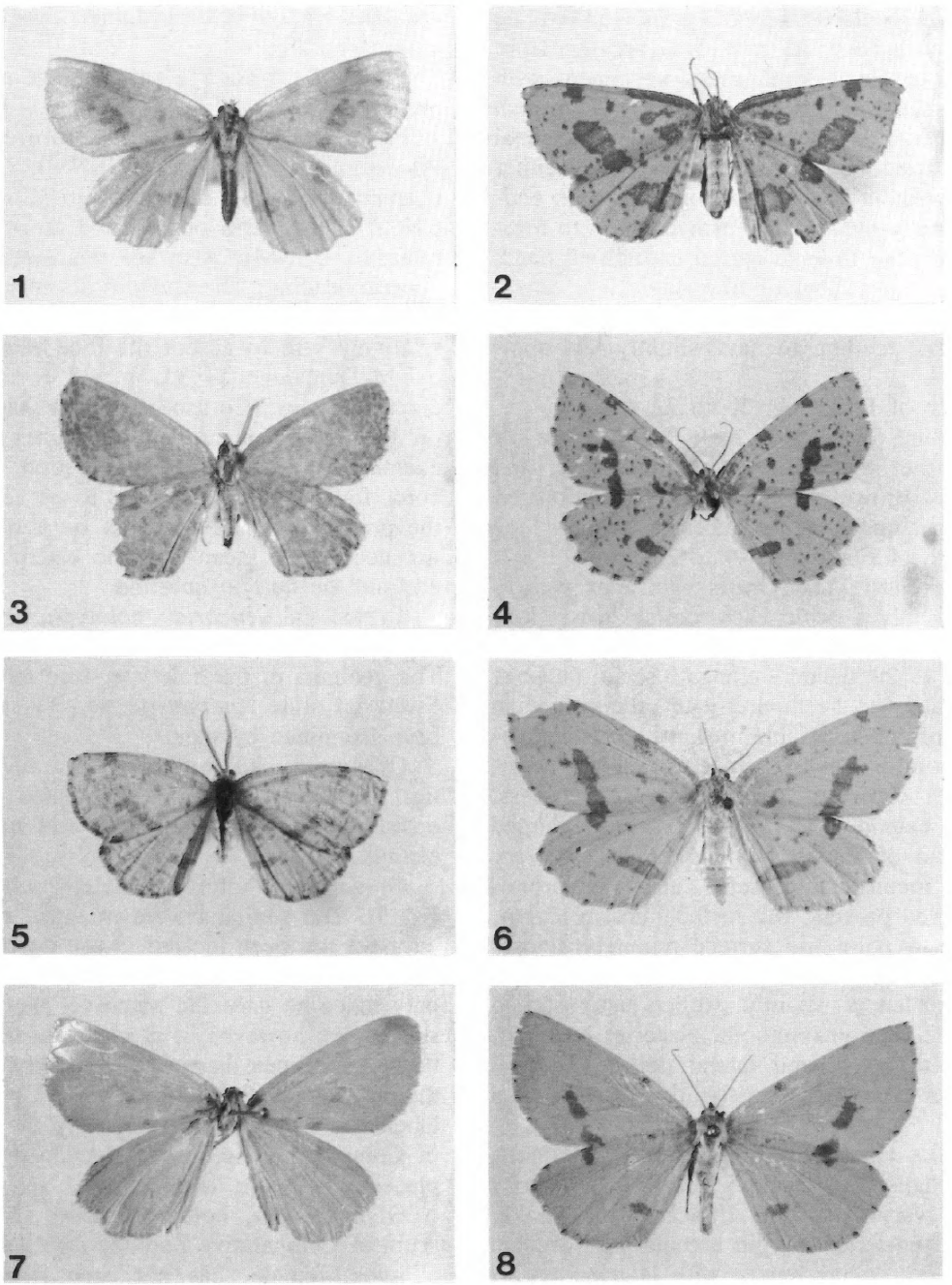
Xanthotype vagaria Swett, 1918, pl. 8, fig. 12 (male holotype). NEW SYNONYMY.

Xanthotype vagaria var. *turbidaria* Swett, 1918, pl. 8, figs. 14, 15 (male holotype, female allotype). NEW SYNONYMY.

DIAGNOSIS: The male genitalia are distinguished by the aedeagus being slender, having almost parallel sides and an unarmed vesica, by the short costal arms, and by the elongate process of each sacculus. In the female, the abdomen has the posterior end of segment 8 evenly tapering, and the genitalia have a wide lamella postvaginalis and large ductus bursae and corpus bursae.

MALE: Head with vertex and front yellow, the latter tending to have ventrolateral and ventral portions pale to dark brown; palpi grayish brown, dark brown, or blackish brown. Thorax yellow above and below; legs with coxae yellow, distal segments variably yellow and brown. Abdomen yellow above and below.

Upper Surface of Wings: All wings unicolorous yellow, with variable amount of brown and lilac-brown spotting; forewings tending to have t. a. line represented by three



FIGS 1-8. Adults of *Xanthotype urticaria* Swett. 1. Holotype, male, Deerfield, Nova Scotia (AMNH). 2. Allotype, female, Nova Scotia (AMNH). 3. *X. urticaria* form *watsoni* Swett, holotype, male, Newfoundland, New Jersey, August 13, 1904 (Watson; AMNH). 4. Female, Port Washington, New York, August 14, 1938 (R. R. McElvare; AMNH). 5. *X. vagaria* Swett, holotype, male, New Washington, Pennsylvania, August 16, 1915 (N. McMurray; MCZ). 6. Female, Rye, New York, June 11, 1929 (V. Ghika; AMNH). 7. *X. vagaria* var. *turbidaria* Swett, holotype, male, head of Plum Creek, Colorado, June 29 (MCZ). 8. Female, Valley View Lodge, Colorado, July 14, 1957 (F. and P. Rindge; AMNH). All ×1.3.

small lilac-centered brown spots located on veins R, Cu, and A; t. p. line varying from complete to obsolescent, many specimens with more or less complete lilac-centered brown band extending from middle of wing to anal margin; fringe concolorous with wing, either with or without brown spots opposite vein endings. Hind wings similar in maculation to forewings, tending to have partial extradiscal band; fringe similar to that of forewing.

Under Surface of Wings: Similar to upper surface but tending to have slightly less spotting.

Length of Forewing: 13 to 22 mm.

FEMALE: Similar to male, with color of wings either the same or slightly paler, and with less brown spotting and maculation on both upper and under surfaces of wings.

Length of Forewing: 14 to 23 mm.

MALE GENITALIA: Uncus with apex weakly bilobed; valves with each costal arm short, curved ventrodistally, posterior margin with from 12 to 20 slender, elongate setae, those at apex tending to be thicker than others; median process of valve variable in shape, subrectangular to more or less triangular, distally or medially with elongate, slender, digitate process; sacculus extending to middle of valve, enlarged just basad of middle, having numerous, very slender, inconspicuous setae, and with prominent curved process, 0.2 to 0.3 mm. in length, tapering to point, its surface minutely setose, with setae laying almost flat on surface; aedeagus slender, slightly swollen just posteriad of middle, margins smooth, posterior end concave, with sclerotized lateral points of equal length, or with right one slightly longer; vesica unarmed.

FEMALE GENITALIA: Sterigma with lamella postvaginalis 0.40 to 0.55 mm. wide, anterior margin varying from truncate to weakly rounded, posterior margin arcuate with median indentation; ductus bursae with lateral margins tending to be weakly convex; corpus bursae with posterior end lightly sclerotized and swollen; signum variable in size, ranging from 0.6 to 1.0 mm. in width. Apophyses posteriores 1.9 to 2.2 mm. in length. Segment 8 with curved depression posteriad of lamella postvaginalis extending width of segment, shallow, and without posteroventral ridges or swellings.

EARLY STAGES: See this section under generic heading.

FOOD PLANTS: *Spiraea* (Rosaceae; CNC), *Rhododendron* (Ericacaea; USNM), *Glechoma* (Labiatae; USNM), and *Solidago* (Compositae; CNC); also from a pupa found on *Alnus* (Betulaceae; USNM). Also see this section under generic heading. The above hosts include those given by Ferguson (1975, p. 27). I think it is relatively safe to accept the food plants given by McDunnough (1933, p. 125), which included *Cornus* (Cornaceae) and a pupa found on *Myrica* (Myricacaeae), although I have not examined the specimens in question. Both records for just the pupae need to be verified, as the presence of the chrysalis on a plant does not necessarily mean that the caterpillar actually ate the host in question.

TYPES: Of *urticaria*, holotype, male, and allotype, female, in AMNH (see figs. 1, 2). The genitalia of the holotype were mounted by Swett on slide *Xanthotype* no. 11, and have been examined by me.

