

A CONTRIBUTION TOWARD THE CLASSIFICATION OF  
THE WEEVIL LARVAE OF THE SUBFAMILY CALEN-  
DRINAE, OCCURRING IN NORTH AMERICA.

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INTRODUCTION.

Until quite recently the larvae of the family Curculionidae have received little attention from taxonomic workers in entomology. Numerous descriptions of economic forms have appeared from time to time but for the most part they are so vague and fragmentary as to be useless for purposes of identification. In recent years Hopkins, Böving, Grandi, Trägårdh, Donisthorpe, Pierce, and others have published detailed descriptions of certain economic forms, which will serve as a basis for future study of this most interesting group of larvae.

Several years ago the writer became interested in the study of the larvae of the family Curculionidae, particularly those belonging to the subfamily Calendrinae, and as opportunity offered, studies were made of the different forms of this group. The writer is very much indebted to Dr. A. G. Böving for his constant help and advice in the preparation of this paper. Through the kindness of Dr. L. Ö. Howard the collection of Calendrine larvae belonging to the United States National Museum was made available for study and made possible the completion of the work. The writer is also indebted to A. F. Satterthwait for the loan of his collection of larvae of the genus *Calendra*.

SUBFAMILY CALENDRINAE IN NORTH AMERICA.

The subfamily Calendrinae is represented in North America by eleven genera and about ninety species. Of the ninety known species more than two-thirds belong to the genus *Calendra* (*Sphenophorus*).

The following classification deals only with generic characters and is based on a study of the larvae of all the genera of this subfamily

found in North America with the exception of *Trichischius*, the larva of which is unknown, and *Eucactophagus*, of which the species listed for North America are introduced forms not known to be established in this country.

#### SUBFAMILY CHARACTERS.

The following characters which are common to all larvae of this subfamily will serve to distinguish them from other Curculionid larvae:

1. Curculionid larvae with head free, subglobular. Eighth and ninth abdominal segments forming a sort of pygidial plate, eighth with tergum declivous and without distinct tergal areas, ninth rather small, somewhat flattened dorsally, either broadly rounded posteriorly or terminating with two fleshy latero-caudal projections, segment usually with four long terminal setae on each side. Tenth abdominal segment small and ventral.

2. Abdominal segments usually with three plicae on dorsal side but occasionally with two or four. Abdominal hypopleura subdivided into at least two and usually three or more superposed lobes.

3. Ocellus one.

4. Antennae fleshy, two-jointed, basal joint with several small papillae.

5. Mandibles stout, triangular, with simple or slightly bifid apex; two dorsal setae.

6. Maxillary palp two-jointed.

7. Hypopharynx composed of a fleshy median area and two setose lateral lobes.

8. Spiracles bifore except in *Rhynchophorus* where bilabiate; all spiracles lateral with air tubes pointing dorsad except on eighth abdominal segment where they are placed dorsally and with air tubes pointing caudad. Spiracular opening oval.

#### DETAILED DESCRIPTION.

The full-grown larvae of the subfamily Calendrinae do not differ radically in general appearance but vary in length from 2.5 mm. in the genus *Sitophilus* to about 35 mm. in the genus *Rhynchophorus*. They are white, legless, fleshy grubs, very thick-bodied. Body integument usually soft and smooth, sometimes with numerous chitinized setae-carrying areas as in *Rhynchophorus*, and in some species of *Cactophagus* with rows of small spines.

Ten abdominal segments, ninth flattened and forming with the eighth a sort of pygidial plate, tenth reduced and ventral.

Head from very pale yellowish-brown to dark reddish-brown in color; longer than broad and somewhat wedge-shaped, the sides

broadly rounded from middle to apex, which is somewhat angular; the sides nearly straight from middle to posterior angles.

Epicranial and frontal sutures distinct; in many genera a longitudinal suture, the adfrontal suture, branches from each of the frontal sutures and usually continues to the posterior end of the head limiting the so-called adfrontal region. In *Cosmopolites* an additional suture runs parallel to and a short distance from the adfrontal suture.

Frons subtriangular, sometimes with endocarina indicated by a short, dark, median line on the surface. Frons provided with five pairs of setae.

Clypeus broadly transverse and bearing at suture separating clypeus and epistoma two fine setae on each side.

Labrum subtriangular, broader than long. On the dorsal surface labrum bears six large setae, usually simple but in *Cosmopolites* and *Metamasius* with some of them branched; on the margin it has 10 or more thickened setae that are simple in some species and branched in others or both simple and branched.

Each epicranial half bears nine large setae and usually one or more minute setae near occiput.

Eye represented by a single ocellus.

Antennae fleshy, two-jointed, located at the lateral angle of frons; first joint broad and short and supplied with several small papillae, second slender and short.

Mandible stout, triangular, at tip with single blunt tooth or slightly bifid, two dorsal setae, no molar part.

Maxilla with cardo distinct and simple. Maxillary mala entire, tip obtuse, ventral surface smooth and lightly chitinized, dorsal surface with a longitudinal row of simple or branched setae and in *Rhynchophorus* proximally with a group of setae. Tip of mala usually with a group of three strong setae. Maxillary palp extending slightly beyond mala, two-jointed, borne by a large membranous palpifer. Proximal joint thick, cylindrical and bearing a single seta on apical membrane, distal joint finger-like, bearing several small terminal papillae. There are three other setae on maxilla, two near base of palpifer and one about midway between palpus and end of cardo. A very minute seta with sensory spot is present near stipes labii but usually concealed by folded skin.

Mentum, submentum, and maxillary articulating area fused into a fleshy region. Three pairs of setae are present. Eulabium posteriorly enforced by a median triangularly-bent chitinization. Between the palpi a small slightly bilobed ligula. Labial palp short, conical, two-jointed, distal joint with several small terminal papillae. Eulabium bears two setae on ventral surface; ligula bears four setae and two sensory spots. These setae are simple in some

and branched in others. In some genera the buccal side of ligula is smooth, partly provided with, or in others entirely covered with a dense mat of hairs.

The main part of the floor of the buccal cavity is composed of the hypopharynx, a fleshy median area, with two setose lateral lobes by many authors interpreted as the maxillulae or paragnathae. Each side of this hypopharyngeal complex is strengthened by a chitinized arm of mentum.

Epipharynx carries a pair of epipharyngeal rods. Between these rods there are four or more small, thickened setae, the number and arrangement differing in the different genera. These setae are simple in most genera but branched in *Scyphophorus*. Epipharynx is often more or less densely setose.

Prothorax dorsally not divided, but the two areas praescutum and scuto-scutellum may be roughly indicated by rows of setae.

The mesothoracic and metathoracic segments are divided into the spindle-shaped praescutum, the scuto-scutellum, and the alar area. Praescutum has one pair of setae and scuto-scutellum four pairs of setae.

The sternum of the thorax consists of eusternum and two coxal or parasternal lobes more or less connected medianly behind the eusternum. The eusternum of each thoracic segment bears a pair of hairs.

