

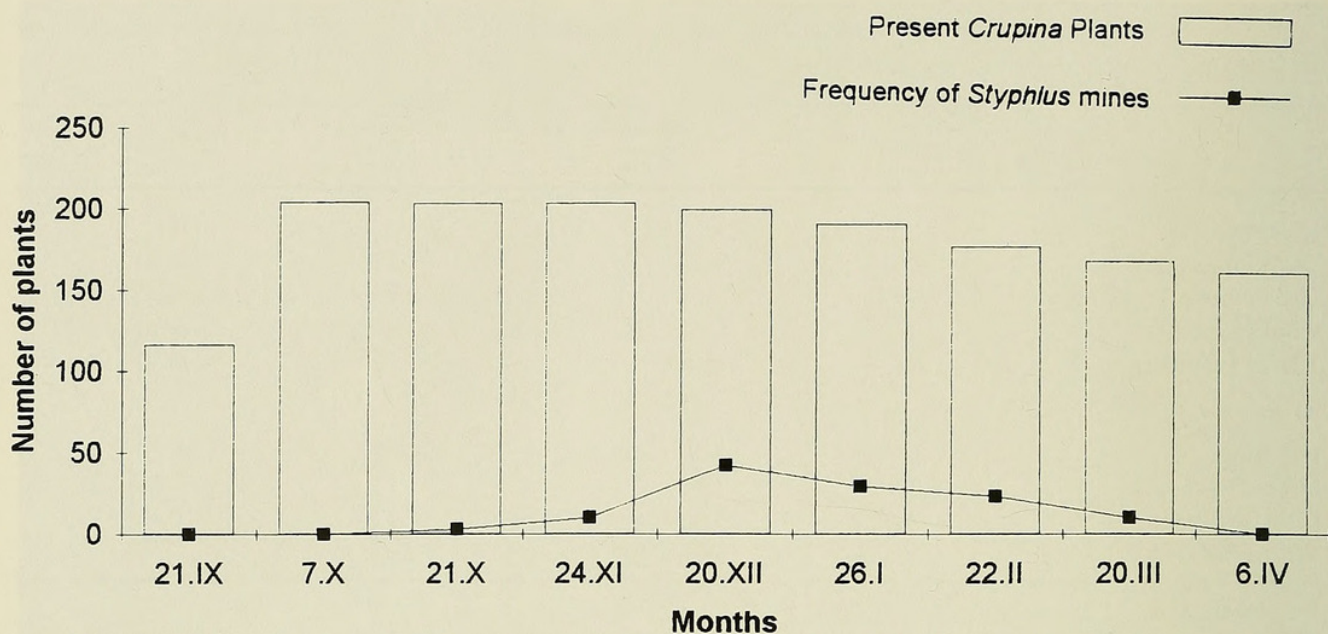


Fig. 3. Number of *Crupina vulgaris* plants and *Styphlus penicillus* mines on *Crupina* leaves in Montferrier during September 1993 to April 1994.

oviposition was observed. Five of the adults died during the period 12 April to 27 May 1994. The remaining two adults rested under stones until October 1994, when they started to feed on *Crupina* rosettes. The number of *C. vulgaris* seedlings increased from 116 on 21 September 1993, to 203 by 21 October 1993. Forty-three of these were dead by 6 April 1994 for unknown reasons. The plants were budding or flowering by mid May. Mines of *S. penicillus* appeared on cotyledons in October, increased during the second half of December, and decreased slowly until 6 April, when no more mines could be found on the plants (Fig. 3).

Field test to determine host specificity.—The first mine was observed on an artichoke leaf on 10 November 1994. Five more mines were found on artichoke leaves on 12 November. All of the mines contained living larvae, identical to *S. penicillus* larvae from *C. vulgaris*; D. M. Anderson and N. J. Vandenberg (SEL), who carefully examined these larvae and compared them with the *Styphlus penicillus* larvae, could not find any morphological differences between them. On 20 December, 1994, mines were also found on the leaves of the following test plants: *Cichorium intybus*, *Lactuca sativa*, *Crepis rubra*, *Cynara*

scolymus, and *Carthamus tinctorius*. Examination of these mines showed the presence of *Styphlus penicillus* larvae which could not be reared to adults. Since feeding was seen on these plants, it was apparent that this weevil has a wide host range and could attack crop and economically important plants. At this point, testing was discontinued and consideration of *S. penicillus* as a control agent of *C. vulgaris* ended.