Of *watsoni*, holotype, male, in AMNH (see fig. 3). The genitalia were mounted by Swett on slide *Xanthotype* no. 14, and have been examined by me.

Of *vagaria*, holotype, male, in MCZ (see fig. 5). The genitalia were mounted by Swett, but have not been located. Swett described this as "*vagaria* variety" and this is apparently the only place he used the name for the nominate subspecies; however, it is sufficient to validate it. The specimen that matches Swett's figure of the holotype (1918, pl. 8, fig. 12) was not labeled as a type; it was found in the Museum of Comparative Zoology collection and I have placed a holotype label on it.

Of *turbidaria*, holotype, male, in the Museum of Comparative Zoology (see fig. 7). The allotype, female, has not been located. The holotype no longer has an abdomen, although it was on the specimen when it was photographed for Swett's plate (1918, pl. 8, fig. 14); there is no blue paper, with Swett's notation that the genitalia were dissected, on the pin of the specimen. The holotype label for *turbidaria* was on an Alberta specimen in the Museum of Com-

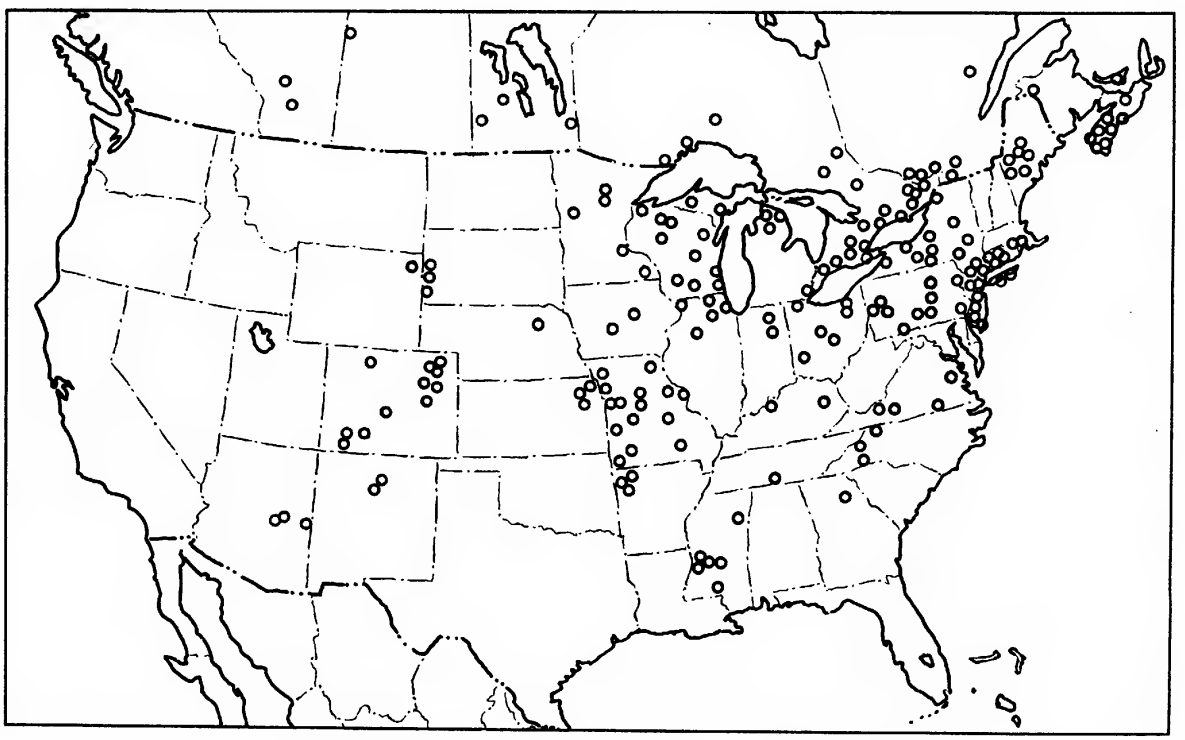
parative Zoology; this was obviously in error, as the type locality was given as Plum Creek, Colorado. A similar situation still exists for the female, as the specimen bearing Swett's allotype label is not from the locality given on his pl. 8, fig. 15. A search of the MCZ collection produced the actual holotype, bearing an unpublished name by Swett. I have transferred the holotype label to the Colorado specimen so that the actual type is now correctly labeled.

TYPE LOCALITIES: Of *urticaria*, "D'f'ld" [Deerfield], Nova Scotia. Of *watsoni*, Newfoundland, Morris County, New Jersey; Swett gave it as "New Foundland" and this was mistaken by subsequent authors (McDunnough, 1926, p. 121; Forbes, 1948, p. 80) for the Canadian province. Of *vagaria*, New Washington, Clearfield County, Pennsylvania. Of *turbidaria*, head of Plum Creek, Douglas County, Colorado; this is west of Larkspur, at about 7000 ft. elevation (see Brown, 1956, p. 211, and 1972, p. 245 for information about this locality).

DISTRIBUTION: Across southern Canada, from Nova Scotia, Prince Edward Island and New Brunswick, west to the foothills of the Rocky Mountains in Alberta. In the United States, from Maine west to eastern Montana and eastern Wyoming, south in the mountains to northern Georgia, in the midwest to Kansas, the Ozark Plateau, and Mississippi, and in the Rocky Mountains, to Colorado, northern New Mexico and to the Mogollon Plateau and White Mountains of Arizona. (See map 1.) The species occurs from sea level up to at least elevations of 7800 and 8000 ft. (2375 and 2440 m.) in Colorado and New Mexico.

FLIGHT PERIOD: June, July, and August in Canada and the Rocky Mountains; from April into September in the southern and southeastern United States.

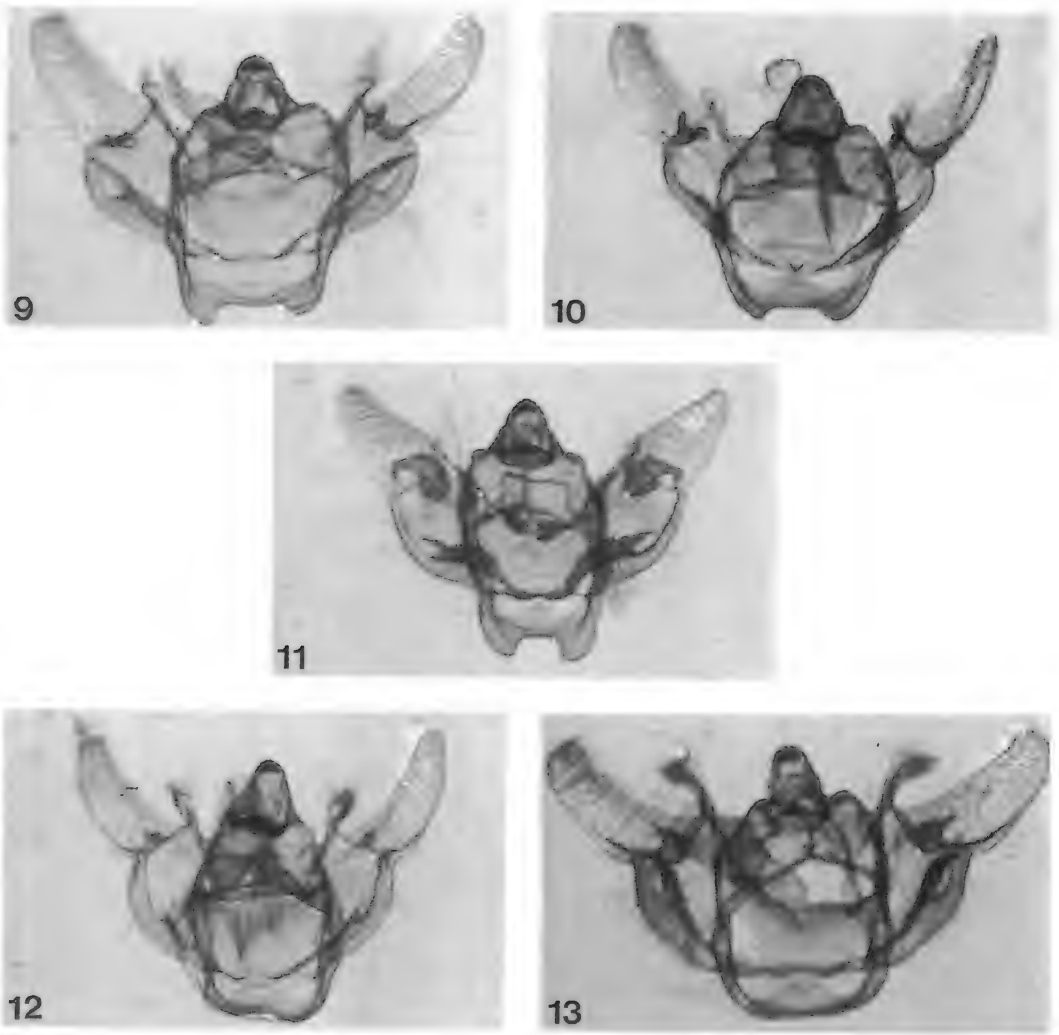
REMARKS: One thousand one hundred ninety specimens (979 males, 211 females) and 131 genitalic dissections (92 males, 39 females) have been studied. The high percentage of males is explained, at least in part, by the large



MAP 1. Distribution of *Xanthotype urticaria* Swett.

series of specimens taken in Crook County, Wyoming (see Remarks under *Xanthotype*), where 265 males and five females were captured. If these figures are subtracted from the number of specimens studied, the total comes to 791 males and 196 females.