The abdominal segments are divided dorsally into from two to four transverse areas. In *Rhynchophorus* and *Cosmopolites* an additional intersegmental fold is present in front of praescutum. Below these transverse areas and adjacent to epipleurum is the alar area. Epipleurum itself dorsally limited by a somewhat indistinct dorso-lateral suture and ventrally by a well-defined ventro-lateral suture; it is large and not subdivided. Below the ventro-lateral suture is hypopleurum. This is subdivided into at least two and usually three or more superposed lobes. The ventral areas are the coxal or parasternal lobes, eusternum, and sternellum. The anus is transverse. Abdominal segments provided with setae as follows: On each side of all typical segments praescutum bears one seta, scutellum from three to five setae, alar area one or two setae, and the epipleural lobe a pair of setae. One of the lobes of hypopleurum bears one or two setae, the coxal lobe one seta, and eusternum two pairs of setae.

Eighth abdominal segment smaller than the typical segments, tergum declivous and without distinct tergal areas. Ninth segment rather small, somewhat flattened dorsally, either broadly rounded posteriorly or terminating with two fleshy latero-caudal projections; segment usually with four long terminal setae on each side. Tenth abdominal segment ventral and small.



Spiracles lateral except on the eighth abdominal segment, where they are placed dorsally. Spiracular opening oval.

Both thoracic and abdominal spiracles located anteriorly and in a separate corner area. The area containing the mesothoracic spiracles, however, is epipleural, while the areas with the abdominal spiracles are derived from the alar area. With the exception of *Rhynchophorus*, where the spiracles are bilabiate, they belong in all genera to the bifore type.

Only one pair of thoracic spiracles are present, the mesothoracic pair; no vestige of a metathoracic spiracle found. All spiracles of same size except the mesothoracic and eighth abdominal; the mesothoracic being about twice as large and the eighth abdominal spiracle considerably larger than the average abdominal spiracle.

The air tubes of the bifore spiracles distinct but varying in size according to the genera; those of mesothorax and abdominal segments 1-7 point dorsad but those of the eighth abdominal segment are directed caudad.

The closing apparatus of the spiracle is similar to that found by Böving in the larvae of the Donaciinae, a detailed description of which appears in his Natural History of the Larvae of Donaciinae.<sup>1</sup>

As shown in plate 7, figure 4, *b* and *c*, the apparatus consists of a constriction of the walls at the beginning of the trachea, formed by a chitinized, wedge-shaped ridge or fold that projects into the lumen of the trachea, and an opposing soft fold that, by the action of a muscle between two hollow arms at the fold, may be forced against the chitinized ridge, thus effectually closing the entrance to the trachea.

KEY TO GENERA.<sup>2</sup>

- |   |                            |
|---|----------------------------|
| 1. Mala with simple setae or with not more than one branched seta.....  | 2                          |
| Mala with branched setae.....   | 4                          |
| 2. Mala dorsally with longitudinal row of eight setae one of which is branched.   |                            |
| Distal end of palpifer dorsally with a tuft of hair....   | <i>Cactophagus</i> , p. 6. |
| Mala dorsally with longitudinal row of six or seven setae none of which are branched. Distal end of palpifer naked..... | 3                          |
| 3. Mala with seven dorsal setae. Body elongate, more than 5 mm. in length.....  | <i>Rhodobaenus</i> , p. 6. |
| Mala with six dorsal setae. Body almost globular, not more than 3.5 mm. in length.....                                  | <i>Sitophilus</i> , p. 6.  |
| 4. Dorsal (or buccal) side of ligula setose.....  | 5                          |
| Dorsal (or buccal) side of ligula not setose.....   | 7                          |

<sup>1</sup> Internationale Revue der Gesamten Hydrobiologie und Hydrographie. 1910. Pp. 50-51, 60-62.

<sup>2</sup> Leng's catalogue has been followed in the use of generic names with the following exceptions: *Calendra* of Leng's catalogue is replaced by *Sitophilus*, and *Sphenophorus* of Leng's catalogue by *Calendra*.

5. Dorsal side of ligula not densely setose. Eulabium with posterior setae branched. Marginal setae of epipharynx all branched. Intersegmental area present in front of praescutum..... *Cosmopolites*, p. 7.  
 Dorsal side of ligula densely setose. Eulabium with simple setae. Marginal setae of epipharynx not all branched. No intersegmental fold in front of praescutum..... 6
6. Mala distally truncate..... *Metamasius*, p. 7.  
 Mala distally rounded..... *Calendra*, p. 7.
7. Mala distally truncate, proximally on dorsal side thick set with setae. Large forms about 35 mm. in length..... *Rhynchophorus*, p. 8.  
 Mala distally rounded. Proximally on dorsal side with none or a few setae .....
8. Dorsal (or buccal) side of mala with eight branched setae. Eulabium with simple setae. Marginal setae of epipharynx mostly simple, only a few branched..... *Scyphophorus*, p. 8.  
 Dorsal (or buccal) side of mala with more than eight branched setae. Eulabium with branched setae. Most of marginal setae of epipharynx branched or tuft-like..... *Yuccaborus*, p. 8.

#### Genus *CACTOPHAGUS* LeConte.

Plate 1, figs. 1-7; plate 10, fig. 3.

The larvae of this genus breed in Cactus plants and attain a length of about 30 mm. Labrum with twelve simple, thickened, marginal setae. Epipharynx somewhat setose and with two pairs of small thickened setae between the epipharyngeal rods. Maxillary mala oval at tip, with a row of seven simple and one branched setae on dorsal surface and with three simple setae at tip. Ligula not setose. Hypopharynx fleshy and laterally densely setose. Body with rows of small spines. Abdominal terga above divided into three distinct areas. Abdominal hypopleurum four-lobed.

#### Genus *RHODOBAENUS* LeConte.

Plate 2, figs. 1-7; plate 10, fig. 2.

The larvae of this genus inhabit the stems of various weeds of the Compositae. They are somewhat elongate and may attain a length of about 16 mm. Labrum with twelve simple, thickened, marginal setae. Epipharynx with two pairs of small thickened setae between the epipharyngeal rods. Maxillary mala oval at tip, dorsal surface with a longitudinal row of seven simple, stout setae, tip with three simple setae. Ligula not setose. Hypopharynx fleshy and laterally densely setose. Abdominal terga above divided into four distinct areas. Abdominal hypopleurum two or three lobed.

#### Genus *SITOPHILUS* Schönherr.

Plate 3, figs. 1-7; plate 10, fig. 1.

The larvae of this genus are seed inhabiting. The three species found in North America are all small, none exceeding 3.5 mm. in

length. Labrum with ten simple thickened marginal setae. Epipharynx with from eight to fourteen small setae between the epipharyngeal rods, the number of these setae differing in the three species. Maxillary mala oval at tip, with a longitudinal row of six simple, stout setae on dorsal surface and with four simple setae at tip, two of the latter being smaller than the others. Ligula not setose. Hypopharynx fleshy and laterally lightly setose. Abdominal terga above divided into two or three distinct areas. Abdominal hypopleurum three-lobed.

**Genus COSMOPOLITES** Chevrolat.

Plate 4, figs. 1-7; plate 10, fig. 4.

The larvae of the only species of this genus found in North America breeds in the roots of the banana. The larvae attain a length of at least 13 mm. Labrum with twelve marginal thickened setae all of which are branched. Epipharynx setose with two pairs of thickened setae between the epipharyngeal rods. Maxillary mala oval at tip, with a row of nine branched setae on dorsal surface and with one branched and two simple setae at tip. Ligula with two somewhat triangular setose areas on dorsal surface. Hypopharynx fleshy, laterally densely setose. Abdominal terga above divided into four distinct areas and an additional intersegmental fold. Abdominal hypopleurum four-lobed.

