

A REVISION OF THE GENUS *PASSALOECUS*  
(HYMENOPTERA: SPHECIDAE) IN  
AMERICA NORTH OF MEXICO

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**Abstract.**—Sixteen species of *Passaloecus* are recognized from the Nearctic and arranged into eight species groups, which are characterized, keyed, and discussed. The 35 known species in the genus are arranged into nine species groups and three group assemblages. Two fossil species are discussed and their wing venation drawn. Published biological information on five species is reviewed and new biological information is given for seven species. The comparative morphology, phylogeny, and distribution of the genus and its included species groups are discussed. Keys, illustrations, descriptions, and distribution maps are provided for species identification.

A neotype is selected for *Pemphredon annulatus* Say and lectotypes are established for *Passaloecus borealis* Dahlbom and Old World *P. turionum* Dahlbom. Type depositories are given for New World species and some Old World species. New taxa are *P. areolatus*, *P. erugatus*, *P. gallicola*, *P. lineatus*, *P. miltoloma*, and *P. patagiatus*. New species synonymy is *P. annulatus* (Say) (= *Pemphredon marginatus* Say). Names raised from synonymy to species status are *P. monilicornis* Dahlbom and *P. turionum*.

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Introduction

The genus *Passaloecus* in America north of Mexico contains 16 species. They are small (4.0–9.0 mm long), black-bodied wasps with white, amber, or brown appendages. Their nests are built in pre-existing cavities or are newly excavated in soft, pithy wood. With few exceptions, they partition cells with resin and provision them with aphids (Homoptera: Aphididae).

The genus is represented in the Nearctic, Oriental, and Palearctic faunal regions. Of the eight species groups represented in the Nearctic, three are endemic (*areolatus*, *armeniaca*, and *relativus* groups), three are holarctic (*corniger*, *insignis*, and *singularis* groups), one is holarctic but is probably adventive in the Nearctic (*gracilis* group), and one is represented in the eastern and northern Nearctic and Japan (*annulatus* group).

The identity of many of our species has been confused because the wasps are small, are poorly represented in collections, and because most species are inadequately described. The unrecognized presence, in North America, of a few holarctic species has compounded the problem. Some of these have been named and described by authors on both continents.

This revision is the first comprehensive, systematic study of *Passaloecus* in America north of Mexico since Fox (1892) revised the genus. He recognized five North American species. Krombein (1938) keyed the species of New York State, naming and describing two species new to North America. Between 1892 and 1938, six new names were added to the literature which are extralimital to Krombein's paper. Krombein (1961) reported *Passaloecus gracilis* (Curtis) (as *Passaloecus turionum* Dahlbom) as an adventive species in the eastern United States.

### Materials and Methods

Integumental surfaces of *Passaloecus* contain reflective areas that produce shadows and glare when illuminated with an incandescent light source. Fluorescent illumination produced relief structures and integumental sculpturing free of glare and shadow (Vincent and Hoffman, 1974). Fluorescent illumination of specimens is recommended for adequate interpretation of characters used in the keys and descriptions.

The trap-nesting technique of Krombein (1967) was used in this study. Pine blocks were drilled to various depths and diameters. Blocks were dipped in paraffin to prevent molding. Traps were placed along wood edges and areas containing cut stems and dead trees in early spring and recovered in the fall. Marked traps were refrigerated at 6°C for 2 or 3 months to break diapause.

In the species synonymies, an asterisk preceding a species name denotes personal examination of the holotype.

### Nesting Activity and Nest Architecture

I have examined nests of six species occurring in North America. Four are new observations. Fye (1965) and Krombein (1967) made extensive observations on several trap-nests of *P. monilicornis* Dahlbom (as *P. ithacae* Krombein) and *P. cuspidatus* Smith. Krombein (1960) observed a single nest of *P. annulatus* (Say). In Europe, observations on *P. singularis* Dahlbom have been made under a number of names: Chevalier (1923) (as *P. turionum* Dahlbom); Bouwman (1927), Enslin (1933), and Leclercq (1939, 1940) (as *P. gracilis* (Curtis)); Grandi (1934), Janvier (1961) (as *P. tenuis* Morawitz). Also in Europe, observations have been made on *P. gracilis* by Corbet and Backhouse (1975). Tsuneki (1955, 1973) reported on nests of *P. monilicornis* from Japan.

Members of the genus construct nests in narrow passageways of abandoned beetle galleries in bark and dead wood, in stems previously excavated by other twig inhabiting insects, in old cynipid (Hymenoptera: Cynipidae) galls, and in self-excavated burrows of stems and vines containing soft or spongy pith. Except for *P. singularis* and Old World *P. clypealis* Faester,



resin is used in the construction of all cell partitions and final nest closures. Nests vary from one cell to elaborate branching complexes containing over twenty cells. Cells are contiguous and in linear rows with the anterior wall of the first cell forming the posterior wall of the second. Only rarely have intercalary cells been observed and never more than one per nest. One to four vestibular cells are often present. I am using the term "vestibular cell" for each empty chamber between the entrance and the brood cells.

Males emerge approximately a week before females, flying about the area and investigating open nests. Mating usually takes place on nearby foliage (details of the copulatory act are unknown). Males do not participate in nest preparation, construction, or defense.

Nest preparation begins after mating and consists of cleaning old burrows or excavating new ones. After the cavity has been prepared, provisioning begins. The prey consists of aphids, although rarely a few psyllids (Homoptera: Psyllidae) have been reported in mixed provisions (Fye, 1965). The wasp carries the prey holding its head between the mandibles. Number of prey per cell, cell length, and thickness of partitions and closures vary greatly, both inter- and intraspecifically. The whitish, sausage-shaped egg is usually deposited on the sternum or pleuron of one of the aphids in the middle of the prey mass, although this too is variable. Nest closures and cell partitions are generally made of resin. A few species incorporate other materials (wood particles, small gravel, aphid remains, fecal pellets) in the resin. Nesting material is carried between the mandibles or between the mandibles and labrum.

### *Passaloecus cuspidatus* Smith

Authors previously reporting biological information on this species are: Packard (1874), Krombein (1956, 1958, 1963, 1967), and Fye (1965). I have observed nesting activity and nest architecture.

*Nesting sites.*—Stems of "elder and syringa" (Packard, 1874), wooden trap-nests (Fye, 1965; Krombein, 1967), abandoned beetle galleries (Krombein, 1956), and soda-straw trap-nests.

*Adult activity.*—On August 12, 1972, at Willard's Peak, Utah (9500'), I observed two females beginning nest preparation. Each nest was first cleaned of debris (wood chips, old cocoons, frass). The debris, held between the mandibles, was carried to the entrance and dropped. The galleries were large enough inside for the female to turn around, for she would always enter head-first and exit head-first. She flew away, returning in 3 to 5 minutes with a drop of resin between her mandibles. The resin was applied to the perimeter of the entrance. Two drops were sufficient to form a ring around the aperture. Then provisioning began. The time between leaving the nest and returning with an aphid ranged from 3.8 to 10.0 minutes ( $\bar{x} = 5.96 \pm 2.85$  min) for eight trips. At approximately 3:45 p.m., activity ceased. Fe-

males returning with aphids entered their respective nests, deposited the prey, turned around, and approached the entrance. Each female spent the night a few millimeters inside her burrow, facing the entrance. No resin-gathering was observed for the two wasps once provisioning began. Other females were observed closing their nests at various times during the day. Resin-gathering flights ranged from 0.5 to 8.0 minutes ( $\bar{x} = 2.04 \pm 1.93$  min) for 13 trips. Drops of resin were spread diagonally across the entrance with individual movements of the mandibles. Usually four drops of resin were sufficient to seal the entrance. The closure was then smoothed with the mandibles. The antennae extended onto the resinous surface and palpitated rapidly. Each usage of resin was followed by grooming periods of 1–5 minutes. After the closure had been smoothed, pieces of wood and bark, some slightly larger than the female's head, were carried to the entrance and incorporated into the closure. Six to 12 of the wood fragments were usually added.

*Nest architecture.*—Eighty-three nests examined were in soda-straw trap-nests set out and collected by Dr. Paul D. Hurd at Montclair, Alameda Co., California. The straws were 90.0 mm long and 4.0 mm in diameter. Nests contained two to nine brood cells ( $\bar{x} = 6.14 \pm 1.75$ ). Female cells ranged from 5.0 to 18.0 mm long ( $\bar{x} = 10.09 \pm 2.19$  mm,  $N = 111$  cells). Male cells ranged from 4.0 to 16.0 mm long ( $\bar{x} = 8.82 \pm 2.16$  mm,  $N = 110$  cells). Individual brood cells were provisioned with 16 to 35 aphids. Partitions were made of resin. Partition thickness ranged from 0.5 to 4.0 mm. Eighty nests contained one to three vestibular cells ranging from 3.0 to 21.0 mm long ( $\bar{x} = 9.89 \pm 3.56$  mm,  $N = 108$  cells). Twenty-two nests contained two vestibular cells each and three contained three. Closures were made of resin with coarse wood particles more or less covering the anterior surface.

Fye (1965) and Krombein (1967) described similar nest architecture for this species. Both reported partitions and closures of resin. Vestibular cells were present in most nests.

*Larval activity.*—Fye (1965) and Krombein (1967) found that the egg was laid on the "side" or venter of one of the aphids. The position of this aphid in the cell was inconsistent. Krombein (1967) reported that eggs hatched in 2 days, that larvae fed for 7 to 9 days, and that a "very vestigial cocoon" was spun in less than a day. The cocoon consisted of only a few "silken strands" at the anterior end or occasionally both ends of the cell. In the straw nests from California, each larva had spun a delicate cocoon over the interior of its cell. Krombein (1967) reported voiding of the meconium as "small, black pellets." I observed a similar meconium at the rear of the cell, free of any cocoon covering.

*Sex ratio.*—Fye (1965) obtained six females and one male from 14 brood cells. Krombein (1967) obtained 22 females and 14 males from 66 brood cells. I recovered 111 females and 110 males from 510 brood cells. Seventy-



eight percent of the emerged females were from the posterior half of the nest and 72 percent of the emerged males were from the anterior half of the nest.

*Generations.*—This species appears to be univoltine throughout its range.

*Prey.*—Fye (1965) listed *Cinara abieticola* (Cholodkovsky), *C. fornacula* Hottes, *Euceraphis betulae* (Koch), *Macrosiphum* sp., *Rhopalosiphum* sp., and an unidentified psyllid. Krombein (1967) reported *Dysaphis plantaginea* (Passerini), and *Rhopalosiphum fitchii* (Sanderson).

*Parasites.*—Krombein (1967) listed a chrysidid, *Omalus aeneus* (Fabricius), and an ichneumonid, *Poemenia americana americana* (Cresson). I found *Omalus aeneus*, *O. purpuratus* (Provancher), and *Poemenia thoracica* (Cresson).

### *Passaloecus monilicornis* Dahlbom

Observations of the nesting habits of this species have been reported by Fye (1965), Krombein (1967), and Tsuneki (1955, 1973).

*Nesting sites.*—Abandoned beetle galleries (Tsuneki, 1955), stems of *Sambucus canadensis* L. (Fye, 1965), wooden trap-nests (Krombein, 1967), and stems of *Miscanthus* sp. (Tsuneki, 1973).

*Nest architecture.*—Fye observed 37 nests from northwestern Ontario in artificially bored twigs. In borings with a diameter of 6.4 mm, he found five to ten cells per nest. Cell length ranged from 4.8 to 12.8 mm in female cells and 4.8 to 11.2 mm in male cells. One to four vestibular cells were usually present, those listed by Fye ranged from 2.4 to 77.0 mm long. The closing plug varied from 1.6 to 3.2 mm in thickness. Partitions and closures were resin. Fye mentions a few wood shavings being incorporated into some partitions but indicates that this may have been "unintentional."

Krombein observed six nests from Derby, New York in trap-nest borings of 3.2 and 4.8 mm diameter. The 3.2 mm borings contained one to six cells (mean 4.0) with a mean length of 9.6 mm in female cells and 6.7 mm in male cells. The only completed 4.8 mm boring contained 12 cells, three of which were very long (19, 25, and 90 mm). The rest were 6 to 12 mm long (mean 8.6 mm). Three of the six nests had one vestibular cell, one nest had two. Interior partitions were 0.25 to 0.5 mm thick. Nest closures were 0.5 to 1.0 mm thick. Partitions and closures were resin.

Tsuneki (1955) reported an unusual nest from Sapporo, Japan in abandoned beetle galleries in a decaying tree trunk. The complex, branched gallery contained 22 brood cells ranging from 7 to 17 mm long ( $\bar{x}$  = 11.86  $\pm$  2.73 mm). There were three vestibular cells, two of which measured 7.0 and 10.0 mm long. The third was filled with wood particles and was termed an "entrance tunnel" by Tsuneki. Its length was not given. Cell partitions measured 0.5 mm thick and were resin with some wood particles occasionally incorporated. Brood cells contained 25 to 37 aphids. Tsuneki (1973)

observed eight nests from Fukui, Japan. Most were incomplete or superceded by other species of wasps. Partitions and closures were resin.

*Larval activity.*—The larva spins a cocoon described by Fye as "tough, varying in density, and off-white in color." Tsuneki described the cocoon as a thick disk at each end of the cell. He found no silk on the cell walls.

*Generations.*—This species is reported as bivoltine in Sapporo, Japan (Tsuneki, 1955) and Derby, New York (Krombein, 1967). Fye (1965) reported a univoltine strain and a bivoltine strain in northwestern Ontario.

*Prey.*—Fye listed the following: *Amphorophora* sp., *Cinara abieticola*, *C. braggii* (Gillette), *C. fornacula*, *C. palmerae* (Gillette), *Euceraphis betulae*, *Macrosiphum* sp., *Neosymydobius americanus* (Baker), and *Pterocomma smithiae* (Monell). Krombein reported these prey: *Acyrtosiphon pisum* (Harris), *A. porosum* (Sanderson), *Macrosiphum rosae* (Linnaeus), and *Masonaphis* sp.

*Parasites.*—Fye reared two chrysidids, *Omalus aeneus* (as *O. laeviventris* Cresson) and *Omalus* sp. near *iridescent* (Norton), and two ichneumonids, *Poemenia albipes* (Cresson) and *Poemenia* sp. near *americana*. Tsuneki (1973) recorded *Omalus aeneus japonicus* (Bischoff).

*Passaloecus annulatus* (Say)

*Nesting sites.*—Krombein (1955, 1958, 1960, 1961a) reported this species nesting in abandoned beetle borings and stems of *Rhus glabra* L. I collected three nests in Missouri. Two were in stems of *R. glabra* and *Juglans nigra* L. from Research Park, Columbia. The other was in a pine trap-nest from Polk County.

*Nest architecture.*—Peckham and Peckham (1905) reported *P. annulatus* using "pellets of mud" to make the nest closure. This was probably a misidentification of *P. singularis* Dahlbom. The single nest described by Krombein (1960) contained two cells, 9.0 and 11.0 mm long. Partitions and closures were resin.

The two nests in twigs from Columbia were partitioned and closed with dark, gummy resin and contained two and four brood cells. Brood cells were 10.0 to 30.7 mm long. The nest with two brood cells contained two vestibular cells, 19.0 and 16.0 mm long. One male and two females emerged from these nests. Three specimens died as prepupae. The nest from Polk County was in a 1.5 mm diameter boring. Partitions were pale colored resin. No closure was visible. Brood cells measured 6.0, 10.0 and 12.0 mm long from back to front of nest. Two males were recovered.

*Larval activity.*—According to Krombein (1960) the larva spins a delicate cocoon. One larva spun a second cocoon covering the meconium. He described the meconium as a "long, black ribbon."



There was no cocoon in the nest from Polk County. Two delicate cocoons were present in each cell in the nests from Columbia. They were in the form of transverse silken partitions. The first partition was only a few strands thick and in four of the six cells was contiguous with the anterior resinous partition. The second silken partition was situated 4.0 to 10.0 mm behind the first. It was slightly thicker and extended posteriorly 0.5 to 1.0 mm onto the cell wall. The meconium was deposited against the posterior cell wall as several small, black pellets, free of any cocoon covering.

*Generations.*—Krombein (1958) reported this species as multivoltine in the Washington, D. C. area. From collecting records, it appears to be univoltine in Missouri.

*Prey.*—Krombein (1955, 1958, and 1961a) reported the following: nymphs of *Drepanaphis acerifoliae* (Thomas) and *Macrosiphum* sp., and one winged adult of *Chaitophorus populicola* (Thomas).

#### *Passaloecus areolatus* Vincent

*Nesting site.*—Two nests of this species were collected six miles west of Bolivar, Polk County, Missouri, in trap-nest borings of 1.5 mm.

*Nest architecture.*—In the one intact nest, interior partitions were resin and the closure was a mixture of resin and wood particles. Two vestibular cells (1.7 and 7.8 mm long) were filled with small, decomposed wood particles. Brood cells measured 8.3, 8.5, 9.0 and 8.5 mm long from back to front of nest. The other nest containing five cells had been disturbed. The closure was a mixture of resin and soft wood particles and had been opened. Interior partitions were of resin. Cells measured 6.8, 7.0, 6.0, 15.5 and 16.0 mm long from back to front of nest. The anterior four cells were empty and partitions were not intact. One male was recovered from the complete nest, one female from the incomplete nest. The others died in rearing.

*Larval activity.*—No cocoon was detected and the meconium was voided at the rear of the cell as dark pellets.

*Generations.*—Krombein (1963) reported this species (as *P. relativus* Fox) as multivoltine in Virginia. It appears to be univoltine in Missouri.

*Prey.*—Krombein (1958) twice observed this species (as *P. relativus* Fox) provisioning nymphs of *Aphis* sp.

*Parasites.*—A chrysidid, *Omalus* sp., was reared from the complete nest from Polk County.

#### *Passaloecus singularis* Dahlbom

Nesting habits of this species have been described by several European authors, those of Janvier (1961) and Danks (1970) being the most detailed.

*Nesting sites.*—In Britain, Janvier (1961) reports this species (as *P. tenuis*) nesting in black alder (*Rhamnus frangula* L.) and Danks (1970) (as *P.*

*gracilis*) lists trap-nests and existing cavities in "bramble, elder, Buddleja, Forsythia, and ash." In France, Janvier lists stems of ash, briar, buckthorn, elder, honeysuckle, and *Symphoricarpus albus* (L.) Blake (as *S. racemosus* Michx.).

*Adult activity and nest architecture.*—Chevalier (1923), Bouwman (1927), Enslin (1933), Grandi (1934), and Leclercq (1939, 1940) reported this species partitioning with bits of sand and gravel. Chevalier (1923), Bouwman (1927), Grandi (1934), and Leclercq (1940) reported closure with resin or gum. Leclercq (1940) stated that closure material was variable because he observed some nests with closures of uncemented sand and gravel.

Janvier (1961) substantiated the difference between cell partitions and the closure. According to Janvier, females dig their own galleries in twigs of young plum trees, scraping pith loose and dragging it toward the entrance with the mandibles and labrum. The number of aphids in each cell ranged from 15 to 103. The egg was found on the venter or tergum of an aphid in the anterior one-fourth of the cell. After oviposition, the female finished provisioning, then brought partitioning material. Partitions were of sand, earth, and small gravel. The particles were often large relative to the diameter of the burrow. They were wedged between the peripheral walls or deposited against the anterior of the provision. Numerous smaller particles were then deposited forming a partition 1.0 to 9.0 mm thick. Partitions were not supported or strengthened by cementing material. The anterior surface of the partition formed the posterior wall of the next cell. Janvier (1961) observed series of cells numbering four to 17 per nest and ranging from 7.0 to 11.0 mm long. The anterior partition of the last provisioned cell was usually of much greater thickness (up to 2 cm long) than those separating other brood cells. There were one to "several" vestibular cells partitioned with sand and gravel. The final closure was 1.0 to 2.0 mm thick and was resin.

Danks (1970) found 114 cells in 37 nests (mean 3.1 per nest). Cell lengths were omitted. Diameters of male and female brood cells averaged 1.8 and 2.2 mm, respectively. Interior partitions ranged from 1.0 to 4.0 mm thick and were of earth particles, lepidopterous larval frass, and seeds. Closures were of similar material and ranged from 3.0 to 24.0 mm thick (mean 9.0 mm). A "few" closures were covered anteriorly with resin (1.0 to 2.0 mm thick).

*Larval activity.*—Janvier (1961) reported that larvae ate their provisions in one week. A short inactive period was followed by voiding of the meconium, described by Janvier as "small, black, sticky masses." This material covered the posterior wall of the cell where it hardened and formed a dark brown layer. The larva then spun a vestigial cocoon, the anterior of which was a "membranous disc" attached to the peripheral walls and con-



minutes before flying off. Occasionally, a female of the same species would invade the nest. Some intruders would empty the nest as if cleaning it. One wasp stole two aphids and carried them to its nest. On a third and fourth try it was expelled by the nest owner. The intruder then began flying away from the log and returning with aphids to its nest. Final closures were made in three steps, 1) depositing resin around the perimeter of the entrance, 2) sealing the entrance by spreading more resin across the middle of the aperture and smoothing it, and 3) placing many fine, hairlike wood fibers in the resin until it appeared as the surrounding wood.

*Nest architecture.*—Partitions and closures were resin. Thirteen nests contained one brood cell each. The rest contained two brood cells each. Brood cells ranged from 6.0 to 26.9 mm long ( $\bar{x} = 11.89 \pm 5.57$  mm). Single vestibular cells were present in eight nests and they ranged from 2.3 to 26.8 mm long ( $\bar{x} = 13.98 \pm 7.89$  mm). Eighteen males and three females emerged.

*Larval activity.*—The larva spun a vestigial cocoon as a thin, silken membrane contiguous with the anterior resin partition or closure. A second membrane was spun immediately anterior of its head. A few fibers were on the peripheral wall.

*Generations.*—This species is univoltine in Utah.

*Prey.*—Provisions consisted of aphids, both alate adults and nymphs.

*Parasites.*—Chrysidids (*Omalus* sp.) and ichneumonids (*Poemenia americana nebulosa* Habeck and Townes) parasitize this species. A bombyliid (*Anthrax irroratus irroratus* Say) was found in a one-celled nest from the same site.

### *Passaloecus gracilis* (Curtis)

No New World nests of this species have been found. In Europe, Corbet and Backhouse (1975) observed *P. gracilis* (Curtis) nesting in abandoned beetle borings in pine boards and fence-posts near Mundford, England. They report that females chose small holes (1.0 to 1.5 mm diameter) exposed to afternoon sun. No new holes were made but some individuals enlarged existing cavities. Closures were resin and were made in the late afternoon. *Aphis fabae* Scopoli and "an immature tree-dwelling aphid of the subfamily Callaphidinae" were recorded as prey. Internal architecture of the nests was not observed.

Corbet and Backhouse (1975) cite previous biological observations of *P. gracilis* by Janvier (1961) (as *P. turionum*) and Danks (1970) (as *P. insignis* (= *P. turionum*)). However, European authors are in disagreement about the status of *P. turionum* (Yarrow, 1970; Merisuo, 1972; Lomholdt, 1975). Thus, I prefer to exclude observations of Janvier (1961) and Danks (1970) under *P. gracilis*.

*Passaloecus relativus* Fox

*Nesting site.*—During summer, 1972, four intact nests were obtained from abandoned anobiid beetle galleries in a large, dead, deciduous tree at Beaver Ski Resort, Logan Canyon, Utah (el. 6000 ft).

*Nest architecture.*—Partitions and closures were resin. Number of brood cells per nest ranged from one to five ( $\bar{x} = 3.25 \pm 1.71$  cells). Brood cells ranged from 5.3 to 9.5 mm long ( $\bar{x} = 8.03 \pm 1.89$  mm). Three nests contained a single vestibular cell 4.3 to 9.3 mm long. Four males and eight females emerged.

*Larval activity.*—Each brood cell was lined with a very delicate cocoon. The meconium was voided as dark pellets at the rear of the cell. Parasites and prey are unknown.

*Generations.*—Individuals were first seen at the nesting site during the last week in July. It appears to be univoltine in Utah.

## Morphology

The head and face of adult *Passaloecus* provide many specific characters. Tyli are present on the flagellum of all males. These structures are often very useful for separating species and have been studied and used by most recent authors. Distribution of tyli on the flagellum is consistent in most Nearctic species but the location of the first and last tylus may vary in a few species by one flagellomere in either direction. Middle tyli are often more strongly developed. Tyli can vary between species in orientation, shape, and color. In the *P. corniger* group each tylus is received by the concave apical margin of the preceding flagellomere. A less pronounced concavity is also found on midflagellomeres of some species in the *P. annulatus* and *P. relativus* groups.