This species is very variable in maculation. In eastern and midwestern North America, most of the specimens have the upper surface of the wings more or less speckled with dark scales; Swett's *watsoni* is an example of a heavily spotted male. Swett's *vagaria* is a specimen that has moderate maculation; I do not know why he named this species and, as no verbal description was printed, he left no clues. As both the above names represent individual variation in the species, they are placed as synonyms of *urticaria*. Specimens of *urticaria* get progressively larger and have less maculation the farther west they occur, as compared

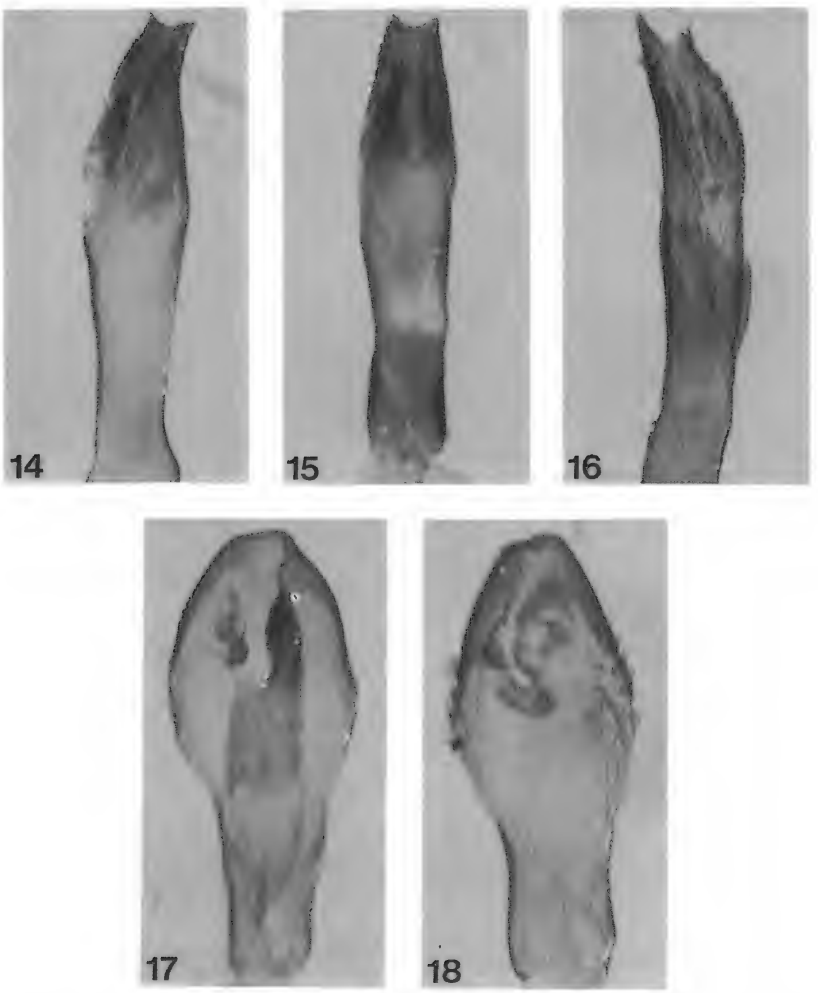


FIGS. 9-13. Male genitalia of *Xanthotype*. 9. *X. urticaria* Swett, 3 mi. NW Warsaw, Missouri, May 31, 1975 (J. R. Heitzman; AMNH). 10. *X. barnesi* Swett, Honn Campground, California, July 1, 1975 (J. P. and K. E. Donahue; LAM). 11. *X. rufaria* Swett, Carteret County, North Carolina, July 19, 1971 (J. B. Sullivan; AMNH). 12. *X. sospeta* (Drury), Chaffey Locks, Ontario, July 28, 1969 (J. C. E. Riotte; AMNH). 13. *X. attenuaria* Swett, Sunshine, Louisiana, April 16, 1972 (V. A. Brou; AMNH).

with eastern moths, culminating in the material from the southern Rocky Mountain States. This is a clinal variation, without any noticeable break in either size or pattern; Swett's *turbidaria* represents the western end of the cline, and hence this name is placed in the synonymy of *urticaria*.

At least one of Swett's paratypes of *turbidaria* is a specimen of *sospeta*; it is a female from Salida, Colorado, July 12, 1898, with the genitalia mounted on slide FHR 18444, and is in the National Museum of Natural History.

The genitalia are much less variable than the maculation, and have the best characters to determine the species. There is relatively little variation within the genitalia of both sexes; some of the apparent variability may be due to the positioning of these structures on the slides, and the degree of flattening by the cover glasses. In the males, there is some variation in the length of the curved process of the sacculus, and in the shape of the median process of the valve. The latter may be either symmetrical or slightly asymmetrical. The usual configuration is for the median process to have a more or less straight distal margin extending



FIGS. 14-18. Aedeagi of *Xanthotype*, from the same specimens as figures 9-13. 14. *X. urticaria* Swett. 15. *X. barnesi* Swett. 16. *X. rufaria* Swett; the aedeagus is partly turned laterally. 17. *X. sospeta* (Drury). 18. *X. attenuaria* Swett. All 2.4 times larger than figures 9-13.

to the pointed or apically rounded digitate process; the basal margin is usually angulate, but this varies in degree. The apex of the aedeagus is variable in shape, due primarily to the depth of the median depression; the latter varies from being very shallow to moderately deep, so that the apex may be almost flat or have two distinct lateral points. In the latter case, the points are either of about equal length or the right one is slightly longer than the one on the left side. In the female structures, there is variation in the size and shape of the lamella postvaginalis; in fact it is difficult to find two specimens that have this structure the same size and shape. Similarly, the signum shows a considerable range in size.

Xanthotype barnesi Swett
Figures 10, 15, 19-22, 28

Xanthotype barnesi Swett, 1918, pl. 8, figs. 10 (allotype female), 13 (holotype male).

DIAGNOSIS: The genitalia are similar to those of *urticaria*, differing mainly, in the male, by having a slightly larger uncus, gnathos, and median process of the valve, and the process of the sacculus is simple and half or less the size of the corresponding structure in *urticaria*; the female genitalia are smaller (see Keys to Species).

MALE: Similar to those of *urticaria* but differing mainly as follows: front yellow, without dark ventral scaling; palpi yellow-brown or with mixed yellow and brown scales; upper surface of wings rather heavily and evenly covered with pale lilac-brown spots; t. p. and extradiscal bands tending to be more complete; discal spot of forewing present; fringes checkered; under surface with complete t. p. and extradiscal bands, and discal dots present on all wings.

Length of Forewing: 20 to 21 mm.

FEMALE: Similar to male but with less brown spotting and reduced maculation on both upper and under surfaces of wings; t. p. and extradiscal bands incomplete.

Length of Forewing: 18 to 20 mm.

MALE GENITALIA: Uncus with apex weakly bilobed; valves with each costal arm small, curved ventrodistally, posterior margin with from 12 to 16 slender, elongate setae; median process of valve with basal portion rectangular, distally with outer margin extending as elongate, flattened process; sacculus extending to middle of valve, strongly swollen basad of middle, ventral surface with numerous, slender setae, and with small simple process 0.1 mm. in length; aedeagus slender, slightly swollen just posteriad of middle, margins smooth, posterior end concave, with left point slightly longer than right one; vesica membranous.

FEMALE GENITALIA: Sterigma with slender lamella postvaginalis 0.5 mm. wide, anterior margin broadly wedge-shaped, posterior margin rounded with median indentation; ductus bursae with lateral margins convex, posterior end with prominent anterolateral rim; corpus bursae with posterior end lightly sclerotized and swollen; signum 1.0 mm. in width. Apophyses posteriores 1.7 mm. in length. Segment 8 with moderate depression on each side of lamella postvaginalis, anteromedian angle with small, sclerotized, rounded projection; without posteroventral ridges or swellings.