**Genus METAMASIUS** Horn.

Plate 5, fig. 1-7; plate 10, fig. 6.

The larvae of the species found in North America breed in the roots of sugar cane. They attain a length of about 15 mm. Labrum with twelve thickened marginal setae, some of which are branched and others simple. Epipharynx somewhat setose, and with two pairs of small thickened setae between the epipharyngeal rods. Maxillary mala truncate at tip, with a row of eight many branched setae on dorsal surface, and with one branched and two simple setae at tip. Ligula densely setose on dorsal surface. Hypopharynx fleshy, laterally densely setose, chitinized mental arms very prominent. Abdominal terga above divided into four distinct areas. Abdominal hypopleurum three or four lobed.

**Genus CALENDRA** Clairville.

Plate 6, figs. 1-7; plate 10, fig. 8.

The larvae of this genus breed in the roots of many grasses and grass-like plants. This genus contains many species, some of them attaining a length of about 15 mm. Labrum with twelve marginal,

thickened setae that are simple in some species and branched in others. Epipharynx somewhat setose and with two pairs of small thickened setae between the epipharyngeal rods. Maxillary mala oval at tip, with a row of eight branched setae on dorsal surface, the basal two being bifurcate at tip, the rest many-branched, tip of mala with two simple and one branched setae. Ligula dorsally setose. Hypopharynx fleshy, laterally densely setose and with a tuft of hairs at posterior limit. Abdominal terga above divided into three distinct areas. Abdominal hypopleurum four-lobed.

**Genus RHYNCHOPHORUS** Herbst.

Plate 7, figs. 1-7; plate 10, fig. 9.

The larvae of this genus breed in the trunks of palm trees. They are the largest of the Calendrid larvae that occur in North America and may attain a length of 35 mm. or more. Labrum with about twenty simple, thickened marginal setae. Epipharynx setose and with two pairs of small thickened setae between the epipharyngeal rods. Maxillary mala subquadrate at tip, with a row of simple and branched setae and a basal group of numerous branched setae on dorsal surface, and with three simple setae at tip. Ligula not setose. Hypopharynx fleshy and laterally densely setose. Body provided with numerous small chitinous seta-carrying areas. Abdominal terga divided above into three distinct areas and with additional intersegmental fold. Abdominal hypopleurum four-lobed.

**Genus SCYPHOPHORUS** Schönherr.

Plate 8, figs. 1-7; plate 10, fig. 7.

The larvae of this genus breed in plants of the Yucca family and related families. They may attain a length of at least 18 mm. Labrum with twelve thickened, marginal setae of which some are simple and others branched. Epipharynx setose and with two pairs of branched thickened setae between the epipharyngeal rods. Maxillary mala oval at tip, with a row of eight branched setae on dorsal surface and with one branched and two simple setae at tip. Ligula not setose. Hypopharynx fleshy, laterally densely setose. Abdominal terga above divided into three distinct areas. Abdominal hypopleurum five-lobed.

**Genus YUCCABORUS** LeConte.

Plate 9, figs. 1-7; plate 10, fig. 5.

The larvae of this genus breed in the plants of the Yucca family. They may attain a length of at least 15 mm. Labrum with about eighteen marginal setae nearly all of which are very much branched.



Epipharynx setose and with three pairs of small thickened setae between the epipharyngeal rods. Maxillary mala oval at tip, with a row of about twelve many-branched setae on dorsal surface and with one branched and two simple setae at tip. Ligula not setose. The usual setae found on ligula are all branched. Hypopharynx fleshy, laterally setose. Abdominal terga above divided into three distinct areas. Abdominal hypopleurum four-lobed.

## EXPLANATION OF PLATES.

<i>a</i> -----	atrium	<i>hp</i> -----	hypopharynx
<i>al</i> -----	alar area	<i>hyp</i> -----	hypopleurum
<i>cm</i> -----	muscle	<i>l</i> -----	labrum
<i>cox</i> -----	coxal lobe	<i>li</i> -----	ligula
<i>cr</i> -----	chitinous ridge	<i>m</i> -----	mala
<i>ep</i> -----	epipleurum	<i>pres</i> -----	praescutum
<i>er</i> -----	epipharyngeal rod	<i>sc</i> -----	scutum
<i>eu</i> -----	eusternum	<i>scut</i> -----	scutellum
<i>f</i> -----	frons	<i>sf</i> -----	soft fold
<i>ha</i> -----	hollow arm	<i>t</i> -----	trachea

## PLATE 1.

*Cactophagus validus* (LeConte).

- FIG. 1. Labrum.  
 2. Head, dorsal view.  
 3. Epipharynx.  
 4. Thoracic spiracle.  
 5. Full grown larva, lateral view.  
 6. Mouth parts, ventral view.  
 7. Mouth parts, dorsal view.

## PLATE 2.

*Rhodobacnus tredecimpunctatus* (Illiger).

- FIG. 1. Labrum.  
 2. Epipharynx.  
 3. Thoracic spiracle.  
 4. Head, dorsal view.  
 5. Full grown larva, lateral view.  
 6. Mouth parts, ventral view.  
 7. Mouth parts, dorsal view.

## PLATE 3.

*Sitophilus granarius* (Linnaeus).

- FIG. 1. Labrum.  
 2. Head, dorsal view.  
 3. Epipharynx.  
 4. Thoracic spiracle.  
 5. Full grown larva, lateral view.  
 6. Mouth parts, ventral view.  
 7. Mouth parts, dorsal view.

## PLATE 4.

*Cosmopolites sordidus* (Germar).

- FIG. 1. Labrum.  
 2. Head, dorsal view.  
 3. Epipharynx.  
 4. Thoracic spiracle.  
 5. Full grown larva, lateral view.  
 6. Mouth parts, ventral view.  
 7. Mouth parts, dorsal view.

## PLATE 5.

*Metamasius scriceus* (Latreille).

- FIG. 1. Labrum.  
 2. Head, dorsal view.  
 3. Epipharynx.  
 4. Thoracic spiracle.  
 5. Full-grown larva, lateral view.  
 6. Mouth parts, ventral view.  
 7. Mouth parts, dorsal view.

## PLATE 6.

*Calendra callosa* (Olivier).

- FIG. 1. Labrum.  
 2. Head, dorsal view.  
 3. Epipharynx.  
 4. Thoracic spiracle.  
 5. Full-grown larva, lateral view.  
 6. Mouth parts, ventral view.  
 7. Mouth parts, dorsal view.

## PLATE 7.

*Rhynchophorus cruentatus* (Fabricius).

- FIG. 1. Labrum.  
 2. Head, dorsal view.  
 3. Epipharynx.  
 4. Thoracic spiracle.  
     a. Opening.  
     b. Longitudinal section of spiracle and trachea showing closing apparatus.  
     c. Cross section showing closing apparatus of spiracle.  
 5. Full-grown larva, lateral view.  
 6. Mouth parts, ventral view.  
 7. Mouth parts, dorsal view.

## PLATE 8.

*Scyphophorus acupunctatus* (Gyllenhal).

