

# ~~Larvae~~ of Geotrupinae

With Keys to Tribes and Genera  
(Coleoptera: Scarabaeidae)

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# Larvae of Geotrupinae with Keys to Tribes and Genera (Coleoptera: Scarabaeidae)

By P. O. RITCHER

The scarabaeid subfamily Geotrupinae, as shown by a study of the larvae, includes 4 tribes and a number of very distinct genera of laparostict beetles. The group consists of the tribes Geotrupini and Lethrini, which show affinities with the Coprinae; the tribe Pleocomini, which shows some affinities with the Melolonthinae; and the tribe Bolbocerini, which occupies an intermediate position.

Several geotrupid genera, such as *Bolboceras* and *Geotrupes*, are nearly world-wide in distribution, while the tribe Lethrini is confined almost entirely to southeastern Europe and southwestern Asia (Boucomont, 1912). Another tribe, the Pleocomini, here included in the Geotrupinae, is restricted to western North America (Davis, 1934, and Linsley, 1938). In the United States the subfamily is represented by some 65 species belonging to 6 genera.

Adult geotrupids range from 5 to about 45 mm in length, are oval to round, and are often strongly convex dorsally. The head often bears a median horn on the clypeus. Adult colors usually range from yellowish brown, orange-brown, reddish brown, and brown to black but some species are blue, green, purple, or metallic bronze.

The biologies of the various genera and species are quite diverse and not too well known, some being saprophagous, some mycetophagous, and some feeding on the shoots or roots of living plants. Adults of many genera are nocturnal and frequently attracted to lights. Males of the peculiar genus *Pleocoma* fly in the rain or following soaking rains or melting of heavy snow. Much of the adult life of all geotrupids is spent in burrows in the soil.

The diversity of structure both in adults and larvae has led to differences of opinion as to the exact systematic position of the group and the genera here assigned to it. Most writers agree that the tribes Bolbocerini, Lethrini, and Geotrupini belong together. Gerstaecker (1883) disputed the position of the genus *Pleocoma*, but it has been the general concensus of opinion that it belongs in a separate subfamily closely related to the geotrupids (Horn, 1883 and 1888; Leng, 1920; Davis, 1934; and Ritcher, 1947). Paulian (1941), on the basis of adult structures, concluded that *Pleocoma* is a geotrupid genus. The writer's recent studies of hitherto unknown geotrupid larvae support that view.

The bizarre larva of *Geotrupes* with its peculiar legs and mandibles has been known for many years. Study of this odd genus has influenced all subsequent treatment of the entire group and several writers have even made a separate family Geotrupidae (Boving and Craighead, 1930-31, and Paulian, 1939). The fact that larvae of several other geotrupid genera, and even of one genus in the same tribe as *Geotrupes*, have neither greatly reduced metathoracic legs nor stridulating organs on the legs (van Emden, 1941) makes such separation from the Scarabaeidae untenable.

*Geotrupes* larvae have been described by Schiodte (1874), Paulian (1939), and others. The rather closely related larva of *Typhoeus* was described by van Emden in 1941 while Golovianko (1936) described the larva of *Lethrus*. *Pleocoma* larvae were described by Osten Sacken (1874-76) and Ritcher (1947) and included in the key of Boving and Craighead (1930-31). Larvae of the tribe Bolbocerini, however, have been completely unknown. Through the courtesy of the U. S. National Museum and Milton W. Sanderson of the Illinois State Natural History Survey, 3 genera of this tribe, *Odontaeus*, *Bolbocerosoma*, and *Eucanthus* are described here for the first time.

In this bulletin the subfamily Geotrupinae is characterized and keys are presented for separating tribes and genera, based on characters of the larvae. A technical description is given of the third-stage larva of each genus, and species where known, followed by a brief account of the biology. To make the study more complete, several descriptions of geotrupid larvae from other parts of the world are included. This paper is the seventh in a series dealing with various groups of the family Scarabaeidae. Papers on the genus *Phyllophaga* and the subfamilies Rutelinae, Dynastinae, Cetoniinae, and Coprinae have been published (Ritcher, 1940, 1943, 1944, and 1945).

### SUBFAMILY GEOTRUPINAE

The subfamily Geotrupinae (including the genus *Pleocoma*) may be characterized as follows: Antenna 3-segmented, with the penultimate segment bearing one or more distal sense organs and the last segment reduced in diameter. Epipharynx usually trilobed with symmetrical tormae. Terga of abdominal segments 3 to 7 with 2 or 4 dorsal annulets. Anal opening often V- or Y-shaped, in some genera surrounded by fleshy lobes. Legs 2-segmented (*Odontaeus*), 3-segmented, or 4-segmented (*Bolbocerosoma* and *Pleocoma*). Mesothoracic and metathoracic legs often with stridulating organs (*Odontaeus*, *Geotrupes*, and *Pleocoma*); metathoracic legs sometimes greatly reduced in size (*Geotrupes*).

## KEY TO TRIBES

1. Last abdominal segment slantingly, flattened (Figs. 1 and 3) and with conspicuous lateral callosities (Figs. 44, 45, 47, and 48). Hypopharyngeal oncyli asymmetrical (Fig. 32).....2
  - Last abdominal segment rounded posteriorly (Figs. 5, 7, and 8) and without conspicuous lateral callosities (Figs. 46, 49, and 50). Hypopharyngeal oncyli, when present, symmetrical (Figs. 30, 33 and 34).....3
2. Anal opening surrounded by a flap-like dorsal anal lobe and a pair of ventral anal lobes (Figs. 44, 45, and 47).....*Geotrupini*
  - Anal opening surrounded by 6 simple radiating rays (Fig. 48) .....*Lethrini*
3. Abdominal segments 3 to 7 with 2 dorsal annulets (Figs. 5, 7, and 9). Legs without fossorial setae (Figs. 25 and 29). Clypeo-frontal suture absent (Figs. 13-15). Epipharynx with phobae distad of the tormae but without plegmatia or heli (Figs. 41 to 43). Hypopharynx with oncyli (Figs. 30, 33, and 34) .....*Bolbocerini*
  - Abdominal segments 3 to 7 with 4 dorsal annulets (Figs. 8 and 10). Legs with fossorial setae (Fig. 35). Clypeo-frontal suture present (Fig. 12). Epipharynx without phobae distad of the tormae but with prominent plegmatia and heli (Fig. 39). Hypopharynx without oncyli (Fig. 37).....*Pleocomini*

## KEY TO GENERA OF THE TRIBE GEOTRUPINI

1. Mesothoracic and metathoracic legs with stridulating organs (Figs. 24 and 28). Metathoracic legs greatly reduced in size (Figs. 1 and 24).....genus *Geotrupes*
  - Mesothoracic and metathoracic legs without stridulating organs. Legs similar in size.....genus *Typhoeus*

*Geotrupes blackburni* (Fab.), Third-Stage Larva  
(Figs. 1, 11, 22, 23, 24, 28, 32, 40, and 45)

Description based on the following material.

1. Cast skin of third-stage larva found in pupal cell with adult. Adult and associated skin dug from pasture soil, November 30, 1942, near Lexington, Kentucky, by P. O. Ritcher. Adult identified by Chapin.
2. Five third-stage larvae dug June 24, 1943, at Lexington, Kentucky, by P. O. Ritcher, from the soil of cage in which 20 adults were put March 27, 1943, and supplied with fresh cow manure. No. 43—15A.
3. One third-stage larva dug June 7, 1944, at Lexington, Kentucky, by P. O. Ritcher from soil of cage in which adults were put May 8, 1944, and supplied with fresh cow manure. No. 44—7K.
4. Seven third-stage larvae dug in June, 1945, at Lexington, Kentucky, by P. O. Ritcher from soil of cage in which adults were put in May, 1945, and supplied with fresh cow manure. No. 45—3J.

