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Classification Of The Larvae Of Ground Beetles.

CLASSIFICATION OF THE LARVAE OF
GROUND BEETLES

BY

CLYDE CARNEY HAMILTON

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I INTRODUCTION

A study of the immature stages of insects offers exceptional opportunities for original research of a new, extremely interesting and profitable nature. In spite of the fact that, in the vast majority of insects, it is the young or growing stage which is of economic importance, comparatively little connected systematic work has been done upon them. The Cicindelidae are no exception to this statement. The larvae were first noted in literature as early as 1798 by Geoffroy, and occasional references have been made since then from time to time. The first work of any importance in America was done by Geo. H. Horn in 1878. He gives a detailed description of a larva from each of the four genera occurring in the United States. His descriptions, however, are too general to be of much taxonomic value. During the same year and several succeeding years F. G. Schaupp published a number of notes on tiger-beetle larvae. From this time until about 1905 very little attention was given to the study of the larvae. In 1907 V. E. Shelford published in the Biological Bulletin an excellent account of the habits and distribution of a number of the species occurring in the vicinity of Chicago, Illinois. The following year he published on the life-history and habits of these same species and considered their relation to hibernation, depth of burrow, moisture, temperature, etc. In later papers he has made detailed comparisons of the ecology of the larvae of the same species and of different species from widely separated regions. In 1907 and 1910 Norman Criddle published in the Canadian Entomologist very good accounts of the habits and life-histories of a number of the species occurring in Manitoba, Canada. Some of the more interesting facts he pointed out are the increased depth of the burrows, the smaller size of the species and the lengthening of the life-history, due to the long severe winters and short summers. An interesting paper on the habits of Amblychila

cylindriformis was printed in the Entomological News for 1914 by F. B. Williams and H. B. Hungerford. The most comprehensive work on all stages of the Cicindelidae, however, is that of Walter Horn published in the Genera Insectorum. He discusses practically every phase of the subject, as classification, morphology, life-history, ecology, coloration, etc., and includes a complete bibliography under each species.

The purpose of the present work is to describe the morphology of the larvae and to homologize the parts, to give analytical table for the identification of species occurring in the United States so far as material was available, and to describe each species and its habitat. Many of the adults are very similar and difficult to separate and a similar condition is found in the study of the larvae. Numerous drawings have been prepared to make the characters by which the larvae are separated as clear as possible and to save detailed descriptions.

The study of the immature stages of any group of insects necessitates a considerable amount of work in collecting and rearing material for identification. This is especially great in the family Cicindelidae where the larvae are very restricted in their habitat and a number of the species are limited in their distribution. The present study was made possible thru the opportunity for the Graduate School of the University of Illinois to purchase a collection of identified larvae from Dr. V. E. Shelford. Thanks are due him for permission to use his unpublished notes, for numerous suggestions on the habits of the larvae, and for help in securing additional material. The work has been carried on under the direction of Professor A. D. MacGillivray to whom especial thanks are due for his helpful suggestions and criticisms. The scope of this paper has been considerably extended by the opportunity to study a collection of the larvae of the genus *Omus*, together with some additional larvae of the genus *Cicindela*, presented to the University of

Illinois by Dr. F. E. Blaisdell Sr. of the Leland Stanford Junior University
Medical School. Thanks are due Miss Alice Ritchie, Hagerman, Idaho and Mr.
A. H. Manee, Southern Pines, North Carolina for collecting larvae to be
reared.

CHARACTERS USED IN CLASSIFICATION

The morphology and taxonomy of the immature stages of many insects present difficulties greater than those encountered in the adults because a considerable part of the body is either membranous or slightly chitinized. In the larvae of the Cicindelidae the majority of the taxonomic characters are found on the head, the pronotum, and the fifth abdominal segment. Some of these structures are quite constant while others vary within certain limits, it has seemed advisable, therefore, to give a general discussion of the characters used.

All measurements have been made with a binocular microscope and an eye-piece micrometer. While in many species the difference between corresponding parts is not great, it is constant enough to be of considerable value. One of the best uses which can be made of measurements, as has been determined by a number of workers upon various species of insects, is the proportional length of one distance to another. This proportion is constant for individuals of different sizes of the same species and often for the different instars. The proportional length and width of the fronto-clypeo-labral area, the proportional diameter of ocellus 2 to the distance between ocelli 1 and 2, the proportional length of the segments of the antenna, and the length and width of the pronotum are all good characters. In general, ocelli 1 and 2, the homology of which is indicated in Figs. 5 & 8, are very much the same size in the large and small species of the genus *Cicindela*, but they appear to be larger in the smaller species, due to the smaller size of the head. As a result the distance between ocelli 1 and 2 is generally less than the diameter of ocellus 2 in the smaller species. The proportional length of the segments of the maxillary palpus and of the labial palpus furnish excellent generic characters but does not vary enough to be of specific value. The position of

the cephalo-lateral angles of the pronotum with respect to the cephalo-mesal part and the general shape of the pronotum varies considerably in the species of the genus *Cicindela*.

The character, number, and position of the setae on the head, pronotum and abdomen provides further characters for separating the species. The setae on the U-shaped ridge at the caudal part of the front in the genus *Cicindela* are very constant in number for those species which have only ^{two setae} / , but in those species which have three an extra seta or two may occasionally be present. In the species of *Tetracha* there are always three setae on the transverse ridge at the caudal part of the front. In *Omus*, however, there is always a single large seta on the middle of this transverse ridge and one or two smaller setae on each side. The setae on the first and second segments of the antenna vary within the limits given in the descriptions but is usually not more than one on either side of the average. The number of setae on the mesal margin of the proximal segment of the galea is quite constant for all species of the genera *Cicindela*, *Tetracha*, and *Omus*.

In the genera *Cicindela* and *Tetracha* the setae are very similar in number and arrangement in the first larval instar. These are the primary setae (Figs.49&52) and are generally the larger and more prominent setae of the mature larvae. The setae which are added at the first and second molts are considered as secondary setae. In the genus *Omus* the arrangement of the primary setae (Fig.82) is slightly different from that of the two genera named. No larvae of the first or second instars of the genus *Amblychila* were studied but the arrangement of the setae on the pronotum of the mature larva would seem to indicate that the arrangement and number of the primary setae are different from that of the other genera studied. The primary setae have been designated by numbers but the secondary setae are too numerous and irregular in number and arrangement to apply numbers to them. In those species

in which the secondary setae are not numerous the setal plan of the second and third instars is generally the same, while in those species which have a large number of secondary setae a part are added at the first molt and the remainder at the second. The secondary setae vary in number and position in different individuals of the same species but used in connection with other structures they provide excellent characters for separating the species.

The setae on the chitinized areas of the abdomen are very similar in number and arrangement for the first instar of all species of the genera *Cicindela* and *Omus* (Figs. 88 & 91) in which the first larval stages were studied. These setae have been designated as primary setae and those setae which are added at the first and second molts as secondary setae. In giving the setal plan of the abdomen, the third segment has been used since it seems to be the least likely to be modified. The setae on the hooks of the fifth abdominal segment are constant in number in those species which have two, but vary in those species which have three or more.

The dorsal aspect of the head and pronotum is very highly colored in many species and, within certain limits, furnishes excellent means for separating them. The color is of two kinds, pigmental and physical. The pigmental colors are dull, usually some shade of brown, and appear the same when examined from any angle. The physical colors are much brighter and are produced by small pit-like depressions. These colors vary with the angle from which the specimen is examined. The surface, when examined with a strong light, may show any of the following colors; purple, purplish-bronze, coppery, coppery-bronze, bronze, blue, or green. When viewed from an acute angle the blue or green color is usually more pronounced and this is spoken of as the color which is reflected.

LIFE-HISTORY AND HABITS OF THE LARVAE

The larvae of this family differ from the larvae of most other predaceous insects in that they live in a definite fixed burrow and lie in wait for their prey to come within reach. The majority of predaceous insects have no definite abode, or if they do, they go out in search of their prey. The habits of the tiger-beetle larvae make them dependant upon chance for their food supply and undoubtedly it is very irregular and at times not plentiful. As a result the length of the larval instars may vary considerably, depending upon the food supply, temperature, and the length of the growing or feeding season.

The life-history of different species of *Cicindela* as given by Shelford (1908) for northern Illinois is of three types and is as follows;

"(a) Eggs laid in late spring or early summer, larvae hibernate usually in the third stage, pupate in the second summer; imagoes emerge about a month after pupation, hibernate, and become sexually mature late in the third spring, -- larval life lasts twelve to thirteen months, adult life ten months, -- two years between generations.

(b) Eggs laid in mid summer, larvae hibernate usually in the third stage, pupate in the following June; imagoes emerge in early July and become sexually mature very soon, -- larval life ten months, adult life two months, -- one year between generations.

(c) Eggs laid in mid-summer; larvae hibernate in the second stage, reach the third stage early in the second summer, hibernate again, and pupate in the following May; imagoes emerge in the early part of the third summer and become sexually mature soon, -- larval life twenty-one months, adult life two months, -- two years between generations".

That the time spent in the larval stage is influenced by temperature, length of the summer or growing season, and possibly other factors is shown

by Criddle (1910);

"It will be noticed, however, that there is a striking difference in the life-cycle of some of the species, observed by Prof. Shelford at Chicago and those noted by me at Aweme, even when the same, or a closely related form, is involved, the difference being the prolongation of the larval life over a second winter in Manitoba. This seemed to be such a remarkable fact, considering that there are less than 600 miles of latitude between the two places, that I felt almost persuaded that some mistake had been made on my part, and consequently decided to make further investigation before publishing these notes. The results have been to leave no doubt that the life-cycle of species carefully observed -- C. Manitoba, venusta, limbata, limbalis, and probably others -- lasts for approximately three years; duration of larval stage 24 to 26 months, pupal two to four weeks, adult, 10 to 12 months".

Many of the larvae are very restricted in their habitat, occurring only in particular kinds of soil and requiring a certain amount of moisture. Cicindela duodecimguttata, repanda, and hirticollis leave their burrows if the soil becomes too dry and seek new places which are sufficiently moist. The female oviposits in small holes about one centimeter deep in soil which is suitable for the development of the larvae. The larva, upon hatching, deepens and widens this burrow and lives in it unless conditions become unfavorable for its development. Before each molt the larva closes the burrow, goes to the bottom, molts and reappears again in about one week. There are only three instars in the larval cycle. When the larva is ready to pupate it makes a pupal chamber or burrow, generally at one side of the main burrow, in which it pupates. The depth of the larval burrow, whether it is perpendicular to the surface, spiral, or slanting, and the character of the pupal chamber, is characteristic for each species.

CLASSIFICATION

As previously stated comparatively little connected systematic work has been done on the immature stages of insects. The vast majority of descriptions of coleopterous larvae are of economic species which have been described by economic workers. As a result they vary considerably with respect to the characters mentioned and in many instances it is almost impossible to draw definite conclusions as to some of the structures described.

Family Cicindelidae

Larvae of medium length, cylindrical; head and pronotum strongly chitinized, wider than the remainder of the body and inclined ventro-cephalad; head concave on the dorsal aspect, strongly convex on the ventral; clypeus and labrum fused with the front; ocelli, four or six on each side of the head, ocelli 1 and 2 larger than the others, ocelli 5 and 6 sometimes absent; antenna four-segmented; mandibles sickle-shaped with a prominent tooth on the middle of the mesal margin, inclined dorso-cephalad at an angle of about 45° ; maxilla with the cardo more or less triangular, stipes considerably longer than wide, galea two-segmented, proximal segment of the galea and the palpifer fused, maxillary palpus two-or three-segmented, lacinia sometimes present; labium with the labial palpus two-segmented; pronotum large, shield-shaped, heavily chitinized and fitting close against the caudal margin of the head; legs long, tarsus with two claws, the cephalic claw longer than the caudal; abdomen with ten distinct segments, fifth segment with a dorsal protuberance bearing two or three pair of hooks; anal cerci wanting; spiracles present on the mesothorax and the first eight abdominal segments.

The characters of the larvae have been determined from the examination of specimens representing the four genera occurring in the United States

and one genus, *Collyris*, an arboreal form occurring in the stems of coffee plants on the Island of Java.

Table for Determining the Genera of Cicindelidae.

A. Ocelli 1 and 2 subequal in size.

B. Median hooks long, curved, and sickle-shaped with the convex side

towards the meson; mesal hooks short, cylindrical, and usually with the distal end suddenly constricted into a spine-like projection; ridge on the caudal part of the front U-shaped and not joining the ridge on the caudal part of the vertex; labial palpus with a distinct chitinized sclerite at its proximal end, proximal segment with two or three spine-like projections on its ventro-distal margin.

Cicindela.

BB. Median hooks thorn-like, straight or very slightly curved towards the

meson; mesal hooks similar in shape to the median hooks and about one-half as long; ridge on the caudal part of the front transverse and joining the ridge on the caudal part of the vertex; labial palpus without a chitinized sclerite at its proximal end, proximal segment without spine-like projections on its ventro-distal margin.

Tetracha.

AA. Ocellus 2 considerably smaller than ocellus 1.

B. Antenna not separated from the mandible by a transverse, chitinized

bar, second segment not twice as long as the first; labial palpus with a distinct chitinized sclerite at its proximal end, proximal segment with a single spine-like projection on its ventro-distal margin, proximal segment longer than the distal segment; fifth abdominal segment bearing three pairs of hooks on the dorsal aspect.

Omus.

BB. Antenna separated from the mandible by a transverse chitinized bar, second segment twice as long as the first; labial palpus without a chitinized sclerite at its proximal end, proximal segment without spine-like projections on its ventro-distal margin, first segment shorter than the second; fifth abdominal segment bearing two pairs of hooks on the dorsal aspect.

Amblychila.

Genus *Cicindela* Linn.

Head with the ridge on the caudal part of the front U-shaped and not continuous with the ridge on the caudal part of the vertex; antecoxal piece of the mandible distinct, rectangular; cephalic margin of the labrum smooth; ocelli 1 and 2 subequal in size, ocelli 3 larger than 4 and not adjacent, ocelli 5 and 6 small and inconspicuous; antenna not separated from the mandible by a transverse chitinized bar, second segment one-half the total length of the others; maxilla with the cardo triangular and bearing a single seta, lacinia absent, maxillary palpus with two or three segments, the first segment the shortest, the second slightly longer than the first, and the third the longest, second segment without a spine-like projection on the latero-distal margin; labium not chitinized on the ventral aspect cephalad and mesad of the labial palpi, ventral aspect not concave and not forming a carina on the caudal and lateral margins; ligula with the two setae near the middle close together; labial palpus with a separate chitinized sclerite at its proximal end, proximal segment longer than the distal and with two or three spine-like projections on its ventro-distal margin, the proximal segment with four or five setae and the distal segment with one; fifth abdominal segment with two pairs of hooks on the dorsal aspect, the lateral hooks wanting; median hooks long, slender, and

sickle-shaped with the concave side laterad and with one to four setae; mesal hooks short, cylindrical, and constricted at the distal end into a sharp spine and with two to twelve setae.

The genus *Cicindela* contains a large number of species and subspecies, more than one hundred having been described from the United States. Many of these are widely distributed and the species present a considerable variation in the range of the characters of the larvae. Among the species described here there are several, the identity of which is not certain and a few which are unknown. They are included, however, with the hope that larvae may later be reared and their identity established.

Table for Determining the Species of the Genus Cicindela.

A. Maxillary palpus with three segments.

B. U-shaped ridge on the caudal part of front bearing two distinct setae.

C. Mesal hooks never with more than two setae on the shoulder; setae on head and pronotum usually white, rarely transparent or brown.

D. Pronotum chestnut brown.

E. Setae on head and pronotum brown; head same color as pronotum; pronotum without a color pattern..... 6-guttata.

EE. Setae on head and pronotum white; head bronze; pronotum with a color pattern of lighter areas..... Species A.

DD. Pronotum not chestnut brown.

E. Median hooks with one or two setae, if with three, one seta much smaller than the others.

F. Mesal hooks with the spine-like projection one-third or more the entire length of the hook.

G. Mesal hooks with the spine-like projection more than one-half the entire length of the hook..... purpurea limbalis.

GG. Mesal hooks with the spine-like projection one-half or less than the entire length of the hook.

H. Pronotum with the secondary setae wanting except a single large one cephalo-laterad of seta 4.... purpurea graminea.

HH. Pronotum with the secondary setae small, twenty or more in number.

I. Ninth abdominal sternum with the caudal margin bearing two groups of three setae each..... latesignata.

II. Ninth abdominal sternum with the caudal margin bearing two groups of four setae each..... Species B.

FF. Mesal hooks with the spine-like projection never more than one-sixth the entire length of the hook.

G. Pronotum with the secondary setae few, not more than ten in number; antenna with the first segment bearing ten or eleven setae; median hooks with a single large seta, if two are present one much smaller than the other repanda.

GG. Pronotum with the secondary setae numerous, fifty or more in number; antenna with the first segment bearing seven or eight setae; median hooks with two setae..... lepida.

EE. Median hooks with three setae.

- F. Mesal hooks with the spine-like projection about one-sixth the entire length of the hook, the setae inserted on a broad shoulder; pronotum with the mesal portion of the cephalic margin extending distinctly cephalad of the cephalo-lateral angles
gratiosa.
- FF. Mesal hooks with the spine-like projection about one-third or more the entire length of the hook, the setae inserted on a sloping shoulder; pronotum with the mesal portion of the cephalic margin not extending distinctly cephalad of the cephalo-lateral angles.
- G. Ninth abdominal sternum with the caudal margin bearing two groups of four setae each..... tranquebarica.
- GG. Ninth abdominal sternum with the caudal margin bearing two groups of three setae each.
- H. Antenna with the first segment bearing eight to eleven setae.
- I. Pronotum with the secondary setae twenty-five or thirty in number and with a row on each side of the meson, the blue reflection very strong..... oregona.
- II. Pronotum with the secondary setae not more than ten in number and not with a row on each side of the meson, the blue reflection not strong..... 12-guttata.
- HH. Antenna with the first segment bearing five or six setae.
- I. Head and pronotum bronze with a slight blue reflection; diameter of ocellus 2 less than the distance between ocelli 1 and 2 punctulata.
- II. Head and pronotum dark purple with a green or blue reflection; diameter of ocellus 2 subequal to or greater than the distance between ocelli 1 and 2.....
flavopunctata rectilatera.
- CC. Mesal hooks with more than two setae on the shoulder; setae on head and pronotum transparent or glassy.
- D. Pronotum with the cephalo-lateral angles extending distinctly cephalad of the mesal portion of the cephalic margin..... unipunctata.
- DD. Pronotum with the cephalo-lateral angles not extending cephalad of the mesal portion of the cephalic margin.
- E. Mesal hooks bearing three prominent setae, the spine-like projection almost obsolete..... abdominalis.
- EE. Mesal hooks bearing ten or eleven prominent setae, the spine-like projection distinct..... marginata.