- FIG. 1. Labrum.  
2. Head, dorsal view.  
3. Epipharynx.  
4. Thoracic spiracle.  
5. Full-grown larva, lateral view.  
6. Mouth parts, ventral view.  
7. Mouth parts, dorsal view.

## PLATE 9.

*Yuccaborus lentiginosus* (Casey).

- FIG. 1. Labrum.  
2. Head, dorsal view.  
3. Epipharynx.  
4. Thoracic spiracle.  
5. Full-grown larva, lateral view.  
6. Mouth parts; ventral view.  
7. Mouth parts, dorsal view.

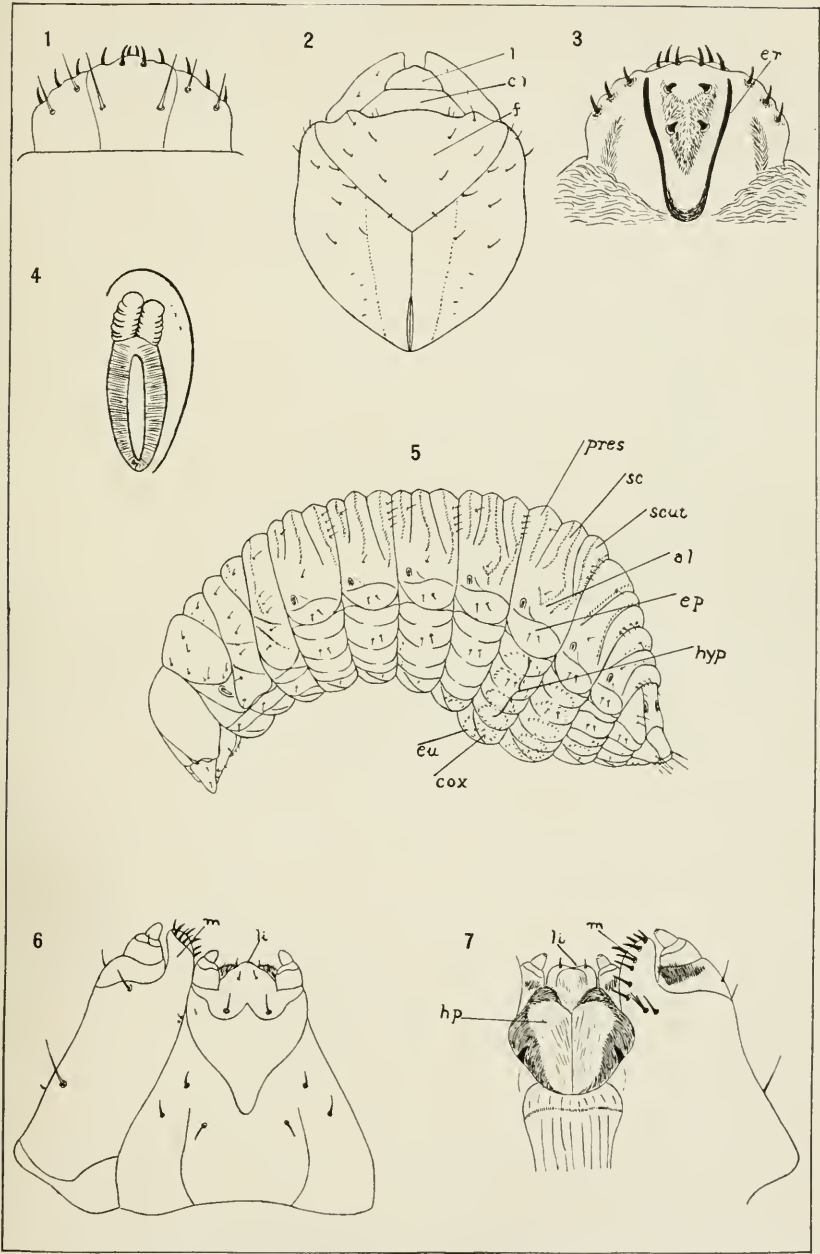
## PLATE 10.

- FIG. 1. *Sitophilus*, buccal side of mala.  
2. *Rhodobaenus*, buccal side of mala.  
3. *Cactophagus*, buccal side of mala.  
4. *Cosmopolites*, buccal side of mala.  
5. *Yuccaborus*, buccal side of mala.  
6. *Metamasius*, buccal side of mala.  
7. *Scyphophorus*, buccal side of mala.  
8. *Calendra*, buccal side of mala.  
9. *Rhynchophorus*, buccal side of mala.



