

T H E S I S

A STUDY OF THE GENITALIA  
OF COMMON LIGHT  
TRAP MOTHS.

---

Submitted by

HAROLD R. WILLIS

In partial fulfillment of the requirements  
for the Degree of Master of Science  
Colorado Agricultural College  
Fort Collins, Colo.  
March 10, 1934.

378.788  
AD  
1934  
9

COLORADO AGRICULTURAL COLLEGE

GRADUATE WORK

April 26, 1934

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY  
SUPERVISION BY Harold R. Willis  
ENTITLED A Study of the Genitalia of Common Light  
Trap Moths  
BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE  
DEGREE OF MASTER OF Science in Entomology  
MAJORING IN Entomology  
CREDITS 14

Chas R Jones

In Charge of Thesis

APPROVED

Chas R Jones

Head of Department

Recommendation concurred in

Committee on Final Examination

Chas R Jones

L. H. Smith

J. A. Schmidt

John L. Starnes

E. P. Sanderson

Chas. N. Lory

Committee on Advanced Degrees

Chas. N. Lory

Robert J. Lundy

E. P. Sanderson

This thesis, or any part of it, may not be published without  
the consent of the Committee on Advanced Degrees of the  
Colorado Agricultural College

378.788

A.O

1934

6

To

The Committee on Advanced Degrees:

This is to certify that Harold  
R. Willis has presented satisfactory  
evidence of his reading knowledge  
of Technical French.

Professor

Lucas D. Kittle  
Head of the Department  
of Languages.

## CONTENTS

	Page
Introduction.....	5
Review of Literature.....	5-6-7
Procedure:	
Collection of Material.....	8
Method of Determining.....	9
Mounting and Drawing.....	10
Observation:	
Nomenclature of Parts.....	11-12
List of Species Studied.....	13
Description of Species.....	14-28
Summary.....	28-29
Plates.....	30-56
Literature.....	57

#### ACKNOWLEDGEMENTS

The author wishes to express his appreciation of the guidance throughout this study and for the corrections and constructive criticisms by Dr. C. H. Jones and Sam C. McCampbell. He wants to thank Dr. J. McDunnough of the Canadian Entomologist and W. C. Cook for their help in determining material, as well as for the loan of literature. Also thanking F. Martin Brown of the American Museum for the help rendered in nomenclature of parts and methods of preparation of material.

# A Study of the Genitalia of Common Light Trap Moths

## INTRODUCTION

The comparison of certain external characters has long been the method used in determining species and sub-species of insects. Recently, a few entomologists throughout the country have been using, to some extent, the method of genitalia determination of insects. In many cases where the specimens are badly damaged and the characters are indistinct, the examination of the genitalia is about the only method by which such specimens can be identified.

The object of this study is to compare the male genitalia of some of the most common species of moths, to ascertain whether or not the genitalia method is of value for accurate species determination. The moths used were caught in the Colorado Agricultural College light trap in 1931 and 1932.

## REVIEW OF LITERATURE

Only a few early references on the work of male genitalia of Lepidoptera are available. The first of these was by Malpighia, (1669), who briefly described the male genitalia of Bombyx mori in connection with his discussion of the reproductive systems. Eyer (IV) <sup>cites?</sup> sights references on genitalia. These works were done by Swammerdan (1737), and Reamur (1742), but were in

connection with reproductive systems and not written for a systematic standpoint.

The works of Burmeister (1848), were the first to give an illustrated, detailed view of the more important visible parts of the male genitalia armature.(4)

Scudder and Burgess (1870), have somewhat changed the genitalia nomenclature. Among these terms "Clasp" used instead of "Valve"; the term "Basal Process" is applied to the basal portion of the clasp, and the "Dorsal Process" of the armature is called the "Upper Organ." (4)

Many workers have done some work on genitalia comparison of the various forms of Lepidoptera. Each has continued this study or added something to the nomenclature of the different parts of the genitalia armature. Buchanan, White and Gosse followed two distinct lines of work, the first was a detailed comparison of the genitalia armature for species separation; the second, a morphological and ontogenical study of these groups, and a comprehensive comparison of the closely related groups.(4)

Zander (1903), probably did the most important work on the ontogeny and morphology of the male genitalia of Lepidoptera. He correlated the nomenclature of Buchanan, White and Gosse with the structures which he

found from the study of a large number of adult moths and butterflies and traced their development in larval and pupal stages. His work on Lepidoptera was a result of similar work that he did on Hymenoptera (1900), and Trichoptera (1901). Through his conception of the common plan of structure, he was able to recognize the various modifications of identical parts and was not obliged to introduce a new system of nomenclature. (4).

"The results of Zander have made clear the significance of the parts of the genitalia and have served as a basis for a uniform system of nomenclature suggested by McDunnough in 1911. This author recommended the adoption of a set of terms to be determined by the law of priority for scientific names, a law which does not apply to morphological nomenclature. Consequently his terminology has been adopted by all workers on Lepidoptera." (4)

F. M. Brown (2), of the American Museum of Natural History, is at the present time an adherent worker on genitalia determination of species. He has published a number of papers on this work and has a completed key of the characters of the male genitalia for species determinations of the genus *Phoebis* and *Aphrissa*.

J. McDunnough (5), published several generic papers in *The Canadian Entomologist*. He has spent much time on



this work and is using the genitalia method for many of his determinations.

Many workers are now recognizing the value of genitalia armature structure and are using this system for species determination.

Bell (1), studied the genitalia characteristics of Phocides and is quite satisfied with his results.

Skinner and Williams (2) have made genitalia studies of the group Hesperidae and have published several papers on this subject. They are satisfied that this method of determination is practical and are using it most in their species determinations.

#### PROCEDURE

In this problem, the first factor of importance was getting an abundance of working material and the second, was the proper identification of it. The third important factor was the proper preparation of the material, the fourth was the mounting of it and the last, the drawings.

The material was taken from the light trap catches during the years 1931 and 1932. The trap was run during 1931 at the west end of the Entomology open air laboratory and in 1932 at the East experiment station farm. The trap was of the Gillette type, consisting of a large funnel attached to a stand. A 40 watt electric bulb was

hung about six inches above the top of the funnel near the center. A quart can partly filled with excelsior and having a small bag in it, containing about one and one-half ounces of NaCN dust, was inserted at the bottom of the funnel.

The light trap was run each night and the catches were taken out early the following morning and mounted before they dried.

A large portion of this material was sent to J. McDunnough of the Canadian Entomological Branch of Agriculture for determination. Many of the specimens were sent to W. C. Cook of the Montana Experiment Station for proper determination. Some of the material was identified by the author, but only certified material was used in this work.

Properly determined material was then set aside and the last five abdominal segments of the males removed and placed in a solution of potassium hydroxide and 95 percent alcohol. They were left in this solution for twenty-four hours. The softened genitalia were then dissected by the use of needles. The hair and scales were then removed by carefully scraping the parts. Notes were taken on their arrangement. The aedoeagus was then removed so as to expose the parts that it concealed.

The dissected portion was then temporarily mounted

on a one-half inch square glass and covered with another piece of the same size. The materials were then dehydrated by passing them through solutions of 50, 75 and 95 percent alcohol. The first two had a duration of six hours each and the latter twelve hours. This was to prevent clouding.

The mounts were then cleared in a solution of turpentine and carbolie acid. This process took about ten hours. After clearing, the specimens were mounted in canadum balsam, labeled and allowed to dry for four weeks.

The materials were then studied and drawn. The accompanying diagrams were made by comparison of the various slides of the same species; that is, when any structure was not plainly discernible in any given slide, that particular structure was studied from the slide in which it showed up the best.

The first drawings were made on graph paper by the use of the micrograph eye-piece, and as a certain part was visible in the scope, it was traced off on the graph paper in the same relative position. These drawings were then traced on plain white paper and checked with the slides, in order that proper corrections could be made. After the corrections were made, the drawings were traced, inked in and photographed. All of the

specimens studied were treated in the above manner. The outstanding differences are discussed in the following paragraphs.

#### OBSERVATION

The following discussion gives briefly the different characteristics used in the separation of species. In choosing these characteristics, the method of Busch and Heinrich as given by Eyer (IV) was used.

