

# LARVAE OF NORTH AMERICAN BEETLES OF THE FAMILY CLERIDAE.

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## INTRODUCTION.

The insects of this family are with few exceptions beneficial and of some economic importance in the preservation of forest trees because they in all stages feed on destructive wood and bark boring beetles.

The larval stages of the numerous genera and species of North American Cleridae have not been systematically described or figured, and but little has been published on their general habits and seasonal history in this country.

The present publication is a contribution from the Division of Forest Insect Investigations, Bureau of Entomology, United States Department of Agriculture, and has been worked out according to suggestions of Dr. A. D. Hopkins, forest entomologist in charge of forest insect investigations.

It consists of two independent parts. The first part, by A. G. Böving, deals with the morphology and taxonomy of the larvae of North American Cleridae and is mainly based on the valuable material, which has been accumulated in the collections in the office of the Forest Entomologist in the United States National Museum, Washington, District of Columbia. The second part, by A. B. Champlain, now Curator of Insects, Pennsylvania Bureau of Plant Industry, Harrisburg, Pennsylvania, deals with the general habits and seasonal history of the Cleridae from notes on file in the same office, critically considered and considerably added to by personal observations of the author.

## PART 1.

### A. BRIEF CHARACTERIZATION OF THE LARVAE OF THE FAMILY CLERIDAE.

Legs with fused tarsus and claw. Body straight with dorsal and ventral surface equally long or nearly so. Intersegmental membranes present. Tenth abdominal segment developed as a locomotory organ, extending from the ventral side of the ninth abdominal segment. No

filaments, no thornbearing dorsal plates, no spiracle bearing tubercles, no gills. Cerci, when present, inarticulate and immovable. Holopneustic. Spiracles annular or bifore. First thoracic spiracle plainly in pre-epipleurum of mesothorax. Head porrect and exerted or slightly invaginated. Labrum and clypeus present. Antennae three jointed. Mandibles posteriorly without mola; decreasing in width from basis to distal end, acuminate with single apex and usually with retinaculum; a deep groove along the cutting edge; no penicillum. Hypostoma with its maxillary margin adjacent only to cardo; postmaxillary margin adjacent to gula, and in some forms detached as a separate "paragular" structure. Ventral mouthparts, forming a compact unit, protracted or only slightly retracted; with restricted, principally dorso-ventral movement. Cardo maxillae as large or larger than stipes maxillae. Stipes maxillae, free, but movable only in dorso-ventral direction. Mala maxillae extending from the distal end of stipes; simple or transversally bisected. Palpus maxillae with three, free joints and a low, not joint-like palpiger, which is closely connected with stipes. Maxillary articulating area absent. Submentum well defined. Mentum small. Labium with two-jointed palpus. Ligula small, with simple, rounded anterior margin. Gula as long as frons, elongate, rectangular, limited by two parallel gular sutures, reaching from cardo's posterior end to foramen occipitale; no special pregular plate. Prothorax in the typical forms with two well separated presternal plates and an unpaired median sternal plate. Abdominal segments fleshy, plicate, without chitinous shield except on the ninth, which in most forms has a chitinous, dorsal cerci carrying plate. The abdominal segments often vividly colored, in many forms hairy, and often with ampullatory lobes.

B. GENERAL MORPHOLOGICAL DESCRIPTION OF THE LARVAE OF THE NORTH AMERICAN CLERIDAE.<sup>1</sup>

The body is digitiform without ampullae or flattened subclaviform, in most of the vividly colored, comparatively free living genera;

<sup>1</sup> Several of the terms used in the present paper may be found to differ from those applied by me in previous papers. In such cases the changes are based on renewed comparative morphological studies, jointly undertaken by Dr. F. C. Craighead and myself on a considerable amount of adult and larval stages of different insects. This revised terminology expresses our final contentions and consequently we regard the terminology expressed in our earlier publications as canceled and not to be drawn into further discussion. For explanation of most of the subsequent terms see: (1) John B. Smith: Explanation of Terms used in Entomology (Published by Brooklyn Entomological Society, Brooklyn, N. Y., 1906); (2) A. D. Hopkins: The Genus *Dendroctonus* (U. S. Dept. Agr., Bur. Ent., Tech. Ser. No. 17, Pt. 1, 1909); (3) Kemner, A.: Beiträge zur Kenntniss einiger Schwedischen Koleopterenlarven (Arch. f. Zool., vol. 7, pp. 2-4, 1912); also Kemner, A.: Våra Clerider (see the subsequent bibliography); (4) F. C. Craighead: Larvae of the Prioninae (U. S. Dept. Agriculture, Off. Sec. Rept., 1915); (5) Alvah Peterson: The Head Capsule and Mouthparts of Diptera (Illinois Biological Monographs, vol. 3, No. 2, 1916); (6) The Bibliography in G. C. Crampton's publication: The Thoracic Sclerites of Immature Pterygotan Insects, with Notes on the Relationships Indicated. (Proc. Ent. Soc. Wash., vol. 20, No. 3, p. 60, 1918.)

digitiform with ampullae or vermiform, in the poorly colored or whitish genera which live permanently hidden in the galleries of their prey.

The Head is directed forward and protruded in free living genera; somewhat invaginate in the hidden forms. The dorsal surface of the head is flattened, the sides subparallel, and the ventral surface moderately convex in most of the free living genera, as *Necrobia*, *Enoclerus*, and *Cymatodera*; the sides of the head are curved, posteriorly diverging, and the head capsule as a whole subconical in the genera *Chariessa*, *Phyllobaenus*, and allies; the dorsal surface is short and flat, the sides posteriorly diverging, and the ventral surface large and very convex in *Priocera*; dorsal surface convex, sides parallel, and ventral surface flat in *Thaneroclerus*.

The Frons (*f*) is in most genera simple triangular, limited by straight or slightly curved frontal sutures, which posteriorly form an acute angle and reach the occipital foramen; in *Hydnocera* a quadrangular frons occurs, posteriorly limited by a transverse line and laterally by straight frontal sutures (*fs*), which reach the occipital foramen separately; in *Priocera* the frons is anteriorly broadly subquadrangular, posteriorly contracted into a narrow, stalk-like projection, which reaches the occipital foramen; finally, in *Thaneroclerus* the frontal sutures do not reach the occipital foramen, but meet in front of it. The dorsal surface of the frons is usually without conspicuous sculpture; in *Priocera castanea* and *Monophylla terminata*, however, it bears a prominent median unpaired elevation. Epistoma (*ep*), the anterior marginal thickening of frons between the upper articulations of the mandibles,<sup>1</sup> is always chitinized, even in forms in which the head is otherwise but slightly chitinized. Anguli frontales (*af*) are present but not large. Medianly and internally a longitudinal endocarina is present and well chitinized in all forms, and often posteriorly widened like an arrowhead.

The Epicranium (*ecr*) is dorsally completely separated by the frons into two epicranial halves, except in *Thaneroclerus*, where the halves meet posteriorly in the middle line and form an epicranial suture; ventrally the epicranial halves are continued behind the attachments of the tentorial arms and are in all Clerids separated by an elongate rectangular gula. The shape of the anterior or maxillary margin (*mh*) of hypostoma<sup>2</sup> is an important aid in the separation of the groups. It is straight in several genera, as *Enoclerus* and *Thanero-*

<sup>1</sup> According to Schiödte's terminology "epistoma" means the entire frons.

<sup>2</sup> Hypostoma is a structure, often of triangular form, along the ventral border of the epicranium. Its anterior or maxillary margin is here understood as the inner margin of hypostoma between the ventral mandibular articulation and the point of intersection between hypostoma and anterior margin of gula; in the Clerid larva this point of intersection is indicated by the posterior tip of cardo.

*clerus*, slightly concave in most of the genera, and conspicuously incurved and oblique in *Trichodes* and *Priocera*. The dorsal and ventral faces of epicranium are smooth or slightly sculptured in all forms, with one exception, *Enoclerus sphegeus*, where a large tubercle is developed dorsally on each epicranial half near the posterior end of the frontal sutures.

The Ocelli (*oc*) are located on epicranium behind the ventrolateral part of the antennal ring. They are usually of moderate size but projecting so much that they can be traced on the cast skins. Their number vary according to genera or groups of genera, with five in the plurality of the forms, four in *Tarsostenus*, three in *Cymatodera*, two in *Necrobia*, one in *Monophylla* and *Priocera*, and no distinctly marked ocellus in *Orthopleura*.

The Clypeus (*c*) is well developed, trapezoidal, without setae; in several forms rather indistinctly, in others distinctly separated from frons.

The Labrum (*l*) is well developed, movable, subrectangular, with rounded corners; its anterior margin may be slightly convex as in *Monophylla*, straight as in *Cymatodera* or slightly sinuate as in *Enoclerus*; a series of setae are placed along the anterior margin and a few on the disk within the margin.

The Antenna (*a*), projecting from an antennal ring, exceeds the anterior margin of the labrum, in all forms except *Hydnocera*, where it reaches that margin; the articulating basal membrane (*bm*) is large, in some forms joint-like, extended. The basal joint (*I*) is large in most of the genera, from two to four times as long as the second joint (*II*); only in *Orthopleura* and *Priocera* short, in the former genus as long as the second joint, in the latter half as long. The second joint carries a small, supplementary joint-like appendix (*fil*), except in *Hydnocera*, where it is well developed; the apical joint (*III*) is conical and small, except in *Hydnocera*, where it is twice as long as the second joint.

The Mandible (*md*) is fitted both to grasp and chew a prey and to gnaw galleries in wood; it is well chitinized and well developed, half or nearly half as long as frons. It is subtriangular; the exterior, lateral face is narrow and without elevated margin; the apex (*apx*) is simple, more or less pointed, except in the deviating genus *Priocera*, where it is blunt; the pars scissoria has a longitudinal groove (*g*) on the ventral side; the retinaculum (*r*) is present on the middle or close to the middle of the cutting edge, and a convex, serrate, or tooth-like elevation is developed in many forms between retinaculum and the tip of the mandible. *Priocera* is the only genus where retinaculum is minute and granuliform and the whole cutting edge nearly entire. No molar part, no prostheca, no mandibular brush is present in any Clerid. There are usually two setae on the lateral

mandibular face or close to it; in the hairy genus *Trichodes* there are about seven setae.

The Ventral Mouthparts are either protracted or, as in *Trichodes* and *Priocera*, slightly retracted. The Cardines and the Submentum form together a large, transversal, subelliptical posterior unit that articulates with the stipites and mentum. The Cardo (*ca*) is large, triangular, or trapezoidal with the longitudinal sides parallel. In the genus *Enoclerus* most of cardo is heavily chitinized and only a small anterior part is membranous, but in the majority of the genera only a narrow band of chitin is found along the posterior margin. The Stipes maxillae (*st*) has about the same size as cardo and is chitinized in much the same way. The Palpus maxillae (*pmx*) has three free joints carried by a broad, low, subannular palpiger maxillae (*pgm*); the latter is closely connected with the stipes, but usually distinguishable as an independent structure by a flat chitinization (*pgc*). In most of the genera the three free joints are of the same length; in *Monophylla* and *Phyllobaenus* the apical joint (*III*) is twice as long as the second (*II*), and in *Hydnocera* the apical joint is very small, about one-fifth the size of the second joint. The Mala (*la*) is flat, setigerous, extending from the end of stipes; in *Enoclerus* and other genera it is transversely bisected into an anterior and a posterior section, the anterior being well chitinized, the posterior membranous. The Area articularia maxillaris (or maxillary sclerite or maxillary articulating lobe) is totally absent. The Submentum (*sm*) is subquadrate or rectangular, laterally limited by cardo, posteriorly by the front margin of gula, and anteriorly separated from mentum by a suture; in some genera as *Enoclerus* the posterior half is chitinized and the anterior membranous, but in most genera the submentum is totally membranous; it is often setiferous. The Mentum (*m*) is free or nearly so, subconical, of somewhat different size in the different genera; usually setiferous; in the genus *Enoclerus* it has a basal chitinization. The Labium (*li*) consists of stipes labii, palpus labii and ligula. Stipes labii (*sl*) is somewhat smaller than mentum, often with palpiger labii (*plg*) separately chitinized. The Palpus labii (*pli*) is two jointed; both joints are well developed and of about equal size, except in *Hydnocera*, where the apical joint is four times as long as the basal joint. The Ligula (*lig*)<sup>1</sup> is present but small. The Gula (*gu*) is much longer than wide, on each side limited by a Gular Suture (*gus*). The gula is as long as frons, elongate, rectangular, often chitinized as a gular

<sup>1</sup>The term ligula is used here according to the terminology of Schiödte and other authors. Instead of ligula some authors, however, (as Alvah Peterson in his previously, p. 576 quoted monograph) use the term glossa.

plate, the surface of which is level in all genera except *Thaneroclerus*, where a large unpaired tubercle is developed medianly. In some forms the inner postmaxillary margin of hypostoma is on each side separated as a Paragular plate (*pgu*), adjacent to the lateral margin of gula.

The Epipharynx (*epx*, fig. 116) forms the dorsal wall of the buccal cavity; it carries a pair of large, rounded epipharyngeal plates (*epxp*), which usually are fused in the middle line; they are slightly chitinized, smooth, and without setae; but a small group of short, very stout, tooth-like setae occur in front of each. On the dorsal surface of labium Lingua (*lin*, fig. 31) forms the anterior part of the ventral wall of the buccal cavity; it is equal in size to the exposed ventral surface of labium, is thick, fleshy, and covered with sensory hairs and papillae. The Hypopharynx (*hy*) forms the posterior part of the ventral surface of the buccal cavity; it is located above the mentum and as large as this structure. Anteriorly on each side of it is found a free, bifid and tooth-like end of a rod-like vertical projection from the ventral chitinous surface of stipes; and, corresponding to the epipharyngeal plate, is developed, at the entrance to pharynx, a pair of rather large, round, smooth, partly coalescent hypopharyngeal plates. Hypo- and Epipharyngeal Rods (*hr* and *er*) are present along the longitudinal margins respectively of hypo- and epipharynx; they fuse on each side at the entrance to pharynx into a simple rod; this follows the pharynx for a short distance, but soon separates as a free structure which continues through the interior of the head and attaches posteriorly to the innerside of frons.

The Tentorium (*tea*) is poorly developed as a pair of slightly chitinized, blade-shaped rods, originating from the gular margin of hypostoma and ending anteriorly as a thin membrane, attached to the innerside of frons near the antennae. A tentorial cross bridge and a pair of posterior prolongations lack, or are possibly represented by a peculiar trifurcate formation (*tb*) attached interiorly to the posterior end of the gular plate.

The Prothorax (*Pr*).—Notches (= *Nodi*).—No distinct notches occur in the cervical membrane except a pleural notch at the upper corner of the hypopleural chitization (*ph*), but posteriorly, in the intersegmental membrane between pro- and meso-thorax, are developed a dorsal notch (*dn*) rather close to the dorsal middle line of the body, a lateral notch (*ln*), a pleural notch (*pn*) just behind the lateral notch, a ventral notch (*vn*) interiorly developed into a spine, and finally a sternal notch (*sn*) in front of the ventral notch and at the end of a median, sternal, chitinous plate.

Sutures.—The prothoracic dorso-lateral suture is indistinct; but the prothoracic ventro-lateral suture (*vl*) between the pleural notch

in front and the lateral notch behind is horizontal and straight, it separates deeply the epipleural and hypopleural areas.

Areas.—The prothoracic tergal region (*Prtg*) is subsellate with transverse straight front margin, with rounded, posteriorly oblique side margin which ends at the dorsal notch and with transverse, short hind margin above the dorsal notch. The median area of epipleurum is incorporated in tergum or possibly replaced by a lowering of tergum. With exception of a narrow lateral margin the whole tergal region is covered by the tergal shield. In most genera, this shield is somewhat broader than the head and only in a few genera, as *Thaneroclerus*, of the same size. The preepipleurum (*pe*) is small, and no preepipleural arm is developed in prothorax. The Postepipleurum (*poe*) is triangular and well developed. The Hypopleurum has usually Pre- and Posthypopleural chitinizations (*ph* and *poh*).<sup>1</sup> These are separated by a short, vertical Hypopleural Suture (*hs*) above a little, ventrally extending hypopleural arm, which carries an articulating fossa for the coxal condyle. The Presternal Area (*pst*) is distinctly developed in the cervical membrane and conspicuously marked by a pair of subtriangular or rounded presternal plates, one on each side of the middle line. The Preeusternum (*pres*), a sternal area in front of the prehypopleural chitinization, and the Eusternum (*es*), behind this structure, are fused and often medianly covered with a common, unpaired Sternal Plate (*stp*). The form of this plate varies according to genera or groups of genera and is of distinct systematic value; narrow and lanceolate in *Enoclerus* and genera related to *Enoclerus*, broad and pyriform in *Chariessa* and genera of this type, and subquadrate in a genus as *Monophylla*. The lateral arms of *Eusternum* are not chitinized. The Sternellum<sup>2</sup> is not present as a distinct area; its median part or Mediosternellum is possibly fused with eusternum and each lateral part or Laterosternellum is possibly fused with the large lobe around coxa. The Posternellum

<sup>1</sup> The terms Pre and Posthypopleural chitinizations are used here instead of the more generally used terms Episternum and Epimeron (compare Crampton, Proc. Ent. Soc. Wash., vol. 20, p. 3, 1918), because a comparison between the muscles from pre- and posthypopleurum in Coleopterous larvae with those from episternum and epimeron in the Coleopterous adults shows that these larval and adult areas are not quite homologous. We find, for instance, that all the muscles in the adults, from episternum to the leg and the region near the leg, only correspond to part of the muscles which in the larvae extend between prehypopleurum and the leg and the region near the leg, while the rest of the prehypopleural muscles in the larvae are homologous with muscles which in the adults attach to the large wing-supporting Prebasalar Plate above episternum.

<sup>2</sup> The Sternellum consists of a median part or Mediosternellum and a lateral part or Laterosternellum on each side. Where the mediosternellum and the laterosternellum are well developed as in the larvae of Carabids and Silphids, the mediosternellum forms a triangular area which anteriorly is separated from the eusternum by a transverse suture between the furcal pits, and laterally defined by oblique sutures between the furcal pits and the sternal notch, while each laterosternellum is anteriorly adjacent to the lobe carrying and surrounding coxa, and laterally and internally adjacent to mediosternellum and posteriorly limited by the suture between the lateral notch and sternal notch.

(*post*)<sup>1</sup> is subtriangular; in forms as *Enoclerus*, large with a small chitinous median plate and a deep ventral notch which inside develops into a strong spina; in other forms as *Monophylla*, rather insignificant.

The Meso- and Metathorax (*Ms* and *Mt*) are subequal.

Notches (*Nodi*).—The notches belonging to meso- and metathorax are present in the same numbers and placed in the same way as between pro- and meso-thorax. Between metathorax and first abdominal segment the dorsal notch is pushed somewhat downwards, while the lateral notch occurs on the same horizontal level as the preceding lateral notch; the ventral notch is only indicated faintly, is without spina, and confluent with the sternal notch just in front of it; the pleural and sternal notches as in prothorax.

Sutures.—The dorso-lateral suture, separating tergum and epipleurum is indistinct; the ventro-lateral suture below epipleurum and between two succeeding lateral notches is horizontal and straight; it is shallow or even indistinct between the lateral notch in front of the segment and the pleural notch immediately behind, but distinct between this pleural notch and the lateral notch behind; it is especially deep above the prehypopleural chitinization; the scuto-scutellar suture, which separates the scutal and scutellar areas, is short and transversal.

Areas.—Tergum is subsellate with a short, straight, transversal front margin above the dorsal notch in front of a segment, with a deeply curvate, posteriorly oblique side margin between two subsequent dorsal notches and with a short hind margin above the dorsal notch behind. The tergal areas are slightly indicated. Prescutum (*psc*) is bandlike and mainly developed as a dorsal part of an intersegmental membrane.<sup>2</sup> Scutum (*sc*) and Scutellum (*scℓ*) are only distinctly separated in front and behind the scuto-scutellar suture. Just behind and below this suture a chitinous plate is developed in many genera; usually larger on meso- than on metathorax. The Alar area (*aa*) is large and reaches the ventro-lateral suture in front of the pleural notch after having replaced or possibly incorporated the

<sup>1</sup> The term Poststernellum is here applied to that area behind sternellum which is limited anteriorly by the transverse, straight suture through a sternal notch between two corresponding lateral notches, and posteriorly by the transverse, curved or medianly angular suture through the ventral notch right behind the sternal notch and between the same pair of lateral notches.

<sup>2</sup> The intersegmental membrane is not a constant, well-defined morphological formation, but is a structure developed for purely mechanical purposes and of changing morphological nature in different coleopterous families as well as in the different insect orders; sometimes the membrane is to be derived from the anterior, sometimes from the posterior parts of the two segments which it connects. The attachments of the longitudinal segmental muscles indicate the morphological nature of the membrane; if they attach in front of the membrane this is composed of presegmental elements, if they attach behind the membrane this is of postsegmental nature. In the Clerids the dorsal part of the intersegmental membrane belongs to prescutum, the lateral part contains both pre- and post-epipleural elements, and the ventral part below the lateral notch belongs to poststernellum.

median area of epipleurum. Postscutellum (*pos*) is of moderate size and forms the membranous hind margin of the tergum. The Preepipleurum (*pe*) is large and carries on mesothorax the well developed first thoracic spiracle, on metathorax the rudimentary second thoracic spiracle; ventrally the preepipleurum is limited by that anterior part of the ventro-lateral suture which is found between the lateral notch and the pleural notch, dorsally it is prolonged into a preepipleural arm in front of tergum, ending at the dorsal notch. The Postepipleurum (*poe*) is very large, triangular, adjacent to the preepipleurum of the next segment along a vertical line from the dorsal to the lateral notch. The Hypopleurum is identical with the hypopleurum of the prothorax. The Presternum (*pst*) is present on each side of the body as a triangular, large, swollen area, dorsally indistinctly limited by the anterior part of the ventro-lateral suture and more or less confluent with the preepipleurum and the ventral corner of the alar area, ventrally reaching the ventral notch. The Preeusternum and the Eusternum (*pres* and *es*) are fused and in some forms, as *Enoclerus sphegeus*, provided with a small, unpaired sternal plate; the eusternal lateral arm is distinguishable in most genera. The Sternellum is not present, its median part or Mediosternellum possibly being fused with eusternum, its lateral part or Laterosternellum with the large lobe, which carries coxa. The Poststernellum (*post*) of mesothorax is, in genera as *Enoclerus*, subtriangular, large, even bided by a transverse line, but small in genera as *Monophylla*; the poststernellum of metathorax is small and developed as intersegmental membrane, with the sternal and ventral notch connected and combined to an insignificant longitudinal deepening.

The Legs are five jointed, no free claws; they are on all segments inserted widely apart, all of same size and same form and the corresponding articles, for instance all femora, are pointing in the same direction; they are medium sized, largest in comparatively free living genera, as *Cymatodera*, shortest in the white, vermiform genera, as *Orthopleura* or *Monophylla*, which permanently live in the galleries of their prey. No Trochantin developed in the skin around coxa. The Coxa (*cox*) has a projecting condyle, is short, conical, with the top obliquely cut; its base is broad, oval with the long diameter pointing backwards and inwards; the height of the outer coxal surface is as large as the length of the mentioned diameter, the height of the inner coxal surface four times shorter; the sizes of the anterior and the posterior coxal surfaces are about equal. The Trochanter (*tro*) is of medium size, with the inner and longer surface as long as the inner surface of coxa. The Femur (*fe*) is, in the shortlegged genera, as long as the long diameter of the coxal base, in the other genera twice as long; its dorsal side is convexly curved; usually it is stretched for-

ward. The Tibia (*tib*) is about as long as femur; dorsally convexly curved; directed forward. The Tarsus (*ta*) is clawshaped, probably fused with a claw, slightly curved and pointed, of medium size, except in *Hydnocera*, where it is small.

The Abdomen is straight and fleshy, varying in general appearance. It may be subclaviform as in *Thaneroclerus* and *Orthopleura*, or digitiform as in *Enoclerus* and *Cymatodera*, or vermiform as in *Monophylla* and *Neichnea*, this variation mainly due to whether most of the abdominal segments have the same size or not, whether postscutellum is large or small, and whether the areas which constitute the intersegmental membranes form an expanded or narrow band. The number of the abdominal segments is 10; the first to eighth segments have laterally placed spiracles; the ninth is without any spiracles and usually carries cerci; the tenth is pierced by the anal opening.

Notches (*Nodi*).—The abdominal notches are located between the segments as described between the metathorax and the first abdominal segment; as here the sternal notch is predominant to the ventral notch, which latter is faintly indicated and fused with the sternal notch or totally absent; the pleural notch is much closer to the lateral notch than in the thoracic segments and not so pronounced; in genera with long abdomen and large intersegmental membranes the dorsal and lateral notches are developed as short longitudinal lines and not as pits.

Sutures.—The dorso-lateral sutures between the dorsal notches and below the spiracles are well defined in all forms except *Orthopleura*, where all sutures are very faint. Anteriorly, behind the pre-epipleural arm, and posteriorly, in front of the post-epipleural arm, the suture is nearly perpendicular; medianly, between the alar area and the epipleurum, horizontal and straight. The ventro-lateral sutures between the lateral notches are horizontal and straight; anteriorly, between a lateral and pleural notch and above presternum, the ventro-lateral suture is faintly indicated or even evanishing, as described in thorax, but posteriorly, above hypopleurum, deeply marked. The scuto-scutellar suture is well developed and provided with an anterior and posterior oblique branch; in *Necrobia* and other forms even a ventrally directed branch is present in direct continuation of the main suture. That suture which defines postscutellum anteriorly is straight, rather perpendicular, and the suture which marks the dorsal boundary of the alar area branches out from it in an oblique forward and ventral direction. In *Necrobia* a deep, transverse suture separates a large preeusternal area from the eusternal area; this suture is not, or only faintly, developed in the other genera. Another transversal suture separates eusternum from mediosternellum. Two oblique

and parallel sutures extend from this latter suture; the one, from near the middle, points forwards and outwards, the other, from the end, points backwards and inwards; the first forms the inner boundary line of parasternum (*pas*), the second the inner boundary line of laterosternellum (*lstl*).