EARLY STAGES: Unknown.

FOOD PLANTS: Unknown.

TYPES: Holotype, male, and allotype, female, in the National Museum of Natural History (see figs. 19, 20). The genitalia of the holotype were mounted by Swett on slide *barnesi* no. 15, and have been examined by me. The allotype has not been dissected; the abdomen has been glued on to the thorax (and is upside down).

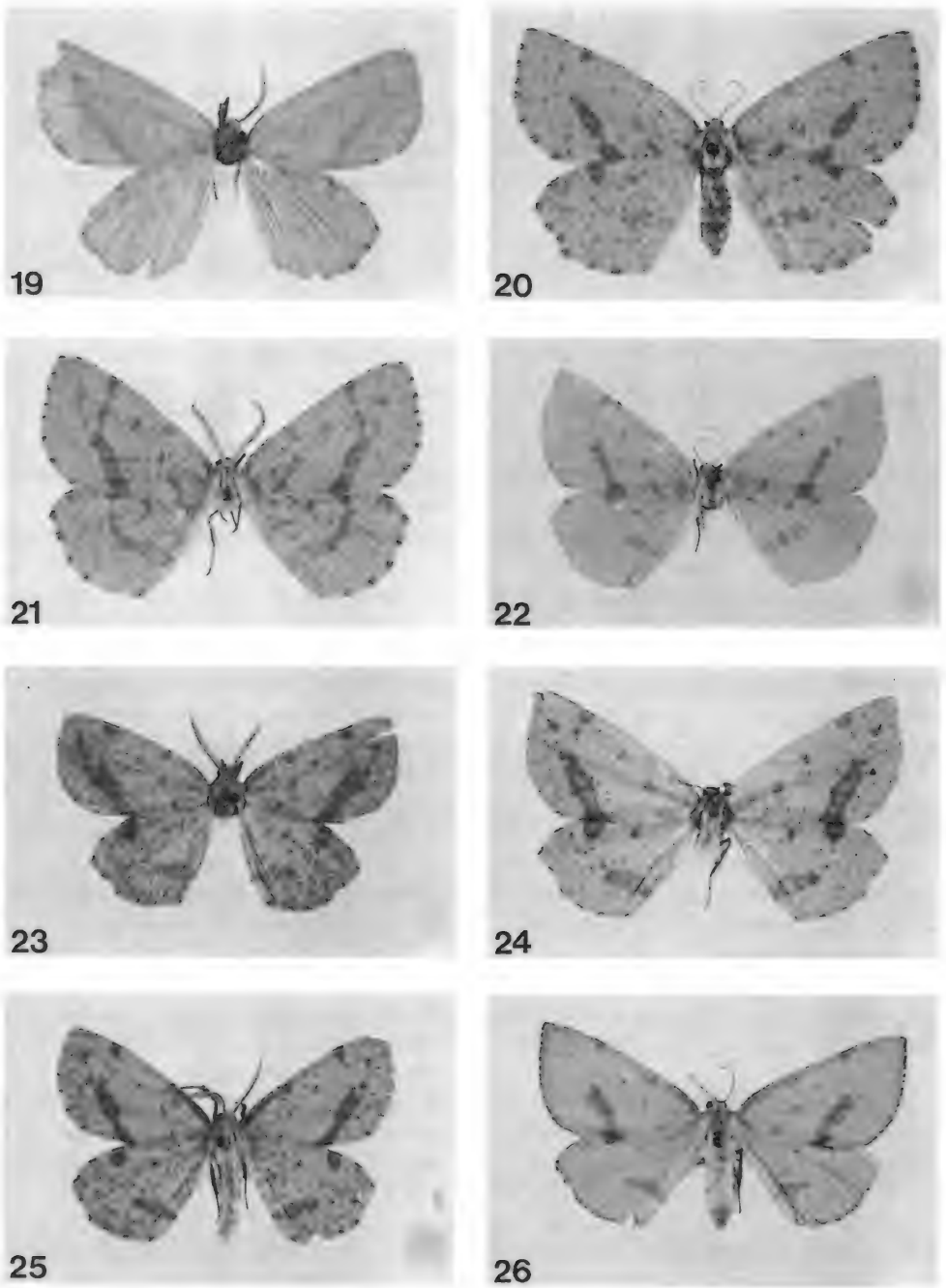
TYPE LOCALITY: Plumas County, California.

DISTRIBUTION: Plumas and Shasta counties, California (see map 2). Two specimens have elevation data on their labels, and 3400 and 3500 ft. (1040 and 1070 m.) are given.

FLIGHT PERIOD: June and July.

REMARKS: Five specimens (three males, two females) and four genitalic dissections (three males, one female) have been studied.

From the few specimens that are available for study, it appears that the maculation of *barnesi* may not be as variable as that of *urticaria*. All males examined have a complete, relatively broad t. p. line present in the lower half of the forewings, whereas in the females this band is somewhat reduced; both sexes have



FIGS. 19-26. Adults of *Xanthotype*. 19-22. *X. barnesi* Swett. 19. Holotype, male, Plumas County, California, July 16-23 (USNM). 20. Allotype, female, Plumas County, California, July 24-30 (USNM). 21. Male, Honn Campground, California, July 1, 1975 (J. P. and K. E. Donahue; LAM). 22. Female, Meadow Valley, California, July 15, 1952 (D. F. Hardwick; CNC). 23-26. *X. rufaria* Swett. 23. Holotype, male, Glenwood, Florida (USNM). 24. Allotype, female, Florida (USNM). 25. Male, Carteret County, North Carolina, April 21, 1974 (J. B. Sullivan; AMNH). 26. Female, Leland, North Carolina, June 20, 1945 (O. Buchholz; AMNH). All ×1.3.

prominent dark spots at the ends of the veins in the fringes. In the male genitalia, there is variability in the shape of the median process of the valve, somewhat as in *urticaria*; the curved process of the sacculus appears to be very similar in all dissections.

Xanthotype rufaria Swett
Figures 11, 16, 23-26, 29

Xanthotype rufaria Swett, 1918, p. 88, pl. 7, figs. 1 (male holotype), 2, 3 (male paratypes), fig. 6G (male genitalia). McDunnough, 1926, p. 120. Forbes, 1948, p. 80, figs. 104a, b (male valve, aedeagus).

DIAGNOSIS: The genitalia are similar to those of *urticaria*, differing mainly, in the male, by the larger and more heavily sclerotized median process of the valve, by the setose sacculus, and by the serrate lateral margins of the aedeagus; the females have the posterior end of segment 8 widened, a sclerotized rim ventrally, and a much more prominent anterior depression, whereas the genitalia have a broader ductus bursae.

MALE: Similar to those of *urticaria* but differing mainly as follows: upper surface of wings darker yellow, tending to have numerous small brown spots narrowly margined by orange-yellow scales, tending to give wings a slightly deeper and warmer tone; t. p. band complete in lower portion of forewing.

Length of Forewing: 14 to 19 mm.

FEMALE: Similar to male but with less brown spotting and hence appearing slightly paler in color.

Length of Forewing: 15 to 25 mm.

MALE GENITALIA: Uncus with apex bluntly pointed; valves with each costal arm very short, apex and posterior margin with from 15 to 20 slender, elongate setae; median process of valve elongate, basal portion more or less rectangular, then slightly narrowed, with apex angled anteriorly and ending in point; sacculus sclerotized to middle of valve, with basal half broadly swollen and covered with numerous thick setae, and with prominent curved process, 0.2 to 0.3 mm. in length, tapering to point, its posterior margin minutely setose, with setae laying almost flat on surface; aedeagus slender, with parallel sides, both margins near posterior end multidentate, apex convex; vesica unarmed.

FEMALE GENITALIA: Sterigma with lamella postvaginalis 0.25 to 0.40 mm. wide, anterior margin strongly convex, posterior margin broadly rounded, medially truncate or shallowly concave; lamella antevaginalis with large mediolateral, heavily sclerotized, curving flange on each side, in length longer than width of lamella, slightly curving anterolaterally, and forming part of transverse depression of segment 8, with semicircular slender ridge extending anteriorly and forming lip of sinus vaginalis; ductus bursae slightly longer than wide, weakly narrowed anteriorly; corpus bursae with posteroventral portion sclerotized and broadly swollen, in width as wide as ductus bursae; signum 0.6 to 1.0 mm. in width. Apophyses posteriores 1.8 to 2.2 mm. in length. Segment 8 with deep, sclerotized, curved depression posteriad of lamella postvaginalis, its anteromedian surface forming flange on each side attached to lamella postvaginalis, and with posterior margin of entire segment with narrow sclerotized rim, arising ventrally on each side from curved depression and becoming thinner dorsally.