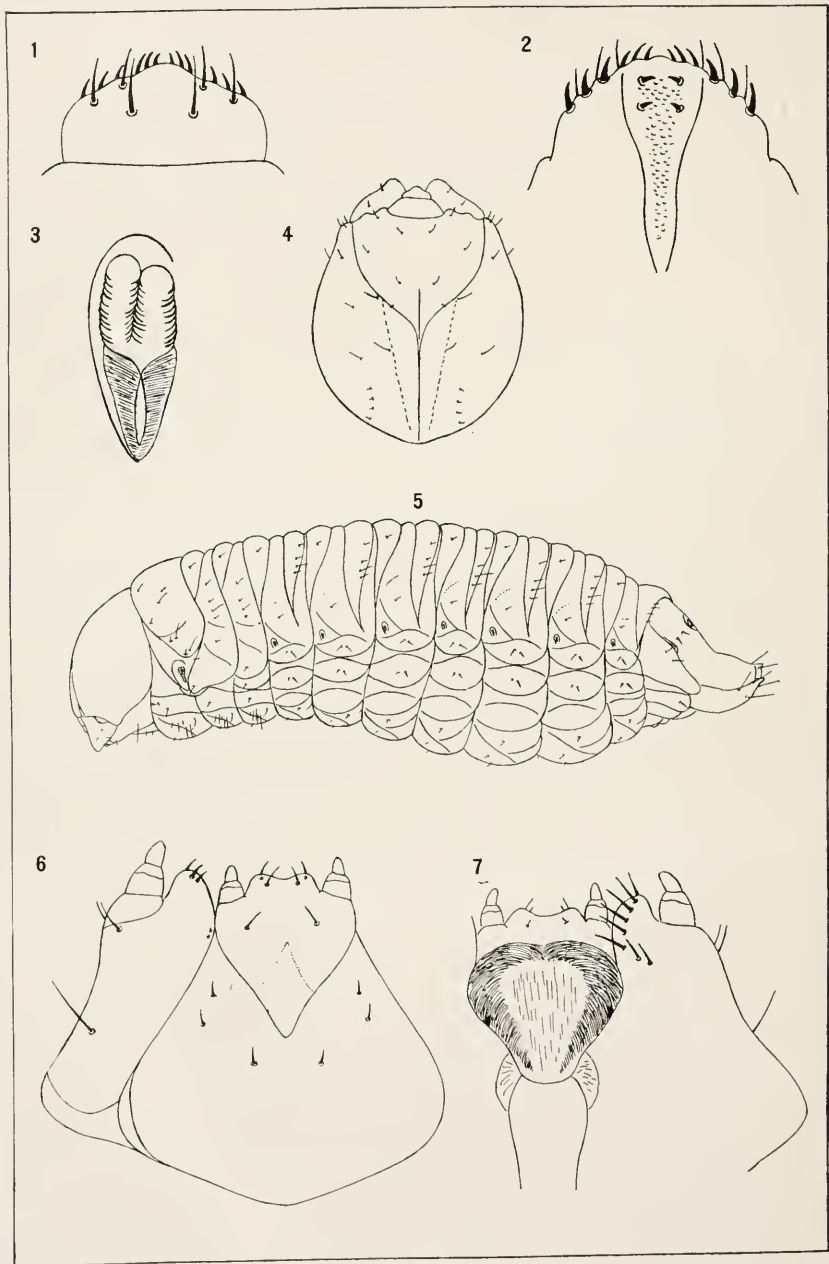






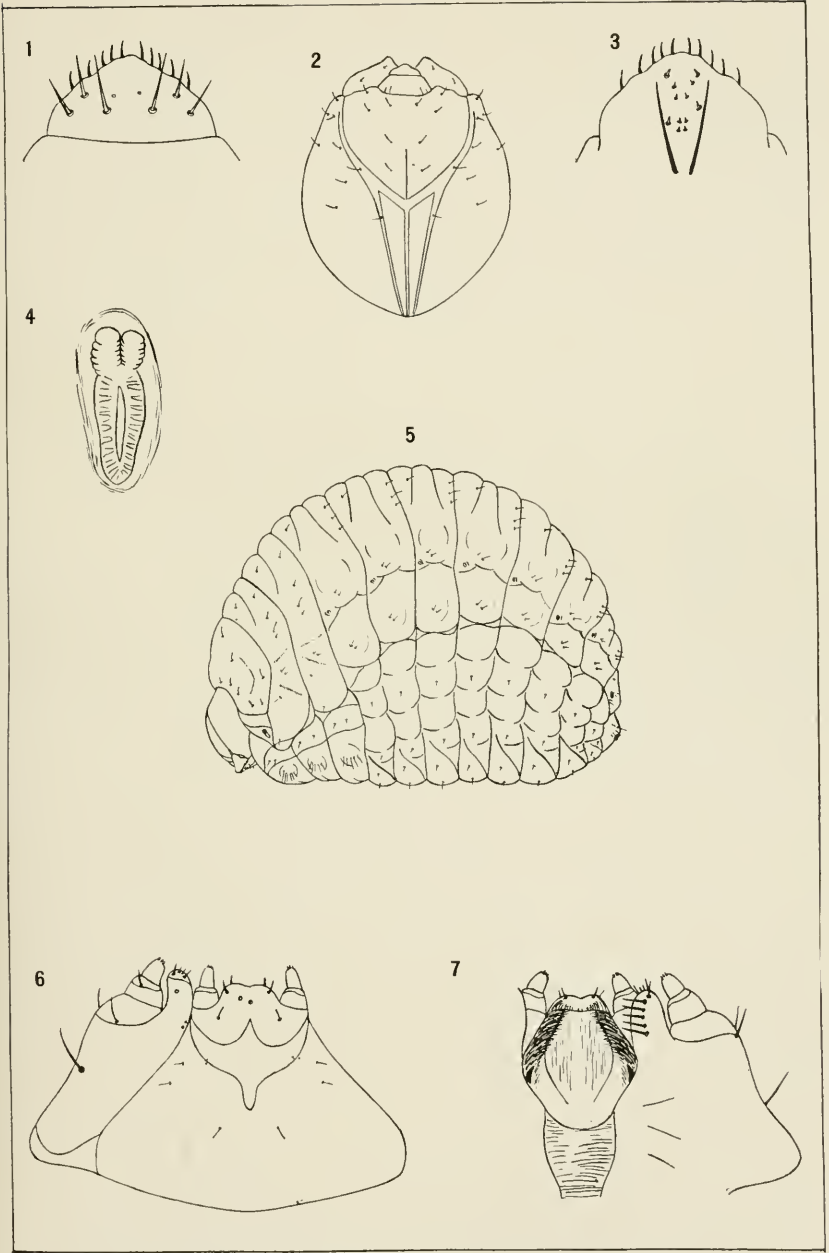
DETAILS OF CACTOPHAGUS VALIDUS (LECONTE)

FOR EXPLANATION OF PLATE SEE PAGE 9



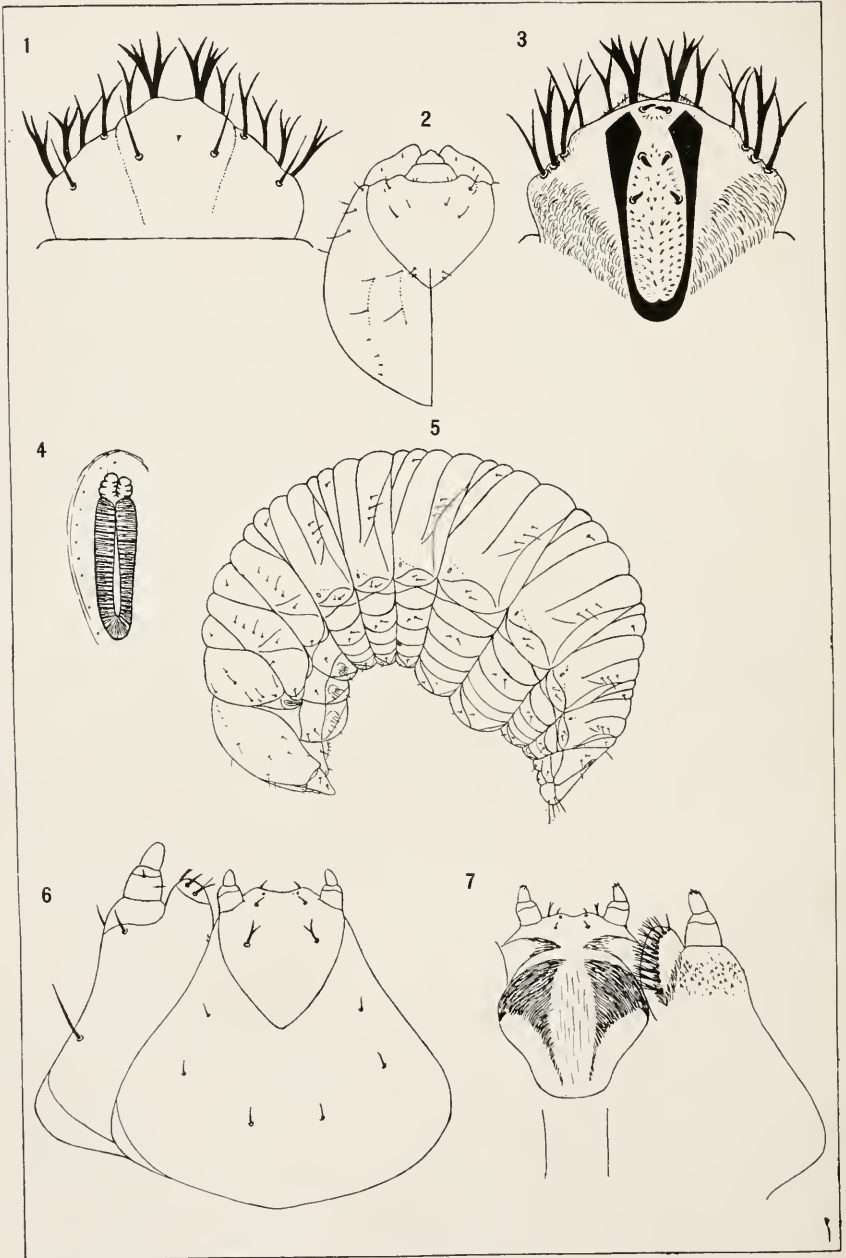
DETAILS OF RHODOBAENUS TREDECIMPUNCTATUS (ILLIGER)

