

THE CRYPTOCEPHALINAE OF OKLAHOMA
(CHRYSOMELIDAE: COLEOPTERA)

By

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Abstract: This thesis reports on the physical and chemical properties of polymerization of vinyl monomers. The study was conducted over a period of six months in the laboratory of Dr. J. H. Duerksen, Department of Chemistry, University of Alberta, Edmonton, Alberta, Canada. The results of the study are presented in the following chapters.

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INTRODUCTION

The leaf beetles form a conspicuous segment of the coleopterous fauna of Oklahoma. The Chrysomelidae, of which there are approximately 200 species recorded from Oklahoma, are a large family of small to medium sized beetles which are generally host specific, Arnett (1960) and although some do feed on field crops and horticultural plants, they are generally not of great economic importance, White (1968).

This work is concerned with one of the 11 subfamilies, Shaddy and Drew (1968), of Chrysomelidae found in the state, the Cryptocephalinae. This subfamily consists of over 3,000 described species and is found throughout most of the world (Arnett 1960). The larvae of the Cryptocephalinae are primarily case bearers (Arnett 1960) and feed on leaves and decayed plant material. The adults feed on leaves, flowers and fruits of live plants (White 1968).

The Cryptocephalinae can be distinguished from other Chrysomelidae by the following: mouth turned anterior; abdominal sternites two to four narrowed medially; pygidium exposed; prosternum without antennal grooves; body not contractile; and the antennae filiform to clavate (Arnett 1960).

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REVIEW OF LITERATURE

Though the Chrysomelidae are extremely numerous in Oklahoma only Shaddy and Drew (1968) have published any specific work on Oklahoma members. Hatch (1930) and Smith (1940) recorded a few new species in Oklahoma, but their work was not concentrated on Chrysomelidae. No definitive work has been done on the Cryptocephalinae of Oklahoma. For these reasons the present work was inaugurated.

The records have been obtained from the Entomology museum, Oklahoma State University; Snow Entomology Museum, University of Kansas; Entomology Museum, Texas Agricultural and Mechanical University; Entomology Museum, University of Arkansas; Stovall Museum, University of Oklahoma; and from literature, Leng (1920), Leng and Mutchler (1931), Blackwelder (1939), Blackwelder and Blackwelder (1948), Clavareau, (1913), Arnett (1960), Crotch (1873), Fall (1915), LeConte (1880), Suffrian (1852), Bowditch (1909), White (1968), Blake (1952), Douglass (1929), Sundman (1965), Dillon and Dillon (1961), Blatchley (1910), Wilcox (1954), Smith (1940) and Stoner, Bryan and Drew (1962).

Arnett's work has been of particular help in identification of the genera. Papers used in determining the species were: White (1968) the genus Cryptocephalus; Crotch (1873) the genus Griburius; LeConte

(1880) the genera Bassareus, Diachus and Triachus; and Fall (1915) the genus Pachybrachis. Synonymy used is found in the above literature, and is not given in this paper.

KEY TO THE SUBFAMILIES OF CHRYSOMELIDAE OF OKLAHOMA

(after Arnett, 1960)

1. Head not inflexed, mouth anterior 2
Head inflexed, mouth turned caudad. 10
2. Abdominal sternites two to four narrowed
 medially; pygidium exposed 3
Abdominal sternites two to four not narrowed
 medially; pygidium not exposed 5
3. Prosternum with lateral antennal grooves;
 body contractile Chlamisinae
Prosternum without lateral antennal grooves;
 body not contractile 4
4. Antennae serrate, dentate, or pectinate from
 beyond third or fourth segment Clytrinae
Antennae filiform or at most clavate Cryptocephalinae
5. Pronotum without lateral margin 6
Pronotum with lateral margin 7
6. Antennal insertions nearly approximate; first
 visible sternite as long as all others
 combined Donaciinae

- Antennal insertions separated by entire width
of front; first visible sternite no longer than
second and third together Criocerinae
7. Antennal insertions separated by entire front . . . 8
Antennal insertions nearly approximate 9
8. Third tarsal segment bilobed; procoxae round . . Eumolpinae
Third tarsal segment not distinctly bilobed,
entire; procoxae transversely oval Chrysomelinae
9. Metafemora slender, adapted for walking Galerucinae
Metafemora swollen, adapted for jumping Alticinae
10. Head exposed; pronotum and elytra without
broadly expanded margins Hispinae
Head concealed; pronotum and elytra with
broadly expanded margins Cassidinae

KEY TO THE GENERA OF THE SUBFAMILY CRYPTOCEPHALINAE
OF THE UNITED STATES (after Arnett, 1960)

1. Claws simple, or if appendiculate, prosternum
 longer than wide 2
 Claws appendiculate; prosternum wider than long Lexiphanes
2. Pronotum margined at base, not crenulate . . . 3
 Pronotum not margined at base, but crenulate . . 4
3. Prosternum flat in front, depressed behind . . . Griburius
 Prosternum feebly channeled Pachybrachis
4. Claws simple (Fig. 1). 5
 Claws appendiculate (Fig. 2) 6
5. Front edge of prosternum laterally sinuous or . . .
 toothed (Fig. 3) Bassareus
 Front edge of prosternum laterally straight . . . Cryptocephalus
6. Segments six to eleven of antennae widened . . . Diachus
 Segments seven to eleven of antennae widened . . Triachus

Griburius Haldeman

The members of the genus Griburius may be distinguished by the following: claws simple; pronotum distinctly margined at the base, not crenulate; prosternum flat in front and depressed behind; segments of the antennae not widened; size variable; color variable. One species has been recorded from Oklahoma.

Griburius scutellaris (Fabricius)

Characteristics: black with shining surface; side margins and a small spot on disk of thorax, yellow; scutellum yellow; median transverse spot and rounded apical spot of elytra, yellow; legs yellow; elytra with rows of five rather distant and feebly impressed punctures.

Length: 5.0 to 6.0 mm

County Records: Adair, Seminole

Pachybrachis Chevrolat

The genus Pachybrachis is a large genus which may be distinguished by the following: claws simple; pronotum distinctly margined at base, not crenulate; prosternum feebly channeled; antennal segments not widened; size variable; color variable. Since the genus is large and difficult, the following will help one to be able to use the key.

The ocular lines are more or less distinct in all species as an impressed line around and contiguous to the upper margin of the eye. For the purpose of the key, if the impressed line continues close to the eye margin and gradually becomes evanescent in the emargination, the species is said to have ocular lines present; however, if the groove around the upper margin of the eye diverges from the eye and continues on the front between the lobes, the species is said to be without ocular lines.

The elytra have sutural, marginal, and eight discal striae on each elytron. These striae may be regular, irregular or confused, depending upon the amount of confusion or displacement of the punctures (Fig. 4).