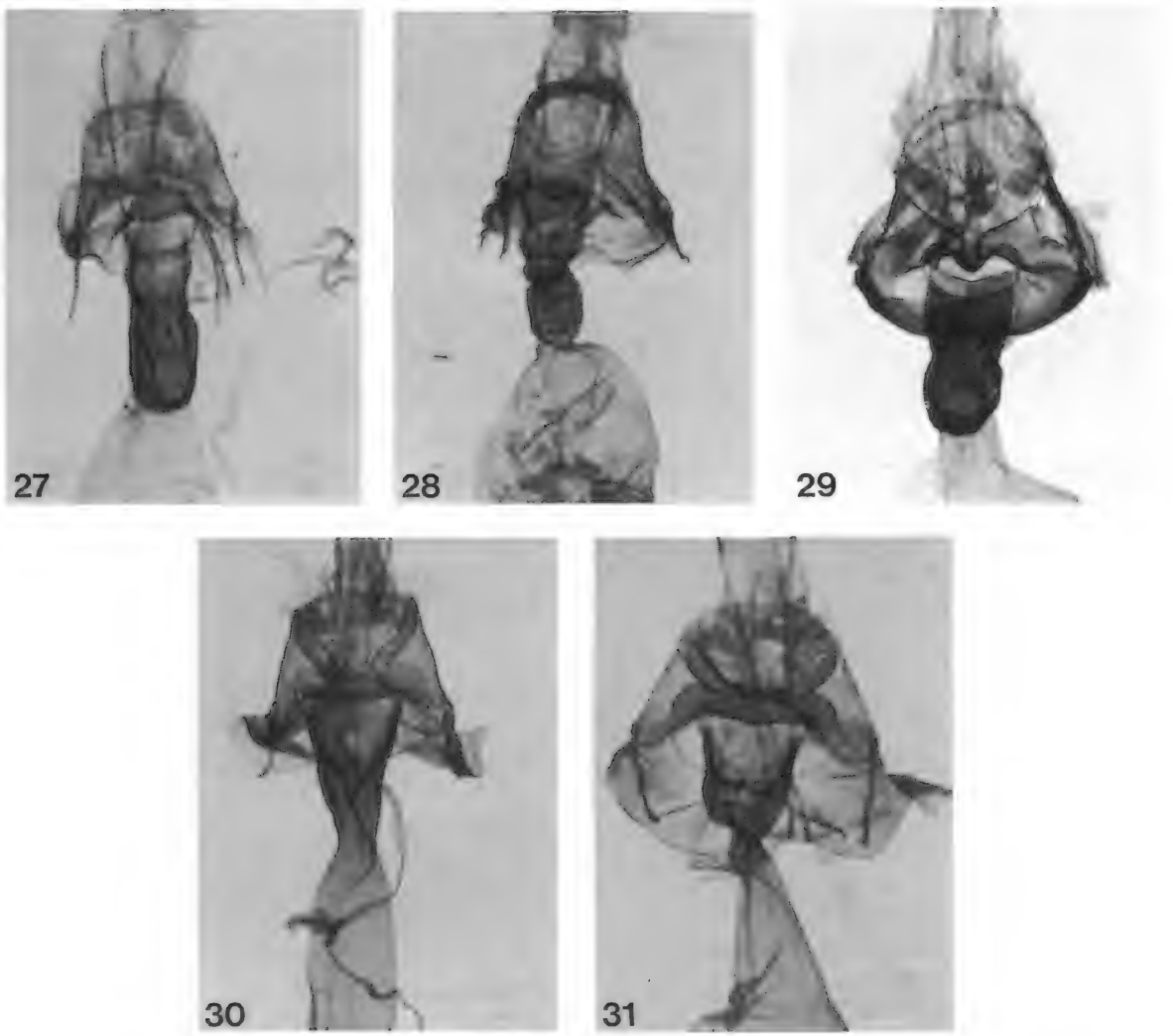
EARLY STAGES: Apparently unknown (see this section under generic heading).

FOOD PLANTS: Apparently unknown (see this section under generic heading).

TYPES: Holotype, male, and allotype, female, in the National Museum of Natural History (see figs. 23, 24). The genitalia of the holotype are mounted on slide HWC 1189, and have been examined by me. The abdomen of the allotype has been cut off near the base, but there is no label on the pin of the specimen to indicate that the genitalia were dissected.

TYPE LOCALITY: Glenwood, Volusia County, Florida.

DISTRIBUTION: Southern Mississippi to peninsular Florida, and north along the coastal plain to North Carolina (see map 2). One specimen (in AMNH) has been examined from Stone Mountain State Park, Wilkes and Allegheny counties, North Carolina; this female is from the inland, mountainous part of the state. Swett made a paratype of one male from the Fort Lee District, Bergen County, New Jersey (in AMNH); if Swett's genitalic dissection is



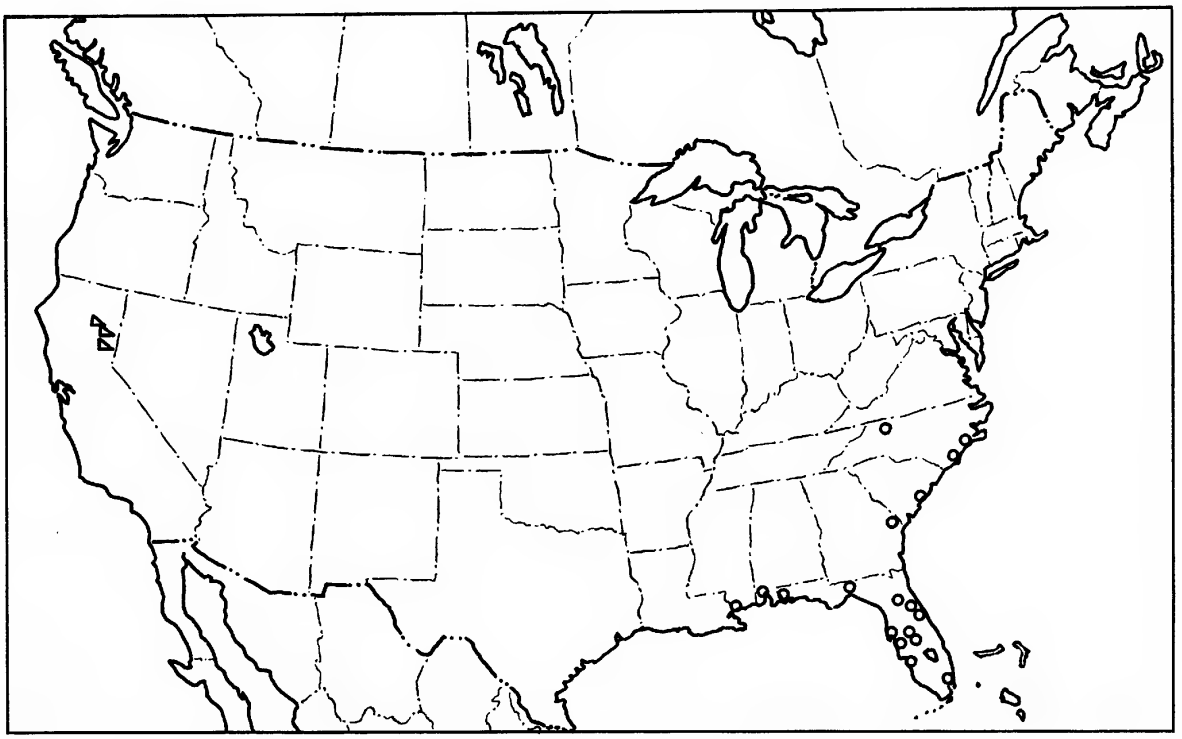
FIGS. 27-31. Female genitalia of *Xanthotype*. 27. *X. urticaria* Swett, Canton, Ohio, July 29, 1938 (E. A. Ferguson; AMNH). 28. *X. barnesi* Swett, Meadow Valley, California, July 15, 1952 (D. F. Hardwick; CNC). 29. *X. rufaria* Swett, Carteret County, North Carolina, May 14, 1971 (J. B. Sullivan; AMNH). 30. *X. sospeta* (Drury), Charlotte, North Carolina (J. B. Sullivan; AMNH). 31. *X. attenuaria* Swett, Tupelo, Mississippi, May 20, 1965 (M. and E. Roshore; AMNH).

correctly associated with the specimen, and if the moth is correctly labeled, this is the northern most record for *rufaria*. However, as I have not seen any valid material from north of North Carolina, I am not accepting this record until more specimens come to hand from northern New Jersey.