Mandibles of *Passaloecus* are sexually dimorphic and are generally more useful for separating females. In most females they are spoon-shaped, concave behind, and have a longitudinal carina and many long setae on the posterior surface. In most species they are bidentate and consist of an acute apical tooth and a broad, arcuate or angulate inner margin. *Passaloecus melanognathus* Rohwer and *P. miltoloma* Vincent have tridentate mandibles. Usually the color is white with a dark border, but this can vary in some species to almost all black (*P. erugatus* Vincent and *P. gracilis*).

Other facial characters include divergence or convergence of the eye inner margins, setal patterns on the frons and clypeus, clypeal lobe form, and ratios such as interantennal distance (IAD) to clypeal lobe width (CLW), length to width of labrum, and length to width of clypeus.

The scutum and mesopleuron contain most thoracic characters. Most involve the presence and form of sulci not affected by sexual dimorphism. Notauli length and their degree of areolation are often helpful. Notauli are



short impressed lines in most species. The structures are longer, more deeply impressed and areolate in the *P. areolatus* group and in *P. gracilis*. The latter has strong notauli that are areolate most of their length and in most specimens extend past the scutum midpoint. Scutal patches are present mesally on the scutum of certain females (group assemblage II). They are circular to oval areas of dense micropunctures. In some species in the "*gracilis*" group they are slightly raised and in *P. gracilis* are often nearly obscured by notauli and transverse carinae.

The presence, absence, or form of certain mesopleural sulci have long been used as diagnostic characters. In *P. annulatus*, *P. singularis*, and *P. insignis* groups the scrobal sulcus is absent or represented by a faint depression. In most other species (two exceptions) it is a strongly impressed, areolate sulcus. In *P. cuspidatus* it is impressed and contains weak, longitudinal carinae. In *P. gallicola* it is weakly impressed, a few weak areolae may or may not be present in individuals. An omaulus is developed to various degrees in the *P. gracilis* group. In *P. borealis* and *P. erugatus* it is contiguous with the episternal sulcus. In *P. gracilis* the omaulus is separated dorsally from the episternal sulcus by a smooth area. Some specimens of *P. armeniacae* have a very narrow omaulus, some have a very narrow area of vertical striations anterior to the episternal sulcus, and some have a widened episternal sulcus. Although a definitive omaulus is lacking in some individuals of *P. armeniacae*, in my opinion the widened condition of the episternal sulcus or the narrow area of striations anterior to it are probably homologous to the omaulus as it exists in other species groups.

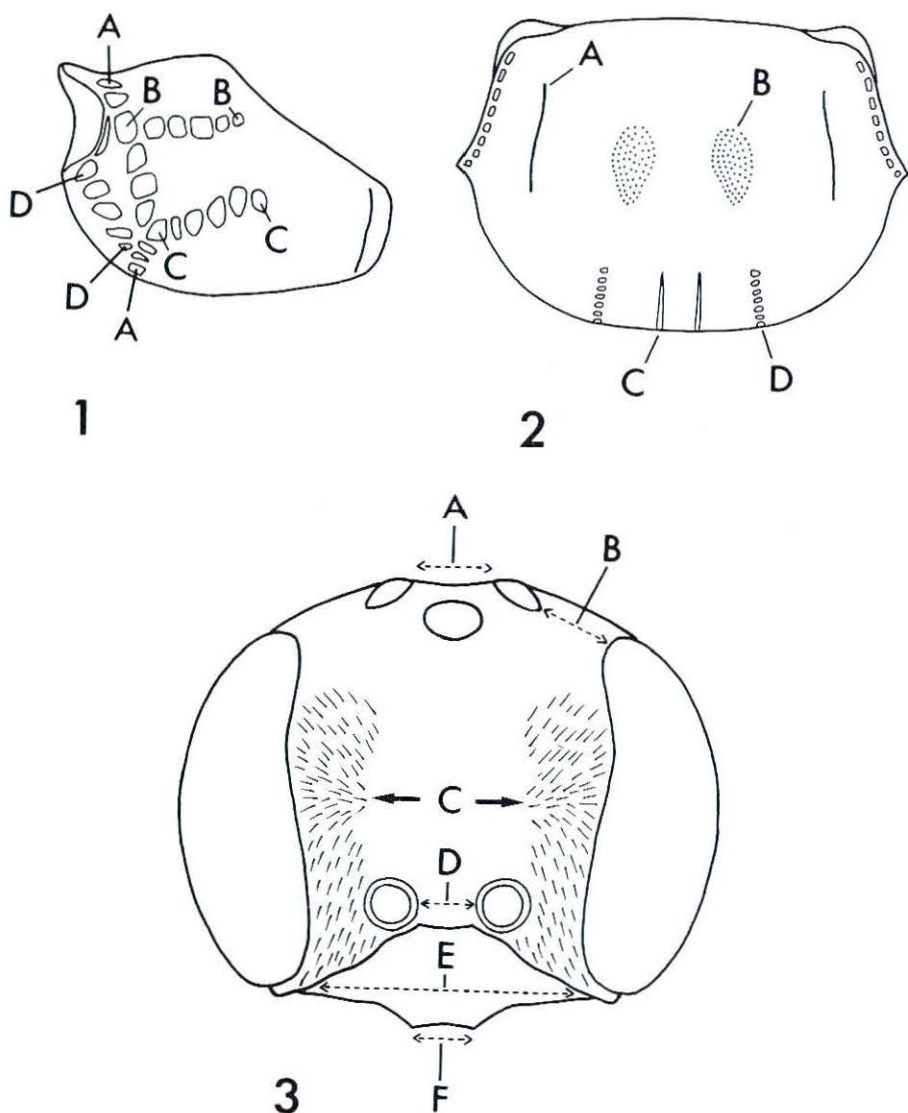
The abdomen provides few but interesting characters. In *P. melanocrus* Rohwer, sternum III is transversely depressed, creating a wide shallow groove. When the abdomen is bent under, the hind margin of sternum II fits into this depression. This may possibly provide more stability when the abdomen is in this posture or may allow the abdomen to be bent under the body at a sharper angle. Spinose tubercles are present mesally on the hind margin of tergum VI of males in group assemblage I. In *P. melanognathus* and *P. cuspidatus* the structures are strongly developed. Similar structures are present on some males of the closely related genus *Diodontus*.

The following glossary defines some morphological terms used in this revision. I am following the terminology of Bohart and Menke (1976) except when peculiarities of the genus require modification of definitions or additional terms.

#### Glossary of Morphological Terms

*Abdominal segment, tergum, or sternum.*—Any segment, tergum, or sternum of the gaster.

*Admedian lines.*—The median pair of longitudinal lines which originate at



Figures 1-3. Morphological landmarks of the mesothorax and face of *Passaloecus* species. Figure 1. Left mesopleuron, lateral view. A-A, episternal sulcus; B-B, scrobal sulcus; C-C, hypersternaulus; D-D, omaulus. Figure 2. Scutum, dorsal view. A, parapsidal line; B, scutal patch (female only); C, admedian line; D, notaulus. Figure 3. Head, anterior view. A, interocellar distance (IOD); B, ocellocular distance (OOD); C, setal pattern division; D, inter-antennal distance (IAD); E, clypeal basal width (CBW); F, clypeal lobe width (CLW).



the base of the anterior slope of the scutum and extend onto the scutal disk (Fig. 2C).

*Areolate*.—Furnished with basin-like cellular areas separated by distinct, raised boundaries.

*Clypeal basal width* (CBW).—Width of the clypeus where its free margin intersects with the malar spaces (Fig. 3E).

*Clypeal lobe*.—The medial projection of the clypeus.

*Clypeal lobe width* (CLW).—Width of the apical margin of the clypeal lobe (Fig. 3F).

*Episternal sulcus*.—In *Passaloecus*, a vertical sulcus on the mesopleuron extending from the subalar fossa to the hypersternaulus and continuing to the mid-ventral line of the thorax (Fig. 1A-A).

*Flagellomere*.—An article of the antennal flagellum.

*Flagellum*.—The jointed portion of the antenna beyond the pedicel, consisting of eleven flagellomeres in the male and ten in the female.

*Gaster*.—The apparent abdomen, excluding the propodeum.

*Hypersternaulus*.—In *Passaloecus*, a horizontal sulcus on the lower one-third of the mesopleuron, intersecting with the episternal sulcus (Fig. 1C-C).

*Interantennal distance* (IAD).—Distance between the sockets (Fig. 3D).

*Interocellar distance* (IOD).—Distance between the hind ocelli (Fig. 3A).

*Notaulus*.—Longitudinal furrow which originates anteriorly on the scutum, laterad of and parallel to the admedian lines (Fig. 2D).

*Ocellocular distance* (OOD).—Distance between the hind ocellus and the eye margin (Fig. 3B).

*Omaulus*.—In *Passaloecus*, an oblique sulcus extending from its dorsal limit at the pronotal lobe to the episternal sulcus near its intersection with the hypersternaulus (Fig. 1D-D).

*Parapsidal line*.—Lateral, longitudinal line on the scutum (Fig. 2A).

*Pronotal lobe*.—Posterolateral part of pronotum covering mesothoracic spiracle.

*Pseudo-sting*.—The spine-like tip of gastral sternum VIII which projects beyond the end of the abdomen (Fig. 25D).

*Scrobal sulcus*.—In *Passaloecus*, a horizontal sulcus extending from the episternal sulcus to the mesopleural scrobe and located dorsad of the hypersternaulus (Fig. 1B-B).

*Scutal patches*.—A pair of oval or round areas, more finely and densely punctate than the surrounding area, located medially on the scutal disk of some female *Passaloecus* (Fig. 2B).

*Setal pattern division*.—In *Passaloecus*, a horizontal line-like division resulting from a divergent orientation of the facial setae (Fig. 3C).

*Spinose tubercles*.—A pair of mesal swellings with dense setae and small,

tiguous with the earthen particles of the anterior partition. A second disk was spun a short distance behind the first. In shorter cells, the two disks were almost contiguous. In longer cells, they were farther apart.

*Generations.*—Janvier (1961) reports this species as bivoltine in France.

*Prey.*—Janvier (1961) lists prey as *Aphis gossypii* Glover and *A. nasturtii* Kaltenbach. Danks (1970) reported *Aphis* sp., *Holcaphis* sp., *Megoura viciae* (Buckton), and *Tuberculoides annulatus* (Hartig).

*Parasites.*—Danks (1970) reported the following: *Eurytoma* sp., *Omalus auratus* (Linnaeus), and *Perithous divinator* (Rossi).

#### *Passaloecus armeniacae* Cockerell

*Nesting site.*—I examined two nests in  $1.0 \times 40.0$  mm trap-nest borings from Beaver Mountain, Beaver County, Utah (el. 7000 ft.).

*Nest architecture.*—Partitions and closures were 0.3 to 0.5 mm thick and were pale, translucent resin. One nest contained a vestibular cell 21.7 mm long and one male brood cell 12.7 mm long. The other nest contained a vestibular cell 16.7 mm long and two male brood cells, 7.8 and 8.5 mm long.

*Larval activity.*—Each larva spun a single, vestigial cocoon as a delicate, transverse, silken partition. No strands were present elsewhere. The meconium was deposited at the rear of each cell.

#### *Passaloecus gallicola* Vincent, new species

Rearing records indicate that this species provisions cavities in old stem galls of *Disholcaspis* sp. on various species of oak (*Quercus dumosa* Nutt.; *Q. lobata* Nee.; *Q. turbinella californica* Tucker). Partitions and closures are resin. John Burnett (UCR) has a paper in progress detailing nesting activity and larval morphology.

#### *Passaloecus borealis* Dahlbom

During summer, 1972, I observed individuals of this species nesting. Later that year, I opened 17 of those nests.

*Nesting site.*—Abandoned anobiid beetle galleries in a large, dead, deciduous tree at Beaver Ski Resort, Logan Canyon, Utah (el. 6000 ft.).

*Adult activity.*—Males were flying on June 13 and females were first seen on June 24. Each female investigated several chambers before nesting in one. The gallery was first cleaned of debris by pulling it backwards to the entrance with mandibles and front legs. Afterward, provisioning began. The number of aphids brought to each nest varied from 27 to 47. The female would alight within a few millimeters of the nest and enter headfirst carrying the aphid. She would usually emerge 5 to 30 seconds later and fly off. Sometimes she would re-enter the nest backwards and remain 1 to 10



stout spines located mesally on the hind margin of tergum VI of some male *Passaloecus* (Fig. 25D).

*Tarsomere*.—An article of the tarsus.

*Tegula*.—An ovoid plate over base of forewing.

*Tylus*.—A linear or ovoid welt on certain flagellomeres of males.

### Systematics

*Generic and infrageneric groupings*.—I concur with Bohart and Menke (1976) in recognizing *Polemistus* Saussure as a separate genus rather than as a subgenus of *Passaloecus*. Characters used in separating *Polemistus* from *Passaloecus* include presence, in *Polemistus*, of scattered, erect setae on the gena; presence of an omaulus which is widely separated from the episternal sulcus; the obtuse angle of the basoposterior corner of submarginal cell I; eyes strongly converging toward the clypeus; the deep scapal basin and, usually, one to three spines along the length of the hindfemur. Presence of erect genal setae in *Polemistus* seems to be the only consistent generic difference between these taxa. Several species of *Passaloecus* have an omaulus but only in *P. gracilis* and Old World *P. vandeli* Ribaut does it appear similar to the omaulus as it appears in all species of *Polemistus*. These two species are also the only *Passaloecus* in which the basoposterior corner of submarginal cell I is an obtuse angle. In a few *Polemistus*, the scapal basin is not deeply formed or the hindfemur lacks spines along its length.

Named infrageneric groupings in *Passaloecus* were first attempted by Verhoeff (1890) who proposed two subgenera, *Coeloecus* and *Heroecus*, distinguished by the absence in the former of a scrobal sulcus and by its presence in the latter. Verhoeff included three species in *Coeloecus*: *P. gracilis* of Dahlbom (= *P. singularis* Dahlbom), *P. roettgeni* Verhoeff (= *P. insignis* (Vander Linden)), and *P. monilicornis* Dahlbom. No species were assigned to *Heroecus*. Pate (1937) designated *Passaloecus gracilis* (Curtis) type species of *Coeloecus*, and *Passaloecus insignis* (Vander Linden) type species of *Heroecus*. Yarrow (1970) pointed out that Verhoeff, like most early authors, misinterpreted *P. gracilis* and that the identity of *P. insignis* had also been confused. Thus, because of Pate's type designations, neither of Verhoeff's subgenera conform to his original concepts. Contrary to Yarrow's (1970) statements, Pate's type designation for *Coeloecus* was valid. I agree that subgenera in *Passaloecus* are unwarranted, hence their misrepresentation is of academic interest only. In my opinion, infrageneric groupings based solely on the presence or absence of the scrobal sulcus results in polyphyletic taxa. In addition, "presence" or "absence" of the scrobal sulcus in some species is often a matter of degree (i.e., whether it is absent, lightly impressed, deeply impressed, or areolate).

Yarrow (1970) established a sound species group classification for the Old World *Passaloecus*, and I agree that they provide a more satisfactory infrageneric arrangement than subgenera when the world fauna is considered. Yarrow's four species groups (*P. monilicornis*, *P. singularis*, *P. corniger*, and *P. gracilis* groups) are distinguished from one another by presence or absence of certain mesopleural sulci, form of clypeal lobe, form of mandibles, length of notauli, and general appearance and location of tyli on flagellomeres of males. Merisuo (1972, 1973c) used the same groups, although he substituted the name *P. borealis* for Yarrow's *P. gracilis* group. In 1974 Merisuo added two new groups, *P. abnormis* and *P. vandeli*. The former, however, belongs in the genus *Polemistus*, and I am including the latter in the *P. gracilis* group.

I am using Yarrow's groups and their names, with one exception. I prefer to substitute the name *P. insignis* for the *P. monilicornis* group. The specificity or conspecificity of the two quite similar species has been a matter of some controversy. It seems more advisable to use the older name *P. insignis* for their species group as its usage will not be affected by any future synonymical decisions. Moreover, other group names represent the earliest named species within each group. Thus, substituting *P. insignis* for *P. monilicornis* would establish consistency in the naming of species groups within the genus.

Yarrow's four groups have New World representatives, but four additional species groups are needed to accommodate New World forms: *P. annulatus*, *P. areolatus*, *P. relativus*, and *P. armeniacae* groups. Characters for separating these groups include (in addition to those already mentioned) presence or absence of paired spinose tubercles on the hind margin of tergum VI of males, presence or absence of paired, densely punctate scutal patches in females, structure and appearance of notauli, and the facial setal pattern.

In separating the *P. singularis* group from the *P. monilicornis* group (= *P. insignis* group), Yarrow (1970) mentioned the presence in the former of circular areas of dense, minute punctures on the scutum of females. These areas also occur on females of the *P. gracilis* and *P. armeniacae* groups. For most species, presence or absence of these areas in females can be inversely associated with the presence or absence of spinose tubercles on the hind margin of tergum VI in males. Tsuneki (1955) noted the presence of this tergal structure in males of *P. annulatus* and *P. nipponicola* Tsuneki as did Lomholdt (1975) in males of *P. eremita* Kohl, *P. corniger* Shuckard, *P. insignis*, and *P. monilicornis*. These presumably specialized secondary sexual characters are interesting when the world fauna is considered for they separate the genus into two major group assemblages (31 species). A third, smaller group assemblage (containing only the *P. relativus* group



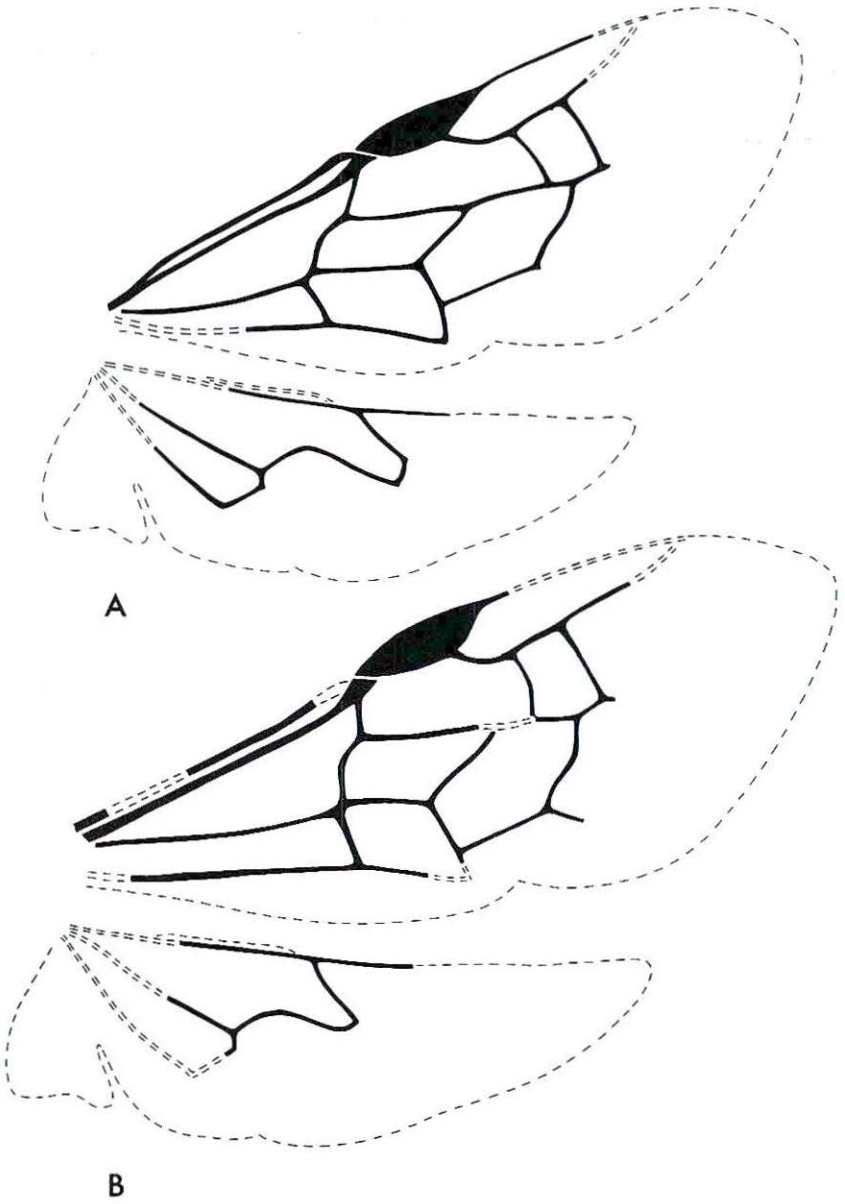


Figure 4. Wings of fossil *Passaloecus* species. A, *P. fasciatus* Rohwer; B, *P. scudderi* Cockerell.

which consists of three species) exhibits neither of these characters. The latter group occurs only in the western United States. I prefer to leave these group assemblages without names and maintain the present concept of species group relationship used by Yarrow and Merisuo.

I have seen specimens of 14 of the 24 Old World species and am familiar with the remainder via description. Table 1 presents my concept of world monophyletic groupings within the genus, based on my studies of these species.

*Fossils*.—Two fossil species of *Passaloecus* have been described (*P. fasciatus* Rohwer and *P. scudderi* Cockerell) from the Tertiary shales of Florissant, Colorado. I have examined both holotypes and drawn their wing venation (Fig. 4). Most diagnostic characters of the body and head are obliterated on both specimens. Determination of sex or affiliations with existing species is impossible. However, both specimens are *Passaloecus* as evidenced by the lack of spines on the hindtibia, short gastral petiole, robust body, broad head, and acute posterobasal angle of submarginal cell I. *Passaloecus fasciatus* appears similar in wing venation and size to some larger species of existing *Passaloecus*.

*Phylogeny*.—*Passaloecus* belongs in the subtribe Pemphredonina which in my opinion is a monophyletic group that probably evolved from a *Diodontus*-like ancestor. The subtribe can be divided into two groups, each of which contains two closely related genera. *Diodontus* and *Pemphredon* form one group. Species in both of these genera have a female pygidial plate, a coarsely sculptured mesopleuron, evanescent mesopleural sulci, a tarsal rake, spinose hindtibia, and general absence of microsculpturing on the head and scutum. *Diodontus*, with its nearly sessile gaster, narrow bidentate mandible, and ground-nesting habit, is the most generalized genus of the subtribe. *Pemphredon*, with its petiolate abdomen, three to six toothed mandible, and a twig-nesting habit, is more specialized. *Passaloecus* and *Polemistus* form the second and more specialized group. The scrobal sulcus and hypersternaulus are present in most species and are usually well defined and areolate. Several *Passaloecus* and all *Polemistus* have an omaulus. The omaulus is sulcate in most *Passaloecus* and carinate in most *Polemistus*. Both genera have a scapal basin although this is more well defined in *Polemistus*. Other characters common to both genera include reticulate microsculpturing in the interspaces on the head and scutum, absence of a pygidial plate, few if any spines on the hindtibia, a broad scoop-shaped mandible in the female, and a twig-nesting habit that usually involves use of resin in closures and partitions. Extensive areolation of head and scutal sulci, long erect setae on the gena, a more narrow face, and a deep scapal basin indicate that *Polemistus* is the most specialized.



## Key to Genera of Subtribe Pemphredonina

1. Episternal sulcus incomplete, not evident between subalar fossa and hypersternaulus; hypersternaulus rising obliquely posterad; labrum emarginate or entire; mandible with two to six teeth; female with pygidial plate; hindtibia usually with a series of spines along posterior margin 2
- Episternal sulcus well developed, extending from subalar fossa to hypersternaulus and beyond; hypersternaulus horizontal; labrum with apex entire, usually roundly produced; mandible with two or three teeth; female without pygidial plate; hindtibia at most with a few scattered, weak spines along posterior margin 3
2. Gastral petiole longer than wide in dorsal view; labrum entire (sometimes weakly notched) *Pemphredon* Latreille
- Gastral petiole wider than long in dorsal view; labrum emarginate *Diodontus* Curtis
3. Gena with scattered, long, erect setae ventrally; inner orbits converging strongly below, interocular distance at midocellus more than one-third greater than least interocular distance; midflagellar articles broader than long; omaulus always present, broadly separated at its dorsal limit from episternal sulcus; hindtibia usually with one to three weak spines along its length *Polemistus* Saussure
- Gena without long, erect setae ventrally; inner orbits nearly parallel (at most converging weakly below), interocular distance at midocellus not more than one-third greater than least interocular distance; midflagellar articles longer than broad; omaulus, when present, usually contiguous at its dorsal limit with episternal sulcus; hindtibia usually without spines along its length *Passaloecus* Shuckard

Genus *Passaloecus* Shuckard

*Xyloecus* Shuckard, 1837. No included species. Preoccupied by Serville, 1833.