Areas.—The Tergal region is limited by a transversal, straight front margin between the two corresponding dorsal notches in front of a segment, by U-shaped side margins between two successive dorsal notches and by a transversal straight hindmargin between the two corresponding dorsal notches behind the segment. The Prescutum (*psc*) is transverse and band-like, mainly developed as intersegmental membrane (*T S*); in most genera narrow and rather indistinctly defined posteriorly, in genera with long abdomen broad and distinctly defined posteriorly. The Scutum (*sc*) and Scutellum (*scl*) have distinct mediotergal subdivisions, which form together a conspicuous Mediotergite. In a few forms, as *Enoclerus sphegeus*, a row of small, pearl-shaped projections are present on each side of the scuto-scutellar suture, and also along the two oblique branches from this suture. In several forms as *Galeruclerus*, *Chariessa*, *Phyllobaenus*, and *Priocera* a pair of Ampullae (*Amp*) develops from the mediotergite of the second to the seventh or eighth abdominal segments. The lateral subdivisions of scutum and scutellum are more or less fused into a combined area, named Parascutum (*pa*). The Alar Area (or Spiracular Area) (*aa*) is large, with a spiracle present anteriorly and near the dorso-lateral suture. The Postscutellum (*pos*) is of medium size in most forms; large in elongate forms. The Pre-epipleural Area (*pe*) is completely or nearly completely developed as intersegmental membrane; in most genera it is elongate, triangular, tapering toward the dorsal notch; in genera as *Mono-phylla* and *Tarsostenus*, where the dorsal notch is linear, it is sub-rectangular, ventrally with a short wedge-shaped cut into the basal margin. The Median Epipleural Area, between the horizontal section of the dorso-lateral suture and the ventro-lateral suture, is in most genera provided with a large Epipleural Lobe (*el*). The Post-epipleural Area (*poe*) is triangular and posteriorly adjacent to the pre-epipleural area of the next segment. No pleural disks are found.<sup>1</sup> The Hypopleurum (*hp*) is dorsally well defined by that part of the ventro-lateral suture, which is behind the pleural notch; ventrally not equally distinctly separated from the adjacent areas; it is fleshy and well developed in most forms. The abdominal Presternum (*pst*) is, like in thorax, located below that part of the ventro-lateral suture,

<sup>1</sup> The anatomy of these structures has been described first (1869) by Schödte as "foveae auditoriae" (Nath. Tidsskr., ser. 3, vol. 6, pp. 356, 366, etc.), later (1917) by W. N. Hess, (The Chordotonal Organs and Pleural Discs of Cerambycid Larvae; Ann. Ent. Soc. Amer., vol. 10, No. 1, pp. 63-74, pls. 4-7) and by him also associated with chordotonal organs.

which is anterior to the pleural notch, but is here a small, triangular structure, and does by far not reach the ventral middle line of the segments. A distinct Preeusternum is not developed except in *Necrobia* and, less pronounced, in some species of *Enoclerus*. Eusternum (*es*) is large, subtriangular, without any longitudinal muscle impression in front of parasternum. Parasternum (*pas*) is well defined, subtriangular, with straight interior limitation. The Mediosternellum (*mstl*), posteriorly ending at the sternal notch, has normally the shape of a small, narrow, transversal band with lanceolate or subtriangular outline; it is unusually large and swollen in *Tarsostenus*. The Laterosternellum (*lstl*) is in most genera small, even indistinct; when well developed, as in *Enoclerus* and *Cymatodera*, it reaches the sternal notch and has a shape similar to parasternum and limiting lines parallel to those of that area. The Poststernellum (*post*) lies behind the mediosternellum and laterosternellum of the segment and in front of the presternum and eusternum of the next segment; it is developed as intersegmental membrane; usually of moderate size, but large in the elongate, vermiform genera. The Coxal Lobe is between hypopleurum, parasternum, and laterosternellum; it is small, often indistinct and confluent with parasternum.

The ninth abdominal segment consists of a large dorsal region, containing both tergal and epipleural elements, and a narrow band-like ventral region with hypopleural and sternal elements; the two regions are separated by the ventro-lateral suture; none of them are differentiated into special areas. In the different species of the large genus *Enoclerus* and also in many other genera, a pair of solid, usually not branched, well-developed Cerci (*cer*, fig. 79) extend from an unpaired, chitinous basal plate (*bp*) on the dorsal region; the shape and size of both cerci and basal plate vary considerably in the family. In *Necrobia* the cerci are slightly branched; in some species of *Cymatodera*, as *Cymatodera bicolor*, they unite into a single, bifurcate, stalk-like formation, which arises from a well-developed disciform basal plate; in *Priocera castanea* the cerci are small and fused into a bifid, conical horizontal prolongation of the basal chitination, which in this form envelops the whole dorsal region; in *Thaneroclerus girodi* the cerci are rudimentary, but the basal plate is well developed; in *Hydnocera* the cerci are rudimentary and the basal plate is not sharply defined; *Phyllobaenus* and *Orthopleura* have a pair of hook-shaped cerci, but no basal plate, and *Neichnea* has neither cerci nor basal plate.

The tenth abdominal segment is developed as a locomotive organ and placed entirely below the ninth segment; it is wart-shaped, ring-like with a triangular anus, which is surrounded by four small papillae in front and one large, lip-like lobe behind.

The Spiracles (*sp*) vary considerably in the family and provide a character of high systematic value. The genus *Necrobia* has large, annular-bifore spiracles with circular peritrema and well-developed, finger-shaped tubes. *Thaneroclerus*, a genus distinctly different from all other genera in the family, has small annular-bifore spiracles. The genera *Enoclerus*, *Galeruclerus*, and others, have pseudo-annular spiracles, which means that the spiracles only apparently are ring-shaped, but in reality, as seen with high power magnification, annular-bifore with a pair of very small finger-like tubes extending backwards from the posterior margin of the ring-shaped peritrema. In a few species of *Enoclerus* the posterior abdominal spiracles are annular-bifore, thus indicating the rather close relationship between the two genera *Enoclerus* and *Necrobia*. Finally, in genera as *Cymatodera*, *Priocera*, *Hydnocera*, and others, the spiracles are all plain annular. The first thoracic spiracle is mesothoracic; usually of the same size or not much larger than the abdominal ones; in *Thaneroclerus* twice as large. The second thoracic spiracle is metathoracic; always rudimentary.

The setae vary much in size, distribution, and number, according to the different genera, species, and even, age stages; they are most normally developed on all body parts in genera as *Enoclerus* and *Cymatodera*; very long, soft, and numerous in *Trichodes*; short, fine, and scarce in forms as *Orthopleura* and *Neichnea*.

The color is varying; all known species belonging to the genera *Necrobia*, *Enoclerus*, *Galeruclerus*, *Cymatodera*, *Trichodes*, and *Thaneroclerus* are vividly colored, red or blue, changing in the same genus according to species or even according to the different larval stages of the same species; in *Enoclerus thoracicus*, *Galeruclerus*, and *Cymatodera* the colored parts are speckled with white or light spots, mainly corresponding to muscle attachments; in *Necrobia* and *Cymatodera* are found on most of the segments a pair, or a transverse series of four orange dots, which probably indicate glands; genera as *Chariessa* or *Phyllobaenus* have a faint, bluish tinge on protuberant structures as the ampullae or the epipleural lobes; genera as *Monophylla*, *Orthopleura*, and *Priocera* are plain whitish; in the genus *Hydnocera* both spotted and unicolored whitish species occur.

#### C. CLASSIFICATION OF THE LARVAE OF NORTH AMERICAN CLERIDAE.

Preceding the discussion on the above given subject, it is thought proper to formulate the following general principles, to which I adhere. The classification of the Coleoptera, which is based entirely on adult characters, should not be materially interfered with by taxonomic studies on a single group of larvae. A new systematic name should only in exceptional cases be applied to families, genera, and species which are established exclusively on larval characters.

A reconstruction of the present classification with due regards to the larvae should not be undertaken before an independent, comprehensive classification of all significant larval types is completed.

Usually the results of taxonomic studies on the larvae do harmonize with some or other system already used or proposed for the adults, thus emphasizing the value of that particular system. In several cases, however, certain larvae or larger groups of larvae do not fit into the schemes of any established system and for such larval forms a new appropriate taxonomic arrangement will have to be assigned in papers exclusively dealing with larvae.

In an obvious way the Clerid larvae represent this latter type of larval forms, and the classification of the Clerid larvae will clearly illustrate how much a taxonomic arrangement of the adults and the corresponding larvae can differ. The customary systematic sequence of the genera of the adult Clerids has been changed in the classification of their larvae; one of the genera which in the adults is considered homogenous must be divided in the larval taxonomy; while in another case two genera which are separated in the adults have been united in the arrangement of the larvae; and finally the Clerid larvae have been grouped together with larvae of other families to form a new series to which no corresponding series exists in the adult taxonomy.

#### C. a. LARVAL CHARACTERS DEFINING THE FAMILY SERIES CLEROIDEA.<sup>1</sup>

The family Cleridae is, according to the adults, by most authors placed in the family series Serricornia, but the Clerid larvae can only be associated with the larvae of part of the families of the Serricornia, namely with those of the Malachiidae, Malacodermidae, Throscidae, Eucnemidae, Rhipiceridae, and the Elateridae. They are, however, also closely related to the larvae of some of the families which belong to the series Clavicornia, namely the Dermestidae, the Trogositidae, and the Parnidae; so are the larvae of the other mentioned Serricornia. Together all these families constitute a series for which I propose the name Cleroidea and which is defined by the following combination of characters:

##### 1. LEGS WITH FUSED TARSUS AND CLAW, "CLAW-SHAPED TARSUS."

This character separates the Cleroidea from the Adepaga with the Gyrinidae, from the Rhysodidae and the Cupesidae, all of which have a definite tarsus and one or two claws; also from the first larval stage of the Micromalthidae, close to the Cupesidae, which have a long, slender tarsus and two claws, and apparently from the first or triungulin stage of some of the Meloidae. The Staphylinid genus

<sup>1</sup> The following taxonomic discussion is based on a joint study on the characterization of Coleopterous larvae families, undertaken by Dr. F. C. Craighead and the author, A. G. Böving.

*Bledius* and Pselaphid genus *Euplectus* have tarsus and one claw, but the other genera of these two groups have fused tarsus and claw. Eucnemids have rudimentary or no legs, but are, through *Throscus dermestoides*, which has well-developed legs, allied to the other Cleroidea.

2. VENTRAL MOUTHPARTS FORM A COMPACT UNIT. MAXILLARY STIPES IMMOVABLE OR MOVABLE PRINCIPALLY IN DORSO-VENTRAL DIRECTIONS. GENERALLY EITHER WITH A SINGLE, OFTEN MORE OR LESS DISTINCTLY TWO JOINTED MALA, OR, WHEN BOTH LACINIA AND GALEA ARE PRESENT, WITH GALEA DEVELOPED AS THE MORE SIGNIFICANT OF THE TWO ORGANS, PALPIFORM AND BIARTICULATE; LACINIA USUALLY TRIANGULAR AND SQAMOSE. MAXILLARY ARTICULATING AREA SMALL OR ABSENT. PREGULAR PLATE<sup>1</sup> NOT PRESENT.

This character excludes the Cleroidea from those Coleoptera larvae which have either a free stipes with turning rotatory motion and a large preular plate, or, attached stipes, movable only in horizontal plane, and usually a large maxillary articulating area. The first alternative applies to a series formed by those larger Staphylinid forms which are represented by genera like *Philonthus* or *Stenus*, by the family Histeridae, the Hydrophilid genus *Helophorus*, that Hydrophilid type which is represented by genera like *Hydrous* or *Sphaeridium*, and by the family Paussidae. The second alternative applies to most Coleopterous families, but is especially worth emphasizing in reference to the small Staphylinids of the *Oxytelus-Tachinus-Syntonium* type, the larger Silphids of the *Silpha-Necrophorus* type, and the Byrrhidae, all of which, in many other respects, are families closely related to the Cleroidea. The small Staphylinids have a single mala; the larger Silphids two malae, lacinia large and rounded, galea short, barbate, and not jointed; the Byrrhidae two malae, lacinia large and falciform, galea elongate and more or less distinctly biarticulate.

3. MANDIBLES POSTERIORLY WITHOUT MOLA; DECREASING IN WIDTH FROM BASIS TO DISTAL END.

This type of mandibles includes the labidomorphic, grasping, mandibles, which are somewhat flattened, triangular, or falciform,

<sup>1</sup>The term "Pregular plate" was introduced in 1909 by Dr. A. D. Hopkins (in his publication on *Dendroctonus*) for an identical structure in adult Coleoptera (U. S. Dept. Agr., Bur. Ent., Tech. Ser. No. 17, 1909, pp. 10-19). A Kemner, in a very interesting and instructive discussion on the term *Hypostoma* (in his previously quoted publication pp. 2-3) describes (1912) the preular plate as "Mental Platte," stating, however, that very likely "it might be a submental structure" (compare Kemner, fig. 14 with explanation). In the Staphylinid larvae, described by Kemner, the plate in question evidently contains both submental and preular elements and might therefore shortly have been named "Submental platte"; but in other forms, for instance the Hydrophilid larvae *Berosus* and *Helophorus* (compare Schiödt's figures of these larvae), the preular plate (Kemner's "mental platte") appears clearly destitute of any submental element, submentum here being present as a distinct area. Consequently the term "Pregular plate" must be adopted as being both the more practical, more correct, and older term. It might be advisable here to point out that it is only in the *Carabids* that Schiödt applies the term "Hypostoma" to the postmaxillary part of what I, following Hopkins (not Schiödt, as Kemner states), term *Hypostoma*. In all other descriptions Schiödt applies this term *Hypostoma* indiscriminately to *Submentum* and *Gula*. When submentum and gula (or pregula) are fused, Schiödt mentions this joint formation as *Hypostoma*; when they are separated, he makes a distinction between the Anterior and Posterior Part of *Hypostoma*, never using the terms *Submentum* and *Gula*.

often provided with retinaculum, and the subulate mandibles, which are awl-shaped, curved, without retinaculum and often perforated. Both the labidomorphic and the subulate mandibles are rather characteristic for the Cleroidea, but do also occur in several families not belonging to this series; for instance: The Adephaga, the above mentioned small Staphylinids, large Silphids, the Rhysodidae, the Cioidae, the Lyctidae and Ptinidae, some Chrysomelidae, as the Donaciini, and some of the Melandryidae. The character separates the Cleroidea from the larvae with palmate<sup>1</sup> mandibles, as in most Chrysomelidae, with coelate, gouge shaped<sup>1</sup> mandibles, as in the Cerambycini, and especially from all larvae with masticomorphic, grinding, mola bearing mandibles. This last, important mandible type is developed in many families which, according to the adults, always have been closely associated with one or another of the Cleroid families, but, according to several larval structures, must be considered to have less affinity with these families than generally supposed; for instance, the Cucujidae, Cryptophagidae, Byturidae, Mycetophagidae, and Coccinellidae, all of which usually are placed near the Trogositidae or the Dermestidae, also the Derodontidae, by D. Sharp, and other authors suggested to belong near the Cleridae, some Dascillid genera as *Dascillus*, and the Cyphonidae, often arranged near the Parnidae, between the Elateridae and Malacodermididae. Masticomorphic or grinding mandibles are furthermore present in a great many families, which do not exhibit any close relationship to the Cleroidea, neither as adults nor as larvae; for instance, the very uniform series of small, closely related forms of the galea-bearing *Choleva*, *Limnebius*, *Hydroscapha*, *Trichopteryx* types or most of the Heteromera or all the Lamellicornia.

4. BODY ORTHOSOMATIC, STRAIGHT WITH DORSAL AND VENTRAL SURFACE EQUALLY LONG OR NEARLY SO; OR BODY CYPHOSOMATIC, WITH THE WHOLE DORSAL SURFACE FORMING A HUMP. INTERSEGMENTAL MEMBRANES PRESENT. TENTH ABDOMINAL SEGMENT USUALLY DEVELOPED AS A LOCOMOTORY ORGAN, EXTENDING FROM THE VENTRAL SIDE OF THE NINTH ABDOMINAL SEGMENT.

This character separates the Cleroidea from the cyrtosomatic, curved larvae, as those of the Bostrichidae, Ptinidae, Donaciini, most Rhynchophora, and the Lamellicornia.

5. NO THORNBEARING DORSAL PLATES.

Such structures characterize many different species and genera, even larger groups of several families not included in the Cleroidea, but do hardly occur in this series.

<sup>1</sup> Palmate and coelate mandibles are anteriorly broad, with a definite front edge, on the inner side excavate, posteriorly without mola. In the palmate mandibles the front edge is multidentate; in the coelate mandibles smooth.

6. CERCI, WHEN PRESENT, INARTICULATE AND IMMOVABLE.<sup>1</sup>

This character may for purely taxonomic use be considered of minor interest, only an additional character to the above-mentioned, yet it separates the Cleroidea from several families or series of families in which most or many or some of the members have jointed and movable cerci; for instance, from most of the *Choleva*, *Limnebius*, *Trichopteryx* types; from many of the Adephega types; many of the *Staphylinus*, *Hister*, *Helophorus* types, and many of the *Oxytelus*, *Tachinus*, *Silpha* types; from some of the Cucujidae, as the genera *Brontes*, *Dendrophagus*, and *Psammoecus*; and from a single species *Cryptophagus lycoperdi* Herbst (European) of the Cryptophagidae.

## 7. SPIRACLES ANNULAR OR BIFORE. FIRST THORACIC SPIRACLE PLAINLY IN PREEPIPLEURUM OF MESOTHORAX.

By this character the Cleroid larvae are separated from all larvae with cribriform spiracles—namely, the Buprestidae, the genus *Dascillus*, the Heteroceridae, and all the Lamellicornia, except *Throx*, which has bifore spiracles.

## C. d. LARVAL CHARACTERS DEFINING THE FAMILIES OF THE CLEROIDEA AND PARTICULARLY THE FAMILY CLERIDAE.

While the above given combination of characters equally applies to all families of the series, and consequently does not classify each individual family definitely, another combination of characters fulfills that requirement and serves in that way to separate every family in the series from the rest.

The characters which particularly define the Cleridae and complete the precise determination of this family are the following:

- (a) *Head porrect and exerted.*
- (b) *Labrum and clypeus present.*
- (c) *Antennae well developed and three jointed.*
- (d) *Mandibles acuminate with single apex and usually with retinaculum; a deep groove along the cutting edge; no penicillum.*
- (e) *Ventral mouthparts protracted or only slightly retracted; maxillary margin of hypostoma adjacent only to cardo; postmaxillary margin of hypostoma adjacent to gula and in some forms detached as a separate "paragular" structure.*
- (f) *Cardo maxillae as large or larger than stipes maxillae.*

<sup>1</sup> When J. A. Hyslop in his important paper, The Phylogeny of the Elateridae, based on larval characters (Ann. Ent. Soc. Amer., vol. 10, 1917, p. 245), writes that the larvae of the Elateridae have "no cerci," he evidently does not consider inarticulate and immovable cerci as real cerci. I, however, follow Schiödte in using the term "cerci" for these structures, as I am convinced that they are homologous to the jointed, movable cerci in other Coleopterous larvae. In the family Carabidae both forms of cerci occur in genera intimately connected, as *Nottophilus* and *Elaphrus*; in fact, even in different species of the same genus, as in the Carabid genus *Chlaenius*, one species, from North Africa, deposited in the Zoological Museum of Copenhagen, has long, jointed, movable cerci, while all the Danish species have stiff, straight cerci. Also in the same Cryptophagid genus *Cryptophagus*, one species *C. lycoperdi* has jointed cerci, while *C. pilosus*, *C. pubescens* and others have solid cerci.

(g) *Palpus maxillae with three free joints and a low, not joint-like palpiger, which is closely connected with stipes.*

(h) *Mala maxillae<sup>1</sup> extending from the distal end of stipes; simple or transversely bisected.*

(i) *Maxillary articulating area absent.*

(j) *Submentum well defined.*

(k) *Gula as long as frons, elongate, rectangular, limited by two parallel gular sutures.*

(l) *Prothorax usually with two well-separated presternal plates and an unpaired median sternal plate.*

(m) *Abdominal segments fleshy, plicate, without chitinous shields, often vividly colored and often with ampullatory lobes.*

The above given combination of characters shows the Cleridae as a comparatively simple larval type. This type, however, does not represent the one from which the other Cleroidea have developed. In fact, the Cleridae must be looked upon as a derived family in the series and developed from the same group of families, the Malachiidae, Dermestidae and Trogositidae, from which probably the whole series, except the Parnids, directly or indirectly has branched.

In general organization the Cleridae are most like the Malachiidae. In characters, as the shape of cardo and submentum and the shape of the mandibles, the Cleridae come nearest to the Malachiidae and Dermestidae; but in other characters, as the well-developed and well-separated presternal plates and the well-defined sternal plate, which is present in the typical Clerid genera, and the occurrence of pseudoannular spiracles in some of the genera, the Cleridae approach remarkably the typical Trogositidae, for instance, the genus *Trogosita*. In common with all three families the family Cleridae has a well-developed labrum and clypeus and a gular area; but it differs from them in having protracted ventral mouthparts, as the three families, like the rest of the series, have retracted. That the gular area is elongate and as long as frons in the Clerids, but shorter than frons and usually square or transversally rectangular in the other three families harmonizes with the different position of their ventral mouthparts.

The more typical Dermestidae have a small but distinct lacinia, a two-jointed galea and a slight indication of a division of ligula into two lobes, what is a decidedly primitive character, not present in any other Cleroid; in the Malacodermidae and Elateridae ligula is even not developed. Most of the Trogositid genera have a porrect and exerted head, as the Clerids, but the Dermestidae, some of the Trogosi-

<sup>1</sup> John B. Smith in *Explanation of terms used in Entomology*, Brooklyn, N. Y., 1906, defines (p. 77) "mala maxillae" as "the lobes of maxilla; outer or galea, inner or lacinia; where only one is present, the term refers to that one." In the Cleridae only one lobe, questionable if lacinia or galea, or both fused, is present.

tidae and, to a less extent, the Malachiidae have a nutant and somewhat invaginated head and resemble in that respect both the Parnidae and the Rhipiceridae.

With the families Parnidae, Rhipiceridae, Throscidae, Eucnemidae, Malacodermidae, and Elateridae, the Cleridae are not so closely associated as with the Malachiidae, Dermestidae, and Trogoxetidae. This can readily be realized from the following brief morphological and phylogenetic analysis of those first mentioned families.

The Parnidae and Rhipiceridae have, as mentioned above, a nutant or seminutant head. Labrum is well developed and clypeus rather distinct; cardo broad and low; stipes maxillae broad. In the Rhipiceridae only a single mala is present; in the Parnidae a well-developed lacinia and well-developed galea. In the Parnidae, mentum has the usual quadrangular form present in most of the Cleroidea, but in the Rhipiceridae the mentum is posteriorly constricted as in some Elaterid genera. In the Parnidae the antennae are three-jointed, in the Rhipiceridae very short, retracted, one or possibly two jointed. In both families the ninth segment enables a perfect sealing of the anal opening; in the Parnidae this ninth segment is often prolonged and conical, in the Rhipiceridae operculate, convex and circular; in the Parnidae the body is terminated by three bunches of gills, in the Rhipiceridae no similar structures are present.

The Parnidae must be derived from the Byrrhids but show also relationship to the Dermestidae. The Rhipiceridae are undoubtedly closer connected with the Dermestidae and the Parnidae, especially the cylindrical Parnidae, than with the Elateridae, from which family they usually are supposed to have branched.

The Throscidae and Eucnemidae are still more remote from the original simple Cleroid type than the Parnids and Rhipicerids. The genus *Throscus*, represented by *Throscus dermestoides* Linnaeus is in many respects the prototype of the Throscid-Eucnemid group, the form from which the Eucnemidae have metamorphosed by a retrogressive development. The legs, which have disappeared in most Eucnemids, are well developed in *Throscus dermestoides*. With exception of the mandibles, which in *Throscus dermestoides* are fused with the mouth frame, but free in some Eucnemid genera, the mouth-parts as well as the antennae are less rudimentary in *Throscus* than in the Eucnemids. Labrum is absent in both families, only represented by a small triangular process from the epistomal margin of frons. The isolated morphological development of the group is indicated by the invagination of the head, but especially apparent in the extraordinary rodshape of the prothoracic presternal, prehyopopleural, and paired sternal (more correctly sternellar) plates.

In *Throscus* the presternal plates are separate, connected with the prehypopleural rods, which interiorly continue into a long rod-like hypopleural apodeme. The anterior basal margin of coxa is separately chitinized, forming a curved rod, which posteriorly terminates as a little projecting hook. These rods are also present in the Eucnemids. The most interesting structures, however, present in both families, are the paired, rod-like sternal (sternellar) plates. Similar structures do not occur in any other Cleroid, but they have their homologa in the two strongly developed, broad plates which cover the whole ventral side of prothorax of the Buprestidae.