- BB. U-shaped ridge on the caudal part of front bearing three or four distinct setae.
- C. Proximal segment of the galea with four stout setae on the mesal margin; head and pronotum light brown; diameter of ocellus 2 distinctly less than the distance between ocelli 1 and 2.
- D. Median hooks bearing two distinct setae; average width of head and pronotum 4.5 mm..... formosa.
- DD. Median hooks bearing three distinct setae; average width of head and pronotum 4.0 mm..... formosa generosa.
- CC. Proximal segment of the galea with three stout setae on the mesal margin; head and pronotum bronze or coppery colored; diameter of ocellus 2 subequal to or greater than the distance between ocelli 1 and 2.
- D. Mesal hooks bearing more than two setae..... scutellaris lecontei.
- DD. Mesal hooks bearing two setae.
- E. Pronotum with the secondary setae few, not over ten, fine, and inconspicuous, and with the cephalo-lateral angles extending as far cephalad as the mesal portion..... pulchra.
- EE. Pronotum with the secondary setae numerous, more than fifty, flat and prominent, and with the cephalo-lateral angles not extending as far cephalad as the mesal portion.
- F. Median hooks with three distinct setae; pronotum with the setae not distinctly flattened..... limbata.
- FF. Median hooks with two distinct setae; pronotum with the setae distinctly flattened..... hirticollis.
- AA. Maxillary palpus with two segments; head and pronotum a bright coppery or orange bronze with a blue reflection; pronotum with the mesal portion of the cephalic margin extending distinctly cephalad of the cephalo-lateral angles..... dorsalis saulcyi.

C. 6-guttata. Fab.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 172-173.

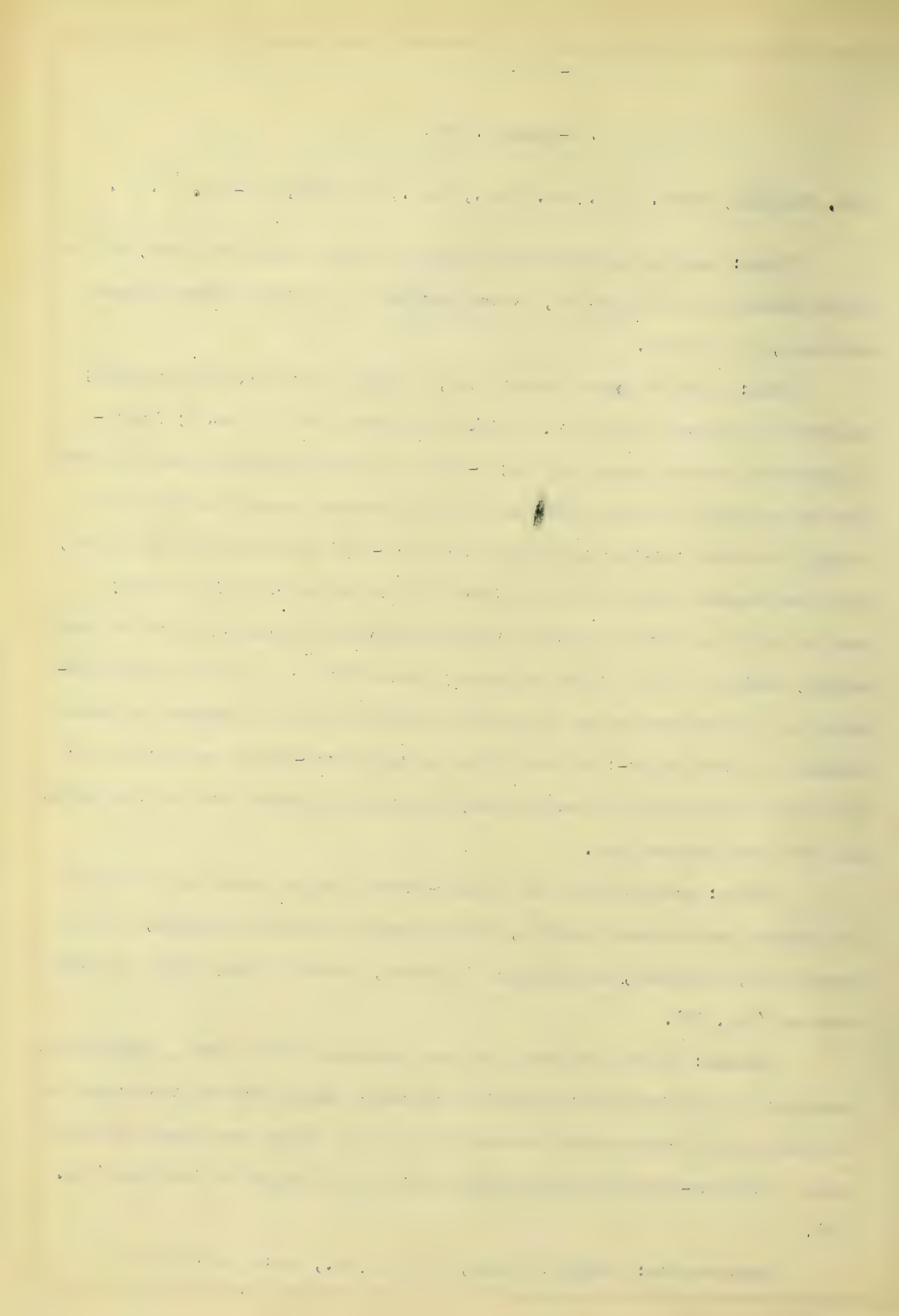
Color: head and pronotum dark chestnut brown or purplish brown, with a slight green or blue reflection, lateral margin of pronotum lighter in some specimens; setae brown.

Head: setae on dorsal aspect long, slightly flattened and prominent; diameter of ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area as broad as long; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first and second segments subequal in length, the third two-thirds and the fourth one-half the length of the second, the first segment with five or six setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment bearing four setae and the distal segment one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins slightly carinate, primary setae large, prominent, and slightly flattened, secondary setae small and not numerous (Fig. 58).

Abdomen: chitinized areas distinct; secondary setae short, fine and not numerous; ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks generally with three setae; mesal hooks with two setae, the spine-like projection about one-third the length of the hook (Fig. 124).

Measurements: length of larva, 20 to 24 mm., width at the third



abdominal segment, 2.0 to 2.5 mm.; diameter of ocellus 2, .25 to .28 mm.; distance between ocelli 1 and 2, .25 to .28 mm.; length of fronto-clypeo-labral area, 1.5 to 1.7 mm., width, 1.5 to 1.7 mm.; length of pronotum, 1.8 to 2.0 mm., width, 2.9 to 3.2 mm.

The larvae of this species can be easily distinguished from those of all other species by the brown setae on the head and pronotum. It is very characteristic in its habitat and is quite different from most others as stated by Shelford (1908);

"This species does not deposit eggs in pure humus but makes use of little irregularities in clay or sand, which, contains a little humus and which is shaded slightly, such conditions as are afforded by falling trees and the erosion of hill sides by small brooks. It prefers a few loose leaves and will lay eggs under them in preference to other places when they are present. It does not, however, appear to like very shady conditions. Several days spent in the beech and maple forests has failed to reveal the presence of one of these insects altho they were present in open and partially cleared places a short distance away where the forest has not become so mesophytic".

The eggs are laid in June or early July and the majority of the larvae reach the third stage by fall. The larvae pupate the following year in July and the adults emerge in August. In northern Illinois the adults rarely appear in autumn and it is probably that they remain in the pupal chamber until spring. There are two years between generations.

C. species A.

Color: head dark purplish brown, pronotum brown with a color pattern of lighter areas; setae on head and pronotum white, the other setae brown.

Head: setae on dorsal aspect medium in length and prominent; diameter of ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area slightly wider than long; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment slightly shorter than the second, the third two-thirds and the fourth one-half the length of the second, the first segment with nine or ten setae and the second with eight or nine; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins not carinate, primary setae large and prominent, seta 7 wanting, secondary setae not more than ten in number, and small (Fig. 59).

Abdomen: chitinized areas distinct, secondary setae short, few and not conspicuous (Fig. 95); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with four setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook (Fig. 125).

Measurements: length of larva, 17 to 19 mm., width at the third abdominal segment, 2.4 to 2.6 mm.; diameter of ocellus 2, .29 to .31 mm.; distance between ocelli 1 and 2, .26 to .28 mm.; length of fronto-clypeo-labral area, 1.10 to 1.15 mm., width, 1.20 to 1.25 mm.; length of pronotum, 1.6 to 1.7 mm., width, 2.5 to 2.7 mm.

The larvae were collected at San Diego, California on the beach in the tide flats just above high tide. They were taken from sand covered with mud

and from pure sand. The holes were from one and one-half to three inches deep.

C. purpurea limbalis Klg.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 164-165.

Color: head and pronotum dark purple with a green reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect long, slightly flattened and prominent; diameter of ocellus 2 distinctly less than the distance between ocelli 1 and 2; frons-clypeo-labral area slightly wider than long; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment slightly shorter than the second, the third two-thirds and the fourth one-half the length of the second, the first segment with five or six setae and the second with seven or eight; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on its ventro-distal margin and with two setae on each side of these spines, proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins slightly carinate, primary setae large, prominent and slightly flattened, secondary setae small, not over ten in number (Fig. 54).

Abdomen: chitinized areas distinct, secondary setae short, fine, and not numerous (Fig. 96); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with two setae; mesal hooks with two setae, the spine-like projection slightly more than one-half the length of the hook (Fig. 126).

Measurements: length of larva, 19 to 22 mm., width at the third abdominal segment, 1.8 to 2.2 mm.; diameter of ocellus 2, .26 to .28 mm.; distance between ocelli 1 and 2, .30 to .35 mm.; length of fronto-clypeo-labral area, 1.70 to 1.75 mm., width, 1.80 to 1.85 mm.; length of pronotum, 2.1 to 2.3 mm., width, 3.1 to 3.5 mm.

This subspecies is very similar to C. purpurea graminea but can be separated from it by the larger number of secondary setae on the pronotum, and the longer length of the spine-like projection of the mesal hooks.

The adults appear from hibernation later in the spring than do those of C. purpurea graminea and the eggs are laid in June. By fall the larvae have reached the second instar, in which instar they pass the winter. They appear the latter part of the following May or the first of June, enter the last larval instar, and pupate in July. Some of the adults appear in August while others remain in the pupal chamber until the following spring. They reach sexual maturity in the spring about a month later than does the true purpurea. The larvae are found in clay on steep banks. The burrows enter at almost a right angle to the surface and curve into a nearly horizontal position at the inner end. They are from seven to ten centimeters deep and there is usually a chimney-like structure around the opening of the burrow which is formed from the soil excavated by the larva. Criddle (1910) states that the larvae are found in similar situations at Aweme, Manitoba, the depth of the burrows varying from three to eight inches. The length of the larval stage is approximately two years and the adult stage from nine to eleven months. In the vicinity of Chicago, Illinois the larval stage lasts about fourteen months and the adult stage ten months.

C. purpurea graminea Schpp.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 160, 172, 173

Color: head and pronotum dark purplish bronze with a green reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect long, slightly flattened and prominent; diameter of ocellus 2 distinctly less than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first and second segments subequal in length, the third almost two-thirds and the fourth slightly more than one-half the length of the second, the first segment with six or seven setae and the second with eight or nine; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with the four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on its ventro-distal margin and with two setae on each side of these spines, proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins slightly carinate, primary setae large, prominent and slightly flattened, secondary setae two in number, one cephalo-laterad of setae 5 (Fig. 60).

Abdomen: chitinized areas distinct, secondary setae not numerous, fine and medium in length (Fig. 97); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with two setae; mesal hooks with two setae, the spine-like projection about one-third the length of the hook (Fig. 127).

Measurements: length of larva, 19 to 22 mm., width at the third abdominal segment, 1.8 to 2.2 mm.; diameter of ocellus 2, .26 to .28 mm.;

distance between ocelli 1 and 2, .33 to .35 mm.; length of fronto-clypeo-labral area, 1.75 to 1.85 mm., width, 1.75 to 1.85 mm.; length of pronotum, 2.0 to 2.3 mm., width, 3.0 to 3.4 mm.

The adults appear from hibernation in April, mate and lay eggs the latter part of the month. The eggs are laid in moist, black soil. The larvae reach the third instar the latter part of August or the first of September, close their burrows and hibernate. The following spring they feed until about the middle of June, pupate in July, and the adults appear the latter part of August. These hibernate and become sexually mature the following April. There are two years between generations.

C. latesignata Lec.

Color: head and pronotum purplish bronze with a green reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect long and prominent; diameter of ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area slightly wider than long; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment slightly shorter than the second, the third two-thirds and the fourth one-half the length of the second, the first segment with five to seven setae and the second segment with ten to twelve; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles not extending as far

cephalad as the mesal portion, lateral margins carinate, primary setae medium in size and prominent, secondary setae about thirty in number, small (Fig. 61).

Abdomen: chitinized areas distinct, secondary setae short, fine, and not numerous (Fig. 98); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook. (Fig. 128).

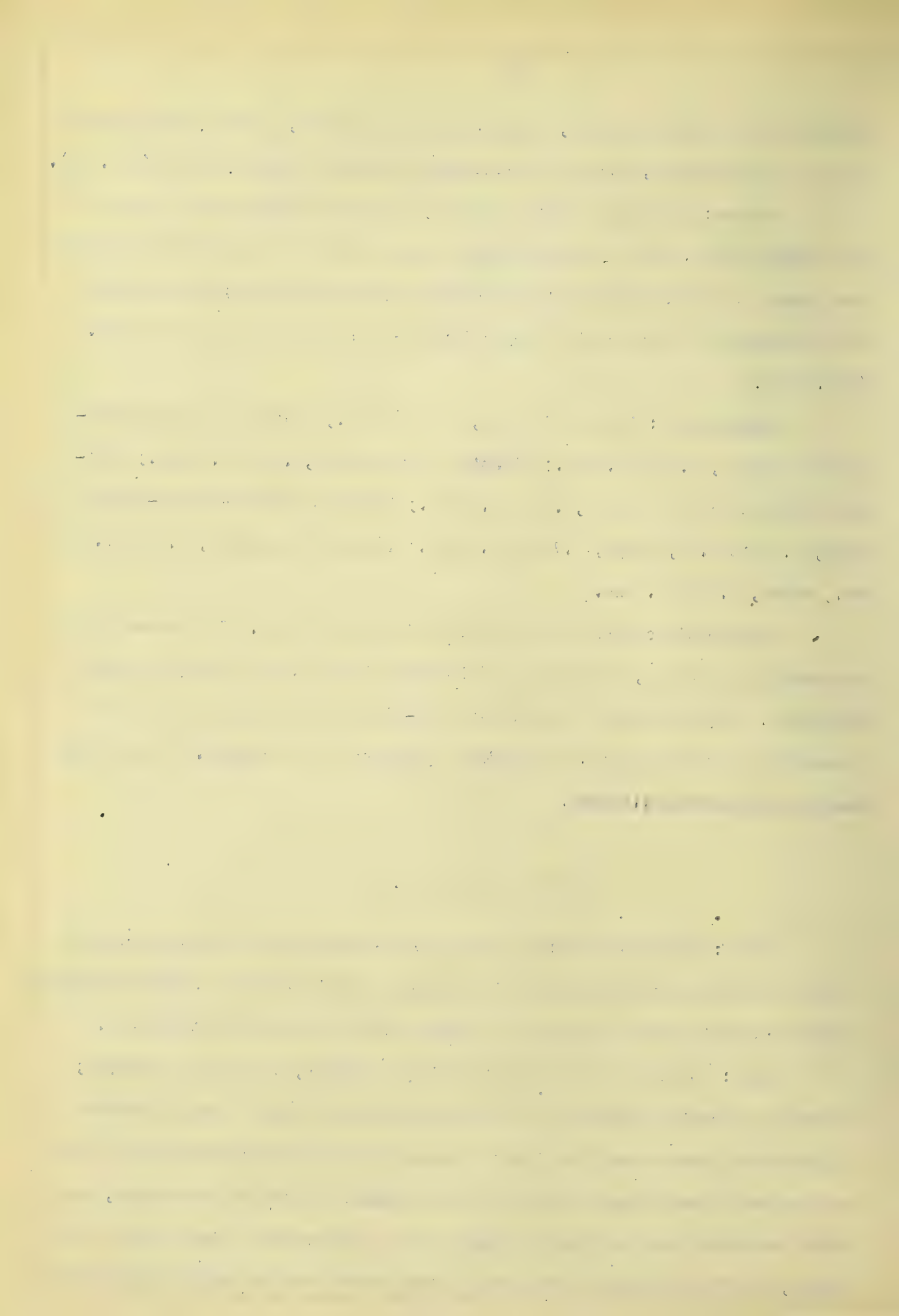
Measurements: length of larva, 18 to 22 mm., width at the third abdominal segment, 2.0 to 2.3 mm.; diameter of ocellus 2, .26 to .28 mm.; distance between ocelli 1 and 2, .26 to .28 mm.; length of fronto-clypeo-labral area, 1.65 to 1.75, width, 1.75 to 1.85 mm.; length of pronotum, 2.9 to 3.2 mm., width, 3.0 to 3.3 mm.

The identification of this species is not positive. The larvae were collected at La Jolla, California on the beach in the tide flats just above high tide. The holes were from one and one-half to three inches deep and frequently curved to a nearly horizontal position at the bottom. The soil was mud or sand covered with mud.

Cicindela species B.

Color: head and pronotum dark purplish-bronze with a strong green or blue reflection, lateral margins of pronotum slightly lighter in some specimens; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect medium in length, stout and prominent; diameter of ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment as long as the second, the third two-thirds and the fourth slightly less than one-half the length of the second, the first segment with seven to nine setae and the second with nine to



eleven; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of the labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, the lateral margins slightly carinate, primary setae long and prominent, secondary setae not more than twenty-five, minute (Fig. 62).

Abdomen: chitinized areas distinct, secondary setae almost as long as the primary setae, prominent and not numerous (Fig. 99); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with two setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook (Fig. 129).

The larvae were collected at Alamosa, Colorado on the banks of the Rio Grande River, in dark, coarse sand on level and sloping land which was always moist. The burrows were from two to four inches deep, usually sloping, the direction varying with the kind of soil.

C. repanda Dej.

1878, Horn, Trans. Amer. Ento. Soc., 7, 1878, 35-37, pl. 2, figs. 4a to b.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 170.

Color: head and pronotum dark coppery bronze with a light green reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect long, stout, and prominent; diameter of

ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; U-shaped ridge on the caudal part of the front bearing two setae; antenna with the first and second segments subequal in length, the third three-fourths and the fourth one-half the length of the second, the first segment with nine or ten setae and the second with seven or eight; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two hooks on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins carinate, primary setae medium in size and prominent, secondary setae small and not numerous (Fig. 63).