Several other promising natural enemies have been reared from *C. vulgaris* in southern France and are under study. These are a pathogen of seedlings, *Ramularia* n. sp.; *Aceria balasi* Farkas (Acarina: Eriophyidae) which attacks flower buds; *Clytie il-lunaris* Huebner (Lepidoptera: Noctuidae), a seed feeder; *Cochylini* sp. (Lepidoptera: Tortricidae), a defoliator; *Ornativalva pluttelliformis* Staudinger (Lepidoptera: Gracilariidae), a seed feeder and *Metzneria april-ella* Herrich-Schäffer (Lepidoptera: Gelechiidae), a seed feeder.

ACKNOWLEDGMENTS

We thank D. M. Anderson and N. J. Vandenberg, Systematic Entomology Laboratory, Washington, D.C., USA, and E. Colonnelli, Univ. of Rome, Italy for insect identifications; J. R. Coulson, ARS, Nation-

al Biological Control Documentation Center, Beltsville, MD; A Kirk, European Biological Control Laboratory, Montpellier, France; R. Pemberton, ARS, Aquatic Weed Control Research, Ft. Lauderdale, Florida; Neal R. Spencer, ARS, Range Weeds and Cereals Research Unit, Sydney, Montana; and an unknown journal reviewer for reviewing the manuscript.

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NEW SPECIES OF *PAUESIA* (HYMENOPTERA: BRACONIDAE:
APHIDIINAE) PARASITOIDS ON *CINARA* (HOMOPTERA: APHIDIDAE:
LACHNINAE) ASSOCIATED WITH CONIFERS IN THE PACIFIC
NORTHWEST

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Abstract.—Three new aphid parasitoid species from Washington State are described and illustrated, and their key distinguishing features, host aphid and plant associations provided: *Pauesia ahtanumensis* n. sp. (host: *Cinara ponderosae* (Williams) on *Pinus ponderosa* Douglas); *P. pahtonis* n. sp. (host: *C. ponderosae* on *P. ponderosa*); and *P. ponderosaecola* n. sp. (host: *C. ponderosae* on *P. ponderosa*).

Key Words: Aphididae, *Cinara*, parasitoids, *Pauesia*

The genus *Pauesia* Quilis (Hymenoptera, Braconidae, Aphidiinae) includes parasitoids that attack aphids of several genera (*Cedrobium* Remaudière, *Cinara* Curtis, *Schizolachnus* Mordvilko, and *Tuberolachnus* Mordvilko) of the subfamily Lachninae. These lachnine aphids are associated mainly with conifers, but a few may be found on deciduous trees and shrubs.

Research on the aphid parasitoids attacking lachnines is much less extensive than that on aphids of agricultural importance, primarily because the lachnines have seldom reached pest status. Some exceptions have been where lachnines appeared as inadvertent introductions outside their native range and without their natural enemies. Parasitoids of the genus *Pauesia* have shown promise as introduced biological agents in several such cases. *Pauesia cedrobii* Starý and Leclant, a parasitoid native to the mountains of North Africa (Starý and Leclant 1977), introduced into France to control the cedar aphid, *Cedrobium laportei*

Remaudière (Fabre and Rabasse 1987), was established in target areas and is now spreading inland within the country (Starý and Remaudière 1993). *Pauesia cinaravora* Marsh, a parasitoid native to George and Florida, introduced into South Africa to control *Cinara cronartii* Tissot and Pepper (accidental introduction from southeastern USA) (Kfir et al. 1985, Kfir and Kirsten 1991), was established as an effective agent. Other *Pauesia* spp. are currently being considered for use against *Cinara cupressi* (Buckton), a new, accidental introduction and threat to the forest and wood based industries of eastern and southern Africa (Kenya Forestry Res. Inst. 1991).

Information on *Pauesia* spp. in North America is limited to a review by Smith (1944), new species descriptions by Muesebeck (1958) and Marsh (1991), and a listing of the Nearctic American species North of Mexico (Marsh 1979). The present work provides descriptions of three new species reared from *Cinara* associated with conifers

in Washington State. Recognition of these parasitoids is fundamental to assessing their potential as natural control agents.