The Throscid-Eucnemidae constitute an isolated, highly specialized group inside the Cleroids, undoubtedly closer to the Elateridae than to any other family of the series, but on the other hand not right away to be considered a transformed and reduced Elaterid type. Rather may a strong convergence toward the Buprestidae be emphasized. In fact, the Throscid-Eucnemids can hardly be separated from this latter family by any other valid character than the different shape of the spiracles, the Buprestidae having cribriform, the Throscid-Eucnemids bifore spiracles. It may, however, be advisable to mention in this connection that, among the Cleroid, the Telephoridae exhibit a type of annular-bifore spiracles with peculiar sponge-like lateral structures, which recalls the large, crescent-shape air-chamber of the cribriform spiracles. Thus the possibility is not excluded that some form among the Cleroid might be found with cribriform spiracles or some Buprestid with annular or bifore spiracles; a discovery which would involve the Buprestidae to be placed among the Cleroidae.

The Elateridae including the Cebriionidae are one of the best studied larvae families.<sup>1</sup> The Malacodermidae are by far not so well known. They include groups of distinctly different appearance. Some are flat, and smoothly chitinized larvae with laterally expanded segments, others fleshy, whitish, slightly chitinized, others again darkcolored, soft, velvety pubescent. Labrum absent in all. Falci-form, toothed mandibles occur in forms as *Photuris* and subulate, often perforated in forms as *Drilus*; normally developed maxillae with a single mala occur in most forms, but maxillae having stipes completely fused with a chitinized mentum exist—for instance in *Lygisto-pteris*; purely bifore spiracles are present in the Lampyrids, pseudo-cribriform in Telephorids; the ninth abdominal segment varies greatly according to groups or genera; it is well developed, soft, posteriorly rounded and without cerci in the Telephorids; large, chitinized with distinct, blunt ending cerci in the *Lygisto-pteris*; rather small, chitinized, and together with the large, cylin-

<sup>1</sup> See Hyslop, J. A. The Phylogeny of the Elateridae based on larval characters, Ann. Ent. Soc. America, vol. 10, 1917, p. 242.

dricul tenth segment, forming an efficient pseudopod in a type as *Phosphaenus*.

The Elateridae have perhaps developed from the Trogositidae.

The relationship of the Malacodermidae is not clear. Through the Telephoridae there is some connection both with the Malachidae and the Elateridae. From the first family, however, the Telephorids are, as shown above, readily distinguished; from the Elateridae not so easily. These two families have practically all characters in common, except the shape of the spiracles; yet a close relationship with the Elaterids might be more apparent than real.

C. C. PHYLOGENETIC AFFINITIES OF THE SINGLE FAMILIES OF THE CLEROIDEA TO OTHER COLEOPTERUS FAMILIES.

After the previously given discussion on the systematic and phylogenetic position of the Cleridae among the families with which they directly or more indirectly are associated and the short characterization of these other families of the series and their probable phylogenetic relations to each other, it might be proper to end with a brief, partly summarizing indication of the possible affinities of the Cleroidea to other families outside this series.

The Cleroidea are connected with the Byrrhidae, the Silphidae, and probably with several of the Chrysomelid groups through the Dermestidae, possibly with the Bothrideridae through the Cleridae and Trogositidae, with the Bostrichidae, Lyctidae, and Ptinidae through the Dermestidae and Trogositidae. The Parnidae and Rhicipiceridae come close to the Byrrhid-like genera *Ptilodactyla* and *Anchytarsus* and to the family Heteroceridae. The Eucnemidae are most likely connected with the Buprestidae.

C. d. TABLE OF SUBFAMILIES, DIVISIONS, SECTIONS AND GENERA OF NORTH AMERICAN CLERID LARVAE.

SUBFAMILY A, p. 597 (large bifore spiracles).

Genus 1. *Necrobia*, p. 597 (two ocelli).

SUBFAMILY B, p. 599 (frons posteriorly pointed; no epicranial suture; second antennal joint small).

DIVISION I, p. 599 (5 ocelli):

Section a, p. 599 (vividly colored, well-developed basal plate, gula long).

Genus 2. *Thanasinus*, p. 601 (unicolorous, cylindrical cerci) and *Enoclerus*, p. 602 (unicolorous; cerci corniform or claviform).

Genus 3. *Enoclerus spehegeus*, p. 604 (epicranial tubercles).

Genus 4. *Galeruclerus*, p. 606 (spotted; with ampullae).

Section b, p. 607 (slightly or not colored; basal plate poorly or not developed).

Genus 5. *Charicssa*, p. 608 (ampullate; basal plate laterally rectilinear).

Genus 6. *Phyllobacnus*, p. 609 (ampullate; large intersegmental membrane; no basal plate).

Genus 7. *Neichnea*, p. 610 (no cerci).

Section c, p. 611 (vividly colored; gula short).

Genus 8. *Trichodes*, p. 611 (very hairy).

## DIVISION II, p. 612 (4 ocelli):

Genus 9. *Tarsostenus*, p. 612 (ampullate; large intersegmental membrane; basal plate distinct).

## DIVISION III, p. 614 (3 ocelli):

Genus 10. *Cymatodera*, p. 614 (spotted; orange punctures).

## DIVISION IV, p. 617 (1 or no ocellus):

Genus 11. *Orthopleura*, p. 617 (swollen; no basal plate).

Genus 12. *Monophylla*, p. 618 (elongate; basal plate distinct).

## SUBFAMILY C, p. 619 (second antennal joint large).

Genus 13. *Priocera*, p. 619 (ninth abdominal segment enveloped by conical, asperse chitinization; cerci small, fused basally).

## SUBFAMILY D, p. 620 (well developed epicranial suture).

Genus 14. *Thaneroclerus*, p. 621 (median gular tubercle).

## SUBFAMILY E, p. 622 (frons posteriorly with straight, transversal margin).

Genus 15. *Hydnocera*, p. 622 (apical and supplementary joints of antennae large).

## C. c. KEY TO GENERA OF FULLGROWN NORTH AMERICAN CLERID LARVAE.

1. Frons posteriorly limited by a transverse line... *Hydnocera*, p. 622.  
Frons posteriorly angulate..... 2
2. Epicranial suture, well developed..... *Thaneroclerus*, p. 621.  
Epicranial suture, not well developed..... 3
3. All spiracles bifore; two ocelli..... *Necrobia*, p. 597.  
Anterior or all spiracles annuliform or pseudo-annuliform..... 4
4. Antenna with large second joint; ninth abdominal segment conical, asperse, bifid..... *Priocera*, p. 619.  
Antenna with small second joint..... 5
5. One or no ocellus..... 6  
More than one ocellus..... 7
6. No basal plate; tumid body..... *Orthopleura*, p. 617.  
Distinct basal plate; elongate body..... *Monophylla*, p. 618.
7. Three ocelli..... *Cymatodera*, p. 614.  
More than three ocelli..... 8
8. Four ocelli; sixth and seventh abdominal segment ampullate; basal plate distinct..... *Tarsostenus*, p. 612.  
Five ocelli..... 9
9. Gula comparatively short, ventral mouth parts somewhat retracted, body very hairy..... *Trichodes*, p. 611.  
Gula elongate..... 10
10. Membranous parts of body with faint bluish tint on exposed areas or white; basal plate indistinct or absent..... 11  
Membranous parts strongly colored; basal plate distinct..... 13
11. With cerci..... 12  
Without cerci..... *Neichnea*, p. 610.
12. Basal plate laterally rectilinear; body finger-shaped..... *Chariessa*, p. 608.  
Basal plate not present; body elongate, worm-shaped..... *Phyllobaenus*, p. 609.
13. Body colored, with whitish pattern; chitinization of cardo occupies half or less of entire cardo surface..... *Galcrucclerus*, p. 606.  
Body of one strong color throughout; chitinization of cardo occupies two-thirds or more of entire cardo surface..... 14
14. Each epicranial half with a dorsal tubercle..... *Enoclerus sphegus*, p. 604.  
Each epicranial half without any dorsal tubercle..... 15
15. Cerci corniform, with long gradually pointed end, or clubshaped with short abruptly contracted end..... *Enoclerus*, p. 602.  
Cerci like the horn of a chamois, cylindrical with rather short, much recurved, pointed end..... *Thaousimus*, p. 601.

C. f. CHARACTERIZATIONS AND DESCRIPTIONS OF SUBFAMILIES, DIVISIONS, SECTIONS, GENERA, AND SPECIES OF NORTH AMERICAN CLERIDS, ARRANGED ACCORDING TO THE RELATIONSHIP OF THE LARVAE.

### Subfamily A (pp. 597-599).<sup>1</sup>

Frons posteriorly limited by an acute angle. Epicranial suture not present. Second antennal joint small, about the same length as apical antennal joint. Ventral mouth parts distinctly exerted. Gula with flat surface. Abdominal preeusternal and eusternal areas well separated. Spiracles all well developed, all annuliform-bifore. Ocelli, two on each side.

#### 1. Genus NECROBIA Latreille.

Body subclaviform, ventrally flattened, widest at fourth to seventh abdominal segments, tapering from here gradually toward head and the ninth segment, which is full and crescentiform. Membranous parts variegated. Setae long, rather thin, numerous, scattered. Headcapsule from middle of epistoma to end of frons as long as the extreme width of the head; sides nearly straight and parallel. Frons with slightly unequal surface. Epicranium dorsally rugose, ventrally smooth. Ocelli two on each side; the anterior more than twice as large as the posterior; anterior ocellus not farther behind pleurostoma than the length of second antennal joint; posterior ocellus placed somewhat obliquely and dorsally behind the anterior one, as far from this as the length of the same second antennal joint. Antenna with lengths of basal, second, and apical joints proportioned as 3:2:1; supplementary joints very small. Mandibles rather slender, considerably longer than wide, apex long and pointed, projecting over inner corner of mandibular base; distinct retinaculum. Maxilla well developed; both cardo and stipes with subrectangular basal chitinization, the chitinization of cardo the larger; mala bidivided, fleshy, reaching middle of second joint of maxillary palpus; palpiger with low semicircular chitinization; joints of maxillary palpus gradually decrease in thickness from basal to apical joint; lengths of basal, well-developed square chitinization between and adjacent to the chitinizations of cardines and as long as these. Mentum with curved anteriorly concave chitinization and a transverse row of four setae. Stipes labii chitinized; labial palp with basal and apical joints shaped and proportioned as second and apical joints of the maxillary palp. Gula nearly as long as frons, its length, in proportion to the

<sup>1</sup> It is not deemed advisable to consider as a family, corresponding to the adult family Corynetidae the present subfamily A, represented by the genus *Necrobia*. Every one of the other five subfamilies, established in the present paper, should in that case logically be raised to family rank.

length of the maxilla from condyle of cardo to end of palpus, is as 5:3. Prothoracic tergal shield along middle line about as long as one of the frontal sutures; prothoracic sternal plate broadly lanceolate. Legs medium sized. Abdomen with normally developed intersegmental membranes; scuto-scutellar suture deep, with anterior and posterior branches evanishing and with an accessory, ventrally directed, deep branch developed in continuation of the main suture; no distinct mediotergal subdivision, scutum and scutellum almost completely separated from alar area; postscutellum narrow; an anterior, large preeusternal area separated by a deep transversal suture from a small eusternal area; parasternum large, meets the corresponding opposite area in the middle line; mediosternellum and laterosternellum normally built. Basal plate of cerci large, well chitinized, anteriorly well defined, laterally rounded, somewhat expanded beyond the attachments of the cerci, covers a great part of the dorsal surface of ninth abdominal segment. Cerci paired, widely separated, rather small, each cercus with a small projection carrying two exceptionally long setae. Tenth abdominal segment prominent, with four large soft-skinned papillae in front of anus. Spiracles annuliform-bifore, with the finger-shaped tubes pointing backwards both on the thoracic and abdominal spiracles. In general appearance and many important characters *Necrobia* is closely related to the genus *Enoclerus*.

The association of the genus *Phyllobaenus* with the genus *Necrobia*, as indicated by Brues and Melander in Key to the families of North American Insects, Boston, 1915 (p. 35), is not supported by the classification of the larvae.

#### NECROBIA RUFIPES Degeer.

No. 486, U. S. N. M. Mature larva taken together with pupa and adult.

Total length<sup>1</sup> of body, about 10 mm.; extreme width, about 2 mm.; fifth to seventh abdominal segments widest; anterior width of prothorax one-half the width of the seventh abdominal segment; extreme thickness, 1½ mm.; seventh abdominal segment thickest. Corneous parts shiny, brown ocher<sup>2</sup>; delicately chitinized parts shiny, pale clay yellow; membranous parts of thorax and abdomen dorsally mauve or lilac with white muscle attachments, ventrally whitish with bluish pattern; while alive probably with four small round conspicuous red marks in a transverse row on the dorsal side of most segments.<sup>3</sup> Frons rugose, anteriorly on each side of middle line

<sup>1</sup> The Clerid larvae vary individually considerably in size, according to the food conditions. The measures given for each species refer as a rule to the type specimen mentioned.

<sup>2</sup> For nomenclature of colors see John B. Smith in his Explanation of terms used in Entomology, 1906.

<sup>3</sup> According to A. Kemmer (see bibliography), such punctures are found in living specimens of the two *Necrobia* species studied by him, but disappeared in specimen preserved in alcohol.

with a shallow deepening. Labrum three times as wide as long; width about one-third the length of frons. Mandibles half as long as frons; length to width as 4:2; retinaculum and tooth same size, are well developed and rather obtuse. Two short mandibular setae. Prothoracic shield two-thirds as long as wide, with parallel sides. Both meso- and metathorax are about as long as prothorax, surpass it one-third or more in width; metathorax a trifle wider than mesothorax; meso- and metathoracic dorsal plates present, small and about the same size. Basal plate of cerci a trifle wider than the prothoracic shield, length to width as 2:3. Cerci one-third the length of basal plate, upwards curved, diverging about 60°.

#### Subfamily B (pp. 599-619).

Frons posteriorly limited by a sharp angle. Epicranial suture not present. Second antennal joint small, about same length as apical antennal joint. Ventral mouthparts exerted or slightly retracted. Gula with flat surface. Abdominal preæusternal and eusternal areas<sup>1</sup> not separated. Spiracles pseudo-annuliform or annuliform.<sup>1</sup> Ocelli 5, 4, 3, 1, or none on each side.

#### DIVISION 1 (pp. 599-612).

Ocelli 5.

#### SECTION A (pp. 599-607).

Body digitiform with extreme width on fourth to seventh abdominal segments, tapering from here gradually anteriorly and posteriorly, ninth abdominal segment crescentiform; dorsally without ampullae, except in one form, *Galeruclerus*; ventrally flattened. Chitinous parts numerous, well developed and with deep brown color prevalent. Membranous parts strongly colored. Setae as a rule rather numerous, scattered. Headcapsule comparatively large, subrectangular, about as wide as long; hypostoma, between articulations of mandible and cardo, straight. Mandible longer than wide; retinaculum at or near middle of mandibular inner margin. Maxilla usually with extensive chitinization of stipes and cardo. Mentum and submentum usually with well developed chitinizations. Gula longer than maxilla from end of cardo to end of palpus. Prothorax subrectangular, as long as frontal suture, not twice as wide as long; prothoracic shield corneous; prothoracic sternal plate lanceolate. Meso- and metathorax with dorsal plates. Basal plate of cerci large, well chitinized; anteriorly well defined; laterally rounded. Cerci well developed, well separated.

<sup>1</sup> In some species of the genus *Enoclerus* a separation is indicated between abdominal preæusternal and eusternal areas. Also are the last abdominal spiracles here developed as annuliform-bifore.

2. Genus represented by *THANASIMUS* and  
*ENOCLERUS ICHNEUMONEUS*, *E. QUADRISIGNATUS*, *E. QUADRI-*  
*GUTTATUS*, *E. HUMERALIS*, *E. ROSMARUS*, *E. MUTTKOWSKII*.

Membranous parts unicolorous. Setae rather numerous, scattered. Head with slightly curved sides, about as thick as long. Frons sculptured. Epicranium dorsally rugose without protuberance, ventrally rugulose. Ocelli arranged in two subparallel, upwards and backwards directed rows; anterior row with three, posterior row with two ocelli, all of same size; distance from pleurostoma to the anterior row as long as the basal joint of the antenna and to the posterior row as long as basal and second antennal joints together; upper posterior ocellus a trifle above upper anterior ocellus, lower posterior ocellus a trifle below. Antenna with the length of basal, second, and apical joints proportioned as  $2\frac{1}{2}:1:1$ ; supplementary joint very small. Mandible with retinaculum well developed, at or near the middle of inner margin; in some species with a tooth between retinaculum and tip of mandible. Maxilla well developed; length from condyle of cardo to end of maxillary palpus in proportion to gula as  $3:5$ ; both stipes and cardo with large subrectangular basal chitinizations, the chitinization of cardo occupying two-thirds or more of the whole cardo surface; maxillary palpus with joints gradually decreasing in thickness from basal to apical joint; length of basal, second, and apical joints proportioned as  $1\frac{1}{3}:1:1$ ; chitinization of palpiger semicircular. Submentum with well developed square chitinization between and adjacent to the chitinization of the cardines and as long as these. Mentum with small transverse chitinization and four setae. Stipes labii chitinized; labial palpus with basal and apical joints shaped and proportioned as second and apical joints of maxillary palpus, and about as long and thick as these. Prothoracic tergal shield, with length to width as  $1:1\frac{1}{2}$ , along middle line about as long as frontal suture; prothoracic sternal plate narrowly lanceolate. Legs medium sized. Abdomen with normally developed intersegmental membranes; no dorsai ampullae; scuto-scutellar suture entire, rather deep, with anterior and posterior branches distinct; inferior branch usually indistinct; with slightly developed or no asperities along the end of scuto-scutellar suture and its branches; postscutellum normal. Spiracles pseudo-annuliform.

The larvae of the different species of *Thanasimus* are congeneric with those species of *Enoclerus*, which belong to the present genus 2, as they have in common all the above-mentioned characters. It is not considered advisable to maintain, in conformity with the adult classification, a separate genus *Thanasimus*, even if all available species of *Thanasimus* admittedly have cylindrical cerci with re-

curved, not contracted apex, while the *Enoclerus* species in question have differently built cerci. In general it may be said that in the family Cleridae the form and the position of the cerci can not be used as a character of generic, only of subgeneric or specific value. This is particularly apparent in the present genus, as the different species of *Enoclerus*, which unquestionably belong here, are to be separated into two subgenera just according to two different types of cerci. Instead of making *Thanasimus* a special genus it will logically be placed as a subgenus of genus 2, equivalent to the two other subgenera.

These three *Subgenera* are characterized as follows:

- Cerci cylindrical, with recurved, not contracted apex .....Subgenus 2a (*Thanasimus*).
- Cerci conical with long gradually attenuated and slightly recurved apex, or subcylindrical, distally slightly swollen and slightly contracted apex .....Subgenus 2b (*Enoclerus ichneumoneus*, *E. quadrisignatus*, *E. quadriguttatus*, *E. humeralis*).
- Cerci subcylindrical, distally swollen, with short abruptly contracted, dentiform apex.....Subgenus 2c. (*Enoclerus ros-marus*, *E. muttkowskii*).

**Subgenus 2a.**

(Figs. 79, 80.)

**THANASIMUS DUBIUS Fabricius.**

(Figs. 44-46, 79, 80, 103, 111, 122.)

No. 1795, U. S. N. M., Marquette, L. S. Mature. Species reared; imago preserved.

Total length, 13 mm.; extreme width, about 2½ mm.; anterior width of prothorax more than two-thirds of the extreme width. Corneous parts shiny, Roman sepia; delicately chitinous parts shiny, brown ocher; membranous parts purplish, ventrally paler. Setae rather delicate, comparatively long and numerous. Frons with two low and flat, cushionlike longitudinal elevations, one behind the other on each side of head, and a shallow groove behind angulus frontalis. Mandible robust; from apex to attachment of retractor tendon five-sevenths the length of frons; length to width as 8½:6; apex right above inner angle of mandibular base; retinaculum at the middle of inner margin; margin between retinaculum and end of apex entire; two mandibular setae. Meso- and metathoracic dorsal plates well developed, the metathoracic being a trifle smaller. Basal plate of cerci about same length as frons, a trifle wider than long. Cerci cylindrical, somewhat converging, about two-thirds the length of basal plate; distance between the outsides of cerci where these

are attached, two-thirds of the length of cerci; apex turned inward, and recurved, not contracted. Spiracles well developed, finger-shaped tubes diminutive on all segments.

*T. dubius* is very close to the European *T. formicarius* Linnaeus (fig. 79), but *T. formicarius* is about 16 mm., with cerci very slightly converging, almost parallel, only a trifle shorter than the distance to the anterior margin of basal plate; distance between the outsides of the cerci where these are attached, about equal to the length of the cerci.

**THANASIMUS REPANDUS** Horn.

Hopk. U. S. No. 15431B; mature. Species reared; cast skin and imago preserved.

Very similar to *T. dubius* and *T. formicarius*; about 16 mm. Cerci slightly divergent, a trifle longer than distance to the anterior margin of basal plate; distance between outsides of cerci, where these are attached, about equal to the length of cerci.

**Subgenus 2b.**

(Figs. 81-83.)

**ENOCLERUS ICHNEUMONEUS** Fabricius.

Hopkins, U. S. No. 9194q; mature. Species reared; cast skin and imago preserved.

(Figs. 17, 31, 47, 64, 81, 125.)

Total length of body, about 11 mm.; extreme width, about  $2\frac{1}{2}$  mm.; extreme thickness, about 2 mm.; anterior width of prothorax a trifle less than 2 mm. Corneous parts shiny, reddish brown, delicately chitinized parts shiny, brown yellowish; membranous parts crimson, ventrally paler. Setae rather soft and long. Frons on each side with two low cushion-like longitudinal elevations, one behind the other; anteriorly a shallow groove behind angulus frontalis. Mandible from apex to attachment of tendon of retractor muscle about three-fourths the length of frons; length to width as 9:6; apex slightly projecting over inner angle of basis; retinaculum a trifle closer to tip than to basis of mandible; margin between retinaculum and end of apex entire; two mandibular setae. Hypopharyngeal plates laterally not extending beyond the bicuspidate end of the vertical arm from stipes. Meso- and metathoracic dorsal plates well developed. Basal plate of cerci about same length as frons, a trifle wider than long. Cerci about same length as basal plate, corniform, nearly parallel, distance between attachments not much shorter than length of cerci; apex not contracted, turned inward, slightly recurved. Spiracle on the eighth abdominal segment annuliform-bifore with large fingershaped tubes.

**ENOCLERUS QUADRISIGNATUS** Say.

Hopkins U. S., No. 12217a; mature. Species reared; cast skin and imago preserved.

(Figs. 48, 65, 82, 117.)

Total length of body, about 11 mm. General shape, the sculpture of frons, epicranium, and other chitinous parts and the color as in *E. ichneumoneus*. The mandible provides the only character by which *E. quadrisignatus* may be separated from *E. ichneumoneus*, as having a small, low, blunt tooth in front of retinaculum, and an apex slightly more slender than in *E. ichneumoneus*. Basal plate of cerci and cerci as in *E. ichneumoneus*.

**ENOCLERUS QUADRIGUTTATUS** Olivier.

Hopkins U. S. No. 5998Fb; mature. Species reared; cast skin and imago preserved.

(Figs. 49, 66, 83.)

Total length of body, about 9 mm. General shape, the sculpture of frons, epicranium, and other chitinous parts as in *E. ichneumoneus*. Color of corneous parts Roman sepia to brown ocher; delicately chitinized parts pale clay yellow; membranous parts purplish. Setae rather delicate, comparatively long, and copious. Mandibles with apex slightly projecting over the mandibular basis; retinaculum a trifle closer to the basis than to the end of the mandible; margin between apex and retinaculum serrate. Basal plate of cerci about as long as frons. Cerci about same length as basal plate with recurved, slightly contracted apex and slightly swollen below apex.

**ENOCLERUS HUMERALIS** Schaeffer.

Hopkins U. S. No. 12538b; mature. Species reared; imago preserved.

Total length of body, about 11 mm.; general shape, sculpture and color of chitinous parts as in *E. ichneumoneus*. Membranous parts pink. Basal plate of cerci about same length as frons. Cerci shorter than basal plate; proportion between length of median line of basal plate and length of cerci as  $1\frac{1}{2}$ :1; cylindrical, rugose, not swollen near apex; apex contracted; space between cerci horseshoe-shaped.

**Subgenus 2c.**

(Figs. 84, 85.)

**ENOCLERUS ROSMARUS** Say.

Hopkins U. S. No. 100771; mature. Species reared; cast skin and imago preserved.

(Figs. 50, 67, 84.)

Total length of body about 7 mm. General shape, the sculpture of frons, epicranium, and other chitinous parts as in *E. ichneumoneus*. Color of the corneous parts rather characteristic, head burnt sienna,

prothorax anteriorly and medianly burnt sienna, posteriorly Roman sepia, meso and metathoracic dorsal plates Roman sepia, basal plate of cerci burnt sienna with four longitudinal lines of sepia, cerci burnt sienna; delicately chitinous parts pale brown; membranous parts purplish. Mandible more robust, not so pointed as in the above-described different species of *Enoclerus*; length to width as  $8\frac{1}{2} : 6$ ; apex right above basis; retinaculum at the middle of the mandibular inner margin; in front of retinaculum with a low, blunt, diminutive tooth. Basal plate of cerci about as long as frons. Cerci nearly as long as basal plate, diverging from each other about  $50^\circ$ ; distally subcylindrical; on inner and lower side swollen like a heel; apex short, dentiform, abruptly contracted.

**ENOCLERUS MUTKOWSKII** Wolcott.

Hopkins U. S. No. 11847*n*; *mature*. Species reared; cast skin and imago preserved.

(Figs. 18, 51, 68, 85.)