Abdomen: chitinized areas distinct, secondary setae very short, small, and not numerous (Fig. 100); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with one seta, if two are present, one is much smaller than the other; mesal hooks with two setae, the spine-like projection about one-sixth the length of the hook (Fig. 130).

Measurements: length of larva, 16 to 18 mm., width at the third abdominal segment, 2.0 to 2.2 mm.; diameter of ocellus 2, .26 to .28 mm.; distance between ocelli 1 and 2, .26 to .28 mm.; length of fronto-clypeo-labral area, 1.50 to 1.60 mm., width, 1.60 to 1.70 mm.; length of pronotum, 1.7 to 1.9 mm., width, 2.7 to 3.0 mm.

The larvae of this species are more general in their habitat than some of the other species of *Cicindela*. They have been collected from wet sandy soil, wet muddy soil, moist clay, and soil with considerable humus. In general,

however, they are found in sandy situations around the margins of small ponds, lakes, and streams which have too much decaying vegetable matter for C. hirticollis. The burrows are about ten centimeters deep and their general direction is at right angles to a sloping surface and oblique to a horizontal surface. The eggs are laid in May and June and the larvae reach the third instar by fall, in which instar they pass the winter. The adults emerge the following summer, hibernate, and appear in May of the second year, reach sexual maturity, lay their eggs and die. The life-history requires two years.

C. lepida Dej.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 172.

Color: head and pronotum bronze with a greenish-blue reflection; setae on dorsal aspect of head and pronotum transparent or glassy, the other setae brown.

Head: setae on dorsal aspect long, slender, and prominent; diameter of ocellus 2 distinctly greater than the distance between ocelli 1 and 2; front-clypeo-labral area slightly broader than long; U-shaped ridge on the caudal part of the front with two setae; antenna with the first segment subequal in length to the second, the third slightly more than one-half and the fourth one-fourth the length of the second, the first segment with six or seven setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with two spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the mesal portion extending distinctly cephalad

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of the cephalo-lateral angles, lateral margins not carinate, primary setae not large or prominent, secondary setae small and numerous (Fig. 64).

Abdomen: chitinized areas distinct, secondary setae about one-third the length of the primary setae, fine and not numerous (Fig. 101); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with two setae; mesal hooks with two setae, the spine-like projection one-sixth the length of the hook (Fig. 131).

Measurements: length of larva, 14 to 16 mm., width at the third abdominal segment, 2.0 to 2.2 mm.; diameter of ocellus 2, .32 to .34 mm.; distance between ocelli 1 and 2, .20 to .222 mm.; length of fronto-clypeo-labral area, 1.45 to 1.55 mm., width, 1.60 to 1.70 mm.; length of pronotum, 1.60 to 1.70 mm., width, 2.5 to 2.7 mm.

The life-history of this species, as given by Shelford (1908) for the northern part of Illinois, differs from that of all others which he had observed, in that the larval stage lasts almost two years and the adult stage but a month or slightly more. The eggs are laid the latter part of July and the second instar is reached by autumn. They pass the winter in this instar, feed the next spring and summer and reach the third instar in June or July. They feed until late fall, hibernate, and come out about the first of the following May. The larvae pupate in June or July, and the adults soon emerge, lay eggs, and die. The species is two-brooded, adults from each brood appearing in alternate years. As a result in May, both second and third stage larvae can be secured, in July, adults, eggs, first and third stage larvae, and in October, second and third stage larvae. The following table gives the life-history and the stages present for the three most important months of the year;

Table I.

The Life-History of *Cicindela repanda**.

Brood No.	1st. year			2nd. year		
	May	July	Oct.	May	July	Oct.
I	3	A - E - 1	2	2	3	3
II	2	3	3	3	A - E - 1	2

Criddle (1910) states that the life-history of *C. repanda* is probably the same at Aweme, Manitoba as at Chicago, Illinois, i.e., the larval stage lasts approximately twenty-two months and the adult stage two months.

The eggs are laid and the larvae live in sand which is slightly shifting. The burrows are from 25 to 37 inches deep in northern Illinois, and from 58 to 72 inches deep at Aweme, Manitoba.

C. gratiosa Guer.

Color: head and pronotum dark purple with a blue reflection, setae on dorsal aspect of head and pronotum transparent or glassy, the other setae brown.

Head: setae on dorsal aspect long, slender, and not conspicuous; diameter of ocellus 2 distinctly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment subequal in length to the second, the third slightly more than one-half and the fourth one-fourth the length of the second, the first segment with seven or eight setae and the second with ten or eleven; maxilla with the proximal segment of the galea

* A = adult, E = egg, 1 = 1st. instar, 2 = 2nd. instar, and 3 = 3rd. instar.

bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one;

Thorax: pronotum with the mesal portion extending distinctly cephalad of the cephalo-lateral angles, lateral margins carinate, primary setae small and inconspicuous, secondary setae minute and numerous (Fig. 65).

Abdomen: chitinized areas on abdomen indistinct, secondary setae short fine and numerous (Fig. 102); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection about one-sixth the length of the hook (Fig. 132).

Measurements: length of larva, 17 to 19 mm., width at the third abdominal segment, 2.0 to 2.3 mm.; diameter of ocellus 2, .30 to .33 mm.; distance between ocelli 1 and 2, .17 to .18 mm.; length of fronto-clypeo-labral area, 1.35 to 1.40 mm., width, 1.35 to 1.40 mm.; length of pronotum, 1.5 to 1.7 mm., width, 2.3 to 2.5 mm.

The larvae of this species were collected at Mobile, Alabama in what was probably an artificial clearing. The soil was sandy and had sufficient clay in it to make it mold well. The larval burrows were vertical and from 22 to 44 inches deep.

C. tranquebarica Herb.

1908, Shelford, Journ.Linn. Soc. Lond., Zool., 30, 1908, 172.

Color: head and pronotum dark purple or purplish-bronze with a strong

green reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect medium in length and prominent; diameter of ocellus 2 slightly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area slightly wider than long; U-shaped ridge on the caudal part of the front bearing two setae; antenna with the first and second segments equal in length, the third two-thirds and the fourth one-half the length of the second, the first segment with seven or eight setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, the lateral margins slightly carinate, primary setae large and prominent, secondary setae small and not over twenty-five in number (Fig. 66).

Abdomen: chitinized areas distinct, secondary setae from one-half to almost as long as the primary setae, prominent and not numerous (Fig. 103); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook (Fig. 133).

Measurements: length of larva, 21 to 24 mm., width at the third abdominal segment, 2.4 to 2.8 mm.; diameter of ocellus 2, .29 to .31 mm.; distance between ocelli 1 and 2, .26 to .27 mm.; length of fronto-clypeo-labral area, 1.80 to 1.90 mm., width, 1.90 to 2.00 mm.; length of pronotum, 2.1 to 2.3 mm., width, 3.3 to 3.8 mm.

The life-history of this species is essentially the same as that of C. purpurea graminea. The eggs are laid in a variety of moist situations but are more often laid in sandy soil with some humus and in among some vegetation. The burrows are straight and from nine to twenty inches deep. At Brandon, Manitoba the larvae were found at a uniform depth of about eighteen to twenty inches and were generally dug from sandy soil. Criddle (1910) says "Two distinct sizes were found among the larvae in autumn, which corresponded to the first and second year of venusta, so that it seems highly probable that the larval life lasts two years, while that of the adult continues for about eleven months".

C. oregona Lec.

Color: head and pronotum dark coppery bronze with a very strong blue reflection; lateral margin of pronotum lighter in some specimens; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect slender, of medium length and not conspicuous; diameter of ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area slightly wider than long; U-shaped ridge on the caudal part of the front bearing two setae; antenna with the first segment slightly shorter than the second, the third two-thirds and the fourth one-half the length of the second, the first segment with nine to eleven setae and the second segment with nine to eleven; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins carinate, primary setae not large or prominent, secondary setae short, about twenty-five or thirty in number and with a row on each side of the meson (Fig. 67).

Abdomen: chitinized areas distinct, secondary setae about one-fourth the length of the primary setae, fine and not numerous (Fig. 104); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection about one-third the length of the hook (Fig. 134).

Measurements: length of larva, 19 to 22 mm., width at the third abdominal segment, 2.3 to 2.5 mm.; diameter of ocellus 2, .26 to .28 mm.; distance between ocelli 1 and 2, .26 to .28 mm.; length of fronto-clypeo-labral area, 1.60 to 1.70 mm.; width, 1.70 to 1.80 mm.; length of pronotum, 1.80 to 2.00 mm., width, 3.0 to 3.3 mm.

This species is similar to *C. 12-guttata* but can be distinguished from it by the larger number of setae on the pronotum, and the blue reflection, which is much stronger. The larvae were collected in New Mexico, Colorado, and California. Those collected in New Mexico were taken from moist clayey soil with some humus mixed in it. The holes were about five inches in depth and entered on a steep, sloping bank and curved to a vertical position at the bottom. Those collected in Colorado were dug from alluvial soil along the bank of a river, which had been deposited by high water. In California the larvae were collected by Dr. F. E. Blaisdell Jr. in sand.

C. 12-guttata Dej.

Color: head and pronotum coppery-bronze with a green reflection, lateral margins of pronotum slightly lighter in some specimens; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect, long, stout, and prominent; diameter of ocellus 2 slightly less than the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment slightly shorter than the second, the third two-thirds and the fourth one-half the length of the second; the first segment with nine to eleven setae and the second with nine to eleven; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending as far cephalad as the mesal portion, lateral margins slightly carinate, primary setae medium in size and prominent, secondary setae minute, not more than ten in number and not with a row on each side of the meson (Fig. 68).

Abdomen: chitinized areas distinct, secondary setae about one-third the length of the primary setae, fine and not numerous (Fig. 105); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook (Fig. 135).

Measurements: length of larva, 18 to 20 mm., width at the third abdominal segment, 2.2 to 2.4 mm.; diameter of ocellus 2, .26 to .28 mm.; distance between ocelli 1 and 2, .28 to .30 mm.; length of fronto-clypeo-labral area, 1.60 to 1.70 mm., width, 1.70 to 1.80 mm.; length of pronotum, 1.90 to 2.10

mm., width, 3.0 to 3.3 mm.

The life-history of this species has not been determined definitely but field observations would seem to indicate that it is similar to *C. repanda*. The larvae are usually found in clay or humus. Criddle (1907) found the larvae burrowing in large numbers along the banks of a river at Aweme, Manitoba, in clayey, muddy, and sandy soil. In the summer time the burrows are from four to five inches in depth and in the winter time from six to fifteen inches. The holes generally slant obliquely into the bank.

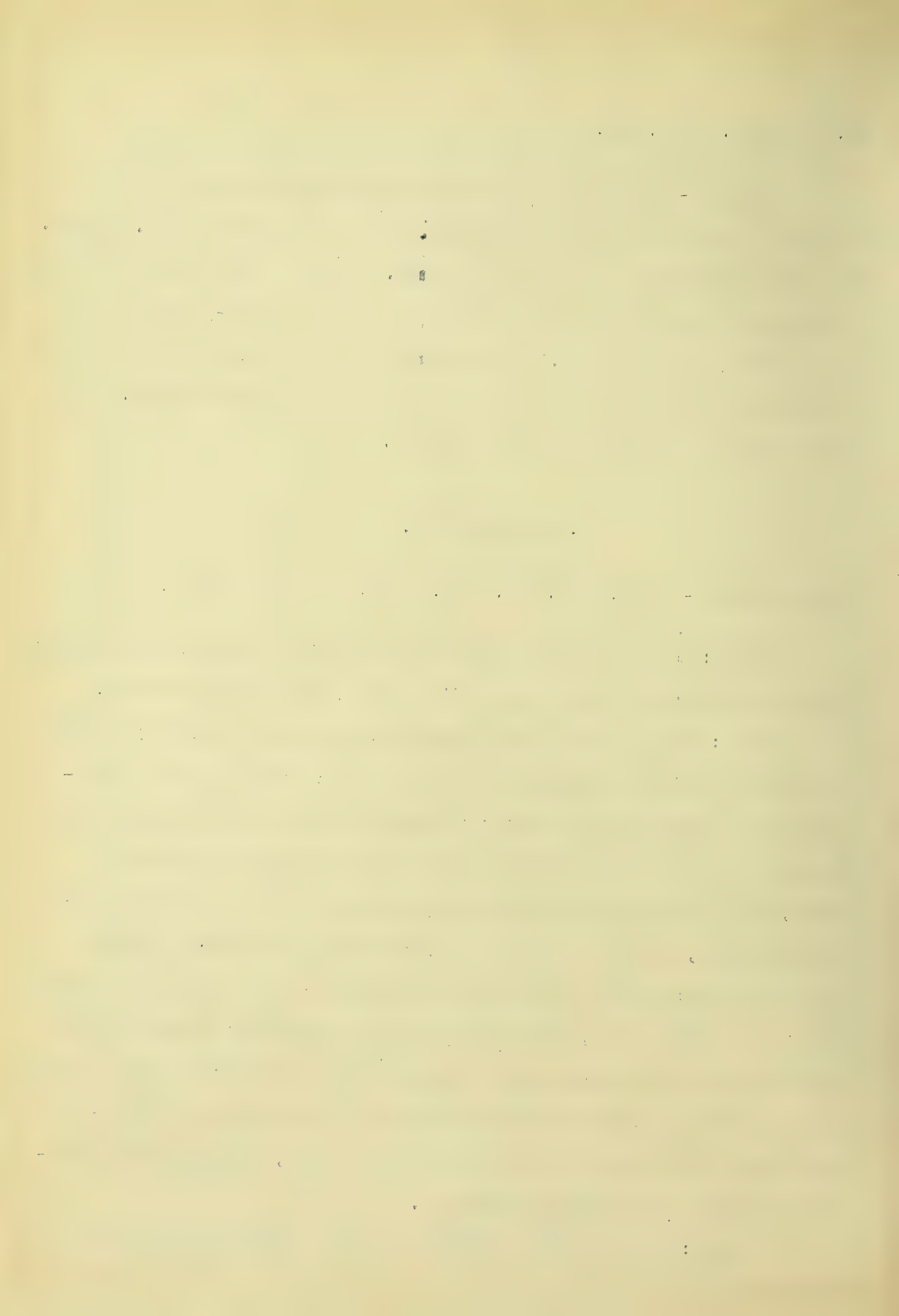
C. punctulata Fab.

1908. Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 172.

Color: head and pronotum purplish bronze with a faint blue reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect medium in length and prominent; diameter of ocellus 2 slightly less than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first and second segments subequal in length, the third slightly shorter than the second and the fourth about one-half its length, the first segment with five or six setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with the four fine setae at the ventro-distal end arranged in a transverse row, proximal segment of labial palpus with three spine-like projections on its ventro-distal margin and with two setae on each side of these spines, proximal segment bearing four setae and the distal segment one.

Thorax: pronotum with the cephalo-lateral angles extending almost as

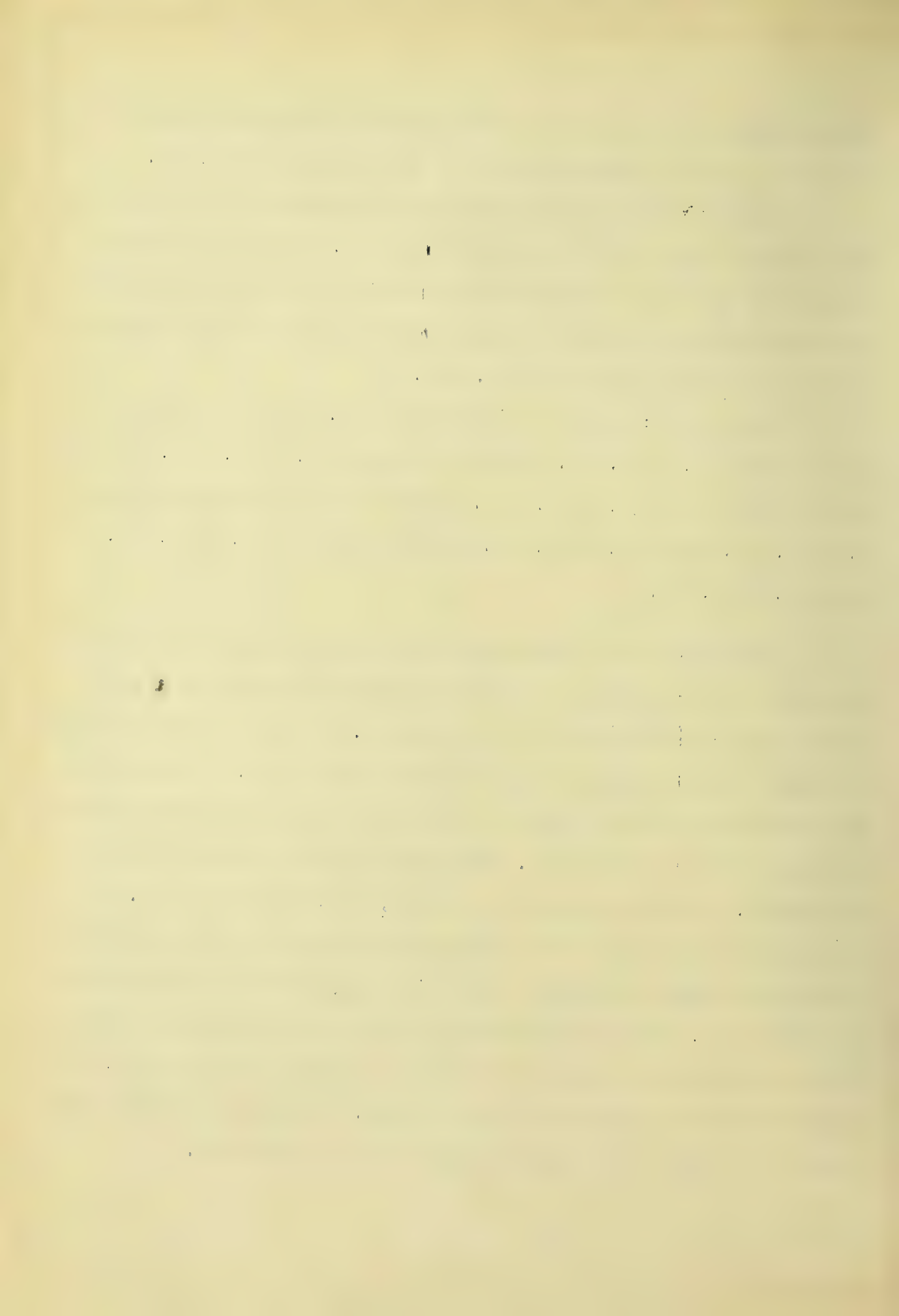


far cephalad as the mesal portion, lateral margins slightly carinate, primary setae 5 and 6 small, secondary setae small and not numerous (Fig. 69).