MATERIAL AND METHODS

Descriptions of taxa are based on both whole dry, and dissected slide-mounted specimens examined under microscope at 90 to 600x. Body lengths are measured and recorded in millimeters. Holotypes were dry-mounted on paper tabs and pinned. The descriptive terminology used is after Huber and Sharkey (1993).

Descriptions

Pauesia ahtanumensis Pike and Starý, NEW SPECIES (Figs. 1–15)

Diagnosis.—Following a key by Smith (1944), the new species keys to a group of species that show distinct and complete areola on the propodeum, and distinct additional carinae inside this areola. It can be distinguished from other species in the group by a 16–17 segmented antenna (female), smooth bicolorous mesonotum, perpendicular setae on both margins of the hind femur, apical setae with simple circular bases on the ovipositor sheath, and stigma coloration uniformly brown.

Etymology.—The name of the species is derived from its type locality, the Ahtanum Valley, Yakima Co., Washington.

Description.—*Female*: Head. Eyes sparsely setose. Malar space $\frac{1}{6}$ shorter than intertentorial line, or equal to $\frac{2}{5}$ width of eye. Tentoriocular line $\frac{1}{6}$ shorter than intertentorial line. Maxillary palpus 4-segmented, labial palpus 3-segmented. Antenna 16–17 segmented, thickened in apical half; flagellomere 1 (=F₁) (Fig. 12) twice as long as wide, longest setae almost perpendicular, subequal to width of segment, with 0–1 longitudinal placode. F₂ (Fig. 13) slightly longer than F₁, with 3 longitudinal placodes. Middle F (Fig. 14) about $\frac{1}{4}$ wider than F₁, 1.5 times as long as wide, setae semi-perpendicular, equal to $\frac{2}{3}$ width of segment,

with 6 longitudinal placodes; preapical F (Fig. 15) as wide as middle F.

Mesosoma.—Pronotum with antescutal depression (Fig. 6). Mesonotum (Fig. 1) with distinct, crenulate-rugose notauli anteriorly, sparsely setose, finely punctate, with glabrous areas on central and lateral lobes. Propodeum (Fig. 8) with distinct central areola, several additional carinae inside areola, with relatively dense, long setae in upper lateral areola.