*Passaloecus* Shuckard, 1837. Essay on the Indigenous Fossorial Hymenoptera, p. 188. Type species: *Pemphredon insignis* Vander Linden, 1829. Original Designation.

*Coeloecus* Verhoeff, 1890: 383. Type species: *Diodontus gracilis* Curtis, 1834. Designated by Pate, 1937.

*Heroecus* Verhoeff, 1890: 383. No included species. Type species: *Pemphredon insignis* Vander Linden, 1829. Included and designated by Pate, 1937.

*Generic diagnosis.*—Forewing with two submarginal cells, three discoidal cells, each submarginal cell receiving a recurrent vein, submarginal cell I with acute posterobasal angle; midtibia with one apical spur; hindtibia usually without spines along posterior margin; gastral petiole about as wide as long; midflagellar articles usually longer than broad; sockets low on face, near dorsal margin of clypeus; face with weak scapal basin; labrum triangular, apex entire and usually rounded, medial projection usually pronounced in female; mandible with two or three weak teeth, posterior surface of female mandible strongly concave, rows of long setae bordering the concavity; lower area of gena with short, appressed setae; occipital carina complete to midventral line of head; pronotal collar with complete, transverse carina; episternal sulcus areolate, extending from subalar fossa to hypersternaulus, continuing to midventral line of thorax; hypersternaulus areolate; pygidial plate absent.

#### Key to Species of North American *Passaloecus* Shuckard

1. Males: eleven flagellomeres; seven visible gastral terga 2  
 – Females: ten flagellomeres; six visible gastral terga 18
2. Spinose tubercles present on hind margin of gastral tergum VI mesally (as in Fig. 25D) 3  
 – Spinose tubercles absent on gastral tergum VI 8
3. Clypeal lobe bi- or tridentate (Fig. 11B, D) “corniger group” 4  
 – Clypeal lobe either truncate or weakly concave 5
4. Clypeal lobe tridentate (Fig. 11B); apex of foretarsomere I produced below (Fig. 25H); length of flagellomere I  $1\frac{1}{2}$  times width; flagellomeres IV–XI with tyli (Fig. 17A) 150  

*P. cuspidatus* Smith (p. 150)

 – Clypeal lobe bidentate (Fig. 11D); apex of foretarsomere I not produced below; length of flagellomere I  $2\frac{1}{2}$  times width; flagellomeres VIII– or IX–XI with tyli (Fig. 17B) 152  

*P. melanognathus* Rohwer (p. 152)
5. Scrobal sulcus deeply impressed, areolate (as in Fig. 23C) 6  

“areolatus group”

 – Scrobal sulcus absent or very weakly impressed (as in Fig. 23B) 7
6. Flagellomeres I–IX with linear tyli not produced in profile (Fig. 18D); mandible, hindtrochanter dark brown or black 162  

*P. lineatus* Vincent, new species (p. 162)

 – Flagellomeres II–VIII or IX with oval tyli arcuately produced in profile (Fig. 18C); mandible white or pale yellow; hindtrochanter pale amber 159  

*P. areolatus* Vincent, new species (p. 159)
7. Flagellomeres III or IV–VIII with tyli, those on IV and V weakly produced, resulting in a weak swelling at joint (Fig. 18A, B); fla-



- gellum with pale bands, apical  $\frac{1}{3}$  to  $\frac{1}{2}$  of flagellomeres III–IX white or pale yellow; hindtrochanter pale amber; IOD less than OOD  
 “*annulatus* group” *P. annulatus* (Say) (p. 157)
- Flagellomeres constricted at joints (Fig. 17D, F), II or III–IX or X with tyli; flagellomeres, trochanters dark brown or black; IOD greater than OOD “*insignis* group” *P. monilicornis* Dahlbom (p. 154)
8. Omaulus present 9  
 – Omaulus absent 12
9. Scutum anteriorly with interrupted, transverse carinae (as in Fig. 24F); notauli extending past midpoint of scutum; omaulus separated from episternal sulcus by a narrow, smooth area (Fig. 23G); no setal pattern division on face, setae directed ventrad (Fig. 15F)  
 “*gracilis* group” *P. gracilis* (Curtis) (p. 177)
- Scutum anteriorly without transverse carinae; notauli about as long as admedian lines; omaulus contiguous with episternal sulcus; setal pattern division strong, midway on face (Fig. 14B; 15B, D) 10
10. Flagellomeres I–X with tyli low in profile (Fig. 19A, B); omaulus broadening dorsally (Fig. 23F); clypeal lobe weakly concave apically (Fig. 15B, D); IOD less than OOD “*gracilis* group” 11  
 – Flagellomeres I–IX or X with tyli arcuately produced in profile (Fig. 18F, G); omaulus narrow, not broadening dorsally (Fig. 23D); clypeal lobe truncate apically (Fig. 14B); IOD greater than OOD  
 “*armeniaca* group” *P. armeniaca* Cockerell (p. 167)
11. Scutal margin opposite tegula strongly reflexed, in most specimens areolate (as in Fig. 24D); parapsidal lines not reaching hind margin of scutum *P. borealis* Dahlbom (p. 173)  
 – Scutal margin opposite tegula flattened, smooth, shining (as in Fig. 24E); parapsidal lines extending to hind margin of scutum  
*P. erugatus* Vincent, new species (p. 176)
12. Scrobal sulcus absent or weakly impressed (weakly areolate in some *P. gallicola*) (Fig. 23B, E) 13  
 – Scrobal sulcus strongly impressed, areolate (as in Fig. 23C, D) 14
13. Flagellomeres II–VIII with flattened, reddish-brown tyli, those on V–VIII truncated against apical margin of preceding flagellomere (Fig. 18E); IOD less than OOD; clypeal lobe weakly trilobed apically (Fig. 13F); pronotal lobe and trochanters dark brown or black; mesopleuron dull with fine, dense microsculpture connecting scattered punctures “*singularis* group” *P. singularis* Dahlbom (p. 165)  
 – Flagellomeres I–VII or VIII with oval tyli weakly produced in profile (Fig. 18H, I) IOD equal to or greater than OOD; clypeal lobe truncate apically (Fig. 14C, D); pronotal lobe white or pale yellow; trochanters pale amber; mesopleuron shiny, scattered punctures not connected by microsculpture

- “*armeniaca* group” *P. gallicola* Vincent, new species (p. 169)
14. Flagellum uniformly brown or reddish-brown “*armeniaca* group” 15  
 – Flagellum with pale markings “*relativus* group” 16
15. Hindtibia with one to three erect spines along its length (Fig. 25E);  
 clypeal lobe weakly concave apically (Fig. 14F); trochanters pale  
 amber *P. miltoloma* Vincent, new species (p. 171)  
 – Hindtibia without spines along its length; clypeal lobe truncate apically (Fig. 14B); trochanters dark brown  
*P. armeniaca* Cockerell (p. 167)
16. Gastral sternum III with shallow, transverse depression (Fig. 25C);  
 posterolateral margin of gastral tergum III angulate (as in Fig. 25A);  
 flagellomeres I– or II–X with spindle-shaped tyli, those on V–VIII  
 received by concave apical margin of preceding flagellomere (Fig.  
 19E); apical  $\frac{1}{3}$  of flagellomeres I–X white or pale yellow; labrum  
 white *P. melanocrus* Rohwer (p. 181)  
 – Gastral sternum III without transverse depression; posterolateral  
 margin of gastral tergum III either angulate or broadly curved; flagellomeres I–VIII or X with linear tyli (Fig. 19D, F); apical margins of flagellomeres not concave; flagellum either with pale bands or grayish-white below; labrum dark brown 17
17. Posterolateral margin of gastral tergum III angulate (as in Fig. 25A);  
 flagellomeres grayish-white below, I–X with tyli (Fig. 19D)  
*P. relativus* Fox (p. 179)  
 – Posterolateral margin of gastral tergum III broadly curved (Fig. 25B); flagellomeres I–X with pale bands on their apico-ventral and lateral third, I–VIII with tyli (Fig. 19F)
- P. patagiatus* Vincent, new species (p. 185)
18. Scutal patches present (Fig. 24C–F) 19  
 – Scutal patches absent 26
19. Omaulus present (Fig. 23D, F, G) 20  
 – Omaulus absent 23
20. Scutum anteriorly with interrupted, transverse carinae (Fig. 24F);  
 notauli extending to midpoint on scutum; omaulus separated from  
 episternal sulcus by a narrow, smooth area (Fig. 23G); no setal  
 pattern division on face, setae directed ventrad (Fig. 15E)  
 “*gracilis* group” *P. gracilis* (Curtis) (p. 177)  
 – Scutum anteriorly without transverse carinae, notauli about as long  
 as admedian lines; omaulus contiguous with episternal sulcus (Fig.  
 23D, F); setal pattern division low on face, setae directed obliquely  
 dorsad from sockets to upper frons (Figs. 14A; 15A, C) 21
21. Clypeal lobe concave apically (Fig. 15A, C); omaulus strong, broadening dorsally (Fig. 23F); scutal patches raised, oval (Fig. 24D, E);



- IOD less than OOD; mandible as in Figure 21D, E "gracilis group" 22
- Clypeal lobe truncate apically (Fig. 14A); omaulus weak, narrow, not broadening dorsally (Fig. 23D); scutal patches circular, flat (as in Fig. 24C); IOD greater than OOD; mandible as in Figure 21A  
     "armeniacaе group" *P. armeniacaе* Cockerell (p. 167)
22. Scutal margin opposite tegula strongly reflexed, in most specimens areolate (Fig. 24D); parapsidal lines not reaching hind margin of scutum  
     *P. borealis* Dahlbom (p. 173)
- Scutal margin opposite tegula flattened, smooth, shining (Fig. 24E); parapsidal lines extending to hind margin of scutum  
     *P. erugatus* Vincent, new species (p. 176)
23. Scrobal sulcus strongly impressed, areolate (Fig. 23D)  
     "armeniacaе group" 24
- Scrobal sulcus absent or weakly impressed (weakly areolate in some *P. gallicola*) (as in Fig. 23B, E) 25
24. Hindtibia with one to three erect spines along its length (Fig. 25E); mandible as in Figure 21C; transverse band on clypeal lobe pale to dark amber; trochanters pale amber  
     *P. miltoloma* Vincent, new species (p. 171)
- Hindtibia without spines along its length; mandible as in Figure 21A; clypeal lobe black; trochanters dark brown or black  
     *P. armeniacaе* Cockerell (p. 167)
25. Clypeal lobe apex truncate, not upturned (Fig. 14C); mandible as in Figure 21B; trochanters pale amber  
     "armeniacaе group" *P. gallicola* Vincent, new species (p. 169)
- Clypeal lobe apex weakly trilobed, upturned (Fig. 13E); mandible as in Figure 20G; trochanters dark brown or black  
     "singularis group" *P. singularis* Dahlbom (p. 165)
26. Clypeal lobe strongly tridentate apically (Fig. 11A, C)  
     "corniger group" 27
- Clypeal lobe truncate, concave, or weakly tridentate apically (as in Figs. 12A, C, E; 13A, C; 16A, C, E) 28
27. Mandible bidentate, inner margin broadly arcuate (Fig. 20A); clypeal setae directed toward midline, frontal setae directed obliquely dorsad (Fig. 11A); IOD less than OOD; inner orbits of eyes converging weakly below (Fig. 11A); labrum about as broad as long (Fig. 22A)  
     *P. cuspidatus* Smith (p. 150)
- Mandible tridentate, middle tooth truncate, inner tooth rounded (Fig. 20B); setal pattern division midway on face, setae below the division directed ventrad, clypeal setae directed ventrad (Fig. 11C); IOD equal to OOD; inner orbits of eyes diverging weakly below (Fig. 11C); labrum twice as broad as long (Fig. 22B)

- P. melanognathus* Rohwer (p. 152)
28. Scrobal sulcus absent or very weakly impressed (as in Fig. 23B) 29  
 – Scrobal sulcus strongly impressed, areolate (as in Fig. 23C) 30
29. Clypeal lobe weakly convex apically (Fig. 12E); IOD less than OOD; trochanters and forefemur pale yellow brown  
     “*annulatus* group” *P. annulatus* (Say) (p. 157)  
 – Clypeal lobe either concave apically or truncate (Fig. 12A, C); IOD equal to or slightly greater than OOD; trochanters and femora dark brown or black “*insignis* group” *P. monilicornis* Dahlbom (p. 154)
30. Notauli strongly impressed, areolate, often twice as long as admedian lines (as in Fig. 24B) “*areolatus* group” 31  
 – Notauli weakly impressed, about as long as admedian lines “*relativus* group” 32
31. CLW equal to IAD (Fig. 13C); apical  $\frac{1}{3}$  to  $\frac{2}{3}$  of mandible dark brown; trochanters dark brown or black  
     *P. lineatus* Vincent, new species (p. 162)  
 – CLW  $1\frac{1}{3}$  times IAD (Fig. 13A); apical  $\frac{1}{3}$  to  $\frac{1}{2}$  of mandible pale yellow-brown; trochanters pale yellow-brown  
     *P. areolatus* Vincent, new species (p. 159)
32. Gastral sternum III with shallow, transverse depression (as in Fig. 25C); posterolateral margin of gastral tergum III angular (Fig. 25A); IOD greater than OOD; labrum white *P. melanocrus* Rohwer (p. 181)  
 – Gastral sternum III without transverse depression; posterolateral margin of gastral tergum III either angular or broadly curved; IOD equal to or less than OOD; at least basal  $\frac{1}{2}$  of labrum brown 33
33. Posterolateral margin of gastral tergum III angular (as in Fig. 25A); IOD less than OOD; labrum uniformly brown *P. relativus* Fox (p. 179)  
 – Posterolateral margin of gastral tergum III broadly curved (Fig. 25B); IOD equal to OOD; apical  $\frac{1}{2}$  of labrum white, basal  $\frac{1}{2}$  brown  
     *P. patagiatus* Vincent, new species (p. 185)

#### “CORNIGER GROUP”—group assemblage I

Females in this holarctic group are characterized by a tridentate clypeal lobe, tridentate mandible (except *P. cuspidatus*), setal pattern division at sockets, (except *P. melanognathus*), and lack of scutal patches (Table 1). In males the setal pattern division is high on face above sockets, flagellomeres are concave apically, a tylus is present on flagellomere XI, and spinose tubercles are present on gastral tergum VI. In both sexes the scrobal sulcus is deeply impressed and the omaulus is lacking.

*Passaloecus cuspidatus* Smith

*Passaloecus cuspidatus* Smith, 1856:427 (holotype female, Hudson's Bay,



Canada—BMNH); Cresson, 1887:283; Fox, 1892:321; Muesebeck et al., 1951:968; Krombein et al., 1967:398; Krombein, 1967:236; Evans and Eberhard, 1970:96; Bohart and Menke, 1976:184.

\**Pemphredon mandibularis* Cresson, 1865:487 (lectotype female, Colorado, U.S., designated by Cresson, 1916—ANSP, type no. 2044).

*Passaloecus mandibularis* (Cresson), Packard, 1867:395; 1874:161; Cresson, 1887:283; Fox, 1892:320; Rohwer, 1909:100; Krombein, 1938:122; Muesebeck et al., 1951:968; Krombein, 1956:42; 1958:24; Evans, 1958:131; 1959:167; Krombein, 1963:275; Evans, 1964:250; Fye, 1965:740, 742.

\**Passaloecus distinctus* Fox, 1892:319 (holotype male, Beverly, Massachusetts, U.S.—ANSP, type no. 4820); Krombein, 1938:123; Muesebeck et al., 1951:968.

\**Passaloecus dispar* Fox, 1892:320 (lectotype male, Nevada, U.S., designated by Cresson, 1928—ANSP, type no. 4821), synonymy by Vincent in Bohart and Menke, 1976; Muesebeck et al., 1951:968.

*Male*.—Black; mandible except apex, palpal segments III–VI of maxilla and II–IV of labium, apical half of labrum, ventral side of scape, pronotal lobe, foretibia above, basal  $\frac{1}{8}$  to  $\frac{1}{4}$  of hindtibia creamy white; wing veins, stigma dark to yellow brown; mandible apex, palpal segments I and II of maxilla and I of labium, flagellum, mid- and hindtibia and tarsus dark brown; setal pattern division strong, midway on face (Fig. 11B); clypeal setae inclined ventrad; flagellomere I length no more than  $1\frac{1}{2}$  times apical width; flagellomeres IV–XI with tyli, a shallow depression near inner margin of tylus on IV–VII, each tylus received by concave apical margin of preceding flagellomere (Fig. 17A); IOD equal to OOD; inner orbits of eyes converging weakly below; CBW less than 4 times CLW, slightly more than twice mid-clypeal length; clypeal lobe tridentate (Fig. 11B); inner margin of mandible obtusely angled (Fig. 20A); notauli impressed (as in Fig. 24A); scrobal sulcus strongly impressed, usually containing scattered, weak, longitudinal carinae (Fig. 23A); lateral projection of forecoxa rounded (as in Fig. 25F); apex of foretarsomere I produced below (Fig. 25H); hind margin of gastral tergum VI with spinose tubercles mesally (Fig. 25D); penis valve as in Figure 26A. Length 3.9–7.9 mm.

*Female*.—Similar to male except as follows: setal pattern division low on face, setae directed obliquely dorsad from sockets to upper frons, below sockets directed laterad (Fig. 11A); clypeal setae inclined toward midline; CBW about three times mid-clypeal length; labrum about as broad as long (Fig. 22A); inner margin of mandible broadly arcuate (Fig. 20A); scutum evenly punctured and microsculptured medially (Fig. 24A). Length 5.5–9.2 mm.

*Discussion*.—This species resembles *P. melanognathus* but differs in position and shape of the tyli. Females can be distinguished by the broadly

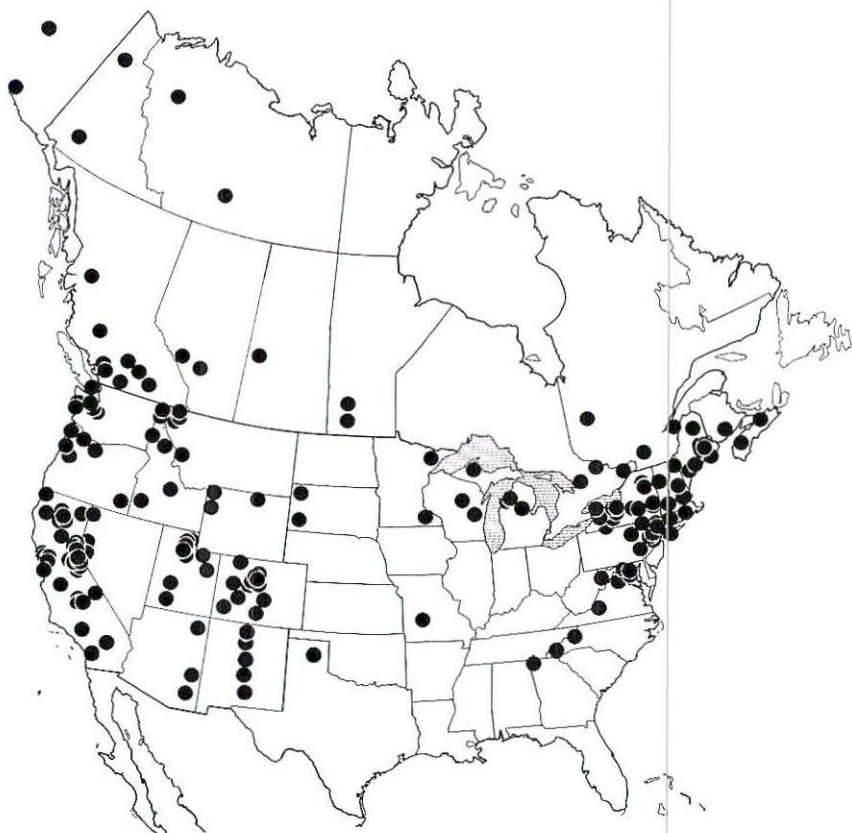


Figure 5. Known distribution of *P. cuspidatus*.

arcuate inner margin of the mandible, medially inclined clypeal pubescence, and shorter flagellomere I.

The hindtibia is sometimes all black and a white spot is present at the base of the midtibia of some specimens. In certain females from western coastal areas of the U.S., the mandibles are somewhat narrowed apically.

*Floral record*.—*Solidago* sp.

*Geographic range* (Fig. 5).—Found over most of U.S. and Canada. I have seen 264 males, 671 females.

*Type material*.—The holotype of *Passaloecus cuspidatus* has been examined by Dr. R. M. Bohart and Dr. K. V. Krombein.

*Passaloecus melanognathus* Rohwer

\**Passaloecus melanognathus* Rohwer, 1910:104 (holotype female, Oregon,



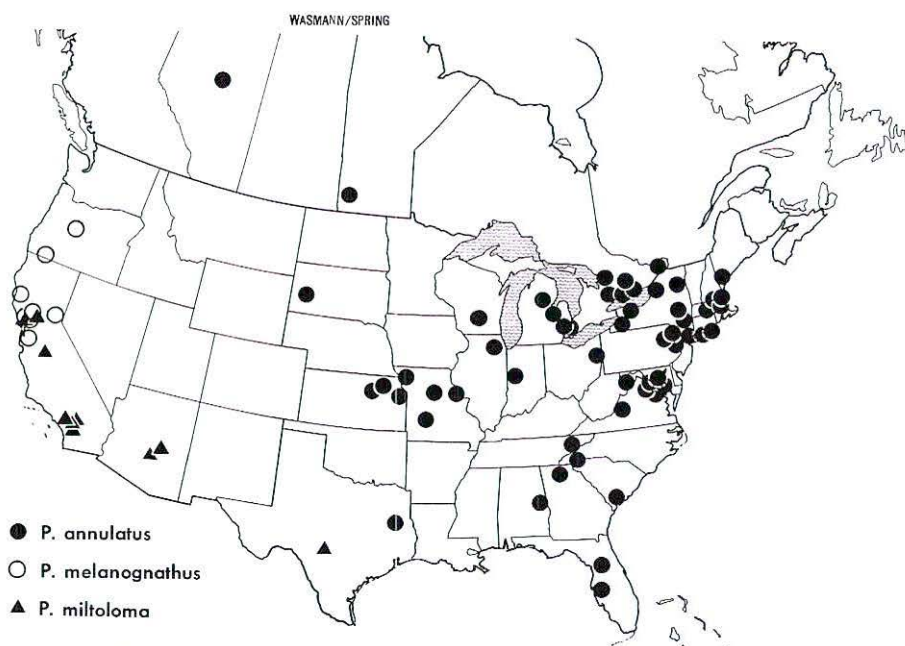


Figure 6. Known distribution of *P. annulatus* (dark circles), *P. melanognathus* (open circles), and *P. miltoloma* (triangles).

U.S.—USNM, type no. 12866); Muesebeck et al., 1951:968; Bohart and Menke, 1976:184.

*Male*.—Black; mandible except apex and margins (on some specimens entirely dark brown), palpal segments III–VI of maxilla and II–IV of labium, ventral side of scape, pronotal lobe, foretibia above, basal  $\frac{1}{6}$  of mid- and hindtibia white to pale yellow; ventral side of flagellum light brown; mandible apex and margins, palpal segments I and II of maxilla and I of labium, labrum, dorsal side of flagellum, tarsi, wing veins, stigma dark brown; setal pattern division strong, midway on face (Fig. 11D); clypeal setae directed ventrad; flagellomere I length more than twice apical width; flagellomeres VIII–XI with tyli, each tylus received by concave apical margin of preceding flagellomere (Fig. 17B); IOD equal to OOD; inner orbits of eyes parallel; CBW more than 5 times CLW, almost 3 times mid-clypeal length; clypeal lobe bidentate (Fig. 11D); inner margin of mandible obtusely angled (Fig. 20B); notauli impressed (as in Fig. 24A); hind margin of gastral tergum VI with spinose tubercles mesally (as in Fig. 25D); penis valve as in Figure 26B. Length 6.0–7.9 mm.