Structures of the legs are frequently used in the key and are in many cases important in species determination. The spur or spine on the front tibia being present or absent and the size of the front tarsal claw in relation to the claws of the other legs are both important characters.

The color and markings of a typical member of the genus are as follows: general color, some shade of yellow with brown or black spots; a group of four spots of the head forming an inverted "Y" (λ), the spots connect the vertex of the head and the antennal fovea; a group of three dark spots on the prothorax, extending from the base and forming an "M" shape; a group of six spots on the elytra arranged in two longitudinal lines; the venter is usually dark and the antennae and legs

bicolored. These markings may be reduced, expanded or combined to give a variety of shades and combinations.

KEY TO THE SPECIES OF PACHYBRACHIS

(Modified from Fall)

1. Individuals vittate, wholly black or black with a few
small pale areas 2
1. Individuals mottled, yellow or testaceous with or
without brown or black marks representing the
standard spots 3
2. Individuals wholly black or in great part black,
the pale areas generally few and small, more
definite and extensive in others. 4
- Individuals with elytra vittate (typically with
sutural and two discal vittae on each elytron,
black) 14
3. Individuals wholly or in great part yellow or
testaceous; legs never entirely black;
thoracic "M" not sharply defined (except
pallidipennis). though often faintly indicated
by diffuse brownish clouds; punctures
usually some shade of brown; elytra
without dorsal cloud or traces of standard
spots 27

- Individuals brown mottled, yellow or testaceous
with brown or black marks representing the
standard spots; markings may vary by extension
or reduction and are often irregularly confluent
or confusedly mottled 22
4. Individuals pubescent 5
Individuals not pubescent 6
5. Color entirely black; punctures of elytra larger
than those of the pronotum pubescens
Color black frequently with diffuse rufous mark-
ings; punctures of the elytra and pronotum
about the same size haematodes
6. Anterior tibia without apical spur trinotatus
Anterior tibia with apical spur 7
7. Pale areas or markings generally broader and
definite in design 8
Pale areas irregularly disposed, generally small
and inconspicuous; pronotal markings, when
present, consists of a narrow median anterior
yellow spot, two yellow basal spots and the
lateral and apical margins are yellow 9
8. Elytra black, pronotum red varying to black with
red side margins hybridus

- Elytra with a broad red irregular or undulating
 median fascia, often interrupted at the suture,
 and a red apical spot subfasciatus
9. Pronotum strongly shining either polished or
 finely alutaceous (pale markings red or red-
 dish yellow) instabilis
- Pronotum not shining, dull, alutaceous 10
10. Elytra entirely black, no yellow spots on
 upper surface carbonarius
- Elytra with pale areas or yellow spots 11
11. Punctures of elytra entirely confused vestigialis
- Punctures of elytra confused except for eighth or
 seventh and eighth striae, which may be sinuous
 but well defined, or striae evident toward sides
 and apex 12
12. Hind tibia rufo-testaceous to yellow with a darker
 median spot impurus
- Hind tibia entirely black or black with a suffused
 yellow base 13
13. Entire upper surface black with small yellow
 speckles atomarius
- Upper surface of elytra black, mottled with yellow
 especially towards sides; pronotum with anterior
 median line and sides red or reddish yellow. . . luridus

14. Punctuation of elytra in great part confused15
 Punctuation of elytra in relatively regular rows . .16
15. Each elytron with one median black or brown
 vitta and three lateral spots representing the
 lateral vitta bivittatus
- Each elytron with two dark vittae, the lateral
 vitta narrow and often interrupted toward the
 apex leaving a detached spot viduatus
16. Pronotum densely strigate punctate othonus
 Pronotum less densely punctate, not strigate . .17
17. Outer elytral vitta confined to the eighth or
 seventh and eighth interspaces18
- Outer elytral vitta not confined to seventh and
 eighth interspaces.19
18. Outer elytral vitta confined to the eighth inter-
 space pawnee
- Outer elytral vitta confined to the seventh and
 eighth interspaces vau
19. Pronotum with alutaceous sculpture20
 Pronotum polished, not alutaceous.21
20. Lateral margin of elytra yellow autolycus
 Lateral margin of elytra black litigiosus
21. Median pronotal strip narrowly V-shaped; size
 smaller (2.7 to 3.8 mm). dubiosus

- Median pronotal stripe not V-shaped, but dilated a little anteriorly, with a thin pale median line; size larger (3.7 to 4.4 mm) virgatus
22. Front femur not stouter than others; tibia without apical spur hepaticus
- Front femur always thickened; at least middle tibia with apical spur 23
23. Pronotum with a broad heavily marked black "M"; elytral striae all regular and entire. pallidipennis
- Pronotal "M" not black or sharply defined; elytral striae less perfect, often confused or absent. . 24
24. Front with ocular lines 25
- Front without ocular lines caelatus
25. Sutural margin blackish abdominalis
- Sutural margin not blackish, possibly a little darker than the elytra 26
26. Legs entirely pale yellow. arizonensis
- Legs pale with diffuse light brown shades on the femur diversus
27. Front with ocular lines 28
- Front without ocular lines 31
28. Elytral striae fairly regular 29

- Elytral striae confused in great part, usually well
 defined at apex and sides 30
29. Pygidium yellow with basal margin brown sobrinus
 Pygidium black with yellow apical spots tridens
30. Pronotal "M" usually dark peccans
 Pronotal "M" not evident, very diffuse if present . postfasciatus
31. Anterior tibia without apical spur m-nigrum
 Anterior tibia with apical spur 32
32. Size smaller (2.4 to 3.2 mm) 33
 Size larger (3.5 to 4.5 mm) 38
33. Legs solid black or black with yellow spots. . . . 34
 Legs brown to yellow with or without other
 markings 35
34. Basal antennal segment solid black vestigialis
 Basal antennal segment bicolored atomarius
35. Striae completely confused 36
 Striae confused in great part but distinct toward
 apex and sides 37
36. Pygidium black or ferruginous impurus
 Pygidium black with two oblique apical spots,
 yellow, and often confluent, and a small yellow
 spot at middle of each side of the pygidium . . . femoratus
37. Color yellow with rust colored punctures and rust
 colored markings representing the standard

- markings roboris
 Color yellow with markings varying from heavy
 black to wanting caelatus
 38. Legs black instabilis
 Legs pale 39
 39. Pygidium black with or without apical yellow
 spots subvittatus
 Pygidium red-brown and yellow, yellow pre-
 dominating turbidus

Pachybrachis abdominalis (Say)

Characteristics: Color pale yellow; elytral punctures pale brown to blackish, arranged in fairly regular striae except in the scutellar region; pygidium yellow with small black spots, which are sometimes absent; body beneath black with pale abdominal margins; legs pale, femora with median brownish spots; ocular lines distinct and well removed from the eye on the front; minutely alutaceous.

