

STUDIES ON THE LARVÆ OF NORTH AMERICAN  
BEETLES OF THE SUBFAMILY TENEBRIONINÆ  
WITH A DESCRIPTION OF THE LARVA AND PUPA OF  
*MERINUS LAEVIS* (OLIVIER).

---

By R. A. ST. GEORGE,

*Of the Bureau of Entomology, United States Department of Agriculture.*

---

INTRODUCTION.

The present paper gives a revised systematic characterization of the larvae of the subfamily Tenebrioninae; discusses a suggested close relationship between the larvae of this subfamily and those of the Blaptinae; it enumerates and gives a detailed account of the larvae of the genera of Tenebrioninae which are present in the National Collection, it further discusses LeConte's old genus *Neatus*, and gives a generic key. In conclusion it has a general morphological description of the hitherto undescribed larva and pupa of *Merinus laevis*. (Olivier).

Family TENEBRIONIDÆ.

The larvae of the family Tenebrionidae were characterized by Schiödte, 1879.<sup>1</sup>

The characterization is still applicable, and comparatively few additions and changes in the original diagnosis are needed in spite of the great number of new larval types described since Schiödte's work was published.

The following family diagnosis is therefore to be considered as a mere translation of his Latin text with some of the original descriptive terms modified to suit the modern nomenclature and with a few new characters added and other slightly changed.<sup>2</sup>

FAMILY CHARACTERIZATION.

Tarsus and claw fused into a single, unguiform article. Legs short, fitted for digging and walking; coxæ conical, inclinate, prothoracic coxæ (normally) approximately contiguous. Head

---

<sup>1</sup> De metamorphosi Eleutheratorum Observationes Tenebriones Naturhist. Tidsskr., ser. 3, vol. 10, pp. 479-598, pls. 5-12.

<sup>2</sup> Insertions into the original text are inclosed by parenthesis.

nutant, no collum, foramen occipitale posterior. Second and third pairs of mouthparts retracted, with large, plicate, moderately convex maxillary articulating area. Clypeus distinctly separated. Labrum large, (nearly) covering the mandibles. Antenna inserted behind mandible, lateral, hardly longer than mandible, triarticulate; membrane connecting antenna with acetabulum protruding, joint-like. Mandible with molar part robust, cutting part bi-ortridentate, ventrally excavate. Maxilla covered by mandible; cardo large, triangular; stipes well developed, broad; cardo and stipes connected with submentum by maxillary articulating area; maxillary mala single, obtuse (or acute), pectinate; maxillary palpus not much longer than mala, triarticulate, with annular basal membrane. Labial palpus short, conical, biarticulate; stipites labii concrete. Mentum large, (normally) barrel-shaped, free; submentum large, trapezoidal, connected with maxillary articulating area. Gula simple, (normally) quadrangular. Ligula small (acute or obtusely pointed), bispinose (or multispinose). Abdomen prolonged, ninth segment terminal with pygidium extending over anal segment. Anal segment short, (sometimes) with two projecting and retractile ambulatory warts (verrucae). Spiracles annular, open, with a single respiratory slit.

#### Subfamily TENEBRIONINAE.

The family Tenebrionidae is divided by modern systematists into a great many subfamilies; Leng's catalogue of North American species records 22 subfamilies. Investigation of the larvæ seems to substantiate the correctness of this classification, which is based entirely on characters from the adults. However, the three main sections into which Schiödte divides the larvae can be considered only to a limited extent equivalent to three series of our subfamilies. Thus his first main section corresponds roughly to the subfamilies Scaurinae, Blaptinae, and Opatrinae; his third main section is equivalent to the subfamily Alleculinae; while his second main section represents at least five subfamilies. Among these is the subfamily Tenebrioninae (created by Gebien, 1910), with which the present paper is particularly concerned.

The Tenebrioninae are represented in Schiödte's work by only one genus, namely, *Tenebrio*, but in the National Collection there are some 13 genera referable to the subfamily and the representation in our collection of the other Tenebrionid subfamilies has increased proportionally. It is therefore obvious that Schiödte's group characterizations are no longer adequate, and in this paper the writer is attempting the needed recharacterization only of the subfamily Tenebrioninae. The other subfamilies, however, have been studied as far as available larval material permitted.

The morphological structures here examined are those which Schiödte discussed in his conspectus and upon the different development of which he formulated his diagnoses. It was due entirely to a lack of sufficient material when Schiödte's conspectus was formulated that it is now antiquated. His methods of research, however, and his sound judgment are still unsurpassed.

#### SUBFAMILY CHARACTERIZATION.

Mandible with the back opposite the cutting edge, without margination<sup>3</sup> and excavated opposite the molar part; without membranous elevation<sup>3</sup>; apically bifid or trifid; with or without additional dorsal tooth between apex and molar part. Ocelli<sup>4</sup> arranged in two transverse, crescent shaped or circular groups on each side of head, and with five more or less fused lenses; or with only ophthalmic spots which vary from being distinct to vanishing. Antenna<sup>4</sup> with basal article distinctly longer than wide. Labrum dorsally without transverse, densely setose elevation. Leg with claw falcate, enlarged at base on exterior side. Pygidium apically bicornute, or without cerci and with side margins sharp and bearing short spine-like setae. Anal segment with or without projecting and retractile ambulatory warts (verrucae). Abdominal spiracles oval and transverse.

#### AFFINITIES BETWEEN THE SUBFAMILIES TENEBRIONINAE AND BLAPTINAE.

The value of the subfamily diagnosis of the Tenebrionidae as given above, depends more on the exact combination of the characters chosen than on a very special and exclusive development of the single characters; hence the diagnosis is formulated with rather liberal allowance for considerable variation in most of them. In this connection it is interesting to notice that through a series of genera these structures show a gradually increasing similarity to the corresponding structures in the genera *Blaps*, *Eleodes*, and *Embaphion*, which constitute an entirely different subfamily, namely, the Blaptinae.

In the genera *Xylopinus*, *Hapladrus*, *Polypleurus*, *Iphthimus*, *Alobates*, and *Glyptotus*, which represent the most typical forms of the subfamily Tenebrioninae, the left mandible has a trifid apex ( $a^1$ ,  $a^2$ ,  $a^3$ , fig. 32) and an additional tooth ( $t$ ) on the dorsal side near apex; the right mandible is also trifid ( $a^1$ ,  $a^2$ ,  $a^3$ , fig. 33) but lacks the additional tooth ( $t$ ) between the apex and molar part. In *Upis*,

<sup>3</sup> Except *Rhinandrus* and *Zophobas*, which have slight marginations and membranous elevations.

<sup>4</sup> In small immature larvæ the ocelli are more prominent and the proportions of antennal articles variable. In *Scotobates* the basal article is nearly as wide as long and the second article is long and globose.

*Merinus*, and *Scotobates* the mandible has changed slightly; both right and left mandibles are still apically trifid but both lack the additional dorsal tooth. (Figs. 2 and 5.) A still further modification of the mandible takes place in *Coelocnemis* and *Tenebrio*, which show the beginning of the mentioned affinity to the Blaptinae. In this subfamily the left mandible is bifid with a dorsal tooth near the molar part, and the right mandible is bifid with a dorsal tooth near apex. Moreover the back of the mandible has a slightly developed carinate edge opposite the cutting part, and opposite the molar part a well developed completely exposed membranous elevation with either a few rather strong setae arranged in groups anteriorly and posteriorly, or with many scattered, rather short and rigid setae. Compared with these structures in Blaptinae, we find in *Coelocnemis* each mandible bifid at apex, the left with an additional dorsal tooth near the molar part, the right with a tooth near apex (*t*, fig. 54). In this particular development, all species of *Tenebrio* are identical with *Coelocnemis*. In the latter genus (fig. 54) and the two species, *Tenebrio molitor* and *Tenebrio obscurus*, there is only one seta anteriorly and two setae posteriorly on the dorsal side of the back of the mandible (fig. 51) but in *Tenebrio picipes* (fig. 53) the setae are scattered and numerous as in some genera of the Blaptinae. Finally, the genera *Zophobas* and *Rhinandrus* demonstrate quite strongly the suggested affinity of the Tenebrioninae with Blaptinae, possessing in addition to the characters of *Coelocnemis*, *Tenebrio molitor*, and *Tenebrio obscurus*, a slight margin on the back opposite the cutting edge and also a membranous elevation opposite the molar part, two characters which do not occur in the other Tenebrioninae. In *Zophobas* the margin on the back of the mandible is rounded (*c*, fig. 62) while in *Rhinandrus* it is sharp (*c*, figs. 60 and 61) which is also typical of the Blaptinae (figs. 64 and 65, *Eleodes*). The setae on the anterior part of the membranous elevation are not as numerous in *Zophobas* and *Rhinandrus* as in the Blaptinae, but otherwise we find the whole structure developed exactly as in this subfamily.