"Uncus, (Gosse, 1883); This is the annal armature. In shape the uncus is hock-like, spoon-shaped, clavate, emarginate, bifid or trifid; it is usually heavily chitinized." (3)

"Harpes (Smith, 1890): or Valvae, (Burmeister, 1832): These are paired clasping organs which articulate to the posterior margin of the vinculum..... They are normally triangular, finger-like, or spoon shaped. In many families, especially among the higher Lepidoptera, the harpes are divided into three distinct lobes or areas, a dorsal, apical and ventral, called by Pierce the costa, valvula or cucullus, and the sacculus. In Noctuidae, et. al. the sacculus and costa frequently develop appendages or processes which become so widely separated from the remainder of the harpes that they have been described as separate structures....." (4)

"Anellus and Juxtae (Pierce, 1914): The anellus is

the cone-like tube through which the pennis enters the ninth somite. It is usually membranous, often covered with spines and bears a triangular or quadrate plate, the juxtae, on its ventral surface. The lateral margins of the juxtae may be produced to form hairy lobes of the central portion elongated into a process which supports the seodagus....." (4)

"Aedoeagus (Pierce, 1900): This structure ordinarily consists of a chitinized tube which enters the ninth somite through the annellus and is supported by it and the juxta. It is heavily chitinized, frequently armed with spines and serrations and has the posterior end inflated to form a blind pouch in which are lodged the retractor muscles of the pennis." (4)

"Saccus : This is located on the harpes near the base. It is usually more membranous than the rest of the valve.

Dorsal Processes on the Valves: This is a chitinized portion of the valves. In most cases it is divided into inner and outer dorsal processes.

The valve may be divided into medium, dorsal and lateral processes.

The following species were studied:

Plate No.		Dyar's Catalog No.
(1)	<i>Heliothis armiger</i> Hubner	1090
(2)	<i>Dasypoudaea meadi</i> Grote	1096
(3)	<i>Porosagrotis orthogonia</i> Morrison	1233
(4)	<i>Euxoa olivia</i> Morrison	1240
(5)	<i>Euxoa dargo</i> Strecker	1245
(6)	<i>Euxoa oblongistigma</i> Smith	1251
(7)	<i>Euxoa pallipennis</i> Smith	1260
(8)	<i>Euxoa misturata</i> gian Strecker	1262-b
(9)	<i>Euxoa infracta</i> Morrison	1275
(10)	<i>Euxoa mimallonis</i> Grote	1301
(11)	<i>Euxoa munis</i> Grote	1351
(12)	<i>Euxoa divergens</i> Walker	1353
(13)	<i>Euxoa tristicula</i> Morrison	1368
(14)	<i>Chorizagrotis auxiliaris</i> Grote	1372
(15)	<i>Chorizagrotis agrestis</i> Grote	1374
(16)	<i>Chorizagrotis montannus</i> Cook	----
(17)	<i>Feltia venerabilis</i> Walker	1397
(18)	<i>Lycophotia margaritosa</i> margaritosa Haworth	1490
(19)	<i>Lycophotia margaritosa</i> saucia Hubner	1490
(20)	<i>Polia renigera</i> Stephens	1750
(21)	<i>Ceramica picta</i> Harrison	1930
(22)	<i>Caradrina extima</i> Walker	2578
(23)	<i>Apamea nictitans</i> Linnaeus	2638

(24)	Erythroecia saavis Hy. Edwards	2656
(25)	Caenuria erechtea Crammer	3135
(26)	Ennomos magnarius Guenne	4665

Cook (3) has changed Dyar's classification to the following: 1372, Chorizagrotis auxiliaris Grote to Chorizagrotis auxiliaris auxiliaris Grote 1374, Chorizagrotis agrestis Grote to Chorizagrotis auxiliaris agrestis Grote. He has also added a third which he calls Chorizagrotis auxiliaris montannus Cook. Material for slides of each of these were determined by Cook and will be discussed later.

A detailed description of the genitalia of the above species is given below.

Heliothis armiger Fabr. (Plate 1)\*: This species

---

\*All of the plates referred to are to be found at the end of this paper.

---

has rather a simple genitalia. Both inner and outer processes; sacculus are missing. Harpes uniform in width throughout entire length, evenly chitinized with a double row of spines at distal end. The number of spines on each harpe, in the specimens examined, varied from fifty-four to fifty-seven. The uncus is moderately long, lightly chitinized, with the distal end prolonged into a long, uncurved process; distal third tapers gradually to the end which is armed with a single short, stout spine. The juxtae heavily chitinized, about one-

third the length of the harpes, more or less flattened at the proximal end. The aedoeagus is very simple and is about one-third the length of the harpes.

Dasypoudaea meadi Grt. (Plate 2). The genitalia of this species is also rather simple. A small ovate sacculus is present. The harpes are pointed at the distal end and bear eleven to twelve spines at the extreme tip. The proximal one-third large and pear shaped. The outer margin is heavily chitinized on its proximal two-thirds. It is armed with seven foot-like spines. The uncus is of medium length and slightly chitinized. The distal portion prolonged into a process gradually tapering to the end which is armed with a stout curved spine. The juxtae are broad, heavily chitinized, about one-half the length of the harpes, upper third less chitinized than the basal portion. The aedoeagus more or less simple with a large, slightly chitinized, irregular process at the distal end. It is about four-fifths the length of the harpes.

Porosagrotis orthogonia Morrison (Plate 3). In this species the harpes are uniform in width in the outer four-fifths, the proximal one-fifth gradually narrowed and rounded into a blunt point, with additional, large, outer dorsal processes. At the proximal end, these processes are the same width as the harpes but



taper gradually to about one-sixth the width of the distal end. The uncus moderately long and slightly chitimized with the medial portion enlarged. The dorsal portion prolonged and tapering. The saculus is pentangular in shape with a V-shaped notch at the distal end. Juxtae about one-third the length of the harpes, with a small, slightly chitimized proximal portion. Aedoeagus simple, about one-half the length of the harpes.

Euxoa olivia Morr. (Plate 4). In this species the harpes are about twice as large at the proximal as they are at the distal end; slightly constricted in the middle; distal half more or less rectangular and armed with nineteen to twenty-one spines. Inner and outer processes heavily chitimized; the inner about one-half as long as the outer. The uncus moderately long and slender, pear shaped at the proximal end; distal end prolonged into a long uncurved digital projection varying slightly in width and terminating in a blunt point. Juxtae are piped-shaped, heavily chitimized, coming to a point at the distal end. The sacculus pentangular with a U-shaped notch at the distal end. Aedoeagus as long as the harpes, slightly chitimized around the outer edge; central third more heavily chitimized.

Euxoa dargo Stke. (Plate 5). The harpes large in the central portion, tapering distally; the width of the

distal end about one-half that of the central portion. Proximal portion slightly tapered to a flattened point. Outer dorsal process about two-thirds the length of the harpes, of even thickness throughout. Inner dorsal processes about one-third the length of the harpes and also of even thickness. The uncus medium in size. The proximal portions small and uniform in thickness. The median portion larger, being about five times as wide as the distal portion; distal part prolonged into an uncurved digital process terminating in a blunt point. The sacculus pentangular, having a rounded V-shaped cut in the distal portion. Juxtae heavily chitimized; the distal half uniform in width; proximal half slightly enlarged and rounded at the end. Aedoeagus about four-fifths the length of the harpes; much larger in the central portion than at the ends. Proximal end is larger and more pointed than the distal end.

Euxoa oblingistigma Sm. (Plate 6). In this species the harpes large in the middle; tapering slightly toward the ends; distal end about two-thirds the width of the middle portion; a row of spines varying from eight to ten in number. The basal half tapers only at the proximal end where it forms a small knob. Dorsal processes heavily chitimized, the outer part about half the length of the harpes. The inner ones are only one-fourth the

length of the harpes. The uncus long and slender, broader in the central portion. The distal portion extended into a long curved digital projection, varying slightly in width and terminating in a blunt point. The juxtae are about one-third in width and terminating in a blunt point. The juxtae are about one-third the length of the harpes. The distal four-fifths of uniform width, the proximal fifth terminating in a large ovate end. The sacculus is pentangular, having a sharp V-shaped notch at the distal end. The aedoeagus simple, slightly chitinized and about one-half the length of the harpes.