Abdomen: chitinized areas indistinct, secondary setae not numerous and about one-half the length of the primary setae (Fig. 106); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook (Fig. 136).

Measurements: length of larva, 14 to 16 mm., width at the third abdominal segment, 1.8 to 2.0 mm.; diameter of ocellus 2, .20 to .23 mm.; distance between ocelli 1 and 2, .23 to .25 mm.; length of fronto-clypeo-labral area, 1.3 to 1.4 mm., width, 1.3 to 1.4 mm.; length of pronotum, 1.5 to 1.7 mm., width, 2.3 to 2.7 mm.

The life-history of this species as given by Shelford (1908) differs from that of other species in that the adults do not hibernate and there is only a single year required for the life-history. The eggs are laid in relatively hard, dry soil, usually humus, the latter part of July. The majority of the larvae are in the third instar by September, in which instar they hibernate and appear early the next spring. They feed until April or early June when they pupate. The adults emerge in early July, mate, lay eggs and die. The larval burrows during the feeding season are from thirty to forty centimeters deep but are slightly shallower in the summer just before the larvae go into the pupal stage. Criddle (1907) states that the larvae are found at Aweme, Manitoba in small mossy place between clumps of grass in dry situations. The depth of the holes ranging from 18 to 26 inches. The adults do not hibernate and it is probable that the larval stage lasts over two winters.



C. flavopunctata rectilatera. Chd.

Color: head and pronotum purple or purplish-bronze with a blue reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect long and prominent; diameter of ocellus 2 greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment slightly shorter than the second, the third a little more than one-half and the fourth a little more than one-third the length of the second, the first segment with five or six setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end; proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending as far cephalad as the mesal portion, lateral margins carinate, primary setae large and prominent, secondary setae small and not numerous (Fig. 70).

Abdomen: chitinized areas distinct, secondary setae almost as long as the primary setae, fine and not numerous (Fig. 107); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook (Fig. 137).

Measurements: length of larva, 17 to 19 mm., width at the third abdominal segment, 2.0 to 2.3 mm.; diameter of ocellus 2, .26 to .27 mm.; distance between ocelli 1 and 2, .23 to .25 mm.; length of fronto-clypeo-labral area,

1.25 to 1.35 mm., width, 1.25 to 1.35 mm.; length of pronotum, 1.7 to 1.8 mm., width, 2.7 to 2.9 mm.

The larvae were collected at Houston, Texas in heavy, clayey soil. The holes were about four inches long and curved to an almost horizontal position at the bottom.

C. unipunctata Fab.

Color: head and pronotum purplish-bronze with a green reflection; setae on dorsal aspect of head and pronotum transparent or glassy, the other setae brown.

Head: setae on dorsal aspect long, stout and prominent; diameter of ocellus 2 slightly less than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment as long as the second, the third two-thirds and the fourth one-half the length of the second, the first segment with seven or eight setae, and the second with seven or eight; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending distinctly cephalad of the mesal portion, lateral margin carinate, primary setae not large or conspicuous, secondary setae wanting or very minute (Fig. 71).

Abdomen: chitinized areas distinct, secondary setae not numerous and from short to slightly more than one-half the length of the primary setae

(Fig. 108); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with three setae; mesal hooks with five or six setae, the spine-like projection about one-third the length of the hook (Fig. 138).

Measurements: length of larva, 22 to 25 mm., width at the third abdominal segment, 3.0 to 3.3 mm.; diameter of ocellus 2, .28 to .30 mm.; distance between ocelli 1 and 2, .31 to .33 mm.; length of fronto-clypeo-labral area, 1.9 to 2.0 mm., width, 1.9 to 2.0 mm.; length of pronotum, 2.1 to 2.3 mm., width, 3.6 to 3.8 mm.

This species is easily separated from all others by the position of the cephalo-lateral angles of the pronotum, which extend distinctly cephalad of the mesal portion. The larvae were dug at La Fallette, Tennessee in bare, rocky soil. The burrows were perpendicular for the first three or four inches and then curved to a horizontal position.

C. abdominalis Fab.

Color: head and pronotum dark purplish-bronze with a green or blue reflection; setae on dorsal aspect of head and pronotum transparent or glassy, the other setae brown.

Head: setae on dorsal aspect, long, slender and not prominent; diameter of ocellus 2 distinctly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of the front bearing three setae; antenna with the first segment slightly shorter than the second, the third one-half and the fourth one-fourth the length of the second, the first segment with seven or eight setae and the second with ten to twelve; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented;

labium with four fine setae not arranged in a transverse row at its ventro-distal end, the two mesal setae caudad of the lateral ones, proximal segment of the labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the mesal portion extending distinctly cephalad of the cephalo-lateral angles, lateral margins slightly carinate, primary setae long, slender and inconspicuous, secondary setae short and fairly numerous (Fig. 72).

Abdomen: chitinized areas indistinct, secondary setae short, fine and numerous and occurring between as well as on the chitinized areas (Fig. 109), ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with three setae, the spine-like projection wanting or inconspicuous (Fig. 139).

Measurements: length of larva, 18 to 20 mm., width at the third abdominal segment, 2.0 to 2.3 mm.; diameter of ocellus 2, .29 to .31 mm.; distance between ocelli 1 and 2, .19 to .21 mm.; length of fronto-clypeo-labral area, 1.65 to 1.75 mm., width, 1.65 to 1.75 mm.; length of pronotum, 1.9 to 2.1 mm., width, 2.3 to 2.5 mm.

The larvae were collected at Southern Pines, North Carolina by Mr. A. H. Manee in hard soil at the side of a road. The burrows were small and about twenty-five inches deep. The identification of this species is not certain.

C. marginata Fab.

Color: head and pronotum dark purplish-bronze with a strong blue reflection; setae on dorsal aspect of head and pronotum transparent or glassy,

the other setae brown.

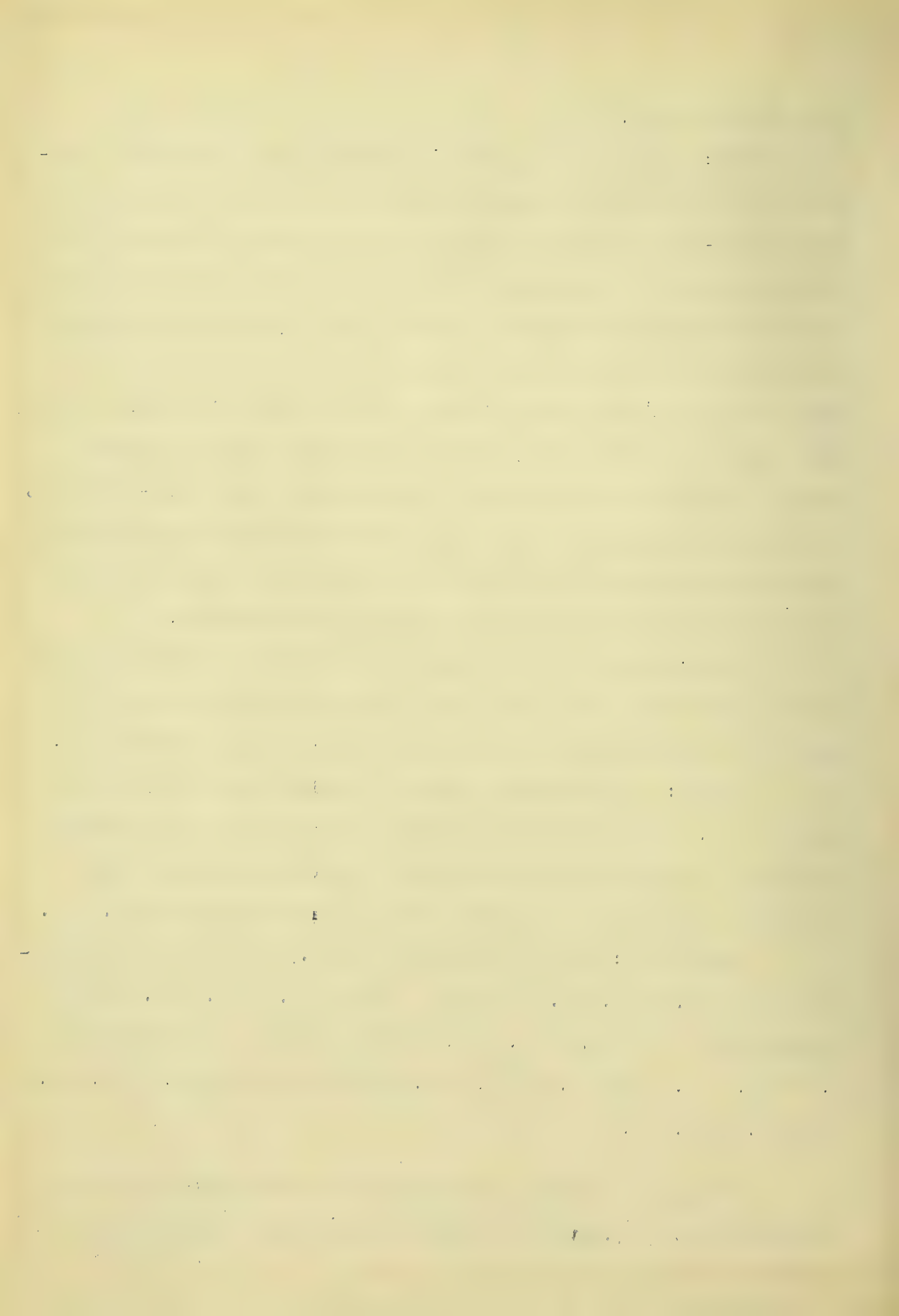
Head: setae on dorsal aspect long, slender, and inconspicuous; diameter of ocellus 2 distinctly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing two setae; antenna with the first segment subequal in length to the second, the third two-thirds and the fourth slightly less than one-half the length of the second, the first segment with nine or ten setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, the proximal segment of the labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles not extending as far cephalad as the mesal portion, the lateral margins slightly carinate, primary setae not large or conspicuous, secondary setae small and not numerous (Fig. 73)

Abdomen: chitinized areas distinct, secondary setae short, fine and numerous (Fig. 110); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with nine or ten setae, the spine-like projection almost obsolete (Fig. 140).

Measurements: length of larva, 19 to 22 mm., width at the third abdominal segment, 2.2 to 2.4 mm.; diameter of ocellus 2, .33 to .35 mm.; distance between ocelli 1 and 2, .28 to .30 mm.; length of fronto-clypeo-labral area, 1.55 to 1.65 mm., width, 1.55 to 1.65 mm.; length of pronotum, 1.7 to 1.9 mm., width, 2.8 to 3.0 mm.

This species is easily distinguished by the large number of setae on the mesal hooks. The larvae were collected at Galveston, Texas on Denver



Beach, a short distance back from the shore line in sandy soil with scattered vegetation, the larvae occurring in the open places. The holes were from nine to ten inches deep.

C. formosa Say.

Color: head and pronotum chestnut-brown with a color pattern of lighter areas; setae on dorsal aspect of head and pronotum transparent to white, the other setae brown.

Head: setae on dorsal aspect long, stout, and prominent; diameter of ocellus 2 distinctly less than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing three setae; antenna with the first segment slightly shorter than the second, the third one-half and the fourth one-fourth the length of the second, the first segment with five or six setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing four setae on the mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with two spine-like projections on the ventro-distal margin and with three setae on the mesal side and two on the lateral side of these spines, proximal segment with five setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins carinate, primary setae not large or prominent, setae 5 and 6 wanting, secondary setae wanting (Fig. 74).

Abdomen: chitinized areas distinct, secondary setae about one-half the length of the primary setae, fine and not numerous (Fig. 111); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with two setae; mesal hooks with four setae, the spine-like projection

one-third the length of the hook (Fig. 141).

Measurements: length of larva, 24 to 26 mm., width at the third abdominal segment, 3.4 to 3.6 mm.; diameter of ocellus 2, .33 to .34 mm.; distance between ocelli 1 and 2, .39 to .40 mm.; length of fronto-clypeo-labral area, 2.5 to 2.5 mm., width, 2.5 to 2.6 mm.; length of pronotum, 2.9 to 3.0 mm., width, 4.2 to 4.5 mm.

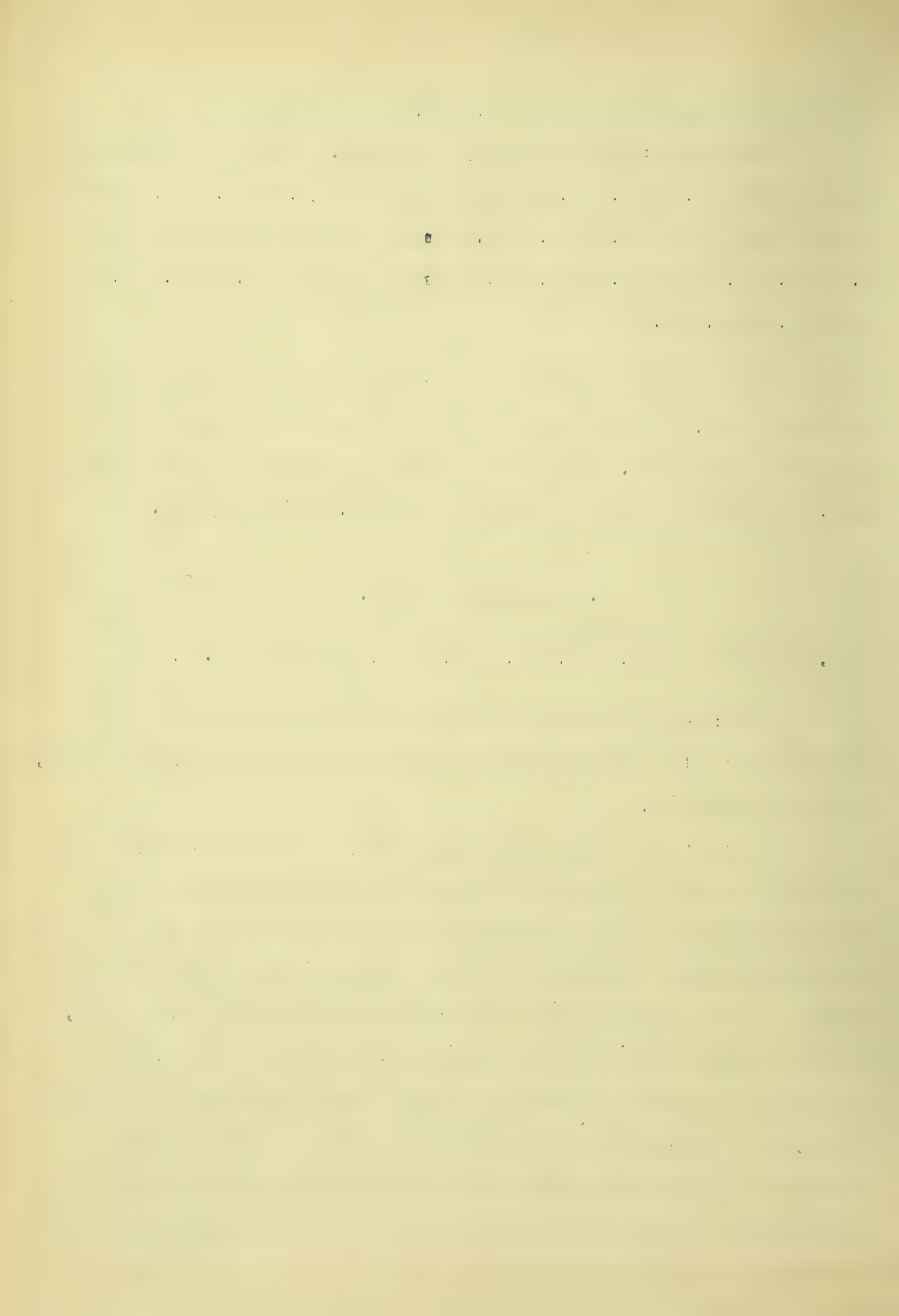
The larvae were collected at Sedalia, Colorado in a sand dune near the Rio Grande river. The sand was coarse and fine mixed and had probably been deposited by high water. The holes were vertical and about twenty-two inches deep. The burrows have a pit similar to that of C. formosa generosa.

C. formosa generosa Dej.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 172.

Color: head and pronotum chestnut-brown with a color pattern of lighter areas; setae on dorsal aspect of head and pronotum transparent to white, the other setae brown.

Head: setae on dorsal aspect long, stout, and prominent; diameter of ocellus 2 distinctly less than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing three setae; antenna with the first segment slightly shorter than the second, the third one-half and the fourth one-third the length of the second, the first segment with six or seven setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing four setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of the labial palpus with two spine-like projections on the ventro-distal margin and



with three setae on the mesal side and two on the lateral side of these spines, the proximal segment with five setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles not extending as far cephalad as the mesal portion, the lateral margins slightly carinate, primary setae not large and prominent, seta 6 wanting, secondary setae wanting (Fig. 51)

Abdomen: chitinized areas distinct, secondary setae almost as long as the primary setae, slender and numerous (Fig. 90); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with three setae; mesal hooks with four setae, the spine-like projection one-third the length of the hook (Fig. 142).

Measurements: length of larva, 22 to 24 mm., width at the third abdominal segment, 3.0 to 3.3 mm.; diameter of ocellus 2, .30 to .32 mm.; distance between ocelli 1 and 2, .37 to .40 mm.; length of fronto-clypeo-labral area, 2.2 to 2.4 mm., width, 2.2 to 2.4 mm.; length of pronotum, 2.4 to 2.7 mm., width, 3.6 to 4.2 mm.

The larvae of this subspecies are similar to those of C. formosa but can be distinguished from them by the smaller average width of the pronotum and the presence of three setae on the median hooks.

The adults emerge from hibernation in April or May and lay eggs in May or June in sandy soil which is slightly shifting. The eggs hatch in June and the larvae reach the third instar by the latter part of August or the first of September. They close their burrows the latter part of September or the first of October and go into hibernation, appearing again in the spring. Pupation takes place in June or July and some of the adults emerge from the pupal chamber during the summer while the remainder stay in the pupal chamber until the following spring. The adults appear in April or May, become sexually mature in about a month, lay eggs, and die.

The larvae of this species are very noticeable because of their peculiar burrows. The main part of the burrow is from twelve to twenty inches deep and vertical thruout the greater part of its course. About two-thirds of an inch from the top the burrow curves sharply to a horizontal position and opens into a small pit. This construction serves to keep the sand, which is always slightly shifting, from filling up the burrow and also serves as a trap for catching insects. The larva cements the sand immediately around the opening with saliva which keeps it from caving in. The pupal chamber is an oblique side cavity about four inches below the surface. The upper part and much of the lower part of the burrow is filled with sand which is taken from this cavity.