Total length of body, about 11 mm. General shape as in *E. ichneumoneus*; sculpture of frons, epicranium, and other chitinous parts more prominent than in the foregoing species. Color of corneous parts sepia; delicately chitinized parts pale yellowish; membranous parts dorsally bluish green, ventrally lavender to cobalt blue. Mandibles of same, comparatively blunt type as in *E. rosmarus*; apex situated just above inner angle of base; retinaculum a trifle closer to the tip than to the base of mandible; margin between retinaculum and apex entire. Basal plate of cerci about as long as frons. Cerci about same length as basal plate, parallel, subcylindrical, distally spherically swollen; apex short, abruptly contracted, dentiform, somewhat inwardly and a trifle forwardly curved.

**3. Genus represented by ENOCLERUS SPHEGEUS** Fabricius.

The larvae of the present form which, according to the adult, is considered a mere species of the genus *Enoclerus*, is so deviating in several characters from the above-mentioned larvae of this genus that it must be treated as a separate genus.

Membranous parts almost unicolored. Setae well developed, numerous, scattered. Head with nearly parallel sides, rather flat; proportion between thickness and length of head as 10:14. Corneous parts heavier than in any of the formerly mentioned forms; this especially applies to the chitin of the headcapsule. Frons with unequal surface. Epicranium dorsally and adjacent to the median part of frontal suture with a conspicuous, rounded protuberance, which is more than half as large as the mandible. Ocelli arranged as in genus 2, except that the anterior and posterior rows are straight parallel. Antenna with length of basal, second and apical joints about as 3:1:1; together the joints are more than half as long as the

mandible; supplementary joint small. Mandible considerably longer than wide; retinaculum well developed, closer to the end than to the base of mandible; no tooth above retinaculum. Distal half of ventral mouthparts more obliquely upward directed than in any of the forms of genus 2. Maxilla very well developed; length from condyle to end of palpus in proportion to gula as 4:5; both stipes and cardo with a subrectangular chitinization, that of cardo about twice as large as that of stipes and about three-fourths of the whole cardo. Maxillary palpus with joints gradually decreasing in thickness towards apex; length of basal, second and apical joints proportioned as  $1\frac{1}{3}$ :1:1; chitinization of palpiger semicircular. Submentum with well developed square chitinization between, adjacent to and as long as the chitinizations of the cardines. Mentum with small, transverse chitinization and four setae. Stipes labii chitinized; labial palpus with basal and apical joints as long and thick as second and apical joints of maxillary palpus. Prothoracic shield along middle line somewhat shorter than frontal suture; prothoracic sternal plate lanceolate. Legs of medium size. Abdomen with normally developed intersegmental membranes; no dorsal ampullae; scuto-scutellar suture entire, rather deep, with anterior and posterior branches distinct, inferior branch indistinct; second to eighth abdominal segments with well marked asperities on each side along the end of scuto-scutellar suture and its anterior and posterior oblique branches; postscutellum normal. Spiracles pseudo-annuliform.

**ENOCLERUS SPHEGEUS Fabricius.**

Hopk. U. S. No. 11936; mature. Species reared; cast skin and imago preserves.

(Figs. 4, 19, 32, 52, 69, 86, 104, 115, 116, 117, 119, 121.)

Total length of body, about 20 mm.; extreme width, about  $3\frac{1}{2}$  mm.; extreme thickness, about 3 mm.; anterior width of prothorax, about 2 mm. Chitinous parts shiny; head brownish black, other corneous parts somewhat lighter; delicately chitinized parts pale brown; membranous parts lilac, where not exposed paler and more bluish gray. Setae long and strong. Frons with median, low, broad, dagger-like longitudinal elevation and on each side with an irregularly corrugated, inversely pear-shaped field. Epicranium dorsally rugose; surface of epicranial protuberance smooth; sides with a few longitudinal lines; ventrally rugulose. Labrum more than twice as wide as long, width as large as half the length of frons. Mandible from apex to retractor tendon about three-fourths the length of frons; length to width as 10:6; apex above inner angle of basis; retinaculum closer to the end than to the basis of the mandible; margin above retinaculum entire; mandibular setae two. Hypopharyngeal plate laterally extending beyond the bicuspidate end of the vertical arm from stipes. Prothoracic shield with length to width as 2:3.

Mesothoracic dorsal plates about three times larger and considerably closer together than the metathoracic plates. Basal plate of cerci about as long as frons, a trifle wider than long. Cerci about the length of basal plate, subparallel; distance between them about half as large as their length, subcylindrical with unequal surface, directed upwards; apex recurved, not contracted, turned slightly inwards. Mesothoracic spiracle twice as large as the rest.

#### 4. Genus GALERUCLERUS Gahan.

Membranous parts motley. Setae thin, long, not numerous. Head with slightly curved sides, as thick as long. Frons sculptured. Epicranium dorsally rugose without protuberance, ventrally rugulose. Ocelli arranged as in genus 2. Antenna with the length of basal, second and apical joints proportioned as 3:1:1½; supplementary joint very reduced. Mandible longer than wide; retinaculum well developed, very slight indication of tooth above retinaculum. Maxilla of medium size, length from condyle of cardo to end of maxillary palpus in proportion to length of gula as 3:6; the chitinization of cardo occupies half or less of its entire surface; maxillary palpus with length of basal, second and apical joints proportioned as 1:1:2; palpiger with large, nearly jointlike chitinization. Submentum and mentum without any chitinization. Stipes labii thinly chitinized; length of basal and apical joints of labial palpus proportioned as 1:2. Prothoracic tergal shield along middle line as long as frontal suture; prothoracic sternal plate broadly lanceolate. Legs of medium size. Abdomen with normally developed intersegmental membranes; second to seventh abdominal segments with dorsal ampullae. Cerci well separated, of moderate size, subcylindrical with slightly contracted apex.

Several characters, particularly the presence of ampullae and the poor chitinization of the posterior region of the ventral mouthparts connect the present genus 4 with the genus *Chariessa* of the following section.

#### GALERUCLERUS OCULATUS Say (=CREGYA OCULATA Say).

Hopkins U. S. No. 10081*y*; mature. Species reared; cast skin and imago preserved.

Total length of body, 9 mm.; extreme width, 2 mm.; extreme thickness, about 1¾ mm.; anterior width of prothorax, about 1½ mm. Chitinous parts shiny. Head sienna brown; prothoracic shield usually anteriorly sienna brown, gradually darkening into sepia on the main part of the shield, posteriorly lighter; in certain specimens, however, the shield is entirely sepia; mesothoracic dorsal plate sepia; metathoracic dorsal plate pale brown; delicately chitinized parts pale yellowish; membranous parts dorsally dark violet, with a whitish pattern corresponding to the muscle attachments; above the heart a

whitish longitudinal mediodorsal line; ventrally lighter with the whitish pattern more predominating than dorsally; intersegmental membranes whitish. Setae thin and long, light yellowish. Frons on each side with a long, linear impression from near the lateral end of clypeus and parallel with the middle line; inside of this impression and beginning near the center of frons a shorter, oblique, forward directed line, and behind angulus frontalis a very shallow deepening. Labrum more than twice as wide as long, only one-third as long as frons. Mandible from apex to attachment of retractor tendon about two-thirds the length of frons; length to width as 2 to 1; retinaculum at the middle of inner margin; tooth above retinaculum very minute or absent; two mandibular setae. Chitinization of cardo band-like, occupies less than half part of the entire surface of cardo. Meso and metathoracic plates well developed. Basal plate of cerci about same length as frons, somewhat wider than long, with four parallel rows of linear dots.<sup>1</sup> Cerci subcylindrical, subparallel, directed slightly upwards, about half as long as basal plate, distance between them about the same as their length, surface tuberculate; apex slightly contracted, upright, somewhat recurved and slightly turned inward.

#### SECTION B (pp. 607-611).

Body elongate digitiform with conical ninth abdominal segment, or vermiform with semiglobular ninth abdominal segment; dorsally with ampullae; ventrally flattened, in one genus *Neichnea* (p. 610), with protuberant sternellum. Chitinous parts moderately or even poorly developed and colored. Membranous parts tinged with pale bluish color or entirely whitish. Setae quite numerous on the chitinous, scarce on the membranous parts. Headcapsule comparatively short; subtriangular, twice as wide as long, or subrectangular not much wider than long; hypostoma slightly emarginate between the ventral articulation of mandible and the articulation of the posterior end of cardo. Mandible about as long as wide; retinaculum at the middle of the inner margin. Maxilla with a narrow, band-like basal chitinization of cardo and stipes. Mentum and submentum with very thin or without any chitinizations. Gula longer than the maxilla from posterior end of cardo to tip of palpus. Prothorax either subrectangular, about as long as frontal suture and twice as wide as long, or transverse oval, slightly wider than long; prothoracic shield delicately chitinized or absent; prothoracic sternal plate broadly pyriform. Meso- and metathorax without dorsal plates. Basal plate of cerci either delicately chitinized, anteriorly without sharp limitation and laterally rectilinear, or not developed. Cerci moderately developed or small or absent.

<sup>1</sup> In specimens not fully hardened the meso- and metathoracic dorsal plates are hardly to be recognized and the basal plate of cerci is slightly chitinized and without distinct marginal limitation.

5. Genus *CHARIESSA* Perty.

Body robust, elongate digitiform with median abdominal segments somewhat wider than the preceding and succeeding segments. Chitinous parts moderately developed with light brown color prevalent. Membranous parts with pale bluish tinge where exposed; otherwise whitish. Head subtriangular, twice as wide as long. Frons slightly sculptured. Epicranium smooth above and below. Ocelli arranged in two subparallel, upward and backward directed rows; anterior row with three, posterior with two ocelli; all ocelli approximately of same size, slightly larger than basal cups of setae; lower posterior ocellus a trifle above upper anterior ocellus. Length of basal, second and apical antennal joints proportioned as 3:1:1; supplementary joint very small. Mandible with a tooth present between retinaculum and apex.<sup>1</sup> Maxilla well developed, its extreme length in proportion to the length of gula as 4:5. Length of basal, second and apical joints of maxillary palpus proportioned as 2:1:1; palpiger with well-developed plate. Submentum and mentum without or with very thin chitination. Stipes labii chitinized; basal and apical joints of labial palpus proportioned as 1:1. Prothorax subrectangular, not much longer than the following segment, twice as wide as long. Prothoracic tergal shield, with length to width as 1:2, along middle line about as long as frontal suture; prothoracic sternal plate about as wide as the distance between the attachments of the front legs. Legs of medium size. Abdomen with normally developed intersegmental membranes, second to seventh abdominal segments with dorsal ampullae; postscutellar areas well developed; sternellar areas normal. Ninth abdominal segment conical, considerably longer than half its extreme width. Basal plate of cerci conical, thinly chitinized, anteriorly not defined, laterally rectilinear. Cerci medium sized, hookshaped.

*CHARIESSA PILOSA* Forster.

Hopkins U. S. No. 11870F; mature. Species reared; cast skin and imago preserved.

(Figs. 5, 20, 33, 53, 70, 88, 89, 112.)

Total length of body, about 21 mm.; extreme width, 4 mm.; extreme thickness,  $3\frac{1}{2}$  mm.; anterior width of prothorax, 3 mm. Mandibles, epistoma, median endocarina of frons and the cerci blackish brown; remainder of frons and anterior part of epistoma slightly lighter, remainder of head capsule brown ocher; prothoracic shield delicately chitinized and pale clay yellow;<sup>2</sup> the other delicately chitinized parts also pale clay yellow; membranous parts lilac where exposed, otherwise whitish. Setae thin, light yellow, of normal

<sup>1</sup> In specimens near pupal stage the apex, tooth and retinaculum are often very blunt.

<sup>2</sup> In half-grown specimens corneous and brown ocher.

size except on the head, where many are very short and placed in small, light yellow pits. Frons with short transversal impression behind clypeus, low and flat elevation behind the angulus frontalis, and with somewhat depressed posterior end. Mandible from apex to attachment of retractor tendon about two-thirds the length of frons; apex does not project over inner corner of mandibular base; tooth in front of retinaculum small; two mandibular setae. Hypopharyngeal plates small, elongate, slightly chitinized, laterally not extended beyond the bicuspidate end of the upward projecting arm from stipes. Basal plate of cerci with four parallel rows of linear impressions. Cerci half as long as frons, the recurved part not included, contiguous where attached, divergent forming an angle of about 30 degrees, slightly upward directed, conical, smooth with apex comparatively long, pointed and recurved.

**CHARIESSA ELEGANS** Horn.

Hopk. U. S. No. 1227a; mature. Species reared; cast skin and imago preserved.

(Fig. 87.)

Total length of body, 22 mm. Somewhat larger and more robust than *Chariessa pilosa*, but difficult to separate from this species, all examined characters, as structures, proportions, chitinizations, and color, being identical.

**6. Genus PHYLLOBAENUS** Spinola.

Body elongate vermiform; thoracic and abdominal segments of about same size. Chitinous parts poorly developed, brown ocher color prevalent. Membranous parts with pale bluish tinge, where exposed, otherwise whitish. Head subtriangular twice as wide as long. Frons slightly sculptured. Epicranium punctate-striate above, smooth below. Ocelli arranged as in *Chariessa* but smaller. Length of basal, second and apical antennal joints proportioned as 3:1:1; supplementary joint very small. Mandible without any tooth between retinaculum and apex. Maxilla in proportion to gula as long as 2:3; length of basal, second and apical joints of maxillary palp proportioned as  $1\frac{1}{2}$ :1:2; palpiger with well-developed plate. Submentum and mentum without chitinizations. Stipes labii with small anterior chitinization; length of basal and apical joints of labial palp proportioned as 1:2. Prothorax subrectangular, more than twice as wide as long; prothoracic tergal shield slightly chitinized; prothoracic sternal plate about as wide as the distance between the front legs. Legs short. Abdomen with large intersegmental membranes; second to seventh abdominal segments with dorsal ampullae. Ninth abdominal segment semiglobular. Basal plate of cerci absent. Cerci small, hook shaped.

## PHYLLOBAENUS DISLOCATUS Say.

Hopk. U. S. No. 11299c4; mature. Species reared; cast skin and imago preserved.

(Figs. 6, 21, 34, 54, 71, 90, 123, 127, 133.)

Total length of body, about 7 mm.; extreme width, 1 mm.; extreme thickness, 1 mm.; anterior width of prothorax, 1 mm. Mandibles, epistoma, median endocarina of frons, and cerci blackish brown; anterior part of frons, anterior part of ventral side of epicranium, chitinous bands of cardo and stipes brown ocher; rest of head delicately chitinized and pale clay yellow; legs and other delicately chitinized parts also pale clay yellow; membranous parts pale lilac where exposed, otherwise whitish. Setae whitish. Frons with short transversal impression behind clypeus, a rather deep pit near center of frons, a flat, very low elevation behind angulus frontalis; posterior end of frons depressed. Mandible about half as long as frons, apex not reaching beyond inner corner of mandibular base; two mandibular setae. Cerci (the recurved part not counted) one-fifth the length of frons, attached separately, parallel, conical, smooth, with a comparatively long, pointed, somewhat recurved apex.

## PHYLLOBAENUS MERKELI Horn.

Hopk. U. S. No. 12259a; mature. Species reared; cast skin and imago preserved.

Length, about 9 mm.; extreme width,  $1\frac{1}{2}$  mm.; extreme thickness, nearly  $1\frac{1}{2}$  mm.; anterior width of prothorax, nearly  $1\frac{1}{2}$  mm. In every other respect identical with *Phyllobaenus dislocatus*.

7. Genus NEICHNEA Wolcott and Chapin (*ELLIPOTOMA* Spinola;  
*ICHNEA* Castelnau).

Body elongate, vermiform, thoracic and abdominal segments of about same size. Chitinous parts very poorly developed. Membranous parts whitish. Head subrectangular, not much wider than long, with slightly curved sides, about as thick as long. Frons somewhat sculptured. Epicranium smooth above and below. Ocelli arranged as in *Chariessa*, rather well developed. Length of basal, second, and apical antennal joints proportioned as 2:1:1; supplementary joints small. Retinaculum well defined and sharp, no tooth between retinaculum and apex. Maxilla in proportion to gula as long as 4:5; length of basal, second and apical joints proportioned as 1:1:2; palpiger with chitinous plate. Submentum and mentum without any chitinization; stipes labii slightly chitinized; length of basal and apical joints of labial palp proportioned as 1:1. Prothorax suboval, slightly wider than long; prothoracic tergal shield absent; prothoracic sternal plate as wide as the distance between the front legs. Legs short and thick. Abdomen with intersegmental membranes about half as large as the segments; dorsal ampullae small, present on second to eighth abdominal segments; postscutellar areas some-

what swollen; epipleural and hypopleural areas protuberant; sternellar areas swollen. Ninth abdominal segment semiglobular. Basal plate of cerci absent. Cerci absent.

NEICHNEA LATICORNIS Say.

Hopk. U. S. No. 10762b; mature. Species reared; cast skin and imago preserved. (Figs. 7, 22, 35, 55, 72, 91, 106, 129.)

Total length of body, about 7 mm.; extreme width,  $1\frac{1}{4}$  mm.; extreme thickness, 1 mm.; anterior width of prothorax, 1 mm. Mandibles, epistoma, median endocarina of frons dark brown; a small anterior part of frons, anterior margin of hypostoma, chitinous parts of ventral trophi and antenna pale brown; membranous parts whitish. Setae whitish. Frons has a short, longitudinal oval deepening midway between carina and frontal suture, and in front of this deepening diverging from carina and close to epistoma a short, straight, rather deep line, which together with the opposite corresponding line limits a small, triangular, flat protuberance. Mandible about half as long as frons; apex nearly reaches beyond inner corner of the mandibular base; two mandibular setae.

SECTION C (pp. 611-612).

Body digitiform with extreme width on fourth to seventh abdominal segments, tapering from here gradually anteriorly and posteriorly; ninth abdominal segment crescentiform; dorsal ampullae not developed.

Chitinous parts moderately developed and colored. Membranous parts conspicuously colored. Setae soft, densely distributed over the whole body. Headcapsule comparatively short, subrectangular, about twice as wide as long; hypostoma with oblique, curved anterior emargination between the ventral articulation of mandible and the posterior corner of cardo. Mandible somewhat longer than wide; retinaculum considerably closer to apex than to basis of mandible. Maxilla with well-developed chitinization of cardo and stipes. Mentum and Submentum without chitinizations. Gula not longer than maxilla from posterior end of cardo to end of palpus. Prothorax subrectangular, about as long as frontal suture, twice as wide as long; prothoracic shield thinly chitinized; prothoracic sternal plate poorly chitinized, pyriform. Meso and Metathorax with dorsal plates slightly or not developed. Basal plate of cerci delicately chitinized without anterior demarcation, or not developed. Cerci short, separate.

8. Genus TRICHODES Herbst.

Frons short and wide, rather smooth; endofrontal carina posteriorly widened like an arrowhead. Epicranium dorsally and ventrally smooth. Ocelli as in *Thanasimus* and related forms (p. 600),

with upper posterior ocellus a trifle above and lower posterior ocellus a trifle below the upper anterior ocellus. Length of basal, second and apical antennal joints proportioned as 2:1½:1; supplementary joint small. Mandible with well-defined retinaculum and a slight elevation on the inner margin between retinaculum and end of mandible. Maxilla from end of cardo to end of palpus somewhat longer than gula; length of basal, second and apical joints of maxillary palpus proportioned as 1:1:1; palpiger without chitinous plate. Stipes labii slightly chitinized; labial palpus with basal and apical joints proportioned as 1:1. Legs well developed. Abdomen with normally large intersegmental membranes, postscutellar areas of medium size; sternellar areas normal. Spiracles annuliform without any trace of fingershaped tubes.

**TRICHODES ORNATUS** Say.

Hopkins U. S. No. 11930a; mature. Species reared; larval skin preserved.

(Figs. 8, 23, 36, 56, 73, 92, 105, 128.)

Total length of body, 13 mm.; extreme width, 3 mm.; extreme thickness, 2¾ mm.; anterior width of prothorax, 2½ mm. Mandibles, epistoma, tip of cerci dark brown; remainder of head capsule, prothoracic shield and other delicately chitinized parts pale cadmium yellow; membranous parts salmon red. Setae thin, long, yellowish. Frons hardly sculptured. Labrum more than twice as wide as long. Mandible from apex to attachment of retractor tendon about two-thirds the length of frons; length to width as 9 to 8; apex does not project over inner corner of mandibular basis; distance between retinaculum and apex of mandible one-third the length of mandibular inner margin; elevation of inner margin between retinaculum and apex slightly convex; at least seven fine mandibular setae. Basal plate of cerci poorly developed. Cerci upright, pointed, conical, slightly curved, from end to attachment less than half as long as frons.

**DIVISION II** (pp. 612-614).

Ocelli 4.

**9. Genus TARSOSTENUS** Spinola.

Body prolonged, vermiform with most of the segments of about equal size; ninth abdominal segment semiglobular; abdomen dorsally with ampullae on some of the posterior segments, ventrally rounded with protuberant sternellar areas. Chitinous parts with rather thin and light colored chitin. Membranous parts variegated. Setae scarce and thin. Head capsule comparatively small, subtriangular. Frons slightly sculptured. Epicranium smooth above and below; anterior margin of hypostoma with slight emargination. Ocelli arranged in two, upward and backward directed rows behind

the antennae; anterior row with two ocelli, posterior with two; all ocelli approximately of same size; lower posterior ocellus a trifle below, and upper posterior a trifle above the upper anterior ocellus. Length of basal, second, and apical antennal joints proportioned as 2:1:1; supplementary joint small. Mandible longer than wide, pointed; retinaculum well developed, somewhat closer to apex than to basis; no tooth between retinaculum and apex. Maxilla with thin but comparatively broad bandlike chitinization at the base of cardo and stipes; length of basal, second and apical joints of maxillary palp proportioned as 1:1:2, palpiger well developed. Gula slightly shorter than frons; somewhat longer than maxilla. Submentum and mentum poorly chitinized. Stipes labii thinly chitinized; length of basal and apical joints of labial palpus proportioned as 1:2. Prothorax rather large, with suboval outline, slightly wider than long, about one-third longer than the following segments; dorsally nearly completely covered with a shield. Sternal plate broadly pyriform, thinly chitinized, with an indistinct median lanceolate region slightly thicker chitinized than the rest. Meso- and metathorax without dorsal chitinizations. Legs normally developed. Abdomen with large intersegmental membranes; dorsal ampullae developed on sixth and seventh abdominal segments; postscutellar areas well developed; sternellar areas somewhat swollen. Basal plate of cerci covers most of dorsal surface of ninth abdominal segment, is rounded, nearly circular, thinly chitinized. Cerci well separated, medium sized, hook-shaped.

The present genus is rather closely related to the genera *Chariessa*, *Phyllobaenus*, and *Neichnea*; in many respects especially to *Neichnea*.

**TARSOSTENUS UNIVITTATUS Rossi.**

Hopk. U. S. No. 11286a; mature. Species reared; cast skin and imago preserved.

(Figs. 9, 25, 37, 57, 74, 93 107.)

Total length of body, 7mm.; extreme width, about  $1\frac{1}{4}$  mm.; extreme thickness, 1 mm.; anterior width of prothorax, about 1 mm. Mandibles, epistoma, median endocarina of frons, and cerci sepia brown; remainder of headcapsule and trophi, prothoracic shield, legs, basal plate of cerci from brown ocher to pale clay yellow; membranous parts violet with whitish median line and whitish muscle attachments, ventrally paler, intersegmental membranes whitish. Setae inconspicuous, whitish. Frons with a short longitudinal impression anteriorly on each side of carina, and inside of each impression an oblique line diverging forward from carina. Mandible about half as long as frontal suture, apex not projecting over inner corner of mandibular base; retinaculum somewhat closer to apex than to base; two mandibular setae. Basal plate of cerci about as long as frons.

Cerci, without consideration of the recurved part, about one-third the length of the basal plate; separately attached; distance between them about equal to their length.

### DIVISION III (pp. 614-617).

Ocelli 3.

#### 10. Genus CYMATODERA Gray.

Body robust; either digitiform with the median abdominal segments only slightly wider than the preceding and succeeding ones, or subclaviform; ninth abdominal segment crescentiform or subtriangular; abdomen dorsally without ampullae, ventrally flattened. Chitinous parts well developed. Membranous parts variegated; most segments with a row of two or four orange, round spots anterior to the scuto-scutellar suture, two on each side of median line. Setae numerous in digitiform species, scarce in subclaviform species. Headcapsule well sized, nearly square. Frons slightly sculptured, posteriorly transversally wrinkled; endocarina posteriorly widened like an arrowhead. Epicranium dorsally and ventrally with fine transversal wrinkles; anterior margin of hypostoma straight, transversal. The three ocelli large, approximately of the same size, often protuberant; their position vary according to species. Length of basal, second and apical antennal joints proportioned about as 2:1:1; supplementary joint small. Mandibles about three-fourths the length of frontal suture, somewhat longer than wide, length to width about as 8:6; retinaculum at the middle of inner margin; with or without a low elevation between retinaculum and apex. Maxilla with band-like chitinization at base of cardo and stipes; length of basal, second, and apical joints of maxillary palpus proportioned about as 1:1:1½; palpiger well developed. Gula as long as frons; length of gula in proportion to length of maxilla as 1:1½. Submentum and mentum not chitinized; stipes labii chitinized; length of basal and apical joints of labial palpus about as 1:1¼. Prothorax subrectangular, as wide as long, about as long but not fully as wide as the following segment; dorsally with large, moderately chitinized shield; ventrally with a long, thin, subrectangular sternal plate, which in some species contains on each side a round thickening just behind and similar in size and form to the well chitinized presternal plates. Meso- and metathorax in some species with dorsal plates, the mesothoracic ones being the larger; in other species no dorsal plates. Legs comparatively long, tibia more slender than femur, clawshaped tarsal joints long and pointed. Abdomen with normally developed intersegmental membranes. Basal plate of cerci large, well chitinized. Cerci well developed, separated or fused, hook-shaped. Spiracles annuliform without any finger-shaped structures.