Euxoa pallipennis Sm. (Plate 7). In this species, the harpes are slightly enlarged and armed with a row of spines varying from sixteen to eighteen in number. The distal half tapers slightly from the outer end to the base and the proximal half almost uniform in width, ending in a broad, blunt point. The outer and inner dorsal processes heavily chitinized, about one-fourth the length of the harpes, tapering to a stout point. The inner processes one-third the length of the harpes, uniform in width and tapering to a large, rounded, ovate end. Uncus long and slender, the distal half prolonged into a long, uncurved digital projection, varying but slightly in width, terminating in a blunt point. Juxtae heavily chitinized and of equal thickness, about one-third the

length of the harpes, terminating in a blunt point at the proximal end. The sacculus is hexangular, having a U-shaped notch at the distal end. The aedoeagus is slightly chitinized, simple and about two-thirds the length of the harpes.

Euxoa misturata gian Stkr. (Plate 8). In this species, the harpes are large at the base, slightly constricted in the middle, tapering slightly to a rounded distal end, which is armed with a row of twelve to thirteen spines. The proximal end is knob-like. Inner and outer dorsal processes heavily chitinized, the former are about one-fourth the length of the harpes and equal in width. The uncus is stout and of medium length, the distal half being prolonged into a moderately long, uncurved digital projection. The juxtae are piped-shaped with the bowl protruding inward, heavily chitinized, coming to a blunt point at the extreme distal end. The aedoeagus is slightly chitinized; as long as the harpes with a fan-shaped distal end.

Euxoa infracta Grt. (Plate 10). The harpes are quite wide in the central portion, tapering slightly to the ends which are about two-thirds the width of the central portion. The distal end is armed with a row of spines varying from nineteen to twenty-one in

number. The inner processes thick and about one-third the length of the harpes. The uncus semicircular at the proximal end with a long digital projection which tapers to a blunt point; length about one-half that of the harpes. The sacculus is pentangular, the digital end having a wide V-shaped notch. The proximal end terminates in a point. The aedoeagus is about four-fifths the length of the harpes; large and rounded at the proximal end, becoming narrower toward the distal end and terminating in an ovate point.

Euxoa minis Grt. (Plate 11). The harpes are wide in the central portion, tapering toward the proximal end, which is more or less pear-shaped. The distal half is narrower in the center and dilated at its extremity, in the specimens examined, and is armed with a row of from twenty-two to twenty-four spines. The inner and outer dorsal processes heavily chitinized. The former is very small; the latter large and stout being about one-twelfth and one-third the length of the harpes respectively. The proximal ends of the uncus are wide at their base, gradually tapering to a point where they meet. The distal end prolonged into a curved digital process, terminating in a stout point. The sacculus is vase-shaped, having a V notch at the distal end. The juxtae are heavily chitinized, large and rounded at the proximal end.

gradually tapering to a blunt point distally. Aedoeagus curved, quite heavily chitinized; a less chitinized portion at the distal end.

Euxoa divergens Wlk. (Plate 12). The distal end of the harpes are armed with a row of twenty spines. The central portions are wider at the distal half, slightly narrower and of equal width. The proximal half roughly triangular in shape, terminating in a small ball-like knob. Inner and outer dorsal processes heavily chitinized, equal in length and about one-third the length of the harpes. The uncus is stout; the distal end terminates in a medium length projection armed with four stout spines. The sacculus is pentangular with a U-shaped notch at the distal end. The juxtae are heavily chitinized, slightly tapering at the distal end; about one-third the length of the harpes. The aedoeagus the same length as the harpes with a slightly chitinized portion in the center and less chitinized outer edge. The distal end tapers to a blunt point; the rest of the process of even thickness and width.

Euxoa tristicula Morr. (Plate 13). The harpes of this species are wide at the distal end and armed with a row of fourteen to sixteen spines. The harpes are slightly constricted near the distal end, tapering out to the same width at the middle and terminating in a wide

blunt point at the proximal end. The inner and outer dorsal processes are heavily chitinized, equal in size and about one-third the length of the harpes. Uncus long and slender, about two-thirds the length of the harpes, the distal half tapering to a blunt point. The sacculus is long, pentangular, having a U-shaped notch at the distal end. The juxtae are heavily chitinized, equal in width, about one-half the length of the harpes and come to a blunt point. Aedoeagus lightly chitinized in the central portion and widened again at the distal portion, which is slightly chitinized.

Chorizagrotis auxiliaris Grt. (Plate 14). The genitalia in this species is large. The harpes are small and curved at the distal end and armed with a row of fourteen to sixteen spines. The middle portion is wider and less curved. The proximal end is about the same throughout. The inner and outer dorsal processes are heavily chitinized, the later being about one-fourth the length of the harpes while the former is about one-sixth the length of the harpes and has a knob-like ending. The juxtae are heavily chitinized, are broad at the proximal end and taper gradually to the distal end. The uncus is long, slightly chitinized, about two-thirds the length of the harpes. The distal portion is extended into a long slender digital process which is

armed with nine tooth-like spines. The sacculus is long and vase-shaped, having a V-shaped notch at the distal end. The aedoeagus is long and slender, lightly chitinized centrally with a less chitinized portion at the distal end. It is about the same length as the harpes.

Chorizagrotis agrestis Grt. (Plate 15). The harpes are similar to that of auxiliaris in general shape, although the proximal end is more rounded. The distal portion armed with a row of from fourteen to fifteen spines with three spine-like hairs at the extreme distal end. The inner dorsal processes about one-tenth the length of the harpes and rounded; outer dorsal processes about one-third the length of the harpes. The uncus is about two-thirds the length of the harpes and slightly chitinized. The distal portion prolonged into a stout, tapering, unarmed process. Sacculus vase-shaped, having a V notch at the distal end. The juxtae are heavily chitinized, broad at the proximal end, gradually tapering distally. The aedoeagus is long and slender, lightly chitinized with a less chitinized portion at the distal end. It is about as long as the harpes.

Chorizagrotis auxiliaris montannus Cook (Plate 16). The harpes are very similar to agrestis and auxiliaris having the same number of spines, and the same general



shape with the exception that the inner dorsal processes are somewhat smaller. The uncus is long and slender, being about two-thirds the length of the harpes. The distal end armed with five tooth-like spines. Sacculus of the same general shape as in agrestis and auxiliaris but a little larger. The aedoeagus is the main distinguishing feature, being of greater thickness, width, and length, and having a larger portion of slightly chitinized material at the distal end. The total length is a little longer than the harpes.

Feltia venerabilis Wlk. (Plate 17). The harpes of this species are of even width throughout the distal half. Distal end rounded and tapered to a curved point. The outer dorsal processes are heavily chitinized, about one-fourth the length of the harpes. The uncus is slender; the distal portion prolonged into a tapering process, terminating in a blunt point and armed with two spines. The sacculus is oblong, having a pointed proximal end. The juxtae heavily chitinized, triangular proximally and about one-half the length of the harpes. The aedoeagus is lightly chitinized, having a less chitinized distal end, and is about the same width and length as the harpes.

Lycophotia margaritosa margaritosa Haw. (Plate 18). The harpes are rounded distally and armed with a row of

twenty-six to twenty-eight spines. Slightly wider at the central portion, tapering gradually to a blunt, beak-like projection at the proximal end. The small inner and outer dorsal processes are heavily chitinized. The outer processes are roughly helmet-shaped and about one-seventh as long as the harpes. The inner processes are stout, terminating in a blunt point and being about the same length as the outer processes, but only half as wide. The uncus is heavily chitinized; stout in the central portion, the inner end is prolonged into a tapering process with a sharp point. The proximal portion is slender. The sacculus is roughly hexangular with a U-shaped notch at the proximal end. The juxtae are heavily chitinized and slender, being about one-third the length of the harpes.

Lycophotia margaritosa saucia Hub. (Plate 19). The genitalia of this species is very closely related to margaritosa margaritosa. The harpes are not wide, the outer dorsal processes are ovate in form, while the inner ones are thinner. The uncus, sacculus and aedoeagus are very nearly the same in structure as that of the above. The juxtae are heavily chitinized and much larger than in margaritosa margaritosa.

Polia renigera Steph. (Plate 20). The distal one-fourth of the harpes are shaped like the head of a bird;

the remaining three-fourths are wider and of equal width to the proximal end where it is blunt and rounded. The outer dorsal processes are heavily chitinized, roughly triangular in shape and about four-fifths the length of the harpes. The inner dorsal processes and sacculus are absent. The juxtae are heavily chitinized, stout, quite wide at the proximal and gradually tapering to the distal end. The aedoeagus is rectangular in shape, the distal end terminating in a sharp point.