In the typical Tenebrioninae the pygidium is bicornute at apex with side margins rounded, and either without setae, or with setae arranged in a transverse series in front of the cerci. (Figs. 36, 41, and 45.) In *Tenebrio molitor* and *Tenebrio obscurus* it is apically bicornute, but with side margins sharp and with two short, spinelike setae on each side near apex. (Figs. 49 and 50.) In *Tenebrio picipes* the apex is acute, not bicornute (fig. 52) and side margins are sharp but with many setae, bearing a striking resemblance to the pygidium of *Eleodes tricostata*. (Fig. 63.) In *Zophobas* and *Rhinandrus* the pygidium is apically obtuse, without cerci and with side margins sharp and bearing two short spinelike setae on each side near apex.

(Figs. 56 and 57.) This form of pygidium shows a strong resemblance to that of *Eleodes opaca* (figs. 66 and 67) and *Eleodes carbonaria* (fig. 68).

In regards to the size of the anterior legs, as compared with that of the second and third pairs, the Tenebrioninae show considerable variation. In *Haplandrus*, *Scotobates*, and *Tenebrio* the first pair of legs are only slightly larger than the second and third pairs so that all legs appear to be nearly of the same size (figs. 47 and 48); but in *Polypleurus*, *Coelocnemis*, *Glyptotus*, *Xylopinus*, *Ipthimus*, *Upis*, *Merinus*, *Alobates*, *Zophobas*, and *Rhinandrus* the first pair of legs are strong and robust, and the second and third pairs rather suddenly decrease in size (figs. 17, 22, 34, 35). This difference is greatest in *Rhinandrus* (figs. 58 and 59), less in the other genera, increasing slightly according to the sequence in which they are mentioned. In this character *Zophobas* and *Rhinandrus* are close to the Blaptinae.

The ocelli also differ somewhat in arrangement and prominence within the subfamily. They are arranged in two transverse, crescent shaped or circular groups. In prominence they may vary from being distinct to vanishing or apparently wanting. The various ocelli on each side of the head may be represented in the ocellar groups either by lenses, more or less fused, or only by pigmented spots which may be either distinct or indistinct. In one Central American species<sup>5</sup> in the national collection, apparently closely related to *Coelocnemis*, five distinct ocelli are present in two transverse groups and the lenses are separated and protruding. In *Upis* and *Merinus* the ocelli in each of the groups are without spaces between the lenses and less protruding. In *Scotobates*, *Ipthimus*, *Haplandrus*, *Glyptotus*, and *Tenebrio* the divisions between the lenses can not readily be seen and the latter are almost fused together, so that each group of ocelli appears more or less as a single large ocellus. This is particularly the case in *Tenebrio*, where the two ocellar groups appear as two single ocelli and are so described by Schiödde. In *Alobates*, *Coelocnemis*, *Rhinandrus*, and *Zophobas*, the ophthalmic spots vary from being present to vanishing. By considering the ocelli as two groups, even when each is fused into what appears to be a single ocellus, we can include all genera of the Tenebrioninae in our characterization. In the Blaptinae the ocelli are evanescent.

The abdominal spiracles are oval and transverse in all genera of both Tenebrioninae and Blaptinae.

<sup>5</sup> Labeled: "Cacao, Trece Aguas, Alto Verapaz, Guatemala, collected April, 1906, by E. A. Schwarz."

From the foregoing it is apparent that *Rhinandrus* and *Zophobas* more closely resemble the Blaptinae than do any other genera of the Tenebrioninae. In fact the only consistent character separating them from the Blaptinae is the absence of any transverse, densely setose elevation on the labrum, a character present in all Blaptinae and absent in all Tenebrioninae.

#### GENERA OF SUBFAMILY TENEBRIONINAE.

Of the 23 genera of the subfamily Tenebrioninae in the United States, which Leng<sup>6</sup> recognizes, larvae of the following 13 were available for study:

The genus *Polypdelurus* Eschscholtz, of which there are three species, is represented by *germinatus* Solier. The material consists of a larval skin and a reared adult. The larva was found by the author in a decayed oak twig at Falls Church, Virginia, July 25, 1918, and reared September 7, 1918.

Material of the genus *Rhinandrus* LeConte consists of several larvae, larval skins, a pupa, pupal remains, and reared adults of *sublaevis* Horn. The larvae were taken by H. G. Hubbard from the nest of a rat (*Neotoma albigula*) in Tucson, Arizona, during the period from January to June, 1897, and reared by T. Pergande. Doctor Schwarz states that it is very difficult to separate the adults from those of *Alobates sublaevis* (Beauvois), and he was at first in doubt as to which genus they belonged. He has not had an opportunity to examine the types. The larvae of these two genera, however, can be easily separated by the characters given in the key. On the other hand, the larvae of Hubbard are hard to separate from *Zophobas*, closely allied to *Rhinandrus*. For this reason Doctor Schwarz, like the writer, feels quite certain that the above-mentioned material is referable to *Rhinandrus*.

The genus *Zophobas* Blanchard contains only one species (*morio* Fabricius). A larval specimen was collected by E. A. Schwarz in the canal zone of Panama, February, 1911. Doctor Schwarz is not positive of the determination, but from a comparison of the characters of this with the closely allied *Rhinandrus sublaevis*, the writer feels quite certain that the determination is correct. Another larval specimen, collected by M. A. Palmer, in a cave at Guana Jay, Cuba, May 5, 1900, is very closely related to this genus.

The genus *Scotobates* Horn, consisting of two species, is represented in the national collection by *calcaratus* (Fabricius). Since this is one of the most abundant species in the eastern part of the

<sup>6</sup> Leng, C. V., 1920, Catalogue of the Coleoptera of America, North of Mexico, pp. 218-219. The names of Leng is followed throughout in discussing the material represented under each genus.

United States, it is well represented. Many of the specimens have been reared.

The genus *Merinus* LeConte is represented by its only species, *laevis* (Olivier). The material, associated with reared adults, consists of several larvae and pupae collected by the writer near Falls Church, Virginia, July 23, 1918. The rest of the larval material, not associated by rearing experiments, consists of the following specimens: one larva taken by H. S. Barber from a dead branch in the top of a cherry tree at Occoquan, Virginia, July 4, 1908; a second larval specimen taken from beneath the bark of a dead maple tree at Dead Run, Virginia (opposite Plummer Island, Maryland), February 17, 1915 (H. G. Champion, collector); and a third specimen taken by the writer from under chestnut bark at Black Pond, Fairfax County, Virginia.

The genus *Xylopinus* LeConte is represented by both its species, *saperdioides* (Olivier) and *aenescens* LeConte. The material consists of several specimens of *saperdioides* associated by rearing, as follows: larval skin (larva taken by A. B. Champlain from a decayed sycamore tree at Harrisburg, Pennsylvania, April 7, 1913, and adult reared June 10, 1913); several larvae taken by F. C. Craighead from the heartwood of a dead, dry oak log at Great Falls, Virginia, May 30, 1916 (pupa collected with these transformed June 8, 1916); and several larvae taken by F. C. Craighead from beneath the bark of a decayed oak log near Great Falls, Virginia, May 25, 1919 (adults reared June 4, 1919, from part of the same collection). The material representing the species *aenescens*, consists of two larval skins; one of larva taken by T. E. Snyder from beneath the bark of a decayed oak at Shipman, Virginia, October 11, 1913, and from which adult was reared May 28, 1914; another of larva taken by T. E. Snyder at Black Mountain, North Carolina, March 22, 1913, which pupated April 15 and transformed to imago May 9, 1913.

The genus *Hapladrus* LeConte, of which there are three species, is represented by *fulvipes* (Herbst). The material associated by rearing consists of the following specimens: Four alcoholic larvae and one larval skin, the latter from a specimen which pupated May 15 and issued May 23, 1913, all out of a collection of five larvae taken by A. B. Champlain from a dead white pine at Charter Oak, Pennsylvania, April 10, 1913; and ten alcoholic larvae and one larval skin, the latter from a specimen which was reared through to adult April 16, 1914, all out of a collection of eleven larvae taken by E. A. Schwarz and H. S. Barber in a dry trunk of redbud at Plummer Island, Maryland, August 27, 1913. Of the material not associated by rearing there are several specimens taken from a rotten oak at Plummer Island, Maryland, by Messrs. Schwarz and Barber. Other specimens were collected as follows: Larval skin and adult taken by

R. C. Shannon from an oak log at Dead Run, Fairfax County, Virginia, August 6, 1915; and a larva collected by C. G. Marshall at Silver Hill, Maryland, February 22, 1916.

An undetermined larva, closely related to the genus *Hapladrus*, was taken by H. S. Barber at Brownsville, Texas, who suggests that it may represent a species belonging to the Mexican fauna.