C. scutellaris lecontei Hald.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 172.

Color: head and pronotum purplish-bronze with a green reflection; setae on the dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect long, stout, and prominent; diameter of ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of the front bearing three setae; antenna with the first segment subequal in length to the second, the third two-thirds and the fourth one-half the length of the second, the first segment with five or six setae and the second with ten to twelve; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins varinate, primary setae large and prominent, secondary setae small, not more than fifty in number, and with a row on each side of the meson (Fig. 75).

Abdomen: chitinized areas distinct, most of the secondary setae short, fine and numerous (Fig. 112); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with three setae; mesal hooks usually with four setae but occasionally with three, the spine-like projection one-third the length of the hook (Fig. 143).

Measurements: length of larva, 20 to 24 mm., width at the third abdominal segment, 2.4 to 2.8 mm.; diameter of ocellus 2, .27 to .30 mm.; distance between ocelli 1 and 2, .27 to .29 mm.; length of fronto-clypeo-labral area, 1.7 to 1.8 mm., width, 1.7 to 1.8 mm.; length of pronotum, 1.7 to 2.0 mm., width, 2.8 to 3.2 mm.

The life-history of this species is similar to that of C. purpurea var. graminea. The adults, however, appear a little later in the spring and remain later in the summer. The eggs are laid in dry sand which contains some humus. The burrows vary from ten to twenty inches in depth.

C. pulchra Say.

Color: head and pronotum dark purple with a light green reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae on dorsal aspect long, stout, and prominent; diameter of ocellus 2 greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of the front bearing three setae; antenna with the first segment slightly shorter than the second, the third one-half and the fourth slightly more than one-third the length of the

second, the first segment with five or six setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending as far cephalad as the mesal portion, lateral margins slightly carinate, primary setae not large or prominent, secondary setae small and not over fifteen in number (Fig. 76).

Abdomen: chitinized areas distinct, secondary setae short, small, and not numerous (Fig. 113); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; median hooks with two setae; mesal hooks with two setae, the spine-like projection one-half the length of the hook (Fig. 144).

Measurements: length of larva, 21 to 23 mm., width at the third abdominal segment, 3.0 to 3.4 mm.; diameter of ocellus 2, .32 to .37 mm.; distance between ocelli 1 and 2, .30 to .32 mm.; length of fronto-clypeo-labral area, 1.9 to 2.1 mm., width, 1.9 to 2.1 mm.; length of pronotum, 2.3 to 2.5 mm., width, 3.7 to 4.0 mm.

The larvae were collected at Albuquerque, New Mexico near the upper end of an arroya in moist, adobe soil. The holes were vertical and from four to eight inches deep. The identification of this species is not positive.

C. limbata Bates.

Color: head and pronotum bright coppery-bronze, with a green or blue reflection; setae on dorsal aspect of head and pronotum white, the other setae

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brown.

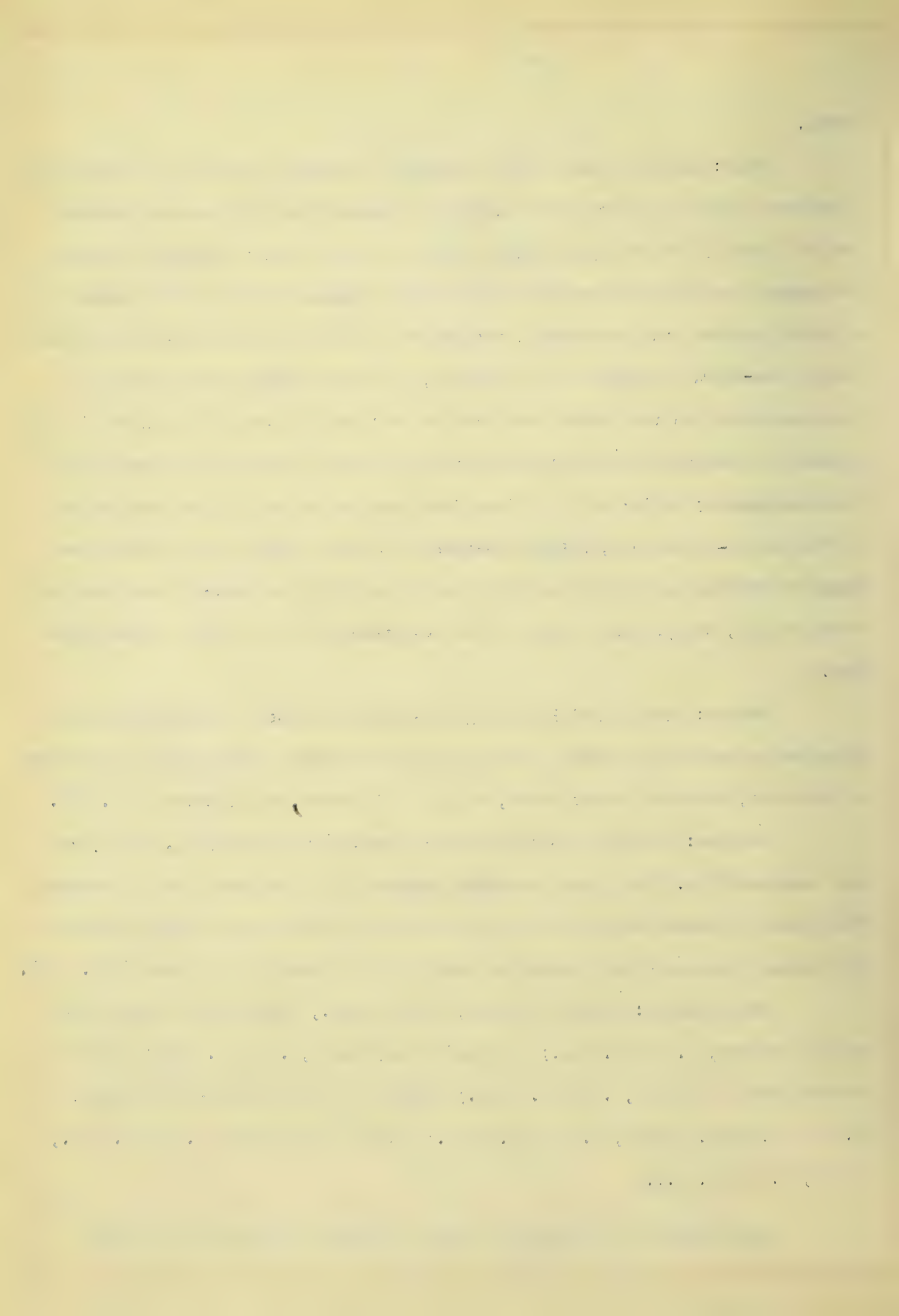
Head: setae on dorsal aspect medium in length, slightly flattened, and prominent; diameter of ocellus 2 distinctly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of front bearing three setae; antenna with the first segment slightly shorter than the second, the third a little more than one-half and the fourth one-third the length of the second, the first segment with twelve or thirteen setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles not extending as far cephalad as the mesal portion, lateral margins carinate, primary setae not large or distinct, secondary setae short, slightly flattened, and numerous (Fig. 77).

Abdomen: chitinized areas distinct, secondary setae short, small, and not numerous (Fig. 114); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with three setae; mesal hooks with two setae, the spine-like projection one-third the length of the hook (Fig. 145).

Measurements: length of larva, 15 to 17 mm., width at the third abdominal segment, 1.8 to 2.0 mm.; diameter of ocellus 2, .23 to .25 mm; distance between ocelli 1 and 2, .20 to .21 mm.; length of fronto-clypeo-labral area, 1.45 to 1.55 mm., width, 1.45 to 1.55 mm.; length of pronotum, 1.5 to 1.6 mm., width, 2.4 to 2.6 mm.

The larvae were collected at Wray, Colorado in bare, white, sand



blowouts. The burrows were straight or slightly spiral and from ten to fourteen inches deep and occurred in clusters of a dozen or more to the square foot. The larvae of C. lepida were dug from the same situations.

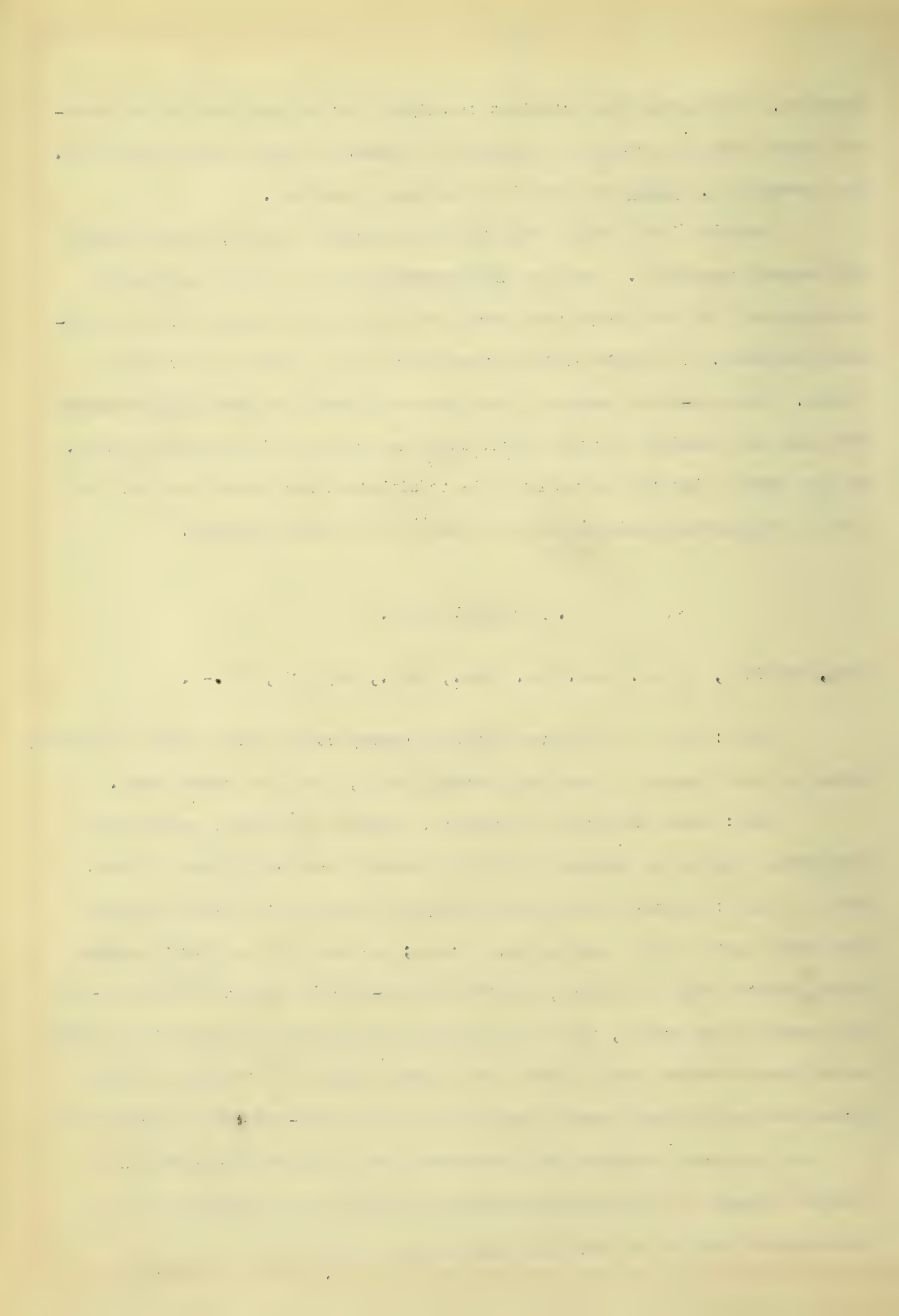
Criddle (1907) states that the larvae occur in large, sandy blowouts with scanty vegetation. They are also sometimes found on small patches of shifting soil but are always much more plentiful in white sand which is constantly drifting. The depth of the burrows varied from seven to seventeen inches. The life-cycle requires three years at Aweme, Manitoba, approximately two years are required for the larval stage and one year for the adult stage. He also states that the larvae are able to withstand much more cold than the adults, the larvae remaining out until the latter part of October.

C. hirticollis Say.

1908, Shelford, Journ. Linn. Soc. Lond., Zool., 30, 1908, 172.

Color: head and pronotum a bright coppery color with a green reflection; setae on dorsal aspect of head and pronotum white, the other setae brown.

Head: setae of dorsal aspect short, somewhat flattened, numerous, and prominent; diameter of ocellus 2 slightly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; U-shaped ridge on the caudal part of front bearing three setae; antenna with the first segment slightly shorter than the second, the third three-fourths and the fourth one-half the length of the second, the first segment bearing seven to nine setae and the second ten to twelve; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus three-segmented; labium with four fine setae arranged in a transverse row at the ventro-distal end, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines;



the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles not extending as far cephalad as the mesal portion, lateral margins slightly carinate, primary setae inconspicuous, secondary setae short, flattened, and numerous (Fig. 57).

Abdomen: chitinized areas distinct; secondary setae short, few, and not prominent (Fig. 93); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with two setae; mesal hooks with two setae, the spine-like projection about one-fourth the length of the hook (Fig. 146).

Measurements: length of larva, 17 to 19 mm., width at the third abdominal segment, 2.2 to 2.4 mm.; diameter of ocellus 2, .39 to .33 mm.; distance between ocelli 1 and 2, .27 to .30 mm.; length of fronto-clypeo-labral area, 1.4 to 1.6 mm., width, 1.8 to 2.0 mm.; length of pronotum, 1.8 to 2.1 mm., width, 2.9 to 3.2 mm.

The larvae of this species are rather distinctive and easily recognized by the large number of white, flattened or scale-like setae on the pronotum. The only other larva which resembles it in this respect is C. limbata which has only about half as many setae on the pronotum and which are not so distinctly flattened. The larvae are very restricted in their habitat, occurring only in clean, moist sand which has very little humus. The burrows are vertical and about five inches deep. The eggs are deposited in late June and July and the larvae reach the third instar sometime in September, close their burrows in October and hibernate. The burrows are opened in May of the following year and the larvae pupate in June or July. The adults emerge in August, hibernate over the winter and become sexually mature the following spring.

C. dorsalis saulcyi Guer.

Color: head and pronotum bright coppery-bronze with a strong blue reflection; setae on dorsal aspect of head and pronotum transparent or glassy, the other setae brown.

Head: setae on dorsal aspect fine and inconspicuous; diameter of ocellus 2 distinctly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area as long as broad; U-shaped ridge on the caudal part of the front bearing four or six setae, the two middle ones larger than the others; antenna with the first segment slightly shorter than the second, the third about two-thirds and the fourth one-third the length of the second, the first segment with five or six setae and the second with nine or ten; maxilla with the proximal segment of the galea bearing three setae on its mesal margin, maxillary palpus two segmented; the first and second segments fused and together as long as the third segment; labium with four fine setae on the ventro-distal end arranged in a transverse row, proximal segment of labial palpus with three spine-like projections on the ventro-distal margin and with two setae on each side of these spines, the proximal segment with four setae and the distal segment with one.

Thorax: pronotum with the cephalo-mesal portion extending distinctly cephalad of the cephalo-lateral angles, lateral margins not carinate, primary setae small and not conspicuous, secondary setae short, fine and numerous (Fig. 78).

Abdomen: chitinized areas indistinct; secondary setae few, short, and not conspicuous (Fig. 115); ninth abdominal sternum with the caudal margin bearing two groups of three setae each; median hooks with two setae; mesal hooks with six or seven setae, the spine-like projection about one-fifth the length of the hook (Fig. 147).

Measurements: length of larva, 15 to 17 mm., width at the third abdominal segment, 1.4 to 1.6 mm.; diameter of ocellus 2, .32 to .34 mm.; distance between ocelli 1 and 2, .19 to .21 mm.; length of fronto-clypeo-labral area, 1.25 to 1.35 mm, width, 1.25 to 1.35 mm.; length of pronotum, 1.5 to 1.7 mm., width, 2.0 to 2.3 mm.

This species is easily distinguished by the labial palpus which is two-segmented. This has evidently occurred thru the fusion of the first and second segments. The larvae were collected at Galveston, Texas on Denver Beach from moist, clean sand outside of the shrubs. It occurs in situations similar to those of C. hirticollis along the New England coast and around the shores of Lake Michigan. The burrows are from twelve to eighteen inches in depth.

Genus *Tetracha* Hope.

Head with the ridge on the caudal part of front transverse and continuous with the ridge on the caudal part of the vertex; antecoxal piece of the mandible distinct, crescent-shaped; cephalic margin of the labrum smooth; ocelli 1 and 2 subequal in size, ocelli 3 and 4 not adjacent, ocelli 5 and 6 present; antenna separated from the mandibles by a narrow, slightly chitinized area, the first and second and the third and fourth segments subequal in length, the first and second twice as long as the third and fourth; maxilla with the cardo triangular and bearing one large and one small seta, lacinia absent, maxillary palpus three-segmented, the first segment the shortest, the second and third subequal in length, the second segment with a spine-like projection on the latero-distal end; labium not chitinized on the ventral aspect mesad and distad of the proximal end of the labial palpi, mesal part of the ligula concave forming a prominent carina on the lateral and caudal margins, the two setae on this depressed area far apart, no chitinized sclerite at the proximal end of the labial palpus, labial palpus with the proximal segment shorter than the distal segment and without spine-like projections on its ventro-distal margin, the proximal segment with six to eight setae and the distal segment with one; fifth abdominal segment with two pair of hooks on the dorsal aspect, the lateral hooks wanting; median hooks straight and thorn-like and bearing a single seta; mesal hooks similar in shape to the median hooks, about one-half their length and bearing two fine, inconspicuous setae.

This genus is represented in the United States by two species, both of which occur in the southern and south-eastern part. In many respects the larvae are very closely related to ^{those of} the genus *Cicindela* but they can be separated from them by the transverse ridge on the caudal part of the front, the length of the segments of the maxillary palpus, the shape of the labium, the length of the

segments of the labial palpus, and by the hooks on the fifth abdominal segment.

Table to the Species of the Genus *Tetracha*.

- A. Diameter of ocellus 2 slightly greater than the distance between ocelli 1 and 2; pronotum less than 4 mm. in width, color of pronotum a dark purple; secondary setae on abdomen not numerous and found only on the chitinized areas..... carolina.
- AA. Diameter of ocellus 2 slightly less than the distance between ocelli 1 and 2; pronotum 4.5 mm. or more in width, color a dark purplish-bronze with a green reflection; secondary setae on abdomen numerous and found between as well as upon the chitinized areas..... virginica.

T. carolina Harris.

Color: head and pronotum dark purple with a green reflection, lateral and caudal margins of pronotum pearly white; setae brown, some of those on the head and pronotum occasionally white.