## CYMATODERA OVIPENNIS LeConte.

Hopk. U. S. No. 9902s; mature. Species reared; imago preserved.

Body digitiform; total length, 17 mm.; extreme width, about 3 mm.; extreme thickness, 2 mm.; anterior width of prothorax,  $1\frac{3}{4}$  mm. Mandibles, epistoma, endocarina of frons and cerci sepia brown; remainder of headcapsule and trophi, antennae, prothoracic shield, basal plate of cerci brown ocher; other chitinous parts clay yellowish; membranous parts dorsally deep violet, nearly black, with whitish spots above the heart and the muscle attachments, ventrally whitish, intersegmental membranes whitish. Setae long, rather stiff, yellow, numerous on head, legs and all segments. Frons with transversal impression behind clypeus, an oblique line defining inner margin of antennal ring and two, rather faint lines on each side of and parallel with the endocarina; posteriorly transversally rugose. Epicranium dorsally transversally rugose, ventrally smooth. The three ocelli arranged to form a right angle; anterior ocellus just behind the ventrolateral part of antennal ring, lower posterior ocellus as far behind the anterior ocellus as the length of second antennal joint, upper posterior ocellus right above the lower posterior one. Mandible with a slight marginal elevation between retinaculum and apex; two mandibular setae. Prothoracic shield transversally rugose. Meso- and metathoracic dorsal plates present, Basal plate of cerci nearly circular, somewhat longer than frons, finely wrinkled; posteriorly in the middle line with a single longitudinal deepening and on each side of middle line with three longitudinal, shallow impressions. Cerci slender and comparatively small, about one-fourth the length of the basal plate, hook-shaped with moderately recurved apex, separate, parallel, as far apart as half of their length.

## CYMATODERA MOROSA LeConte.

Hopk. U. S. No. 12630a; mature. Species reared, larval skin and imago preserved.

(Figs. 11, 24, 38, 58, 95, 114, 124, 130.)

Very close to *C. ovipennis*; size, structural details, and color of chitinous parts as in that form. Difference only found in the color of membranous parts, these being more bluish and lighter in *C. morosa* than in *C. ovipennis*.

## CYMATODERA BALTEATA LeConte.

Hopk. U. S. No. 11855b; mature. Species reared, larval skin and imago preserved.

Digitiform; length 11 mm. Chitinous parts dark colored, femora with two dark spots. Membranous parts purple with whitish pattern above heart and muscle attachments, ventral surface and intersegmental skin whitish. Setae numerous on head and all seg-

ments, long, rather soft, yellowish. Frons and epicranium sculptured as in *C. ovipennis*. Ocelli touch each other and are placed in a nearly straight, oblique line, parallel with frontal suture; anterior ocellus just behind ventrolateral part of antennal ring, lower posterior ocellus moved upwards into the interspace between anterior and upper posterior ocellus. Meso- and meta-thoracic dorsal plates well developed. Basal plate of cerci circular except anteriorly, where the outline is about straight; surface sculptured as in *C. ovipennis*. Cerci one-third the length of basal plate, contiguous where attached, divergent.

**CYMATODERA UNDULATA** Say.

Hopk. U. S. No. 12299a8; mature. Species reared, larval skin and imago preserved.

(Figs. 10, 94.)

Similar to *C. balteata* in size, chitinizations, colors, and hairiness; differs from this species only in the position of the ocelli, the shape of basal plate, and the length of cerci. Ocelli arranged in an angle of 120 degrees where the lower posterior ocellus occurs. Basal plate of cerci subtriangular. Cerci about one-half the length of basal plate, contiguous where attached and divergent as in *C. balteata*.

**CYMATODERA BICOLOR** Say.

Hopk. U. S. No. 10077a; mature. Species reared, larval skin and imago preserved.

Body subclaviform. Total length, 14 mm. Color of chitinous parts as in *C. ovipennis*; membranous parts dorsally pink to light red with yellowish or cream spots above heart and muscle attachments; ventral surface and intersegmental membranes yellowish or cream. Setae fine, long, white; numerous on head, thoracic segments, legs and ninth segment, very scarce on other segments. Frons with transversal impression behind clypeus, with a pit behind angulus frontalis, two rather faint oblique lines on each side of mediocarina, posteriorly transversally aciculate. Epicranium dorsally with fine longitudinal striation. Ocelli closely set but not touching each other, placed in a straight oblique line parallel with frontal suture, anterior ocellus just behind ventrolateral part of antennal rings. Mandible without any elevation or tooth between retinaculum and apex. Prothoracic shield transversally aciculate. Meso- and meta-thoracic dorsal plates hardly developed. Basal plate of cerci subtriangular laterally with somewhat convex margin; slightly longer than frons, surface smooth. Cerci smooth, slender, about as long as basal plate; distal half divergent, hook-shaped with apex moderately recurved, proximal half fused, stalk-like, medianly and dorsally with an unpaired small protuberance.

## CYMATODERA INORNATA Say.

Hopk. U. S. No. 9791e; mature. Species reared; larval skin and imago preserved.

(Fig. 96.)

Very close to *C. bicolor* in size and all structural details; differs from this species only in the following characters: Posterior part of frons and dorsal side of epicranium transversally rugulose, basal plate of cerci transversally rugulose, no unpaired median protuberance present dorsally on stalk-like proximal half of cerci, color of membranous parts is dorsally purple with whitish pattern.

## DIVISION IV (pp. 617-619).

Ocellus one or none.

## 11. Genus ORTHOPLEURA Spinola.

Body tumid claviform with comparatively small thoracic segments and fourth to sixth abdominal segments large; ninth abdominal segment small and short, anteriorly comparatively wide, subconical; abdomen dorsally without ampullae, ventrally rounded. Chitinous parts poorly developed. Membranous parts whitish. Setae thin, short, and scarce. Headcapsule small, subtriangular with strongly curved sides. Frons without sculpture. Epicranium without sculpture; anterior margin of hypostoma slightly emarginate. Ocellus absent, possibly represented by a slightly protuberant, rather large, round, colorless spot just behind the ventrolateral part of antennal ring. Length of basal, second, and apical antennal joints proportioned as  $1\frac{1}{2}:1:1$ ; supplementary joint small. Mandible about one-third the length of frontal suture, a trifle longer than wide, pointed; retinaculum well developed, situated slightly above middle of inner margin; tooth present between retinaculum and apex. Maxilla with low, band-like chitinization at the base of cardo and stipes; length of basal, second and apical joints of maxillary palpus proportioned as  $1:1:1\frac{1}{2}$ ; palpiger well developed with small chitinization. Gula not chitinized, laterally poorly defined, slightly shorter than frons, not much longer than maxilla. Submentum and mentum not chitinized. Stipes labii thinly chitinized; length of basal and apical joints of labial palpus proportioned about as  $1:1$ . Prothorax subconical, about as wide as long, somewhat longer and narrower than the following thoracic segments; no prothoracic shield; no sternal plate. Meso- and meta-thorax without dorsal chitinization; hypopleural support for legs chitinous. Legs short, poorly chitinized. Abdomen with normally developed intersegmental membranes; abdominal segments smooth, without ampullae, swollen to the extent that the different areas can not be defined. No basal plates of cerci. Cerci well separated, very small, hook-shaped.

This genus is in many respects closely related to genera as *Neichnea* and *Phyllobaenus*.

**ORTHOPLLEURA DAMICORNIS** Fabricius.

Hopk. U. S. No. 10369*d*; mature. Species reared; cast skin and imago preserved.

(Figs. 12, 26, 39, 59, 77, 99, 108, 131.)

Total length of body, 10mm.; extreme width about  $2\frac{1}{2}$  mm.; extreme thickness,  $2\frac{1}{4}$  mm.; anterior width of prothorax, about 1 mm. Mandible, epistoma, endocarina of frons, tarsi, and cerci pale brown; remainder of headcapsule, antennal, maxillary, labial chitinizations and legs pale clay yellowish; membranous parts of body whitish. Setae whitish. Mandible with sharp retinaculum; tooth between retinaculum and apex about as large and sharp as retinaculum; two thin mandibular setae. Cerci, without consideration of the recurved part, one-ninth the length of frons.

**12. Genus MONOPHYLLA** Spinola.

Body vermiform with short thoracic segments and prolonged abdominal segments; long intersegmental membranes; ninth abdominal segment rather small, subcrescentiform; no dorsal ampullae, laterally with protuberant lobes, ventrally rounded. Chitinous parts moderately developed. Membranous parts whitish. Setae thin; numerous on chitinous, scarce on membranous parts. Head capsule small, subtriangular with curved sides. Frons sculptured; in one species with an unpaired median protuberance. Epicranium rather smooth with well-marked pits for the setae; anterior margin of hypostoma slightly concave. Ocellus moderately developed, situated just behind ventrolateral part of antennal ring. Length of basal, second, and apical antennal joints as 3:1:2; supplementary joint small. Mandible about half as long as frontal suture, a trifle longer than wide, rather stump; retinaculum well developed, situated just above the middle of the inner margin; tooth present above retinaculum (fig. 27). Maxilla with low, bandlike chitinization at the base of cardo and stipes. Length of basal, second and apical joints of maxillary palpus proportioned as 2:1:2; palpiger with chitinous plate. Gula as long as frons; nearly twice as long as the maxilla. Submentum and mentum poorly chitinized. Stipes labii moderately chitinized; length of basal and apical joints of labial palpus proportioned about as 1:2. Prothorax transversely subrectangular, about three times as wide as long, hardly as wide but longer than the following thoracic segment; prothoracic shield poorly developed; sternal plate large, rectangular, longer than wide, thinly chitinized. Meso- and metathorax without dorsal chitinizations; hypopleural chitinized support for the legs present, but not strong. Legs short, moderately chitinized. Abdomen with intersegmental membranes

about one-third the size of the segments; dorsal ampullae not developed, alar area protuberant, postscutellum large, epipleural lobe protuberant. Dorsal side of ninth segment thinly chitinized, but a definite basal plate is not developed. Cerci well separated, of medium size, hookshaped.

The present genus is in many respects closely related to *Neichnea* and *Phyllobaenus*, as well as to *Tarsostenus*.

MONOPHYLLA TERMINATA Say.

Hopk. U. S. No. 12228b; mature. Species reared; cast skin and imago preserved.

(Figs. 13, 27, 40, 60, 75, 97, 109.)

Total length of body, 16 mm.; extreme width, about 2 mm.; extreme thickness, 2 mm.; anterior width of prothorax,  $1\frac{1}{2}$  mm. Mandible, epistoma, mediocarina of frons, and tarsi Roman sepia; remainder of head capsule, trophi, antenna, dorsal chitinization of prothorax, legs, hypopleural chitinization and cerci brown ocher; membranous parts whitish. Setae cream white. Frons with transversal impression behind clypeus; a deepening behind angulus frontalis, and in the center a round conical protuberance with a small pit in the top. Mandible with sharp retinaculum; tooth between retinaculum and apex about as large and sharp as retinaculum; one mandibular seta. Cerci, without consideration of the recurved part, about half as long as frons.

MONOPHYLLA CALIFORNICUS Fall (M. PALLIPES Schaeffer).

Hopk. U. S. No. 12654b; mature. Species reared; cast skin and imago preserved.

In every respect identical with *M. terminata* except in the sculpture of frons, where the central round, conical protuberance with the small pit in the top is lacking.

Subfamily C (pp. 619-620).

Frons posteriorly limited by an obtuse angle. Epicranial halves dorsally adjacent to a posterior free prolongation of the endocarina of frons; a distinct unpaired epicranial suture thus not present. Second antennal joint large, three times longer than apical antennal joint. Gula with flat surface. Abdominal preeusternal and eusternal areas not distinctly separated. Spiracles all annuliform. Ocelli, one on each side.

13. Genus PRIOCERA Kirby.

Body robust, digitiform with median abdominal segments only slightly larger than the other segments; ninth abdominal segment rather large, oblong, conical; abdomen with ampullae. Chitinous parts moderately developed. Membranous parts whitish. Head capsule well sized, subglobose, with ventral side predominant. Frons

conspicuously sculptured with unpaired median protuberance. Epicranium dorsally and posteriorly obliquely wrinkled, otherwise smooth; anterior margin of hypostoma concave. Ocellus small, close behind ventrolateral margin of antennal ring. Basal, second, and apical antennal joints proportioned as  $1\frac{1}{2}:3:1$ ; supplementary joint small; basal connecting membrane elongate, cylindrical. Mandible plump, as long as wide, length about three-fourths of frontal suture; apex blunt, not projecting over inner corner of mandibular base; retinaculum hardly developed; one tiny, rounded tooth present below apex; two very short and fine mandibular setae. Maxilla with cardo and stipes basally covered by a comparatively large chitinization; length of basal, second and apical joints of maxillary palpus proportioned as  $2:1:1$ ; palpiger jointlike, chitinized. Gula poorly chitinized, as long as frons and as long as maxilla. Submentum and mentum poorly chitinized. Stipes labii chitinized; length of basal and apical joints of labial palpus proportioned about as  $1:1$ . Prothorax anteriorly about as wide as head, posteriorly somewhat wider, about two-thirds as long as wide, somewhat longer and narrower than the following thoracic segments; dorsally chitinized, no distinctly defined thoracic shield; no distinct sternal plate. Meso- and metathorax slightly or not chitinized dorsally. Legs poorly chitinized, rather short. Abdomen with well-developed ampullae on second to seventh abdominal segments; lateral areas swollen. No definite basal plate of cerci; the whole dorsal surface of ninth segment slightly chitinized, posteriorly with grainlike asperites. Cerci short, straight proximally fused, distally divergent, apically bifid. Mesothoracic spiracles twice as large as the abdominal ones.

The systematic position of the present genus is isolated.

**PRIOCERA CASTANEA Newman.**

U. S. Nat. Mus., Wash., D. C.; Specimen labeled "*Priocera castanea* in white oak log with Lymexylon, Va., shore opp. Plummer's Island, Md., July 25, 1909; adults bred last year and also collected on same log this year." H. S. Barber, Colr.

(Figs. 14, 28, 41, 61, 76, 98, 110.)

Total length, 13 mm.; extreme width,  $2\frac{1}{2}$  mm.; extreme thickness,  $2\frac{1}{4}$  mm.; anterior width of prothorax, 2 mm. Mandibles, epistoma, endocarina of frons, end of cerci Roman sepia; remainder of head capsule and trophi, antennae, prothoracic shield, and tarsi from brown ocher to pale cadmium yellow; membranous parts whitish. Setae fine, short, and whitish; numerous on chitinized, sparse on membranous parts. Two mandibular setae.

Subfamily D (pp. 620-622).

Frons posteriorly limited by an acute angle. Epicranial suture present, short. Second antennal joint small, about as long as apical

antennal joint. Gula with unpaired, large chitinous tubercle. Abdominal preeusternal and eusternal areas not distinctly separated. Spiracles very small, all bifore. Ocelli, five on each side.

#### 14. Genus *THANEROCLERUS* Lefebvre.

Body elongate, digitiform; ninth abdominal segment well developed, semiglobose. Chitinous parts well developed. Membranous parts unicolorous, with vivid color. Setae thin, rather numerous, scattered. Head capsule subrectangular, longer than wide, dorsally convex. Frons without distinct sculpture. Epicranium dorsally without sculpture; ventrally, posterior to the gular tubercle with deep, transverse, curved wrinkles; anterior margin of hypostoma straight transversal. Ocelli five; three in an anterior, upwards and backwards oblique row behind lateral part of antennal ring, two in a posterior row parallel with the anterior one; the lower posterior ocellus on the level with the upper anterior ocellus. Length of basal, second, and apical antennal joints proportioned as  $1\frac{1}{2}:1:1$ ; supplementary joint small. Mandible about half as long as frontal suture; length to width about as  $3:2$ , pointed, apex right above inner corner of mandibular base, retinaculum small, at the middle of inner margin of mandible; tooth above retinaculum low, rather obtuse. Maxilla with a band-like chitinization at the base of cardo and a comparatively large rectangular chitinization on stipes; length of basal, second, and apical joints of maxillary palpus proportioned about as  $1:2:2$ ; palpiger well developed with joint-like chitinization. Gula well chitinized, as long as frons, about three times as long as maxilla; unpaired tubercle large, placed centrally. Submentum and mentum somewhat chitinized. Stipes labii chitinized; length of basal and apical joints of labial palp proportioned as  $1:1$ . Prothorax subrectangular, half as long as wide; twice as long and somewhat narrower than the following thoracic segment, dorsal shield well chitinized; sternal plate narrow, lanceolate. Meso- and meta-thorax with conspicuous dorsal chitinizations. Hypopleural chitinization for the support of the leg well developed. Legs of moderate size, well chitinized. Abdomen with normally developed intersegmental membranes; ampullae slightly indicated. Basal plate of cerci circular, flat, well chitinized, covers median half of the dorsal surface of ninth abdominal segment. Cerci rudimentary in mature forms, reduced to two granuliform elevations; in the previous stages comparatively larger and more lobeshaped.

The systematic position of this genus is very isolated.

#### *THANEROCLERUS GIRODI* Chevrolat.

Hunter U. S. No. 3459; mature. Species reared, imago preserved.

(Figs. 15, 29, 42, 62, 78, 100, 101, 113, 126.)

Total length of body, 9 mm.; extreme width, about 2 mm.; extreme thickness,  $1\frac{3}{4}$  mm.; anterior width of prothorax,  $1\frac{1}{4}$  mm. Head

capsule with length to width as 5:4. Chitinous parts shiny. Head capsule Indian red; mandibles dark brown; prothoracic shield brown ocher, posteriorly with two sepia brown spots; Meso- and meta-thoracic plate, basal plate of cerci sepia brown; remainder of chitinized parts brown ocher to pale brown; membranous parts vermilion red. Setae pale yellow. Mandible with two setae. Spiracles very small, the mesothoracic spiracles somewhat larger than the abdominal ones; peritrema and finger-shaped tubes slightly chitinized.

Subfamily E (pp. 622-624).

Frons posteriorly limited by a transversal line. Epicranial suture not developed. Second antennal joint small, considerably shorter than both basal and apical antennal joints. Ventral mouthparts slightly retracted. Gula with plain surface. Preensternal and Eusternal areas not separated. Spiracles bifore. Ocelli, five on each side.

15. Genus **HYDNOCERA** Newman.

Body short, digitiform or oval, somewhat flattened; ninth abdominal segment semioval or semicircular. Chitinous parts well developed. Membranous parts unicolorous or variegated. Setae numerous, scattered. Head capsule trapezoidal, posteriorly wider than anteriorly; somewhat wider than long. Frons smooth. Epicranium smooth. Ocelli five, anterior row bent slightly forwards. Length of basal, second and apical antennal joints proportioned as 3:1:3; supplementary joint twice as long as second joint. Mandible about half as long as frontal suture, length to width about as 6:5; pointed; apex somewhat retracted behind inner corner of mandibular base; posterior half of inner margin convex; retinaculum hardly developed; tooth behind apex low and blunt; with a single mandibular seta. Length of maxilla from end of palpus to posterior corner of cardo in proportion to gula about as 1:2; posterior parts of cardo and stipes without special chitinizations; maxillary palpus with small apical joint; length of basal, second and apical joints of maxillary palpus proportioned as 3:5:1; palpiger with plate-shaped chitinization. Gula about same length as frontal suture. Basal and apical joints of labial palpus proportioned about as 1:3. Prothoracic tergal shield well developed, along middle line about as long as frontal suture; prothoracic sternal plate large, subtriangular, anteriorly fused with the presternal chitinizations; posteriorly pointed. Legs well developed. Abdomen with normally developed intersegmental membranes; dorsal ampullae absent, but substituted by very small dorsal plates. Ninth abdominal segment dorsally slightly chitinized. Cerci absent. Spiracles small; the two spiracular tubes short and about circular.

## 1. HYDROCERA SCABRA LeConte.

U. S. Nat. Mus., Wash., D. C.; labl. D. W. Coquillett 4981. Not reared.

Total length, 5 mm. Color of head capsule pale yellow, the same color throughout; prothoracic dorsal shield brown ocher, prothoracic sternal plate light brown ocher; legs pale yellow; basal plate on ninth abdominal segment pale yellow. Membranous parts motley bluish with whitish pattern above heart and muscle attachments, all abdominal segments colored alike. Setae thin and light yellowish. Ninth abdominal segment with semioval, nearly semicircular basal plate. Cerci not present.

## HYDROCERA VERTICALIS Say.

(Hopk. U. S. No. 10084c; mature. Species reared, cast skin and imago preserved. Description after cast skin.)

(Figs. 16, 30, 43, 63, 102, 118, 120, 132.)

Total length, about  $2\frac{1}{2}$  mm. Head capsule pale yellow with ocellar field and posterior third of frons black brown, ventral hind margin of epicranium and hind margin of gular plate with small black brown darkening; prothoracic dorsal shield pale yellow with two large black brown spots on each side, adjacent to the middle line; prothoracic sternal plate and presternal chitinizations pale brown; leg pale yellow with black brown coxa and a black brown spot at the distal end of femur, tarsus pale brown; abdominal segment with small dorsal plates; surface of epipleural lobes somewhat chitinized; basal plate of ninth abdominal segment pale yellow, posteriorly gradually darkening. Membranous parts light. Setae long, stiff, dark brown. Ninth abdominal segment with semioval basal plate.

## HYDROCERA PUBESCENS LeConte (?).

Hunter U. S. No. 3062V, 1. ♂; possibly not mature. Species not reared.<sup>1</sup>

Total length,  $2\frac{1}{2}$  mm. Head capsule pale yellow with hind margin of frons and dorsal hind margin of epicranium dark brown; prothoracic dorsal shield brown ocher, on each side with three more or less confluent dark brown spots; the anterior spot laterally at the front corner of the shield, the posterior and smallest spot at the back corner close to the middle line, and the median and largest spot at the beginning of the hind margin right between the anterior and posterior spots; prothoracic sternal plate dark brown; leg pale yellow with dark brown coxa; basal plate of ninth abdominal segment dark brown, gradually changing into a median lighter field. Membranous parts of meso- and metathorax variegated, blackish blue with whitish pattern; first abdominal segment blackish blue with whitish muscle attachments, second and third abdominal segment nearly entirely

<sup>1</sup> Determination kindly given by Dr. W. D. Pierce. Compare bibliography.

whitish; fourth, fifth, sixth segments nearly entirely blackish blue, seventh whitish. Setae long, stiff, light brownish. Basal plate nearly semicircular.<sup>1</sup>

## PART II.

### NOTES ON THE SEASONAL HISTORY AND BIOLOGY OF NORTH AMERICAN CLERIDAE.

The Cleridae are among the principal predators of wood and bark boring beetles. They are predaceous in both larval and adult stages, the adults attacking the adults of the destructive species while the larvae feed upon the eggs and broods in the bark and wood.

Under natural conditions they may be of but nominal importance but can be turned to considerable account in control measures with the additional help of man, who can overbalance the natural conditions in favor of the predators by properly conducted control work.

To benefit by their predaceous habits it becomes necessary to learn as much as possible concerning their general habits and seasonal history.

With this knowledge gained, control work can be conducted at times best suited to the preservation of the predators or at least by taking measures for their protection while destroying the host. This would greatly facilitate the control on barkbeetles as recommended by Hopkins<sup>2</sup>, which includes the percentage principle of control, namely the disposal of 50 to 75 per cent of the tree-killing beetles.

Whenever practicable the dissemination of Cleridae in quantities in badly infested regions in addition to control measures would evidently be of great value. Especially in the case of the genera *Thanasimus* and *Enoclerus* among which are to be found the most important economic species.

The adults of most of the species of Cleridae are very active, and when disturbed take flight readily or drop and crawl into the debris upon the ground.

Some of them are active at night, others in the daylight. Most of them prefer bright sunny days when they may be observed running over infested trees or on flowers. The nocturnal species may be observed by the aid of a small searchlight upon infested trees. They are attracted to artificial light and may be captured with trap lanterns. The nocturnal species do not frequent flowers.

Adult Clerids consume numbers of Scolytoidea and other small insects. Sometimes they will attack insects much larger than themselves. In the usual method of attack the Clerid remains motionless until a wandering Scolytoid or some other insect approaches close

<sup>1</sup> According to Bulletin 100, Bureau of Entomology, Department of Agriculture, 1912, page 68, a single specimen of the species *Hydnocera pallipennis* Say was reared April 6, 1907, but the larval skin was not saved. No larva determined as belonging to this species is present in the special collections of the Bureau of Entomology nor in the general collections of the United States National Museum in Washington, District of Columbia.

<sup>2</sup> Bulletin 83, pt. 1. Bur. Entom., U. S. Dept. Agri. 1909.

enough. Then running with a rapidity that resembles a leap, it seizes the prey. Grasping it with the front and middle pair of legs and holding on to the bark by the hind pair, sometimes balanced by the tip of the abdomen against the bark, it proceeds to feed. With its strong jaws it breaks the chitin or separates the segments and feeds upon the soft tissue and viscera within.

In several genera there are instances where the adults are apparently not predaceous, but are to be found on flowers, where they feed upon the pollen.

During their activities mating occurs, on flowers, on infested trees, or trees being attacked by barkbeetles. It is more difficult to find them ovipositing. The eggs are usually placed in or near the entrance gallery of their host.

Certain species of Clerid larvae in all stages are found in the galleries and mines of bark and wood borers. They prey upon the eggs, larvae, and sometimes the dead (?) parent adults of the host. They feed voraciously and grow rapidly. As mature larvae they pass a considerable time often without taking much food. During this stage they construct the pupal cell in which considerable time is spent previous to pupation. The pupal cell may be made in the earth, the bark, or in the cell of the host. Many species line their cells with an exudation of a white silvery color. Others use it to seal the ends of borer cells which they reconstruct to suit their purposes. Others make a complete cocoon, utilizing the exudation or cement to hold the particles of earth together and to form a smoother interior on which to lie as pupae.