Length: 3.25 to 3.75 mm

County Records: Recorded from adjacent states

Pachybrachis arizonensis Bowditch

Characteristics: Color light yellow or pale rufo-testaceous, pale brown punctate; pronotum with faint diffuse rufous clouds; under surface and legs entirely pale; ocular lines distinct, finely impressed; minutely alutaceous.

Length: 2.8 to 4.0 mm

County Records: Recorded from adjacent states

Pachybrachis atomarius (Melsheimer)

Characteristics: Color fuscous, speckled with few to many small yellow spots; under surface black; legs black and yellow, hind tibia entirely black, or at most yellowish for a short distance at the base; punctation confused over a large part of elytra, seventh and eighth striae fairly well defined throughout; ocular lines absent; basal

antennal joint bicolored.

Length: 2.2 to 3.0 mm

County Records: Carter, Woodward

Pachybrachis autolyucus Fall

Characteristics: Color yellow with suture and two black discal vittae black, varying to black with subsutural vitta and margin yellow; pronotum with broad sharply defined "M", the lateral stripe rarely disconnected from the median one; pygidium black with large yellow apical spots; ventral surface black with last ventral apically yellow; legs yellow; front without ocular lines.

Length: 2.5 to 3.9 mm

County Records: Cleveland, Latimer, Logan, Major, McLain,
Oklahoma, Payne

Pachybrachis bivittatus (Say)

Characteristics: Color yellow, pronotal disk usually broadly suffused with rufous; elytron with a median black or brown vitta and three lateral spots one or more of which may be absent; pygidium yellow with base blackish; ventral surface brown to black, with apex and sometimes sides of abdomen pale; legs rufo-testaceous, the tarsi becoming darker; ocular lines subcontiguous to the eyes.

Length: 3.9 to 5.0 mm

County Records: Alfalfa, Beaver, Canadian, Carter, Greer,

Jackson, LeFlore, McCurtain, Payne, Pittsburg,
Roger Mills, Sequoyah, Washington

Pachybrachis caelatus LeConte

Characteristics: Color pale yellow, markings varying, almost black to entirely wanting on the elytra and with only faint brownish shades on the pronotum; pygidium yellow with black markings or black with yellow markings; body beneath black with the last ventral often pale; legs pale with faint median femoral and tibial clouds which become more pronounced in darker specimens; elytral striae for most part fairly regular and entire; front without ocular lines.

Length: 2.5 to 3.2 mm

County Records: Recorded from adjacent states

Pachybrachis carbonarius Haldeman

Characteristics: Color usually entirely black, rarely with elytral margin at apex rufous; legs black with tips of femora and tibia brownish; pronotum strongly alutaceous; front without ocular lines.

Length: 2.5 to 3.75 mm

County Records: Woodward

Pachybrachis diversus Fall

Characteristics: Color yellow, brown punctures, markings usually pale rust colored; pygidium pale with darker basal margin and

spots feebly defined; body beneath varies from uniform yellow to yellow with median portions darker, ventral surface usually some shade of brown; legs pale with diffuse brown shades on the femora.

Length: 2.5 to 3.3 mm

County Records: Noble, Payne

Pachybrachis dubiosus LeConte

Characteristics: Color yellow, prothorax with three entire black stripes, the medium stripe widely bifurcate in front but does not join the lateral stripes; outer elytral vitta beginning on seventh and eighth interspace and ending on sixth and seventh interspace; pygidium black in basal half, apex yellow; body black beneath, last ventral with pale apical margin; legs entirely rufo-testaceous; front without ocular lines.

Length: 2.7 to 3.8 mm

County Records: Payne

Pachybrachis femoratus (Olivier)

Characteristics: Color blackish and yellow, mottled, the darker color usually dominant on pronotum, and often on elytra; pygidium black with two yellow apical spots, often confluent, and a small yellow spot at the middle of each side margin; legs yellow, femur and tibia with diffuse black or brown spots at the middle; front without ocular lines.

Length: 2.6 to 3.0 mm

County Records: Recorded from adjacent states

Pachybrachis haematodes Suffrian

Characteristics: Color black variegated with diffuse rufous marks; pubescence long and conspicuous over the entire body; punctation of elytra and pronotum confused and the punctures of the two about the same size.

Length: 3.4 to 4.8 mm

County Records: Ellis, Muskogee, Payne

Pachybrachis hepaticus (Melsheimer)

Characteristics: Color gray brown or yellow brown more or less maculate with darker brown or fuscous; ventral surface brown with last segment paler at sides; legs brownish yellow, the femora often with diffuse darker rings; front without ocular lines; front femora not larger than mid and hind femora.

Length: 1.9 to 3.4 mm

County Records: Recorded from adjacent states

Pachybrachis hybridus Suffrian

Characteristics: Elytra black; pronotum red, varying to black with red side margins; ventral surface black; legs black; front without ocular lines.

Length: 3.3 to 4.2 mm

County Records: Carter, Delaware, Mayes, McCurtain,
Pawnee

Pachybrachis impurus Suffrian

Characteristics: Color dark brown to fuscous in the male, ferruginous in the female, markings broad and diffuse; pygidium and ventral surface black in the male and ferruginous in the female both with the apex lighter in color; legs rufo-testaceous to yellow with darker or blackish median femoral and tibial spots; front without ocular lines.

Length: 2.75 to 3.2 mm

County Records: Recorded from adjacent states

Pachybrachis instabilis Fall

Characteristics: Color black, variably marked with red or reddish yellow, the latter occasionally predominant in the male; the inner elytral spots black, usually confluent; the outer elytral spots when not confluent are distinct; the elytra often black with an apical red spot; the ventral surface and legs black; front without ocular lines.

Length: 3.4 to 4.5 mm

County Records: Payne

Pachybrachis litigiosus Suffrian

Characteristics: Color yellow with black pronotal "M" and elytra with the sutural edge, two discal vittae and the lateral edge black; pygidium at base black and yellow at the apex; ventral surface black, the last ventral segment yellow in part; legs rufo-testaceous with apical portions of the femora and the base of tibiae whitish yellow; front without ocular lines.

Length: 2.9 to 4.0 mm

County Records: Delaware, Ellis, Latimer, McCurtain,
Oklahoma, Payne, Seminole

Pachybrachis luridus (Fabricius)

Characteristics: Color black, elytra mottled with yellow, especially toward the sides; pronotum with anterior median line and sides red or reddish yellow; the color varies from the above and from elytra entirely yellow to the whole insect black or black with pronotum entirely red; pygidium and ventral surface black; legs black, front femora often with an oval yellow spot, hind and middle femora pale at the base and apex in lighter colored forms; front without ocular lines.