Head: setae on dorsal aspect long, slightly flattened, and prominent; diameter of ocellus 2 slightly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area longer than wide; transverse ridge on the caudal part of front with three setae; antenna with the first segment slightly longer than the second, the third slightly more than one-half and the fourth slightly less than one-half the length of the second, setae long and stout, the first segment with nine to eleven setae and the second with eleven to thirteen; maxilla with the proximal segment of the galea bearing four setae on its mesal margin; labium with four fine setae at the ventro-distal end not in a transverse row, the two mesal setae caudad of the lateral ones, proximal segment of the labial palpus with six or seven setae, and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending cephalad of the mesal portion, lateral margins slightly carinate, primary setae large

and prominent, secondary setae small and not numerous (Fig. 80).

Abdomen: chitinized areas distinct; secondary setae short, fine, not numerous, few occurring between the chitinized areas (Fig. 116); median hooks with a single prominent setae; mesal hooks about one-half the length of the median hooks, with two fine, inconspicuous setae; three prominent setae cephalad of the mesal hooks and mesad of the distal half of the median hooks usually forming a longitudinal row.

Measurements: length of larva, 25 to 30 mm., width at the third abdominal segment, 3.0 to 4.0 mm.; diameter of ocellus 2, .40 to .43 mm.; distance between ocelli 1 and 2, .37 to .40 mm.; length of fronto-clypeo-labral area, 2.3 to 2.5 mm., width, 2.0 to 2.2 mm.; length of pronotum, 2.4 to 2.6 mm., width, 3.5 to 3.8 mm.

The larvae were collected from a variety of situations and are not as restricted in their habitat as most of the larvae of the Cicindelidae. Dr. V. E. Shelford has dug the larvae at Galveston and Houston, Texas and at Columbus, Georgia. Those dug at Huston, Texas were taken from bare, artificially exposed soil of a fine moldy nature, not sticky. At Galveston, Texas the larvae were dug along the beach from moist sand covered with a scattered growth of vegetation. Those collected at Columbus, Georgia were dug from moist, clayey soil. Mr. A. H. Manee collected the larvae at Southern Pines, North Carolina from hard stony and gravelly soil, clayey soil, and moist, loose, black soil. The openings to the burrows are large, the burrows straight or slightly inclined from the vertical, and from eight to twelve inches deep.

T. virginica Linn.

Color: head and pronotum very dark bronze with a green reflection, lateral and caudal margins of pronotum pearly white; setae brown, some of those

on the head and pronotum occasionally white.

Head; setae on the dorsal aspect long, slightly flattened, and prominent, diameter of ocellus 2 slightly less than the distance between ocelli 1 and 2; fronto-clypeo-labral area longer than wide; transverse ridge on the caudal part of front bearing three setae; antenna with the first segment slightly longer than the second, the third one-half and the fourth slightly less than one-half the length of the second, setae long and stout, the first segment with eleven to thirteen setae and the second with ten to twelve; maxilla with the proximal segment of the galea bearing four setae on its mesal margin; labium with four fine setae at its ventro-distal end not in a transverse row, the two mesal setae caudad of the lateral ones, proximal segment of the labial palpus with five to seven setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending cephalad of the mesal portion, lateral margins slightly carinate, primary setae large and prominent, secondary setae small and not numerous (Fig. 79).

Abdomen: chitinized areas distinct; secondary setae numerous, part of them long and slender, the others short and fine and occurring between the chitinized areas (Fig. 117); median hooks with a single prominent seta; mesal hooks about one-half the length of the median hooks and with two fine, inconspicuous setae; two of the large setae cephalad of the mesal hooks and mesad of the distal half of the median hooks usually forming a transverse or almost transverse row.

Measurements: length of larva, 28 to 30 mm., width at the third abdominal, 4.0 to 5.0 mm.; diameter of ocellus 2, .40 to .43 mm.; distance between ocelli 1 and 2, .43 to .50 mm.; length of fronto-clypeo-labral area, 2.75 to 2.85 mm., width, 2.45 to 2.55 mm.; length of pronotum, 2.9 to 3.2 mm., width 4.0 to 4.5 mm.



This species is similar to T. carolina but can be separated from it by its larger size, the absence of a distinct purple color to the pronotum, the presence of a large number of secondary setae on the pronotum, and the different arrangement of the setae cephalad of the mesal hooks and mesad of the distal half of the median hooks.

The larvae were collected at Southern Pines, North Carolina by Mr. A. H. Manee in sandy and gravely soil, clayey soil, and in moist loose soil. They occur in the same situations as T. carolina and the larvae of both species have been collected from the same place. The openings to the burrows are about three-eighths of an inch in diameter, the burrows are straight or slightly inclined from the vertical and from eight to twelve inches deep.

Genus *Omus*. Esch.

Head with the ridge on the caudal part of front transverse and continuous with the ridge on the caudal part of vertex; antecoxal piece of the mandible distinct; cephalic margin of the labrum crenulate; ocellus 2 about one-half the size of ocellus 1, ocelli 3 and 4 distinct, ocellus 5 small, conical, and distinct, ocellus 6 about one-half the size of ocellus 5, small, and indistinct; antenna not separated from the mandibles by a heavily chitinized area, first three segments subequal in length, the fourth about one-half the length of the second; maxilla with the cardo triangular and bearing two setae, lacinia present, first segment of the maxillary palpus slightly shorter than the second and the second slightly shorter than the third; labium not chitinized on the ventral aspect mesad and distad of the labial palpi except for a small triangular projection which extends cephalad between the palpigers, a distinct chitinized sclerite at the proximal end of the labial palpi, the first segment of the labial palpus longer than the second and produced on its ventro-distal end into a spine-like projection with a single stout seta on each side of the spine, proximal segment with two setae and the distal segment with one; fifth abdominal segment with three pairs of hooks on the dorsal aspect, the lateral hooks present; lateral hooks short and bearing from six to eight setae; median hooks long, the proximal half cylindrical and the distal half thorn-like and slightly curved ventrad, and with two setae at about the middle; mesal hooks about one-half the length of the median hooks, the proximal two-thirds cone-shaped and with two setae at its distal part, the distal one-third thorn-shaped and projecting cephalad.

The species of this genus occur only on the Pacific coast from British Columbia to the southern part of California. Henshaw, in his check list of

Coleoptera, 1895, lists eleven species in the genus *Omus*. Horn (1908) lists three species and eighteen subspecies. Casey in his memoirs on the Coleoptera, 1914, divides the genus into three subgenera. In the subgenus *Omus* he describes forty-five species and subspecies.

Table for Determining the Species of the Genus *Omus*.

- A. Cephalic margin of the labrum with the crenulate emarginations deep; pronotum distinctly lighter colored than the head; tergal sclerites of the abdomen with two large, adjacent setae on the lateral margin. californicus.
- AA. Cephalic margin of the labrum with the crenulate emargination shallow; pronotum but little, if any, lighter colored than the head; tergal sclerites of the abdomen usually with three large, adjacent setae on the lateral margin.
- B. Cephalic margin of the labium with the median crenulate lobe distinctly wider than those on each side; pronotum with more than sixty setae. ambiguus.
- BB. Cephalic margin of the labrum with the median crenulate lobe not distinctly wider than those on each side; pronotum never with more than fifty setae..... sequoiarum.

Omus californicus Esch.

Color: head dark bronze or black and uniformly colored; pronotum light chestnut brown; setae on head and pronotum the same color as the head, the other setae light brown.

Head: setae on dorsal aspect long, slender, and prominent; diameter of ocellus 2 slightly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; transverse ridge on the caudal part of front bearing five setae, the middle seta much larger than those on each side; cephalic margin of the labrum with the crenulate emarginations deep, the median lobe not distinctly wider than those on each side (Fig. 46); antenna with the first three segments subequal in length, the fourth one-half the length of the second, the first segment bearing four or five setae and the second five or six; maxilla with the proximal segment of the galea bearing three setae on its mesal margin; labium with four fine setae arranged in a transverse row on its ventro-distal end, proximal segment of the labial palpus with a single spine-like projection on the ventro-distal margin and with a single seta on each side of this spine, the proximal segment with two setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending as far cephalad as the mesal portion, lateral margins slightly carinate, setae not more than forty in number (Fig. 84).

Abdomen: chitinized areas distinct; secondary setae short and not numerous, and with two large, adjacent setae on the lateral margin of the tergal sclerites (Fig. 119); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; mesal hooks five-eighths the length of the median hooks and with two setae; median hooks with two setae; lateral hooks with five to seven setae.

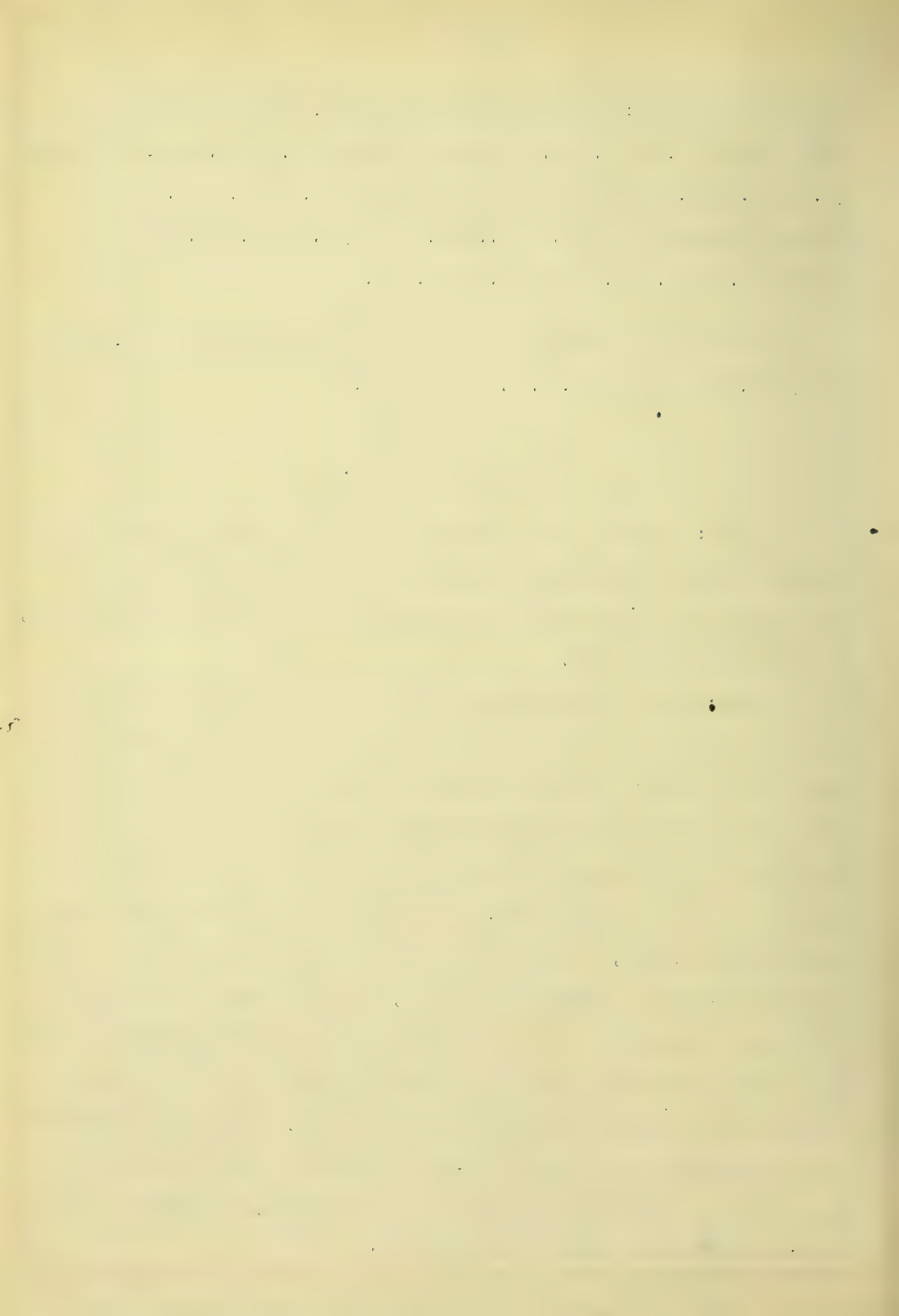
Measurements: length of larva, 26 to 28 mm., width at the third abdominal segment, 3.2 to 3.4 mm.; diameter of ocellus 1, .51 to .54 mm.; of ocellus 2, .36 to .38 mm.; distance between ocelli 1 and 2, .29 to .31 mm.; length of fronto-clypeo-labral area, 2.4 to 2.6 mm., width, 2.7 to 2.8 mm.; length of pronotum, 2.9 to 3.2 mm., width, 5.0 to 5.2 mm.

The larvae were collected at Alhambra Valley, Contra Costa Co., California, Dec. 29, 1905, by Dr. F. E. Blaisdell Sr.

Omsis ambiguus Schaupp.

Color: head dark brown or bronze, the cephalic portion between the mandibles lighter; pronotum dark chestnut brown, slightly lighter than the caudal part of the head; setae on dorsal aspect of head and pronotum dark brown, the other setae light brown.

Head; setae on dorsal aspect long, stout, and prominent; diameter of ocellus 2 equal to the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; transverse ridge on the caudal part of front bearing five setae, the median seta much larger than those on each side; cephalic margin of the labrum with the crenulate emarginations shallow, the median lobe distinctly wider than those on each side (Fig. 47); antenna with the first segment slightly longer than the second, the third as long as the second and the fourth slightly more than one-half the length of the second, the first segment bearing four or five setae and the second five or six; maxilla with the proximal segment of the galea bearing three setae on its mesal margin; labium with four fine setae arranged in a transverse row on the ventro-distal end, the proximal segment of the labial palpus with a single spine-like projection on the ventro-distal margin and with a single seta on each side of this spine, the proximal segment with two setae and the distal segment with one.



Thorax: pronotum with the cephalo-lateral angles extending slightly cephalad of the mesal portion, lateral margins slightly carinate, setae more than sixty in number (Fig. 86).

Abdomen: chitinized areas distinct; secondary setae fairly numerous and prominent, lateral margin of tergal sclerites usually bearing three large, adjacent setae (Fig. 121); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; mesal hooks five-eighths the length of the median hooks, and with two setae; median hooks with two setae; lateral hooks with six to eight setae.

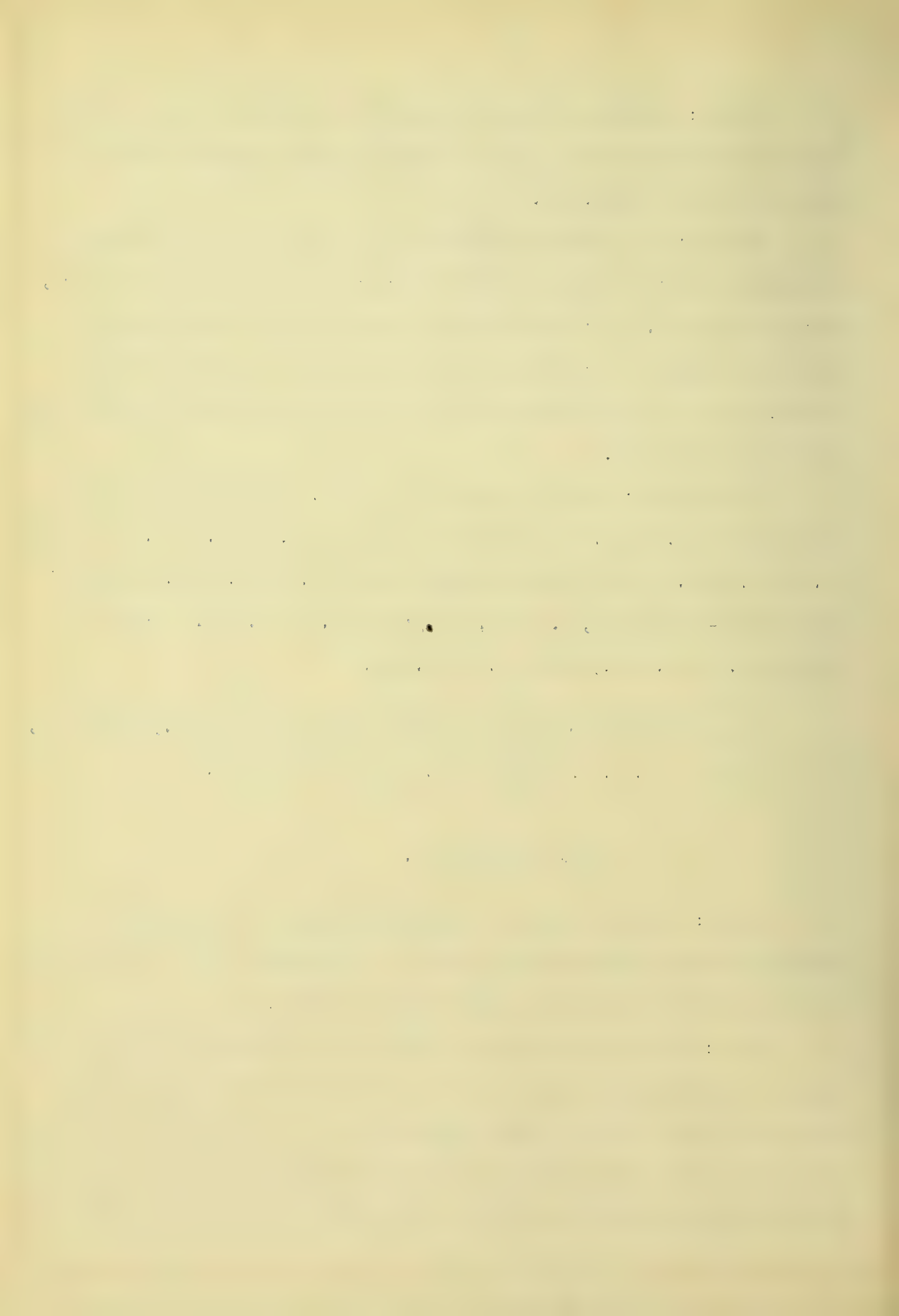
Measurements: length of larva, 26 to 28 mm., width at the third abdominal segment, 3.2 to 3.4 mm; diameter of ocellus 1, .50 to .52 mm., of ocellus 2, .30 to .32 mm.; distance between ocelli 1 and 2, .30 to .22 mm.; length of fronto-clypeo-labral area, 2.6 to 2.8 mm., width, 2.3 to 2.5 mm.; length of pronotum, 2.7 to 2.9 mm., width, 4.7 to 5.0 mm.

The larvae were collected at Shasta Retreat, Siskiyou Co., California, July 31, 1905, by Dr. F. F. Blaisdell Sr. and Beverly Letcher.

Onus sequoiarum Cr.