Clerids overwinter, sometimes in all stages, sometimes in a certain stage. The time of transformation to adults is generally in the spring but it varies. Some of the species may have more than one generation in a season, especially if there are several generations of the host. Others appear to pass several years in the larval stage.

The following notes are from the records on file in the office of the forest entomologist, United States National Museum, made by members of the Branch of Forest Entomology, of the Bureau of Entomology, United States Department of Agriculture, and from special notes and observations by the author.

#### Genus MONOPHYLLA Spinola.

##### MONOPHYLLA CALIFORNICA Fall (=M. PALLIPES Schaeffer).

Is a predator on Bostrychidae and small secondary woodborers in *Acacia greggii* and *Prosopis juliflora* from Arizona. Collected by M. Chrisman and reared at Eastern Station, Forest Insect Branch. *Schizax senex* reared from same wood.

**MONOPHYLLA TERMINATA** Say.

Is a predator on borers in dead deciduous trees and seasoned wood. The adults are to a great extent nocturnal in habits, hiding during the daytime in crevices and beneath the bark.

There is a great variety of hosts, but it appears to be most plentiful in dry wood attacked by *Sinoxylon*.

It has been reared from *Celastrus scandens* infested by small Cerambycidae; wild grape infested by *Phymatodes amoenus*; *Diospyros virginiana* infested by *Sinoxylon*; hickory infested by *Sinoxylon*, *Lyctus* and other borers; sassafras with *Ptinid*; ashboard infested by *Lyctus*; *Celtis* infested with *Scolytus muticus*; also oak, honey locust, mesquite, and probably most any hardwood.

The adults fly May and June.

The species occurs throughout the Eastern, Central, South, and Southwestern United States.

Observations by Hopkins, Fiske, Van Horn, Kirk, Chrisman, Champlain.

**Genus CYMATODERA** Gray.

The adults of this genus are to a great extent nocturnal. They are attracted by strong light, may be found at arc lights or taken in trap lanterns.

The seasonal histories of the different species studied are very similar. The larvae are predators on the larvae of secondary woodborers, principally Cerambycidae and Buprestidae. They tunnel through the sawdust-packed mines of the woodborers, feeding on the woodboring larvae or pupae and finally utilizing their mines or cells as pupal cells of their own.

They do not line their cells as heavily as do the *Enoclerus* but all soft particles are held together with interior smooth and ends sealed with the exudation that is common to them for this purpose.

**CYMATODERA BRUNNEA** Melsh.

Adults active during July in Pennsylvania. Champlain.

**CYMATODERA BICOLOR** Say.

Is a predator in the larval stage on the larvae and pupae of secondary woodborers. It overwinters in the larval and pupal stages. Adults active during May, June, July; habits retiring, nocturnal; are attracted to lights; mate and oviposit at night.

Larvae are found in the galleries or mines of host. At Lyme, Connecticut, they occur in dead dry dogwood (*Cornus florida*) and *Benzoin benzoïn*, in the larval mines, and pupal cells of *Cryptophorus verrucosus* and other borers.

They may be traced and located by following their small, unpacked mines, which are tunneled through the sawdust-packed galleries of their host.

In most instances the pupal cell of the host was utilized, but in some cases they constructed pupal cells in the galleries or in the wood. Pupae were found from December 1st until spring. The majority overwinter in the pupal stage rather than that of mature larvae, as do most of the Clerids studied. The pupal cell was but slightly lined with the whitish exudation, but the loose particles and frass at each end of the cell were firmly sealed with it.

In most cases the pupae rested vertically in the cell.

The transformation from pupal to adult stage takes place in early spring. The adults begin to emerge in June.

The species occurs in Eastern and Central States, Southwest to Texas. Observations by Champlain.

Adults collected by Fiske beneath chips and dead bark of girdled chestnut, Melrose, North Carolina, May 18, 1903; by Hopkins, Wood County, West Virginia, May 15, 1891.

**CYMATODERA INORNATA Say.**

Is a predator on secondary woodborers. Reared from dead, dry limbs of hickory infested by *Bostrychus bicornus*; from dead standing birch infested by *Melasis* and *Buprestid* larvae; also reared from oak, hackberry, and beech.

Adults fly during June and July in Pennsylvania.

Occurs in Eastern and Central United States.

Observations by Hopkins, Craighead, Van Horn, Champlain.

**CYMATODERA MOROSA LeConte.**

Is a predator in larval stage on *Cerambycid* and *Buprestid* borers infesting scrub oak in Colorado. Found feeding on *Chrysobothris* larvae beneath bark and larvae of *Brothylus geminatus* in the base and roots. The life history as far as noted is very similar to *C. bicolor*, except that pupae were not observed until spring. Observations by Champlain, at elevations ranging from 6,000 to 7,000 feet in Colorado.

**CYMATODERA UNDULATA Say.**

Is a predator on wood; stem and twig borers. Reared from chestnut infested by *Callidium acreum*; maple infested by *Eucnemids*; *Populus deltoides* infested by *Oberea*; oak infested by *Elaphidion*; also from sumac, wild grape, hackberry, birch, butternut, *Celastrus scandens* and *Ampelopsis quinquefolia*.

Adults fly during July, August, and September. Occurs in Eastern and Central United States. Observations by Hopkins, Kirk, Fiske, Craighead, Webb, Van Horn.

**CYMATODERA BALTEATA LeConte.**

Adults reared from dying wild grape infested by *Clytoleptus albofasciatus* in Pennsylvania; also reared from hickory and hack-

berry infested by secondary borers. Observations by Kirk and Champlain. Reared from dead *Morus rubra* infested by *Cerambycidae*, J. N. Knull.

**CYMATODERA OVIPENNIS** LeConte.

Is a predator on Lepidopterous larvae infesting cones of *Pinus jeffreyi*; reared from cones of *Pinus ponderosa* and *Pseudotsuga taxifolia*; from Piñon pine infested with secondary *Pityophthorus* and from big cone spruce infested with *Carphoborus* and *Callidium*.

Observations by A. D. Hopkins in Ventura County, California, and by J. M. Miller at Ashland, Oregon.

**Genus PRIOCERA** Kirby.

**PRIOCERA CASTANEA** Newman.

Is apparently a predator on barkbeetles and borers in coniferous trees. Larvae taken at Damascus, Virginia, from moist sapwood of pitch pine killed by *Dendroctonus frontalis* by T. E. Snyder. From pine at Tryon, North Carolina, by W. F. Fiske. Adult on bark of pine attacked by *Dendroctonus valens* at Flagstaff, Arizona, by J. L. Webb. Adults taken at night near Harrisburg, Pennsylvania, by H. B. Kirk. Adult flies during June. On dead hickory at night, Pennsylvania, J. N. Knull.

**Genus TARSOSTENUS** Spinola.

**TARSOSTENUS UNIVITTATUS** Rossi.

Is principally a predator on powder post beetles as *Lyctus* and *Sinoxylon* in dry, seasoned wood products.

Reared from ash timber infested with *Lyctus parallelocollis*, received from Portsmouth Navy Yard; from hickory lumber infested with *Lyctus*; persimmon blocks containing work of *Lyctus* and *Sinoxylon*; white oak infested with *Lyctus*; from hickory axe handles containing *Lyctus*, and other similar articles. Observations by T. E. Snyder.

**Genus THANASIMUS** Latreille.

**THANASIMUS TRIFASCIATUS** Say.

Note by W. F. Fiske, made October 19, at Grand Lake, Michigan. "Clerid adults and larvae in cells at base of *Picea* killed by *Dendroctonus*. Clerid larvae were extremely common at base of tree. They seemed to migrate there. From the location of some, it seems as though they went into their pupal cells from the outside." Pennsylvania, reared from white pine. J. N. Knull.

**THANASIMUS DUBIUS** Fabricius.

Is a predator on barkbeetles, *Ips*, *Dendroctonus*, *Polygraphus*, etc., *Pissodes* and other borers in coniferous trees, mostly pine and spruce.

An article by Dr. A. D. Hopkins that appeared in the West Virginia Agriculture Experiment Station, Bulletin No. 56, published April, 1899, gives a good account of this species, as follows:

The American barkbeetle destroyer is often quite common on the bark of spruce trees infested with barkbeetles. It passes the winter in all stages from larva to adult in the bark in which it is bred, the latter sometimes in the loose bark and moss at the base of the tree. The adults appear in the spring, soon after the barkbeetles commence to emerge from their winter quarters and fly to the trees, logs, or tops, which are infested with barkbeetles. There they station themselves beneath loose flakes of bark, awaiting an opportunity to pounce upon any barkbeetle that comes near. They also move rapidly about over the bark in search of the prey, or the entrances to the barkbeetle galleries in which the females deposit their eggs. The eggs soon hatch into minute-active worms, which find their way into the egg and brood galleries of the barkbeetles where they feast upon the eggs and young found there until they have attained their full growth, when they leave the inner bark and excavate cavities in the outer corky bark in which they change to pupae and adults.

This clerid attacks and feeds upon all kinds of barkbeetles which infest spruce and pine and has been found attacking barkbeetles in deciduous trees. It is widely distributed over the State (West Virginia) and doubtless has a wide range throughout North America.

It is a common insect wherever the pines and spruces grow in the State, and doubtless exerts a considerable influence in preventing the undue increase and devastations of pine and spruce barkbeetles.

Distribution, eastern United States southwest to Texas.

**THANASIMUS UNBULATUS** Say, and variety **NUBILIS** Klug.

Is a predator on *Dendroctonus* and other barkbeetles in coniferous trees, *Pinus*, *Picea*, *Pseudotsuga*, *Larix*, *Abies*, and *Cedar*, and occurs wherever these trees are found.

Habits very similar to *T. dubius*. Observed at elevations ranging to 10,000 feet. Adults fly May to September.

Observations by Hopkins, Burke, Fiske, Champlain.

**THANASIMUS NIGRIVENTRIS** (Le Conte) (= **ENOCLERUS NIGRIVENTRIS** LeConte).

Is a predator on barkbeetles on coniferous trees.

Adults are active during sunny days from April to October, running over newly cut trees and branches. They feed upon the small Scolytoids that attack these trees, such as *Ips*, *Pityophthorus*, etc., and *Dendroctonus* in larger trees.

Mr. J. L. Webb describes the feeding of this species in his notes, as follows:

Elmore, S. Dak., Aug. 23, 1902.—Pine. Clerid discovered on bark of experiment tree, preying on *Dendroctonus ponderosa*. *Dendroctonus* not dead. Jaws of Clerid inserted between prothorax and mesothorax. When dropped into a dry vial, Clerid, after running about a little while, still holding the *Dendroctonus*, braced itself against the cork of the bottle, bottle being held horizontally. With the two hind feet holding on to the cork and the posterior end of the body against the cork, the Clerid proceeded to make its meal.

During the first part the prothorax of the Clerid rested on the lower side of the bottle, body of the Clerid upside down. Later the front of the body was lifted clear of the floor and the meal was finished in midair.

The two front pairs of legs were used to grasp and turn the victim, much as a squirrel holds a nut while eating it. The Clerid ate ravenously of the interior of the prothorax, inserting the jaws between the head and thorax. Finally, the head and thorax being severed from the abdomen, the Clerid finished up on this.

They mate and oviposit at this time. The eggs are deposited in the entrance galleries of host. The larvae upon hatching crawl through the galleries and mines, feeding upon the barkbeetle broods.

According to W. S. Fiske (in notes) the pupal cells are made in the bark of the tree. Adults ready to emerge observed Apr. 23.

Distribution: Western and Middle Western United States; also recorded from Michigan and Wisconsin.

Observations by Hopkins, Webb, Fiske, Edmonston, Burke, Champlain.

#### Genus PLACOPTERUS Wolcott.

##### PLACOPTERUS THORACICUS Olivier.

Is a predator on the smaller barkbeetles and borers in twigs and limbs of deciduous trees. W. F. Fiske states in his notes: "This species was very common in the jarring for *Curculio* in Georgia in 1901. And without question is an enemy of *Scolytus rugulosus*."

The adults may be taken during the summer months upon the foliage of trees and sometimes on flowers.

Early larval stage not noted. At Lyme, Connecticut, it overwinters in the abandoned pupal cells of *Magdalis olya* in hickory and probably prey upon the *Magdalis* broods. Also found overwintering in the galleries of *Oncideres* in hickory twigs, infested with *Chramesus icoriae*, and in butternut twigs infested with small *Cerambycid* larvae.

The larvae were all prepupal in their cocoon-like cells, lined with the frothy exudation and attached to the wood.

Observations by Hopkins, Fiske, Champlain. Pennsylvania, Kirk, Knoll.

#### Genus ENOCLERUS Gahan.

Some of the species of this genus are the most important predators on barkbeetles and might be utilized to considerable advantage in control measures.

The general habits of the different species vary considerably. One species is active at night, others in daylight. Some are to be found on flowers, where they feed to some extent on pollen; others are never found on flowers.

All of the species studied line their pupal cells heavily with an exudation that is foam-like in substance, of a silvery luster, making a smooth interior, attaching exterior to the bark or if cells are in

the earth, holds together the loose particles and forms a sort of cocoon.

They are all active and strong fliers and are predaceous in both adult and larval stages.

**ENOCLERUS HUMERALIS** Schaeffer.

Adults emerged from infested cones of *Pseudotsuga taxifolia*, Waldo, Oregon, August 16, 1914, P. D. Sargent, predaceous Clerid feeding on the insects which are issuing from cones of *P. taxifolia*. Quincy, California, September 21, 1916. Observations by F. P. Keen.

**ENOCLERUS QUADRIGUTTATUS** Olivier.

Is a predator on the larvae and adults of *Scolytoids* and *Pissodes* in coniferous trees, pine, spruce, juniper, etc., and on *Scolytoids*, *Curculionids* and small borers in hardwood trees, butternut, ash, mulberry, wild cherry, etc.

Adults are diurnal and may be observed running over infested trees throughout the summer months. Adults have been found during the winter months beneath bark and debris and it is very probable that this is the general method of overwintering.

All records show that this is a common species and one that could be utilized in control.

W. F. Fiske notes the feeding of this species on the larvae of *Pissodes strobi* in white pine terminals. "Three Clerid larvae were found with the *Pissodes* in terminals examined. One of the larger ones was found in the cells of a *Pissodes* which was partly devoured and its tracks could be traced backward through four and possibly six empty cells."

Dr. A. D. Hopkins records pupae and adults in white lined pupa cases in outer bark at base of White Pine stump infested by *Hylurgops*. August 27. Also larvae and pupae in cocoons in outer loose bark of red cedar, August 6.

The species is distributed throughout the eastern part of the United States to the Mississippi and in the southwest.

**ENOCLERUS ROSMARUS** Say.

Adults are found on flowers during summer months. Falls Church, Virginia, H. B. Kirk, Sumac. Reared at eastern station. Pennsylvania, Kirk, Knull, Champlain.

**ENOCLERUS EXIMIUS** Mannerheim.

Clerid adult on live oak limb September 17. Chiricahua Mountains, Arizona. J. L. Webb.

**ENOCLERUS MUTKOWSKII** Wolcott.

Clerid larva under bark of *Tsuga canadensis*. Bemis, West Virginia. Collected by H. G. Champion. Reared at eastern station.

## ENOCLERUS SPINOLAE LeConte.

Clerid common, larvae in pupae cases in outer bark of *Yucca*. Hesperia, California, May 12. Observations by Dr. A. D. Hopkins.

## ENOCLERUS MOESTUS Klug.

Adults active during daytime, July, August. Observed on various conifers (in Colorado) and is probably a predator on barkbeetles and other borers. Especially common on small pinon pine infested with barkbeetles and small Cerambycid larvae. Seems to range slightly higher in altitude than does *E. sphegeus* in Colorado.

Collected on tanglefoot screen. August. Altitude 7,500 feet. Observations by Edmonston, Hofer, Champlain.

## ENOCLERUS SPHEGEUS Fabricius.

Is an important predator on *Dendroctonus* and other barkbeetles in the Western States. My studies were made in Colorado, where it is predaceous on barkbeetles in various conifers at elevations ranging from 6,000 to 8,000 feet.

It is an important enemy of *Dendroctonus ponderosae* Hopkins and its history in connection with this species is as follows:

*Adults.*—The adults appear in June and are at once attracted to infested trees. These trees would contain overwintered broods in the case of *D. ponderosae*. On sunny days the adults may be observed running about mating or feeding. They may remain motionless for a considerable time while waiting for their prey, but drop or fly when disturbed. Their food consists of any small insects that are attracted to the infested trees, principally barkbeetles. They are able to handle objects three times their own size, but prefer smaller objects. The adults continue to live during the warm summer months, sometimes four or five months.

*Eggs.*—The eggs are deposited soon after the adult emerge, latter part of May or June. The eggs are placed in trees that contain *Dendroctonus* (*D. ponderosae*) broods and must hatch soon after being laid, as the larvae must feed and make their growth before the *Dendroctonus* beetles emerge.

*Larvae.*—The larvae, being voracious feeders, grow rapidly, and during this time they consume many *Dendroctonus* larvae and pupae.

About the 1st of August the *Dendroctonus* broods consist mostly of adults ready to emerge. Now we find the almost full-grown *Clerus* larvae wandering about among the galleries and beneath the bark.

Upon the emergence of the *Dendroctonus* broods, the Clerid larvae being full grown, go into the ground at the base of the same tree for hibernation. This migration occurs at night. They enter the ground and burrow for several inches in depth close to the

base of the tree and begin to construct their pupal cells. They overwinter in these cells in the larval stage.

The cells are made in the dirt and debris, in bark crevices, or any suitable place. The cell is lined with the exudation, foam-like and of a silvery luster. This tends to hold all loose particles together, especially when the cell is made in the soil, and provides a smooth surface for the larva and pupa to rest upon as well as a protective covering.

No larvae were found in trees containing the overwintering *Dendroctonus* broods.

*Pupae*.—Exact duration of pupal stage not learned, but probably short. After transformation the adults may remain for a time in their cells and emerge in May, appearing in numbers in June.

The control of *D. ponderosae* in Colorado should be attempted between September and April, inclusive, of the following year in order to prevent the destruction of these predators which are then in their cells at the base of trees from which the *Dendroctonus* broods have already emerged.

During May, June, July, and August the Clerid larvae are in the trees feeding upon the *Dendroctonus* broods. The larvae of *E. sphegeus* were seldom found among the *D. ponderosae* broods during the winter months.

Observations by Champlain, assisted by W. D. Edmonston and George Hofer.

There are more records of *E. sphegeus* on file in the office of the forest entomologist than any other species. It is very common and easily handled, and should prove of great benefit as a predator on *Dendroctonus* and other barkbeetles in coniferous trees during control operations.

Its seasonal history in connection with the species to be controlled would be the first item; then proper measures for the safety of the predator could be made while destroying the host.

It is found in most of the western pines, spruce, and fir; also *Pseudotsuga taxifolia* and *Larix occidentalis*. All of the records show that it was predaceous upon or associated with barkbeetles, principally *Dendroctonus*.

Observations by Hopkins, Burke, Webb, Edmonston, Fiske, Bruner, Champlain.

#### ENOCLERUS ICHNEUMONEUS Fabricius.

Is important as a predator on *Scolytus 4-spinosus* in hickory. Reared from *Juniperus virginiana* infested with *Phloeosinus* and *Cerambycidae*; also from sweet gum and maple.

The adults are diurnal and crawl over infested trees during sunny days. They prey upon *Scolytus* and other insects and are usually very abundant where they occur. The adults may be found through-

out the summer months, and finally crawl into cracks or beneath thick bark, where they overwinter. I have observed 15 or 20 individuals packed together beneath the thick bark of a dead tree during the winter months in Pennsylvania.

The larvae are to be found in the larval mines and galleries of the host. In the case of *Scolytus 4-spinosus*, they are very beneficial and consume large numbers of the broods. Pupae not observed.

Recorded from Pennsylvania, New Jersey, North Carolina, South Carolina, West Virginia, Virginia.

Observations by Fiske, Hopkins, Van Horn, Knull, Champlain.

#### ENOCLERUS QUADRISIGNATUS Say.

All of the forest insect records as well as my own show that this species is principally a predator on *Scolytus 4-spinosus*. It is abundant where it occurs.

The adults are nocturnal and may be observed at night, by the aid of a strong light, running over the *Scolytus*-infested trees, feeding upon the *Scolytus* and other insects attracted to these trees. I have observed an adult carrying off the adults of *Saperda discoidea* that were ovipositing in the tree.

Adults were observed during June, July, and August. They are attracted to light and may be caught with trap lanterns. Mating and ovipositing take place at night.

The adults are hidden during the daytime beneath bark, in cracks or in debris at base of tree.

Eggs are placed in the entrance gallery of *Scolytus*. The larvae upon hatching begin their travel into the galleries and through the mines of the *Scolytus*, feeding as they go. They consume a large quantity of the *Scolytus* broods.

Larvae of this species overwinter in the *Scolytus* larval mines. No pupae were observed.

Recorded from Pennsylvania, North Carolina, West Virginia, Missouri.

Observations by Kirk, Hopkins, Kirk, Champlain.

#### ENOCLERUS LUNATUS Spinola.

Notes by W. F. Fiske: "This species has been very frequently noted and taken crawling over peach trees which have been attacked by *Scolytus rugulosus* in Georgia."

During June and July the adults may be found on flowers and foliage. It is more of a southern species.

Recorded from Georgia and North Carolina, Fiske; Falls Church, Virginia, J. N. Knull. New Jersey, E. Daecke.

#### ENOCLERUS PALMI Schaeffer.

Waldo Canon, El Paso County, Colorado, May 10. Adult on bark surface of trees infested with *Dendroctonus ponderosae*; at elevation

of 7,500 feet; also from tanglefoot screen June 25, W. D. Edmonston.

Catalina Mountains, Arizona. Collected by M. Chrisman. Clerid larva from yellow-pine limb. Reared at eastern station.

**ENOCLERUS CUPRESSI** Van Dyke.

Pacific Grove, California, November 14. Reared from cones of *Cupressus macrocarpa* J. M. Miller.

**Genus TRICHODES** Herbst.

The adults of *Trichodes* may be found during the daytime on flowers, where they feed upon the pollen. They do not seem to be predaceous in the adult stage.

The larvae of the species studied are predaceous on the larvae of bees, wasps, etc., and may also feed upon the pollen or material stored as food for the bee larvae.

*Trichodes* larvae may be found in the cells of bees and wasps in logs, stumps, and the stems of plants, or in the hives of domestic bees.

**TRICHODES ORNATUS** Say.

Is a predator in the larval stage on the larvae of bees and wasps.

*Adults.*—In Colorado the adults are very common and are found on flowers from June to September, and range from 6,000 to 10,000 feet elevation. They feed upon the pollen of flowers and are not predaceous in the adult stage. Mating takes place at this time.

Larvae occur in the cells and galleries of bees and wasps in dead logs and stumps. They are predaceous on the larvae of bees or wasps, and possibly feed upon material stored by the parent bees for their young.

Mature larvae pupate in the spring and emerge in June. Is known from most of the Western States. Observations by Champlain.

**TRICHODES APIVORUS** Germar.

Adults occur on flowers, June to August. Are pollen feeders. Larvae are predaceous in the nests of bees and wasps.

Distribution, Pennsylvania, New Jersey, New Mexico, Texas, Colorado, North Carolina.

**TRICHODES NUTTALLI** Kirby.

Adults occur on flowers, June to August. Are pollen feeders. Larvae are predaceous in nests of bees and wasps.

Distribution, Indiana, Wisconsin, South Dakota, Pennsylvania.

**Genus HYDROCERA** Newman.

The adults may be found flying or resting on foliage during sunny days and may be collected with the sweep net on low herbage.

The larvae are predaceous on the larvae of small woodborers, the larvae of gallmakers, and on the larvae of insects inhabiting the pith of annual plants.

**HYDROCERA UNIFASCIATA** Say.

Tryon, North Carolina. Larvae from galleries of *Hyperplatys* in sumac. W. F. Fiske.

**HYDROCERA VERTICALIS** Say.

Harrisburg, Pennsylvania. Larvae reared from *Celastrus* infested with Cerambycidae. F. C. Craighead. Lyme, Connecticut, *Hydnocera* larvae apparently predaceous on *Phymatodes amoenus* in wild grape. Champlain.

**HYDROCERA TABIDA** LeConte.

East Falls Church, Virginia. *Hydnocera* pupae in stems of annual plant infested with *Mordellid* larvae. Champlain.

Genus **XENODOSUS** Wolcott.

**XENODOSUS SANGUINEUS** Say.

Adults collected at night on oak bark near base of tree, June, July. Adults collected in winter months at base of oak. Pennsylvania, Connecticut. Champlain.

Camp Caribou, Maine, May 28. Adults on bark of spruce trees dead and dying from attack of *Dendroctonus piceaperda*. June 7, adult on spruce infested with *Polygraphus* (placed living *Polygraphus* in bottle with it, which it at once attacked and slowly killed by biting at base of prothorax.) Webster Springs, West Virginia, June 20. Adult on decaying wound in living beech.

Waterville, New Hampshire, May 2. Adult under loose bark of large dead white pine. Observations by A. D. Hopkins.

Genus **PHYLLOBAENUS** Spinola.

**PHYLLOBAENUS DISLOCATUS** Say.

Is a predator on small Scolytoids and other small borers. Adults observed feeding on *Pityophthorus* attacking red oak. Are active during daytime, April to August. They may be found on and flying about infested trees where they feed, mate, and oviposit.

The larvae are to be found in the larval mines of small wood and bark borers, where they prey upon the borer broods. They are predaceous on *Elaphidion villosum* in oak twigs; *Chramesus icoriae* in hickory twigs; *Micracis* in redbud; *Scolytus mutica* and *Agrilus lecontei* in hackberry; and will probably attack almost any small borers in deciduous trees.