*Female*.—Similar to male except as follows: CBW about 4 times CLW or mid-clypeal length (Fig. 11C); labrum twice as broad as long (Fig. 22B);

clypeal lobe strongly tridentate (Fig. 11C); mandible tridentate, middle tooth truncate, inner tooth rounded (Fig. 20B); inner orbits of eyes weakly divergent below (Fig. 11C); scutum evenly punctured, microsculptured medially (as in Fig. 24A). Length 6.7–9.1 mm.

*Discussion.*—Related to *P. cuspidatus* but differs in males by its bidentate clypeus, lesser number of tyli, and simple foretarsomere I. Distinguishing characters of females include tridentate mandibles, ventrally directed clypeal setae, longer flagellomere I, and slightly divergent inner orbits of eyes below.

*Geographic range* (Fig. 6).—I have seen eight males, eight females from the following localities: California: Alameda Co., Arroyo Macho near Livermore; Lake Co., Cobb Mountain; Mendocino Co., Hopland, Pigmy Forest near Mendocino City; Napa Co., north slope of Mount St. Helena; Placer Co., Penryn; Oregon: Coleston.

#### “*INSIGNIS* GROUP”—group assemblage I

Females in this holarctic group lack scutal patches (Table 1) and have a setal pattern division at sockets, concave to truncate clypeal lobe apex, and bidentate mandible. Males are characterized by a setal pattern division high on face above sockets, flagellomeres constricted at joints, and spinose tubercles on gastral tergum VI. The scrobal sulcus and omaulus are lacking in both sexes.

#### *Passaloecus monilicornis* Dahlbom

\**Passaloecus monilicornis* Dahlbom, 1842:12 (lectotype female, Helsingland, Karbole, Sweden, designated by Yarrow, 1970—LUZI) REVISED STATUS: Dahlbom, 1844:243 (in part); 1845:505 (in part); Taschenberg, 1866:188; Bold, 1868:226; Taschenberg, 1869:95; Saunders, 1880:258 (in part); Verhoeff, 1890:383; Saunders, 1904:249; Ferton, 1908:564; Richards, 1937:105; Tsuneki, 1955:6; de Beaumont, 1964a:109; Yarrow, 1970:168, 179; Oehlke, 1971:745; Balthasar, 1972:194 (in part); Merisuo, 1972:204; 1973c:109; Tsuneki, 1973:63; Lomholdt, 1975:125.

*Passaloecus monilicornis* var. *dahlbomi* Sparre-Schneider, in Kohl, 1905:523; Schmiedeknecht, 1930:672; Yasumatsu, 1934b:113; 1938:175; Zavadil and Snoflak, 1948:47; Faester, 1951:451; Erzsebet, 1957:788.

*Passaloecus shuckardi* Yasumatsu, 1934a:36.

\**Passaloecus ithacae* Krombein, 1938:126 (holotype female, Ithaca, New York, U.S.—USNM, type no. 55768), synonymy by Vincent in Bohart and Menke, 1976; Muesebeck et al., 1951:968; Evans, 1964:249; Fye, 1965:737; Krombein, 1967:234; Krombein et al., 1967:398.

*Passaloecus insignis* (Vander Linden) of Vincent, in Bohart and Menke, 1976:184 (in part) REVISED STATUS.



*Male*.—Black; mandible except apex and posterior surface, ventral side of scape, palpal segments III–VI of maxilla and II–IV of labium, pronotal lobe creamy-white; fore- and midfemur at apex, fore- and midtibia, fore- and midtarsus pale to dark amber; mandible apex, palpal segments I and II of maxilla and I of labium, labrum, dorsal side of scape, hindtibia, hindtarsus, wing veins and stigma dark brown; setal pattern division strong, midway on face (Fig. 12B, D); clypeal setae directed ventrad; midflagellomeres arcuate above, truncate apically, II or III–VIII or IX with thin, raised tyli (Fig. 17C, D, E, F); IOD equal to OOD; clypeal lobe weakly concave apically (northeastern and northcentral U.S., Fig. 12B) or truncate (western U.S. and Canada, Fig. 12 D); inner margin of mandible obtusely angled (Fig. 20C); notauli impressed (as in Fig. 24A); scrobal sulcus absent or in some specimens weakly impressed and incomplete (Fig. 23B); mesopleuron dull, scattered punctures connected by fine, dense microsculpture (northeastern and northcentral U.S.) or shiny, scattered punctures with glossy interspaces (western U.S. and Canada); hind margin of gastral tergum VI with spinose tubercles mesally (as in Fig. 25D); penis valve as in Figure 26C. Length 4.0–6.1 mm.

*Female*.—Similar to male except as follows: palpal segments dark to light brown in Old World and northern U.S. specimens; midfemur and tarsus brown; setal pattern division low on face, setae directed obliquely dorsad from sockets to upper frons, below sockets directed laterad (Fig. 12A, C); clypeal setae directed toward midline (Fig. 12A, C); clypeal lobe concave apically (Fig. 12A, C), in western specimens weakly concave or truncate; inner margin of mandible broadly arcuate (as in Fig. 20C); scutum evenly punctured and microsculptured medially. Length 4.6–6.9 mm.

*Discussion*.—This holarctic species shows much variation throughout its distribution. In the New World, it can be separated into two main morphological forms. The smaller, pale-colored form is western in distribution and follows the Rocky Mountains. The larger, darker form extends from eastern and northeastern U.S. across Canada to the Rocky Mountains northward into Alaska. *Passaloecus monilicornis* in the Old World is present throughout northern Europe and eastward through most of Asia. Old World specimens are very similar to northern U.S. specimens. In northern U.S. specimens the labrum is narrowed more abruptly in females and flagellomeres are less strongly arcuate above in the male. Specimens from western and southwestern U.S. compared with those from eastern and northeastern U.S. often show a striking degree of difference in both color and structure. Most specimens from western U.S. have pale palpal segments, amber tibiae, and shiny mesopleuron. In addition, most females have a pale amber to dark brown labrum and a weakly concave clypeal lobe apex; most males have flagellomeres which are strongly arcuate dorsally (II–VIII with tyli) and the clypeal surface is weakly depressed near its apex. Most specimens from

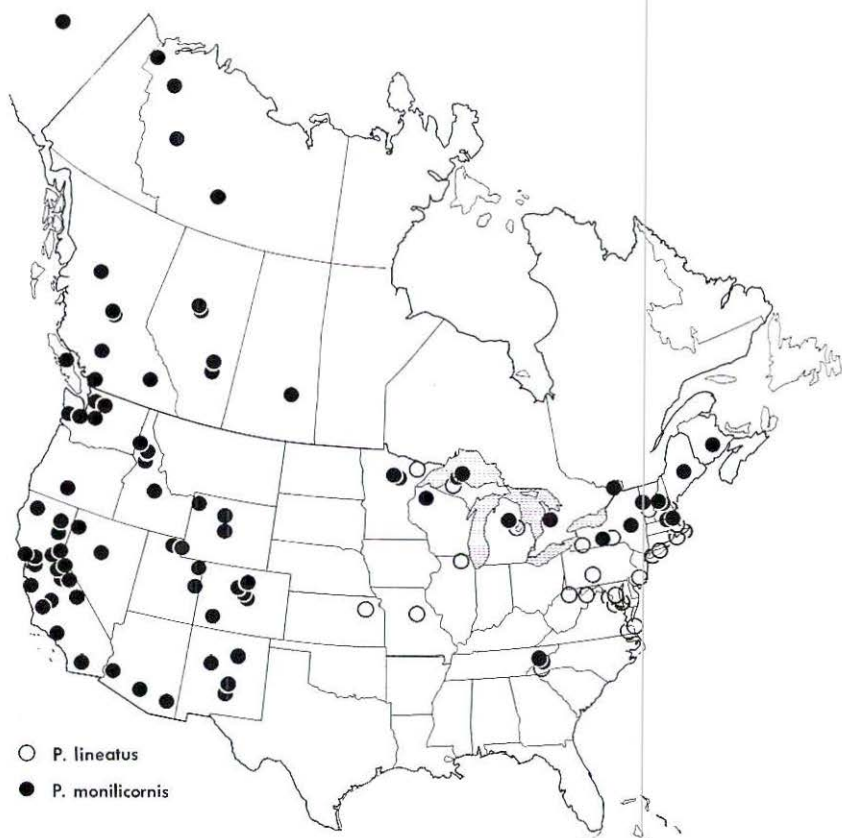


Figure 7. Known nearctic distribution of *P. monilicornis* (dark circles) and *P. lineatus* (open circles).

northcentral and eastern North America have a dark brown labrum, brown tibiae, and a dull mesopleuron with dense microsculpturing. In addition, most females have brown palpal segments and a strongly concave clypeal lobe apex; most males have longer, less strongly arcuate midflagellomeres (II–IX with tyli) and the clypeal surface is convex medially from base to apex. Because of variation within each population, no single character can be used to separate these populations into different taxa. Moreover, in the northern Rocky Mountains where the populations meet, some specimens are intermediate in combinations of different characters, development of individual character states, or both. It is possible that the western North American population is a complex of several very similar species. However, for the present I prefer to consider these populations as one highly variable species.



This species has no close relatives in North America. It is similar to *P. annulatus* but is distinguished in males by dark, swollen flagellomeres, in most females by a broadly concave clypeal lobe apex, and in both sexes by a broader IOD and dark trochanters.

*Floral record* (Nearctic).—*Heracleum lanatum* Michx.

*Geographic range* (Fig. 7).—Holarctic—in the New World, found throughout Canada, the Rocky Mountains, and the Appalachian Mountains. In the Old World, found throughout Europe, eastward through Asia to Japan and Kamchatka. I have seen 122 males, 318 females from North America, 27 males, 22 females from Europe.

### “ANNULATUS GROUP”—group assemblage I

Females are characterized by a strongly projecting, weakly convex clypeal lobe apex, slender mandibles, and lack of scutal patches (Table 1). Males have pale yellow bands on the flagellomeres, and spinose tubercles on gastral tergum VI. Both sexes lack a scrobal sulcus and omaulus, and have a setal pattern division at sockets, a narrow IOD, and pale amber legs. The group is represented in the Nearctic and Asia.

#### *Passaloecus annulatus* (Say)

*Pemphredon annulatus* Say, 1837:379 (syntypes female and male, Indiana, U.S.—destroyed; neotype female, Turkey Run Park, Parke Co., Indiana, U.S., present designation—MCZ, type no. 32405); Smith, 1856:429.

*Pemphredon marginatus* Say, 1837:379 (holotype female (?), Pennsylvania, U.S.—destroyed) NEW SYNONYMY; Smith, 1856:429; Cresson, 1887:283; Rohwer, 1917:102; Muesebeck et al., 1951:968.

*Passaloecus annulatus* (Say), Packard, 1867:395 (male only); Cresson, 1887:283; Krombein, 1938:123, 124; 1951:143; Muesebeck et al., 1951:968; Krombein, 1955:16; 1958:24; Krombein et al., 1958:190; Krombein, 1960:35; 1961a:65; 1963:275; Krombein et al., 1967:398; Bohart and Menke, 1976:184.

\**Passalaccus* (sic) *rivertonensis* Viereck, 1904:243 (holotype male, Riverton, New Jersey, U.S.—ANSP, type no. 10202); Krombein, 1938:124; Muesebeck et al., 1951:968.

\**Passalaeus* (sic) *equalis* Viereck, 1906:212 (holotype male—misidentified as female, Douglas Co., Kansas, U.S.—UKL), synonymy by Vincent in Bohart and Menke, 1976; Muesebeck et al., 1951:968.

*Male*.—Black; palpi, pronotal lobes white; basal  $\frac{2}{3}$  of flagellomeres dark brown; hindfemur and wing stigma brown; apical  $\frac{1}{4}$  of mandible, labrum, trochanters, fore- and midfemur, tibiae, tarsi, wing veins pale amber; basal  $\frac{3}{4}$  of mandible, apical  $\frac{1}{3}$  to  $\frac{1}{2}$  of flagellomeres I–X, ventral side of scape

pale yellow; setal pattern division low on face, setae above sockets directed obliquely dorsad, below sockets directed laterad (Fig. 12F); clypeal setae directed ventrad; flagellomere I as long as apical width; flagellomeres IV–V weakly produced at common juncture, III–VIII with tyli (Fig. 18A, B), tyli on flagellomeres IV–VI weakly produced and broadly oval, on III, VII, and VIII narrowly oval and low in profile, on III–VI received by concave apical margin of preceding flagellomere (Fig. 18A); IOD less than OOD; inner orbits of eyes converging weakly below; clypeal lobe weakly convex apically (Fig. 12F); inner margin of mandible a right angle (Fig. 20D); notauli weakly impressed (as in Fig. 24A); scrobal sulcus absent (Fig. 23B); hind margin of gastral tergum VI with spinose tubercles mesally (as in Fig. 25D); penis valve as in Figure 26D. Length 3.7–6.2 mm.

*Female*.—Similar to male except as follows: flagellomeres uniformly brown; clypeal setae directed toward midline (Fig. 12E); inner margin of mandible broadly arcuate (Fig. 20D); scutum evenly punctured, microsculptured medially. Length 4.2–6.2 mm.

*Discussion*.—Related to *P. monilicornis* but differs in females by a narrow IOD, pale amber trochanters, and a weakly convex clypeal lobe apex. In addition, males can be identified by the weakly produced juncture of flagellomeres IV and V, the banded appearance of the flagellum, the oval tyli, and a low frontal setal pattern division. This species is similar to *P. lineatus* and *P. areolatus* but lacks a scrobal sulcus and has weakly developed notauli.

I have listed *Pemphredon marginatus* Say as a junior synonym of *Passaloecus annulatus* (Say). Say (1837) described both as *Pemphredon* in the same publication. Smith (1856) placed them with a question mark under *Pemphredon*. Packard (1867) gave a detailed description of *Passaloecus annulatus*. Cresson (1887) placed “*annulatus*” under *Passaloecus* but listed “*marginatus*” in the genus *Pemphredon*. Fox (1892) revised the North American *Passaloecus* without including *P. marginatus*. Rohwer (1917) listed “*marginatus* as “probably *Passaloecus*.” Muesebeck et al. (1951) placed *marginatus* under *Passaloecus* with a question mark. The holotypes of *P. annulatus* and *P. marginatus* are presumably destroyed like most of Say’s material. In my opinion, both *P. annulatus* and *P. marginatus* are *Passaloecus* because no *Pemphredon* have a “subsessile abdomen” or pale markings. Say described a female and male of *P. annulatus*. His description of the male indicates a specimen of the only eastern species in which the male’s flagellum is, in Say’s words, “annulate, one half of each joint being yellowish.” Three specimens (1 male, 2 females) in the Thaddeus Harris collection (MCZH) were identified as *P. annulatus* by Say and returned to Harris. The male (headless) and one female are conspecific with the male of the original description. The other female belongs to the species which



I have described as *P. areolatus*. It is quite possible that the original type series of *P. annulatus* was likewise mixed. The original descriptions of *P. marginatus* (sex not given) and the female *P. annulatus* are not adequate for positive determination of Say's specimens. The format of both descriptions is very similar, and it is probable that *P. marginatus* was based on a female. Moreover, *P. marginatus* and the female *P. annulatus* were both pale-legged specimens ("feet honey-yellow") with a dark flagellum, and a pale-colored scape and mandible. These descriptions could be applied to females of three eastern U.S. species—*P. annulatus* (based on the male), *P. areolatus*, and *P. gracilis*. In my opinion, based on these color characters, it is more probable than not that *P. marginatus* and the female *P. annulatus* were conspecific with the male *P. annulatus*. Thus I am accepting the interpretation of *P. annulatus* (based on the original description of the male), and I am considering *P. marginatus* as its junior synonym.

*Floral record.*—*Helianthus tuberosus* L.; *Carya* sp.; *Liriodendron tulipifera* L.

*Geographic range* (Fig. 6).—East of the Rocky Mountains in U.S. and Canada. I have seen 56 males, 212 females.

*Type material.*—The syntypes in Say's collection presumably were destroyed. Only the male of the original description of *P. annulatus* can be positively identified. Packard (1867) interpreted the male correctly but not the female. If the syntypes of *P. annulatus* were not conspecific, Fox (1892) and Rohwer (in Viereck, 1916) may have correctly interpreted *P. annulatus* (based on the female). However, Krombein (1938) based his interpretation of this species on the male and Tsuneki (1955, 1974) described subspecies using Krombein's interpretation. In my opinion, the stability of this name can be assured only by the selection of a neotype. I have seen only one specimen which is both conspecific with the original male and is from the type locality. Therefore, I propose as neotype of *Pemphredon annulatus* Say a female specimen from Turkey Run Park, Parke Co., Indiana, U.S., collected on September 1, 1964 by H. E. Evans. The specimen carries my neotype label and is in the Museum of Comparative Zoology, Cambridge, Massachusetts (type no. 32405).

#### "AREOLATUS GROUP"—group assemblage I

Females in this nearctic group have a strongly projecting, truncate clypeal lobe apex, bidentate mandibles, and lack scutal patches (Table 1). Males have pale flagellomeres ventrally, and spinose tubercles on gastral tergum VI. Both sexes lack an omaulus, and have a setal pattern division high on face above sockets, areolate scrobal sulcus, and long areolate notauli.

*Passaloecus areolatus*, new species

Table 1. Infrageneric Groups of *Passaloecus*.

Group assemblage I: female, scutal patches absent; male, spinose tubercles present.	
1. <i>P. corniger</i> Shuckard—group	
2. <i>P. cuspidatus</i> Smith	
3. <i>P. dubius</i> Tsuneki	
4. <i>P. eremita</i> Kohl	
5. <i>P. melanognathus</i> Rohwer	
6. <i>P. insignis</i> (Vander Linden)—group	
7. <i>P. monilicornis</i> Dahlbom	
8. <i>P. annulatus</i> (Say)—group	
9. <i>P. nipponicola</i> Tsuneki	
10. <i>P. areolatus</i> Vincent—group	
11. <i>P. lineatus</i> Vincent	
12. <i>P. iwatai</i> Merisuo—group	
Group assemblage II: female, scutal patches present; male, spinose tubercles absent.	
13. <i>P. gracilis</i> (Curtis)—group	
14. <i>P. borealis</i> Dahlbom	
15. <i>P. brevilabris</i> Wolf	
16. <i>P. erugatus</i> Vincent	
17. <i>P. pictus</i> Ribaut	
18. <i>P. ribauti</i> Merisuo	
19. <i>P. turionum</i> Dahlbom	
20. <i>P. vandeli</i> Ribaut	
21. <i>P. armeniacae</i> Cockerell—group	
22. <i>P. gallicola</i> Vincent	
23. <i>P. miltoloma</i> Vincent	
24. <i>P. singularis</i> Dahlbom—GROUP	
25. <i>P. altaicus</i> Merisuo	
26. <i>P. australis</i> ? Merisuo	
27. <i>P. clypealis</i> Faester	
28. <i>P. cuspidifrons</i> Merisuo	
29. <i>P. hinganicus</i> ? Merisuo	
30. <i>P. longiceps</i> Merisuo	
31. <i>P. vigilans</i> Merisuo	
32. <i>P. turanicus</i> Gussakovskij	
Group assemblage III: female, scutal patches absent; male, spinose tubercles absent.	
33. <i>P. relativus</i> Fox—group	
34. <i>P. melanocrus</i> Rohwer	
35. <i>P. patagiatus</i> Vincent	



*Passaloecus annulatus* (Say), of Fox, 1892:318; Rohwer, in Viereck, 1916:689.

*Passaloecus relativus* Fox, of Krombein, 1938:123, 124; 1951:143; 1958:25; Krombein et al., 1967:398.

*Etymology*.—The species epithet is a noun in apposition from the Latin *area* meaning "open space" and refers to the areolate notauli.

*Holotype male*.—Black; basal  $\frac{4}{5}$  of mandible except margins, palpi, ventral side of scape, pronotal lobes pale yellow; apical  $\frac{1}{5}$  of mandible, dorsal side of scape, dorsal side of flagellum, hindfemur, wing stigma brown; labrum, ventral side of flagellum, tyli, trochanters, fore- and midfemur, tibiae, tarsomeres I–IV, wing veins pale yellow-brown; setal pattern division strong, midway on face (Fig. 13B); clypeal setae directed ventrad; flagellomeres II–VIII with thinly oval tyli (Fig. 18C); tyli on flagellomeres IV–VII arcuate in profile; IOD equal to OOD; CLW  $1\frac{1}{4}$  times IAD; clypeal lobe truncate apically (Fig. 13B); inner margin of mandible obtusely angled (Fig. 20E); notauli extending to midway on scutum, strongly areolate anteriorly (as in Fig. 24B); scrobal sulcus strongly areolate (as in Fig. 23C); hind margin of gastral tergum VI with spinose tubercles mesally (as in Fig. 25D); penis valve as in Figure 26E. Length 4.4 mm.

*Female*.—Similar to male except as follows: apical  $\frac{1}{4}$  of mandible pale yellow-brown; CLW  $1\frac{1}{3}$  times IAD (Fig. 13A); inner margin of mandible broadly arcuate (Fig. 20E); scutum (except notauli) evenly punctured, microsculptured medially. Length 4.3–5.8 mm.

*Discussion*.—Closely related to *P. lineatus* Vincent but distinguished by pale yellow-brown trochanters, pale-colored mandibles, and a broader clypeal lobe. In males the arcuately produced tyli are distinctive.

In certain specimens, the mandible is pale amber, the fore- and midtibiae are dark brown, or the hindtarsus is brown. In some males, the pedicel below, flagellomeres I–III or IV below, and apical margins of IV or V–X below are yellow-brown. Lengths of male paratypes range from 3.9–4.8 mm.

*Floral record*.—*Carya* sp.; *Liriodendron tulipifera*.

*Geographic range* (Fig. 10).—Northeastern and northcentral U.S., extending southward to Florida, westward to Iowa and Missouri.

*Type material*.—The holotype (from Millwood, New York, U.S.; collected June 20, 1936, by J. G. Franclemont) is in the National Museum of Natural History, Washington, D.C. (type no. 74061). There are 98 paratypes (23 males, 75 females) from the following localities: U.S.: Arkansas: Marion Co. (USNM); Connecticut: Fairfield Co., Weston (USNM); District of Columbia: Rock Creek (USNM); Washington (USNM); Iowa: North Ely, Basswood Lake (USNM); Sioux City (USNM); Maryland: Bowie (USNM); Plummers Island (USNM); Massachusetts: Essex Co. (CUI); Milton (MCZ); Woods Hole (USNM); Michigan: Cheboygan Co. (USNM); Missouri: Co-

lumbia (USNM); Polk Co., near Bolivar (USNM); New Hampshire: Pelham (USNM); New Jersey: Bergenfield (USNM); Princeton (USNM); New York: Albany (USNM); Ithaca (CUI); Millwood (USNM); Rens'l'ville (USNM); North Carolina: Buncombe Co., Black Mountain (MCZ); Haywood Co., Lake Junaluska (SPBF); Ohio: Hamilton Co. (USNM); Pennsylvania: Davidsburg (USNM); Gladwyn (AMNH); Harrisburg (USNM); Tennessee: Humphreys Co., Hurricane Mills (USNM); Vermont: Windham Co., Jamaica (MCZ); Virginia: Arlington (ANSP, CUI, USNM); Dunn Loring (CUI, USNM); Falls Church (USNM); Rosslyn (USNM); West Virginia: Hardy Co., Lost River State Park (USNM); Wisconsin: Vilas Co., Trout Lake (UWM). Canada: Toronto (USNM).

*Passaloecus lineatus*, new species

*Etymology*.—The species epithet is a noun in apposition from the Latin *linea* meaning "line" and refers to the linear tyli on flagellomeres of males.

*Holotype male*.—Black; palpi, ventral side of scape, pronotal lobe creamy-white; mandible, flagellum above, trochanters, fore- and midfemur below, hindtibia, fore- and midtarsomere V, hindtarsomeres above, wing stigma dark brown; labrum, ventral side of flagellum, fore- and midfemur above, fore- and midtibia, fore- and midtarsomeres I–IV, hindtarsomeres I–IV below, wing veins pale yellow-brown; setal pattern division strong, midway on face (Fig. 13D); clypeal setae directed ventrad; flagellomeres I–IX with low profile, linear tyli (Fig. 18D); IOD equal to OOD; CLW equal to IAD; clypeal lobe truncate apically (Fig. 13D); inner margin of mandible a right angle (Fig. 20F); notauli extending to midway on scutum, strongly areolate anteriorly (Fig. 24B); scrobal sulcus strongly areolate (Fig. 23C); hind margin of gastral tergum VI with spinose tubercles mesally (as in Fig. 25D); penis valve as in Figure 26F. Length 4.6 mm.