Maximum width of head capsule 3.9 to 4.6 mm. Surface of cranium yellow-brown, shining, and vaguely wrinkled. Frons on each side with 1 posterior frontal seta or none, 3 to 5 setae in each anterior angle, a single (rarely 2) exterior frontal seta and 1 or 2 anterior frontal setae (Fig. 11). Clypeo-frontal suture absent. Labrum trilobed, wider than long; clypeus somewhat asymmetrical. Antenna fairly long, 3-segmented. First antennal segment the longest, cylindrical. Second antennal segment clavate. Third antennal segment cylindrical, much reduced in diameter. Penultimate segment distally with a single hemispherical sense organ. Mandibles (Figs. 22 and 23) with nearly symmetrical scissorial areas but asymmetrical molar areas. Each scissorial area with a rather narrow bladelike portion separated from a posterior toothlike portion by the scissorial notch. Inner margin of mandible between scissorial and molar areas with a prominent bifurcate process. Grinding surface of left molar area strongly concave, overhung proximally by an acia; grinding surface of right molar area rather flat. Maxillary stridulating area (Fig. 32) consisting of a sparsely set row of 5 to 7 conical teeth on each stipes and a similar row of 3 to 5 teeth along the posterior margin of the palpifer. Hypopharynx with 2 well-developed oncyli which are strongly asymmetrical. Glossa emarginate. Epipharynx (Fig. 40) very similar to that of coprinid larvae with tormae united mesally, posterior and anterior epitormae present, and phobae surrounding the pedium. Pedium covered with spicules. Each chaetoparia with 12 or more chaetae. Respiratory plates of spiracles (Fig. 1) crescent-shaped with concave margins facing ventrally or slightly cephalad. Spiracles cribriform. Respiratory plates with a great many small "holes" arranged in a large number of definite transverse rows. Spiracles of eighth abdominal segment much smaller than those of abdominal segments 1 to 7 inclusive.

Body (Fig. 1) swollen posteriorly with swollen anal lobes protruding on each side of the last abdominal segment. Dorsa of abdominal segments 1 to 8 each with 2 rather vaguely defined dorsal annulets. Anterior annulet of first abdominal segment bare; posterior annulet with a narrow transverse row of setae most of which are long. Anterior annulet of second abdominal segment with a small, sparsely set patch of short setae; posterior annulet with a transverse band of short setae fringed caudally with long setae. Anterior annulets of abdominal segments 3 to 5 inclusive each with a triangular patch of short setae; posterior annulets each bare mesally and with a transverse patch of setae on each side.

Dorsal annulets of abdominal segments 6 to 8 inclusive each with a transverse patch of rather long setae. Dorsum of abdominal segment 9 with a transverse patch of setae. Last abdominal segment short, slantingly flattened caudally and with protruding lateral and ventral lobes (Fig. 45). Defining sclerotized lines of ventral anal lobes not meeting at any point. Sclerotized lines of endoskeletal figure converging toward the anal opening. Endoskeletal figure narrowed toward its middle by a process from each ventral anal lobe forming a triangular area. Ventrad of this triangular area the endoskeletal figure is constricted into a narrow stalk. Venter of last abdominal segment, anterior to ventral anal lobes, bare except for 1 to 3 setae on each side. Legs 3-segmented (Figs. 1 and 24). Prothoracic and mesothoracic legs rather long; metathoracic legs much reduced in size (Figs. 24 and 28). Legs with well-developed stridulating organs, those on the mesothoracic legs consisting of a striated area on the outer apical portion of each coxa (Fig. 24) those on the metathoracic legs consisting of a sparsely set, single row of 9 or 10 teeth on the lower, inner surface of the fused trochanter-femur and a single small tooth on the tibio-tarsus (Fig. 28). All legs with minute claws.

*Geotrupes blackburni* (Fab.) occurs from Connecticut to Florida and westward to Indiana, according to Leng (1920). It is fairly common at Lexington, Kentucky, especially in the early spring when it can be collected in numbers from soil beneath fresh cow dung. In March, 1943, the writer dug over 20 adults from burrows beneath one pile of cat dung. The species is also attracted to lights. Adult oval, shining black, moderately convex, 13 to 17 mm long and 8 to 10 mm wide. Adults construct winding verticle burrows in the soil and pack the lower end of each with an elongate wad of dung in which a single larva develops. Winter is passed in the adult stage.

*Geotrupes ulkei* Blanch., Third-Stage Larva  
(Fig. 44)

Description based on the following material.

Two third-stage larvae (and one second-stage larva) associated with 2 adults. Material collected July 7, 1934 at Cold Spring, Monte Sano, Madison County, Alabama by W. B. Jones. Loaned by U. S. National Museum.

Maximum width of head capsule 2.45 to 2.52 mm. Surface of cranium straw-colored, shiny. Frons on each side with 1 posterior frontal seta, 1 or 2 setae in each anterior angle, 1 exterior frontal seta, and 1 or 2 anterior frontal setae. Antenna 3-segmented with the second segment slightly longer than the first. Mandibles and maxillae practically identical with those of *G. blackburni* except that the maxillary stridulating area of *ulkei* consists of a sparsely set row of 5 or 6 conical teeth on each stipes but with only 1 or 2 teeth on each palifer. Epipharynx similar to that of *G. blackburni* but each chaetoparia bears only 5 or 6 chaetae.

Dorsal annulets of abdominal segments 6 to 8 inclusive each with a short, anterior patch of moderately long setae and a long, caudal, transverse band of long setae. Last abdominal segment (Fig. 44) with defining sclerotized lines of ventral anal lobes not meeting at any point. Endoskeletal figure oblong in general outline; posteriorly, sharply narrowed for less than one third of its length.

*Geotrupes ulkei* Blanch. is an uncommon species occurring in Virginia (Blanchard, 1888-90) and in Alabama (Loding, 1935). Adult oval, rather strongly convex, shining dark brown with metallic luster, ranging from 11 to 12 mm in length and 6.5 to 7 mm in width. According to Blanchard the adults are found in fungi. Loding and Jones in June, 1934, collected a number of adults under leaves, on level ground, at the side of mountain paths on Monte Sano, Madison County, Alabama. Each adult was found in or near a small cylindrical hole the size of a lead pencil and 1½ to 2 inches deep, containing leaf frass in the bottom (Loding, 1935). The following July, Jones visited the same site and collected several adults and the 3 larvae described in this paper. Two of the larvae were found in one burrow and one in another. The food appeared to be decomposing leaves.



*Typhoeus typhoeus* L., Third-Stage Larva

(Fig. 47)

Description taken from van Emden (1941). Larva not seen.

Antenna 3-segmented, first antennal segment at least as long as second, much longer than third. Penultimate antennal segment with a sensorial appendage at inner side of apex. Mandibles and epipharynx exactly like that of *Geotrupes*.<sup>1</sup> Anal lobes swollen much as in *Geotrupes*. Sclerotized line of anal segment with a deep indentation on dorsoexterior part, near base of lateral callus (Fig. 47). Endoskeletal figure of ventral anal lobe broad at anus, suddenly narrowed into a stalk which reaches the ventral edge; the two defining lines do not meet at any point and follow the ventral edge on each side. Legs normal, without stridulating organs.

## TRIBE LETHRINI

*Lethrus apterus* Laxm., Third-Stage Larva

(Figs. 3 and 48)

Description taken from Golovianko (1936). Larva not seen.

Antenna 3-segmented. Labrum trilobed as in *Geotrupes*. Body almost naked. Anal lobes swollen. Last abdominal segment (Fig. 48) slantingly flattened, with round anal opening surrounded by 6 simple, radiating rays. Legs 3-segmented (Fig. 3) almost equally short, conical, each ending with a straight claw. Legs without stridulating organs. Length of larva up to 40 mm.

Adults of *Lethrus apterus* Laxm. cut the young shoots of plants, especially of grape, and carry them into their burrows (Boucomont, 1902).

## KEY TO GENERA OF THE TRIBE BOLBOCERINI

1. Legs 2-segmented (Figs. 25 and 31). Mesothoracic and metathoracic legs with stridulating organs. Claws absent. Penultimate antennal segment with a single, distal, sense organ. Last abdominal segment with a single, unpaired lower anal lobe (Fig. 46).....genus *Odontaeus*

<sup>1</sup>According to correspondence with van Emden who very kindly examined larvae of *Typhoeus* in the British Museum collection.