The genus *Coelocnemis* Mannerheim, of which there are five species, is represented by *dilatocollis* Mannerheim. The material consists of two larval specimens, not associated by rearing, collected by D. W. Coquillett in Los Angeles County, California. The rest of the material is without specific determination and consists of two larvae taken by H. S. Barber from under stones at Williams, Arizona, between May 30 and June 8, 1901; one larva taken by E. A. Schwartz from the ground at Oracle, Arizona, July, 1898; and a third larval specimen taken by Schwarz and Barber from Cacao trees at Aguas Alta, Verapaz, Guatemala, April, 1906.

The genus *Iphthimus* Truqui, consisting of three species and three varieties, is represented by *serratus* (Mannerheim) and its varieties. The material representing the variety *sublaevis* Bland consists of: Larval specimens found in *Pinus ponderosa* at El Paso County, Colorado, February 26, 1914 (A. B. Champlain, collector), from a larva taken with them an adult was reared July 3, 1914; two larval specimens, not associated by rearing, taken by E. A. Schwarz and H. S. Barber at Williams, Arizona, during June, 1901; and a third larva taken from the decayed part of a telephone pole above the ground, on the Montgomery to New Orleans line, during August, 1921. The remaining specimens of the species *serratus*, not associated by rearing, were collected as follows: One larva from a decayed log in a Tamarack swamp at Detroit, Michigan (H. G. Hubbard, collector); a second larva taken at Field Brooks, California, May 19, 1903 (H. S. Barber, collector); and a third larval specimen from a sycamore log at Smith Point, Texas, November 15, 1918 (H. S. Barber, collector). One other larva, determined as *Iphthimus* species, was taken by H. G. Hubbard from a decayed log at Hood River, Oregon, May 21, 1892.

The material representing the variety *lewisi* Horn consists of four larvae taken together with adults, from under the bark of a tree at Lake Tahoe, California, July 8, 1891 (H. G. Hubbard, collector), and three pupae and one adult taken by F. G. Schaupp at Kelly, New Mexico, July, 1890.

The genus *Alobates* Motschulsky, of which there are three species, is represented by *pennsylvanica* (De Geer). As this species is very common in the eastern part of the United States there are many specimens of it. The larval material, of which part is associated by rearing, has been taken mainly from beneath the bark and in the outer



sapwood of maple, oak, chestnut, tulip, and sycamore trees. Adults of this species usually emerge about the first week in July. A single larval specimen, collected by D. W. Snyder at Luebo, Congo, Africa, appears to be closely related to this genus.

The genus *Glyptotus* LeConte, containing the single species *cribratus* LeConte, is represented by only one larval specimen. It was taken by H. S. Barber from a dead limb of a palm tree (*Thrinax*) on Big Pine Key, Florida, March 6, 1919. This specimen was determined by the writer, by locality, by comparison with size of adult and by a process of elimination of larval characters. Doctor Schwarz states that the species *cribratus* is about the only one there of its size and that it occurs in large numbers.

The genus *Upis* Fabricius is represented by its only species *ceram-boides* Linnaeus. The reared material consists of several larvae which were taken by S. A. Rohwer from beneath the bark of a dead white birch tree at Trout Lake, Wisconsin, September 23, 1913. Some larvae of this lot of material were caged September 27 and from them an adult emerged July 3, 1914. Of the material not associated by rearing experiments there are several larvae which were taken by H. G. Hubbard on the shores of Lake Superior, Michigan, July, 1876; and one larva taken from a decayed log by the same collector at Hood River, Oregon, May 21, 1892.

The genus *Tenebrio* Linnaeus, of which Leng recognizes the three species *obscurus* Fabricius, *molitor* Linnaeus, and *picipes* Herbst, is well represented by material from various parts of the United States and a few specimens from Europe. Part of the material from this country has been reared.

The larval habits of the two first-mentioned species are interesting in view of the fact that they have so many hosts. Besides being found in stored grain, they have also been found in a nest of *Bombus*, debris of a flying squirrel's nest, in *Tigridia*, in roots of *Althaea*, and in hydrolyzed sawdust, which was being fed to cattle.

The material representing *picipes* Herbst consists of the following: Larva and adult taken from a rotten log at Rockville, Pennsylvania, November 13, 1913 (H. B. Kirk, collector); three larvae and two adults found in nest of *Bombus* at Detroit, Michigan, probably in July, 1876 (H. G. Hubbard, collector); and a single larval specimen collected "on strawberries" at De Queen, Arkansas, March 26, 1921 (J. W. Berg, collector).

#### DISCUSSION OF LECONTE'S OLD GENUS NEATUS.

It may have been realized from the comments in the preceding discussion that, in the little group of species which are included under the genus *Tenebrio* Linnaeus, the species *picipes* Herbst occupies a position distinctly separate from the more typical forms, *molitor*

Linnaeus and *obscurus* Fabricius. This is largely due to differences in structures exhibited by the larvae. These can be briefly summarized as follows: Setae on the dorsal side of the back of mandible are scattered and numerous, instead of grouped with one seta anteriorly and two setae posteriorly as in the two latter forms mentioned above; and pygidium is apically acute, without cerci and with many short, spinelike setae along the lateral margins, instead of bicornute and with only two spinelike setae along each margin near cerci.

LeConte in his Classification of the Coleoptera of North America,<sup>7</sup> founded a new genus *Neatus*, based on *tenebriodes* Beauvois. Later this species was identified with the European *Tenebrio picipes* Herbst. His genus was unfortunately lost sight of for many years.

From the standpoint of larval characters it should be recognized either as a good genus or a marked subgenus. Seidlitz, in Erickson's Naturgeschichte der Insecten Deutschland,<sup>8</sup> gives a concise key to the larvae of *Tenebrio* which is here translated and slightly changed to properly set off *Neatus* LeConte as a distinct genus.

1. The last dorsal segment terminating in two hook-shaped points, on the sides of which there are at most two small spines..... 2.  
The last dorsal segment terminating only in one point, near which on either side, are numerous small spines..... **Neatus picipes** Herbst.
2. The two points of the last dorsal segment distinctly bent upward..... 3.  
The two points on the last dorsal segment almost horizontal  
**Tenebrio opacus** Duftschmid.
3. The last dorsal segment shorter than its width at the base; the two points are little divergent; the upper side light yellow  
**Tenebrio molitor** Linnaeus.  
The last dorsal segment as long as its width at the base; the two points are more strongly divergent; the upper side is dark brown  
**Tenebrio obscurus** Fabricius.

Later Mr. Edmund Reitter, in his Fauna Germanica<sup>9</sup> treats *Neatus* as a subgenus of *Tenebrio* without giving any characters.

The genera previously described in this paper can be separated by the following characters:

KEY TO THE GENERA OF TENEBRIONINAE.

- Back of mandible opposite molar part with membranous elevation (*S*, figs. 60, 61, 62)..... 1.  
Back of mandible opposite molar part without membranous elevation (figs. 2, 5, and 32)..... 2.
1. Back of mandible opposite cutting edge with margin sharp (*c*, figs. 60 and 61); near condyle for ventral articulation of mandible, two strong setae (Lower California and Arizona)..... **Rhinandrus** LeConte.  
Back of mandible opposite cutting edge with margin round (fig. 62); near condyle for ventral articulation of mandible, one strong seta (Central and South America and Florida)..... **Zophobas** Blanchard.

<sup>7</sup> Part 1, 1861, p. 233.

<sup>8</sup> Vol. 5, 1896, pp. 628-630.

<sup>9</sup> Vol. 3, 1911, p. 347.