*Female*.—Similar to male except as follows: basal  $\frac{1}{2}$  to  $\frac{1}{3}$  of mandible creamy-white; inner margin of mandible broadly arcuate (Fig. 20F); scutum (except notauli) evenly punctured, microsculptured medially. Length 4.6–5.8 mm.

*Discussion*.—Closely related to *P. areolatus* but distinguished in males by low profile, linear tyli, and the dark brown mandible and trochanter. In addition to the dark mandible and trochanter, females can be identified by the narrow clypeal lobe (Fig. 13C).

A small, pale dot is at the base of the mandible of some specimens. Lengths of male paratypes range from 4.4–4.9 mm.

*Geographic range* (Fig. 7).—Northeastern and northcentral U.S. and southern Canada, extending southward into the Smokey Mountains, westward to British Columbia.



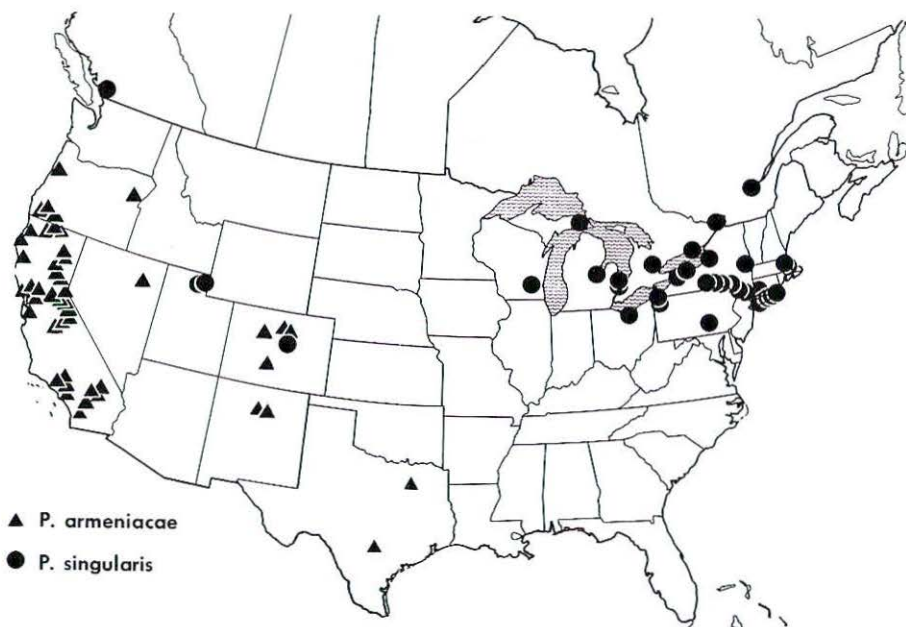


Figure 8. Known nearctic distribution of *P. singularis* (circles) and *P. armeniaca* (triangles).

*Type material*.—The holotype (from Lost River State Park, Hardy Co., West Virginia, U.S.; collected July 4, 1955, by K. V. Krombein) is in the National Museum of Natural History, Washington, D.C. (USNM type no. 74065). There are 52 paratypes (43 females, 9 males) from the following localities: U.S.: District of Columbia: Rock Creek (USNM); Washington (USNM); Illinois: McHenry Co., Algonquin (ANSP); northern Illinois (USNM); no locality (ANSP); Kansas: Douglas Co., Baldwin (USNM); Wabaunsee Co. (MCZ); Maine: Piscataquis Co., Mt. Katahdin (MCZ); Maryland: Bowie (USNM); Glen Echo (USNM); Plummers Island (USNM); Massachusetts: Bedford (MCZ); Concord (MCZ); Woods Hole (USNM); Michigan: Midland Co. (USNM); Ontonagon Co. (USNM); Missouri: Columbia (USNM); New Jersey: Burlington Co., Medford Lakes (CUI); New York: Bemus Point (USNM); Greene Co. (USNM); Ithaca (CUI, MCZ); Long Island, Farmingville (USNM), Huntington (AMNH); North Carolina: Haywood Co., Lake Junaluska (SPBF); Pennsylvania: Davidsburg (USNM); Vermont: Woodstock (MCZ); Virginia: Arlington (USNM); Dunn Loring (USNM); Suffolk (USNM); West Virginia: Hardy Co., Lost River State Park (USNM). Canada: British Columbia: Robson (CNC).

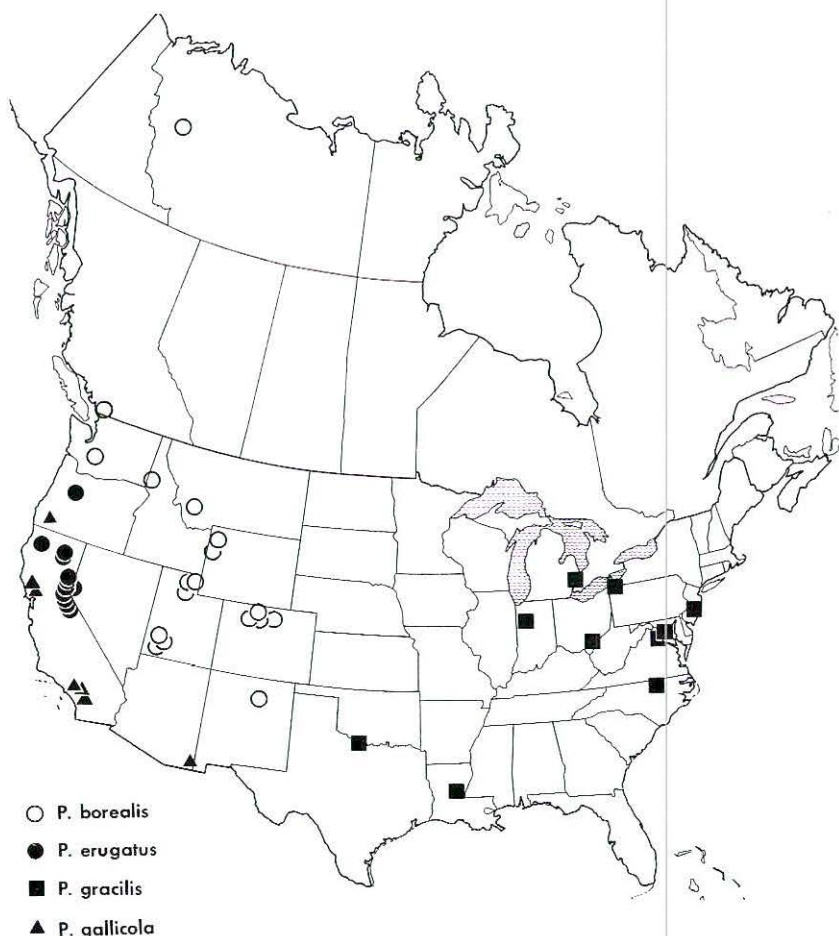


Figure 9. Known nearctic distribution of *P. borealis* (open circles), *P. erugatus* (dark circles), *P. gracilis* (squares), and *P. gallicola* (triangles).

### “*SINGULARIS* GROUP”—group assemblage II

Members of this holarctic group form an element quite different from the rest of group assemblage II (Table 1). Merisuo (1976a, 1976b) places some of its Old World species into monotypic groups. In my opinion, similarity of mesopleural characters and presence of scutal patches provide a sound basis for grouping these species. Females have a weakly trilobed clypeal lobe, setal pattern division at sockets, and scutal patches. Males have very flat, bullet-shaped tyli, setal pattern division high on face above sockets, and lack spinose tubercles on gastral tergum VI. Both sexes have a narrow



IOD, and lack a scrobal sulcus and omaulus. *Passaloecus singularis* and Old World *P. clypealis* Faester are the only species known to partition nests with soil pellets.

*Passaloecus singularis* Dahlbom

\**Passaloecus singularis* Dahlbom, 1844:243 (holotype male, Scania, Sweden—LUZI); Dahlbom, 1845:505; Smith, 1856:427; Yarrow, 1970:171; Merisuo, 1972:204; 1973c:109; Lomholdt, 1975:126; Bohart and Menke, 1976:184.

*Passaloecus gracilis* (Curtis), of Shuckard, 1837:190 (in part); Dahlbom, 1842:12; 1844:242; 1845:505; Wesmael, 1852:284; Smith, 1856:427 (in part); Taschenberg, 1866:188; 1869:95; Thomson, 1870:238; Costa, 1871:44; Thomson, 1874:200 (as *P. gracellis*); Verhoeff, 1890:383; Kohl, 1893:38; Berland, 1925:145; Bouwman, 1929:207; Enslin, 1933:9; Richards, 1935:165; Leclercq, 1939:61; 1940:51; Giner Mari, 1943:39; Zavadil and Snoflak, 1948:47; Tsuneki, 1955:5; Erzsebet, 1957:788; Noskiewicz and Pulawski, 1960:63, 65; Balthasar, 1972:195.

\**Passaloecus tenuis* Morawitz, 1864:462 (for type material, see below); Andre, 1888:199; Kohl, 1905:522, 526; Schmiedeknecht, 1930:672; Grandi, 1934:47; Yasumatsu, 1934b:112; Ribaut, 1952:24; Evans, 1958:132; Janvier, 1961:847; de Beaumont, 1964a:105, 107, 109; Evans, 1964:251; Oehlke, 1971:746.

?*Passaloecus annulatus* (Say), of Peckham and Peckham, 1905:87.

\**Passaloecus gertrudis* Krombein, 1938:124 (holotype female, Forest Lawn, Buffalo, New York, U.S.—USNM, type no. 55769), synonymy by Vincent in Bohart and Menke, 1976; Muesebeck et al., 1951:968; Krombein et al., 1967:398.

*Male*.—Black; mandible except margins and apical  $\frac{1}{3}$ , palpi, ventral side of scape, basal  $\frac{1}{3}$  of hindtibia creamy-white; fore- and midfemora apical  $\frac{1}{6}$ , foretibia, midtibia basal and apical  $\frac{1}{4}$ , fore- and midtarsi yellow-brown; tyli reddish brown; labrum, fore- and midfemora except apices, hindfemur, midtibia medial  $\frac{1}{2}$ , hindtibia apical  $\frac{2}{3}$ , hindtarsus, wing veins, stigma dark brown; setal pattern division strong, midway on face (Fig. 13F); clypeal setae directed ventrad; flagellomeres II–VIII with oval, flattened tyli, each tylus truncated against anterior margin of preceding flagellomere (Fig. 18E); IOD less than OOD; clypeal lobe weakly trilobed apically (Fig. 13F); inner margin of mandible acutely angled (Fig. 20G); notauli weakly impressed (as in Fig. 24C); scrobal sulcus absent (as in Fig. 23B); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26G. Length 3.9–5.9 mm.

*Female*.—Similar to male except as follows: setal pattern division low on face, setae directed obliquely dorsad from sockets to upper frons, below

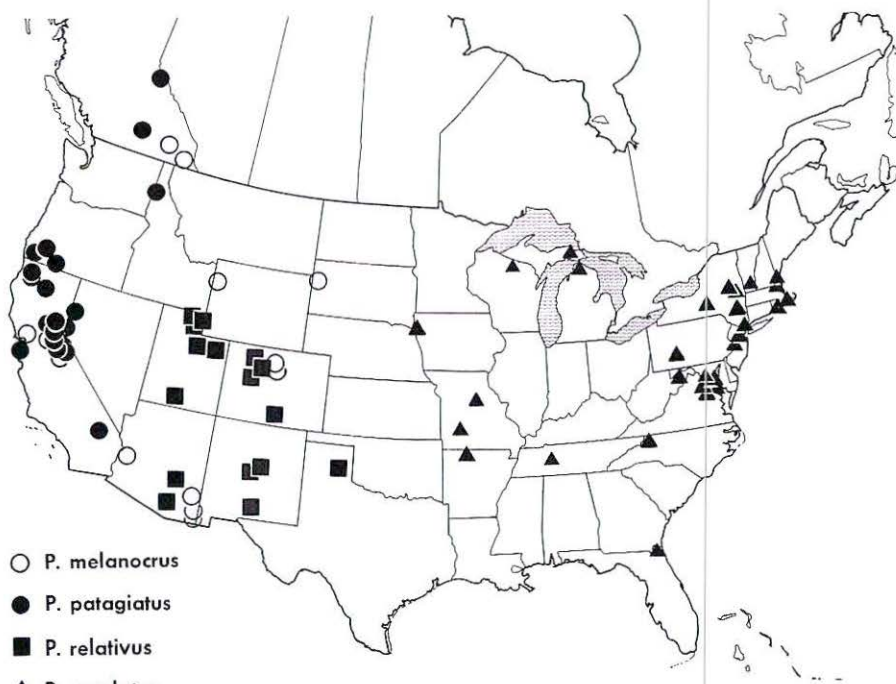


Figure 10. Known distribution of *P. melanocrus* (open circles), *P. patagiatus* (dark circles), *P. relativus* (squares), and *P. areolatus* (triangles).

sockets directed laterad (Fig. 13E); clypeal setae sparse, directed ventrad; clypeal surface below each socket bare; inner margin of mandible weakly concave (Fig. 20G); clypeal lobe upturned apically (Fig. 13E); scutal patches present, circular (Fig. 24C). Length 4.5–5.9 mm.

**Discussion.**—There are no close relatives of this species in North America. Resembles *P. annulatus* but distinctive characters are the uniformly dark flagellum, bullet-shaped tyli, and lack of tergal spinose tubercles in males, scutal patches and upturned clypeal lobe apex in females and dark pronotal lobes and trochanters in both sexes.

**Floral record (Nearctic).**—*Lotus corniculatus* L.; *Melilotus alba* Medik. *M. officinalis* Lam. Desr.; *Vaccinium* sp.

**Geographic range (Fig. 8).**—Holarctic—in the New World, found in northeastern U.S. and southern Canada, extending westward into mountains of Colorado, northern Utah, and British Columbia. In the Old World, found throughout Europe, extending through Asia to Japan. I have seen 85 males, 85 females from North America, 18 males, 20 females from Europe.

**Type material.**—*Passaloecus tenuis* is a name proposed by Morawitz



(1864) for "*P. gracilis* (not Curtis and Shuckard)" of Dahlbom and others (male and female) and *P. singularis* Dahlbom (male only). Morawitz does not mention any material except that of Dahlbom. Therefore, it is assumed that the type material of *P. tenuis* is a syntype series which consists of material listed by Dahlbom (1842, 1844) as *P. gracilis* and the holotype male of *P. singularis* Dahlbom. This material is at Lunds Universitetets Zoologiska Institution, Lund, Sweden.

"*ARMENIACAE* GROUP"—group assemblage II

Members of this nearctic group are closely related to those of the *P. gracilis* group and can be separated only weakly into their own group. A well developed omaulus and scrobal sulcus are stable characters in the *P. gracilis* group. In the *P. armeniacae* group, only *P. armeniacae* has an omaulus (weakly developed) and *P. gallicola* lacks a well developed scrobal sulcus. Females of the *P. armeniacae* group have a truncate clypeal lobe. In females of *P. armeniacae* and *P. miltoloma* the subapical inner margin of the mandible is divided into two weak teeth (Fig. 21A, C). It should be noted that only *P. turionum* (*P. gracilis* group) and *P. gallicola* (*P. armeniacae* group) are known to nest in galls.

*Passaloecus armeniacae* Cockerell

\**Passaloecus armeniacae* Cockerell, in Cockerell and Fox, 1897:141 (holotype female, Santa Fe, New Mexico, U.S.—ANSP, type no. 10057); Muesebeck et al., 1951:968; Bohart and Menke, 1976:184.

*Passaloecus relativus* Fox, of Rohwer, 1909:100 (in part).

*Male*.—Black; mandible except apex, palpi except segment I of maxilla, ventral side of scape, pronotal lobe pale yellow to creamy-white; palpal segment I of maxilla, labrum, dorsal side of scape, flagellum, wing stigma dark brown; mandible apex, gastral segment VII reddish to blackish brown; mid- and hindtibiae apical  $\frac{2}{3}$  to  $\frac{3}{4}$ , hindtarsus above brown; foretibia, mid- and hindtibiae basal  $\frac{1}{4}$  to  $\frac{1}{3}$ , fore- and midtarsi, hindtarsus below, wing veins pale yellow-brown; setal pattern division strong, midway on face (Fig. 14B); clypeal setae directed ventrad; flagellomeres I–IX or X with oval tyli which are arcuately produced in profile, flagellomere apical margins straight (Fig. 18F, G); IOD slightly greater than OOD; clypeal lobe truncate apically (Fig. 14B); inner margin of mandible a right angle (Fig. 21A); notauli weakly impressed, about as long as admedian lines (as in Fig. 24C); scrobal sulcus deeply impressed, areolate (Fig. 23D); omaulus weakly developed, very narrow, contiguous with episternal sulcus (Fig. 23D); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26H. Length 3.4–5.3 mm.

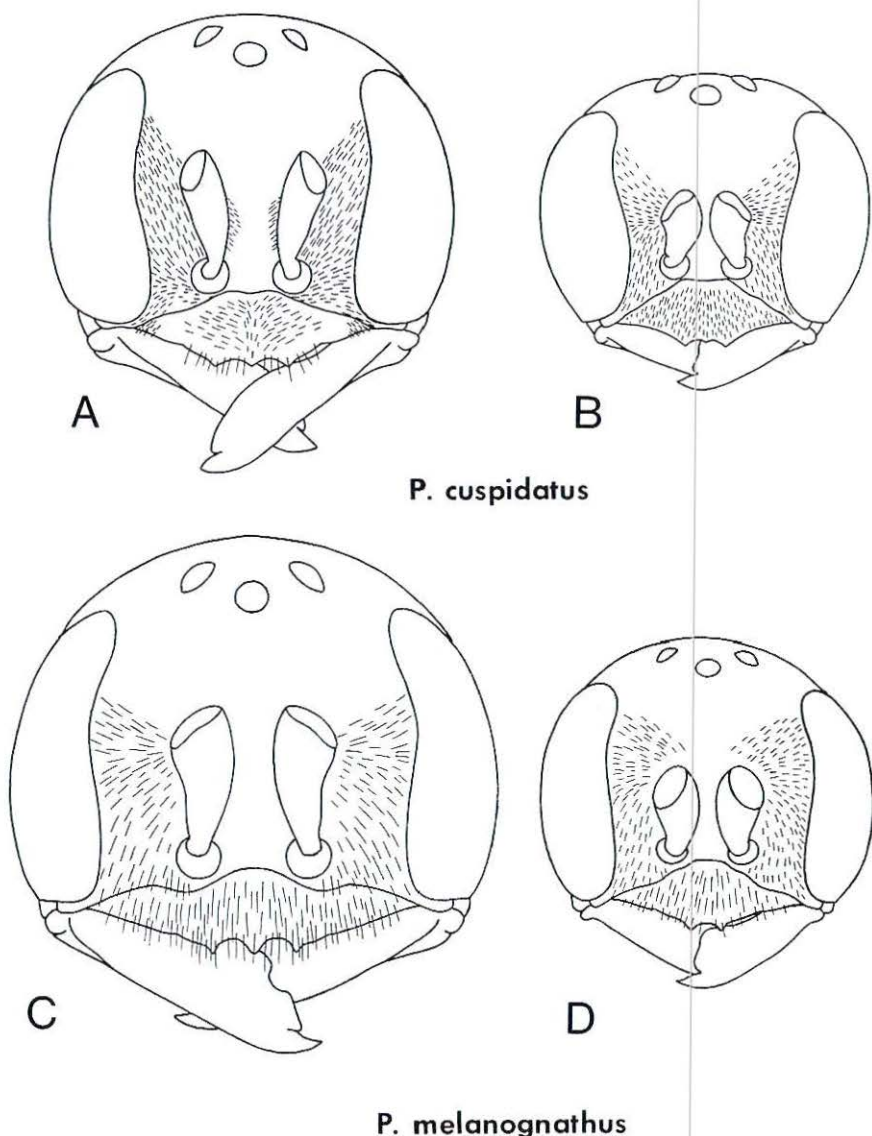


Figure 11. Facial outlines of *Passaloecus* species. A, C, female; B, D, male.

*Female*.—Similar to male except as follows: labrum pale amber to dark brown; setal pattern division low on face, setae above sockets directed obliquely dorsad, laterad of sockets directed laterad (Fig. 14A); clypeal setae directed toward midline (Fig. 14A); inner margin of mandible weakly



tridentate, middle tooth either truncate or rounded, inner "tooth" a weak, obtuse angle (Fig. 21A); scutal patches weakly raised, circular (as in Fig. 24C). Length 3.6–5.7 mm.

*Discussion.*—In some specimens, the omaulus is weakly expressed either as a very narrow area of weak, vertical striae forward of the episternal sulcus or as a slight forward widening of the episternal sulcus. Closely related to *P. miltoloma* and *P. gallicola* but distinguished by dark trochanters, deeply impressed scrobal sulcus, and lack of spines along the length of the hindtibia. Males resemble *P. borealis* but have a wide IOD, truncate clypeal lobe, and more narrow omaulus.

*Floral record.*—*Chrysothamnus* sp.; *Eriogonum* sp.; *Lathyrus latifolius* L.; *Rosa* sp.; *Vicia villosa* Roth.

*Geographic range* (Fig. 8).—Western U.S. I have seen 73 males, 108 females.

### *Passaloecus gallicola*, new species

*Etymology.*—The species epithet is a noun in apposition derived from the Latin words *galla*—meaning "plant gall" and *cola*—meaning "inhabitant" and refers to the usual nesting site.

*Holotype, female.*—Black; palpi, ventral side of scape, pronotal lobe grayish white; mandible apex, flagellum, forecoxa, femora except apex, hindtarsus V, wing stigma dark brown; mandible except apex, labrum, trochanters, femora at apex, tibiae, tarsi except hindtarsus V, tegula, wing veins, lateral margins of gastral terga pale amber; setal pattern division weak, setae above sockets sparse, broadly radiating dorsad and ventrad, setae laterad of sockets dense, directed obliquely ventrad (Fig. 14C); clypeal setae dense laterally, sparse medially, in dorsal  $\frac{1}{2}$  directed obliquely ventrad toward midline (Fig. 14C); IOD equal to OOD; clypeal lobe weakly produced, truncate apically (Fig. 14C); inner margin of mandible broadly arcuate (Fig. 21B); scutal patches weakly raised, circular (as in Fig. 24C); notauli strongly impressed, without areolae, slightly longer than admedian lines; scrobal sulcus weakly areolate (Fig. 23E); mesopleural punctures scattered, interspaces smooth, shiny; hindtibia without spines along length. Length 3.9 mm.

*Male.*—Similar to female except as follows: labrum, apical  $\frac{3}{4}$  of hindtibia above, hindtarsus dark brown; setal pattern division strong, midway on face (Fig. 14D); clypeal setae directed ventrad; flagellomeres I–VII or VIII with oval tyli which are arcuately produced in profile (Fig. 18H, I); inner margin of mandible acutely angled (Fig. 21B); scrobal sulcus very weakly impressed (absent in some specimens); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26I. Length 3.3–4.0 mm.