Legs 3- or 4-segmented (Figs. 5, 7, 27 and 29), without stridulating organs. Claws present. Penultimate antennal segment with 2 or more distal sense organs (Figs. 14 and 15). Last abdominal segment with paired lower anal lobes (Fig. 49).....2

2. Legs short, 3-segmented (Figs. 5 and 27). First antennal segment very short (Fig. 15); penultimate segment distally with 4 or 5 conical sense organs. Mandibles with a toothlike process distad of the molar area (Figs. 18 and 19). Glossa of labium not emarginate (Fig. 30). Venter of last abdominal segment with spinose raster.....genus *Eucanthus*

Legs well-developed, 4-segmented (Fig. 7 and 29). First two segments of antenna nearly equal in length (Fig. 14), penultimate segment distally with 2 conical sense organs. Mandibles without a toothlike process distad of the molar area (Fig. 17). Glossa emarginate (Fig. 33). Venter of last abdominal segment almost bare.....genus *Bolbocerosoma*

*Eucanthus lazarus* (Fab.), Third-Stage Larva  
(Figs. 4, 5, 15, 18, 19, 27, 30, and 43)

Description based on the following material.

One third-stage larva associated with 2 adults reared from 2 other larvae. The 3 larvae were collected during the summer of 1942, near Fayetteville, Arkansas, by Milton W. Sanderson, from the soil of a vineyard.

Maximum width of head capsule 2.3 mm. Surface of cranium light yellow-brown, faintly reticulate. Frons on each side with a pair of posterior frontal setae, a single seta in each anterior angle and a single exterior frontal seta (Fig. 15). Anterior frontal setae and clypeo-frontal suture absent. Labrum trilobed, wider than long. Antenna 3-segmented with the first segment very short but of the same diameter as the second, which is cylindrical and about 4 times as long. Third segment cylindrical, much smaller in diameter than second segment. Penultimate segment distally with 4 or 5 conical sense organs. Distal half of last antennal segment covered with tactile points.

Mandibles (Figs. 18 and 19) nearly symmetrical, each with a blade-like scissorial area. Just distad of the molar area is a toothlike process. Maxillary stridulating area (Fig. 30) with a patch of 10 to 11 sharp, conical teeth on each side. Hypopharynx with 2 symmetrical bulbous oncyli covered with cilia. Glossa not emarginate. Tormae of epipharynx (Fig. 43) not united mesally, each with a prominent pternotorma. Haptochus with 3 sensilla on each side, mesally with a dense phoba.

Spiracles not cribriform, somewhat resembling the "biforous" type (Fig. 4). Thoracic spiracles slightly smaller than abdominal spiracles.

Body (Fig. 5) not humped or conspicuously swollen. Dorsa of abdominal segments 1 to 8 inclusive each with 2 annulets. Each anterior annulet with a short, transverse, rather sparsely set patch of short setae. Each posterior annulet with a long, transverse, rather dense covering of longer setae. Last abdominal segment with a pair of ventral anal lobes and an unpaired dorsal anal lobe; lobes not fleshy. Anal opening V-shaped. Raster, on each side, consisting of a large, rather sparsely set patch of fairly short, stiff, laterad-pointing setae. Legs (Figs. 5 and 27) short, similar in size, 3-segmented, each with a sharp terminal claw. Legs without stridulating organs.

*Eucanthus lazarus* (Fab.) is the only species in the genus and is widely distributed over the United States, east of the Rocky Mountains. It is fairly common in Illinois, where it is often taken at lights, but seems quite rare in Kentucky as only a single specimen has been collected, taken April 28, 1946, at Sand Gap. Adult oval, reddish-brown, with a bifurcate process on the head. Adult ranging from 9 to 11 mm long and 5.5 to 6 mm wide. According to Manee (1908) who figured the burrow, adults of *E. lazarus* construct vertical tunnels in sandy soil. Soil pushed to the surface forms a mound about 2 inches in diameter over the entrance to each burrow, in the shape of radiating ropes of sand. He concluded that *E. lazarus* is a scavenger since the species is found under decaying leaves. Brown (1928) reports collecting adults of *E. lazarus* near Stillwater, Oklahoma, from burrows along country lanes or in pasture land in company with adults of *Bolboceras* and *Bolbocerosoma*. Sim found adults burrowing in golf courses and into the sides of deep wheel-ruts in old roads (Wallis, 1928).

*Bolbocerosoma* sp., (prob. *tumefactum* [Beauv.]) Third-  
Stage Larva

(Figs. 6, 7, 9, 14, 17, 29, 33, 41 and 49)

Description based on the following material.

One third-stage larva collected October-November, 1941, near Dover, Delaware, by J. M. Amos, from soil. Loaned by U. S. National Museum.

Maximum width of head capsule 3.2 mm. Surface of cranium straw colored. Frons on each side with a widely separated pair of posterior frontal setae, 1 to 3 setae in each anterior angle, 2 exterior frontal setae and 3 to 4 anterior frontal setae (Fig. 14). Clypeo-frontal suture absent. Labrum entire, broadly rounded, wider than long. Antenna

3-segmented, the first two segments nearly equal in length. Third segment cylindrical, much smaller in diameter than first two. Penultimate segment distally with a pair of conical sense organs. Mandibles (Fig. 17) nearly symmetrical; each with a scissorial area consisting of a distal bladelike portion separated from a blunt proximal toothlike portion by the scissorial notch. Region distad of the molar area without a distinct toothlike process. Maxillary stridulating area (Fig. 33) with a band of 20 to 25 sharp conical teeth arranged in 2 or 3 irregular rows. Hypopharynx symmetrical with 2 bulbous oncyli. Glossa emarginate. Tormae of epipharynx (Fig. 41) not united mesally, each with a pternotorma in the curve of which are found 5 to 7 sensilla. Haptolachus mesally with 2 dense longitudinal mesophobae, between whose proximal portions are 4 macrosensilla.

Spiracles not cribriform (Fig. 6). Respiratory plates with a number of prominent trabeculae. Thoracic spiracles much larger than abdominal spiracles.

Body (Fig. 7) not humped or conspicuously swollen. Dorsa of abdominal segments 1 to 8 inclusive each with 2 annulets. Each anterior annulet (prescutum) is short and diamond-shaped when viewed from above; each posterior annulet (scutum) is broad and extends from the spiracular area of one side across the dorsum to the other. Prescuta of abdominal segments 3 to 5 inclusive and scuta of abdominal segments 1 to 8 inclusive are densely covered with setae. Last abdominal segment (Figs. 7 and 49) with a pair of rather fleshy oval, ventral anal lobes and an unpaired, rather fleshy, dorsal anal lobe. Anal opening Y-shaped. Venter of last abdominal segment bare except for a few scattered setae on each side. Legs (Figs. 7 and 29) well developed, all three pairs similar in size and shape, 4-segmented. Claws on mesothoracic and metathoracic legs falcate and sharp, those on prothoracic legs very short. Legs without stridulating organs.

*Bolbocerosoma tumefactum* (Beauv.) occurs in Connecticut, New Jersey, Maryland, Virginia, North Carolina, and Alabama (Dawson and McColloch, 1924). A single male was collected June 29, 1893, at Lexington, Kentucky. According to the same authors adults range from 8 to 11 mm in length and from 5.7 to 8 mm in width. Adults are oval, strongly convex, orange brown and black, with the black distal spot on each elytron not meeting the sutural stripe. According to Sim (1930) this beetle is often reported as a pest of golf courses from its habit of throwing up mounds of sand at the mouths of its burrows on golf greens and fairways. Sim also found the species frequenting old roadways, near Rancocas, New Jersey, that were not too well shaded, and between August 21 and October 3, 1927 collected 75 adults.

*Odontaeus simi* Wallis, Third-Stage Larva

(Figs. 2, 13, 16, 25, 31, 34, 42, and 46)

Description based on the following material.

Two third-stage larvae. Larvae and associated adults dug in September, 1927, at Riverside, New Jersey, by R. J. Sim. One larva pupated November 10, 1927. Loaned by U. S. National Museum.