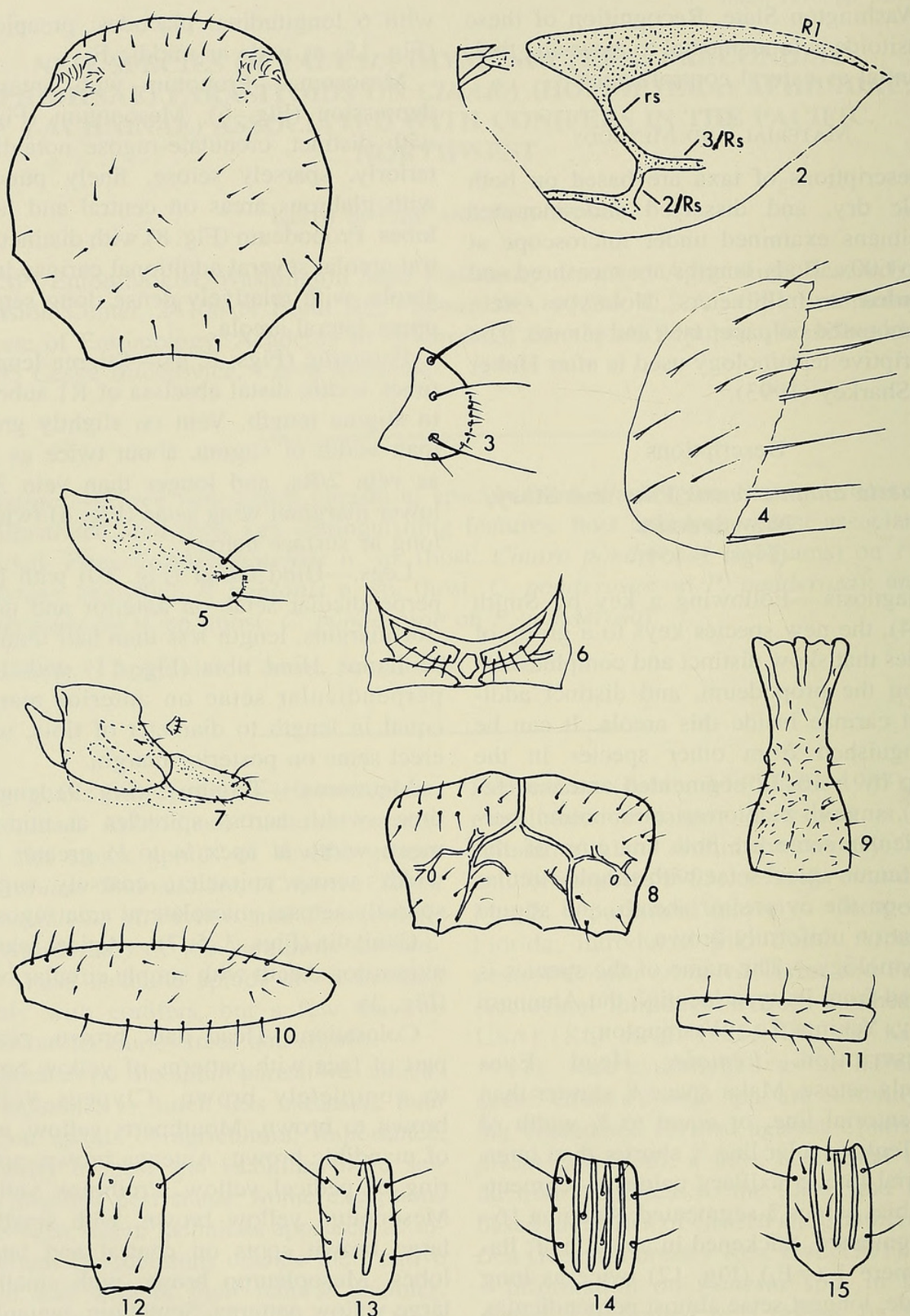
Forewing (Figs. 2, 4).—Stigma length 3 times width, distal abscissa of R1 subequal to stigma length. Vein rs, slightly greater than width of stigma, about twice as long as vein 2/Rs, and longer than vein 3/Rs; lower marginal wing setae (Fig. 4) twice as long as surface hairs.

Legs.—Hind femur (Fig. 10) with long, perpendicular setae on anterior and posterior margins, length less than half diameter of femur. Hind tibia (Fig. 11) with long, perpendicular setae on anterior margin, equal in length to diameter of tibia, semi-erect setae on posterior margin.

Metasoma.—Tergum 1 (Fig. 9) length 3 times width across spiracles at mid-segment; width at apex $\frac{1}{4}$ to $\frac{1}{3}$ greater than width across spiracles; coarsely rugose, sparsely setose; anterolateral area rugose.

Genitalia (Figs. 3, 5, 7).—Apical setae of ovipositor sheath with simple circular bases (Fig. 3).

Coloration.—Head dark brown, central part of face with patterns of yellow brown to completely brown. Clypeus yellow brown to brown. Mouthparts yellow, apex of mandible brown. Antenna brown, apical ring of pedicel yellow. Prothorax yellow. Mesonotum yellow brown, with small or large brown spots on central and lateral lobes. Mesopleuron brown with small or large yellow patterns. Scutellum, metapleuron and propodeum brown; metanotum sometimes with lighter patterns in lower portion. Tegula yellow. Wing venation brown; stigma uniformly brown. Legs yellow brown, middle and hind femur and tibia sometimes dark, apex of tarsus infuscated.



Figs. 1-15. *Pauesia ahtanumensis*, female paratypes (illustrations not to equal scale). 1, Mesonotum. 2, Forewing, in part. 3, Apex of ovipositor sheath. 4, Forewing surface and lower marginal setae, close-up. 5, Ovipositor sheath. 6, Antescutal depression of pronotum. 7, Genitalia. 8, Propodeum. 9, Metasomal tergum 1. 10, Hind femur. 11, Hind tibia, central part. 12, Flagellomere 1. 13, Flagellomere 2. 14, Middle flagellomere. 15, Preapical flagellomere.