Color: head dark bronze or black and uniformly colored; pronotum dark chestnut-brown with lighter areas; setae on dorsal aspect of head and pronotum the same color as the head, the other setae light brown.

Head: setae on dorsal aspect, long, stout, and prominent; diameter of ocellus 2 slightly greater than the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; transverse ridge on the caudal part of front bearing five setae, the median seta much larger than those on each side; cephalic margin of the labrum with the crenulate emarginations shallow, the median lobe



not distinctly wider than those on each side (Fig. 45); antenna with the first segment as long as the second, the third slightly less and the fourth slightly more than one-half the length of the second, the first segment with four or five setae and the second with five or six; maxilla with the proximal segment of the galea bearing three setae on its mesal margin; labium with four fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with a single spine-like projection on its ventro-distal margin and with a single seta on each side of this spine, proximal segment with two setae and the distal segment with one.

Thorax: pronotum with the cephalo-lateral angles extending almost as far cephalad as the mesal portion, lateral margins slightly carinate, setae not more than fifty in number (Fig. 85).

Abdomen: chitinized areas distinct; secondary setae fairly prominent and numerous, tergal sclerites with three large, adjacent setae on the lateral margins (Fig. 120); ninth abdominal sternum with the caudal margin bearing two groups of four setae each; mesal hooks five-eighths the length of the median hooks and with two setae; median hooks with two setae; lateral hooks with five to seven setae.

Measurements: length of larva, 24 to 26 mm., width at the third abdominal segment, 3.2 to 3.4 mm.; diameter of ocellus 1, .42 to .44 mm., of ocellus 2, .29 to .31 mm.; distance between ocelli 1 and 2, .26 to .28 mm.; length of fronto-clypeo-labral area, 2.1 to 2.3 mm., width, 2.4 to 2.6; length of pronotum, 2.5 to 2.8 mm., width, 4.0 to 4.3 mm.

The larvae were collected at Licking Fork, Mokelumne River, California, at an elevation of 2900 to 3100 feet, by Dr. F. E. Blaisdell Sr. and Beverly Letcher.

A single larva of Omus Edwardsii Cr., the identity of which was questioned, was secured from Dr. F. E. Blaisdell Sr. This larva was collected in the same locality as Omus sequoiarum Cr. and seems to be identical with it. The pronotum (Fig. 87) shows a few more setae than that of O. sequoiarum (Fig. 85) but larvae of the latter species were observed which had a similar setal plan.

Genus *Amblychila* Say.

Head with the ridge on the caudal part of front transverse and continuous with the ridge on the caudal part of the vertex; antecoxal piece of the mandible fused with the clypeus; cephalic margin of the labrum slightly crenulate; ocellus 2 much smaller than ocellus 1, ocelli 3 and 4 adjacent, rudimentary, ocelli 5 and 6 wanting; antennae separated from the mandibles by a heavily chitinized area, second segment longer than all the other segments combined; maxilla with the cardo triangular and bearing eight or nine setae, lacinia absent, maxillary palpus three-segmented, the first and second segments subequal in length and longer than the third, the second segment with a spine-like projection on the latero-distal end; labium heavily chitinized on the ventral aspect mesad and distad of the proximal end of the labial palpi, ventral aspect of ligula concave forming a prominent carina on the lateral and caudal margins, the two setae on this depressed area close together, no separate chitinized sclerite at the proximal end of the labial palpus, labial palpus with the proximal segment shorter than the distal segment and without spine-like projections on its ventro-distal margin, the proximal segment with five or six setae and the distal segment with twelve to fifteen; fifth abdominal segment with two pair of hooks on the dorsal aspect, the lateral hooks wanting; median hooks bluntly thorn-shaped, broad at the base and with eighteen to twenty short, stout setae; mesal hooks similar in shape to the median hooks, about one-half their length, and with twelve to fifteen short, stout setae.

The genus *Amblychila* includes two species both of which are limited in their distribution to the south and south-central part of the United States between the Mississippi river and the Rocky Mountains. The larvae are larger, fleshier and more grub-like than ^{the larvae of} any of the other genera occurring in the United States.

A. cylindriformis Say.

Color: head and pronotum dark chestnut brown; setae brown.

Head: setae on dorsal aspect of head long, slender and prominent; ocellus 2 about one-half the diameter of ocellus 1, diameter of ocellus 2 subequal to the distance between ocelli 1 and 2; fronto-clypeo-labral area wider than long; transverse ridge on the caudal part of front with six to eight setae; crenulate/emarginations on the cephalic edge of the labrum subequal; antenna with the second segment twice the length of the first, three times the third and ten times the fourth, setae long and slender, the first segment with six to twelve setae and the second with fifteen to twenty (Fig. 26); maxilla with the proximal segment of the galea bearing five or six setae on its mesal margin; labium with six fine setae arranged in a transverse row at its ventro-distal end, proximal segment of labial palpus with five or six setae and the distal segment with twelve to fifteen (Fig. 20).

Thorax: pronotum with the cephalo-lateral angles extending cephalad of the mesal portion, lateral margins slightly carinate, setae numerous, short and conspicuous (Fig. 81).

Abdomen: chitinized areas indistinct; setae short to long, numerous and occurring between as well as upon the chitinized areas (Fig. 123); median hooks with eighteen to twenty setae; mesal hooks with twelve to fifteen setae (Fig. 148).

Measurements: length of larva, 45 to 50 mm., width at the third abdominal segment, 7 to 8 mm.; diameter of ocellus 1, .40 to .45 mm., of ocellus 2, .20 to .27 mm.; distance between ocelli 1 and 2, .20 to .24 mm.; length of fronto-clypeo-labral area, 3.3 to 3.4 mm., width, 3.6 to 3.8 mm.; length of pronotum, 4.2 to 4.8 mm., width, 6.0 to 6.4 mm.

The habits of the larvae, as given by Williams and Hungerford (1913) are as follows; "They usually occur in colonies of from 2 to 11, the individual burrows being close together, often not more than 1 1/2 inches apart. Usually a colony can be circumscribed by a ten inch radius.----- The larger ones (burrows) were a little less than 1/2 inch in diameter and about 30 inches deep. The rim was slightly elevated above the surface of surrounding level, and the entrance perfectly circular. The burrows have quite a characteristic way of going straight down for about 18 inches and then, turning to an angle of about 45° downward, proceed about 18 inches further. This lower portion has a tendency to be feebly spiral. The burrow for the last 10 or 8 inches is quite noticeably enlarged, especially laterally and the extreme end is invariably packed with the remains of former repasts. The holes are generally located on the brow of a cliff, but one colony was found in muddy silt at the foot of a cliff-like bank, well below the recent flood level of the stream. Still others occurred on the high plain some half a mile back from the bluffs. Two or three were found that had their openings in the face of the cliff. These sloped back and did not conform to the normal burrows. It was often noticed that these larval burrows were situated near some larger hole, as that of the field mouse or badger".

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Plate I

Larvae, Lateral View.

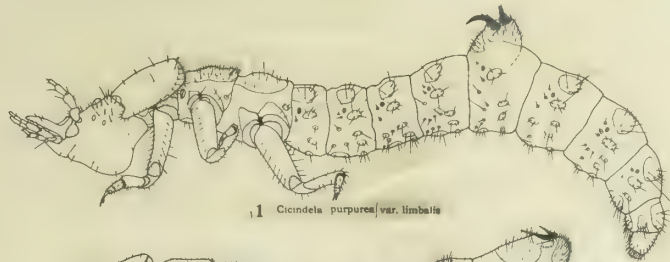
Fig. 1. Cicindela purpurea var. limbalis.

Fig. 2. Tetracha carolina.

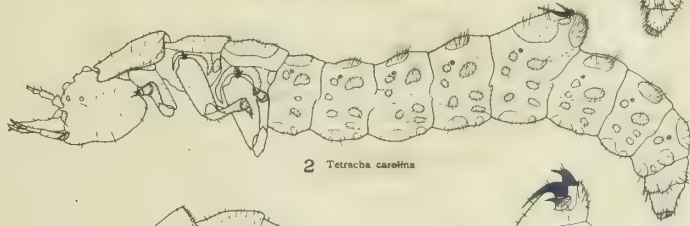
Fig. 3. Omus californicus.

Fig. 4. Amblychila cylindriformis.

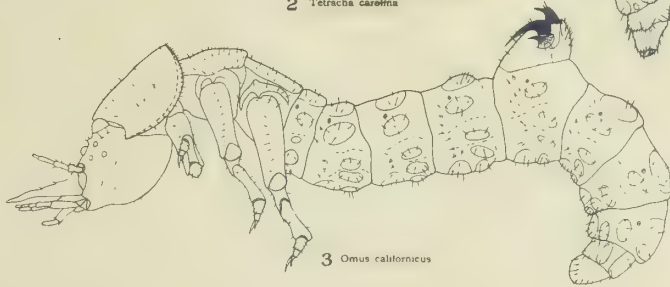
Plate I



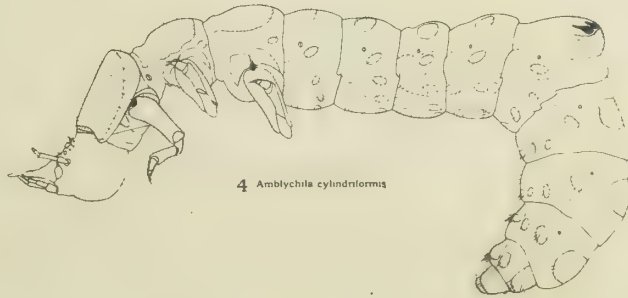
1 *Cicindela purpurea* var. *limbata*



2 *Tetracha carolina*



3 *Omus californicus*



4 *Amblychila cylindricornis*

Plate II

Heads.

- Fig. 5. Cicindela purpurea var. limbalis, lateral aspect, mouth-parts removed.
- Fig. 6. Cicindela purpurea var. limbalis, ental aspect, tentorium.
- Fig. 7. Cicindela purpurea var. limbalis, ental aspect.
- Fig. 8. Cicindela purpurea var. limbalis, dorsal aspect.
- Fig. 9. Tetracha carolina, dorsal aspect.
- Fig. 10. Amblychila cylindriformis, ventral aspect, mouth-parts removed.
- Fig. 11. Amblychila cylindriformis, dorsal aspect.
- Fig. 12. Omus californicus, dorsal aspect.
- Fig. 13. Omus californicus, ventral aspect.
- Fig. 14. Cicindela purpurea var. limbalis, ventral aspect.
- Fig. 15. Tetracha carolina, ventral aspect.
- Fig. 16. Amblychila cylindriformis, ventral aspect.

Plate II

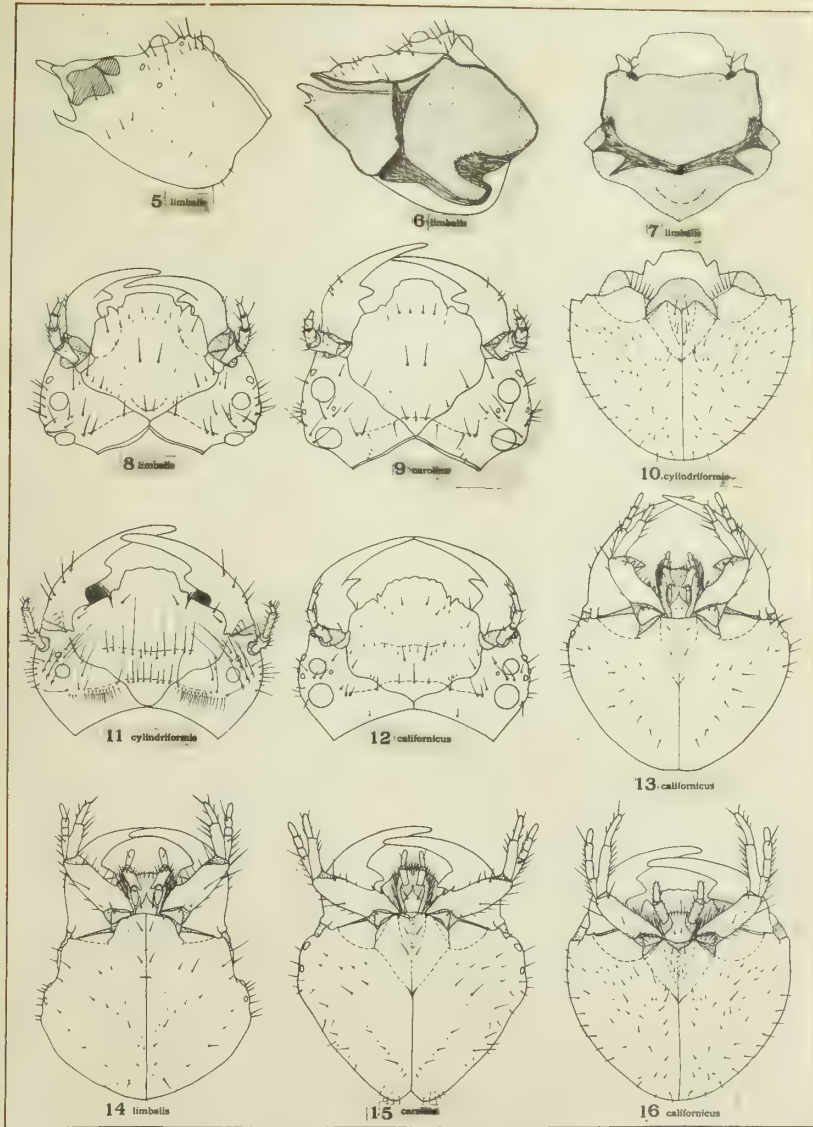


Plate III

Labia, Antennae, Maxillae, and Legs.

- Fig. 17. Cicindela purpurea var. limbalis, labium, ventral aspect.
- Fig. 18. Tetracha carolina, labium, ventral aspect.
- Fig. 19. Omus californicus, labium, ventral aspect.
- Fig. 20. Amblychila cylindriformis, labium, ventral aspect.
- Fig. 21. Cicindela purpurea var. limbalis, labium, dorsal aspect.
- Fig. 22. Cicindela purpurea var. limbalis, antenna, dorsal aspect.
- Fig. 23. Cicindela purpurea var. limbalis, antenna, ventral aspect.
- Fig. 24. Tetracha carolina, antenna, dorsal aspect.
- Fig. 25. Omus californicus, antenna, dorsal aspect.
- Fig. 26. Amblychila cylindriformis, antenna, dorsal aspect.
- Fig. 27. Cicindela purpurea var. limbalis, maxilla, dorsal aspect.
- Fig. 28. Cicindela purpurea var. limbalis, maxilla, ventral aspect.
- Fig. 29. Tetracha carolina, maxilla, ventral aspect.
- Fig. 30. Omus californicus, maxilla, ventral aspect.
- Fig. 31. Amblychila cylindriformis, maxilla, ventral aspect.
- Fig. 32. Cicindela purpurea var. limbalis, mandible, dorso-caudal aspect.
- Fig. 33. Cicindela purpurea var. limbalis, metathoracic leg, cephalic aspect.
- Fig. 34. Tetracha carolina, metathoracic leg, cephalic aspect.
- Fig. 35. Omus californicus, metathoracic leg, cephalic aspect.
- Fig. 36. Amblychila cylindriformis, metathoracic leg, cephalic aspect.

Plate III

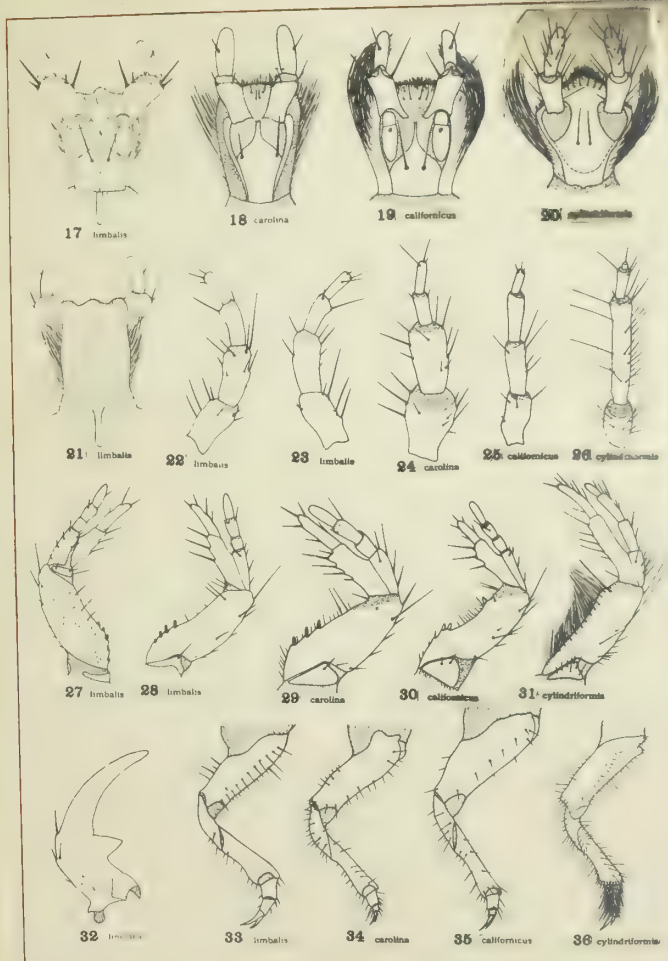


Plate IV

Thorax and Abdomen.

- Fig. 37. Cicindela purpurea var. limbalis, thorax, dorsal aspect.
- Fig. 38. Cicindela purpurea var. limbalis, thorax, ventral aspect.
- Fig. 39. Cicindela purpurea var. limbalis, abdomen, dorsal aspect,
segments seven to ten.
- Fig. 40. Cicindela purpurea var. limbalis, fifth abdominal segment.
- Fig. 41. Amblychila cylindriformis, fifth abdominal segment.
- Fig. 42. Cicindela purpurea var. limbalis, abdomen, ventral aspect,
segments seven to ten.
- Fig. 43. Tetracha carolina, fifth abdominal segment.
- Fig. 44. Omus californicus, fifth abdominal segment.
- Fig. 45. Omus sequoiarum, labrum, cephalic margin.
- Fig. 46. Omus californicus, labrum, cephalic margin.
- Fig. 47. Omus ambiguus, labrum, cephalic margin.
- Fig. 48. Omus edwardsii, labrum, cephalic margin.