Length: 2.75 to 4.0 mm

County Records: Carter, LeFlore, McCurtain, Payne

Pachybrachis m-nigrum (Melsheimer)

Characteristics: Color yellow with the standard markings so broad and heavy or broadly confluent that the pronotum is described as black with two elongate spots, a narrow oval median spot and side margins and anterior margins all yellow; elytra black with the apex, two lateral transverse spots yellow, a small basal and the basal margin yellow, an intranumeral basal spot and a median spot on the shield yellow; ventral surface black, the last segment with a small lateral yellow spot; legs black and yellow, the femora black in the basal half, the tibiae in the distal half; front without ocular lines.

Length: 3.25 to 3.9 mm

County Records: Recorded from adjacent states

Pachybrachis othonus (Say)

Characteristics: Color black with yellow stripes; pronotum with entire margin and a narrow median anterior stripe yellow; elytra with a narrow subsutural, discal and marginal vittae, yellow; pygidium black with apical yellow spots; ventral surface black with margin of last segment yellow in part; legs yellow, the hind femora often with fuscous spot; front without ocular lines.

Length: 3.0 to 3.75 mm

County Records: LeFlore, McCurtain, Payne

Pachybrachis pallidipennis Suffrian

Characteristics: Color yellow, pronotum with a heavy complete black "M", elytra yellow with sutural edge and tip of shoulder knob black; pygidium black at base, yellow apically; ventral surface black, last segment yellow in great part; legs yellow; elytra with eight regular and complete striae; front without ocular lines.

Length: 3.5 to 4.5 mm

County Records: Recorded from adjacent states.

Pachybrachis pawnee Fall

Characteristics: Color yellow, pronotum with three black stripes not attaining the apical margin, the middle stripe furcate but not joining the lateral stripes; elytra with sutural bead and two discal

stripes, black, the outer vitta confined to the eighth interspace; pygidium yellow with a black base; ventral surface black, the last segment margined with yellow; legs yellow; front without ocular lines.

Length: 3.0 to 3.5 mm

County Records: Recorded from adjacent states

Pachybrachis peccans Suffrian

Characteristics: Color black and yellow mottled, varying to reduction of black markings until in extreme forms all traces of elytral spots have disappeared leaving only rows of blackish brown punctures; pygidium black, typically with yellow apical spots; ventral surface black, apex and sometimes side margins yellow; legs yellow with dark femoral and tibial spots; front with ocular lines.

Length: 2.4 to 3.3 mm

County Records: Recorded from adjacent states

Pachybrachis postfasciatus Fall

Characteristics: Color yellow with confused brown punctures, elytra with very diffuse standard spots, the posterior ones coalescing to form a more or less distinct fascia on the elytral declivity; pygidium brown with small yellow spots; ventral surface brown, last segment yellow with or without a lateral pale spot; femora yellow with broad brown rings, tibia brown; front with ocular lines, may be very faint.

Length: 2.5 to 2.9 mm

County Records: Recorded from adjacent states.

Pachybrachis pubescens (Olivier)

Characteristics: Color entirely black with sparse short grayish pubescence; punctation confused and the elytral punctures are larger than those of the pronotum.

Length: 3.4 to 4.8 mm

County Records: Logan

Pachybrachis roboris Fall

Characteristics: Color yellow with close set rust colored punctures; the standard spots are diffuse and rust colored, becoming dark brown or fuscous in darker forms; pygidium brown with two oval spots and a smaller lateral spot; ventral surface brown with last segment yellow in great part; front legs brown and yellow, middle and hind femora brown with extremities pale, the corresponding tibiae brown occasionally with the basal third yellow; front without ocular lines.

Length: 2.4 to 3.2 mm

County Records: Atoka, Rogers

Pachybrachis sobrinus (Haldeman)

Characteristics: Color yellow, maculate with brown or black, the standard spots of elytra usually distinct; the two posterior spots of the elytra often confluent; front with ocular lines.

Length: 2.6 to 3.25 mm

County Records: Recorded from adjacent states

Pachybrachis subfasciatus LeConte

Characteristics: Color black, sides of pronotum red or yellow, elytra with median irregular fascia and an apical spot red or yellow; pygidium, ventral surface and legs black; front without ocular lines.

Length: 2.75 to 3.25 mm

County Records: Delaware

Pachybrachis subvittatus LeConte

Characteristics: Color yellow, pronotum with three stripes, the middle one is black and divided anteriorly, the lateral stripes more diffuse and broader, brown in color; elytra with a sutural and lateral edges black, small standard spots black, the outer series, submarginal and distinct; the inner spots narrow and forming a dislocated discosutural vitta; pygidium black with or without apical yellow spots; ventral surface black; legs rufo-testaceous, the tarsi and apical parts darker; front without ocular lines.

Length: 3.6 mm

County Records: Delaware, McCurtain

Pachybrachis tridens (Melsheimer)

Characteristics: Color yellow with broad sharply limited black markings; pronotum with subquadrate black spots on each side, nearer the base than the apex, a dilated median spot divided anteriorly by a yellow line; elytra with a transverse black basal fascia, wide at the suture along which it narrowly joins a wider posterior fascia;

pygidium black with the usual yellow apical spots; ventral surface black with sides of abdomen and last segment yellow; legs yellow with a small faint median dark cloud on the femora; front with fine ocular lines.

Length: 2.2 to 3.2 mm

County Records: Recorded from adjacent states

Pachybrachis trinotatus (Melsheimer)

Characteristics: Color black, pronotum with side margin, apical edge and three discal spots, fulvous (pronotal "M" heavy and sharply defined); elytral color almost entirely black, the basal edges in part often yellow, and sometimes with one or two other minute yellow spots; pygidium, ventral surface, and legs black; front tibia without apical spur; front without ocular lines.

Length: 3.9 to 4.6 mm

County Records: LeFlore, McCurtain

Pachybrachis turbidus LeConte

Characteristics: Color yellow with red-brown markings which may become nearly black on the elytra; pronotum with broad diffuse markings; elytra with standard spots more or less defined, the anterior two and the posterior two usually form irregular transverse fasciae; pygidium red-brown and yellow, the latter predominating; ventral surface reddish brown, pale at apex; legs rufo-testaceous throughout or yellowish with the middle and hind femora faintly clouded or rufous;

front without ocular lines.

Length: 3.7 to 4.3 mm

County Records: Murray

Pachybrachis vau Fall

Characteristics: Color pale yellow or testaceous, pronotum with a black median V-shaped mark and a black stripe on each side; elytra with the suture and two discal stripes black, the outer occupying the seventh and eighth interspaces; pygidium black with two yellow apical spots; ventral surface black, the last segment broadly yellow at sides; legs entirely pale yellow; front with ocular lines.

Length: 2.75 to 3.75 mm

County Records: Noble, Payne, Woodward

Pachybrachis vestigialis Fall

Characteristics: Color varies from almost entirely black to black with yellow speckles; pygidium and ventral surface entirely black; basal antennal segment entirely black; legs black and yellow to variable extents; front without ocular lines.