Ceramica picta Harr. (Plate 21). The harpes are rounded at the proximal end, tapering toward the center where it widens into an irregular fan-shaped process. Inner and outer dorsal processes missing. The uncus with slender proximal arms and a stout central and distal portion, the distal half triangular, with a wide extreme end. The sacculus long and slender, distal portion rounded; the proximal end with the distal three-fourths narrow and of even width, about two-thirds the length of the harpes. Aedoeagus long and slender, slightly chitinized and about as long as the harpes.

Caradrina extima Wlk. (Plate 22). The harpes are of almost even thickness at the proximal end and taper slightly at the distal end, terminating in a bifid process. The inner dorsal processes are absent. The outer dorsal processes are about four-fifths the length and

one-tenth the width of the harpes. The uncus is ovate, the distal third terminating in a blunt point. Sacculus small. Aedoeagus as long as the harpes and club shaped. Juxtae about one-fourth the length of the harpes and heavily chitinized.

Apamea nicitaenus L. (Plate 25). The harpes are constricted the central portion and ovate at the proximal and distal ends, with a large number of spines scattered over the distal one-fourth. The outer dorsal processes are heavily chitinized and about one-half the length of the harpes. The distal ends of the juxtae terminate in a claw-like point. Juxtae about one-half the length of the harpes. The uncus is semi-circular, quite stout in the center, the distal one-third terminating in a blunt point. The aedoeagus lightly chitinized; the distal end less so; about four-fifths the length of the harpes.

Caenurgia erechtea Cram. (Plate 27). The harpes are of about equal thickness throughout but slightly larger in the central portion, tapering to a large blunt point at the proximal end. The outer dorsal processes are heavily chitinized, about one-third the length of the harpes. The inner dorsal processes short, stalky and about one-half the length of the harpes. The sacculus is missing. Aedoeagus pear-shaped, wider at the proximal

end, with four stout spines on the upper half. It is about the same length as the harpes.

Ennomos margnarius Geu. (Plate 28). The harpes are large and rounded at the distal end, tapering to a blunt, rounded, proximal end. The central portion of the distal half is armed with a large number of spines. The inner and outer dorsal processes are absent. Uncus tri-lobed proximally, tapering gradually distally, where it ends in a blunt point. Between each lobe, there are about sixteen small spines. Sacculus roughly triangular; slightly chitimized. The juxtae are absent. The sedoeagus is four-fifths the length of the harpes, lightly chitimized, with a less chitimized knob-like distal end.

#### SUMMARY

In the study of different genitalia, it was found that there are not sufficient differences between Chorizagrotis auxiliaris and agrestis to grant separation to species. There seems however, to be enough variance to support Cook's conclusion that these forms should be separated into varieties of the species auxiliaris as described by him.

There also seems to be enough variation to grant separation of the two forms, Lycophotia margaritosa margaritosa and saucia, into varieties but not separate

species.

Enough variation between different genera is also present to make it possible to separate them by genitalia method. This is shown by the two genera, *Porosagrotis* and *Euxoa*, which are closely related in McDunnough's *Lepidoptera* catalog.

There seems to be enough variation in the genitalia of closely related species to conclude that this method is of unquestionable value. Its possibilities are well shown in the genus *Euxoa* where ten closely related species were studied.

SCALE OF DRAWINGS ARE x32

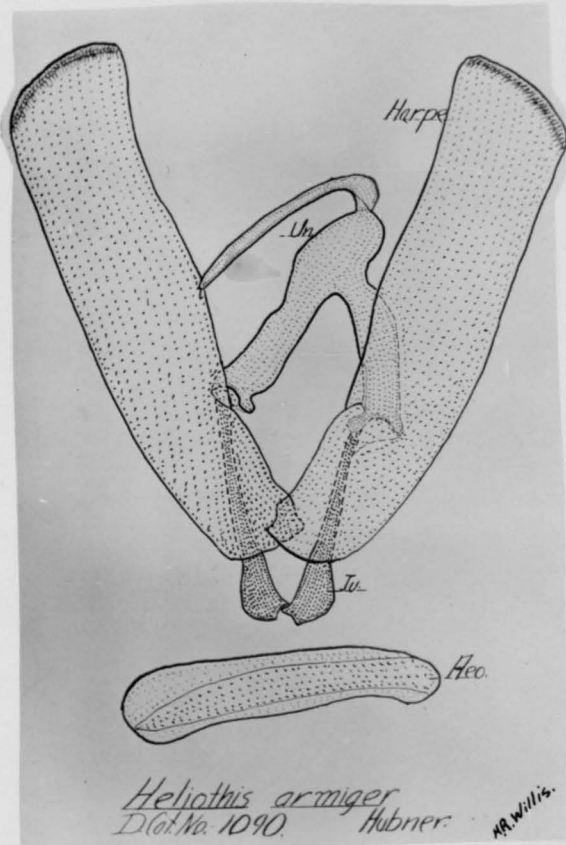


Plate I.



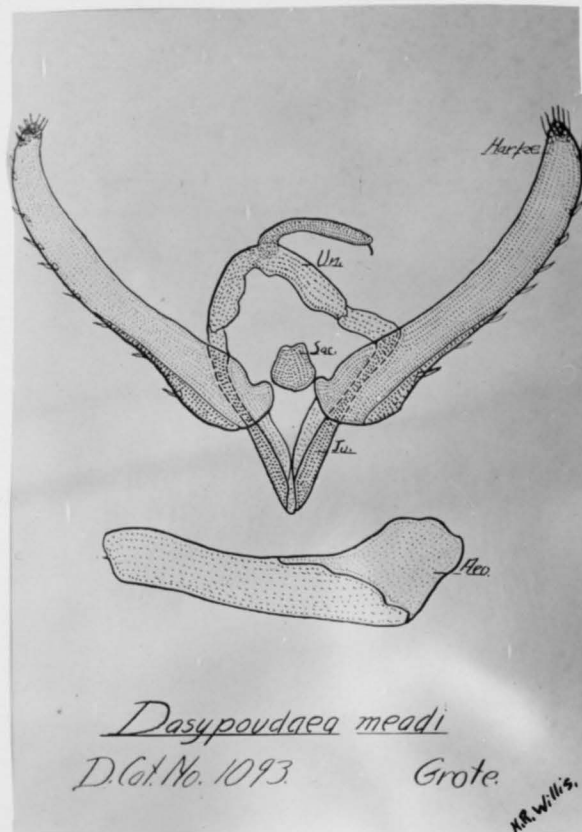
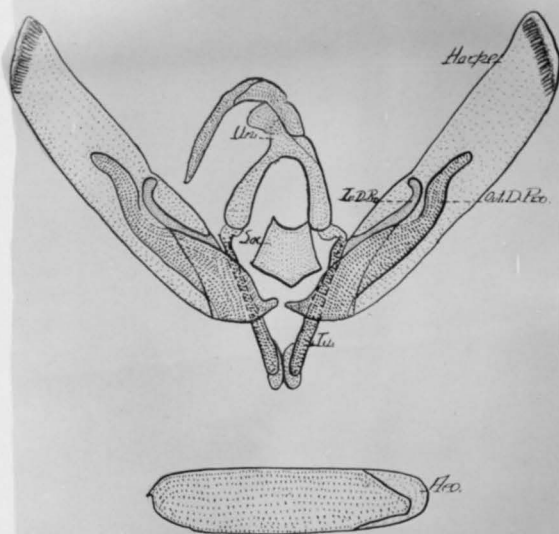
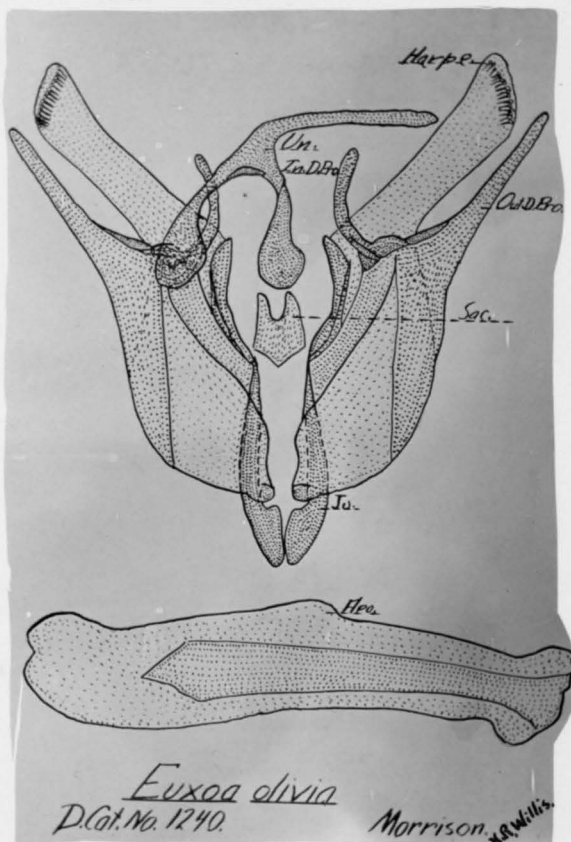


Plate 2.