FOR EXPLANATION OF PLATE SEE PAGE 9



DETAILS OF SITOPHILUS GRANARIUS (LINNAEUS)

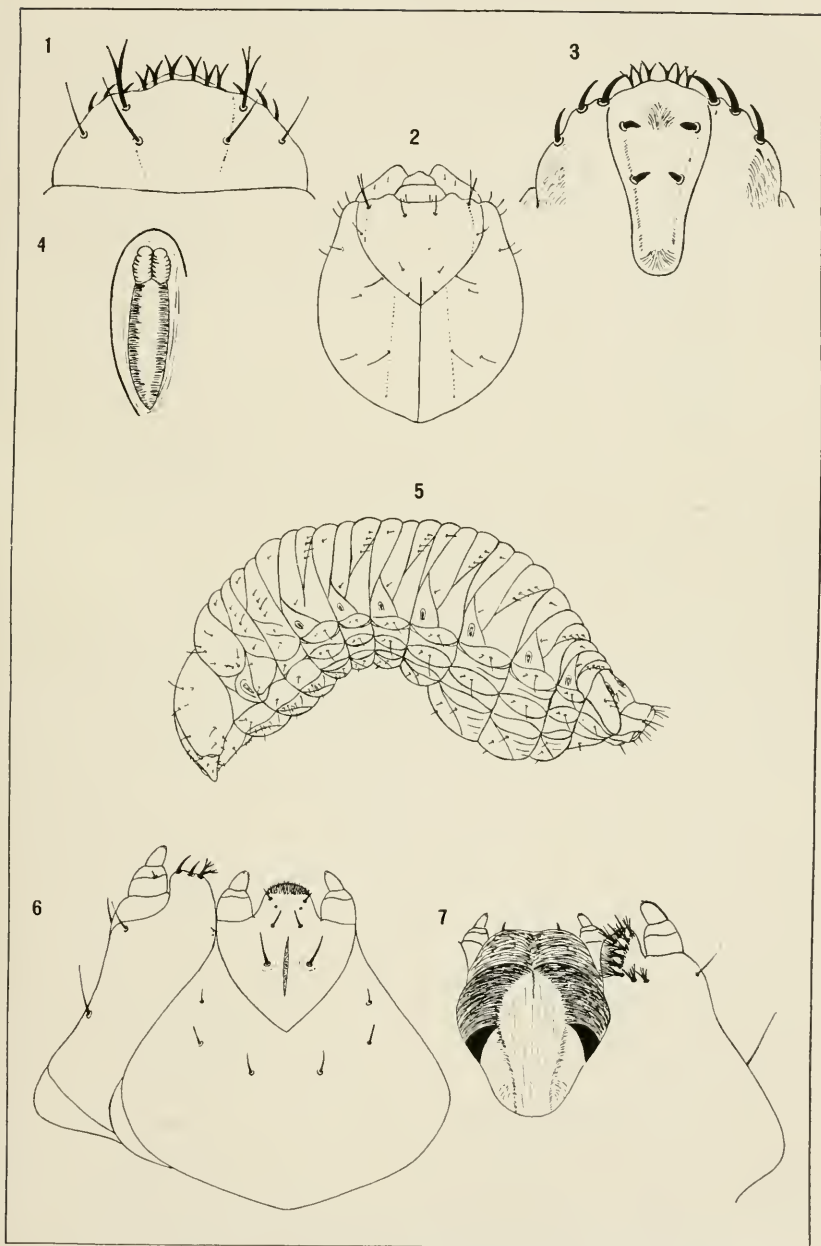
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DETAILS OF *COSMOPOLITES SORDIDUS* GERMAR