Length: 2.2 to 3.0 mm

County Records: Noble, Payne

Pachybrachis viduatus (Fabricius)

Characteristics: Color yellow with sharply defined broad black frontal marks and a pronotal "M", elytra with sutural bead,

median vitta and a narrow lateral vitta all black; pygidium black with two large often confluent oval yellow apical spots; ventral surface black with the last segment yellow; legs yellow, the bases of the femora and tibial apex are often clouded with brownish shades; front without ocular lines.

Length: 3.5 to 4.5 mm

County Records: Recorded from adjacent states

Pachybrachis virgatus LeConte

Characteristics: Color yellow, pronotum with three entire black or brown stripes, the middle one dilated anteriorly; elytra with suture, two discal stripes and a marginal bead black; pygidium black in basal half, yellow apically; ventral surface black with pale apical margin; legs rufo-testaceous; front without ocular lines.

Length: 3.7 to 4.4 mm

County Records: Payne

Cryptocephalus Müller

The members of the genus Cryptocephalus may be distinguished by the following: claws simple; pronotum not margined at the base, but crenulate; front edge of prosternum laterally straight; antennal segments not widened; color and size variable.

KEY TO THE SPECIES OF CRYPTOCEPHALUS

(Modified from White, 1968)

1. Elytron black with red to yellow basal and apical spots sometimes connected 2
- Elytron not as above, usually light with dark markings, if black without light markings 5
2. Pronotum pubescent. mucoreus
- Pronotum not pubescent 3
3. Basal spot attaining both scutellum and apical spot (joined at sixth and seventh or eighth intervals) notatus
- sellatus
- Basal spot attaining either scutellum or apical spot, never both 4
4. Basal spot attaining scutellum notatus
- quadrifasciatus
- Basal spot not attaining scutellum quadrifasciatus

5. Punctures at elytral apex confused and completely obscure inner and outer rows tinctus
- Punctures at elytral apex not or but slightly confused, inner and outer rows of punctures distinct and clearly meeting 6
6. Pronotum with a broad, median, longitudinal dark spot bounded on each side by distinct yellow stripes trivittatus
- Pronotum not as above 7
7. Pronotal median line light, bordered by longitudinal dark stripes 8
- Pronotal coloring not as above 9
8. Elytral intervals two and four yellow throughout, devoid of dark pigment amatus
- amatus
- Elytral intervals two and four dark, at least in part; elytra with transverse, undulating vittae; discal spots rarely touching leucomelas
- leucomelas
9. Pronotum pale, with large central and one or two small lateral dark spots on each side; each elytron has eight dark spots and a common sutural spot, discal spots are sometimes joined. egregius

- Pronotum and/or elytra not as above 10
10. Each elytron with at least one, completely dark,
 longitudinal stripe 11
- Elytral markings of incomplete or interrupted
 stripes, spots or transverse markings, may
 be irregular 19
11. Elytral vittae confined to one interval (except
 sometimes lateral spots) 12
- Elytral vittae or markings broad, at least one
 at widest point including two or three
 intervals. 13
12. Dark markings of pronotum black, distinct;
 margins sometimes narrowly reddish,
 background color or elytra reddish spurcus
vandykei
- Pronotum predominantly to entirely dark orange
 to reddish, usually with two basal and lateral
 and apical margins yellowish, with reddish to
 black lateral to each light basal spot; legs
 predominantly yellowish or reddish. confluentus
confluentus
13. Anterior margin of prosternum with a stout spine
 or distinct V-shaped lobe 14

- Anterior margin of prosternum simple, evenly
 arcuate, or with a broadly rounded or
 slightly pointed lobe. 15
14. Elytron with inner of two vittae dark and distinct,
 outer vitta much reduced, represented by
 one, two or three spots; females only. venustus
ornatulus
- Elytron with both vittae distinct and complete,
 black or rarely dark reddish. venustus
venustus
- also male venustus ornatulus
15. Elytral epipleuron all or mostly black, lateral
 raised margin dark to black; pronotum
 gibbous gibbicollis
gibbicollis
- Elytral epipleuron black in part, lateral raised
 margin yellow to orange; pronotum normal
 to gibbous 16
16. Size 5.4 to 6.7 mm; females. bispinus
 Size 4.0 to 5.7 mm; males and females 17
17. Outer elytral vitta interrupted once, twice or
 nearly absent, sometimes confluent with
 inner vitta insertus
- Outer elytral vitta complete 18

18. Males 4.0 to 4.9 mm; females 5.4 to 6.7 mm long . bispinus
 Males 4.2 to 4.5 mm; females 4.8 to 5.6 mm long. calidus
19. Each elytron with seven or eight subequal,
 approximately oval light spots separated
 by their diameters or less, pronotal marking
 vague or absent; ventral surface and pronotum
 reddish guttulatus
 Elytral patterns not as above; pronotum often
 with distinct markings. 20
20. Dark discal marking of elytron attaining the
 lateral margin behind middle 21
 Dark discal marking not attaining the lateral
 margin behind middle mutabilis
21. Elytron at base with dark markings broadly
 attaining lateral margin; pronotum lacking
 paired light spots at base badius
 Elytron at base with dark marking not attaining
 lateral margin; pronotum unicolorous
 throughout or with margins vaguely lighter
 never with eight basal spots; dark elytral
 markings consists of two or three narrow,
 orange or red vague or interrupted trans-
 verse bands fulguratus

Cryptocephalus amatus amatus Haldeman

Characteristics: Pronotum yellow with four longitudinal orange or black bands. The two median bands broadest at middle, lateral two bands broadest basally, sometimes confluent with median bands near apex. Elytra yellow with black vittae. The vitta on the third interval is broadly interrupted, the fifth and sixth interval are darkened at the apical half, the eighth interval is darkened to black throughout; the humerus black. Eight rows of punctures with fifth, sixth, and seventh confused, inner and outer rows distinct and clearly meeting. The prosternum is lobed anteriorly with a vertical spine behind the margin in the male; that of the female broadly lobed.

Length: 3.4 to 4.3 mm

County Records: Ellis

Cryptocephalus badius Suffrian

Characteristics: Pronotum orange to deep red often with lateral and apical margins yellow; usually with paired light spots at the base. Each elytron yellow to orange and with three transverse, undulating stripes red to brown in color. The basal dark markings of elytra broadly attaining the lateral margin. Seven rows of punctures and a short row behind the humerus, fifth and sixth rows are interrupted at the middle, and joining behind the middle, sometimes confused posterior of the junction; inner and outer rows distinct and clearly meeting. The prosternum in both sexes is evenly arcuate and somewhat

produced.