*Discussion.*—Lengths of female paratypes range from 4.4 to 4.7 mm. In

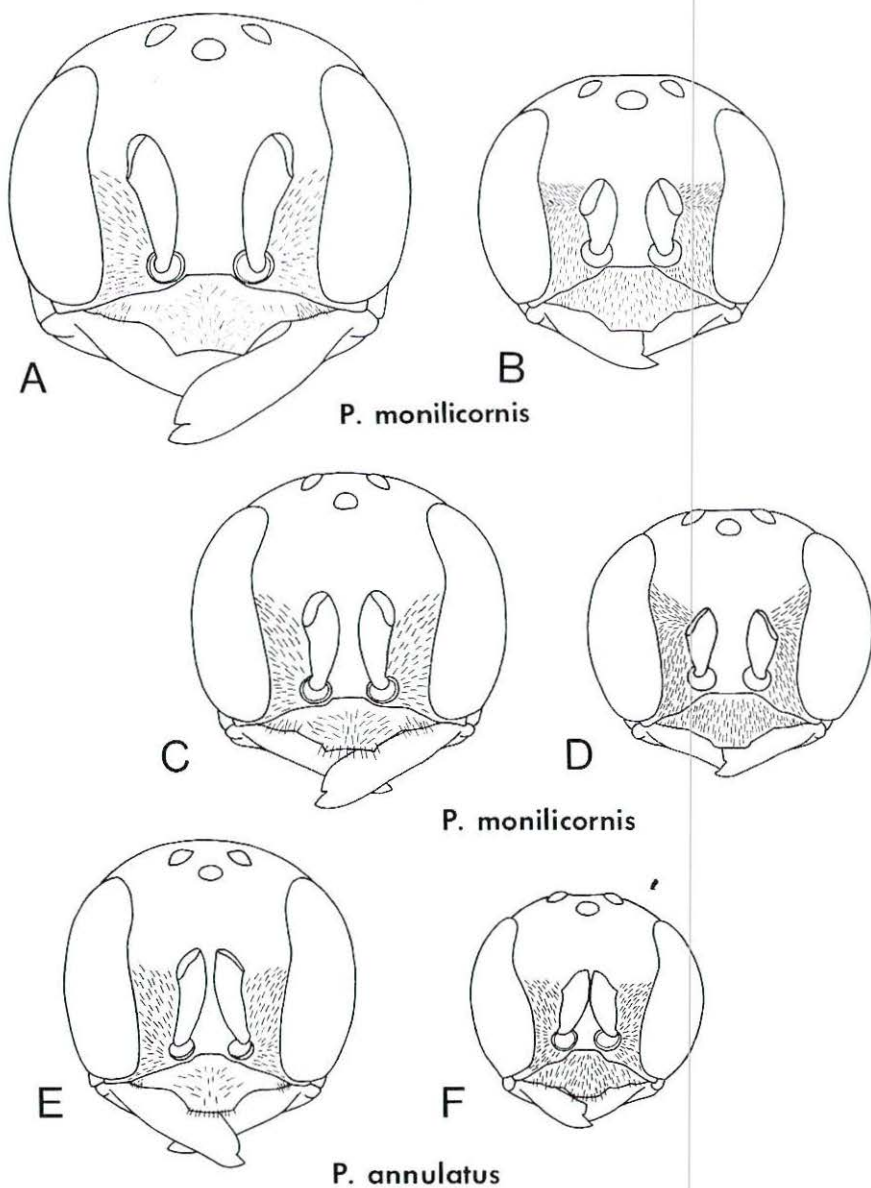


Figure 12. Facial outlines of *Passaloecus* species. A, C, E, female; B, D, F, male; A, B, eastern and northern population; C, D, western population.



certain specimens of either sex, the scrobal sulcus is absent. In some females the basal  $\frac{3}{4}$  of the mandible is dingy-white.

Closely related to *P. armeniaca* and *P. miltoloma* but distinguished by amber trochanters and absence of spines along the length of the hindtibia.

*Geographic range* (Fig. 9).—Extreme western U.S.

*Type material*.—The holotype (from Camp Baldy, Los Angeles Co., California, U.S., Hopkins no. 15616a; reared August 1–18 (no year given), collector L. H. Weld) is in the National Museum of Natural History, Washington, D.C. (type no. 75257). There are 22 paratypes (8 males, 14 females) from the following localities: Arizona: Cochise Co., Portal (CUI); California: Lake Co., Middletown (CAS); Los Angeles Co., Camp Baldy (USNM), Tanbark Flat (LACM); Napa Co., Monticello Dam (BBS); Riverside Co., Idyllwild (USNM); San Bernardino Co., Cajon Pass (JAB); Oregon: Josephine Co., Grants Pass (USNM).

*Passaloeocus miltoloma*, new species

*Etymology*.—The species epithet is a noun in apposition derived from the Greek words *miltos*—meaning “red” and *loma*—meaning “border” and refers to the reddish-brown band near the clypeal apex.

*Holotype, female*.—Black; mandible except apex and dorsal margin, palpi except segment I of maxilla, labrum medially, ventral side of scape, pronotal lobe, tegula medially, foretibia above, basal  $\frac{1}{4}$  of midtibia, basal  $\frac{1}{3}$  of hindtibia creamy-white; mandible apex, palpal segment I of maxilla, dorsal side of scape, pedicel, flagellum, stigma dark brown; dorsal margin of mandible, mid- and hindtarsomere V brown; transverse band above clypeal lobe margin, wing veins, trochanters, femora at apex, foretibia below, apical  $\frac{3}{4}$  of midtibia, apical  $\frac{2}{3}$  of hindtibia, tarsi except mid- and hindtarsomere V yellow-brown; labrum laterally, tegula perimeter translucent, pale amber; setal pattern division low on face, setae dense, above sockets directed obliquely dorsad, laterad of sockets directed laterad; clypeal setae dense, in dorsal  $\frac{1}{2}$  directed toward midline, remainder directed ventrad (Fig. 14E); IOD less than OOD; clypeal lobe truncate apically (Fig. 14E); inner margin of mandible tridentate, middle tooth truncate, inner tooth angulate (Fig. 21C); scutal patches poorly developed, weakly raised areas of coalesced punctures, remaining punctures on scutum well separated, interspaces smooth, shiny; notauli very weakly impressed, shorter than admedian lines; scrobal sulcus strongly impressed, areolate (as in Fig. 23D); mesopleural punctures scattered, interspaces smooth, shiny; hindtibia with two small, erect spines along posterior margin (as in Fig. 25E). Length 5.3 mm.

*Male*.—Similar to female except as follows: labrum, trochanters, apical  $\frac{2}{3}$  of hindtibia brown; setal pattern division strong, midway on face (Fig. 14F); clypeal setae directed ventrad; flagellomeres I–VIII with oval tyli

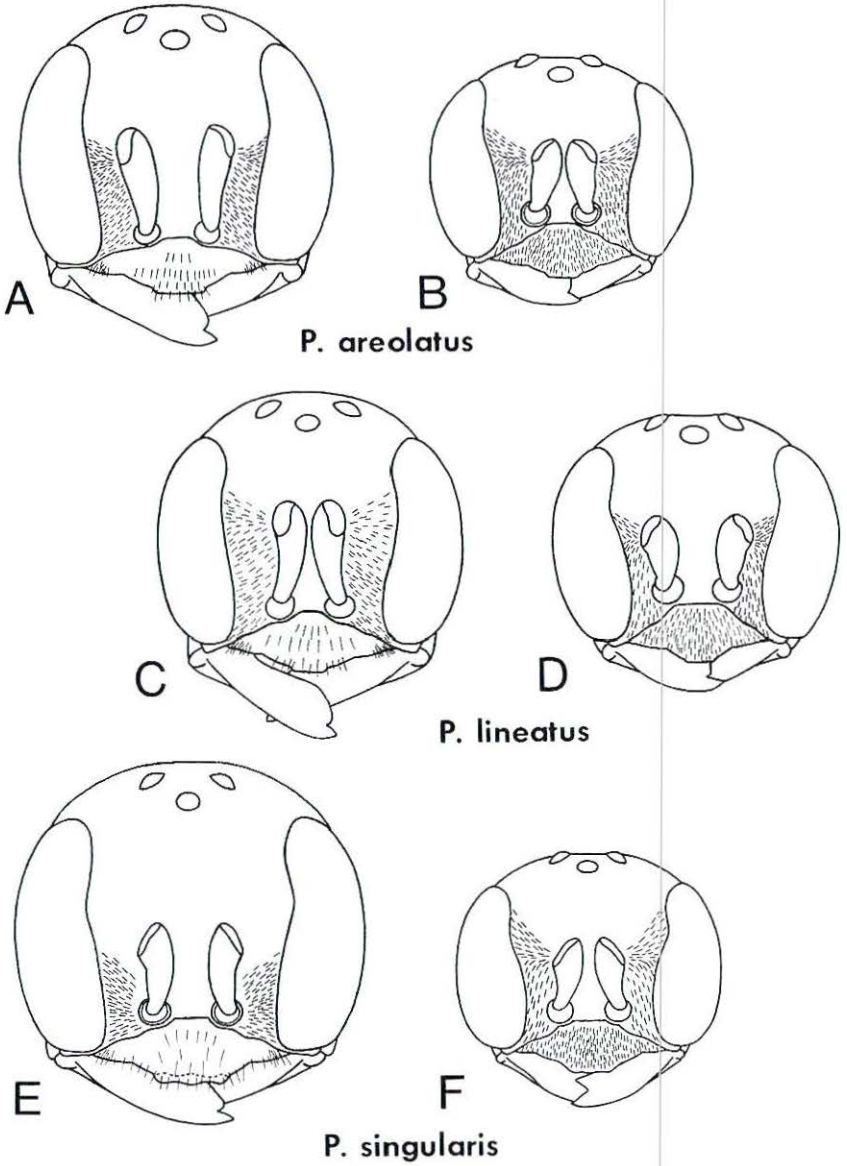


Figure 13. Facial outlines of *Passaloecus* species. A, C, E, female; B, D, F, male.



which are weakly produced in profile (Fig. 18J, K); flagellomere apical margins straight; clypeal lobe weakly concave apically (Fig. 14F); inner margin of mandible acutely angled (Fig. 21C); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26J. Length 4.2–5.1 mm.

*Discussion.*—Lengths of female paratypes range from 4.5 to 6.2 mm. Two females from Palm Canyon, Riverside Co., California do not have a pale amber band on the clypeus. There are three spines along the hindtibia of most paratypes. Two males from Kerryville, Texas, have tyli on flagellomeres I–X, a truncate clypeal lobe, and roughly sculptured scutum. Two males from Davis and Napa Co., California, respectively, have tyli on flagellomeres I–IX and a truncate clypeal lobe. I have tentatively identified the four males as *P. miltoloma* but have not designated them as paratypes.

Closely related to *P. armeniacae* and *P. gallicola* but identified in both sexes by erect spines on the hindtibia. In addition, females have an amber-colored labrum and trochanters, dorsally directed frontal setae, and a tridentate mandible with a strong, angulate inner tooth. In males the clypeal lobe is weakly concave apically.

*Floral record.*—*Lotus scoparius* (Nutt.) Ottley.

*Geographic range* (Fig. 6).—Extreme southwestern U.S.

*Type material.*—The holotype (from Phoenix, Arizona, U.S., Baker no. 2571; collected April 4, 1897, by B. C. Cunze) is in the National Museum of Natural History, Washington, D.C. (type no. 75256). There are 18 paratypes (4 males, 14 females) from the following localities: Arizona: near Roosevelt Lake (USNM); California: Fresno Co., Panoche Creek (BBS); Riverside Co., Deep Canyon (UCB), Palm Canyon (CAS, MCZ), Palm Springs (BBS), Riverside (UCB, UCR).

#### “GRACILIS GROUP”—group assemblage II

This holarctic group as I have constructed it is somewhat diverse. Merisuo (1974) places the Old World *P. vandeli* into a monotypic group. In my opinion, either grouping method is satisfactory and results in monophyletic taxa. Females are characterized by a setal pattern division at sockets (except *P. gracilis* and *P. vandeli*), bidentate mandibles, a concave clypeal lobe apex (except Old World *P. pictus* Ribaut), and scutal patches (Table 1). Males have protruding tyli, setal pattern division high on face above sockets (except *P. gracilis* and Old World *P. vandeli*), and lack spinose tubercles on gastral tergum VI. A well developed scrobal sulcus and omaulus are present in both sexes.

*Passaloecus borealis* Dahlbom

\**Passaloecus borealis* Dahlbom, 1844:247 (lectotype female, Asele, Swe-

den, present designation—LUZI); 1845:505; Smith, 1856:427; Taschenberg, 1866:188; 1869:95; Kohl, 1905:522, 525; Berland, 1925:146; Schmiedeknecht, 1930:672; Giner Mari, 1943:39–41; Zavdil and Snoflak, 1948:48; Ribaut, 1952:25, 26; Erzsebet, 1957:788; Noskiewicz and Pulawski, 1960:64; de Beaumont, 1964b:107, 109, 110; 1964a:297; Oehlke, 1971:743; Yarrow, 1970:174; Balthasar, 1972:197; Merisuo, 1972:205; 1973c:110; Lomholdt, 1975:120; Bohart and Menke, 1976:184.

*Passaloecus insignis* (Vander Linden), of Valkeila, 1961:145.

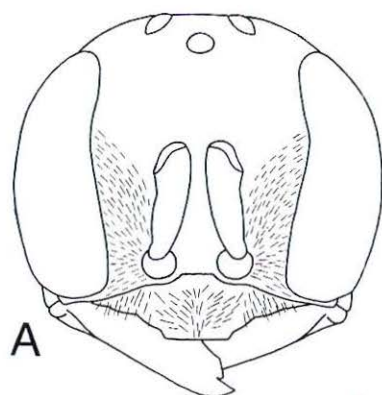
*Male*.—Black; mandible except margins, apical  $\frac{1}{4}$  and posterior surface, palpal segments III–VI of maxilla and II–IV of labium, ventral side of scape, pronotal lobe, foretibia above, mid- and hindtibia basal  $\frac{1}{3}$  to  $\frac{1}{5}$  creamy-white; fore- and midtarsus yellow-brown; mandible margins, apical  $\frac{1}{4}$  and posterior surface, palpal segments I and II of maxilla and I of labium, labrum, hindtarsus brown; setal pattern division strong, midway on face (Fig. 15B); clypeal setae directed ventrad; apical margins of flagellomeres straight, I–X with spindle-shaped tyli (Fig. 19A); IOD less than OOD; clypeal lobe weakly concave apically (Fig. 15B); inner margin of mandible a right angle (Fig. 21D); notauli weakly areolate, about as long as admedian lines (as in Fig. 24D); scutal margin opposite tegula strongly reflexed, areolate (as in Fig. 24D) parapsidal lines not reaching hind margin of scutum; scrobal sulcus strongly areolate (Fig. 23F); omaulus present, contiguous with episternal sulcus, broadening dorsally (Fig. 23F); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26K. Length 5.3–7.5 mm.

*Female*.—Similar to male except as follows: setal pattern division low on face, setae directed obliquely dorsad from sockets to upper frons, except along eye margin and below sockets where it is directed obliquely ventrad (Fig. 15A); setae on dorsal  $\frac{1}{2}$  of clypeus directed toward midline, on ventral  $\frac{1}{2}$  of clypeus directed ventrad (Fig. 15A); clypeal surface below each socket bare; inner margin of mandible broadly arcuate (Fig. 21D); scutal patches raised, oval (Fig. 24D). Length 5.1–6.4 mm.

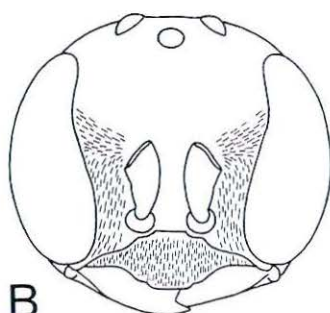
*Discussion*.—Closely related to *P. erugatus* but distinguished by the strongly reflexed, areolate scutal margins and the short parapsidal lines which do not reach the hind scutal margin. This species is similar to *P. gracilis* but has a narrow IOD, short notauli, and the omaulus is wholly contiguous with the episternal sulcus. In Europe, some authors consider this species conspecific with *P. turionum* Dahlbom (see discussion under *P. gracilis*).

*Geographic range* (Fig. 9).—Holarctic—in the New World, found in western U.S. and Canada. In the Old World, known from boreo-alpine areas of Europe and southwestern U.S.S.R. I have seen 18 males, 22 females from North America, 4 males, 5 females from Europe.



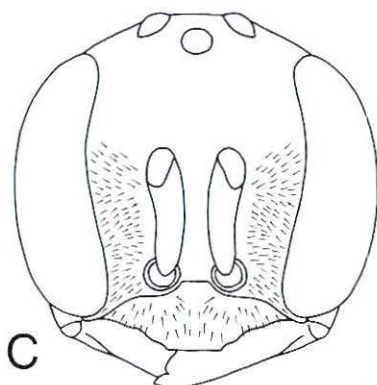


A

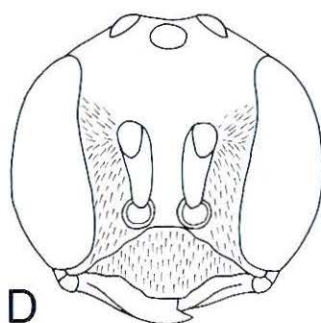


B

***P. armeniacae***

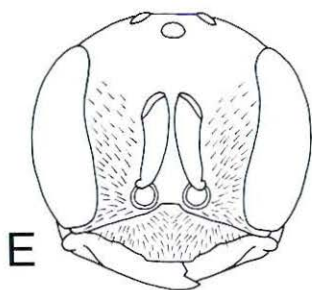


C

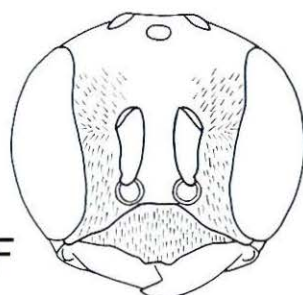


D

***P. gallicola***



E



F

***P. miltoloma***

Figure 14. Facial outlines of *Passaloecus* species. A, C, E, female; B, D, F, male.

*Type material.*—Dahlbom had before him a male and a female when he described this species. The male (from Ostre Naess, Verdaliae, Norway) is lost, but I have examined the female which is in Dahlbom's collection in the Museum Entomologicum of the Lunds Universitetets Zoologiska Institution. Faester placed a lectotype label on the specimen but never designated it by publication. Therefore, I am now designating as lectotype of *Passaloecus borealis* the female collected by Dahlbom at Asêle, Sweden, July 26, 1832, which carries Faester's lectotype label (no date) and my lectotype label (1973).

*Passaloecus erugatus*, new species

*Etymology.*—The species epithet is a past participle derived from the Latin verb *erugo* meaning "smooth" and refers to the smooth posterolateral margin of the scutum.

*Holotype, male.*—Black; mandible in front except margins and apical  $\frac{1}{3}$ , palpal segments II–VI of maxilla and II–IV of labium, foretibia above, basal  $\frac{1}{5}$  of mid- and hindtibia creamy-white; foretarsomeres II–III, midtarsomere II yellow-brown; mandible margins and apical  $\frac{1}{3}$  on front and posterior surface reddish brown; foretarsomeres I, IV, and V, midtarsomeres I and III–V brown; labrum, antenna, pronotal lobe, apical  $\frac{4}{5}$  of midtibia, hindtarsus blackish brown; setal pattern division strong, midway on face (Fig. 15D); clypeal setae directed ventrad; apical margins of flagellomeres straight; flagellomeres I–X with spindle-shaped tyli (Fig. 19B); IOD less than OOD; clypeal lobe weakly concave apically (Fig. 15D); inner margin of mandible at right angle (Fig. 21E); notauli strongly impressed, weakly areolate anteriorly, slightly longer than admedian lines (as in Fig. 24E); scutal margin opposite tegula flattened, smooth, shining (as in Fig. 24E); scutum with two raised areas medially; parapsidal lines reaching hind margin of scutum (as in Fig. 24E); scrobal sulcus strongly areolate; omaulus present, wholly contiguous with episternal sulcus (as in Fig. 23F); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26L. Length 4.5 mm.

*Female.*—Similar to male except as follows: setal pattern division low on face, setae directed obliquely dorsad from sockets to upper frons except along eye margins and between eye margin and socket where it is directed obliquely ventrad (Fig. 15C); clypeal setae on dorsal  $\frac{1}{2}$  directed toward midline, on ventral  $\frac{1}{2}$  directed ventrad (Fig. 15C); clypeal surface below each socket bare; inner margin of mandible broadly arcuate (Fig. 21E); scutal patches raised, oval (Fig. 24E). Length 4.9–7.0 mm.

*Discussion.*—Closely related to *P. borealis* and similar to *P. gracilis* but distinguished by shiny, smooth scutal margins and long parapsidal lines which reach the hind scutal margin. The mandible, pronotal tubercle, ventral



side of scape, and basal  $\frac{1}{5}$  of mid- and hindtibiae range from white to black. In some males, a very small tylus is present on flagellomere XI. Lengths of male paratypes range from 5.1 to 5.8 mm.

*Geographic range* (Fig. 9).—Known only from mountains of Oregon, northern California, and western Nevada.

*Type material*.—The holotype (from Leevining, California, U.S.; collected June 25, 1948, by Henry Townes and family) is from the K. V. Krombein collection in the National Museum of Natural History, Washington, D.C. (type no. 74067). There are 69 paratypes (14 males, 55 females) from the following localities: California: Alpine Co., Hope Valley (UCB); Amador Co., Silver Lake (UCB), Tragedy Spring (UCD); El Dorado Co., Echo Lake (UCB), Myers (UCD); Fresno Co., Leevining (USNM), Mono Hot Springs (UCB); Mono Co., Leavitt Meadow (CAS), Mammoth Lake (UCD); Nevada Co., Russell Valley (UCD), Sagehen Creek (UCB, UCD, UCR), White Cloud Campground (CAS); Placer Co., Donner Pass (USNM); Plumas Co., Mohawk (CAS); Shasta Co., Burney (UWM), Lassen Peak (UCB); Sierra Co., Gold Lake (UCD), Weber Lake (UCD), Yuba Pass (CAS, UCD); Trinity Co., Coffee Creek (UCD); Tuolumne Co., Dardanelle (USNM), Lake Tahoe at Carnelian Bay (UCD), Sonora Pass (UCB, UCD, USNM), Strawberry (UCB), Tuolumne Meadows (UCB), Yosemite National Park (USNM); Nevada: Washoe Co., Mt. Rose (UCD); Oregon: Linn Co., High Cascade Mts. (USNM).

*Passaloecus gracilis* (Curtis)

*Diodontus gracilis* Curtis, 1834:496 (lectotype male, Glanville Wooten, Dorset, England, designated by Yarrow, 1970—National Museum of Victoria, Melbourne, Australia).

*Passaloecus gracilis* (Curtis), Shuckard, 1837:190 (in part); Smith, 1856:427 (in part); Andre, 1888:199; Yarrow, 1970:173, 185; Merisuo, 1972:205; 1973c:110; Corbet and Backhouse, 1975:11; Lomholdt, 1975:117; Bohart and Menke, 1976:184 (in part).

*Passaloecus insignis* (Vander Linden), of Dahlbom, 1842:12; 1844:248; 1845:505; Wesmael, 1852:285; Smith, 1856:427 (in part); Taschenberg, 1866:188; 1869:95; Saunders, 1880:258; Richards, 1935:165; Zavadil and Snoflak, 1948:48; Leclercq, 1954:291; Noskiewicz and Pulawski, 1960:64; Valkeila, 1961:145 (in part); ?Danks, 1970:341; Balthasar, 1972:196.

*Passaloecus brevicornis* Morawitz, 1864:462 (for type material see below); Thomson, 1870:237; 1874:199; Kohl, 1893:38; 1905:521, 526; Schmiedeknecht 1930:672.

*Passaloecus turionum* Dahlbom, of Costa, 1871:43; Berland, 1925:146; Richards 1935:165; Giner Mari, 1943:40; Ribaut, 1952:25; Leclercq, 1954:290; Erzsebet, 1957:788; ? Janvier, 1961:878; Krombein, 1961b:258; de Beau-

mont, 1964b:107, 109, 110; Krombein, et al., 1967:398; Oehlke, 1971:747; Vincent, in Bohart and Menke, 1976:184 (in part). REVISED STATUS for *P. turionum* Dahlbom see discussion.

*Male*.—Black; mandible except apex, palpi, ventral side of scape, pronotal lobe, foretibia above, basal  $\frac{1}{4}$  of mid- and hindtibiae creamy-white; ventral side of flagellum, foretibia below, tarsi yellow-brown to dark brown; mandible apex, gastral segment VII, gastral sternum VIII (pseudo-sting) reddish-brown; labrum, dorsal side of flagellum, apical  $\frac{3}{4}$  of mid- and hindtibiae brown to dark brown; frontal and clypeal setae directed ventrad (Fig. 15F); flagellomeres I–IX or X with broadly oval (in some specimens nearly circular) tyli which are strongly arcuate in profile (Fig. 19C); IOD greater than OOD; clypeal lobe weakly concave apically (Fig. 15F); inner margin of mandible a right angle (Fig. 21F); notauli extending past midway on scutum; scutum anteriorly with interrupted, transverse carinae (as in Fig. 24F); scutal margin opposite tegula strongly reflexed, areolate; scrobal sulcus areolate (Fig. 23G); omaulus present, separated from episternal sulcus by a narrow, smooth area (Fig. 23G); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26M. Length 3.7–5.1 mm.