Plate IV

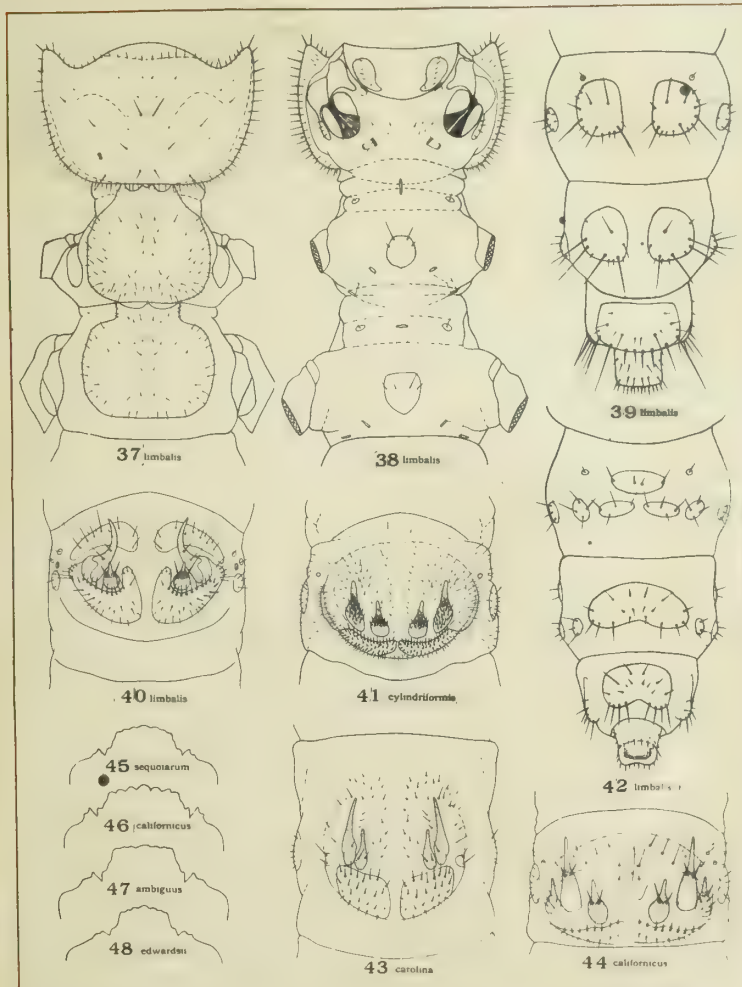


Plate V

Pronota, Setal Plans.

- Fig. 49. Cicindela formosa var. generosa, first instar.
Fig. 50. Cicindela formosa var. generosa, second instar.
Fig. 51. Cicindela formosa var. generosa, third instar.
Fig. 52. Cicindela purpurea var. limbalis, first instar.
Fig. 53. Cicindela purpurea var. limbalis, second instar.
Fig. 54. Cicindela purpurea var. limbalis, third instar.
Fig. 55. Cicindela hirticollis, first instar.
Fig. 56. Cicindela hirticollis, second instar.
Fig. 57. Cicindela hirticollis, third instar.
Fig. 58. Cicindela 6-guttata, third instar.
Fig. 59. Cicindela species A, third instar.
Fig. 60. Cicindela purpurea var. graminea, third instar.
Fig. 61. Cicindela latesignata, third instar.
Fig. 62. Cicindela species B, third instar.
Fig. 63. Cicindela repanda, third instar.

Plate V

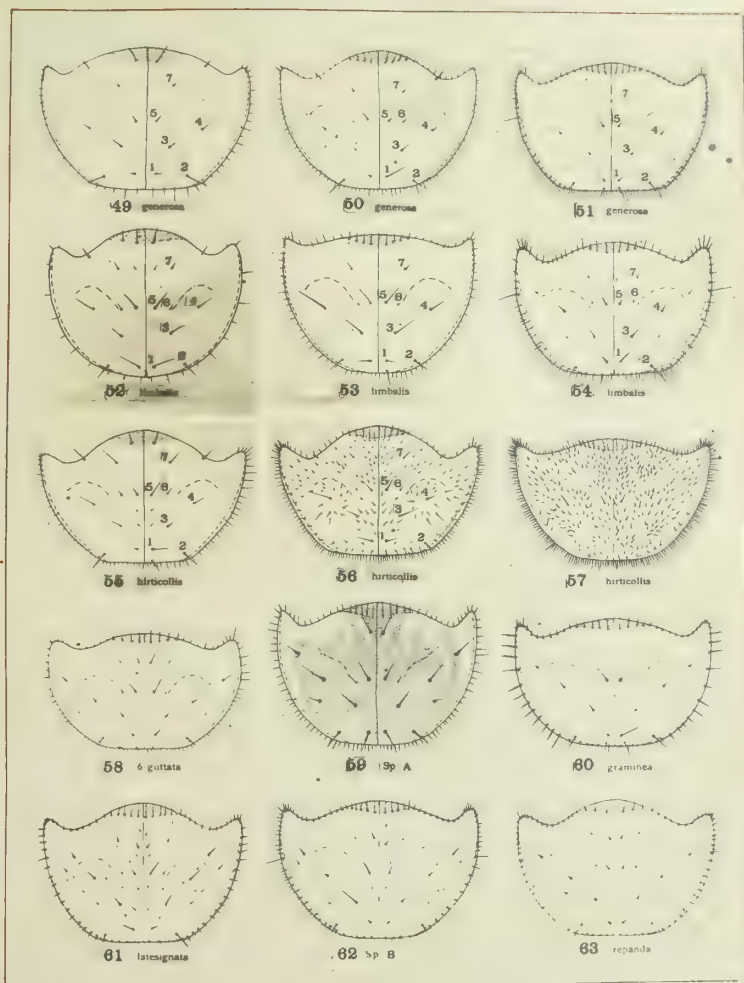


Plate VI

Pronota, Setal Plans.

- Fig. 64. Cicindela lepida, third instar.
- Fig. 65. Cicindela gratiosa, third instar.
- Fig. 66. Cicindela tranquebarica, third instar.
- Fig. 67. Cicindela oregona, third instar.
- Fig. 68. Cicindela 12-guttata, third instar.
- Fig. 69. Cicindela punctulata, third instar.
- Fig. 70. Cicindela flavopunctata var. rectilatera, third instar.
- Fig. 71. Cicindela unipunctata, third instar.
- Fig. 72. Cicindela abdominalis, third instar.
- Fig. 73. Cicindela marginata, third instar.
- Fig. 74. Cicindela formosa, third instar.
- Fig. 75. Cicindela scutellaris var. lecontei, third instar.
- Fig. 76. Cicindela pulchra, third instar.
- Fig. 77. Cicindela limbata, third instar.
- Fig. 78. Cicindela dorsalis var. sauleyi, third instar.

Plate VI.

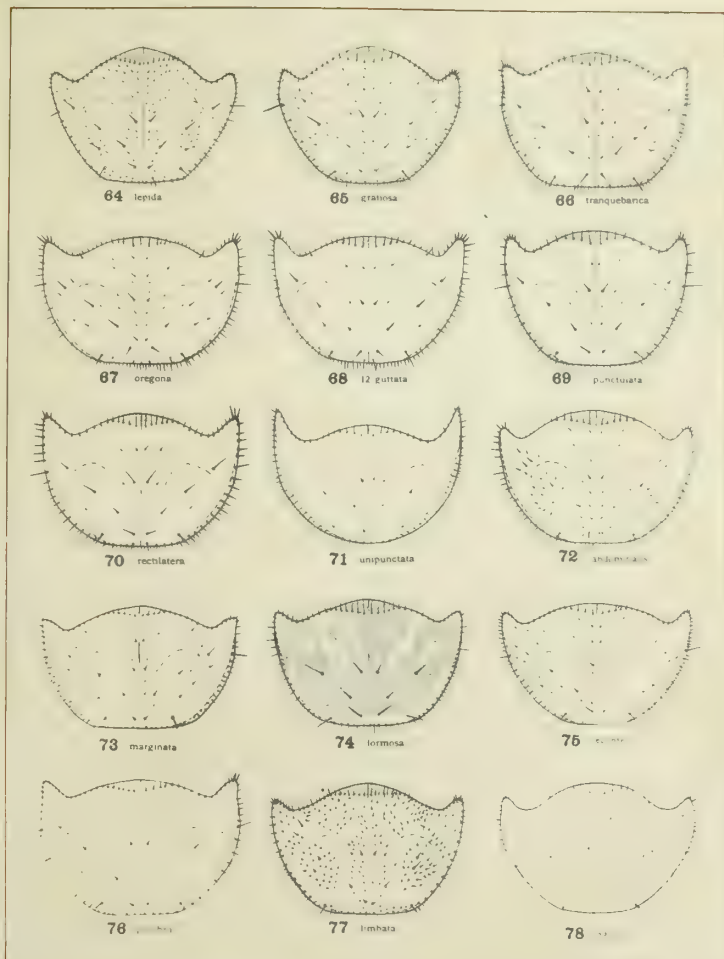


Plate VII

Pronota, Setal Plans.

- Fig. 79. Tetracha virginica, third instar.
Fig. 80. Tetracha carolina, third instar.
Fig. 81. Amblychila cylindriformis, third instar.
Fig. 82. Omus californicus, first instar.
Fig. 83. Omus californicus, second instar.
Fig. 84. Omus californicus, third instar.
Fig. 85. Omus sequoiarum, third instar.
Fig. 86. Omus ambiguus, third instar.
Fig. 87. Omus edwardsii, third instar.

Third Abdominal Segment, Setal Plans.

- Fig. 88. Cicindela formosa var. generosa, first instar.
Fig. 89. Cicindela formosa var. generosa, second instar.
Fig. 90. Cicindela formosa var. generosa, third instar.
Fig. 91. Cicindela hirticollis, first instar.
Fig. 92. Cicindela hirticollis, second instar.
Fig. 93. Cicindela hirticollis, third instar.
Fig. 94. Cicindela 6-guttata, third instar.
Fig. 95. Cicindela species A, third instar.
Fig. 96. Cicindela purpurea var. limbalis, third instar.
Fig. 97. Cicindela purpurea var. graminea, third instar.
Fig. 98. Cicindela latesignata, third instar.
Fig. 99. Cicindela species B, third instar.

Plate VII

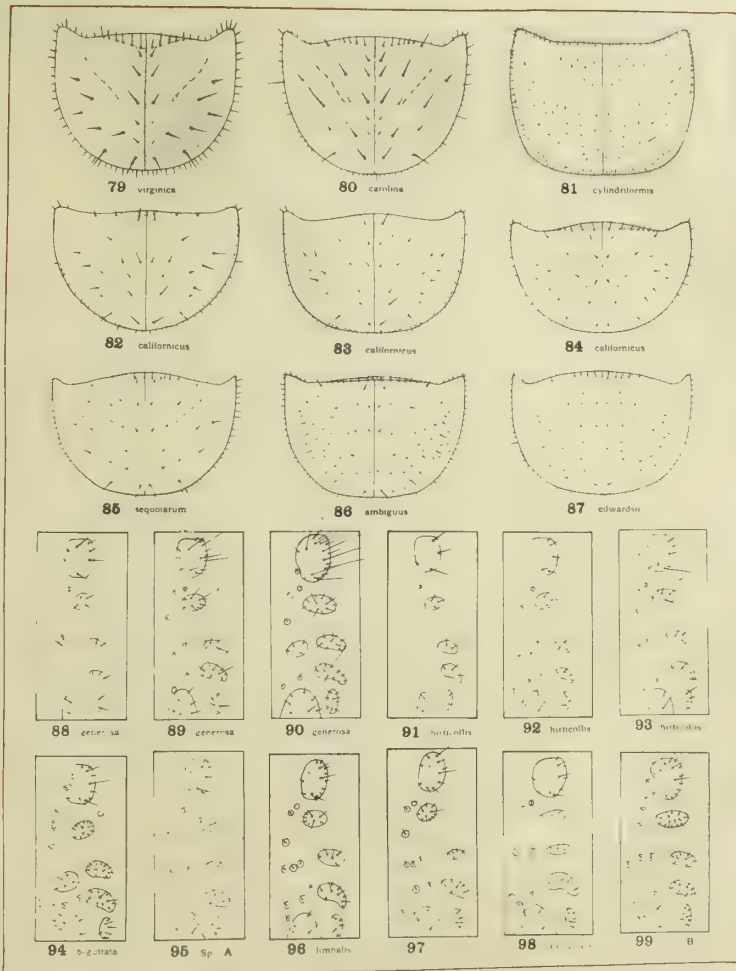
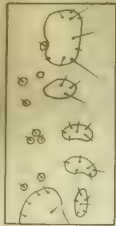


Plate VIII

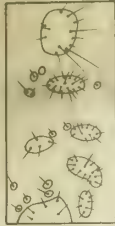
Third Abdominal Segments, Setal Plans.

- Fig. 100. Cicindela repanda, third instar.
- Fig. 101. Cicindela lepida, third instar.
- Fig. 102. Cicindela gratiosa, third instar.
- Fig. 103. Cicindela tranquebarica, third instar.
- Fig. 104. Cicindela oregona, third instar.
- Fig. 105. Cicindela 12-guttata, third instar.
- Fig. 106. Cicindela punctulata, third instar.
- Fig. 107. Cicindela flavopunctata var. rectilatera, third instar.
- Fig. 108. Cicindela unipunctata, third instar.
- Fig. 109. Cicindela abdominalis, third instar.
- Fig. 110. Cicindela marginata, third instar.
- Fig. 111. Cicindela formosa, third instar.
- Fig. 112. Cicindela scutellaris var. lecontei, third instar.
- Fig. 113. Cicindela pulchra, third instar.
- Fig. 114. Cicindela limbata, third instar.
- Fig. 115. Cicindela dorsalis var. sauleyi, third instar.
- Fig. 116. Tetracha carolina, third instar.
- Fig. 117. Tetracha virginica, third instar.
- Fig. 118. Omus californicus, first instar.
- Fig. 119. Omus californicus, third instar.
- Fig. 120. Omus sequoiarum, third instar.
- Fig. 121. Omus ambiguus, third instar.
- Fig. 122. Omus edwardsii, third instar.
- Fig. 123. Amblychila cylindriformis, third instar.

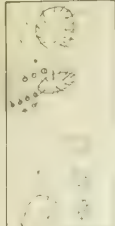
Plate VIII



100 repanda



101 lepida



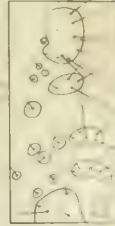
102



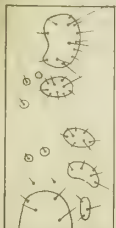
103 tranquebarica



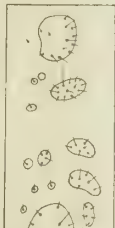
104 oregona



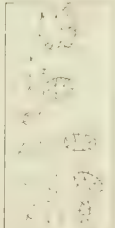
105 latitans



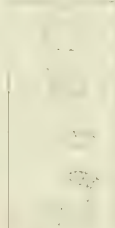
106 punctulata



107 rectilata



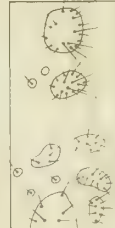
108



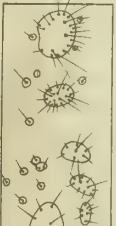
109 abdominalis



110 marginata



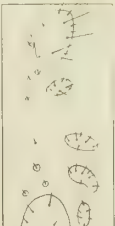
111 formosa



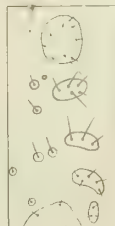
112 lecontei



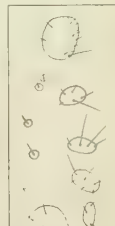
113 pulchra



114 limbata



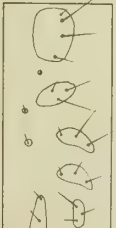
115 sauleyi



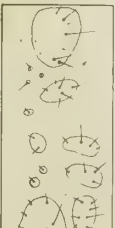
116 carolina



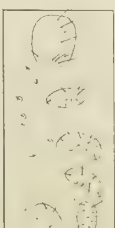
117 nigra



118 californicus



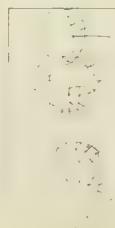
119 californicus



120 sequoiarum



121 ambiguus



122 edwardsii



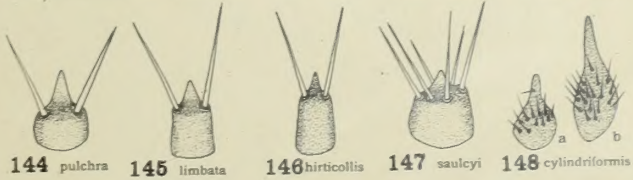
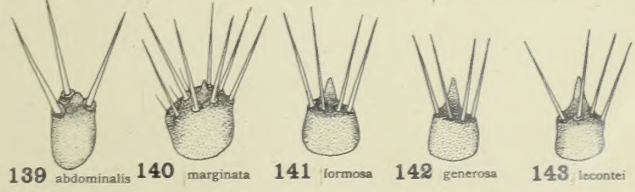
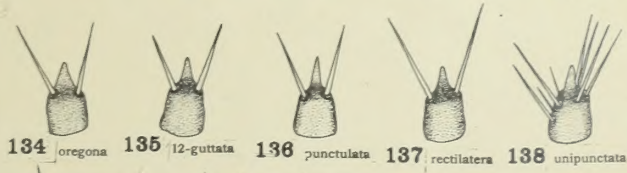
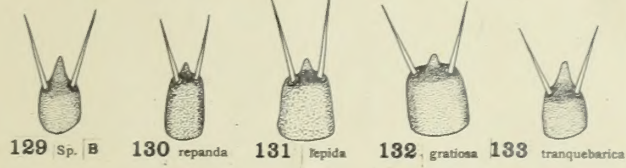
123 cylindriciformis

Plate IX

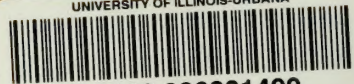
Mesal Hooks.

- Fig. 124. Cicindela 6-guttata.
- Fig. 125. Cicindela species A.
- Fig. 126. Cicindela purpurea var. limbalis.
- Fig. 127. Cicindela purpurea var. graminea.
- Fig. 128. Cicindela latesignata.
- Fig. 129. Cicindela species B.
- Fig. 130. Cicindela repanda.
- Fig. 131. Cicindela lepida.
- Fig. 132. Cicindela gratiosa.
- Fig. 133. Cicindela tranquebarica.
- Fig. 134. Cicindela oregona.
- Fig. 135. Cicindela 12-guttata.
- Fig. 136. Cicindela punctulata.
- Fig. 137. Cicindela flavopunctata var. rectilatera.
- Fig. 138. Cicindela unipunctata.
- Fig. 139. Cicindela abdominalis.
- Fig. 140. Cicindela marginata.
- Fig. 141. Cicindela formosa.
- Fig. 142. Cicindela formosa var. generosa.
- Fig. 143. Cicindela scutellaris var. lecontei.
- Fig. 144. Cicindela pulchra.
- Fig. 145. Cicindela limbata.
- Fig. 146. Cicindela hirticollis.
- Fig. 147. Cicindela dorsalis var. sauleyi.
- Fig. 148. Amblychila cylindriformis; a, mesal hook; b, median hook.

Plate IX



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