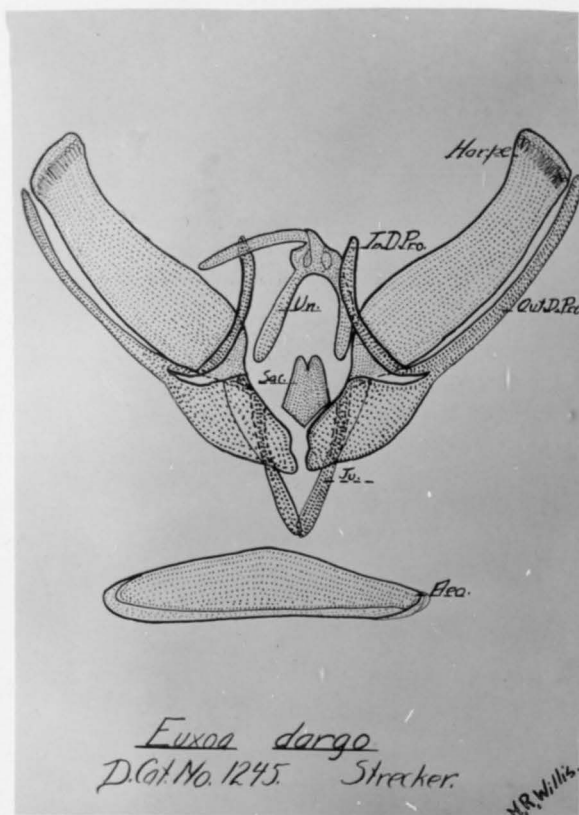
*Porosagrotis orthogonia*  
D. Col. No. 1233. Morrison.  
X.R. Willis.

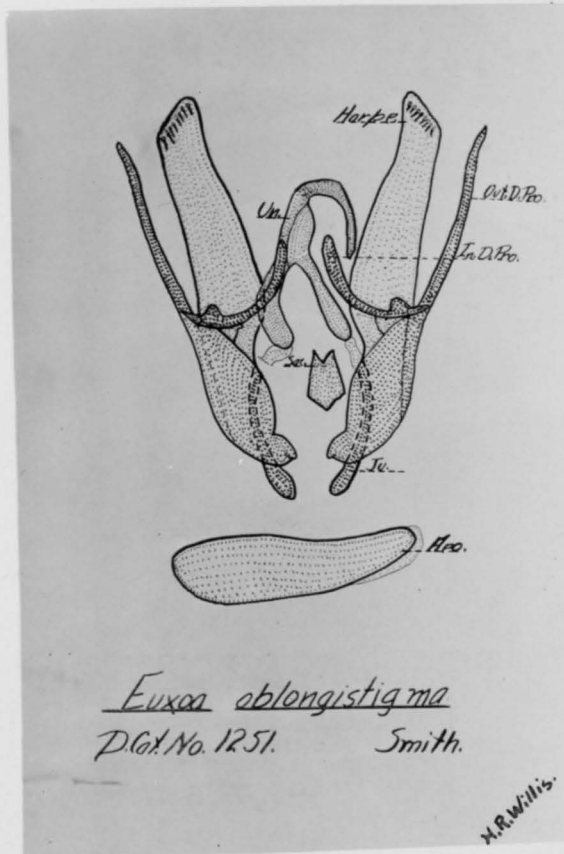


*Euxoa olivia*  
D. Cat. No. 1240.

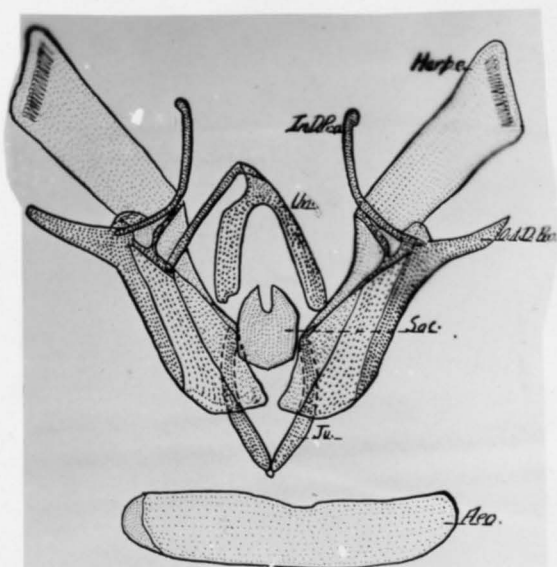
Morrison. A. Willis.

Plate 4.

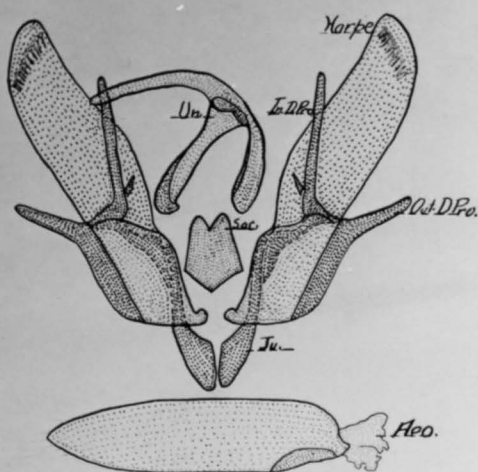






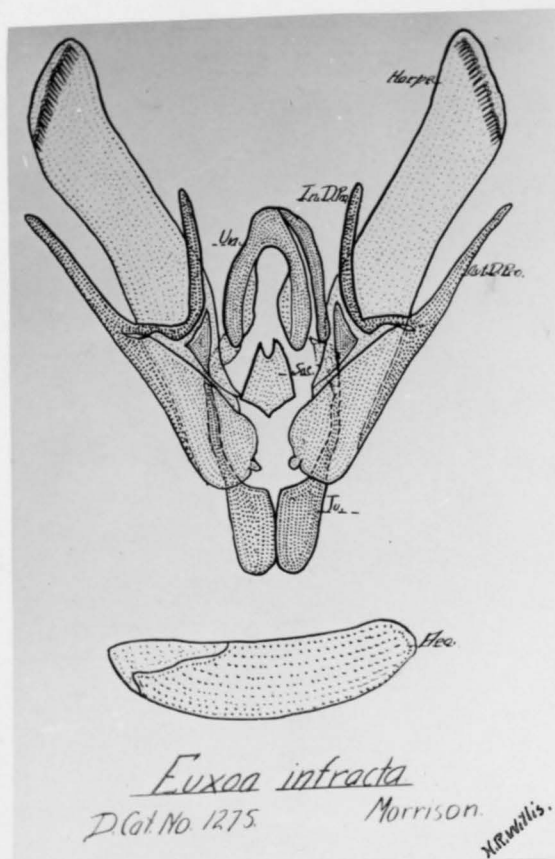


*Euxoa pallipennis*  
D.G. No. 1260. Smith.  
X.R. Willis.

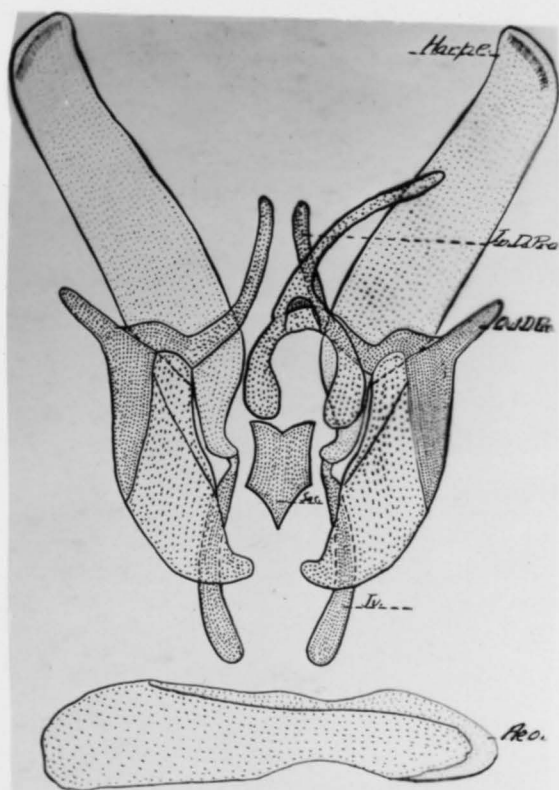


*Euxoa m-gian*  
D.G. No. 1262-b Strecker.