FLIGHT PERIOD: Throughout the year, even though I have not seen any January specimens as yet. J. B. Sullivan has caught *rufaria* in Carteret County, North Carolina, from mid-April until mid-October (based on 79 males and 10 females in AMNH).

REMARKS: One hundred sixty specimens (124 males, 36 females) and 25 genitalic dissections (15 males, 10 females) have been studied.

The variation in maculation is expressed mainly in the amount of brown spotting on the upper surface of the wings. In general, specimens caught in the summer and fall tend to be



MAP 2. Distribution of *Xanthotype barnesi* Swett (triangles) and *X. rufaria* Swett (circles).

more heavily spotted than those from the winter and early spring months. Nearly all the females examined have about the same amount or even less spotting than the lightest colored males.

There is considerable individual variability in the shape of the median process of the valve; so much so, in fact, that it is difficult to find any two that are alike. Nevertheless, this structure maintains a basic diagnostic shape so that it can be used for recognizing the species. There are also some differences in the posterior part of the aedeagus, as the width, shape of the apex, and amount of lateral spining are somewhat variable. In the female structures, there is variation in the size and shape of the lamella postvaginalis, with no two specimens examined having this structure the same size and shape. Similarly, the signum shows a considerable range in size.

Xanthotype sospeta (Drury)

Figures 12, 17, 30, 32-39

Phal[*aena*] *Noct*[*ua*] *sospeta* Drury, 1773, p. 39, pl. 22, fig. 3 (holotype female).

Xanthotype sospeta: McDunnough, 1926, p. 120. Forbes, 1948, p. 78, figs. 102a, b (male valve, aedeagus).

Venilia sospita [*sic*]: Warren, 1894, p. 464.

Angerona sospetaria [*sic*]: Guenée, 1857, p. 115. Oberthür, 1912, p. 273 (placed as "race" of *crocataria*).

Phalaena crocataria Fabricius, 1798, p. 450.

Angerona crocataria: Guenée, 1857, p. 114.

Xanthotype crocataria: Swett, 1918, p. 38, figs. 1G-3G (male, female genitalia). McDunnough, 1926, p. 120 (placed as synonym of *sospeta*).

Angeronia [*sic*] *crocaotaria* [*sic*]: Bowles, 1871, p. 9.

Angeronia [*sic*] *crocataria*: Dyar, 1894, p. 62.

Therapis citrinaria Hübner, [1824], p. 26, pl. [86], figs. 499, 500 (holotype female).

Angerona citronaria: Guenée, 1857, p. 114 (placed as synonym of *crocataria*).

Xanthotype citrina: Dyar, "1902" [1903], p. 336 (error in spelling).

Angerona crocataria var. *caelaria* Hulst, 1886, p. 208.

Xanthotype crocataria caelaria: Dyar, "1902" [1903], p. 336.

Xanthotype crocotaria [*sic*] *caelaria*: Smith, 1903, p. 79.

Xanthotype crocataria ab. *caelaria*: Barnes and McDunnough, 1917, p. 120.
Xanthotype caelaria: Swett, 1918, p. 42 (placed as synonym of *crocataria*).
Xanthotype manitobensis Swett, 1918, p. 78, pl. 8, fig. 11 (holotype male), fig. 4G (male genitalia). McDunnough, 1926, p. 120. NEW SYNONYMY.
Xanthotype sospeta manitobensis: McDunnough, 1938, p. 167.
Xanthotype sospeta var. *manitobensis*: Forbes, 1948, p. 80.
Xanthotype attenuaria marylandensis Swett, 1918, p. 86. NEW SYNONYMY.
Xanthotype attenuaria race *marylandensis*: Forbes, 1948, p. 80.

DIAGNOSIS: The male genitalia are distinguished by the broadly swollen aedeagus, the vesica having a weakly sclerotized, rectangular area, and the very small, short, smooth process of the sacculus. In the female, the abdomen has the posterior end of segment 8 with a deep depression and anterior flangelike lip on each side ventrally, and the anterior depression is small and membranous.

MALE: Similar to those of *urticaria* but differing mainly as follows: tending to be somewhat larger and slightly paler in color, with fewer brown spots and with maculation often somewhat reduced on both upper and under surfaces.

Length of Forewing: 17 to 23 mm.

FEMALE: Similar to male, with color of wings either the same or slightly paler, and with less brown spotting and maculation on both upper and under surfaces of wings.

Length of Forewing: 19 to 25 mm.

MALE GENITALIA. Uncus with apex variable in shape, rounded, truncate, or weakly bilobed; valves with each costal arm elongate, 0.3 to 0.4 mm. in length, flattened medially, slightly swollen apically, apical and outer areas with from 40 to 50 prominent setae; median process of valve more or less triangular, elongate, tapering to flattened point; sacculus extending as sclerotized ridge to middle of valve, scarcely swollen basally, with inconspicuous setae, and with short, smooth, pointed process 0.2 to 0.5 mm. in length; aedeagus broadly swollen posteriorly, with width almost half of length, posterolateral margins either smooth or with a few small dentitions; vesica with irregularly rectangular sclerotized area.

FEMALE GENITALIA: Sterigma with lamella postvaginalis 0.4 to 0.7 mm. wide, anterior margin weakly to strongly convex, posterior margin with sides bluntly tapering, concave medially; lamella antevaginalis in form of ridge extending anteromedially from each side of curved depression of segment 8; ductus bursae slightly wider than long, slightly narrowed anteriorly; corpus bursae with posterior portion membranous, elongate, becoming slightly narrower than ductus bursae; signum 0.5 to 0.9 mm. in width. Apophyses posteriores 1.9 to 2.5 mm. in length. Segment 8 with moderate curved depression posteriad of lamella postvaginalis, its anterior margin tending to be sclerotized, and with small depression on each side posteroventrally, anterior side with prominent flangelike lip, posteriorly with less strongly developed ridge.

EARLY STAGES: See this section under generic heading.

FOOD PLANTS: See this section under generic heading. Adults, examined during the preparation of this paper, have been reared from caterpillars on *Gladiolus* (Iridaceae; CNC), *Spiraea*, rose (Rosaceae; CNC), *Ribes* (Saxifragaceae; CNC), *Viburnum* (Caprifoliaceae; CNC), and chrysanthemum (Compositae; EQ).

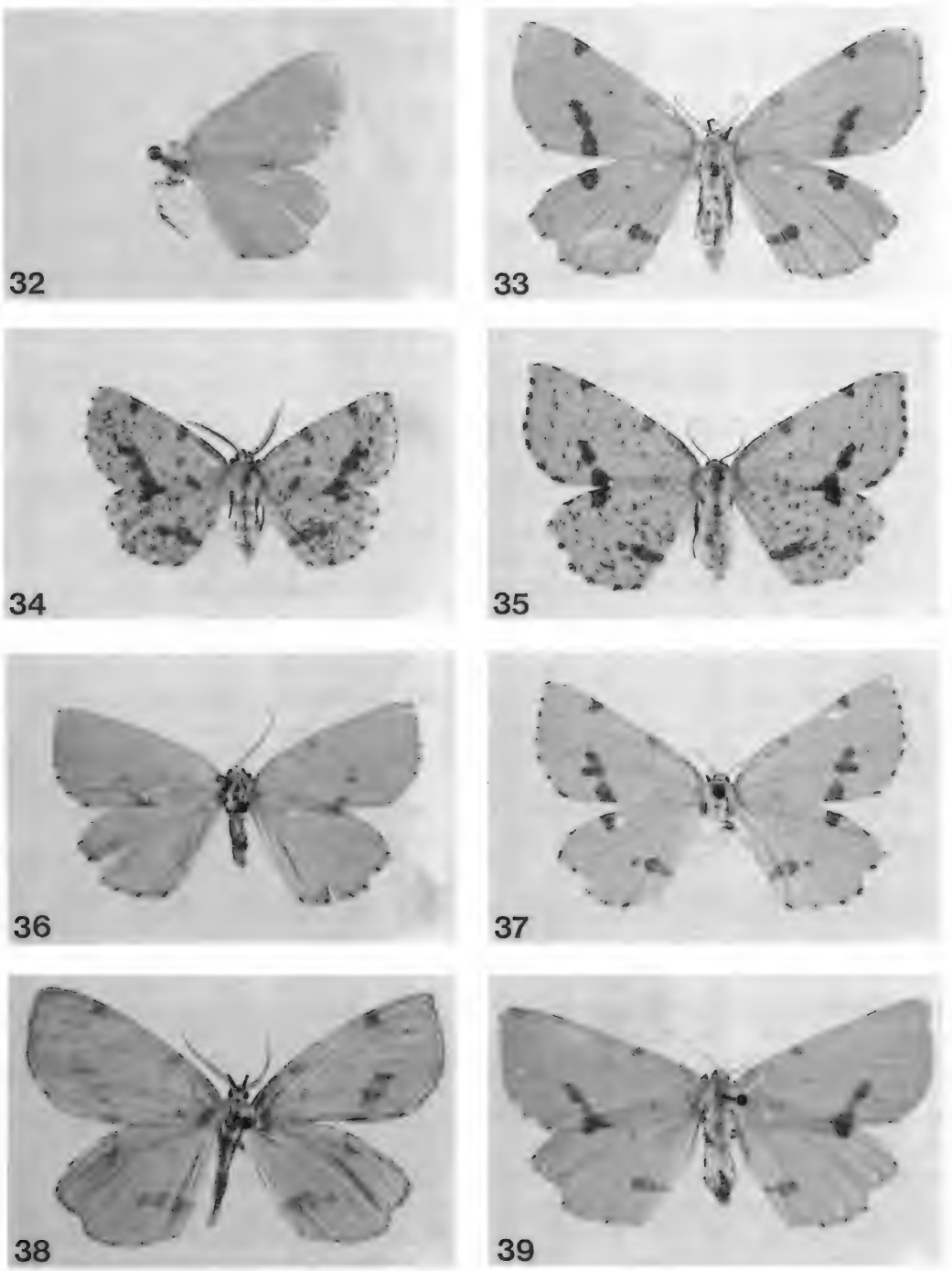
TYPES: Of *sospeta*, lost. Drury's Lepidoptera collection was sold to the British Museum (Nat. Hist.); no Lepidoptera types were identified (Zimsen, 1964, p. 16).