Maximum width of head capsule 2.1 to 2.2 mm. Surface of cranium straw colored, faintly reticulate. Frons on each side with about 4 posterior frontal setae, 2 setae in each anterior angle and 1 to 3 exterior frontal setae (Fig. 13). Anterior frontal setae absent. Clypeo-frontal suture indistinct. Labrum trilobed, wider than long. Antenna 3-segmented, the segments subequal in length. Third antennal segment obovate, smaller in diameter than the first 2 segments. Penultimate segment with a single, distal, subconical sense organ. Distal half of last antennal segment covered with tactile points. Mandibles (Fig. 16) nearly symmetrical, each with a scissorial area consisting of a distal bladeliike portion separated from a blunt, proximal toothlike portion by the scissorial notch. Region distad of the molar area without a toothlike process. Maxillary stridulating area (Fig. 34) with a small group of 7 to 8 sharp teeth. Hypopharynx symmetrical with 2 bulbous oncyli. Glossa not emarginate. Tormae of epipharynx (Fig. 42) united mesally, having a prominent posterior epitorma and a smaller anterior epitorma. Pternotormae absent. Pedium surrounded by phobae and covered with spicules.

Spiracles not cribriform (Fig. 2). Thoracic spiracle only slightly larger than abdominal spiracles.

Body not humped, thorax and first 4 abdominal segments rather swollen. Dorsa of abdominal segments 1 to 8 inclusive with 2 annulets as in *Bolbocerosoma* and *Eucanthus*. Each annulet on dorsa of abdominal segments 2 to 8 with a rather dense covering of setae. Last abdominal segment (Fig. 46) with a single, unpaired ventral anal lobe and an unpaired dorsal anal lobe; lobes not fleshy. Anal opening transverse, faintly V-shaped. Venter of last abdominal segment with a sparse covering of about 15 setae anterior to the lower anal lip. Legs (Figs. 25 and 31) 2-segmented, the prothoracic legs noticeably smaller than the mesothoracic and metathoracic legs, which are similar in size. Claws entirely absent. Mesothoracic and metathoracic legs with stridulating organs, those on the mesothoracic leg consisting of a filelike area on the coxa (Fig. 25) and those on the metathoracic leg consisting of a sparse row of 4 sclerotized teeth on the fused trochanter-femur-tibiotarsus (Fig. 31).

*Odontaeus simi* Wallis occurs from Michigan and Indiana eastward into Connecticut, Massachusetts, and New Jersey (Wallis, 1928). According to the same writer adults are oblong-oval, dark yellowish-brown, with a movable horn on the clypeus. Adults range from 5.18 to 7.49 mm long and from 3.29 to 4.83 mm wide. R. J. Sim, after whom the species is named, dug adults from vertical burrows in the greens and fairways of golf courses in New Jersey. The burrows vary from several inches to more than a foot in depth and are marked at the surface by a pile of sand "sausages" the diameter of the hole. He also collected the species in a pine-oak bush lot near Riverside and in and near an old road at Arney Mountain, New Jersey (Sim, 1930). Sim thinks the female oviposits in a mass of humus packed into an elongate mass at the lower end of the burrow (Wallis, 1928).

### TRIBE PLECOMINI

This tribe contains a single genus, *Pleocomma*, characterized as follows. Haptomerum of epipharynx with a group of heli. Epipharynx with plegmatia and with prominent chaetoparia and acanthoparia. Hypopharynx without oncyli. Legs 4-segmented. Trochanters and femora of mesothoracic and metathoracic legs with fossorial setae. Mesothoracic legs and metathoracic legs with stridulating organs. Terga of abdominal segments 3 to 7, inclusive, with 4 dorsal annulets. Anal opening Y-shaped, not surrounded by fleshy lobes.

#### *Pleocomma hirticollis vandykei* Linsley, Third-Stage Larva

(Figs. 8, 10, 12, 20, 21, 35-39 and 50)

Description based on the following material.

Nine third-stage larvae and a cast skin of a larva found associated with a dead male in its pupal cell. These specimens, together with about 30 other larvae, were dug from pasture soil, March 8, 1946, near Patterson Pass, California, by R. F. Smith, J. W. McSwain, several of Linsley's graduate students, and P. O. Ritcher.

Larva (Fig. 8) typically scarabaeiform with whitish body and light yellow-brown head. Length of mature larva ranging from about 45 to 50 mm. Maximum width of cranium ranging from 6.5 to 9 mm with a mean of 8 mm. Surface shining and generally smooth with a series of fine longitudinal striae on each side of the epicranial suture (ES). Frons bearing on each side an irregular, transverse row of 5 to 10 posterior frontal setae, one large seta in each anterior angle (rarely with an ad-

ditional small seta), a single large exterior frontal seta and often with 1 or 2 small setae, and a single large anterior frontal seta plus 2 to 4 small setae (Fig. 12). Epicranium with 2 large dorsoepicranial setae on each side of the epicranial suture. Clypeo-frontal suture present. Labrum slightly wider than long, symmetrical, and apically trilobed.

Antenna (Fig. 12) almost as long as cranium, fairly slender, 3-jointed, and borne on a cylindrical basal piece fused to the epicranium. First segment as long as second and third segments together; third segment very small, about one third as long and half as wide as second segment. First and second segments bearing numerous setae. End of second antennal segment, below juncture with apical segment, with a small oval sensory spot. Apical segment without sensory spots; apex with 2 to 4 olfactory pegs.

Mandibles (Figs. 20 and 21) shorter than cranium, approximately symmetrical, subtriangular in outline, each with a strong, bladelike scissorial area (SA) and a rather small, molar area (MO). Scissorial area blackish with a slightly concave or nearly straight cutting edge. Molar areas also blackish, those of left and right mandibles similar in size but somewhat asymmetrical. Molar area of left mandible with 2 dorsal and 4 ventral lobes bounding a central concavity. Molar area of right mandible with a transverse apical lobe and a curved median lobe, the latter surrounding a small, longitudinal proximal lobe. At the base of each molar area is a dense brush of setae or brustia (BR).

Epipharynx (Fig. 39) trilobed apically. Apical lobe, or corypha (CO) set with coarse setae and bounded on each side by a clithrum (CL). Plegmatia present. Each plegmatium consisting of about 11 to 15 semi-circular, sclerotized plegmata, each surrounding the base of a coarse acanthoparial seta. Chaetoparia (CPA) large, separated from the acanthoparia by a narrow gymnoparia (GP). Each chaetoparia consisting of a dense patch of sharp setae not interspersed with sensilla. Chaetae stoutest toward the pedium (PE). Haptomerum (H) bearing a rather sparsely set, semicircular group of 9 to 12 large, stout heli. Tormae symmetrical, not branched, not meeting mesally. Haptolachus incomplete, nesia absent. Caudomesad of the inner end of each torma is a longitudinal curved phoba (PH). The area laterad of each phoba has 20 to 30 crepidial punctures (CP). Four macrosensilla (MS) are found between the caudal ends of the phobae. Posterior to the phobae is the curved, transverse crepis (CR).

Respiratory plates of spiracles kidney-shaped, with their concavities facing ventrally (Figs. 8 and 10). Spiracles cribriform but "holes" of respiratory plate rather opaque, not arranged in definite rows. Thoracic

spiracles considerably larger than the abdominal spiracles which are alike in size.

First and second abdominal segments each with 3 dorsal areas. Each prescutum with a transverse band of short, stout setae; that on the first abdominal segment 2 or 3 rows wide. Each scutum with a long, transverse band of setae consisting anteriorly of about 5 irregular rows of short, stout setae and posteriorly of a single, sparsely set row of fairly long, slender setae. Scutellum of first abdominal segment with a short, sparsely set transverse patch of short, stout setae on each side and a bare, mid-dorsal area. Scutellum of second abdominal segment with a long, narrow, transverse, single or double row of short, stout setae. Abdominal segments 3 to 7 inclusive each with 4 dorsal annulets, a prescutum, scutum, scutellum and postscutellum (Fig. 10). Each prescutum bears a transverse patch of about 5 to 7 irregular rows of short, stout setae. Each scutum with a short, transverse, irregular, double row of short, stout setae. Each scutellum has a long transverse band of short, stout setae posterior to which is a single sparsely-set row of rather long, slender setae. Each postscutellum except that of abdominal segment 7 which is bare, with a long, transverse, irregular double or triple row of short, stout setae.