Metasoma yellow brown, apical third dark brown. Ovipositor sheath dark brown.

Length of body about 2.6–3.0 mm.

Male: Antenna 19–21 segmented. Coloration similar but generally darker than female. Pronotum yellow brown. Mesosoma largely uniformly dark brown; propleuron often brown; mesonotum with yellow brown margins near the base of notauli.

Holotype.—Female. USA, WA, Yakima Co., Ahtanum Valley, 3-VI-1994, P. Starý & K. S. Pike. Host: *Cinara ponderosae* (Williams) on *Pinus ponderosa* Douglas, sample 94–65. Deposited in USNM, Washington D.C., Type No. 105346.

Paratypes. 65 females; 75 males, same data as holotype (Sample no. 94–95). Deposited in part in the Washington State University Collection, James Museum, Pullman, Washington; the Washington State University Collection-Prosser, Washington; the collection of P. Starý, České Budejovice, Czech Republic; and the USNM, Washington D.C.

Note.—Mummified aphids are black.

***Pauesia pahtonis* Pike and Starý,
NEW SPECIES
(Figs. 16–28)**

Diagnosis.—This new species belongs to a group of species characterized by an incomplete areola on the propodeum, i.e. longitudinal carinae are absent. The new species is distinguished from others by having a 20-segmented antenna (variation unknown, possibly range 19–21), delicately sculptured and uniformly black mesonotum with notauli indicated over most of the surface.

Etymology.—The name of the species is derived from the aboriginal Yakama name of a volcano near the type locality, Pahto (Mt. Adams).

Description.—*Female*: Eye sparsely setose. Tentoriocular line and malar space $\frac{2}{3}$ intertentorial line, also, subequal to $\frac{1}{3}$ width of eye. Maxillary palpus 4-segmented, labial palpus 3-segmented. Antenna 20-segmented (variation unknown), not thickened

in apical half. Flagellomere 1 ($=F_1$) (Fig. 25) less than twice as long as wide, longest semi-perpendicular setae somewhat longer than half width of segment, with 4 longitudinal placodes. F_2 (Fig. 26) equal to F_1 . Middle F (Fig. 27) equal to F_1 , with 8 longitudinal placodes. Preapical F (Fig. 28) as wide as F_1 .

Mesosoma.—Mesonotum (Fig. 16) with distinct, crenulate-rugose notauli in ascendent portion, then weakly traced as indicated over granularly punctate sculptured surface, sparsely setose with distinct glabrous areas on central and lateral lobes. Propodeum (Fig. 22) with incomplete central areola, longitudinal carinae absent, upper lateral areolae with relatively dense and unusually long setae.