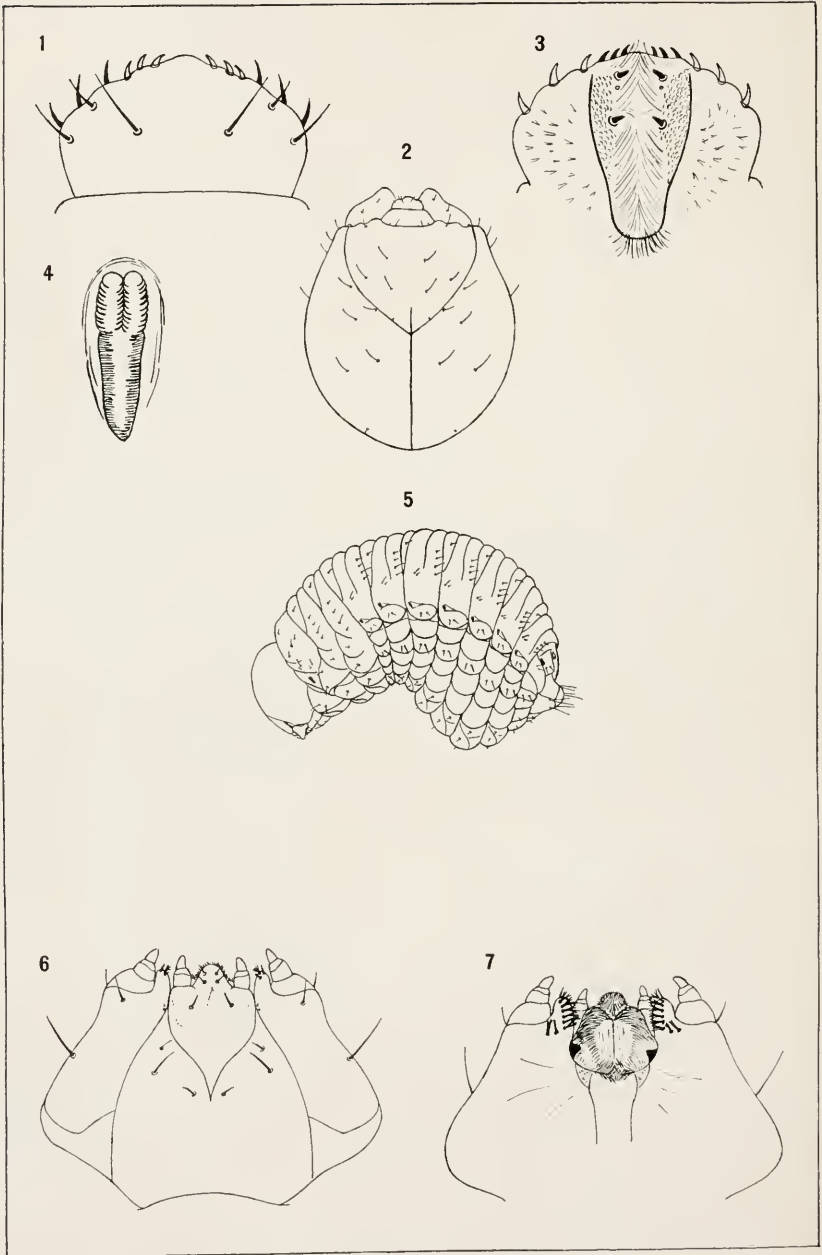
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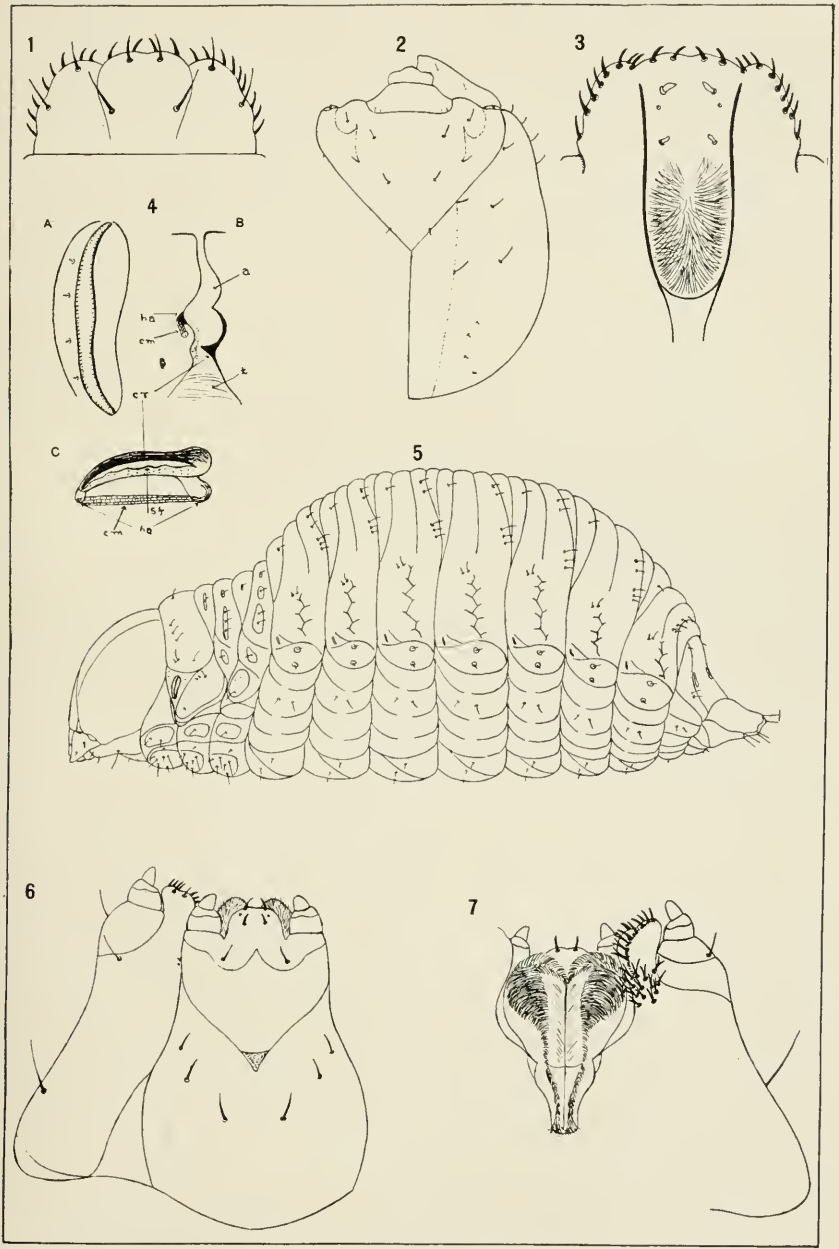
DETAILS OF *METAMASIVS SERICEUS* (LATREILLE)

FOR EXPLANATION OF PLATE SEE PAGE 10



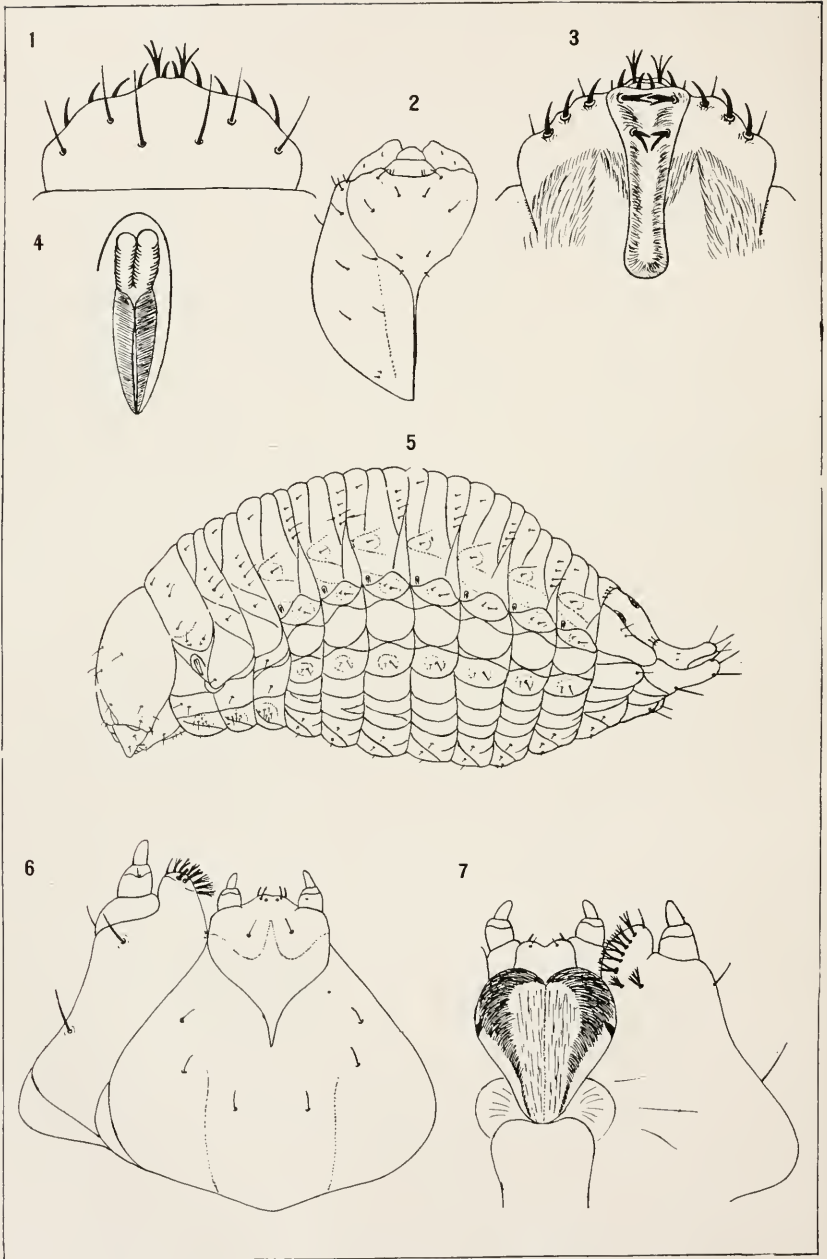
DETAILS OF CALENDRA CALLOSUS (OLIVIER)

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DETAILS OF RHYNCHOPHORUS CRUENTATUS (FABRICIUS)