2. Mandibles apically trifold ( $a^1$ ,  $a^2$ ,  $a^3$ ) with (figs. 32) or without (figs. 2 and 5) an additional dorsal tooth ( $t$ ) between apex and molar part ( $m$ )— 3.  
Mandibles apically bifid ( $a^1$ , and  $a^2$ ) with an additional dorsal tooth ( $t$ ) between apex and molar part (figs. 51, 53, 60, and 62)----- 12.
3. Left mandible with additional tooth between apex and molar part; right mandible without tooth ----- 4.  
Both left and right mandibles without additional tooth between apex and molar part ----- 10.
4. Ninth abdominal segment short and upwardly directed; dorsal shield of ninth articulating by lateral condyles with dorsal shield of eighth ring; cerci with basal projections (figs. 36, 37, 38, 39)----- 5.  
Ninth abdominal segment not short and upwardly directed, dorsal shield continuous with that of eighth segment; cerci without basal projections (figs. 14, 40, 45, 49)----- 6.
5. Eighth tergum posteriorly produced into a transverse series of conelike projections or teeth (fig. 36)----- An undetermined specimen.  
Eighth tergum entire, not produced into a transverse series of conelike projections (fig. 37)----- **Haplandrus** LeConte.
6. Pygidium with small seta-bearing spines anterior to cerci (figs. 9, 40, 41, 55)----- 7  
Pygidium without small seta-bearing spines anterior to cerci (fig. 45)  
**Polypleurus** Eschscholtz.
7. Epipharynx with many short, spinelike setae on the soft skinned part (fig. 1) (eastern and southern species)----- **Xylopinus** LeConte.  
Epipharynx with only two short, spinelike setae on the soft skinned part (*eph*, fig. 31)----- 8.
8. Pygidium with transverse row of strong, hook-shaped, seta-bearing spines anterior to cerci----- **Glyptotus** LeConte.  
Pygidium with small, but not hook-shaped, seta-bearing spines anterior to cerci (fig. 44)----- 9.
9. Trochanter and femur of all legs similarly armed with small seta-bearing spines (figs. 42 and 43) (northern and western species)  
**Iphthimus** Truqui.  
Trochanter and femur of all legs not similarly armed; anterior pair with large, coarse, blunt, seta-bearing spines, second and third pairs armed with setae and a few small spines (figs. 34 and 35)  
**Alobates** Motschulsky.
10. Pygidium with small seta-bearing spines anterior to cerci, dorsally with one pair stronger and bifid (figs. 9 and 14); prothoracic legs strong, considerably larger than rest; hypopharyngeal sclerite anteriorly tricuspidate, without median vertical projection (*hsc*, fig. 8); anal segment without projecting and retractile ambulatory warts (verrucae) (figs. 12 and 14); body soft membranous----- 11.  
Pygidium without seta-bearing spines anterior to cerci (fig. 45); prothoracic legs nearly the same size as rest (figs. 47 and 48); hypopharyngeal sclerite anteriorly tricuspidate with median, verticle projection bifid or grooved at apex (fig. 46); anal segment with two projecting and retractile ambulatory warts (verrucae) (*aw*, fig. 45); body corneous-- **Scotobates** Horn.
11. Epipharynx with many short, spinelike setae on soft-skinned part, no two of which are distinctly larger or more prominent than rest (*eph*, fig. 1); back of mandible with two setae, one anteriorly at base of teeth, other near fossa for dorsal articulation of mandible (figs. 2 and 15); trochanter

- of prothoracic leg usually<sup>10</sup> with four consecutive seta-bearing tubercles beneath callous wart on apex (figs. 16, 17). Eastern United States, Indiana, and Missouri)----- **Merinus** LeConte.
- Epipharynx with very few spinelike setae on soft-skinned part, two of which are distinctly larger and more prominent than rest (*eph*, fig. 15); back of mandible with four setae, two anteriorly at base of teeth and two posteriorly near fossa for dorsal articulation of mandible; trochanter of prothoracic leg usually with one small and two large seta-bearing tubercles beneath callous wart at apex (fig. 18) (northern species) - **Upis** Fabricius.
12. Pygidium with apically bicornute cerci (figs. 49, 50, 55)----- 13.  
Pygidium without cerci (fig. 52)----- **Neatus** LeConte.
13. Pygidium without wartlike projections anterior to cerci but with two short, spinelike setae on each side near cerci (figs. 49 and 50); side margins sharp; anal segment with two projecting and retractile ambulatory warts (verrucae) (*aw*, fig. 49)----- **Tenebrio** Linnaeus.
- Pygidium with a transverse series of wartlike chitinous projections anterior to cerci, each one apically with spinelike projections (fig. 55); side margins not sharp; anal segment without projecting and retractile ambulatory warts (verrucae) (figs. 10, 40, 44)----- **Coelocnemis** Solier.

#### LARVA AND PUPA OF MERINUS LAEVIS (OLIVIER).

While collecting in a wood lot near Falls Church, Virginia, July 23, 1918, the author found several prepupal larvae, pupae, and adults under the bark of a large, decaying limb of a maple tree which had fallen to the ground. The material was determined by Dr. E. A. Schwarz as *Merinus laevis* (Olivier). Previous records show that the larvae have also been taken from under the bark of chestnut, red oak, and cherry trees. According to Leng this species is found principally in the eastern part of the United States, but specimens in the national collection and in the collection of the Bureau of Entomology, Division of Forest Insects, show that it occurs as far west as Indiana and Missouri. In the North, *Merinus* is replaced by the closely allied genus *Upis*.

#### GENERAL MORPHOLOGICAL DESCRIPTION OF THE LARVAE.<sup>11</sup>

Length 40 mm., color testaceous with head somewhat darker, submentum, presternum, prehypopleurum and anterior-lateral margin of the prothoracic tergum, castaneous-testaceous; anterior and posterior margins of prothorax and posterior margins of the following segments finely striated longitudinally. Surface coriaceous. Form elongate, cylindrical, about ten times longer than wide; dorsally con-

<sup>10</sup> The spines of the legs, while constant to a certain degree, sometimes vary in number and development in different specimens, and occasionally on opposite legs of the same specimens.

<sup>11</sup> Conforming with Doctor Böving's description of the larva of *Embaphion muricatum* (Journ. of Agri. Research, vol. 22, 1921, no. 6, ser. K., 103, pp. 323-334) to facilitate a comparison between the morphological structures of these two species, which represent the two distinct, but in many respects closely related subfamilies, Tenebrioninae and the Blaptinae.

vex, ventrally slightly flattened, pygidium, subtrapezoidal, apically bicornute. Head, thorax, and abdomen covered with pale, thin, reddish brown hairs.

Cranium rounded, nutant, exserted, two-thirds broader than long (from epistomal margin (*epi*, fig. 3) to foramen occipitale), broadest medianly, dorsally somewhat convex. Anterior frontal angle (*fa*) rounded. Frons (*f*) three-fourths the length of cranium, about half as long as wide, with extreme width anteriorly; sides anteriorly and posteriorly convex, medianly concave; frons somewhat triangular, near the center two small circular impressions. Epicranial halves (*epc*) meeting dorsally; epicranial suture about one-fourth the length of cranium; the halves ventrally separated by gula (*gu*, fig. 7); epicranium with evenly distributed thin setae. Gula distinct, coriaceous, barrel-shaped, with ventral tentorial pits (*tp*) just below the middle of the side margins. Clypeus (*cl*, fig. 3) trapezoidal, widest behind, length to extreme width, one to three; medianly with a transverse deepening, set on each side with two well-developed setae near the lateral margin; anterior third testaceous, posteriorly castaneous-testaceous. Labrum (*lab*) well-developed, movable, transversely rectangular, a little more than twice as wide as long, anterior margin slightly crenate, anterior corners rounded; disk between the center and each lateral margin with two large setae,<sup>12</sup> the one nearer the margin a little more anteriorly placed; on the anterior half of the lateral margins and on the front margin a series of long, thin, slightly chitinized setae and between these many irregularly placed short, rigid setae; behind those on the anterior corner but on the ventral side of labrum, usually three shorter, stronger, curved setae. (Fig. 1.) Ocelli composed of two groups on each side, just behind the outer antennal ring; both transverse, the anterior one composed of three, more or less fused lenses, the posterior one of two partly fused lenses; near ocelli a few slender setae. Antenna close behind the mandible, attached to distinctly colored rim below the dorsal mandibular fossa; basal antennal membrane well developed, with posterior portion somewhat corneous; three articles; basal article clavate, about as long as clypeus; second article shorter than first, about as long as labrum, cylindrical; apical article very small, cylindrical, about one-third the length of the second, carrying one short seta; no supplementary appendix from second article beside the apical article. Mandibles (figs. 2 and 5) both alike, apically trifid ( $a^1, a^2, a^3$ ), obtusely pointed, with the median tooth ( $a^1$ ) larger and longer; molar part (*m*) of right mandible with crown bearing four transverse somewhat arched ridges which fit into corresponding cavities of the left molar part; cutting part smooth, ventrally slightly excavated; exterior surface ("the

<sup>12</sup> These two setae occupy always the same position, while the number, size, and position of the rest of the labral setae vary somewhat according to different specimens.