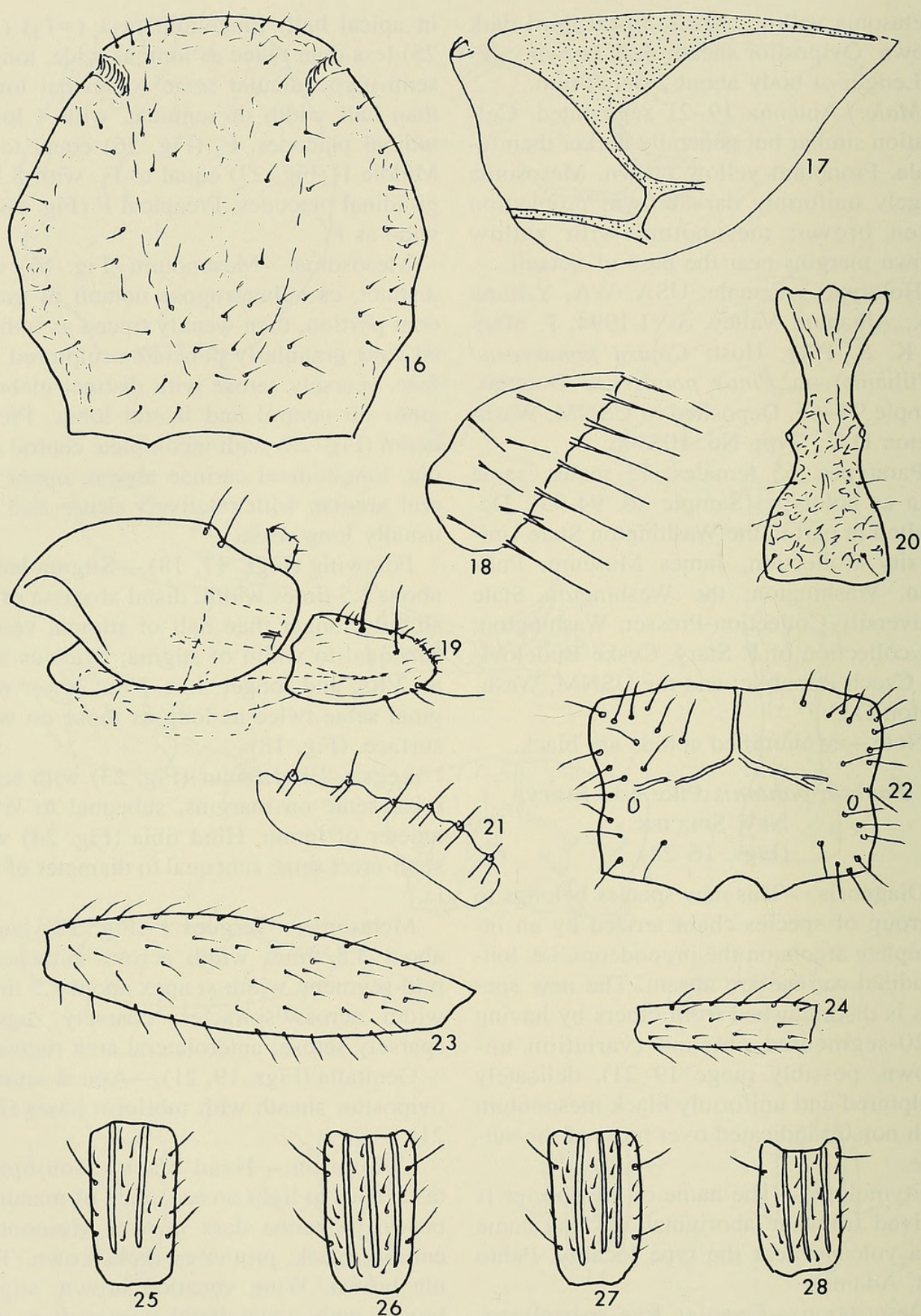
Forewing (Figs. 17, 18).—Stigma length about 2.5 times width; distal abscissa of R1 slightly longer than half of stigma; vein rs subequal to width of stigma; twice as long as $2/R_s$, and longer than $3/R_s$; lower marginal setae twice as long as those on wing surface. (Fig. 18).

Legs.—Hind femur (Fig. 23) with semi-erect setae on margins, subequal to $\frac{1}{3}$ diameter of femur. Hind tibia (Fig. 24) with semi-erect setae subequal to diameter of tibia.

Metasoma.—Tergum 1 (Fig. 20) length about 3.5 times width across spiracles at mid-segment; width at apex about 1.5 times width across spiracles; coarsely rugose, sparsely setose; anterolateral area rugose.

Genitalia (Figs. 19, 21).—Apical setae of ovipositor sheath with tubiform bases (Fig. 21).

Coloration.—Head black. Mouthparts testaceous to light brown, apex of mandible brown. Antenna dark brown. Mesonotum entirely black, prothorax dark brown. Tegula brown. Wing venation brown; stigma brown with white basal corner. Fore and middle legs largely testaceous, with trochanters, trochantelli and anterior part of femora brown; hind legs brown. Metasoma brown; tergum 1 dark brown. Ovipositor sheath brown.



Figs. 16–28. *Pauesia pahtonis*, female paratypes (illustrations not to equal scale). 16, Mesonotum. 17, Forewing, in part. 18, Forewing surface and lower marginal setae, close-up. 19, Genitalia. 20, Metasomal tergum 1. 21, Apex of ovipositor sheath. 22, Propodeum. 23, Hind femur. 24, Hind tibia, central part. 25, Flagellomere 1. 26, Flagellomere 2. 27, Middle flagellomere. 28, Preapical flagellomere.

Length of body about 3.0–3.2 mm.

Male: Antenna 22-segmented. Coloration similar to female, but generally darker; mouthparts brown, stigma uniformly brown.