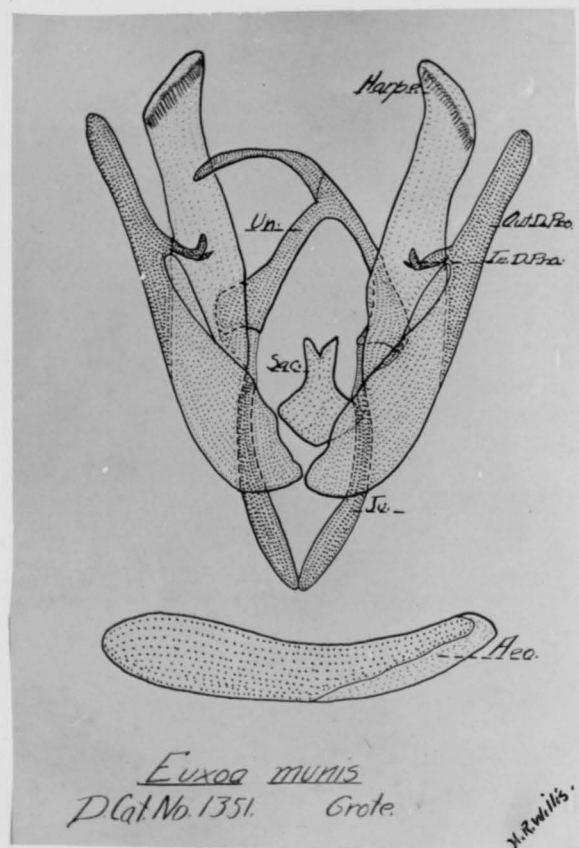
M.R. Willis.

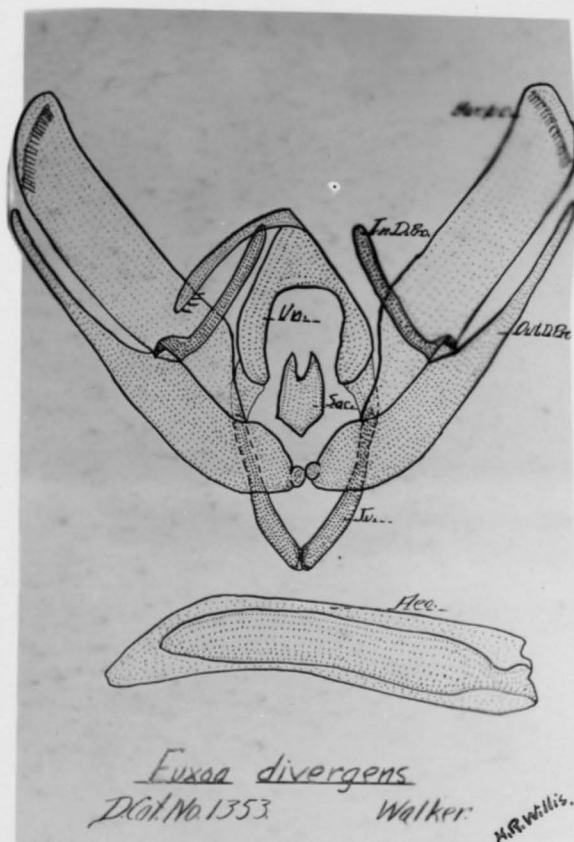


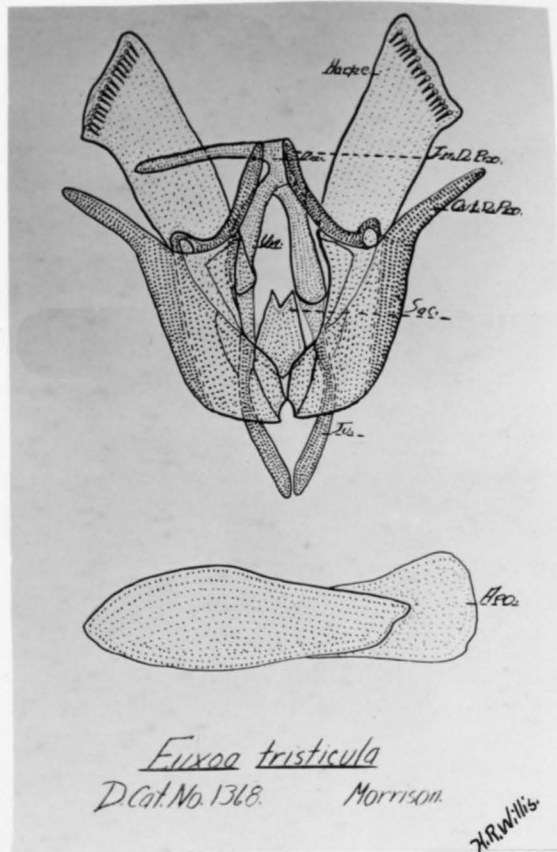


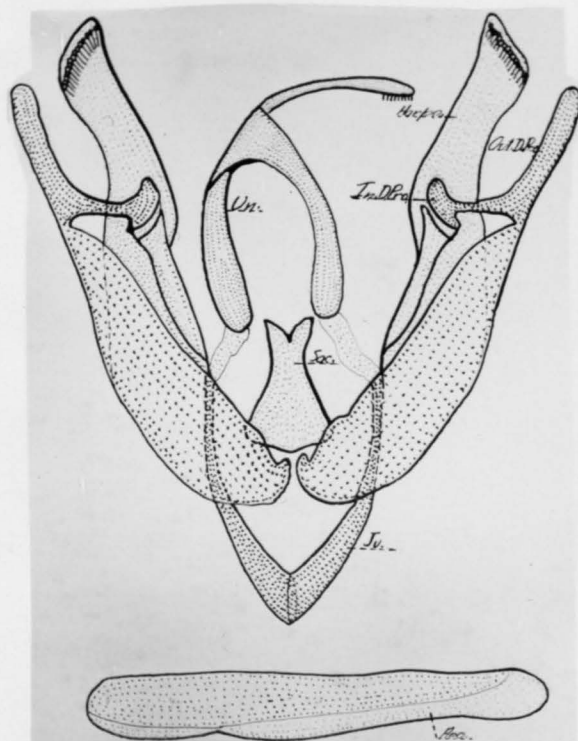


Euxoa mimmallonis  
D. Cat. No. 1303. Grate. xxiwils.





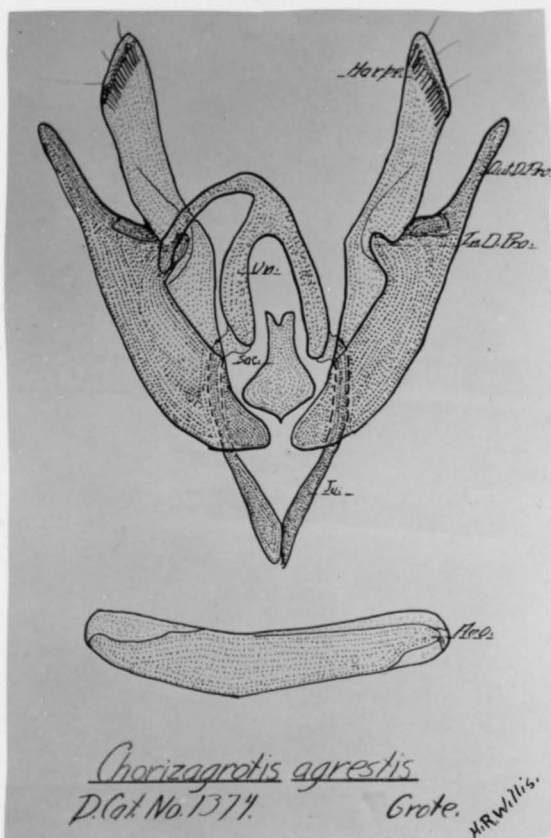




*Chrizagrotis auxiliaris*  
D. Cat. No. 1372. Grotz.

X.R. Willis.