back of the mandible"), distally (*c*) rounded above, without margination, bearing a single weak seta on dorsal surface arising from slight excavation at base of apical teeth; proximally (*p*, fig. 5) (opposite the molar part) excavated, bearing two setae, a long thin one on dorsal surface above fossa and another short one on ventral surface near condyle. Maxilla dorsally almost completely covered by mandible, coriaceous; palpus surmounting mala (*ma*, fig. 7) with one-third of its own length; palpiger maxillae (*pag*) small, apically on outer side with semicircular chitinization, on inner side fused with stipes; three articles, basal article clavate, about one-third of the entire length of palpus, with minute seta near base on outer side; second article subequal with basal, cylindrical, bearing two thin setae anteriorly; apical article, shorter than second, conical, with soft tip, apically covered with minute tactile hairs; mala on dorsal (buccal) surface (*ma*, fig. 6) with a median longitudinal series of well-developed somewhat curved setae and a corresponding series along the free margin, apically with a few strong setae beneath which extends an inner series of small, weak but distinct setae; mala on ventral (exterior) surface, (*ma*, fig. 7) apically bearing a few stiff setae. Anterior malar margin truncate, median emargination divided into two parts, inner part of which is chitinized and obtusely pointed; mala slightly concave on the inside, slightly convex on the outside. Stipes (*sti*) fused with mala; base of stipes (*ba*) near cardo articulation, narrowed, bearing a single, long, thin seta; proximal half of inner margin of stipes (*is*<sub>1</sub>) connected with maxillary articulating area (*ar*), distal half (*is*<sub>2</sub>) immediately behind mala, free, bearing a short, weak seta near margin; just below palpiger, near exterior margin, three long, thin setae. Cardo (*ca*) about as long as maxillary palpus, entire, adjacent to curved hypostomal thickening (*hyp*) between fossa for ventral mandibular condyle (*fm*) and fossa for tip of cardo (*fc*); inner margin of cardo near center, with an indication of fusion with maxillary articulating area. Maxillary articulating area (*ar*) protuberant, divided into halves; exterior half connected with maxilla, subdivided into an upper and lower portion; interior half connected with submentum, entire; no setae. Submentum (*sm*) distinct, trapezoidal, broadest posteriorly; side margins slightly concave, near the middle of each, a long thin seta. Mentum (*me*) barrel-shaped, side margins free; on each side two long, thin setae. The two stipites labii (*stla*) fused into a slightly chitinized unit with a pair of long, thin setae. Labial palpus about half as long as maxillary palpus; two articles; basal article cylindrical, slightly shorter than that of maxillary palpus; apical article conical, shorter than basal article, apex covered with minute tactile hairs. Ligula (*li*, figs. 6 and 7) of medium size, slightly broader than long, apically somewhat truncate, bearing several rather short, rigid setae along the front margin and on the

buccal surface.<sup>13</sup> Hypopharyngeal sclerite (*hsc*, figs. 4, 8, 13) supported above the hypopharyngeal bracon (*hbr*) by a chitinous plate extending from the latter sclerite; nearly square, projecting, strong, heavily chitinized; anteriorly tricuspitate; disk excavate, in center thinly chitinized. The hypopharyngeal bracon is a well-developed rod in the buccal membrane between the ventral mandibular articulations and the hypopharyngeal region; in the latter region the rod is heavily chitinized, and here somewhat fused with plate extending to the hypopharyngeal sclerite, near the former region slightly membranous. Epipharynx (*eph*, fig. 1) forming the buccal surface of labrum, slightly coriaceous with a posterior, transverse, broad, sinuous, chitinous band, just behind which are two chitinous triangular projections; on the slightly coriaceous part, anterior to the band, many short, rigid setae arranged in a somewhat semicircular manner about the chitinous band; medianly, near the anterior margin, a few scattered ring-shaped punctures. Legs well developed, surrounded at base by a large articulating area (*ar*). Prothoracic legs (figs. 14, 16, and 17) considerably stronger than those of mesothorax and metathorax (fig. 22); coxae (*cox*) of the first pair attached so closely together that they are nearly contiguous at the base (fig. 20), nearly as long as wide, a few thin setae on exterior and interior surfaces, mostly along anterior margin near articulating membrane between coxa and trochanter; trochanter (*tr*), about as long as coxa, inner side distally with a callous wart, below which are usually four consecutive spinelike projections or tubercles, each bearing short seta, near these a few thin setae; femur (*fe*), about as long as, and somewhat wider than trochanter, armed with two spinelike, seta-bearing tubercles with a much smaller one near them, besides many strong scattered setae; tibia (*ti*) slightly shorter and much thinner than femur, proportions about two to three, distally armed with three spinelike setae, besides many thin setae; tarsus (*ta*) a little more than half the length of tibia, claw-shaped and strong, basal portion enlarged,<sup>14</sup> backward facing surface distally excavate, with proximal portion round, rather soft skinned, bearing a strong seta distally at base of excavation on either side. Second and third pairs of legs inserted farther apart than the first pair, but legs considerably thinner and not as long; the proportions of the articles also about the same as those of first pair, excepting the coxae which are nearly twice as long as wide.

Presternal area (*y*, fig. 20), in the intersegmental region between head and prothorax, slightly chitinized, twice as wide as gula;<sup>15</sup>

<sup>13</sup> Ligula is conically pointed and apically set with one pair of long setae in *Embaphion* and also in certain species of *Elcodes* and in a few genera of *Tenebrioninae*.

<sup>14</sup> Enlarged at base on exterior side more than that of *Embaphion*.

<sup>15</sup> Compare with *Embaphion* in which the united presternal areas have nearly the same width as gula and are partly separated by the preeusternal subdivision of eusternum.

anteriorly on each area with two minute hairs, and posteriorly below chitinizations with a long thin seta. Immediately below, and not separating the presternal areas, a suboval single area bearing two setae. This suboval area is a preeusternal subdivision of eusternum (*peu*).

Ventral intersegmental region between prothorax and mesothorax and between mesothorax and metathorax, membranous, composed of distinct post-sternellar and preepipleural areas but with indistinct presternal areas.<sup>16</sup>

Prothorax with eusternum (*eu*, fig. 20) large, subtriangular; with prehypopleural chitinization (*h*<sub>1</sub>), large and strong, internally adjacent to ventral intersegmental region; sternellum (*stl*), well developed, somewhat smaller than eusternum, forming with eusternum a clepshydral region; poststernellum (*z*) transverse, somewhat spindled-shaped; prothoracic tergal region (fig. 14) transverse, subquadrate, with anterior and posterior margins as mentioned above; just back of anterior margin and also near posterior margin, a transverse row of long, thin hairs, lateral margin with few scattered hairs. Mesothorax and metathorax with large subtriangular preeusternal regions (*peu*) bearing a few short hairs,<sup>17</sup> and with V-shaped eusternal (*peu*) regions; near anterior part of prehypopleural chitinizations (*h*) three small hairs; presternal areas not demarkated. Prehypopleural chitinizations (*h*) well developed; posthypopleural chitinization (*h*<sub>2</sub>) very small, not to be confused with the adjacent rather large, oval chitinization in the articulating skin of the leg; coxae rather distant; sternellum anteriorly fused with eusternum; poststernellum of metathorax not present; preepipleurum of mesothorax and metathorax (*e*<sub>1</sub>) subtriangular, the former carrying first thoracic spiracle, the latter the rudimentary spiracle; median area of epipleurum (*e*) of both segments well developed, postepipleurum (*e*<sub>2</sub>) small; mesothoracic and metathoracic tergal shields (*te*, figs. 14 and 20) transverse, subrectangular, about twice as wide as long, right behind anterior margin a dark serrated transverse line behind which a row of small oval elevations as long as the line, posterior margin with transversal band finely striated longitudinally; setae arranged as on prothoracic shield.

The six anterior typical abdominal segments cylindrical, somewhat wider than long, with fused sternal areas (*ster*); hypopleural region (*hp*) indistinct; epipleural region (*ep*) narrow; tergal region (*ter*) transverse, rectangular, having on the first abdominal segment right back of anterior margin. dark, serrated, transverse line (fig. 14) and behind this a row of elevations similar to those on the

<sup>16</sup> In *Embaphion* ventral intersegmental region is formed by distinct poststernellar, preepipleural, and presternal areas.

<sup>17</sup> In *Embaphion* preeusternal subdivision of eusternum small and indistinct.



mesothorax and metathorax; on the second and third abdominal terga the serrated, transverse line is lacking but the elevations are present; on the rest of the terga both line and elevations are lacking; on the posterior margin of each tergum a faint transverse, longitudinally striated band; spiracles laterally placed, with faint horizontal line above. Setae scattered, rather soft, on sternal areas arranged in two transverse rows; on epipleura none; on terga, below spiracle a few scattered setae, above with two transverse series. The seventh and eighth abdominal segments are similar to the anterior ones but somewhat longer. The ninth abdominal segment (figs. 9, 10, 12, 14) is somewhat smaller than the preceding segments; sternum soft, subtrapezoidal, widest anteriorly; tergum or pygidium, slightly raised longitudinally, apex bicornute; proximally (anterior to cerci), a pair of bifid seta-bearing spines, usually on either side and slightly anterior to these, another but much smaller pair; sometimes, about base of cerci, one or more minute seta-bearing spines; setae on sternum arranged in two transverse series; on pygidium a continuous series along lateral and posterior-ventral margins, and two transverse series dorsally. The tenth abdominal or anal segment (figs. 10, 12, 14), very small, with ventral lip inwardly faintly bilobed. Spiracles (fig. 11) annular, broadly oval, transversely placed, openings linear, unprotected by hairs at bottom of cup-shaped peritreme.