Length: 3.6 to 4.6 mm

County Records: Payne, Pontotoc

Cryptocephalus bispinus Suffrian

Characteristics: Pronotum red to orange with lighter oblique basal spots, lateral and apical margins light. Light areas not sharply delimited. Each elytron yellow to orange with two dark orange to red vittae. One vittae from the base of second third and fourth intervals to the apex of the first interval, always complete. The other vittae from the humerus to the apex of the fourth, fifth and sixth intervals, nearly always complete but may be interrupted once. Eight rows of punctures, sixth and seventh confused; inner and outer rows distinct at apex and usually clearly meeting. The anterior margin of the prosteronum is arcuate in both sexes.

Length: 4.0 to 6.7 mm

County Records: Hughes, Marshall, McCurtain

Cryptocephalus calidus Suffrian

Characteristics: Pronotum orange to dark red, usually with two oblique, light basal spots and with apical and lateral margins light. Light marking not sharply delimited. Each elytron yellow with two red vittae. One from the base of the second, third and fourth intervals to near the apex of the second interval, always complete; the other from the humerus to the apex of the fourth and combined fifth, sixth and

seventh intervals, may be interrupted or expanded. Eight rows of punctures, fifth, sixth and seventh rows confused; sometimes sixth greatly reduced, inner and outer rows distinct and usually clearly meeting at the apex. Anterior margin of prosternum evenly arcuate, not produced.

Length: 4.2 to 5.6 mm

County Records: Adair, Cleveland, Jackson, Muskogee, Payne

Cryptocephalus confluentus confluentus Say

Characteristics: Pronotum orange to reddish, usually with light yellowish markings in two basal oblique spots and apical and lateral margins. Elytra is creamy yellow to light orange with three dark vittae on each elytron. One on the second interval usually complete, sometimes vague apically; on the fourth interval, sometimes vague or interrupted before the middle, rarely vague at basal and apical ends; on the sixth interval, often vague or reduced at the base. Seven distinct rows of punctures and a short series behind the humerus. Inner and outer rows distinct at apex and meeting. Anterior margin in male is produced ventrally into a distinct pointed lobe. In the female produced into a distinct sometimes pointed lobe.

Length: 4.0 to 5.7 mm

County Records: Recorded from adjacent states

Cryptocephalus egregius Schaeffer

Characteristics: Pronotum dull creamy yellow to orange, with black sharply delimited markings. The dark markings are a broad median longitudinal spot from base to apex, midline with narrow disconnected spots of yellow; each side of the median spot with oval to triangular spots, usually connected with the median spot; each side usually has a very tiny black spot. The elytra dull creamy yellow to orange with sharply delimited black markings. The dark markings on each elytron are as follows: three medium sized spots, one centered before the base of the second stria, one centered before the apex of the second interval, one centered behind the middle of the sixth stria. These spots may be expanded and confluent; with six small spots, one on suture before the apex of the sutural stria, one on the humerus, two behind the humerus (above and below diagonally), one at the apex of the fourth interval, one at the apex of the seventh interval. Eight rows of punctures, usually fifth, sixth and seventh rows confused. Inner and outer rows distinct and usually clearly meeting. The anterior margin of the prosternum is ventrally produced in the female.

Length: 6.0 to 6.7 mm

County Records: Not recorded from Oklahoma

Cryptocephalus fulguratus LeConte

Characteristics: Pronotum dull orange to red with yellow poorly delimited at margins. Elytra creamy yellow with stria and dark markings red. The dark markings on each elytron are as follows: from

the base of the second interval curving to the apex of the second stria; at base, middle and apex of the fourth stria; behind base, behind middle and on apex of the sixth stria, on humerus; behind base at middle of the seventh stria. The above markings may be reduced or transversely joined to form three undulating bands. Seven rows of punctures and a short row behind the humerus, sixth stria interrupted and joined to fifth. Inner and outer rows distinct and clearly meeting. The anterior margin of prosternum of the male is produced into a broad lobe, and the female feebly produced.

Length: 3.8 to 5.0 mm

County Records: Recorded from adjacent states

Cryptocephalus gibbicollis gibbicollis Haldeman

Characteristics: Pronotum orange to red, with two basal oblique spots, lateral and apical margins yellowish. Yellow markings not sharply delimited. Elytra yellowish with two complete sharply delimited dark vittae on each elytron. One from the base of the second, third and fourth interval to the apex of the second interval; from the humerus to the apex of the seventh to fourth intervals. Eight rows of punctures, usually sixth and seventh rows confused. Inner and outer rows distinct and clearly meeting at the apex; epipleuron black throughout. The anterior margin of the prosternum is somewhat produced in both sexes.

Length: 5.2 to 7.1 mm

County Records: Recorded from adjacent states.

Cryptocephalus guttulatus Olivier

Characteristics: Pronotum light reddish to brown, basal angles, basal oblique spots, lateral and apical margins yellowish. Elytra reddish with eight nearly subequal, oval, creamy yellow spots on each elytron. Spots as follows: one centered at the base of the scutellar stria, one centered at the base of the fifth interval, one centered at the base of the last stria, one centered at the middle of third interval, one centered before the middle of the third stria, one centered before the apex of the eighth interval, and one centered at the junction of the inner and outer stria. Eight rows of punctures, sixth confused and reduced, seventh interrupted or somewhat confused. Inner and outer rows distinct and meeting at the apex. Anterior margin of the prosternum produced in both male and female, more so in the male.

Length: 3.9 to 6.0 mm

County Records: Craig, Noble

Cryptocephalus insertus Haldeman

Characteristics: Pronotum orange to brown with two oblique basal spots, lateral and apical margins yellowish. Yellow markings not sharply delimited. Elytra yellowish with two dark vittae on each elytron. One dark marking from the base of the second, third and fourth intervals to the apex of the second interval, rarely reduced and often expanded. Usually the second vittae is in the form of two or three spots, spaced from the humerus to the apex of the seventh to fourth interval.

Eight rows of punctures, sixth row slightly confused, seventh row usually confused. Inner and outer rows distinct and meeting at the apex. The anterior margin of the prosternum is evenly arcuate and feebly produced in both sexes.

Length: 3.8 to 5.8 mm

County Records: Comanche (in Kansas University Museum)

Cryptocephalus leucomelas leucomelas Suffrian

Characteristics: The pronotum is creamy yellow to orange, with four red to brown or black, longitudinal, sharply delimited vittae from base to apex, sometimes narrowly meeting at the apex or base. Elytra yellow to orange with red to brown transverse markings. Each elytron marked as follows: a transverse band at the basal third, broadly meeting the suture before apex of the scutellar stria; a transverse band just behind the middle from about the fifth stria to the suture; humeral and subhumeral spots; a lateral spot about the apical third; two apical spots; spots expanded to form three undulating transverse bands. Eight rows of punctures, fifth row sometimes confused, sixth row much reduced and confused, seventh row confused, often reduced; inner and outer rows distinct and meeting at the apex. The anterior margin is produced into a pointed lobe in the male; feebly produced to evenly arcuate in the female.