Probably occurs in most of the eastern half of the United States, southwest to Texas.

Observations by Hopkins, Fiske, Craighead, Kirk, Champlain.

## PHYLLOBAENUS MERKELI Horn.

Is a predator on barkbeetles, Jeffery pine infested with *Ips*, alligator juniper infested with *Phloeosinus* and reared from cypress. New Mexico, Arizona, and California. Observations by Hopkins, Webb, and Chrisman.

Genus NEICHNEA Wolcott and Chapin (*ELLIPOTOMA Spinola*;  
*ICHNEA Castelnau*).

## NEICHNEA LATICORNIS Say.

Is one of the principal enemies of the smaller *Scolytoidea* in the east. Is a predator on *Phloeosinus* in *Juniperus virginiana* and *Taxodium distichum*, *Chramesus icoriae*, and sometimes *Scolytus 4-spinosus* in hickory, *Phloeophthorus* in *Morus*, *Phloeophthorus* in *Cercis canadensis*, *Phloeotribus* in *Celtis* and many other *Scolytoidea*s in various trees.

The adults are active during the summer months, June to August. They are diurnal and can be found running over or resting on infested twigs or on foliage.

The eggs are laid in or at the entrance gallery of host. The larvae are to be found in the primary egg gallery of the *Scolytoidea*. They feed upon the dead parent adults, the eggs and first larvae of their host. But one larva of the Clerid occurs in the primary egg gallery of the *Scolytoidea*.

The Clerid larva when mature remains in the primary egg gallery where it overwinters. It probably feeds to some extent on the moisture, etc., in the gallery, but does not follow the larvae of host into their mines, nor does it wander from the gallery.

Prepupal larvae and first pupae may be found in the spring (May 26, at Westbury, Long Island, New York). Adults emerge in June. In localities where two generations of the host occur it is very probable that there will be two generations of the predator.

The pupae occur bare in the primary egg gallery of the host. No protective covering or whitish exudation observed.

Distribution: Pennsylvania, New Jersey, Connecticut, West Virginia, Virginia, Florida, Maryland, North Carolina.

Observations by Fiske, Hopkins, Craighead, Champlain.

## Genus CHARIESSA Perty.

## CHARIESSA ELEGANS Horn.

Is a predator on various woodborers in deciduous trees. Adults crawling over bark of oak trees blown over preceding winter, Placerville, California, February 15. H. E. Burke.

Larvae and adults in pupal cells of *Xylotrechus conjunctus* in *Quercus californicus*, Walker, California, August 28. F. C. Craighead.

Larvae from Cerambycid galleries in Oregon oak, Ashland, Oregon. G. Hofer, collector.

Larvae from Neoclytus-infested white oak, Catalina Mountains, Arizona. M. Chrisman, collector.

**CHARIESSA PILOSA** Forster.

Is a predator on primary and secondary wood and bark borers, among which are *Scolytus 4-spinosus* and *Magdalis olyra* in hickory; Cerambycid and Buprestid borers beneath bark and in wood. Is the most common eastern Clerid. It has been reared from oak, hickory, walnut, sassafras, linden, grape, birch, chestnut, and rarely in coniferous trees. It undoubtedly attacks borers in any tree or wood.

Adults begin to emerge during May and June and are attracted to infested trees. They are active during daytime and may be seen throughout the summer months, mating, ovipositing, and searching for prey. They feed upon small insects that are attracted to the infested trees. The eggs are placed in crevices in the bark or in wounds and galleries made by the borers.

Upon hatching the larvae begin at once to search for prey, traveling through the larval mines of the borers. In relation to *Magdalis olyra* in hickory saplings, the Clerid larvae were about one-fourth inch long by August 15. They fed until cold weather arrived, being three-eighths to one-half grown. They overwintered in the mines of the host, resuming the attack in the spring. These larvae continued in this tree for one year after the *Magdalis* had emerged, making a total of two years in the larval stage.

During the second year they were found in the galleries and mines of secondary borers. Overwintered again in immature larval stage, pupating in the spring. Whether this was the exception or the rule is yet to be determined, although some unfinished observations in connection with *Scolytus 4-spinosus* were very similar.

First pupae observed May 12 to 15 (Connecticut and New York) in trees abandoned by barkborers previous June.

*C. pilosa* does not construct a special pupal cell, but utilizes the gallery or cell of a wood borer. The pupae are bare in the cell.

Distribution: Eastern half of the United States.

Observations made by most of the attachés of the forest insect branch.

**Genus PELONIUM** Spinola.

**PELONIUM LEUCOPHAEUM** Klug.

Reared from branches of *Taxodium* containing young larvae of Cerambycidae; also from section of small cypress. Adult collected flying about cut branches of juniper containing Cerambycid larvae November 21. Observations by W. F. Fiske.

Genus GALERUCLERUS Gahan (*CREGYA*).

## GALERUCLERUS OCULATUS Say.

Is a predator on Scolytoids and secondary wood borers in conifers and deciduous trees. *Scolytus* infesting *Pinus rigida*; *Pogonocherus* infesting *Pinus rigida*; *Liopus* and *Scolytoids* in *Rhus*; *Liopus* in Virginia creeper.

Adults taken at trap lantern in May, also by sweeping low herbage.

Larvae were observed at Westbury, Long Island, New York, in Pitch Pine stems. Tops attacked by *Pityophthorus*, bases by *Pogonocherus*. Clerid larvae were found in the *Pityophthorus* mines and in the cells of *Pogonocherus*. The latter were utilized as pupal chambers. The pupal cell was slightly lined with the frothy exudation and the frass at each end of the cell was cemented together.

Recorded from Pennsylvania, New York, West Virginia, District of Columbia, North Carolina.

Observations by Hopkins, Fiske, Van Horn, Champlain.

## Genus ORTHOPLEURA Spinola.

## ORTHOPLEURA DAMICORNIS Fabricius (not Klug).

Is predaceous on borers in dead and dying deciduous trees. Reared from chestnut and oak infested with *Chrysobothris femorata*; oak infested with *Neoclytus longpipes*; sassafras infested with *Curculionids*; ash infested with *Obrium*; hickory, grape, locust, and persimmon infested with secondary borers; and red oak infested with *Tillamorpha geminata*.

Adults are nocturnal; may be observed at night on infested trees, April to July; at arc lights, or taken in trap lanterns. Usually hide during daytime in crevices and beneath bark.

Larvae occur in the galleries and mines of host. In a note by W. F. Fiske, made April 20, 1904, at Tryon, North Carolina, he writes: "Newly hatched Clerid larva found to-day attached to *Chrysobothris femorata* larva."

Distribution: Virginia, Pennsylvania, North Carolina, Georgia, Maryland.

Observations by Hopkins, Fiske, Craighead, Kirk, Champlain.

## Genus ENOPLIUM Latreille.

## ENOPLIUM QUADRIPUNCTUM Say.

Bred from dead black walnut branches by A. D. Hopkins, Wood County, West Virginia, April, 1890.

## PART III.

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## PART IV.

EXPLANATION OF PLATES.<sup>1</sup>

- |  |   |
|--|---|
| <i>A 1</i> .....First abdominal segment.   | <i>I S</i> .....Intersegmental membrane, containing prescutal, epipleural, and poststernellar elements. |
| <i>A 2</i> .....Second abdominal segment.  | <i>l</i> .....Labrum.   |
| <i>aa</i> .....Alar area.  | <i>la</i> .....Mala maxillae.   |
| <i>af</i> .....Angulus frontalis.  | <i>lig</i> .....Ligula (or mala labii).   |
| <i>Amp</i> .....Ampulla (fig. 112).  | <i>lin</i> .....Lingua (fig. 31).   |
| <i>apx</i> .....Apex of mandible (fig. 48).  | <i>ln</i> .....Lateral nodus (=lateral notch).  |
| <i>bm</i> .....Basal membrane of antenna.  | <i>isl</i> .....Laterosternellum.   |
| <i>bp</i> .....Basal plate of cerci (figs. 79 and 121).  | <i>m</i> .....Mentum.   |
| <i>c</i> .....Clypeus.   | <i>md</i> .....Mandible.  |
| <i>ca</i> .....Cardo maxillae.   | <i>mh</i> .....Maxillary, anterior margin of hypostoma.   |
| <i>cer</i> .....Cercus.  | <i>mstl</i> .....Mediosternellum.   |
| <i>cond</i> .....Condyle below angulus frontalis for dorsal articulation of the mandible (fig. 116). | <i>Ms</i> .....Mesothorax.  |
| <i>cox</i> .....Coxa.  | <i>Mstg</i> .....Mesotergite.   |
| <i>dl</i> .....Dorso-lateral suture.   | <i>Mt</i> .....Metathorax.  |
| <i>dn</i> .....Dorsal nodus (=dorsal notch).   | <i>Mttg</i> .....Metatergite.   |
| <i>ecr</i> .....Epicranium.  | <i>oc</i> .....Ocellus.   |
| <i>el</i> .....Epipleural lobe.  | <i>pa</i> .....Parascutum.  |
| <i>ep</i> .....Epistoma.   | <i>pas</i> .....Parasternum.  |
| <i>epx</i> .....Epipharynx (fig. 116).   | <i>pe</i> .....Preepipleurum.   |
| <i>epxp</i> .....Epipharyngeal plate (fig. 116).   | <i>pgc</i> .....Chitinization of palpiger maxillae (fig. 32).   |
| <i>er</i> .....Epipharyngeal rod (fig. 116).   | <i>pgm</i> .....Palpiger maxillae.  |
| <i>es</i> .....Eusternum (=Basisternum).   | <i>plg</i> .....Palpiger labii.   |
| <i>f</i> .....Frons.   | <i>pgu</i> .....Paragular plate.  |
| <i>fe</i> .....Femur.  | <i>ph</i> .....Prehypopleurum.  |
| <i>fil</i> .....Supplementary, jointlike appendix on second antennal joint.                          | <i>pli</i> .....Palpus labii.   |
| <i>fs</i> .....Frontal suture.   | <i>pls</i> .....Pleurostoma.  |
| <i>g</i> .....Longitudinal groove of mandible (fig. 48).   | <i>pmx</i> .....Palpus maxillae.  |
| <i>gu</i> .....Gula.   | <i>pn</i> .....Pleural nodus (=pleural notch).  |
| <i>gus</i> .....Gular suture.  | <i>poe</i> .....Postepipleurum.   |
| <i>hp</i> .....Hypopleurum.  | <i>poñ</i> .....Posthypopleurum.  |
| <i>hr</i> .....Hypopharyngeal rod (fig. 31).   | <i>pos</i> .....Postscutellum.  |
| <i>hs</i> .....Hypopleural suture.   | <i>post</i> .....Poststernellum.  |
| <i>hy</i> .....Hypopharynx (fig. 31).  |   |

<sup>1</sup> Drawings by Adam G. Böving.

<i>pres</i> _____	Preeusternum.	<i>sp</i> _____	Spiracle.
<i>Pr</i> _____	Prothorax.	<i>st</i> _____	Stipes maxillae.
<i>Prtg</i> _____	Prothoracic tergal region.	<i>stl</i> _____	Sternellum.
<i>pse</i> _____	Prescutum.	<i>stp</i> _____	Sternal plate.
<i>pst</i> _____	Presternum.	<i>ta</i> _____	Tarsus.
( <i>pst</i> 1-3_	Presterna pertaining to the thoracic segments.	<i>tb</i> _____	Tentorial bridge (?) (fig. 31).
<i>pst</i> 4-5_	Presterna pertaining to the abdominal segments.)	<i>tea</i> _____	Tentorial arm (fig. 31).
<i>r</i> _____	Retinaculum of mandible (fig. 48).	<i>tib</i> _____	Tibia.
<i>sc</i> _____	Scutum.	<i>tro</i>	Trochanter.
<i>scl</i> _____	Scutellum.	<i>vl</i> _____	Ventro-lateral suture.
<i>sc-scl</i> _____	Scuto-scutellar suture.	<i>vn</i> _____	Ventral nodus (= ventral notch).
<i>sli</i> _____	Stipes labii (with palpiger labii, <i>plg</i> , and mala labii, <i>lig</i> .)	<i>I</i> _____	First or proximal joint of antenna.
<i>sm</i> _____	Submentum.	<i>II</i> _____	Second joint of antenna.
<i>sn</i> _____	Sternal nodus (= sternal notch).	<i>III</i> _____	Third or apical joint of antenna.

## PLATE 42.

STRUCTURAL DETAILS OF LARVAE OF FAMILY CLERIDAE. SLIGHTLY DIAGRAMMATIC.

- FIG. 1. Ventral view.  
 2. Lateral view.  
 3. Dorsal view.

## PLATE 43.

LATERAL VIEW OF HEAD STRUCTURES.

- FIG. 4. *Enoclerus sphegeus*.  
 5. *Chariessa pilosa*.  
 6. *Phyllobaenus dislocatus*.  
 7. *Neichnea laticornis*.  
 8. *Trichodes ornatus*.  
 9. *Tarsostenus univittatus*.  
 10. *Cymatodera undulata*.  
 11. *Cymatodera morosa*.  
 12. *Orthopleura damicornis*.  
 13. *Monophylla terminata*.  
 14. *Priocera castanea*.  
 15. *Thaneroclerus girodi*.  
 16. *Hydnocera verticalis*.

## PLATE 44.

DORSAL VIEW OF HEAD STRUCTURES.

- FIG. 17. *Enoclerus ichneumoneus*.  
 18. *Enoclerus muttkowskii*.  
 19. *Enoclerus sphegeus*.  
 20. *Chariessa pilosa*.  
 21. *Phyllobaenus dislocatus*.  
 22. *Neichnea laticornis*.  
 23. *Trichodes ornatus*.  
 24. *Cymatodera morosa*.

- FIG. 25. *Tarsostenus univittatus*.  
 26. *Orthopleura damicornis*.  
 27. *Monophylla terminata*.  
 28. *Priocera castanea*.  
 29. *Thaneroclerus girodi*.  
 30. *Hydnocera verticalis*.

PLATE 45.

VENTRAL VIEW OF HEAD STRUCTURES.

- FIG. 31. *Enoclerus ichneumoneus*:  
*hr*, Hypopharyngeal rod; *hy*, Hypopharynx (buccal surface above mentum and submentum); *lig*, Ligula (malae labii); *lin*, Lingua (buccal surface of labium); *s*, Maxillary buccal tooth; *tea*, tentorial arm; *tb* Tentorial bridge (?).  
 32. *Enoclerus sphegeus*.  
*pge*, Chitinization of palpiger maxillae.  
 33. *Chariessa pilosa*.  
 34. *Phyllobaenus dislocatus*.  
 35. *Neichnea laticornis*.  
 36. *Trichodes ornatus*.  
 37. *Tarsostenus univittatus*.  
 38. *Cymatodera morosa*.  
 39. *Orthopleura damicornis*.  
 40. *Monophylla terminata*.  
 41. *Priocera castanea*.  
 42. *Thaneroclerus girodi*.  
 43. *Hydnocera verticalis*.

PLATE 46.

MANDIBLES.

- FIG. 44. *Thanasimus formicarius*, dorsal view.  
 45. *Thanasimus dubius*, dorsal view.  
 46. *Thanasimus formicarius*, ventral view.  
 47. *Enoclerus ichneumoneus*, ventral view.  
 48. *Enoclerus quadrisignatus*, ventral view.  
*apx*, apex of mandible; *g*, groove along cutting edge (= caverna partis scissorlae); *r*, retinaculum (larger posterior tooth of cutting edge.)  
 49. *Enoclerus quadriguttatus*, ventral view.  
 50. *Enoclerus rosmarus*, ventral view.  
 51. *Enoclerus muttkowskii*, ventral view.  
 52. *Enoclerus sphegeus*, ventral view.  
 53. *Chariessa pilosa*, ventral view.  
 54. *Phyllobaenus dislocatus*, ventral view.  
 55. *Neichnea laticornis*, ventral view.  
 56. *Trichodes ornatus*, ventral view.  
 57. *Tarsostenus univittatus*, ventral view.  
 58. *Cymatodera morosa*, ventral view.  
 59. *Orthopleura damicornis*, ventral view.  
 60. *Monophylla terminata*, retinaculum.  
 61. *Priocera castanea*—(a) ventral view; (b) dorsal view.  
 62. *Thaneroclerus girodi*, ventral view.  
 63. *Hydnocera verticalis*, ventral view.

## PLATE 47.

## LATERAL VIEW OF CERCI.

- FIG. 64. *Enoclerus ichneumoncus*.  
 65. *Enoclerus quadrisignatus*.  
 66. *Enoclerus quadriguttatus*.  
 67. *Enoclerus rosmarus*.  
 68. *Enoclerus muttkowskii*.  
 69. *Enoclerus spegeus*.  
 70. *Chariessa pilosa*.  
 71. *Phyllobaenus dislocatus*.  
 72. *Neichnea laticornis*.  
 73. *Trichodes ornatus*.  
 74. *Tarsostenus univittatus*.  
 75. *Monophylla terminata*.  
 76. *Priocera castanea*.  
 77. *Orthopleura damicornis*.  
 78. *Thaneroclerus girodi*.

## PLATE 48.

## DORSAL VIEW OF CERCI (EXCEPT FIGURES 87 AND 88, WHICH GIVE THE VENTRAL VIEW).

- FIG. 79. *Thanasimus formicarius*.  
*bp*, basal plate carrying the cerci; *cer.* cercus.  
 80. *Thaneroclerus dubius*.  
 81. *Enoclerus ichneumoncus*.  
 82. *Enoclerus quadrisignatus*.  
 83. *Enoclerus quadriguttatus*.  
 84. *Enoclerus rosmarus* (outline drawing).  
 85. *Enoclerus muttkowskii*.  
 86. *Enoclerus spegeus* (outline drawing; *cfr.* fig. 121).  
 87. *Chariessa elegans*, ventral view of cerci.  
 88. *Chariessa pilosa*, ventral view of cerci.  
 89. *Chariessa pilosa*, dorsal view of cerci.  
 90. *Phyllobaenus dislocatus*.  
 91. *Neichnea laticornis*.

## PLATE 49.

## DORSAL VIEW OF CERCI.

- FIG. 92. *Trichodes ornatus*.  
 93. *Tarsostenus univittatus*.  
 94. *Cymatodera undulata* (outline drawing).  
 95. *Cymatodera morosa*.  
 96. *Cymatodera inornata* (outline drawing).  
 97. *Monophylla terminata*.  
 98. *Priocera castanea*.  
 99. *Orthopleura damicornis*.  
 100. *Thaneroclerus girodi*; first stage larva.  
 101. *Thaneroclerus girodi*; mature larva.  
 102. *Hydnocera verticalis*.

## PLATE 50.

## LATERAL VIEW OF LARVA.

- FIG. 103. *Thanasimus formicarius*.  
 104. *Enoclerus spegeus*.  
 105. *Trichodes ornatus*.

PLATE 51.

LATERAL VIEW OF LARVA.

- FIG. 106. *Neichnea laticornis*.  
 107. *Tarsostenus univittatus*.  
 108. *Orthopleura damicornis*.  
 109. *Monophylla terminata*.  
 110. *Priocera castanea*.

PLATE 52.

DORSAL VIEW OF LARVA.

- FIG. 111. *Thanasimus formicarius*.  
 112. *Chariessa pilosa*.  
 113. *Thaneroclerus girodi*.  
 114. *Cymatodera morosa* (color pattern indicated).

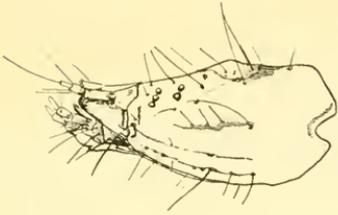
PLATE 53.

MISCELLANEOUS STRUCTURES.

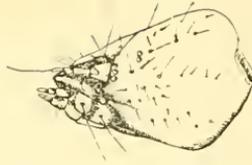
- FIG. 115. *Enoclerus sphegeus*; dorsal view of head, thorax, and the two first abd. segments.  
 116. *Enoclerus sphegeus*; view from buccal cavity.  
*cond.*, Condyle below angulus frontalis for dorsal articulation of mandible; *epx*, Epipharynx; *epxp*, Epipharyngeal plate; *er*, Epipharyngeal rod; *f*, Underside of frontal shield.  
 117. *Enoclerus quadrisignatus*; left maxilla with, as seen from buccal cavity, dorsal membranous walls of stipes and cardo removed.  
*s*, maxillary buccal tooth.  
 118. *Hydnocera verticalis*; ventral view of ventral mouth parts.  
 119. *Enoclerus sphegeus*; Posterior angle of frontal shield from the underside. *eca*, frontal endocarina.  
 120. *Hydnocera verticalis*; right antenna from above.  
 121. *Enoclerus sphegeus*; dorsal view of 7th, 8th, and 9th abdominal segments.  
 122. *Thanasimus formicarius*; ventral view.  
 123. *Phyllobaenus dislocatus*; dorsal view.  
 124. *Cymatodera morosa*; annular spiracles of the mesothoracic and third abdominal segments.  
 125. *Enoclerus ichneumonoides*; the pseudoannular spiracles of the mesothoracic and third abdominal segments, and the bifore spiracle of eighth abdominal segment.  
 126. *Thaneroclerus girodi*; bifore spiracles of the mesothoracic and third abdominal segments.  
 127. *Phyllobaenus dislocatus*; ventral view of the three thoracic and two first abdominal segments. *stp*, Prothoracic sternal plate.  
 128-132. Lateral view of left leg of the third pair.  
 128. *Trichodes ornatus*.  
 129. *Neichnea laticornis*.  
 130. *Cymatodera morosa*.  
 131. *Orthopleura damicornis*.  
 132. *Hydnocera verticalis*.  
 133. *Phyllobaenus dislocatus*; dorsal view of 7th, 8th, and 9th abdominal segments.



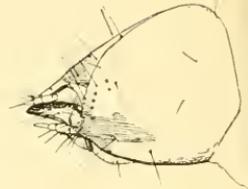




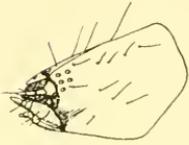
4 *Enoclerus sphaeus*



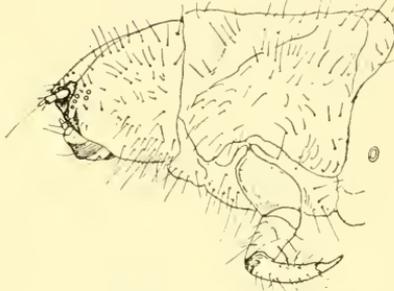
5. *Chariessa pilosa*



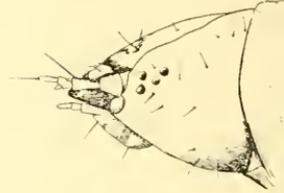
6 *Phyllobaenus*



7. *Neichnea*



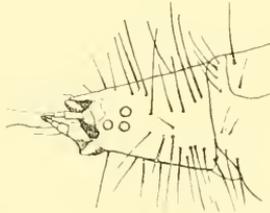
8. *Trichodes ornatus*



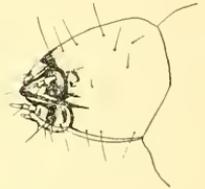
9 *Tarsostenus*



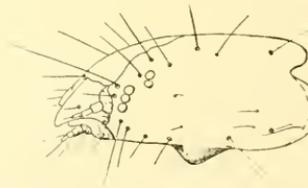
10. *Cymatodera*



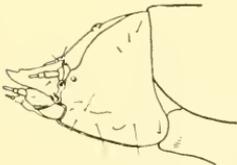
11 *Cymatodera morosa*



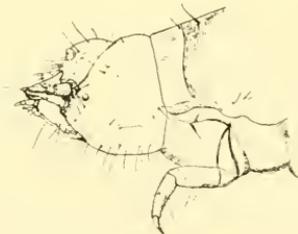
12. *Orthopleura*



15. *Phaneroclerus*



13 *Monophylla*



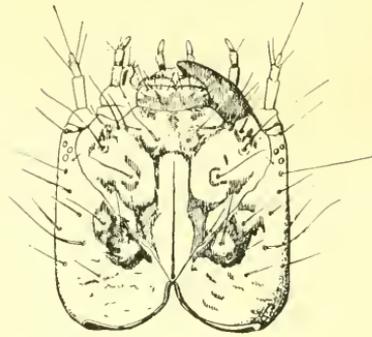
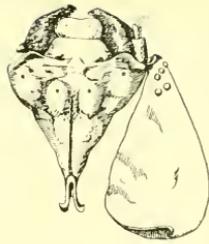
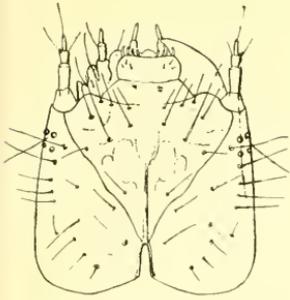
14 *Proccera*



16 *Hydnocera*

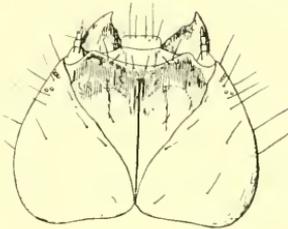
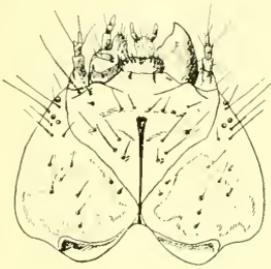
LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 646.