General morphological description of pupa of *Merinus lacvis*.<sup>13</sup>

Length 28 mm.; width of body 6 mm.; greatest width from knee to knee 9 mm. Color yellowish white; surface somewhat coriaceous; form elongate, subcylindrical, slightly arcuate; dorsally moderately depressed; head somewhat flexed against prosternum; appendages semitranslucent; pygidium subtrapezoidal, apically bicornute. Head, thorax, with exception of elytra, and abdomen, sparsely haired.

Head, concealed beneath prothorax (figs. 21, 23, 27); cranium convex, longer than wide (from clypeal margin to foramen occipitale) widest anteriorly, bearing a few weak hairs; frons, more or less distinct (according to stage of development of pupa), transverse, about one-third as wide as long, separated from clypeus by a distinct transverse suture; between base of antenna and frons and fused with both, arises a conical projection, directed laterally; clypeus subtrapezoidal, widest posteriorly, anteriorly indistinctly separated from labrum; along latter margin a transverse series of soft hairs; labrum bent under, anterior margin bilobed; antenna curving backward against side of prothorax over profemora, at which point it is

<sup>13</sup> For the sake of convenient comparison, given in conformity with Doctor Blaisdell's description of the pupa of *Eleodes clavicornia* Eschscholtz (U. S. Nat. Mus. Bull. 63, pp. 500-501) of the Tenebrionid subfamily Blaptinae, which, as mentioned in footnote 11, is in many respects closely related to the Tenebrioninae.

scarcely visible when viewed from below. Mandible apically chitinized, proximally with two short soft hairs, basally with a soft hair near each articulation. Pronotum convex, wider than long, subrectangular, anterior margin feebly and broadly emarginate, frontal angle rounded, side margins arcuate, posterior corners more angular, posterior margin broadly emarginate; all but part of posterior portion, covered with fine, short setae. Mesonotum, slightly convex, transverse, sparsely haired; elytral pads passing obliquely backward between tibia and tarsus of mesothoracic and metathoracic legs, apical fourth visible from beneath; scutellum trapezoidal, widest anteriorly. Metanotum, a little longer than mesonotum, slightly sinuate behind; setae arranged as on mesonotum.

Legs somewhat prominent laterally, not appressed against body, distinctly compressed, not very broad; tarsi separated from each other in median line, except the metatarsi which are in contact from base of metatarsus to claw; coxae and sterna visible in the median line.

Abdominal segments convex ventrally, less so dorsally; first six terga transversely rectangular; seventh and eighth arcuate posteriorly; each tergum bearing two transverse rows of weak setae; lateral portion of terga of first seven abdominal segments produced into subrectangular, platelike processes.<sup>19</sup>

Lateral process of first abdominal tergum anteriorly (fig. 19) drawn out into a spur directed outward with tip chitinized, bearing at base a long, thin seta; medianly (*m*) deeply emarginate; posteriorly (*p*) forming bifid spur directed laterally and with tip chitinized, base of anterior tooth (*t*) bearing seta; second to sixth lateral processes inclusive (figs. 24, 25), usually alike,<sup>20</sup> having anterior spur (*a*) bifid, with one tooth (*t*) hooklike and directed inward and other tooth (*t*) directed outward with seta at base, posterior spur (usually) bifid, directed posteriorly and with seta at base of tooth (*t*); seventh process as sixth, except posterior spur (*p*, fig. 26) which is single with seta at base and is constant; eighth tergum (fig. 29) with platelike processes reduced to two minute chitinous spines, one medianly (*m*) and one posteriorly placed (*p*), each with a seta at base; ninth tergum or pygidium, subtrapezoidal (figs. 28, 30) bearing apically two long, conical cerci, chitinized at tips and each bearing at base, on outer side, a short seta; ninth tergum medianly with two fleshy spinelike projections, the apices of which are bifid and chitinized; anterior margin of tergum concave, lateral margins slightly arcuate.

<sup>19</sup> Blaisdell, in his description of the pupa of *Elcodes clavicornis*, refers to these platelike processes as arising from the pleurum. The author prefers to accept Schiodte's view in which he refers to them as arising from the tergum.

<sup>20</sup> Sometimes the posterior spur may be single instead of bifid (*p*, fig. 24) on lateral process of second abdominal segment, or the opposite (*t*, fig. 26) on anterior spur of seventh segment.

posterior truncate; lateral margins bearing few short setae. Sterna of first six abdominal segments (figs. 21 and 27) transversely rectangular, seventh and eight more arcuate posteriorly; ninth transverse, subtrapezoidal; tenth very small, tubular (fig. 30). First eight abdominal segments bearing two transverse rows of short, thin setae; ninth with three short setae on each lateroposterior margin; tenth without setae. Spiracles (fig. 21) annular, broadly oval.

## EXPLANATION OF PLATES.

Figures drawn with aid of camera lucida by the author. All figures from 1 to 30, inclusive, except 15 and 18, refer to *Merinus laevis*, the latter refer to *Upis ceramboides*. Figures 1 to 18, inclusive, 20, and 22 refer to the larvae; Figures 19, 21, and 23 to 30, inclusive, refer to the pupa; Figures 31 to 68, inclusive, refer to many different genera and species.

## PLATE 1.

- FIG. 1. *Merinus laevis*. Epipharynx (*eph*) and anterior margin of labrum.
2. *Merinus laevis*. Dorsal side of right mandible;  $a^1$ ,  $a^2$ ,  $a^3$ , the tricuspidate apex; *m*, molar part; *c* rounded surface on exterior side of cutting edge; *p*, excavation opposite molar part.
3. *Merinus laevis*. Head; *lab*, labrum; *cl*, clypeus; *fa*, anterior angle of frons; *epi*, epistoma; *f*, frons; *epc*, epicranium.
4. *Merinus laevis*. Lateral view of buccal cavity with mouth parts removed; *cl*, clypeus; *lab*, labrum; *eph*, side of epipharynx; *hsc*, hypopharyngeal sclerite; *oes*, esophagus with entrance shown; *hbr*, hypopharyngeal bracon.
5. *Merinus laevis*. Ventral side of left mandible. Explanation same as for Figure 2.
6. *Merinus laevis*. Maxillae seen from the buccal cavity; hypopharyngeal region removed; *ma*, mala; *li*, dorsal (buccal) surface of ligula.
7. *Merinus laevis*. Second and third mouth parts from ventral side; *epc*, epicranium; *gu*, gula; *tp*, ventral tentorial pit; *sm*, submentum; *me*, mentum; *stla*, stipes labii; *li*, ligula; *hyp*, hypostoma; *fm*, fossa for ventral articulation of mandible; *fc*, fossa for cardo; *ar*, maxillary articulating area; *ca*, cardo; *sti*, stipes maxillaris; *bs*, base of stipes; *is<sub>1</sub>* and *is<sub>2</sub>*, inner margin of stipes; *ma*, mala maxillaris; *pag*, basal membrane of maxillary palpus.
8. *Merinus laevis*. Hypopharyngeal region, esophagus and hypopharyngeal bracon, corresponding to the piece removed from Figure 6, *hsc*, hypopharyngeal sclerite; *hbr*, hypopharyngeal bracon; *fm*, mandibular ventral fossa; *oes*, esophagus.
9. *Merinus laevis*. Eighth and ninth terga; dorsal view.
10. *Merinus laevis*. Ninth abdominal ("pygidial") segment; lateral view.
11. *Merinus laevis*. First thoracic spiracle.
12. *Merinus laevis*. Pygidium; ventral view; *IX*, ninth abdominal ("pygidial") segment; *X*, tenth abdominal ("anal") segment, showing its upper lip; lower lip not visible.
13. *Merinus laevis*. Hypopharyngeal region; same structures as in Figure 8 reversed; *hsc*, base from which hypopharyngeal sclerite originates; *hbr*, hypopharyngeal bracon; *fm*, mandibular ventral fossa; *oes*, esophagus.
14. *Merinus laevis*. Lateral view of larva.