Length: 4.0 to 6.0 mm

County Records: Delaware, Canadian, Cleveland, LeFlore, Love
McCurtain, Payne

Cryptocephalus mucoreus LeConte

Characteristics: The pronotum with a fine silvery pubescence; black throughout. The elytra with a fine silvery pubescence. Each elytron black with the following orange to red parts: basal fourth and side to middle, apex; basal marking, rarely almost attaining the apical spot. The posterior margin of the basal marking is concave. Nine rows of punctures, sixth and seventh rows sometimes confused. Inner and outer rows distinct and usually meeting. The anterior margin of the prosternum is a large, sharp, downward and posteriorly directed spine in the male; the female has a simple or feeble, longitudinal, median carina.

Length: 4.2 to 5.5 mm

County Records: Recorded from adjacent states

Cryptocephalus mutabilis Melsheimer

Characteristics: The pronotum orange to red to black and with two oblique, elongate yellowish basal spots. Lateral margins broadly and apical margin narrowly yellowish. Elytra creamy yellow to light or orange with red to brown markings. Each elytron with small oval spots as follows: at the base of the second interval, at base of fourth interval, or humerus, before base on eighth stria, before base of sixth stria, and at apex of third and seventh intervals. Elytron with a large spot from suture behind scutellum diagonally to fourth stria to past its middle, then diagonally nearly to elytral apex; and elongate

spot at side behind middle; smaller spots of above pattern often reduced or expanded. Eight rows of punctures fifth sometimes, sixth always and seventh sometimes confused. Inner and outer rows distinct and usually clearly meeting. The anterior margin of the prosternum produced ventrally into a broad lobe in the male; into a feeble lobe in the female.

Length: 4.3 to 6.5 mm

County Records: Kingfisher, Muskogee, Woodward

Cryptocephalus notatus quadrimaculatus Say

Characteristics: The pronotum black with a bluish tint. Elytra black with orange marking on each elytron. Each elytron with a basal and apical orange spot, the basal spot easily attains the scutellum but not attaining the apical spot. Eight and sometimes nine rows of punctures, fifth sometimes, and sixth nearly always confused and seventh sometimes confused. Inner and outer rows distinct and usually clearly meeting at the apex. The anterior margin of the prosternum produced into a distinct, stout, ventrally directed spine in the male; a short, broadly rounded to somewhat pointed lobe in the female.

Length: 3.6 to 5.5 mm

County Records: Recorded from adjacent states

Cryptocephalus notatus sellatus Schaeffer

Characteristics: The pronotum black with a bluish tint; elytra black with an apical and basal spot orange on each elytron. The markings and striation are similar to C. n. quadrimaculatus except the

basal spot always attains both the apical spot and the scutellum, joining the former about sixth to eighth intervals. The anterior margin of the prosternum is produced downward into a sharp, distinct spine in the male; to a pointed lobe in the female.

Length: 3.6 to 5.1 mm

County Records: Caddo, Cleveland, Comanche, Creek, Ellis,
Grady, Love, McIntosh, McLain, Oklahoma,
Payne, Pottawatomie, Woods

Cryptocephalus quadruplex Newman

Characteristics: The pronotum is black with a bluish tint. The elytra black with orange markings. Each elytron is marked with orange as follows: at base from third stria to side and posteriorly to middle of elytron, often nearly square; with a moderate sized apical spot. Eight or nine rows of punctures, fifth sometime, sixth and seventh usually confused. Inner and outer rows usually distinct and clearly meeting at the apex. The anterior margin of the prosternum is a distinct sharp ventrally directed spine in the male; an evenly arcuate to a broad, sometimes pointed lobe in the female.

Length: 2.9 to 4.0 mm

County Records: Delaware, Caddo, Cleveland, McCurtain, Payne

Cryptocephalus spurcus vandykei B. E. White

Characteristics: The pronotum reddish-brown with lateral and apical margins yellow. The elytra is yellow with black vittae on the

second, fourth and sixth intervals, variable in development. Seven rows of punctures and a short series behind the humerus; fifth and sixth rows often slightly confused. The inner and outer rows distinct and usually meeting at the apex. The anterior margin of the prosternum is produced into a V-shaped lobe in the male; a broadly U-shaped lobe in the female.

Length: 4.2 to 5.5 mm

County Records: Woodward

Cryptocephalus tinctus LeConte

Characteristics: The pronotum is light orange to reddish. The elytra light orange to reddish with three rather vague to distinct, darker reddish, transverse, undulating bands. The dark bands arranged as follows: one basal, one behind middle and one apical and narrow, often bands expanded and nearly meeting. Nine rows of punctures sometimes slightly irregular, six and seventh rows confused. Inner and outer rows obscured at apex by confused punctures. The anterior margin of the prosternum is produced into a short, pointed lobe in the male; not or feebly, broadly produced in the female.

Length: 2.8 to 4.5 mm

County Records: Ellis

Cryptocephalus trivittatus Olivier

Characteristics: The pronotum is creamy yellow to light orange, with three rather broad, distinct, longitudinal, red to black vittae;

median vitta broadest at its middle, lateral two broadest at their base. The elytra creamy yellow to light orange, with reddish-brown markings as follows: at basal fourth of the third interval (may be reduced or absent), at middle of fifth interval to apex; entire sixth and seventh intervals from base to apex. Eight rows of punctures, sixth and seventh rows confused. Inner and outer rows distinct and clearly meeting. The anterior margin in both sexes not produced, nearly evenly arcuate throughout.

Length: 3.3 to 4.3 mm

County Records: McCurtain

Cryptocephalus venustus ornatulus Clavareau

Characteristics: The pronotum orange to red, two vague oblique basal spots, lateral and apical margins yellowish. The elytra creamy yellow to light orange, each elytron with dark red to black markings as follows: entire second interval, base of fourth interval; three subequal spots on the side, one on the humerus, middle of the eighth interval, and at the apex of the fourth interval. Striation the same as v. venustus but less frequently confused or reduced rows. The prosternum is the same as v. venustus in female.

Length: 4.8 to 6.0 mm

County Records: Recorded from adjacent states

Cryptorephalus venustus venustus Fabricius

Characteristics: Pronotum orange to red with two light oblique

basal spots, lateral and apical margins yellowish. Light marking and margins never sharply delimited. The elytra creamy yellow to light orange, each elytron with two dark red to black distinct vittae from the base of the second, third and fourth intervals to the apex of the second interval and from the humerus to the apex of fourth to seventh intervals. Nine rows of punctures, rows five to eight crowded, one or more often confused or reduced. Inner and outer rows distinct and clearly meeting at the apex. The anterior margin of prosternum is produced ventrally into a distinct, stout spine in the male; a broad, short pointed, often spinelike lobe in the female.