Dorsa of abdominal segments 8 and 9 not divided into distinct annulets. Each dorsum anteriorly with scattered slender setae and an occasional short, stout seta, posteriorly with a sparsely-set transverse row of long, slender setae. Dorsum of tenth abdominal segment with a transverse sinuate dorsal impressed line. Region between dorsal impressed line and anterior margin of abdominal segment 10 set with scattered short, stout setae. Dorsal area, between dorsal anal lip (DAL, Fig. 50) and dorsal impressed line, clothed with short, stout setae interspersed with several long, slender setae.

Anal slit (Fig. 50) Y-shaped, basal cleft short. Anus bordered dorsally by the triangular dorsal anal lip (DAL), and ventrally by the mesally cleft ventral anal lip (VAL). Both anal lips covered with short, stout setae.

Raster (Figs. 8 and 50) consisting of a simple teges (T) in the form of a narrow, transverse band of 50 to 70 narrow, short, stout, caudally directed setae, located cephalad of the lower anal lip. Cephalad of the teges, especially toward each side, are several long, slender setae. Anterior to these setae and the teges, the venter of the tenth abdominal segment is bare.

Legs (Figs. 8 and 35) well-developed with the prothoracic shorter than the metathoracic pair. Each leg 4-jointed, consisting of a fairly long, stout, subcylindrical coxa (CX), a slightly shorter trochanter (TR),



a short femur (FE) and a short tibiotarsus (TT) which bears a terminal claw. Mesothoracic and metathoracic legs with stridulating organs consisting of a finely striated area on the posterior surface of the mesocoxa (Fig. 26) and a V-shaped row of about 12 sclerotized teeth, each tooth at the base of a seta, on the anterior surface of the metatrochanter (Fig. 35). Anterior ventral surface of mesothoracic and metathoracic trochanters and ventral surface of mesothoracic and metathoracic femora densely set with stout, spinelike setae undoubtedly useful in burrowing through hard soil. Claws simple, each consisting of a straw colored base and a dark, slender, sharp distal portion. Base of each claw with 2 setae. Prothoracic claws much longer than mesothoracic and metathoracic claws.

*Pleocoma hirticollis vandykei* Linsley occurs in Sonoma, Contra Costa, and Alameda counties, California, and is very abundant in a small pasture area near Patterson Pass in open, hill grassland in the latter county. Adult males are oval, black, and range from 20 to 24.5 mm in length; females are oval, brown, and range from 24.5 to 29 mm in length (Linsley, 1938, 1941, and 1945). The males fly in the fall after rain of half an inch or more and seek out the females which remain in their open burrows. October 30, 1944, Smith and Potts (1945) collected 37 males and on the following November 4 collected 78 males from the same spot. Seventeen females were dug from open burrows, most of them at depths of 3 to 10 inches and accompanied by cast pupal or larval skins. Four larvae, including 3 sizes, were taken. While visiting at the University of California, in Berkeley, early in 1946, the writer was shown 8 larvae of the same species collected February 26, 1946, by Smith and McSwain from the same spot. A second trip to Patterson Pass, March 8, 1946, by Smith, McSwain, several of Linsley's graduate students, and the writer, yielded over 40 additional larvae (Ritcher, 1947). They were found from 1 to 3 inches deep in the pasture soil, feeding on grass roots. Larvae of all 3 instars were collected, suggesting that the life cycle lasts several years. A dead male was found in its pupal cell at a depth of 5 inches.

## BIBLIOGRAPHY

- ARROW, G. J.  
1904. Sound-production in the lamellicorn beetles. Ent. Soc. London Trans. (4):709-750.
- BLANCHARD, F.  
1888-90. Some account of our species of *Geotrupes*. Psyche 5:103-110.
- BOUCOMONT, A.  
1902. Coleoptera Lamellicornia: Fam. Geotrupidae. Genera Insectorum 7:1-20.  
1912. Scarabaeidae: Taurocerastinae, Geotrupinae. Coleopterum Catalogus 46: 1-47. Edited by S. Schenking. W. Junk, Berlin.
- BOVING, A. G. and CRAIGHEAD, F. C.  
1930-31. An illustrated synopsis of the principal larval forms of the order Coleoptera. Ent. Amer. 11 (N.S.) (1-4):351 pages.
- BROWN, W. J.  
1928. Two new species of *Bolbocerosoma* with notes on the habits and genitalia of other species. Canad. Ent. 60:192-196.
- DAVIS, A. C.  
1934. A revision of the genus *Pleocomma*. South. Calif. Acad. Sci. Bul. 33(3): 123-130. Continued in 34 (1):4-36.
- DAWSON, R. W. and MCCOLLOCH, J. W.  
1924. New species of *Bolbocerosoma*. Canad. Ent. 56:9-15.
- EMDEN, F. I. VAN  
1941. Larvae of British beetles. II. A key to the British lamellicornia larvae. Ent. Monthly Mag. 77:117-127, 181-192.
- FABRE, J. H.  
1912. Social life in the insect world, Ch. 16: A truffle-hunter: the *Bolboceras gallicus*. Trans. by Bernard Miall. The Century Company, N. Y. pp. 217-237.
- GERSTAEKER, C. E. A.  
1883. Ueber die Stellung der Gattung *Pleocomma* Lec. in System der Lamellicornier. Ent. Zeitung (Stettin) 44:436-450. Translation by J. B. Smith found in Ent. Amer. 3:202-11.
- GOLOVIANKO, Z. S.  
1936. Les larves plus communes des Coleopteres lamellicornes de la partie europeenne de l' U. R. S. S.-Tahl. Analyt. Fn. U. R. S. S., 20, Inst. Zool. Acad. Sci. U. R. S. S., 1-65, 70 figs. (In Russian).
- HORN, G. H.  
1883. *Pleocomma* Lec. Its systematic position and indication of new species. Ent. Amer. 3:233-5.  
1888. Review of the species of *Pleocomma* with a discussion of its systematic position in the Scarabaeidae. Amer. Ent. Soc. Trans. 15:1-18.
- LENG, C. W.  
1920. Catalogue of the Coleoptera of America, North of Mexico. John D. Sherman, Jr., Mt. Vernon, N. Y.
- LINSLEY, E. G.  
1938. Notes on the habits, distribution, and status of some species of *Pleocomma*. Pan-Pacific Ent. 14:49-58, 97-104.  
1941. Additional observations and descriptions of some species of *Pleocomma*. Pan-Pacific Ent. 17 (4):145-152.  
1945. Further notes on some species of *Pleocomma* (Coleoptera, Scarabaeidae). Pan-Pacific Ent. 21(3):110-114.
- LINSLEY, E. G. and MICHENER, C. D.  
1943. Observations on some Coleoptera, from the vicinity of Mt. Lassen, California. Pan-Pacific Ent. 19(2):75-79. Found larvae and pupae of *Odontaeus obesus* Lec.