18 *Enoclerus ichneumonaeus* 18 *Muttkowskii*

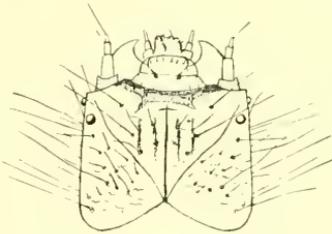
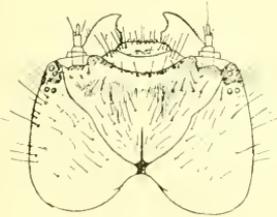
19 *Enoclerus sphaeus*



20 *Chariessa pilosa*

21 *Phyllobaenus dislocatus*

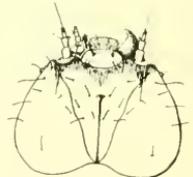
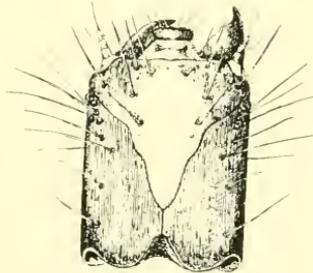
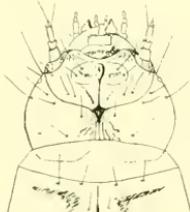
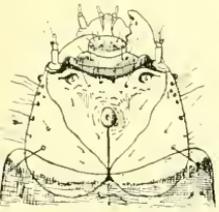
22 *Neichonea*



23 *Trichodes ornatus*

24 *Cymalodera morosa*

25 *Tarsostenus*



27 *Monophylla*

28 *Priocera*

29 *Thamerocterus*

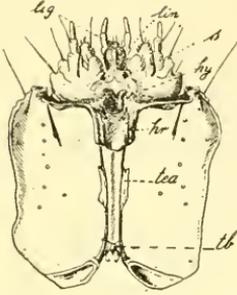
26 *Ortholeura*



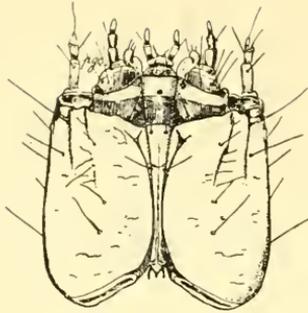
30 *Hydrocera*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

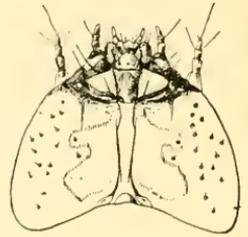
FOR EXPLANATION OF PLATE SEE PAGES 646 AND 647.



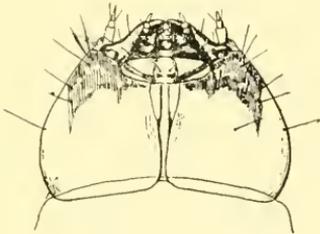
31 *Enocherus ichneumoncus*



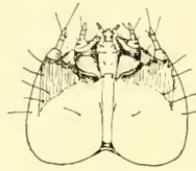
32 *Enocherus sphegeus*



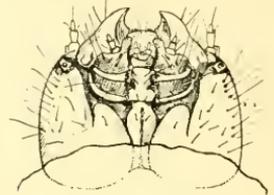
33 *Chariessa pilosa*



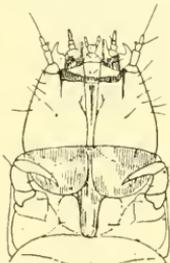
34 *Phyllobaenus*



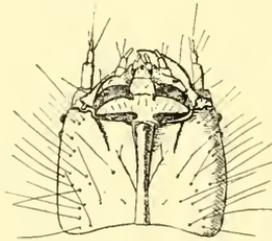
35 *Neichmea*



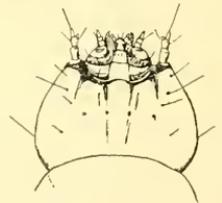
36 *Trichodes ornatus*



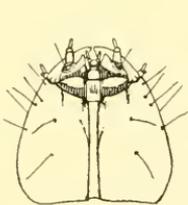
37 *Farsostenus*



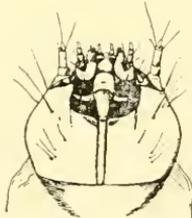
38 *Cymatodera morosa*



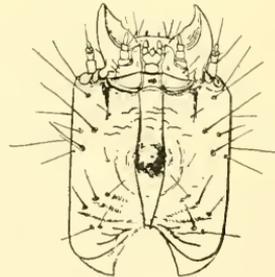
39 *Orthopleura*



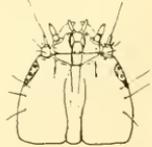
40 *Monophylla*



41 *Priocera*



42 *Thameroclerus*



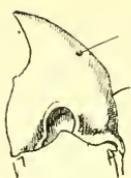
43 *Hylodocora*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

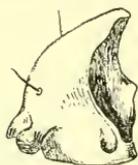
FOR EXPLANATION OF PLATE SEE PAGE 647.



44. *Thanosimus formicarius*



45. *dubius*



46. *formicarius*



47. *Enoclerus ichneumonius*



48. *quadrisignatus*



49. *quadrigulatus*



50. *rosmarus*



51. *mullkowskii*



52. *Enoclerus sphegus*



53. *Chariessa*



54. *Phyllobaenus*



55. *Neichnea*



56. *Trichodes*



57. *Tarsostenus*



58. *Cymatodera morosa*



59. *Orthopseura*



60. *Monophylla*



61. *Priocera*



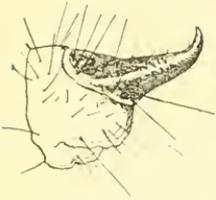
62. *Thanoeroderus*



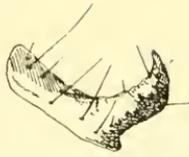
63. *Hydnocera*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

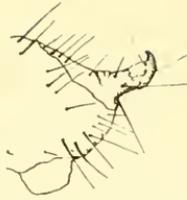
FOR EXPLANATION OF PLATE SEE PAGE 647.



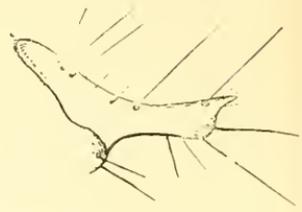
64. *Enoclerus ichneumonius*



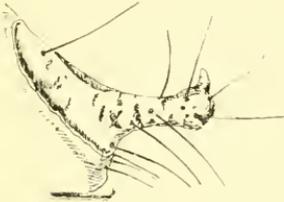
65 *quadri-*  
*signatus*



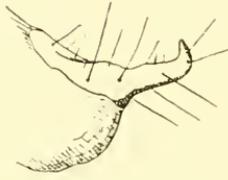
66 *quadrigut-*  
*tatus*



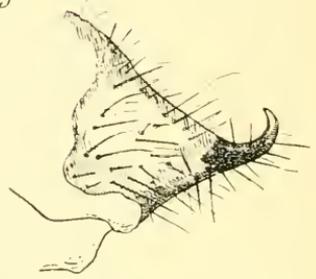
67. *rosmarus.*



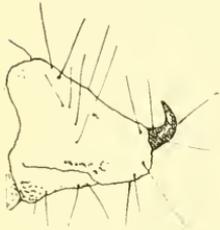
68. *muttkowskii*



69. *sphegeus*



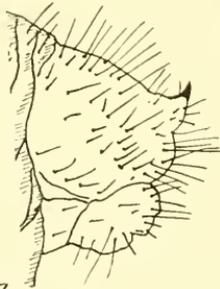
70 *Charussia pilosa*



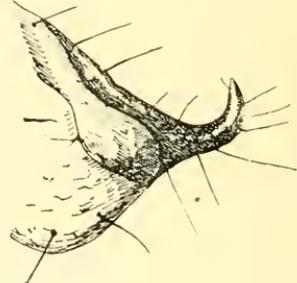
71 *Phyllobaenus*  
*dislocatus*



72 *Neichnea*



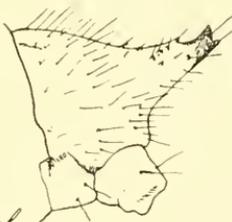
73 *Trichodes*



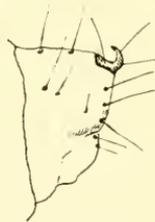
74 *Tarsosterus*



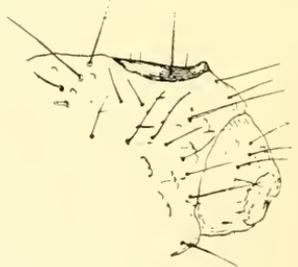
75. *Monophyl-*  
*la terminata*



76. *Priocera*



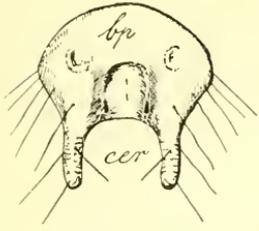
77. *Orthopleura*



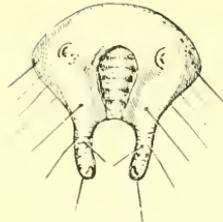
78. *Thanooclerus*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

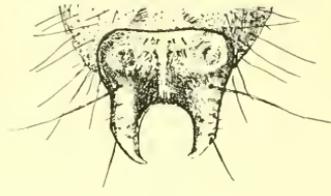
FOR EXPLANATION OF PLATE SEE PAGE 648.



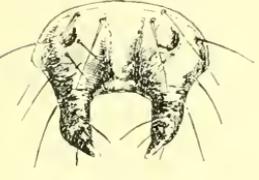
79 *Francosinus fornicarius*



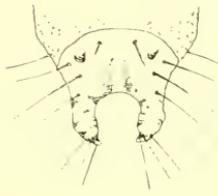
80 *dubius*



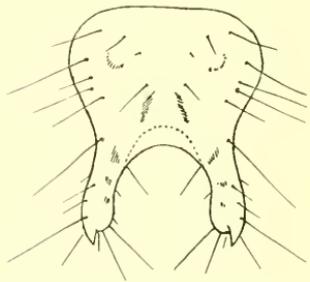
81 *Enoclerus ichneumonius*



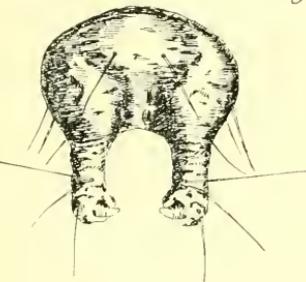
82 *quadrisignatus*



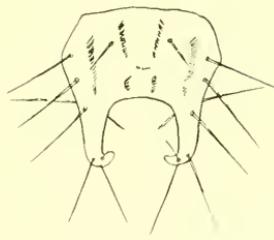
83 *quadriguttatus*



84 *rosmarus*



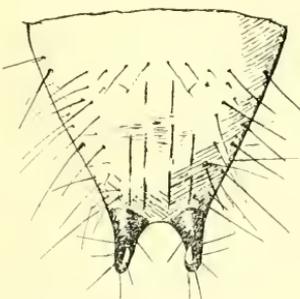
85 *mutzkowskii*



86 *Enoclerus sphegeus*



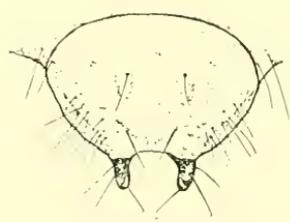
87 *Chariessa elegans*



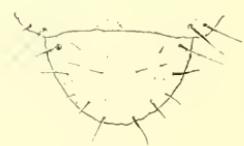
89 *Chariessa pilosa*



88 *Chariessa pilosa*



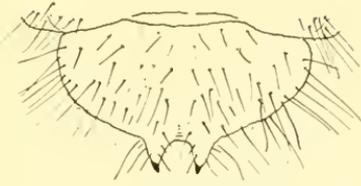
90 *Phyllobaenus distocatus*



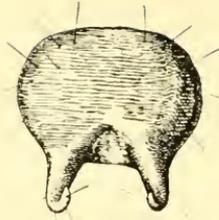
91 *Neichnea*

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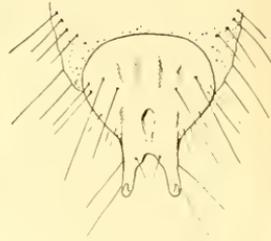
FOR EXPLANATION OF PLATE SEE PAGE 648.



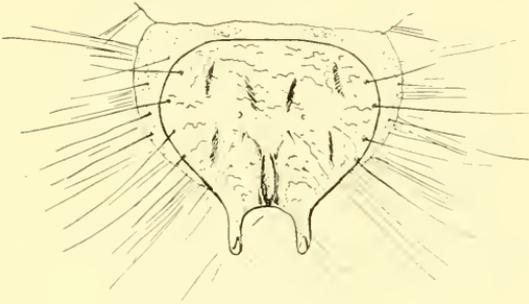
92. *Trichodes ornatus*



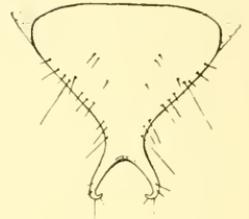
93 *Tarsostenus*



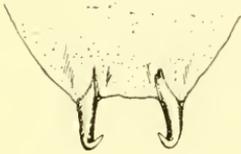
94 *Cymalodera*



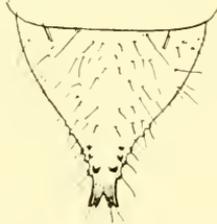
95 *Cymalodera morosa*



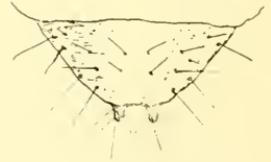
96 *Cymalodera inornata*



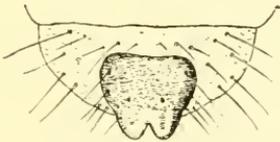
97. *Monophylla terminata*



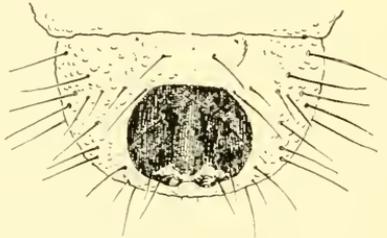
98 *Priocera castanea*



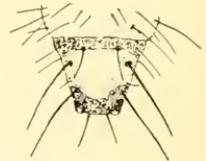
99 *Orthopleura damicornis*



100 *Thaneroclerus girodi*



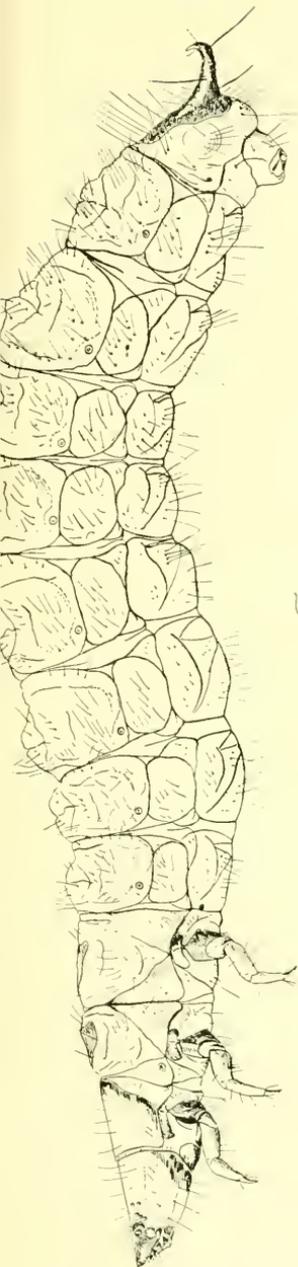
101. *Thaneroclerus girodi*



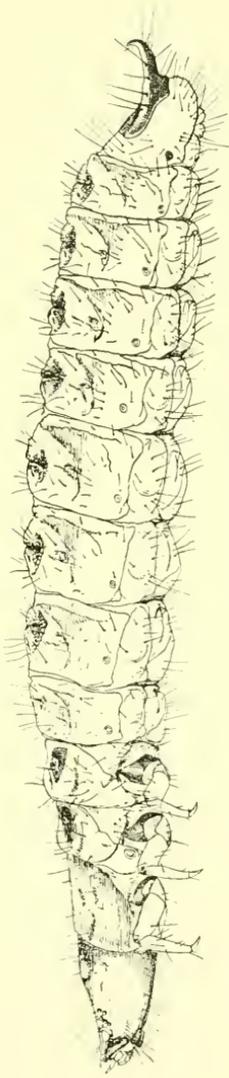
102 *Hydnoera*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

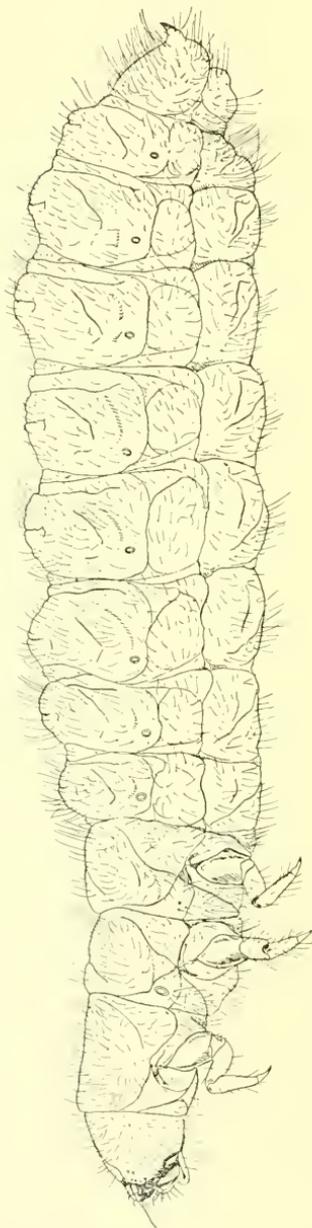
FOR EXPLANATION OF PLATE SEE PAGE 618.



103. *Thanasimus formicivorus*



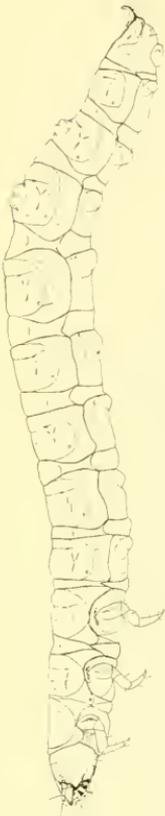
104. *Enoclerus spicatus*



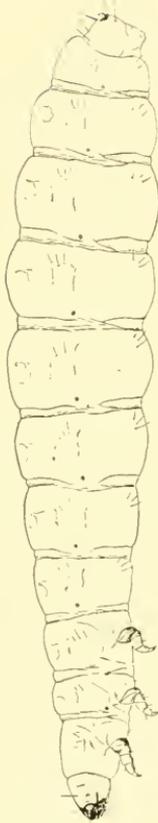
105. *Trichodes ornatus*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

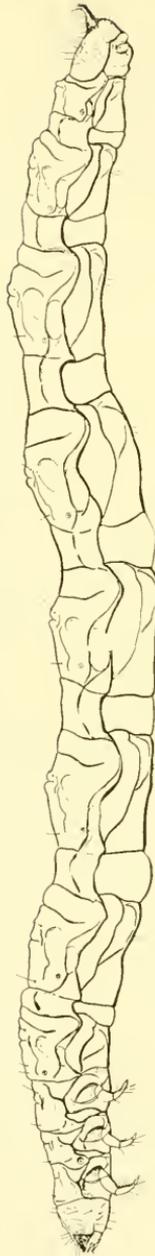
FOR EXPLANATION OF PLATE SEE PAGE 618.



107 *Tarsostenus univittatus*



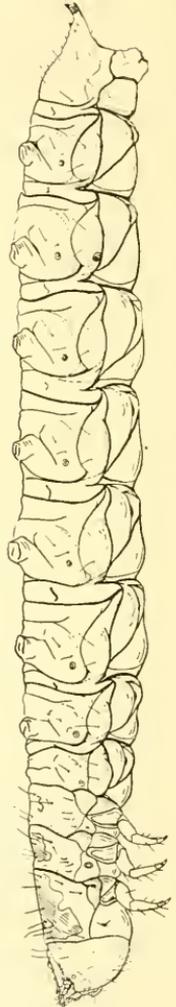
108 *Colopluera damicornis*



109 *Menophylla lominata*



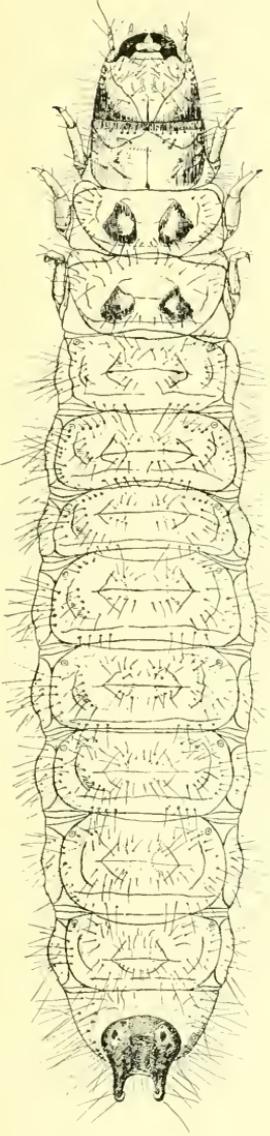
110 *Nictineta talicornis*



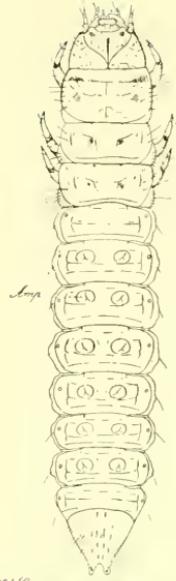
111 *Tricoma castanea*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

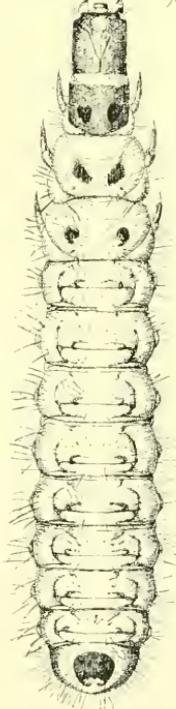
FOR EXPLANATION OF PLATE SEE PAGE 649.



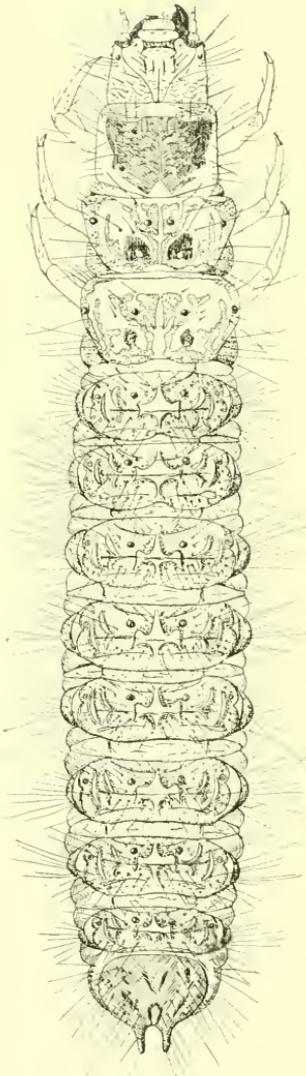
111 *Tharsomus formicarius*



112 *Tharsomus pilosa*



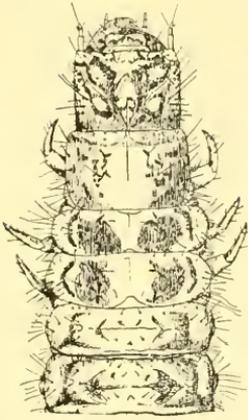
113 *Tharsomus -clerus*



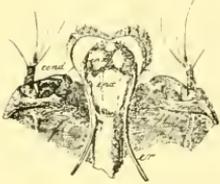
114 *Gynaloderia mucronata*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 649.



115 *Enoclerus sphegus*



116 *Enoclerus sphegus*



117 *Enoclerus quadrisignatus*



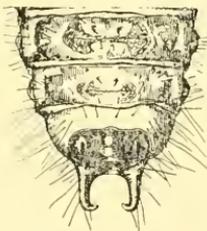
118 *Hydrocera*



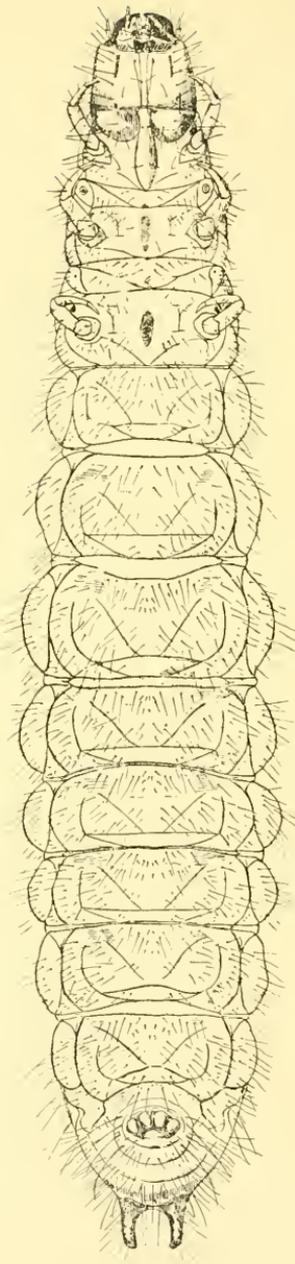
119 *Sphegus*



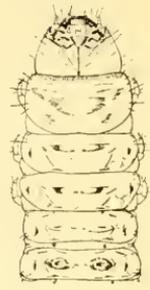
120 *Hydrocera*



121. *Enoclerus sphegus*



122. *Thanastmus formicarius*



123 *Phyllobaenus asteratus*



124 *Cymalotera morosa*



125 *Enoclerus ichneuomenus*



126. *Thanoreoclerus girardi*



127. *Phyllobaenus*



125 *Trichodes*



129 *Nischneia*



130. *Cymalotera*



131 *Orthopleura*



132 *Hydrocera*



133 *Phyllobaenus*

LARVAE OF THE NORTH AMERICAN BEETLE FAMILY CLERIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 549.