Length: 4.1 to 6.0 mm

County Records: Nowata, Payne, Washington, Hughes

Bassareus Haldeman

The members of the genus Bassareus are easily separated from the genus Cryptocephalus, which they most closely resemble, by the following: claws simple; pronotum not margined at the base, but crenulate; front edge of prosternum laterally sinuous or toothed; color variable; size variable. The following species have been recorded from Oklahoma.

KEY TO THE SPECIES OF BASSAREUS

1. Elytra with spots 2

Elytra black with reddish yellow margins, anterior

edge of prosternum laterally obtusely toothed . lituratus
recurvus

2. Elytra with four reddish spots, anterior edge
of prosternum laterally obtusely toothed. . . . mammifer
- Elytra with numerous yellowish spots, anterior
edge of prosternum laterally acutely toothed. . . . congestus

Bassareus congestus (Fabricius)

Characteristics: Head and thorax dull reddish-brown, each with pale yellow spots, those on the thorax near the front and hind angles. Elytra reddish-brown with three transverse rows of yellowish spots, the basal row sometimes elongate, the others irregular. The apical half of the antennae, tibia and tarsi are blackish.

Length: 3.8 to 5.0 mm

County Records: LeFlore, Payne

Bassareus lituratus recurvus Say

Characteristics: Head black; thorax with a large black spot which reaches the base, side and apical margins reddish-yellow; elytra black with side and apical margins reddish-yellow.

Length: 3.0 to 3.5 mm

County Records: Alfalfa, Cleveland, Garfield, McCurtain, Payne

Bassareus mammifer (Newman)

Characteristics: Head black, thorax black, with a narrow front margin, wider side margins and two rounded spots near the base yellow; elytra black, each with a large basal red spot, reaching nearly to the suture and an apical reddish spot which is not connected to the

basal spot.

Length: 3.5 to 4.5 mm

County Records: Payne, Seminole

Diachus LeConte

The following characters are used to distinguish the genus Diachus: claws broadly appendiculate; pronotum not margined at base, but crenulate; front edges of prosternum straight; antennal segments six to eleven widened; color with metallic tinge; size small. Only one species has been recorded from Oklahoma.

Diachus auratus (Fabricius)

Characteristics: Oval, subcylindrical. Head and thorax reddish-brown, bronzed; the elytra brassy-green or brownish; antennae, legs, sides and undersurface of thorax dull yellow; abdomen black, the thorax very finely alutaceous. Elytral striae fine but complete.

Length: 1.5 to 2.0 mm

County Records: Cleveland, Jackson

Triachus LeConte

The following characters are used to distinguish the genus Triachus: claws broadly appendiculate; pronotum not margined at the base, but crenulate; front edges of prosternum straight; color yellowish; size very small. No species have been recorded from Oklahoma but at least one is likely to occur.

Triachus vacuus LeConte

Characteristics: Oval, convex. Dull yellow, the elytra often clouded with darker color. The thorax sparsely and finely punctured, more deeply laterally, not margined at the base. Rows of elytral punctures fine but distinct on the disk.

Length: 1.0 to 1.3 mm

County Records: Recorded from adjacent states

ILLUSTRATIONS

Figure 1 Pachybrachis sp., showing simple claws

Figure 2 Diachus auratus, showing appendiculate claws

Figure 3 Bassareus congestus, ventral view showing front
edge of prosternum laterally toothed

Figure 4 Cryptocephalus trivittatus, dorsal view showing
striae and intervals

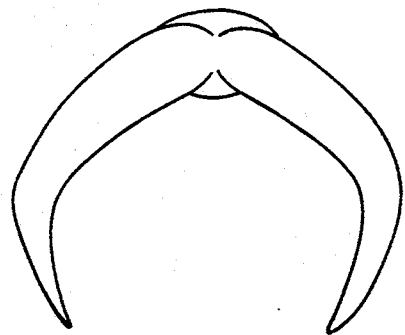


Figure 1

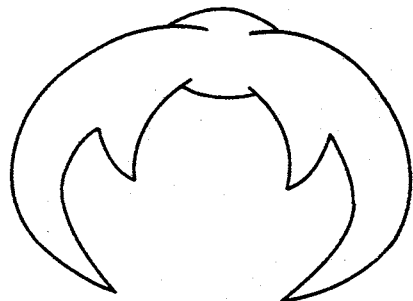


Figure 2

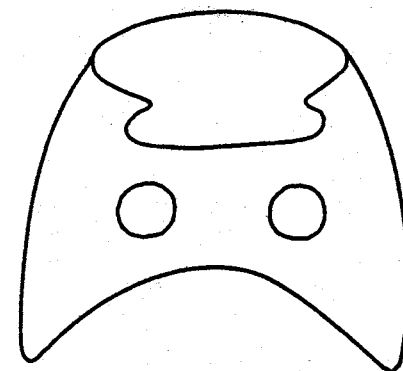


Figure 3

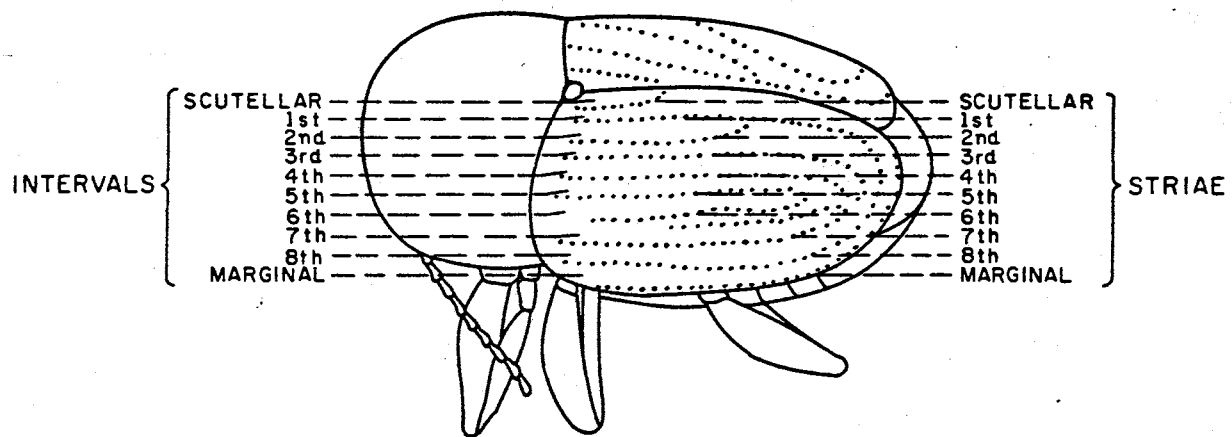


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