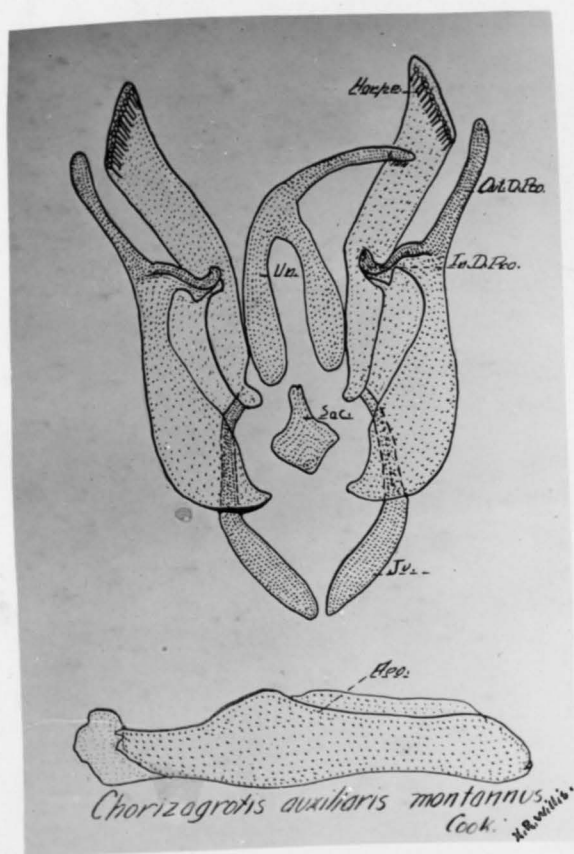
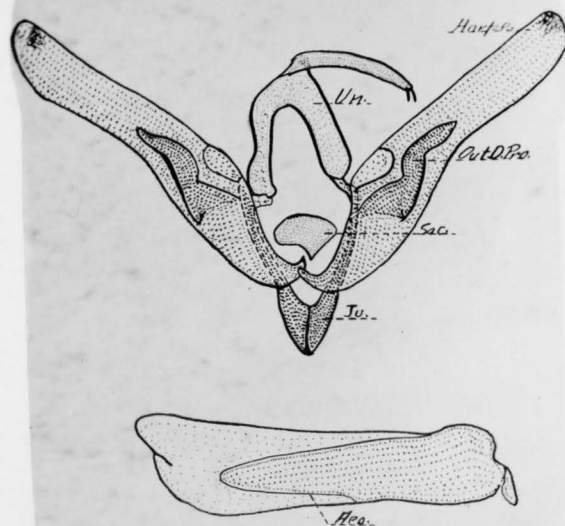


Plate 16.

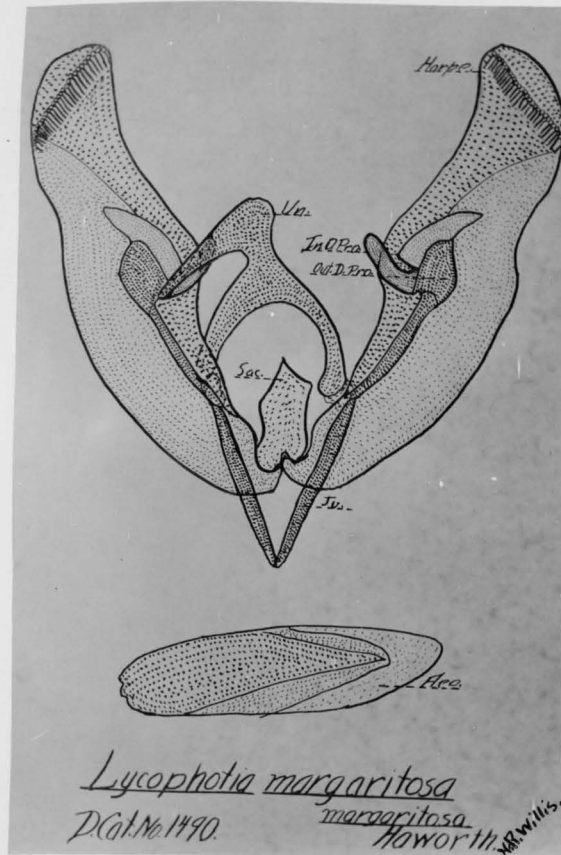


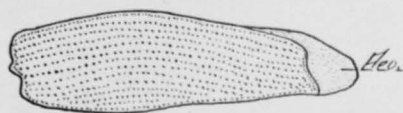
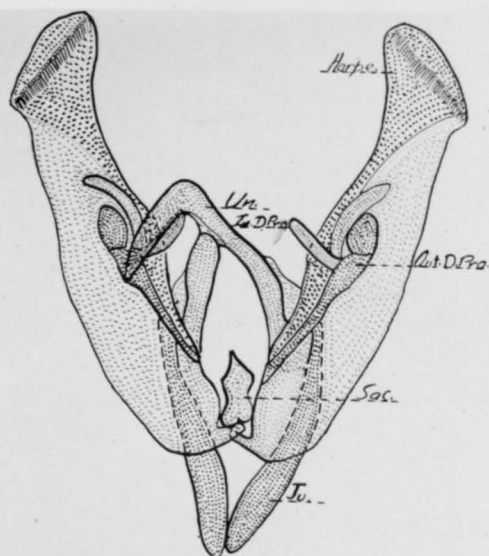
*Feltia venerabilis*  
D. Cat. No. 1397

Walker.

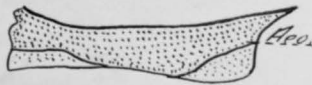
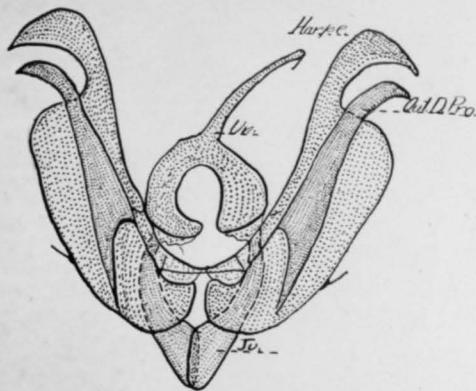
M.R. Willis.





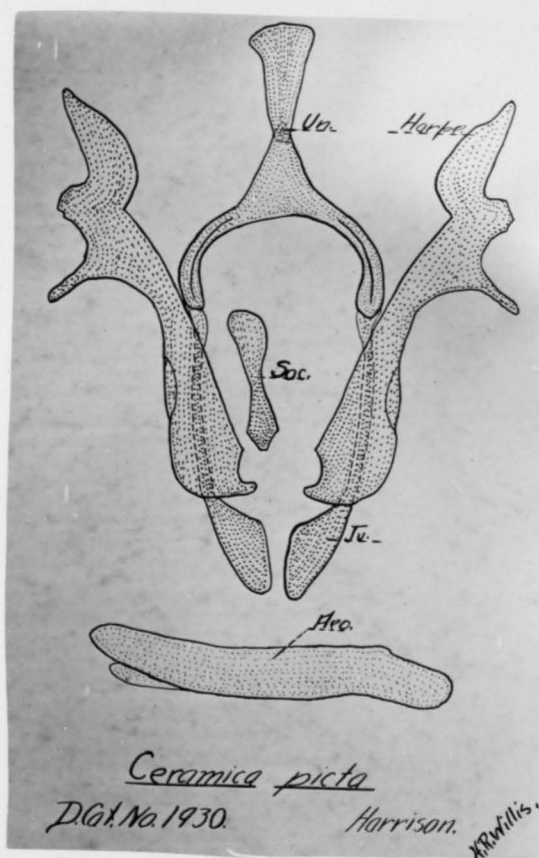


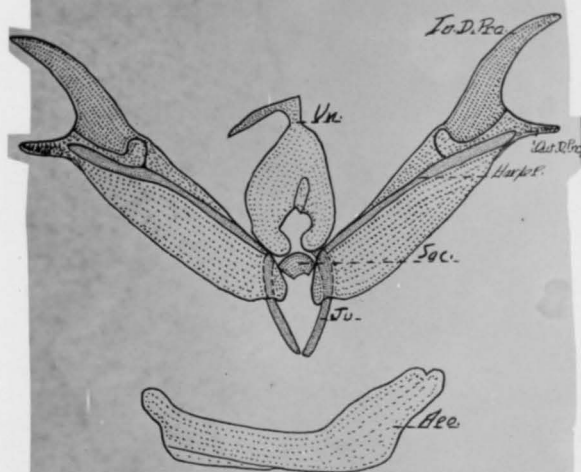
*Lycophotia margaritosa*  
 D. C. No. 1490. *sauvia* *puberula*  
 H. A. Willis.