*Female*.—Similar to male except as follows: clypeal setae below sockets directed obliquely ventrad toward midline (Fig. 15E); inner margin of mandible a weak, obtuse angle (Fig. 21F); scutal patches raised, oval, partially obscured by transverse carinae (Fig. 24F). Length 4.0–5.4 mm.

*Discussion*.—Similar to *P. borealis* and *P. erugatus* but distinguished by the wider IOD, longer notauli, transverse scutal carinae, and the omaulus which is separated from the episternal sulcus by a narrow, smooth area.

In Europe *P. gracilis*, *P. turionum*, and *P. borealis* have been referred to collectively by some authors as a "complex." Yarrow (1970) and Lomholdt (1975) treat them as separate taxa. I once considered *P. gracilis* and *P. turionum* conspecific (Bohart and Menke, 1976) but have since changed my opinion.

*Floral record* (Nearctic).—*Grindelia* sp.

*Geographic range* (Fig. 9).—Holarctic—present throughout Europe and possibly adventive in the New World. I have seen 7 males, 7 females from the following localities in the U.S.: Indiana: Tippicanoe Co.; Louisiana: La Salle Parish; Maryland: Rockville; Michigan: Macomb Co.; New Jersey: Chatsworth; North Carolina: Durham; Ohio: Rutland; Pennsylvania: Presque Isle State Park; Texas: Wichita Falls; Virginia: Vienna. I have seen six males, four females from Europe.

*Type material*.—In 1948 O. W. Richards examined one of the two syntype males of *Diodontus gracilis*. He found that it was conspecific with what was then known to most authors as *P. insignis* (Vander Linden) (male only).



However, Yarrow (1970) pointed out that *P. insignis* should be based on the female. Therefore, *P. insignis* of authors became *P. gracilis* (Curtis). Yarrow (1970) designated the male seen by Richards as lectotype of *Diodontus gracilis* Curtis.

In 1973 I examined material of Dahlbom's on loan from the Museum Entomologicum, Lund, Sweden. In this material was a female which Faester had selected as lectotype of *P. turionum*. Because Faester did not publish this selection, I now propose it as lectotype of *Passaloecus turionum* Dahlbom. The specimen was labeled "Resinan, Rz Brg" by Dahlbom. Professor Roy Danielson (in lit.) interprets this to mean that it was taken by Ratzeburg in galls (or galleries ?) of *Tortricis resinana*. The specimen carries Faester's lectotype label (no date) and my lectotype label (1973).

*Passaloecus brevicornis* is a name proposed by Morawitz (1864) for specimens presumably misidentified by earlier authors. Thus, in my opinion, the type material is a syntype series consisting of the male which Vander Linden doubtfully associated with *P. insignis* (IRSN), Dahlbom's specimens labeled *P. insignis* (LUZI), and Shuckard's material labeled *P. gracilis* (BMNH).

#### "RELATIVUS GROUP"—group assemblage III

These three species from western Nearctic lack both scutal patches in females and spinose tubercles in males (Table 1). Therefore, I have placed them into a third group assemblage. Females have a very weakly tridentate clypeal lobe apex and lack a well developed setal pattern division. Males have pale markings on the flagellum, and a setal pattern division high on face above sockets. Both sexes have a well developed scrobal sulcus and lack an omaulus.

#### *Passaloecus relativus* Fox

*Passaloecus relativus* Fox, 1892:319 (holotype male, Colorado, U.S.—ANSP, type no. 4819); Cresson, 1928:52; Muesebeck et al., 1951:968.

*Male*.—Black; mandible except margins and apical  $\frac{1}{3}$ , palpal segments III–VI of maxilla and II–IV of labium, ventral side of scape and flagellum, pronotal lobe pale yellow to creamy-white; mandible margins and apical  $\frac{1}{3}$ , palpal segments I–II of maxilla and I of labium, labrum, dorsal side of scape and flagellum, hindtibia apical  $\frac{4}{5}$ , midtarsus segment V, hindtarsus, tegula, wing veins and stigma dark brown; forefemur apical  $\frac{1}{2}$  above, basal  $\frac{1}{5}$  of hindtibia, foretarsus, midtarsomeres I–IV pale yellow-brown; setal pattern division strong, midway on face (Fig. 16B); clypeal setae dense, directed ventrad; flagellomeres entire apically, I–X with linear tyli (Fig. 19D); IOD less than OOD; clypeal lobe truncate apically (Fig. 16B); inner margin of mandible a right angle (Fig. 21G); notauli impressed, weakly areolate, about

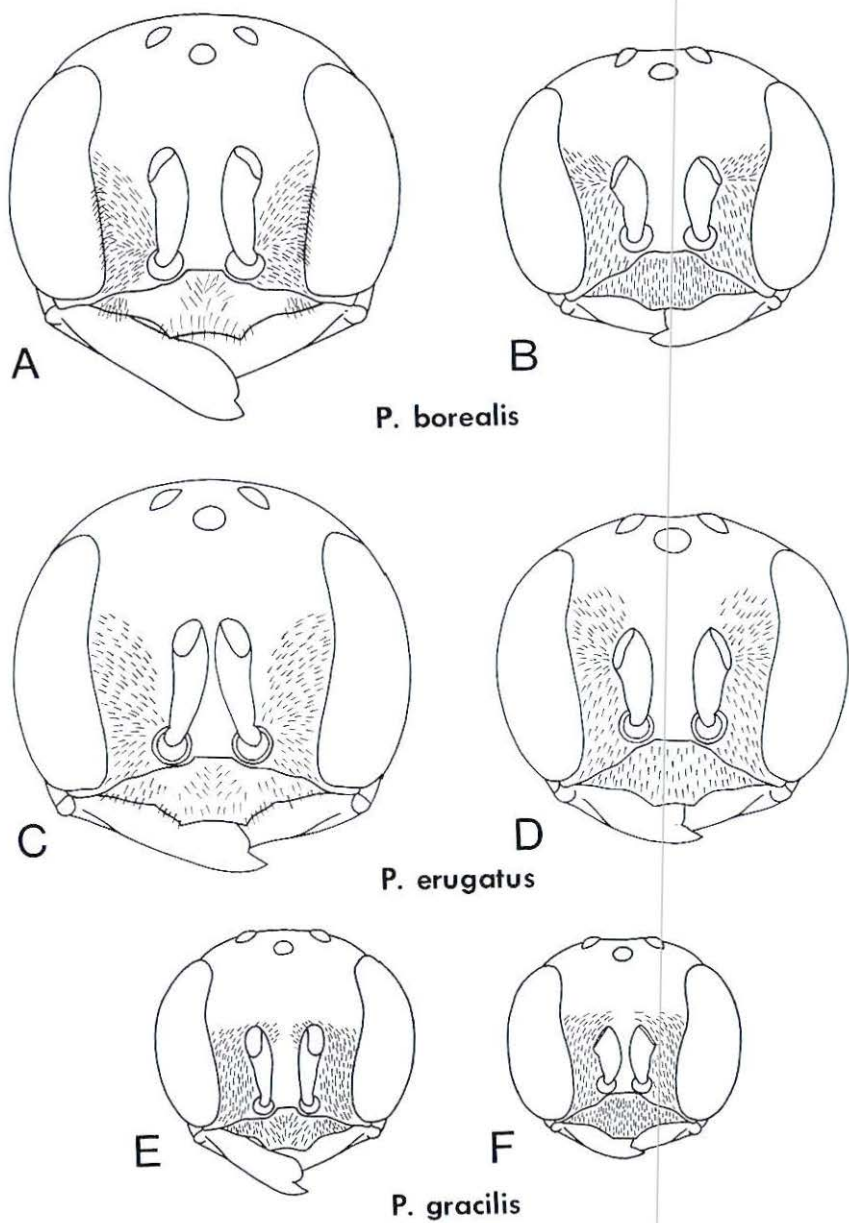


Figure 15. Facial outlines of *Passaloecus* species. A, C, E, female; B, D, F, male.



as long as admedian lines; scrobal sulcus areolate (as in Fig. 23C); gastral sternum III smooth; posterolateral margin of gastral tergum III angulate (as in Fig. 25A); hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26N. Length 4.1–5.3 mm.

*Female*.—Similar to male except as follows: no setal pattern division, frontal setae directed laterad; clypeal setae sparse, directed ventrad; clypeal lobe weakly upturned apically, weakly produced medially (Fig. 16A); inner margin of mandible broadly arcuate (Fig. 21G); scutum evenly punctured and microsculptured medially. Length 4.6–5.4 mm.

*Discussion*.—Closely related to *P. melanocrus* and *P. patagiatus*. It is distinguished in males by ventrally pale, dorsally dark flagellomeres with straight apical margins and linear tyli, and in both sexes by the all-dark labrum, narrow IOD, angulate posterolateral margins of gastral tergum III, and smooth gastral sternum III.

*Geographic range* (Fig. 10).—Mountains of central southwestern U.S. I have seen 12 males, 26 females.

*Passaloecus melanocrus* Rohwer

\**Passaloecus melanocrus* Rohwer, 1911:561 (holotype male, Davis Mts., Texas, U.S.—USNM, type no. 13740); Muesebeck et al., 1951:968; Bohart and Menke, 1976:184.

*Passaloecus relativus* Fox, of Rohwer, 1909:100 (in part).

*Male*.—Black; mandible except apex, palpi, labrum, ventral side of scape, apical  $\frac{1}{3}$  of flagellomeres I–X, pronotal lobe, tegula medially, foretibia above, basal  $\frac{1}{4}$  to  $\frac{1}{3}$  of mid- and hindtibiae creamy-white; apical  $\frac{2}{3}$  to  $\frac{3}{4}$  of hindtibia brown; mandible apex reddish brown; foretibia below, apical  $\frac{2}{3}$  to  $\frac{3}{4}$  of midtibia, tarsi pale yellow-brown; setal pattern division strong, midway on face (Fig. 16D); clypeal setae dense, directed ventrad; flagellomeres V–VIII with concave apical margin, II–X with spindle-shaped tyli (Fig. 19E); IOD equal to OOD; clypeal lobe truncate apically (Fig. 16D); inner margin of mandible obtusely angled (Fig. 21H); notauli deeply impressed, weakly areolate, about as long as admedian lines; scrobal sulcus areolate (as in Fig. 23C); gastral sternum III with shallow, transverse depression (Fig. 25C); posterolateral margin of gastral tergum III angular (as in Fig. 25A) hind margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26O. Length 4.4–5.7 mm.

*Female*.—Similar to male except as follows: no setal pattern division, frontal setae directed laterad; clypeal setae directed obliquely ventrad toward midline (Fig. 16C); clypeal lobe weakly tridentate apically (Fig. 16C); inner margin of mandible broadly arcuate (Fig. 21H); scutum evenly punctured and microsculptured medially. Length 4.8–6.2 mm.

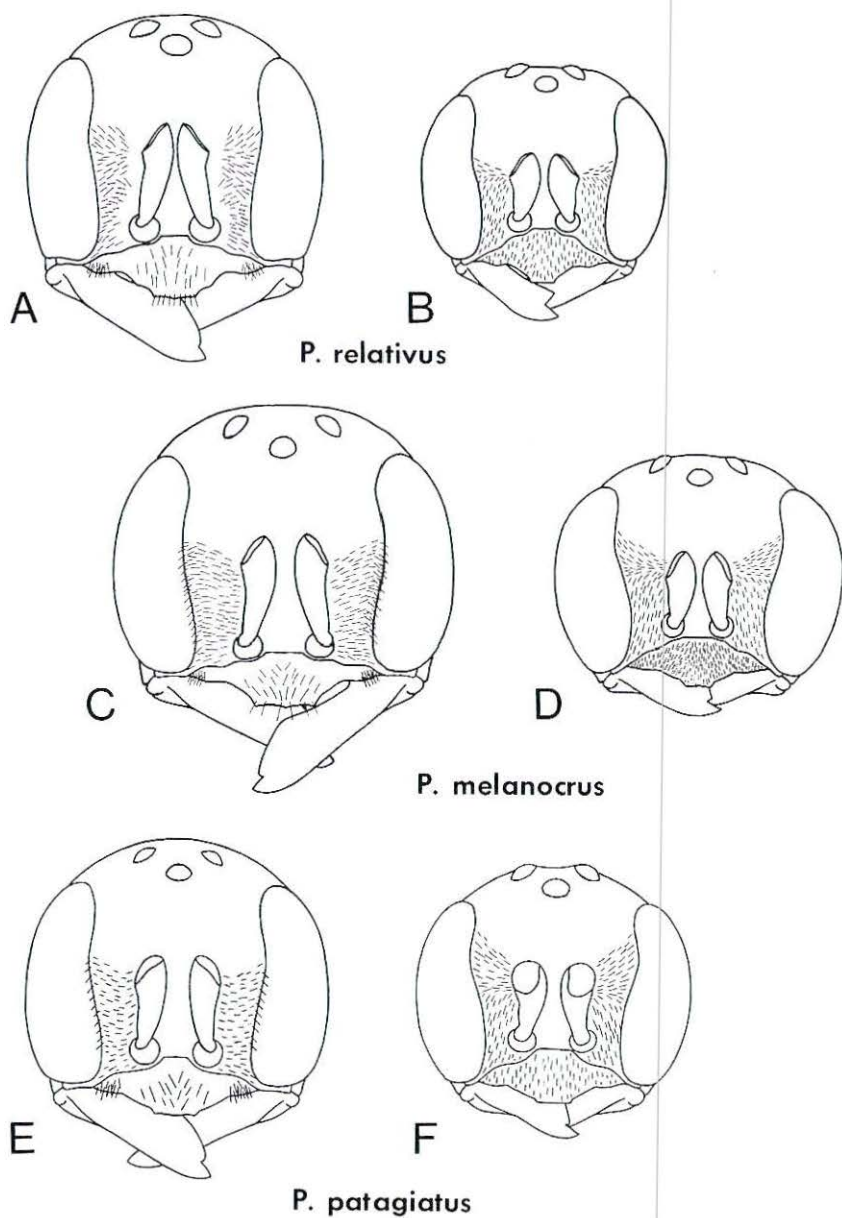


Figure 16. Facial outlines of *Passaloecus* species. A, C, E, female; B, D, F, male.



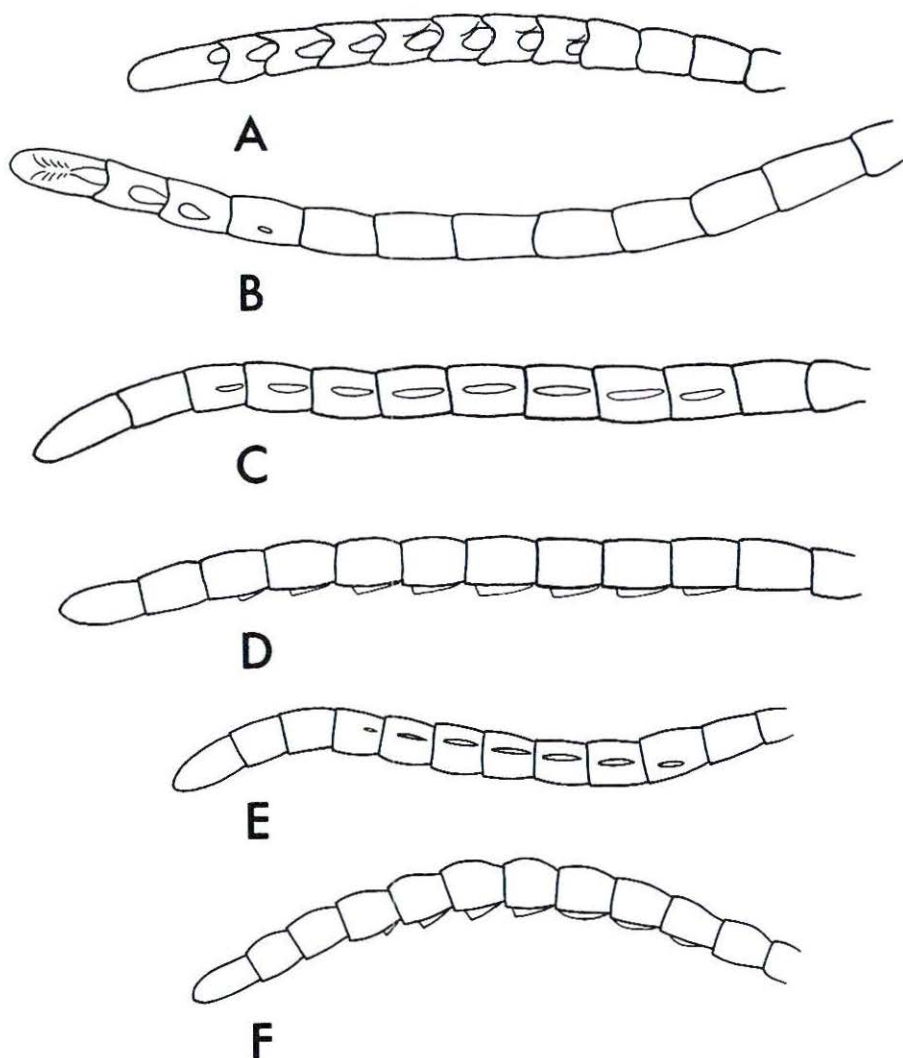


Figure 17. Flagella of *Passaloecus* species, male; A, B, C, E, ventral view; D, F, lateral view. A, *P. cuspidatus*; B, *P. melanognathus*; C, D, *P. monilicornis* (northern and north-eastern population); E, F, *P. monilicornis* (western population).

*Discussion.*—Closely related to *P. relativus* and *P. patagiatus*, but distinguished in males by apically concave, broadly banded flagellomeres, and in both sexes by the all-white labrum and a transverse depression on gastral sternum III.

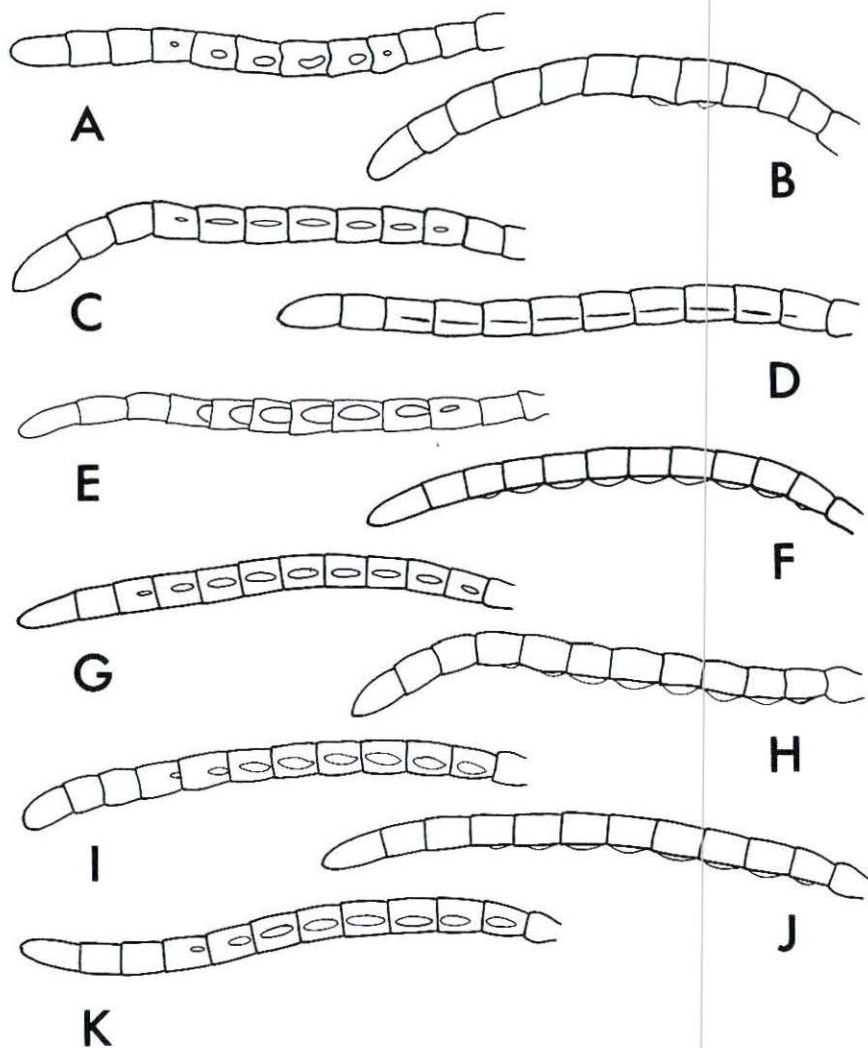


Figure 18. Flagella of *Passaloecus* species, male; A, C, D, E, G, I, K, ventral view; B, F, H, J, lateral view. A, B, *P. annulatus*; C, *P. areolatus*; D, *P. lineatus*; E, *P. singularis*; F, G, *P. armeniacae*; H, I, *P. gallicola*; J, K, *P. miltoloma*.



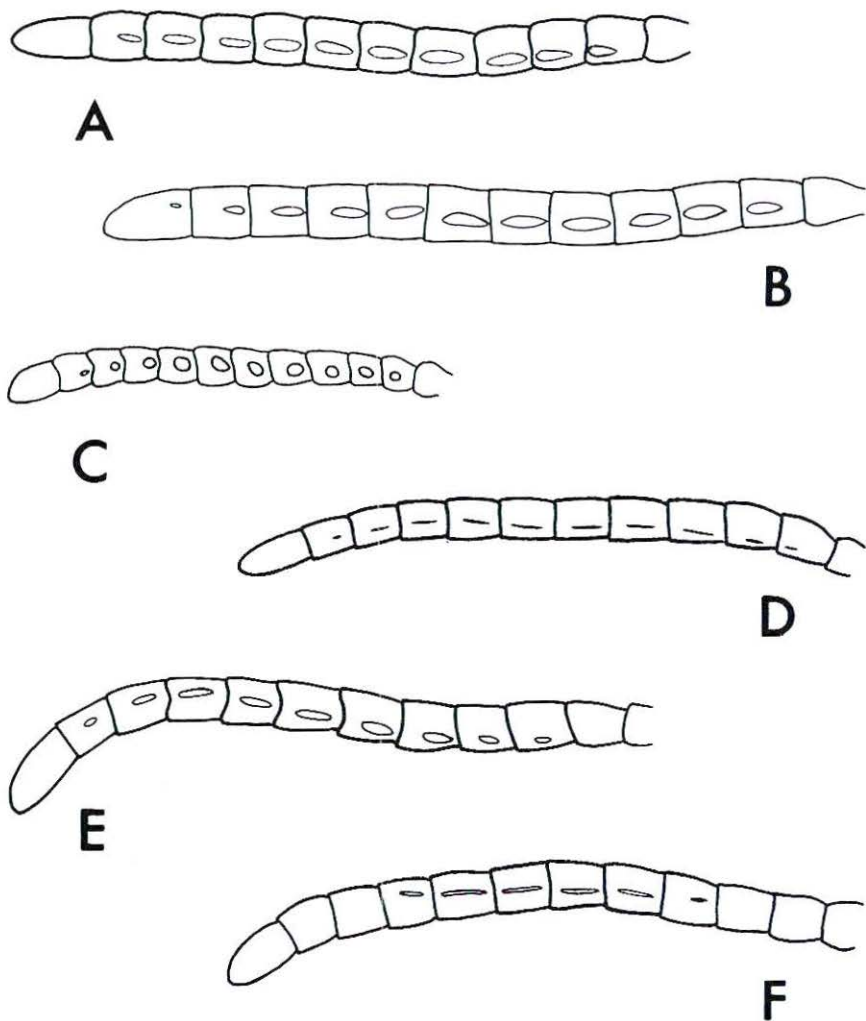


Figure 19. Flagella of *Passaloecus* species, male; ventral view. A, *P. borealis*; B, *P. erugatus*; C, *P. gracilis*; D, *P. relativus*; E, *P. melanocrus*; F, *P. patagiatus*.

*Geographic range* (Fig. 10).—Throughout western half of the U.S. and extreme southwest Canada. I have seen 22 males, 37 females.