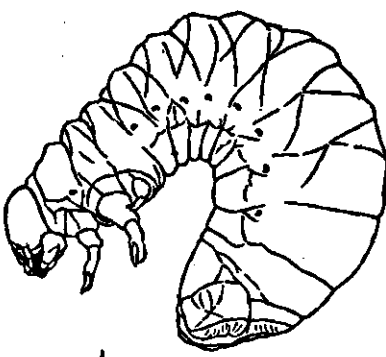
- LODING, H. P.  
1935. *Geotrupes ulkei* Blanchard. Brooklyn Ent. Soc. Bul. 30:108.
- MANEE, A. H.  
1908. Some observations at Southern Pines, N. Carolina. Ent. News 19 (Dec.): 459-462. Biology of *Eucanthus lazarus* (Fab.) and *Bolboceras ferrugineus* (Beauv.).
- OSTEN SACKEN, R.  
1874-76. Description of the larva of *Pleocoma*, Lec. Amer. Ent. Soc. Trans. 5: 84-87.
- PAULIAN, R.  
1939. Les caracteres larvaires des Geotrupidae (Col.) et leur importance pour la position systematique du groupe. Soc. Zool. de France Bul. 64:351-360.  
1941. La position systematique du genre *Pleocoma* Le Conte. (Col. Scarabaeidae). (Rev. Franc. d' Ent. 8 (3):151-155.
- PERRIS, E.  
1876. Larves des Coleopteres: Lamellicornes et Pectinicornes. Annales de la Societe Lineenne de Lyon 22:91-122.
- RITCHER, P. O.  
1940. Kentucky white grubs. Ky. Agr. Expt. Sta. Bul. 401.  
1943. The Anomalini of eastern North America with descriptions of the larvae and key to species (Coleoptera: Scarabaeidae). Ky. Agr. Expt. Sta. Bul. 442.  
1944. Dynastinae of North America with descriptions of the larvae and keys to genera and species (Coleoptera: Scarabaeidae). Ky. Agr. Expt. Sta. Bul. 467.  
1945a. Rutelinae of eastern North America with descriptions of the larvae of *Strigodermella pygmaea* (Fab.) and three species of the tribe Rutelini (Coleoptera: Scarabaeidae). Ky. Agr. Expt. Sta. Bul. 471.  
1945b. North American Cetoniinae with descriptions of their larvae and keys to genera and species (Coleoptera: Scarabaeidae). Ky. Agr. Expt. Sta. Bul. 476.  
1945c. Coprinae of eastern North America with descriptions of larvae and keys to genera and species (Coleoptera: Scarabaeidae). Ky. Agr. Expt. Sta. Bul. 477.  
1947. Description of the larva of *Pleoroma hirticollis vandykei* Linsley (Coleoptera: Scarabaeidae). Pan-Pacific Ent. 23 (1):11-20.
- SCHIODTE, I. C.  
1874. De metamorphosi eleutheratorum observationes: hidreg til insekternes udviklings-histoire. Pars 8, Scarabaei. Saetryk of Naturh. Tidsskr. (ser. 3) 9:227-376.
- SIM, R. J.  
1930. Scarabaeidae, Coleoptera; observations on species unrecorded or little known in New Jersey. N. Y. Jour. Ent. Soc. 38 (2):139-147. Biologies of *Odontaeus*, *Bolbocerosoma*, and *Eucanthus*.
- SMITH, R. F. and POTTS, R. W. L.  
1945. Biological notes on *Pleocoma hirticollis vandykei* Linsley (Coleoptera: Scarabaeidae). Pan-Pacific Ent. 21 (3):115-118.
- WALLIS, J. B.  
1928. Revision of the genus *Odontaeus*. Dej. (Scarabaeidae, Coleoptera). Canad. Ent. 60:119-128, 151-156, 168, 176.

## Plate I

- Fig. 1. *Geotrupes blackburni* (Fab.). Third-stage larva, left lateral view (setation omitted).
- Fig. 2. *Odontaeus simi* Wallis. Thoracic spiracle.
- Fig. 3. *Lethrus apterus* Laxm. (After Golovianko). Third-stage larva, left lateral view (setation omitted).
- Fig. 4. *Eucanthus lazarus* (Fab.). Thoracic spiracle.
- Fig. 5. *Eucanthus lazarus* (Fab.). Third-stage larva, left lateral view (setation omitted).
- Fig. 6. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Thoracic spiracle.
- Fig. 7. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Third-stage larva, left lateral view (setation omitted).
- Fig. 8. *Pleocoma hirticollis vandykei* Linsley. Third-stage larva, left lateral view.
- Fig. 9. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Third abdominal segment, left lateral view.
- Fig. 10. *Pleocoma hirticollis vandykei* Linsley. Third abdominal segment, left lateral view.

## Symbols Used on Plate I

EUS—Eusternum.	SP—Spiracle.
PEA—Pedal area.	SCL—Scutellum.
PLL—Pleural lobe.	SCU—Scutum.
PRSC—Prescutum.	SPA—Spiracular area.
PSCL—Postscutellum.	

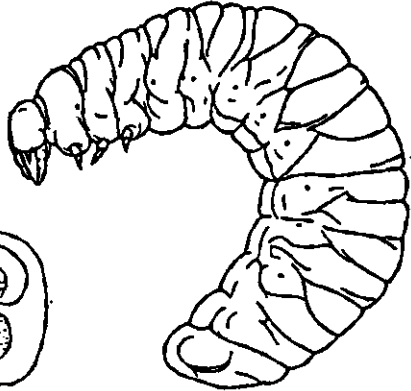


C. BLACKBURNI



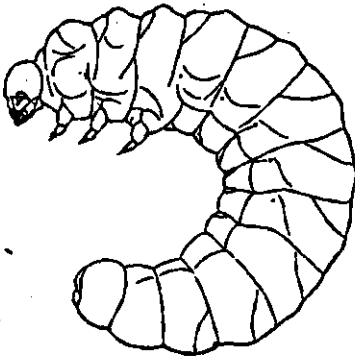
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G. SIMI



3

L. APTERUS  
AFTER GOLDFAHN



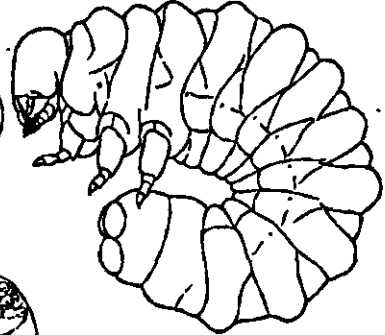
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E. LAZARUS



5

E. LAZARUS



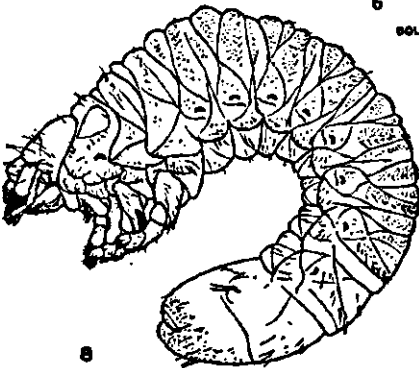
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BOLBOCEROSOMA



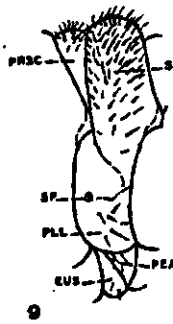
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BOLBOCEROSOMA



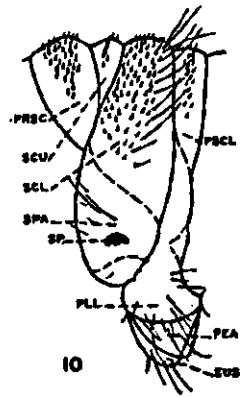
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P. HIRTICOLLIS  
VANDYKEI



9

BOLBOCEROSOMA



10

P. HIRTICOLLIS  
VANDYKEI

## Plate II

- Fig. 11. *Geotrupes blackburni* (Fab.). Head.  
 Fig. 12. *Pleocoma hirticollis vandykei* Linsley. Head.  
 Fig. 13. *Odontaeus simi* Wallis. Head.  
 Fig. 14. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Head.  
 Fig. 15. *Eucanthus lazarus* (Fab.). Head.  
 Fig. 16. *Odontaeus simi* Wallis. Left mandible, dorsal view.  
 Fig. 17. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Left mandible, dorsal view.  
 Fig. 18. *Eucanthus lazarus* (Fab.). Left mandible, dorsal view.  
 Fig. 19. *Eucanthus lazarus* (Fab.). Right mandible, dorsal view.  
 Fig. 20. *Pleocoma hirticollis vandykei* Linsley. Left mandible, dorsal view.  
 Fig. 21. *Pleocoma hirticollis vandykei* Linsley. Left mandible, ventral view.  
 Fig. 22. *Geotrupes blackburni* (Fab.). Left mandible, dorsal view.  
 Fig. 23. *Geotrupes blackburni* (Fab.). Right mandible, dorsal view.