Of *crocataria*, lost. Fabricius described this species from a specimen in the Bosc collection; none of the Lepidoptera types from that collection are known to be extant (Zimsen, 1964, pp. 17, 583).

Of *citrinaria*, presumably lost.

Of *caelaria*, lectotype, male, USNM 34298 (see fig. 32). This specimen was so designated by Swett (1918, p. 42) but was not labeled; I have placed a lectotype label on the specimen. The moth is in very poor condition, consisting of part of the thoracic exoskeleton on the pin, with the right wings still attached. The other pair of wings are on the pin with the labels. The head and abdomen are lost, and the genitalia presumably have also been destroyed.

Of *manitobensis*, holotype, male, in Na-



FIGS. 32-39. Adults of *Xanthotype sospeta* (Drury). 32. *Angerona crocataria* var. *caelaria* Hulst, lectotype, male L[ong] I[sland, New York] (USNM). 33. Female, Alpine, New Jersey, June 14, 1970 (F. H. Rindge; AMNH). 34. Male, Hyattsville, Maryland, emerged September 25, 1951 (Ghika; AMNH). 35. Female, Hyattsville, Maryland, emerged September 30, 1951 (Ghika; AMNH). 36. *X. manitobensis* Swett, holotype, male, Aweme, Manitoba (N. Criddle; USNM). 37. Female, Long Prairie, Minnesota, July 8, 1963 (J. Schrenk; AMNH). 38. Male, Fort Collins, Colorado, July 21, 1975 (K. Bogdonas; AMNH). 39. Female, Platte Canyon, Colorado (Oslar; AMNH). All ×1.3.

tional Museum of Natural History (see fig. 36). Swett mounted the genitalia on slide *manitobensis* no. 12, and have been examined by me.

Of *marylandensis*, holotype, male in National Museum of Natural History. Swett mounted the genitalia on slide *marylandensis* no. 2, and have been examined by me.

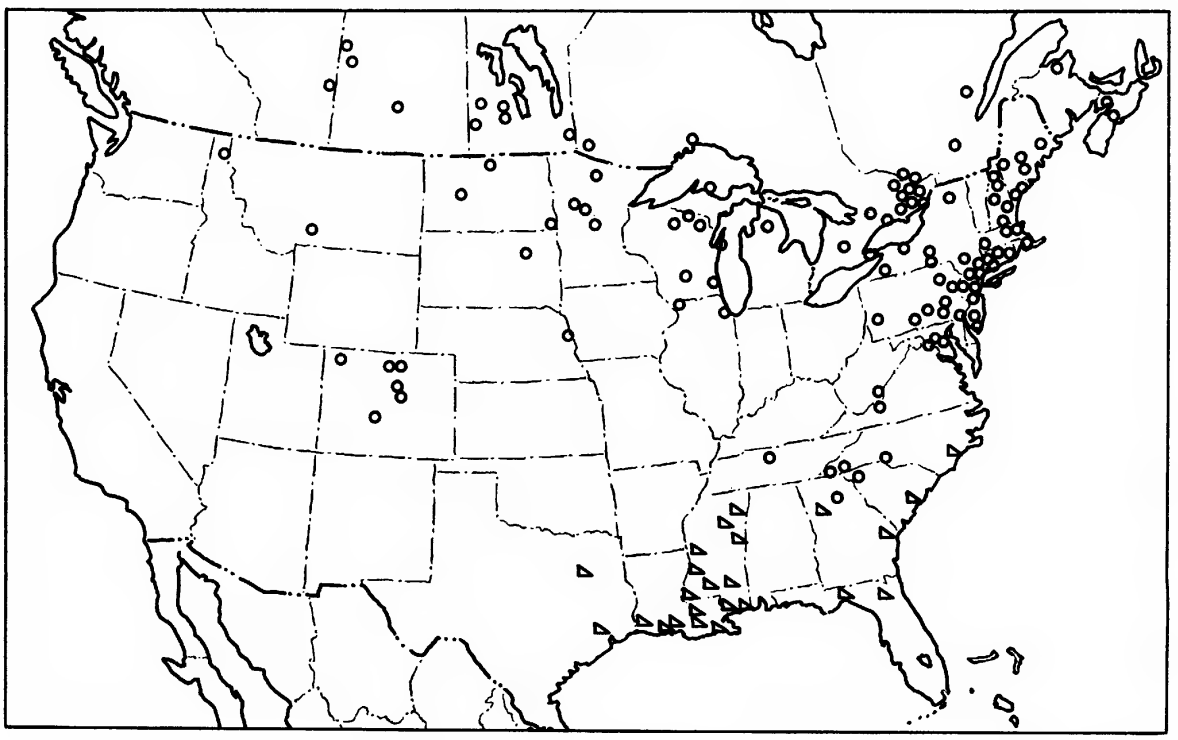
TYPE LOCALITIES: Of *sospeta*, "Jamaica"; McDunnough (1926, p. 120) was correct in stating that this was in error, as it does not refer to the Antillean island, but that the type locality might be New York. Of *crocataria*, Virginia. Of *citrinaria*, North America. Of *caelaria*, New York. Of *manitobensis*, Aweme, Manitoba. Of *marylandensis*, Plummer's Island, Maryland.

DISTRIBUTION: Across southern Canada, from Nova Scotia and New Brunswick to eastern Alberta. In the United States, from Maine west to Montana and northern Idaho, south in the mountains to northern Georgia, and in the Rocky Mountains to Colorado (see map 3). The species occurs from sea level up to at least 7400 ft. (2250 m.) in elevation in Colorado.

FLIGHT PERIOD: June and July in the northern portion of the range and in the Rocky Mountains; from May into September in the southeastern United States.

REMARKS: Three hundred ninety-two specimen (246 males, 146 females) and 88 genitalic dissections (59 males, 29 females) have been studied.

This species is not as variable in maculation as in the commoner and more widespread *urticaria*. Specimens from the eastern portion of the range of *sospeta* have, on the average, less spotting and somewhat reduced maculation, as compared with *urticaria*; *caelaria* represents an individual with greatly reduced maculation. Specimens of *sospeta* tend to have even less maculation as the species extends westward;



MAP 3. Distribution of *Xanthotype sospeta* (Drury; circles) and *X. rufaria* Swett (triangles).

many moths from western Ontario and Manitoba have only part of the t. p. line remaining on the upper surface of the forewings. Swett's *manitobensis* was based on a male with this type of maculation, and it is therefore placed in the synonymy. Specimens from the Dakotas and the Rocky Mountains are larger than eastern specimens.

As with the preceding species, there is considerable variation in the shape of the median process of the valve. There is also a considerable difference in the length of the curved process of the sacculus. In the majority of the specimens dissected, this process tends to be small and rather insignificant, but in others it may be up to 0.5 mm. in length. There is also some variability in the amount of spining on this process; usually there are no setae, but in specimens with an elongate process some spining may be present. However, in no example that I have seen does the length and spining of this process begin to approach that of *attenuaria*. The aedeagus of these two species are of the same type, but those of *sospeta* have either smooth or weakly serrate posterolateral margins, whereas in *attenuaria* the margins are more strongly serrate. Swett based his *marylandensis* on specimens with relatively long and weakly spinose curved processes of the sacculus, and with weakly serrate aedeagi. This condition is found in all specimens whose dissections (11 in number, including the holotype) I have studied from Maryland and with considerable variation from specimen to specimen; these conditions also are found in some specimens from southern New Jersey, New York, Nova Scotia, Ontario and Nebraska. Based on all the characters, I am transferring *marylandensis* from *attenuaria* (where Swett placed it) to *sospeta*, and am placing it in the synonymy of the latter species.