*Polia renigera*  
D. Col. No. 1750 Stephens.

M.R. Willis.





*Caradrina extima*  
D. Gt. No. 2578. Walker.

M. R. Willis.



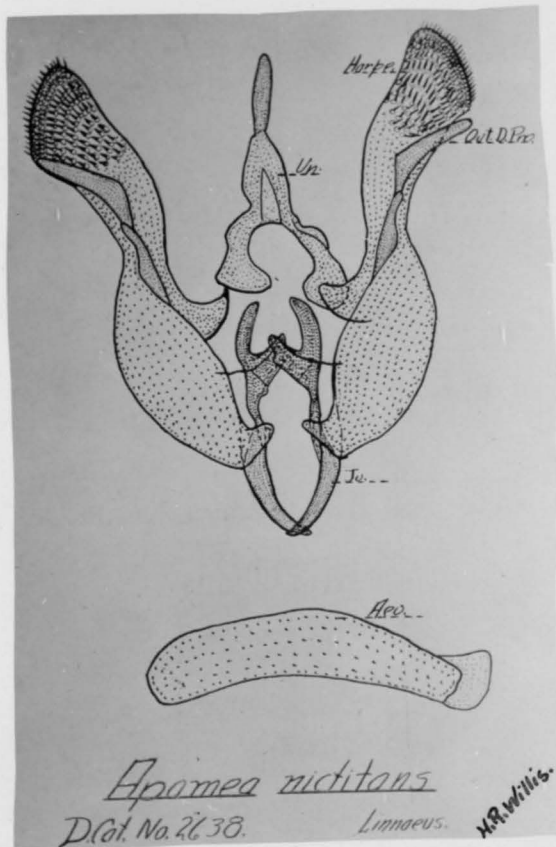
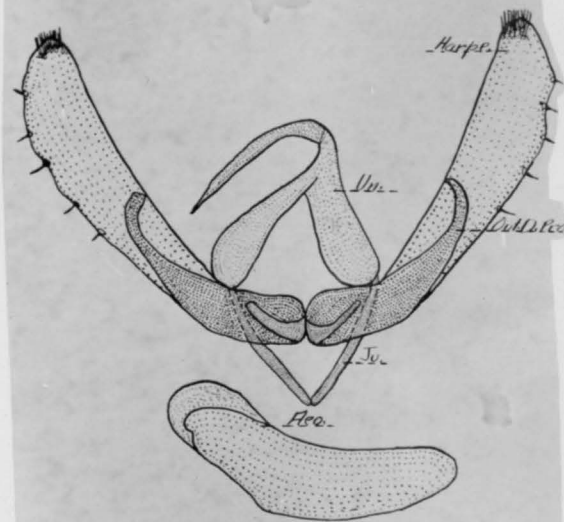
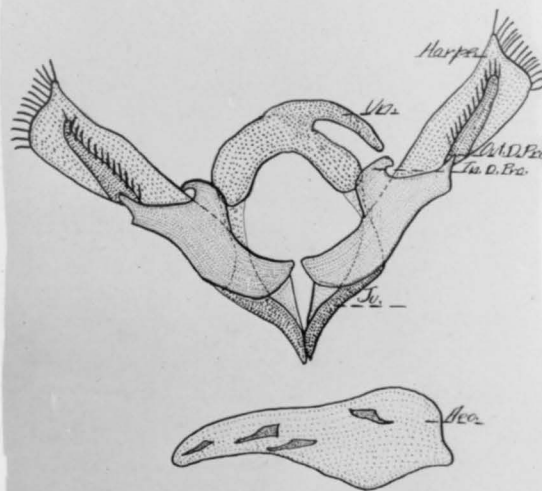


Plate 23.



*Erythroecia suavis*  
D. Cat. No. 2656. Hy. Edwards.

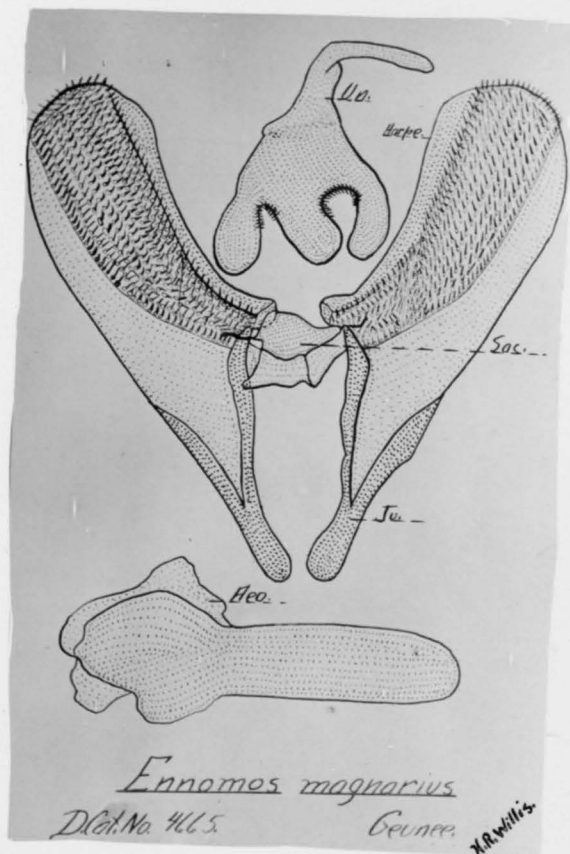
X.R. Willis.



Caenurgia erecta  
D. Cat. No. 3135. Cramer.

H.R. Willis.





## LITERATURE

- (1) Bell, E. L., "Studies in the Genus *Phocides* with Descriptions of New Species." Transactions of the American Entomological Society, Vol. 58, No. 2, June 1932.
- (2) Brown, F. M., "A Revision of the Genus *Phoedis* (Lepidoptera)." American Museum Novitates, Sept. 5, 1929. No. 368, 2 plates.
- (3) Cook, W. C., "A New Species of *Euxoa* and Some Notes on *Chorizagrotis*." Excerpt from The Canadian Entomologist, Vol. LXII, No. 2, July 1930.
- (4) Eyer, John R., "The Comparative Morphology of Male Genitalia of Primitive Lepidoptera." Annals of the Entomological Society of America, Vol. XVII, No. 3, Sept. 1924, pp. 275-342, plates 38.
- (5) McDunnough, J., "New Species of Lepidoptera," The Canadian Entomologist, Vol. LII, No. 7, July 1920, pp. 161-165, 1 plate.
- (6) Skinner, H. and Williams, R. C., "On Male Genitalia of the *Hesperaidae* of N. A." - Transactions of the American Entomological Society, Vol. I, No. 2, pp. 177 -208, 2 plates.

# A STUDY OF THE GENITALIA OF COMMON LIGHT TRAP MOTHS.

## ABSTRACT

The basis of this thesis is the study of genitalia characters of certain light trap moths, most of which belong to the family Noctuidae. Specimens used in this work were caught in light traps operated by the author during the summer seasons of 1931 and 1932. The usual labels of locality, date and accession numbers were placed on each specimen. Much of this material was sent to J. McDunnough and W. C. Cook for determination, and this classified material furnished a basis for comparison of later genitalia studies.

Genitalia were removed from specimens, cleared, and mounted on slides. Drawings were made from these mounts with the aid of a micrograph eyepiece and graph paper. From these drawings, tracings were made on standard drawing paper, and final copies completed in waterproof ink. The principal labels were of the following parts: Uncus, Saccus, Harpes, Aedoeagus, Juxtae, Inner and Outer Dorsal processes of the Harpes.

Twenty-six species were studied and drawings made of each. Some of these studies are noted here.

Genitalia characters are of value in the determination and separation of genera. This is demonstrated in studies of Porosagrotis and Euxoa. They are also of

value in separation species. As an illustration, the description of Euxoa munis Grote and Euxoa divergens Wlk. are cited.

The above characters are valuable in separating forms of certain species. This was apparent in the study of Chorizagrotis auxiliaris auxiliaris Grt., C. a. agrestis Grt. and C. a. montanus Cook, and Lycophotia margaritosa margaritosa Haw. and L. m. saucia Hbn.