## Symbols Used on Plate II

- |                                      |                              |
|--------------------------------------|------------------------------|
| A—Antenna.                           | L—Labrum.                    |
| AA—Setae of anterior angle of frons. | MO—Molar region.             |
| AF—Anterior frontal setae.           | PA—Preartitis.               |
| BR—Brustia.                          | PC—Preclypeus.               |
| DMS—Dorso-molar setae.               | PFS—Posterior frontal setae. |
| E—Epicranium.                        | PSC—Postclypeus.             |
| EFS—Exterior frontal setae.          | PTA—Postartitis.             |
| ES—Epicranial suture.                | SA—Scissorial area.          |
| F—Frons.                             | VP—Ventral process.          |
| FS—Frontal suture.                   |                              |

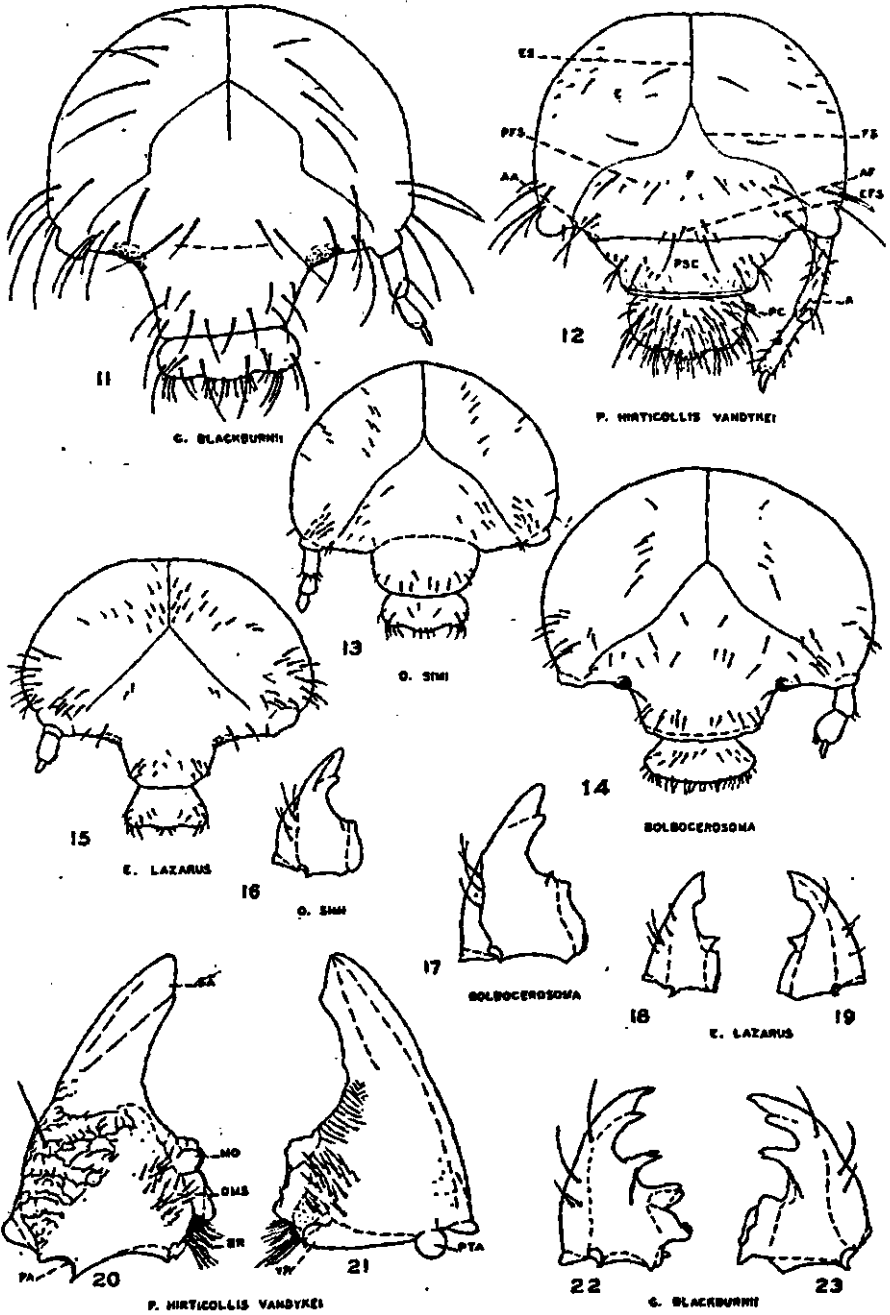


PLATE II

## Plate III

- Fig. 24. *Geotrupes blackburni* (Fab.). Left metathoracic and mesothoracic legs, lateral view.
- Fig. 25. *Odontaeus simi* Wallis. Left mesothoracic leg, lateral view.
- Fig. 26. *Pleocomma hirticollis vandykei* Linsley. Proximal portion of left mesothoracic leg, lateral view.
- Fig. 27. *Eucanthus lazarus* (Fab.). Left metathoracic leg, lateral view.
- Fig. 28. *Geotrupes blackburni* (Fab.). Left metathoracic leg.
- Fig. 29. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Left metathoracic leg, lateral view.
- Fig. 30. *Eucanthus lazarus* (Fab.). Left maxilla, labium and hypopharynx.
- Fig. 31. *Odontaeus simi* Wallis. Left metathoracic leg.
- Fig. 32. *Geotrupes blackburni* (Fab.). Left maxilla, labium and hypopharynx.
- Fig. 33. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Right maxilla, labium and hypopharynx.
- Fig. 34. *Odontaeus simi* Wallis. Right maxilla, labium and hypopharynx, dorsal view.
- Fig. 35. *Pleocomma hirticollis vandykei* Linsley. Right metathoracic leg.
- Fig. 36. *Pleocomma hirticollis vandykei* Linsley. Left maxilla, dorsal view.
- Fig. 37. *Pleocomma hirticollis vandykei* Linsley. Labium and hypopharynx, dorsal view.
- Fig. 38. *Pleocomma hirticollis vandykei* Linsley. Right maxilla and labium, ventral view.

## Symbols Used on Plate III

CAR—Cardo.

CL—Claw.

CX—Coxa.

FE—Femur.

FOS—Fossorial setae.

G—Galea.

GL—Glossa.

HP—Hypopharynx.

LA—Lacinia.

LL—Lateral lobe.

LP—Labial palpus.

MP—Maxillary palpus.

O—Oncylus.

PMP—Postmentum.

PRM—Prementum.

SD—Stridulating area.

ST—Stipes.

TR—Trochanter.

TT—Tibiotarsus.

UN—Uncus.