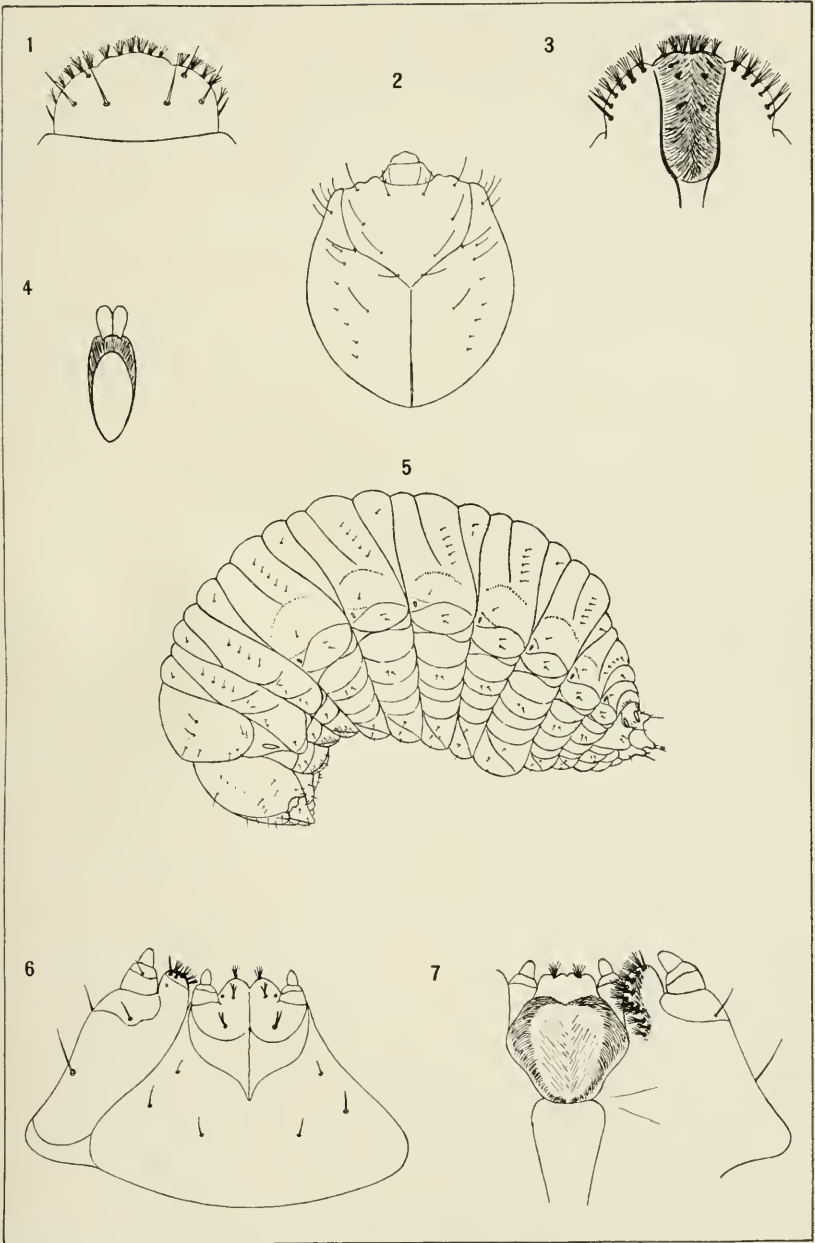
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DETAILS OF SCYPHOPHORUS ACUPUNCTATUS (GYLLENHAL)

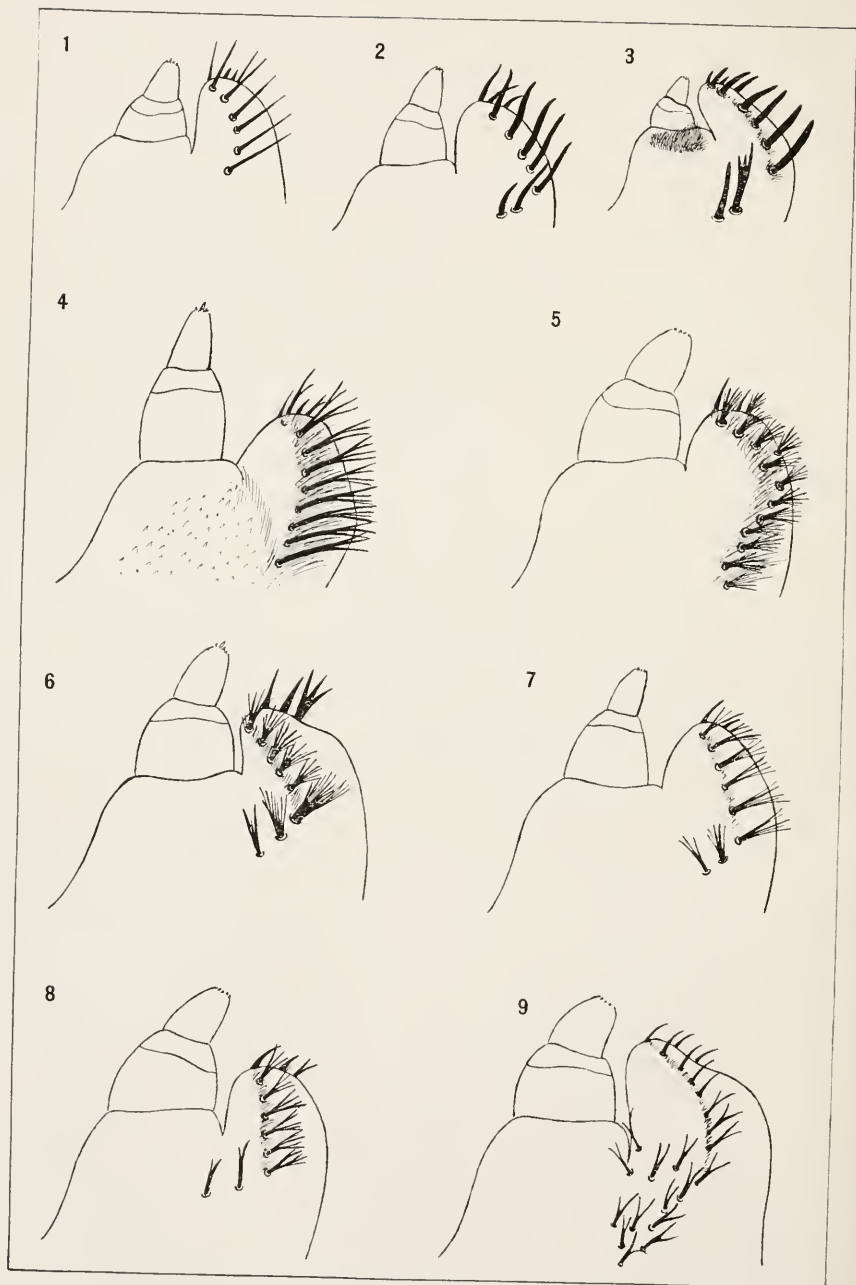
FOR EXPLANATION OF PLATE SEE PAGE 11





DETAILS OF THE GENUS *YUCCABORUS* LECONTE

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BUCCAL CHARACTERS OF CALEDRINAE

FOR EXPLANATION OF PLATE SEE PAGE 11