*Passaloecus patagiatus*, new species

*Etymology*.—The species epithet is a noun in apposition from the Latin

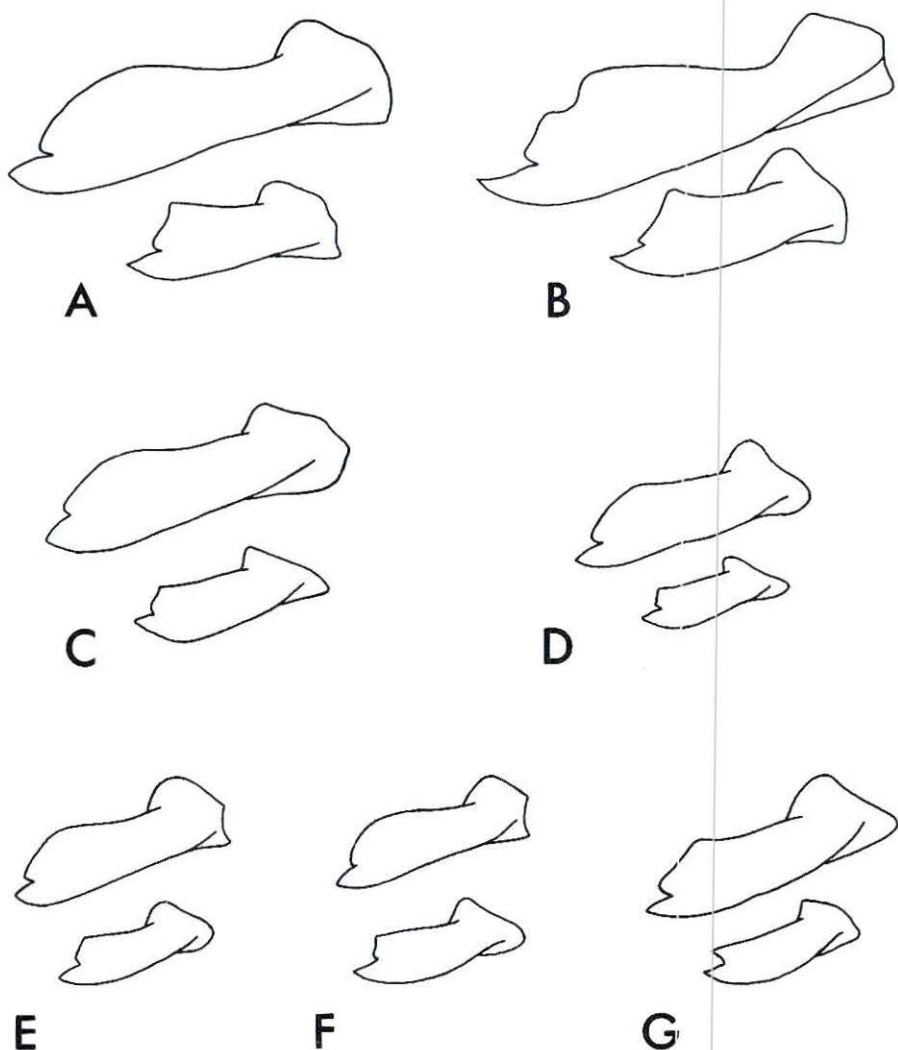


Figure 20. Mandibles of *Passaloecus* species (female above, male below). A, *P. cuspidatus*; B, *P. melanognathus*; C, *P. monilicornis*; D, *P. annulatus*; E, *P. areolatus*; F, *P. lineatus*; G, *P. singularis*.

*patagium* meaning "gold edging" and refers to the pale bands on flagellomeres of males.

*Holotype, male*.—Black; basal  $\frac{4}{5}$  of mandible, palpal segments II–VI of maxilla and II–IV of labium, ventral side of scape, apical  $\frac{1}{3}$  of flagellomeres



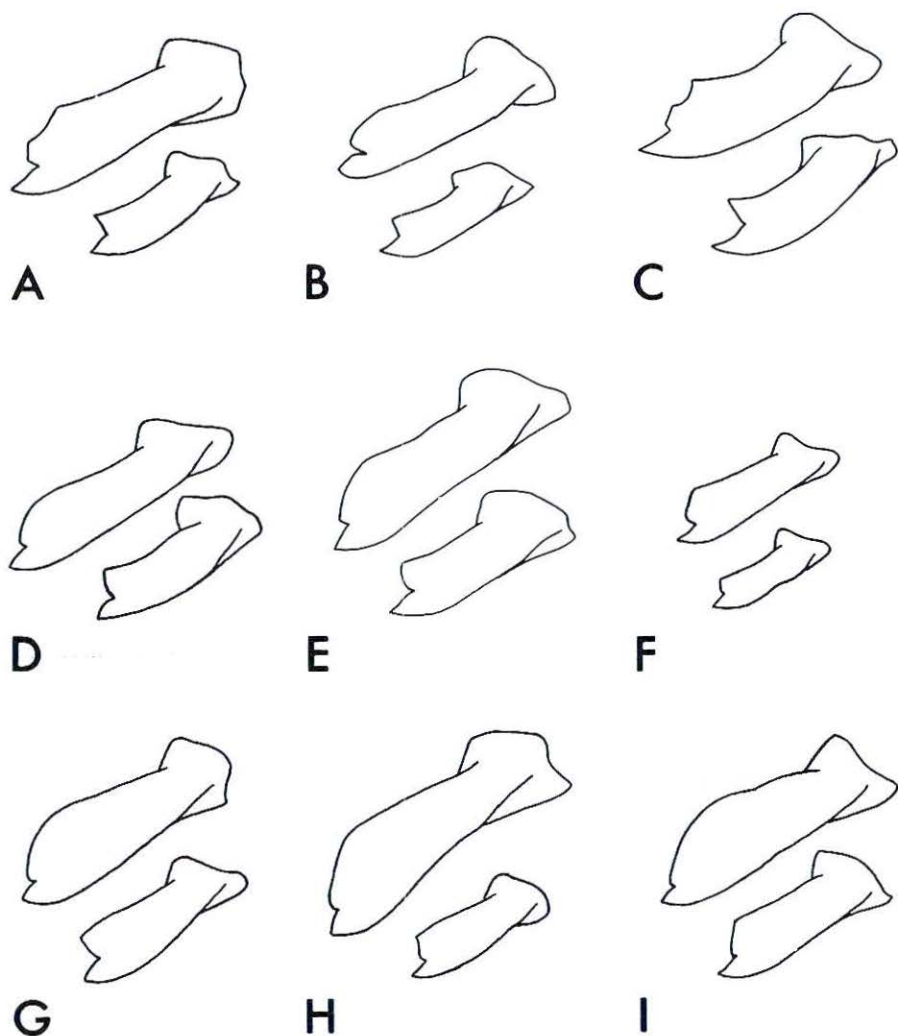


Figure 21. Mandibles of *Passaloecus* species (female above, male below). A, *P. armeniacae*; B, *P. gallicola*; C, *P. miltoloma*; D, *P. borealis*; E, *P. erugatus*; F, *P. gracilis*; G, *P. relativus*; H, *P. melanocrus*; I, *P. patagiatus*.

I-X, pronotal lobe creamy-white; apical  $\frac{1}{5}$  of mandible, labrum, basal  $\frac{2}{3}$  of flagellomeres I-X, femora, tarsi segment V, tegula, wing veins and stigma dark brown; palpal segment I of maxilla and labium, hindtibia apical  $\frac{3}{4}$ , fore- and midtarsus segment V, hindtarsus segments III-V brown; fore- and midtibiae, fore- and midtarsi segments I-IV, hindtarsus segments I-II yel-

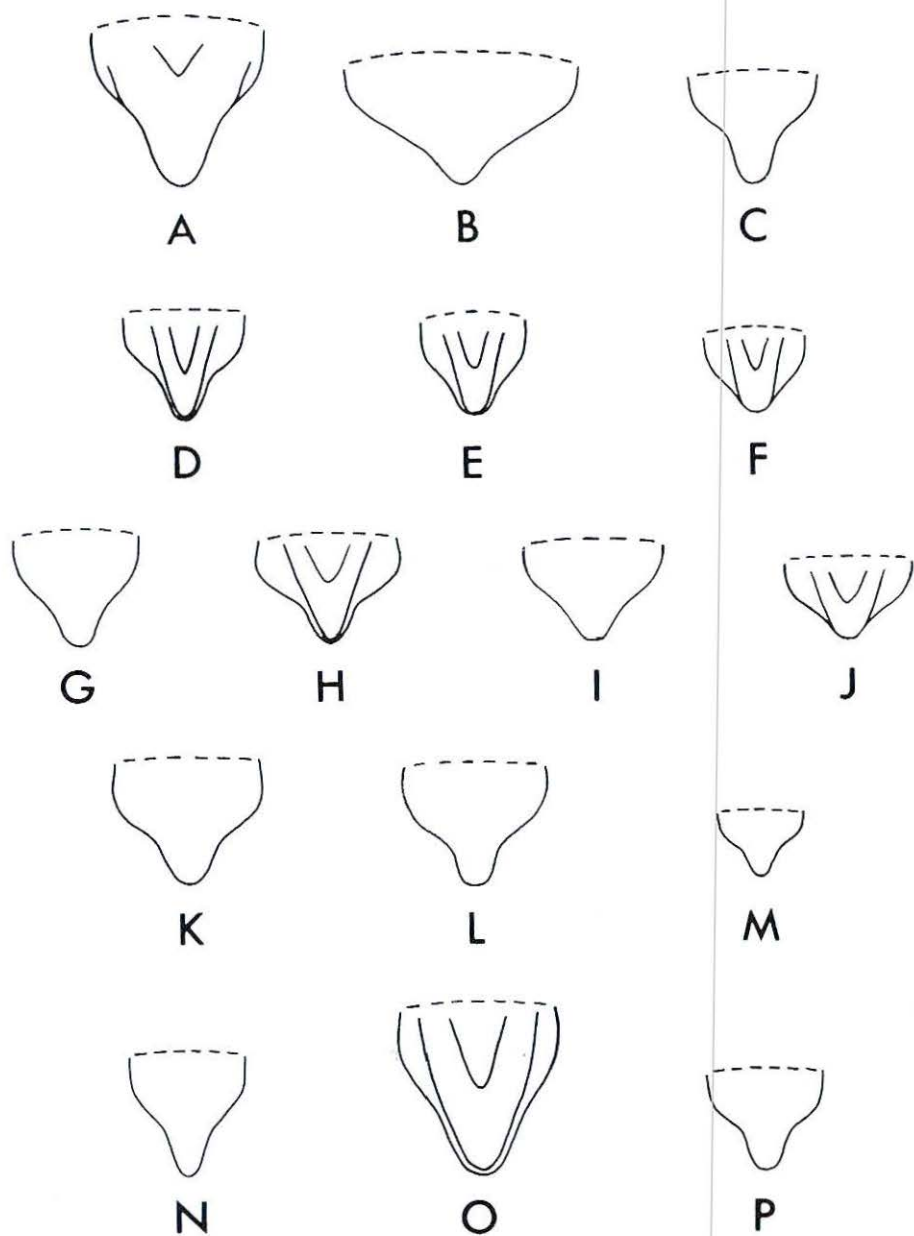


Figure 22. Labrum of *Passaloecus* species, female. A, *P. cuspidatus*; B, *P. melanognathus*; C, *P. monilicornis*; D, *P. annulatus*; E, *P. areolatus*; F, *P. lineatus*; G, *P. singularis*; H, *P. armeniacae*; I, *P. gallicola*; J, *P. miltoloma*; K, *P. borealis*; L, *P. erugatus*; M, *P. gracilis*; N, *P. relativus*; O, *P. melanocrus*; P, *P. patagiatus*.



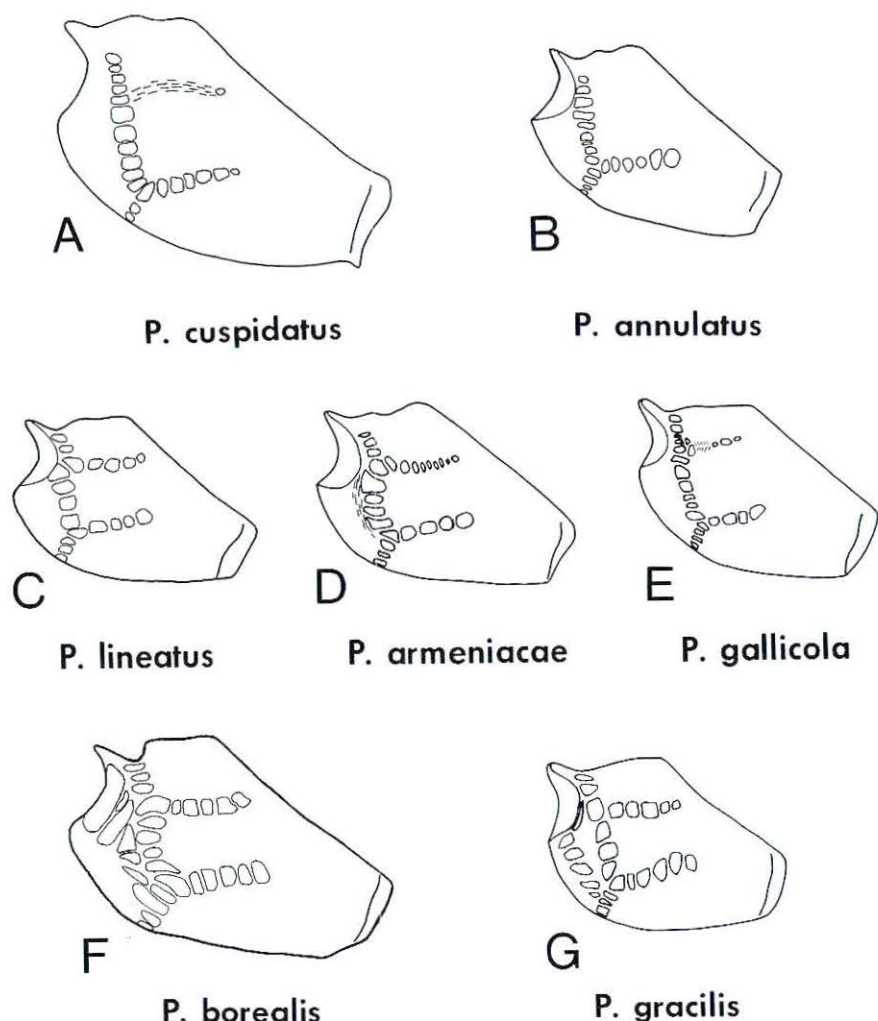
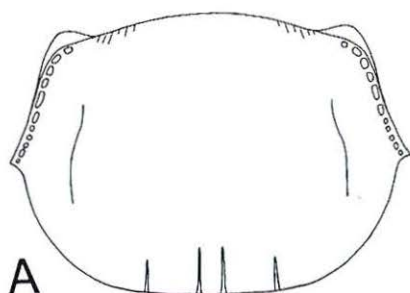
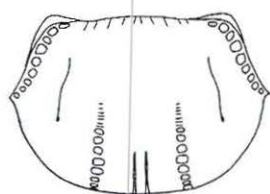


Figure 23. Mesopleuron of *Passaloecus* species.

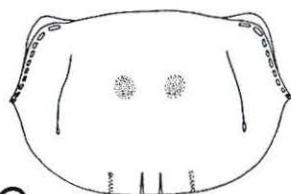
low-brown; setal pattern division strong, midway on face (Fig. 16F); clypeal setae dense, directed ventrad; flagellomeres with straight apical margins, I–VIII with narrow tyli (Fig. 19F); IOD equal to OOD; clypeal lobe truncate apically (Fig. 16F); inner margin of mandible obtusely angled (Fig. 21I); notauli impressed, weakly areolate, slightly longer than admedian lines; scrobal sulcus areolate (as in Fig. 23C); gastral sternum III smooth; postero-lateral margin of gastral tergum III broadly curved (as in Fig. 25B); hind



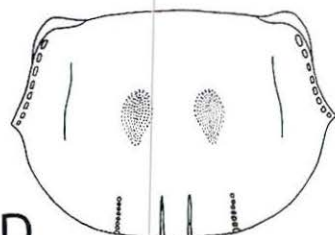
A

**P. cuspidatus**

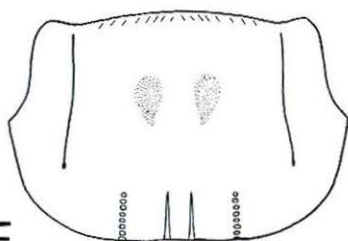
B

**P. lineatus**

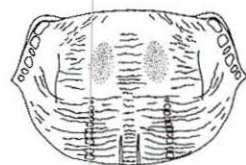
C

**P. singularis**

D

**P. borealis**

E

**P. erugatus**

F

**P. gracilis**Figure 24. Scutum of *Passaloecus* species, female.

margin of gastral tergum VI with minute, scattered setae mesally; penis valve as in Figure 26P. Length 4.6 mm.

*Female*.—Similar to male except as follows: basal  $\frac{3}{4}$  to  $\frac{2}{3}$  of mandible except margins, apical  $\frac{1}{2}$  of labrum pale yellow; flagellum, hindtarsus dark brown; apical  $\frac{1}{4}$  to  $\frac{1}{3}$  and margins of mandible, basal  $\frac{1}{2}$  of labrum, apex of fore- and midfemur yellow-brown; no setal pattern division, setae directed

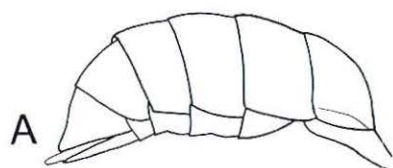
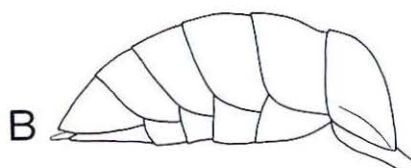
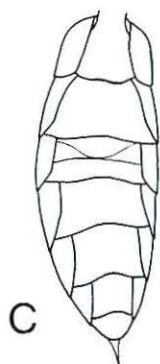
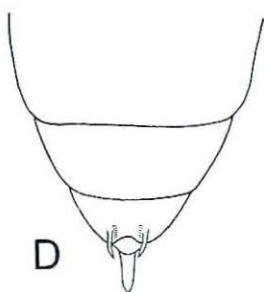
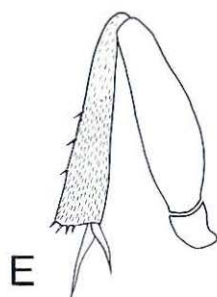
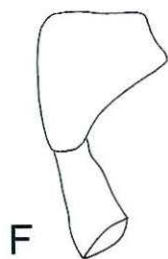
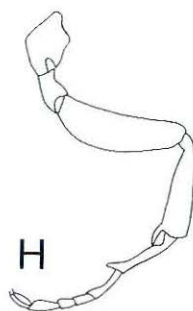
**P. melanocrus****P. patagiatus****P. melanocrus****P. cuspidatus****P. miltoloma****P. cuspidatus****P. melanognathus****P. cuspidatus**

Figure 25. Structural features of *Passaloecus* species. A, B, E, F, G, female; C, D, H, male. A, B, gaster, lateral view; C, gaster, ventral view; D, gastral terga IV, V, and VI, dorsal view; E, trochanter, femur, tibia of hind leg, lateral view; F, G, forecoxa, anterior view; H, foreleg, lateral view.



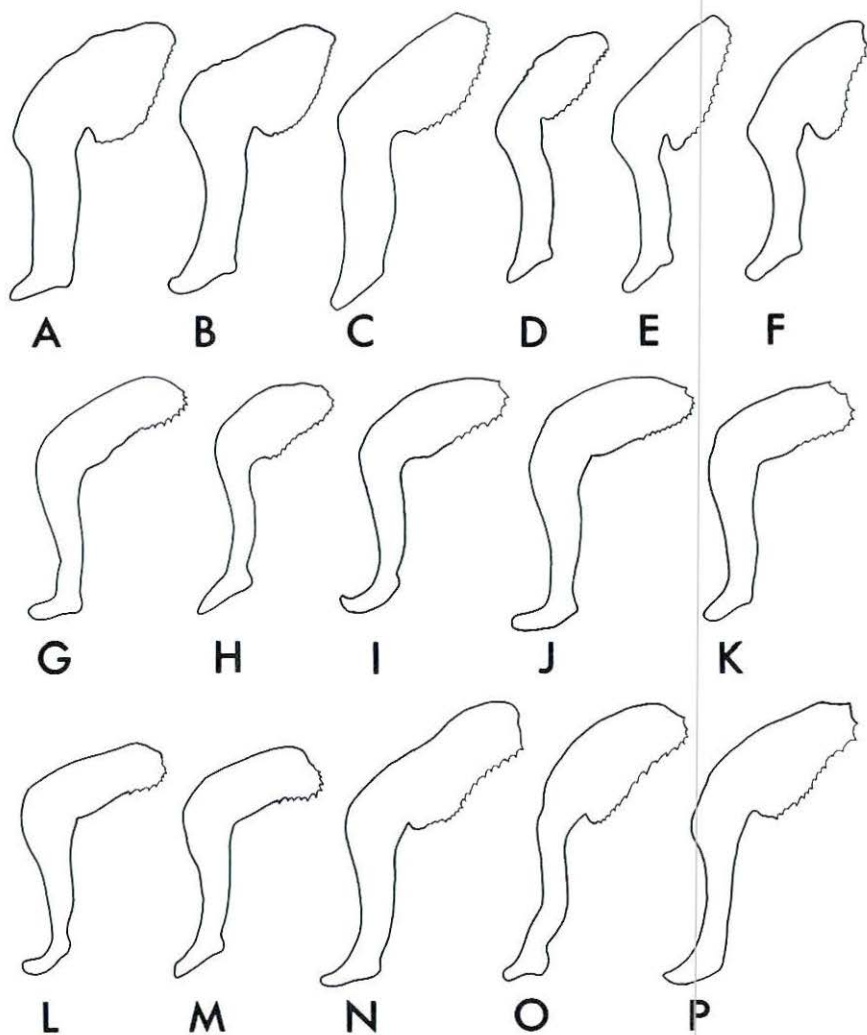


Figure 26. Penis valves of *Passaloecus* species, lateral view. A, *P. cuspidatus*; B, *P. melanognathus*; C, *P. monilicornis*; D, *P. annulatus*; E, *P. areolatus*; F, *P. lineatus*; G, *P. singularis*; H, *P. armeniacae*; I, *P. gallicola*; J, *P. miltoloma*; K, *P. borealis*; L, *P. erugatus*; M, *P. gracilis*; N, *P. relativus*; O, *P. melanocrus*; P, *P. patagiatus*.

laterad except at eye margins directed obliquely ventrad (Fig. 16E); clypeal setae sparse, directed ventrad, subantennal areas bare; clypeal lobe apex weakly dentate at corners (Fig. 16E); inner margin of mandible broadly arcuate (Fig. 21I); scutum evenly punctured and microsculptured medially. Length 5.2–6.0 mm.

*Discussion*.—Closely related to *P. melanocrus* and *P. relativus* but distinguished in males by narrow tyli on flagellomeres I–VIII, in females by the yellow-brown tip of the labrum, and in both sexes by the broadly curved posterolateral margin of tergum III. Lengths of male paratypes range from 4.3 to 5.5 mm.

*Floral record*.—*Eriogonum latifolium nudum* (Dougl. ex Benth.) Stokes; *Penstemon* sp.

*Geographic range* (Fig. 10).—Western U.S. and Canada.

*Type material*.—The holotype (from Pokegama, Klamath Co., Oregon, U.S., Hopkins no. 10186b; reared June 1, 1913, by W. D. Edmonston) is in the National Museum of Natural History, Washington, D.C. (type no. 74066). There are 40 paratypes (9 males, 31 females) from the following localities: U.S.: California: Alpine Co., Hope Valley (UCD); Eldorado Co. (KU); Madera Co., Green Mountain (CAS); Mono Co., Leavitt Meadow (CAS); Leevining (USNM); Nevada Co., Jackson Lake (UCD), Sagehen Creek near Hobart Mills (UCD); Placer Co., Brockway Summit (UCD), Tahoe City (CAS); Plumas Co., Lake Almanor (UCD); Riverside Co., Keen Camp (UCD); San Bernardino Co., Upper Santa Ana River (KU); San Mateo Co., San Mateo Memorial Park (CAS); Santa Clara Co., Mountain View (USNM), Santa Cruz Mountains (USNM); Shasta Co., Old Station (UCD); Sierra Co., near Sierraville (UCD); Siskiyou Co., Salmon Trinity Alps Wilderness Area (CAS), Yreka (USNM); Trinity Co., Butter Creek near Hyampon (CAS); Idaho: Kootenai Co., Grizzly Mountain near Coeur d'Alene (USNM); Nevada: Washoe Co., (UCD); Oregon: Jackson Co., Ashland (USNM), Medford (UCD); Josephine Co., near Cave Junction (CAS); Canada: British Columbia: Robson Mountain (CNC), Vernon (CAS).

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