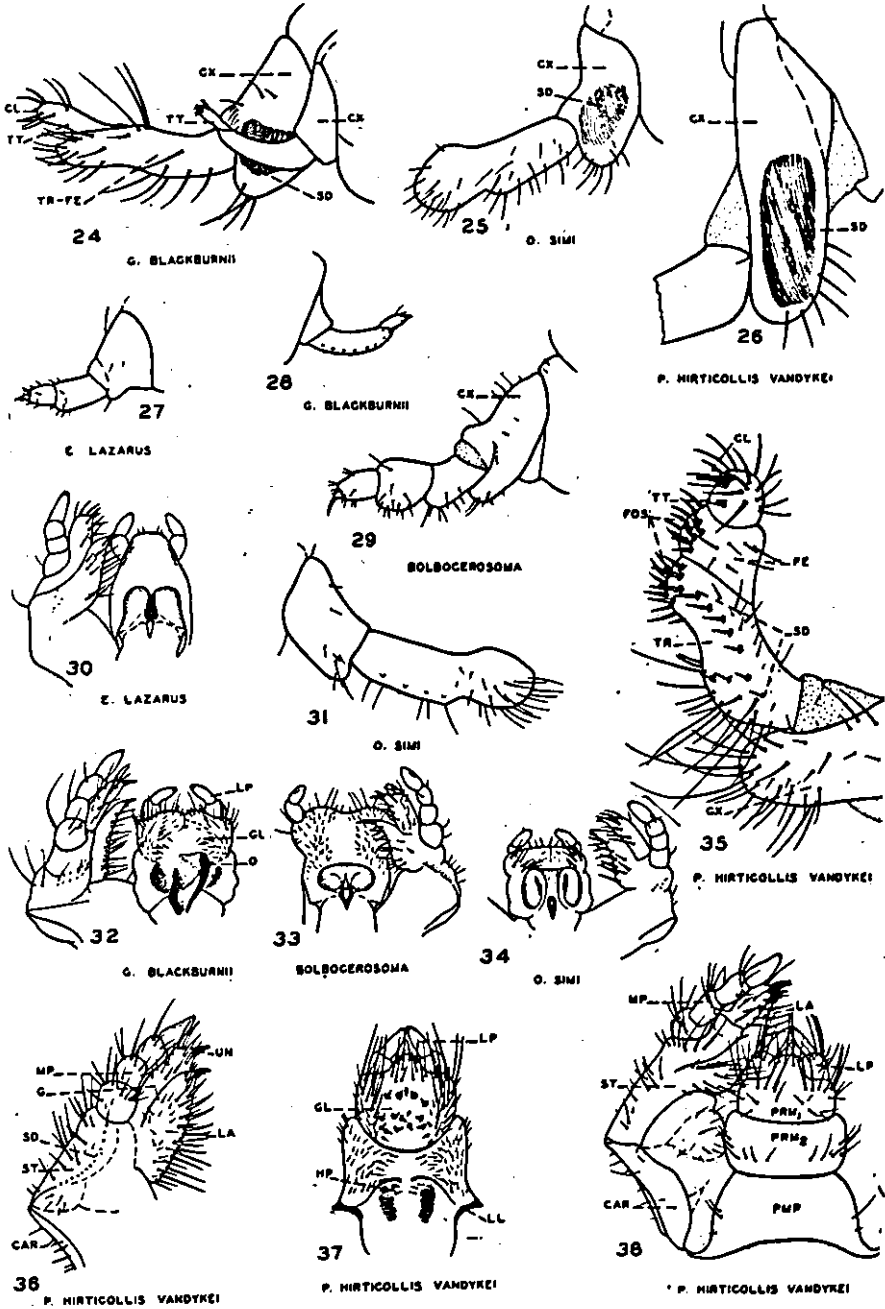


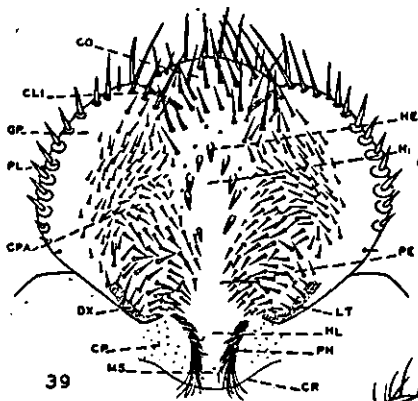
PLATE III

## Plate IV

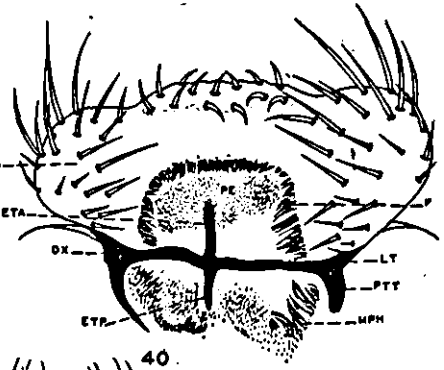
- Fig. 39. *Pleocoma hirticollis vandykei* Linsley. Epipharynx.  
 Fig. 40. *Geotrupes blackburni* (Fab.). Epipharynx.  
 Fig. 41. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Epipharynx.  
 Fig. 42. *Odontaeus simi* Wallis. Epipharynx.  
 Fig. 43. *Eucanthus lazarus* (Fab.). Epipharynx.  
 Fig. 44. *Geotrupes ulkei* Blanch. Caudal view of last abdominal segment.  
 Fig. 45. *Geotrupes blackburni* (Fab.). Caudal view of last abdominal segment.  
 Fig. 46. *Odontaeus simi* Wallis. Caudal view of last abdominal segment.  
 Fig. 47. *Typhoeus typhoeus* L. Caudal view of last abdominal segment (After van Emden).  
 Fig. 48. *Lethrus apterus* Laxm. Caudal view of last abdominal segment (After Golovianko).  
 Fig. 49. *Bolbocerosoma* (prob. *tumefactum* [Beauv.]). Caudal view of last abdominal segment.  
 Fig. 50. *Pleocoma hirticollis vandykei* Linsley. Caudal view of last abdominal segment.

## Symbols Used on Plate IV

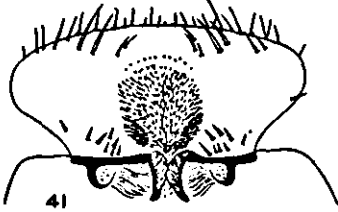
- |                          |                       |
|--------------------------|-----------------------|
| ASL—Anal slit.           | HE—Helus.             |
| CLI—Clithrum.            | HL—Haptolachus.       |
| CO—Corypha.              | LL—Lateral lobe.      |
| CP—Crepidial punctures.  | LT—Laeotorma.         |
| CR—Crepis.               | MPH—Mesophoba.        |
| CPA—Chaetoparia.         | MS—Macrosensilla.     |
| DAL—Dorsal anal lobe.    | PE—Pedium.            |
| DX—Dexiotorma.           | PH—Phoba.             |
| ESF—Endoskeletal figure. | PL—Plegma.            |
| ETA—Anterior epitorma.   | PTT—Pternotorma.      |
| ETP—Posterior epitorma.  | T—Teges.              |
| GP—Gymnoparia.           | VAL—Ventral anal lip. |
| H—Haptomerum.            |                       |



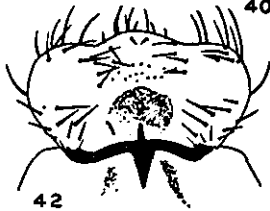
P. HIRTICOLLIS VANDYKEI



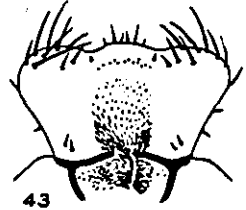
G. BLACKBURNII



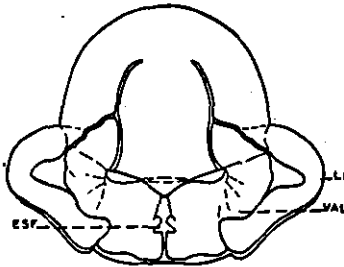
BOLBOCEROSOMA



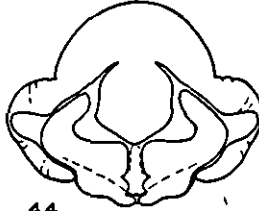
O. SIMI



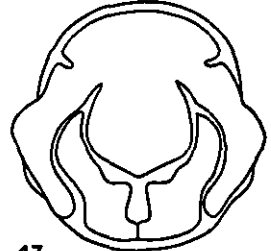
E. LAZARUS



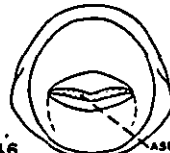
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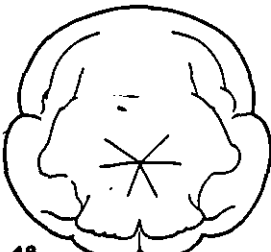
G. ULKEI



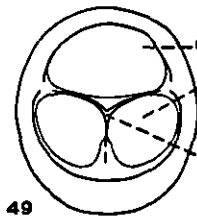
T. TYPHOEUS  
AFTER VAN EMBDE



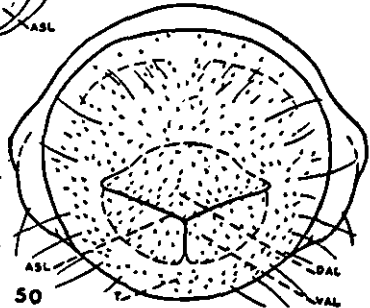
O. SIMI



L. APTERUS  
AFTER COLOMANNO



BOLBOCEROSOMA



P. HIRTICOLLIS VANDYKEI

PLATE IV