The female genitalia of *sospeta* tend to have a long and narrow lamella postvaginalis, although this is a variable character. More characteristic of the species is the curved depression posteriad of the lamella postvaginalis; it is rather shallow and not too well defined. On the other hand, this depression in *attenuaria* is deep, more heavily sclerotized, and often has a distinct posterior ridge that meets the anterior, prominent flangelike lip that borders the posteroventral depression. Dissections made from specimens from Maryland (four in number) agree with the characters of *sospeta*; this verifies my placing *marylandensis* as a synonym of *sospeta*.

Xanthotype attenuaria Swett
Figures 13, 18, 31, 40-43

Xanthotype attenuaria Swett, 1918, p. 79, pl. 7, figs. 7 (male holotype), 8 (female allotype), 9 (male paratype), fig. 5G (male genitalia). McDunnough, 1926, p. 120.

DIAGNOSIS: The genitalia are similar to those of *sospeta*, differing mainly, in the male, by the much larger and spinose process of the sacculus, and by the more dentate lateral margins of the aedeagus; the females have a deeper and more sclerotized anterior depression on the ventral surface of segment 8.

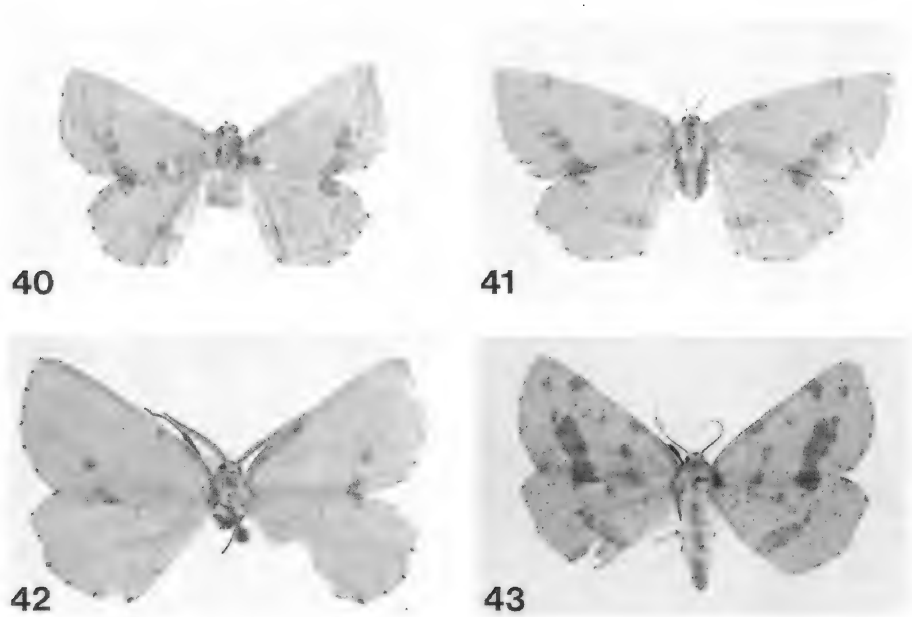
MALE: Similar to those of *sospeta* but differing mainly as follows: smaller; wings slightly darker in color, tending to have more lilac-brown spots and more complete representation of t. a., t. p., and extradiscal bands on both upper and lower surfaces.

Length of Forewing: 15 to 21 mm.

FEMALE: Similar to male, with color of wings a paler, clearer yellow, and with less brown spotting and maculation on both upper and under surfaces of wings.

Length of Forewing: 18 to 23 mm.

MALE GENITALIA: Uncus with apex variable in shape, rounded, truncate, or bilobed; valves with each costal arm elongate, 0.4 to 0.5 mm. in length, flattened medially, slightly swollen apically, apical and outer areas with from 30 to 40 prominent setae; median process of valve more or less triangular, with or without medioposterior swelling, elongate, tapering to point; sacculus extending as sclerotized ridge to middle of valve, barely swollen basally, with inconspicuous setae, and with elongate process 0.4 to 0.7 mm. in length, covered with numerous, short, thick setae; aedeagus broadly swollen posteriorly, with width half of length, posterolateral margins spinose; vesica with



FIGS. 40-43. Adults of *Xanthotype attenuaria* Swett. 40. Holotype, male, Dallas, Texas (Boll; MCZ). 41. Allotype, female, Dallas, Texas (Boll; MCZ). 42. Male, Prairieville, Louisiana, March 6, 1974 (V. A. Brou; AMNH). 43. Female, Edgard, Louisiana, August 26, 1977 (V. A. Brou; AMNH). All ×1.3.

irregularly rectangular sclerotized area.

FEMALE GENITALIA: Sterigma with lamella postvaginalis 0.45 to 0.70 mm. in width, anterior margin with ends tending to be weakly concave, medially bluntly pointed or rounded, posterior margin flatly to broadly rounded, concave medially; lamella antevaginalis in form of ridge extending anteroventrally from each side of curved depression of segment 8; ductus bursae slightly wider than long, narrowed anteriorly; corpus bursae with posterior portion membranous, slightly narrower than ductus bursae; signum 0.6 to 0.9 mm. in width. Apophyses posteriores 2.0 to 2.3 mm. in length. Segment 8 with moderate curved depression posteriad of lamella postvaginalis, its anterior margin sclerotized, and with posteroventral portions of segment sclerotized, either angulate, with curved ridge on each side, or with small depression on each side, anteriorly with flangelike lip, posteriorly with broader ridge.

EARLY STAGES: Apparently unknown (see this section under generic heading).

FOOD PLANTS: Apparently unknown (see this section under generic heading).

TYPES: The holotype, male, and allotype, female, are MCZ 14633 (see figs. 40, 41). The genitalia of the holotype are on Swett's slide *attenuaria* no. 1, and of the allotype, *attenuaria* no. 4; both are mounted on the same slide, and have been examined by me.

TYPE LOCALITY: Dallas, Dallas County, Texas.

DISTRIBUTION: From eastern Texas to northern Florida, and north up the coastal plain to North Carolina (see map 3). The species extend inland up the Mississippi and Tombigbee River valleys in Mississippi, and to Atlanta, Georgia (specimens in AMNH).

FLIGHT PERIOD: From March into October.

REMARKS: One hundred thirty-eight specimens (89 males, 49 females) and 23 genitalic dissections (14 males, nine females) have been studied.

Specimens caught early in the year tend to be larger and to have less spotting than those caught in the summer and fall months.

The longest series I have studied from a single state is 50 males and 35 females from Louisiana; these were all caught by V. A.

Brou, with the exception of one male by R. O. Kendall. The specimens, by month, are as follows: February (1 ♂, 0 ♀), March (13 ♂, 0 ♀), April (12 ♂, 2 ♀), May (4 ♂, 14 ♀), June (6 ♂, 7 ♀), July (3 ♂, 1 ♀), August (5 ♂, 5 ♀), September (3 ♂, 3 ♀), October (2 ♂, 3 ♀). These figures indicate the possibility of a large spring generation, followed by a smaller summer brood or broods.

As with all the preceding species there is individual variation in the shape of the median process of the valve; nearly all specimens have the apex pointed. Also variable is the process of the sacculus; this structure is broader, longer, and more heavily beset with thicker setae than the comparable structure in *sospeta*. See the discussion under Remarks of the latter species concerning *marylandensis*.

In the female genitalia there is variation in the width and shape of the lamella postvaginalis; it tends to be narrower in *attenuaria* than in *sospeta*.

LIST OF SPECIES WITH THEIR KNOWN DISTRIBUTION

Genus *Xanthotype* Warren, 1894

1.	*urticaria* Swett, 1918	Eastern North America to the Rocky Mountains
	watsoni Swett, 1918	
	vagaria Swett, 1918	
	turbidaria Swett, 1918	
2.	*barnesi* Swett, 1918	California
3.	*rufaria* Swett, 1918	Southeastern United States
4.	*sospeta* (Drury), 1773	Eastern North America to the Rocky Mountains
	crocataria (Fabricius), 1798	
	citrinaria (Hübner), 1824	
	citrina Auctorum	
	caelaria (Hulst), 1886	
	manitobensis Swett, 1918	
	marylandensis Swett, 1918	
5.	*attenuaria* Swett, 1918	Southeastern United States

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