## PLATE 2.

- FIG. 15. *Upis ceramboides*. Epipharynx (*eph*) and anterior margin of labrum.
16. *Merinus laevis*. Right prothoracic leg, showing posterior face; *cox*, coxa; *tr*, trochanter; *fe*, femur; *ti*, tibia; *ta*, tarsus.
17. *Merinus laevis*. Same leg as in Figure 16; anterior face; *cox*, coxa.
18. *Upis ceramboides*. Right prothoracic leg; anterior face; *cox*, coxa.
19. *Merinus laevis*. Pupa; lateral platelike processes of first abdominal segment; *a*, anterior spur; *m*, median emargination; *p*, posterior bifid spur; *t*, anterior tooth of posterior bifid spur.
20. *Merinus laevis*. Larva; ventral view of part of head, of the thoracic segments and of the anterior portion of first abdominal segment; *epc*, epieranium; *gu*, gula; *y*, presternum; *peu*, preeusternal subdivision of eusternum; *eu*, eusternum; *stl*, sternellum; *z*, poststernellum; *ar*, articulating membrane of leg; *h<sub>1</sub>*, prehypopleurum; *h<sub>2</sub>*, posthypopleurum; *e*, epipleurum; *e<sub>1</sub>*, preepipleurum; *e<sub>2</sub>*, postepipleurum; *te*, thoracic tergite; *ster*, sternal shield of abdominal segments; *hp*, abdominal hypopleurum; *ep*, abdominal epipleurum; *ter*, abdominal tergite.
21. *Merinus laevis*. Lateral view of pupa.
22. *Merinus laevis*. Metathoracic right leg of larva; anterior face.
23. *Merinus laevis*. Dorsal view of pupa.
24. *Merinus laevis*. Pupa; lateral platelike process of second abdominal segment; *a*, anterior spur; *m*, median emargination; *p*, posterior spur; *t*, anterior tooth of spur; *t<sub>1</sub>*, posterior tooth of spur.
25. *Merinus laevis*. Pupa; lateral process of sixth abdominal segment. Explanation of letters same as for Figure 24.
26. *Merinus laevis*. Pupa; lateral process of seventh abdominal segment. Explanation of letters same as for Figure 24.
27. *Merinus laevis*. Pupa; ventral view.
28. *Merinus laevis*. Pygidium of pupa; dorsal view.
29. *Merinus laevis*. Part of eighth tergite of pupa, showing lateral process reduced to two minute spines; *m*, median spine; *p*, posterior spine.
30. *Merinus laevis*. Pygidium of pupa; ventral view; VIII, part of sternum of eighth abdominal segment; IX, sternum of ninth abdominal ("pygidial") segment; X, tenth ("anal") abdominal segment.

## PLATE 3.

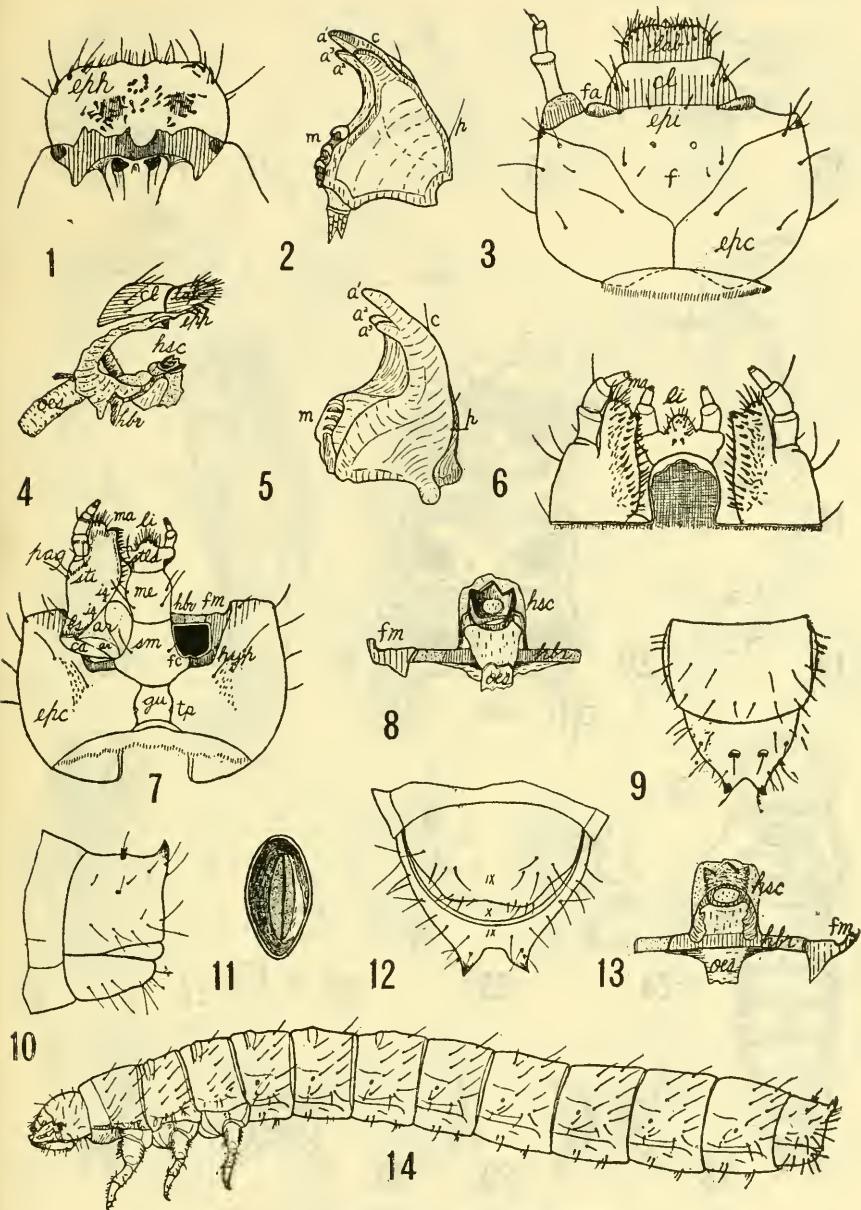
- FIG. 31. *Alobates pennsylvanica*. Epipharynx (*eph*) and anterior margin of labrum.
32. *Alobates pennsylvanica*. Dorsal side of left mandible; *a<sub>1</sub>*, *a<sub>2</sub>*, *a<sub>3</sub>*, the tricuspidate apex; *m*, molar part; *c*, rounded surface on exterior side of cutting edge; *e*, excavation opposite molar part; *t*, additional tooth between apex and molar part on left mandible.
33. *Alobates pennsylvanica*. Dorsal side of right mandible. Same explanation for letters as on Figure 32.
34. *Alobates pennsylvanica*. Right prothoracic leg, showing posterior face; *cox*, coxa; *tr*, trochanter; *fe*, femur; *ti*, tibia; *ta*, tarsus.
35. *Alobates pennsylvanica*. Right mesothoracic leg, posterior face. See explanation of letters for Figure 34.

- Fig. 36. *Undetermined species*. Lateral view; *VIII*, eighth abdominal segment, showing *cp*, conelike projections; *IX*, ninth abdominal ("pygidial") segment, showing *bp*, basal projections of cerci and *cd*, lateral articulating condyles; *X*, tenth abdominal ("anal") segment, showing upper and lower lips.
37. *Undetermined species*. Posterior view of same structures as in Figure 36. Explanation same as for Figure 36.
38. *Haplandrus femorata*. Lateral view; *VIII*, eighth abdominal segment; *IX*, ninth ("pygidial") abdominal segment; *X*, tenth ("anal") abdominal segment; *bp*, basal projections of cerci; *cd*, articulating condyles.
39. *Haplandrus femorata*. Posterior view of same structures as in Figure 38. Explanation same as for Figure 38.
40. *Haplandrus femorata*. Lateral view of ninth abdominal ("pygidial") segment.
41. *Haplandrus femorata*. Posterior view of same structures as in Figure 40.
42. *Iphthimus sublaevis*. Right prothoracic leg, posterior face; *cox*, coxa.
43. *Iphthimus sublaevis*. Mesothoracic leg, posterior face; *cox*, coxa.
44. *Iphthimus sublaevis*. Lateral view of ninth abdominal segment.
45. *Scotobates calcarata*. Lateral view of eighth, ninth, and tenth abdominal segments; *X*, tenth abdominal segment with upper and lower lips; *aw*, projected ambulatory wart.
46. *Scotobates calcarata*. Hypopharyngeal region, hypopharyngeal bracon and esophagus; *hse*, hypopharyngeal rite showing median projection bifid at apex; *hbr*, hypopharyngeal bracon; *fm*, mandibular ventral fossa; *oes*, esophagus.
47. *Scotobates calcarata*. Right prothoracic leg; *cox*, coxa.
48. *Scotobates calcarata*. Right mesothoracic leg, showing it nearly the same size as the prothoracic one.
49. *Tenebrio obscurus*. Lateral view of pygidium. Explanation of letters same as in Figure 45.
50. *Tenebrio obscurus*. Pygidium, dorsal view.
51. *Tenebrio molitor*. Dorsal view of left mandible;  $a^1$  and  $a^2$ , the bicuspidate apex; *t*, additional tooth near molar part; *m*, molar part; *e*, excavation opposite molar part; *c*, rounded surface on exterior side of cutting edge.