Holotype.—Female. USA, WA, Skamania Co., Goose Lake, 8-VI-1994, P. Starý & K. S. Pike. Host: *Cinara ponderosae* (Williams) on *Pinus ponderosa* Douglas (young trees along roadside, coniferous forest), sample no. 94-131. Deposited in USNM, Washington D.C., Type No. 105347.

Paratypes.—3 females; 4 males (sample nos. 94-131), same data as holotype. Deposited in part in the Washington State University Collection, James Museum, Pullman, Washington; the Washington State University Collection-Prosser, Washington; and the collection of P. Starý, Ceské Budejovice, Czech Republic.

***Pauesia ponderosaecola* Pike & Starý,**

NEW SPECIES

(Figs. 29–41)

Diagnosis.—This new species belongs to a group of species manifesting an incomplete areola on the propodeum where longitudinal carinae are lacking. It is related to *P. ponderosae* (Muesebeck), but differs in having 22–23 segmented antenna (female), presence of stubs of longitudinal carinae on the propodeum, and coloration.

Etymology.—The name of the new species is derived from its association with the ponderosa pine forest.

Description.—*Female*: Head. Eye sparsely setose. Tentoriocular line equal to $\frac{2}{3}$ intertentorial line, $\frac{1}{3}$ width of eye. Maxillary palpus 4-segmented, labial palpus 3-segmented. Antenna 22–23 segmented, not thickened in apical half. Flagellomere 1 (=F₁) (Fig. 38) length less than 2 times width, setae semiperpendicular and slightly longer than half diameter of segment, with 5–6 longitudinal placodes. F₂ (Fig. 39) equal to F₁, with 6–7 longitudinal placodes. Middle F (Fig. 40) and preapical F (Fig. 41) similar to F₁, with 7–9 longitudinal placodes.

Mesosoma.—Mesonotum (Fig. 29) with

distinct, crenulate-rugose notauli anteriorly, sparsely setose, with glabrous areas on the central and lateral lobes; granularly punctate sculptured, with notauli indicated over most of the surface. Propodeum (Fig. 32) with incomplete areola, longitudinal carinae missing, upper lateral areolae with relatively dense, long setae.

Forewing (Figs. 30, 31).—Stigma length 2.5 times width. Distal abscissa of R1 about $\frac{2}{3}$ length of stigma. Vein rs about equal to width of stigma, distinctly longer than 2/Rs and 3/Rs. Lower marginal setae twice as long as those on wing surface (Fig. 31).

Legs.—Hind femur (Fig. 36) with semierect setae on anterior and posterior margins. Length of anterior marginal setae subequal to $\frac{1}{3}$ diameter of femur, $\frac{1}{3}$ longer than posterior marginal setae. Hind tibia (Fig. 37) with semierect setae on anterior and posterior margins, length greater than half diameter of tibia.

Metasoma.—Tergum 1 (Fig. 35) length 4 times width across spiracles at mid-segment; width at apex about 1.5 times width across spiracles; anterolateral area rugose.

Genitalia (Figs. 33, 34).—Apical setae of ovipositor sheath with tubiform bases (Fig. 34).

Coloration.—Head yellow orange, vertex and most of occiput brown. Mouthparts yellow, apex of mandible brown. Antenna dark brown; scape brown, with lighter markings, rarely yellow orange; pedicel with yellow orange apical ring. Mesosoma distinctly bicolorous; prothorax and mesonotum yellow orange, without dark spots; remaining mesosoma dark brown; mesopleuron with narrow, slightly yellow markings along suture with prothorax. Tegula yellow. Wing venation brown, stigma with distinct whitish basal corner connecting prestigma. Fore and middle legs and coxae yellow orange, sometimes middle coxa brown, with tibia and apex of tarsus infuscate. Hind legs brown, hind coxa dark brown. Metasomal tergum 1 brown, tergum 2 yellow with brown central spot, remaining terga yellow



Pike, Keith S and Star, P. 1996. "New species of *Pauesia* (Hymenoptera: Braconidae: Aphidiinae) parasitoids on *Cinara* (Homoptera: Aphididae: Lachninae) associated with conifers in the pacific northwest." *Proceedings of the Entomological Society of Washington* 98, 324–331.

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