## PLATE 4.

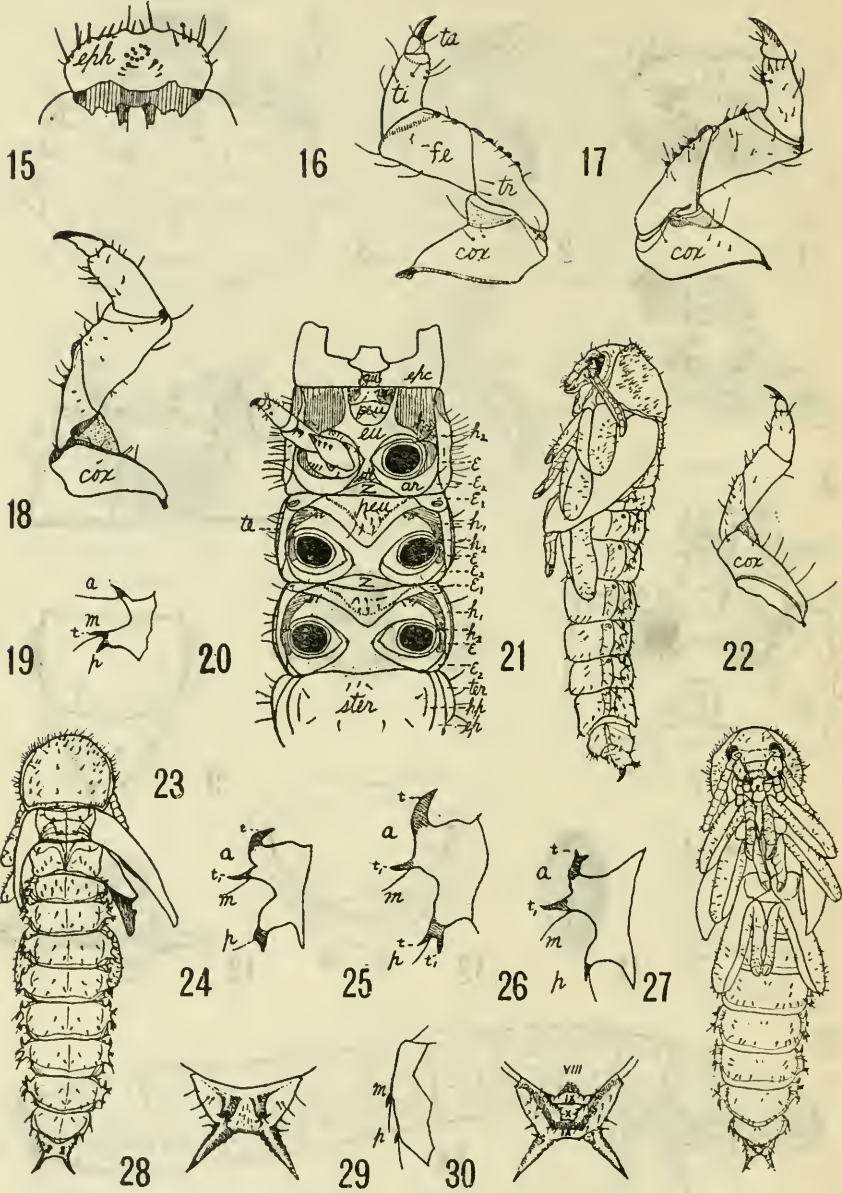
- Fig. 52. *Neatus picipes*. Pygidium; dorsal view.
53. *Neatus picipes*. Dorsal view of left mandible. Explanation for letters as in Figure 51.
54. *Coelocnemis californica*. Dorsal view of right mandible;  $a^1$  and  $a^2$ , the bicuspidate apex; *t*, additional tooth near apex; *m*, molar part; *e*, excavation opposite molar part; *c*, rounded surface on exterior side of cutting edge.
55. *Coelocnemis californica*. Dorsal view of ninth abdominal ("pygidial") segment.
56. *Rhinandrus sublaevis*. Dorsal view of ninth abdominal segment.
57. *Rhinandrus sublaevis*. Lateral view of ninth and part of tenth abdominal segment; *aw*, ambulatory wart partly retracted.
58. *Rhinandrus sublaevis*. Right prothoracic leg, posterior face; *cox*, coxa.

- FIG. 59. *Rhinandrus sublaevis*. Right mesothoracic leg, posterior view. Notice the difference in size between this leg and the prothoracic leg Figure 58.
60. *Rhinandrus sublaevis*. Ventral view of right mandible;  $a^1$  and  $a^2$ , the bicuspidate apex;  $t$ , additional tooth near apex;  $m$ , molar part;  $e$ , excavation opposite molar part;  $s$ , membranous elevation opposite molar part;  $c$ , back with sharp margin of mandible opposite cutting part.
61. *Rhinandrus sublaevis*. Dorsal view of right mandible. The mandible is old and worn, so that the apical teeth and molar part are not sharp as in Figure 60. Explanation of letters same as in Figure 60.
62. *Zophobas morio*. Ventral view of right mandible; the back opposite the cutting part with round margin. Explanation of letters same as in Figure 60.
63. *Eleodes tricostat*. Pygidium, dorsal view; apex acute.
64. *Eleodes tricostata*. Ventral view of right mandible. Explanation of letters same as in Figure 60.
65. *Eleodes tricostata*. Dorsal view of right mandible. Explanation of letters same as in Figure 60.
66. *Eleodes opaca*. Pygidium, dorsal view, apex obtuse and rounded.
67. *Eleodes opaca*. Lateral view; IX, ninth abdominal segment; X, tenth abdominal segment;  $aw$ , ambulatory wart.
68. *Eleodes carbonaria*. Pygidium, dorsal view, apex obtuse and mucronate as in *Blaps*.



LARVAE OF TENEBRIONINAE

FOR EXPLANATION OF PLATE SEE PAGE 19



LARVAE AND PUPAE OF TENEBRIONINAE.

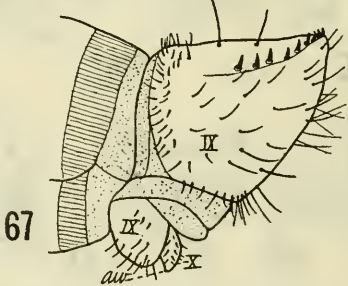
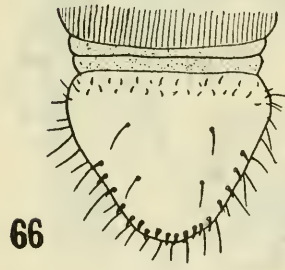
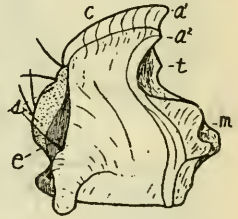
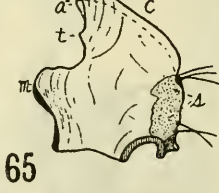
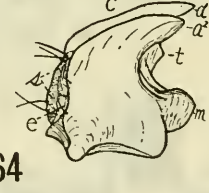
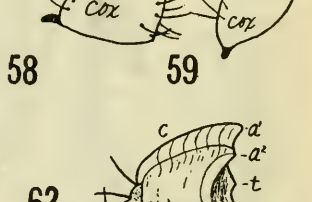
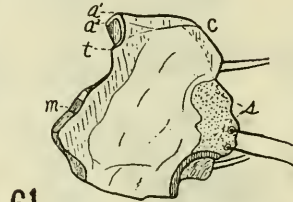
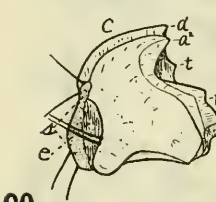
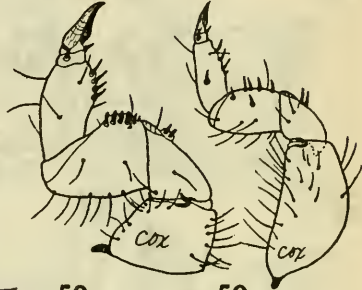
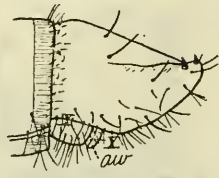
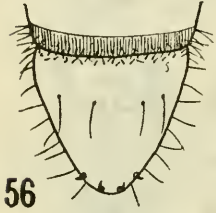
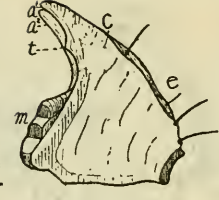
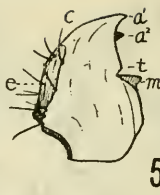
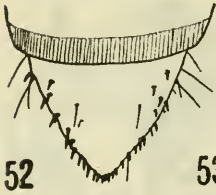
FOR EXPLANATION OF PLATE. SEE PAGE 23





LARVAE OF TENEBRIONINAE.

FOR EXPLANATION OF PLATE SEE PAGES 20 AND 21.



LARVAE OF TENEBRIONINAE.

FOR EXPLANATION OF PLATE SEE PAGES 21 AND 22.