

## Description of *Pauesia (Pauesia) anatolica* (Hymenoptera: Braconidae, Aphidiinae) sp. nov., a Parasitoid of the Cedar Aphid *Cinara cedri*

J.M. Michelena,<sup>\*</sup><sup>1</sup> Fabienne Assael<sup>2</sup> and Z. Mendel<sup>2</sup>

The first parasitoid species reared from a population of the cedar aphid, *Cinara cedri* Mimeur, 1935 (Hemiptera: Aphididae), from the peninsula of Anatolia in Turkey is described. *Pauesia anatolica* (Hymenoptera: Braconidae, Aphidiinae) is closely related to some species of the *laricis* group of *Pauesia* from which it differs in the number of antennomers, the propodeum and features of the female genitalia. Its potential use as a natural enemy in areas where the aphid has been introduced is discussed.

KEY WORDS: Hymenoptera; Braconidae; Aphidiinae; Hemiptera; Aphidoidea; Aphididae; *Cinara cedri*; parasitoid; *Pauesia anatolica*; cedar.

### INTRODUCTION

The origin of the cedar aphid *Cinara (Cinara) cedri* Mimeur, 1936 (Hemiptera: Aphididae) is unclear. However, it occurs today in the Mediterranean Basin and western Europe (2,4). Until recently no parasitoids had been recovered from *C. cedri* populations, but during the last few years parasitized colonies of this aphid were collected from Lebanon cedar (*Cedrus libani*) in southern Turkey. The main objective of the present study is to describe a new species of the genus *Pauesia* reared from colonies of cedar aphid, which was collected in the natural distribution area of the Lebanon cedar in southern Turkey.

### METHODS, TERMINOLOGY AND ABBREVIATIONS

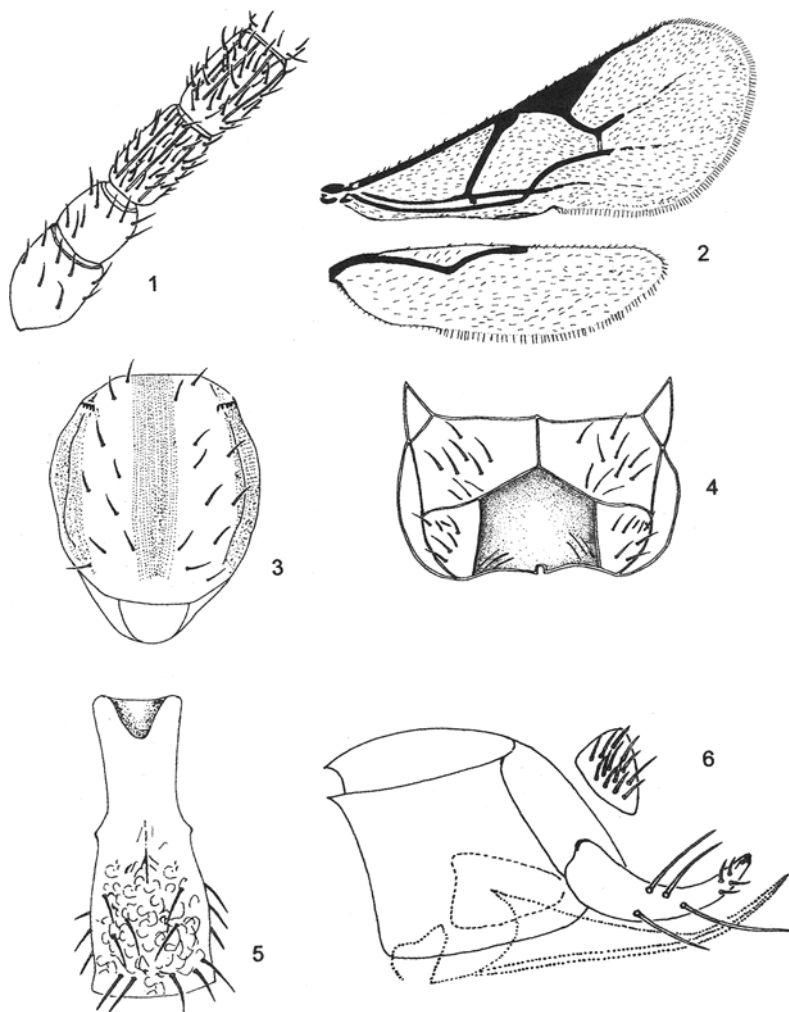
The material examined was obtained from three sources: (i) individuals that emerged from mummies of *C. cedri* from *C. libani* in several areas in southern Anatolia in Turkey: 10-year-old planted stands in Pozanti (1100 m alt.) and ornamental trees (ca 5-year-old individuals) in Çamalan (740 m alt.) and 8-year-old plantations in Hacialani forest (1760 m alt.); (ii) a brood of individuals collected in Turkey that were produced in the laboratory by rearing on *C. libani* at The Volcani Center, Israel; and (iii) individuals that emerged from colonies of *C. cedri* collected from *Cedrus atlantica* trees planted in a recreation area in the Golan Heights (En Ziwan camping ground) one year after the release of the parasitoid at the site.

Wing nomenclature follows the system proposed by Starý (14), which is a slightly modified version of that proposed by Bouček (1). This arrangement is not adequate from a phylogenetic perspective (6,13), but is widely used and acceptable for taxonomic purposes.

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<sup>1</sup>Inst. Cavanilles de Biodiversitat i Biologia Evolutiva, Universitat de Valencia, Aptdo de correos 2085, 46071 Valencia, Spain. \*Corresponding author [e-mail: jose.m.michelena@uv.es].

<sup>2</sup>Dept. of Entomology, ARO, The Volcani Center, Bet Dagan 50250, Israel. [e-mail: zmendel@volcani.agri.gov.il].



Figs. 1-6. *Pauesia anatolica* new species. 1, flagellomeres 1 and 2 (F<sub>1</sub>, F<sub>2</sub>); 2, wing; 3, mesonotum; 4, propodeum; 5, tergite 1; 6, ♀ genitalia.

***Pauesia(Pauesia) anatolica* Michelena, Assael & Mendel, sp. nov.**

*Female*

**Head** The head is transverse, smooth and shiny, wider than the thorax at the tegulae, and narrowing behind the eyes. The occiput is distinctly margined. The eyes are subspherical, medium sized, slightly convergent towards the clypeus, and sparsely haired. The malar space is equal to approximately one-third of the longitudinal eye diameter. The clypeus is transverse, slightly convex, smooth, with sparse hairs, and separated from the face by a shallow arched groove. There are deep and clearly distinguishable tentorial pits. The labrum has long hairs, and the face has sparse hairs. The tentorial index (tentoriocular distance/intertentorial distance) is *ca* 0.82. The maxillary palpi are 4-segmented, the labial

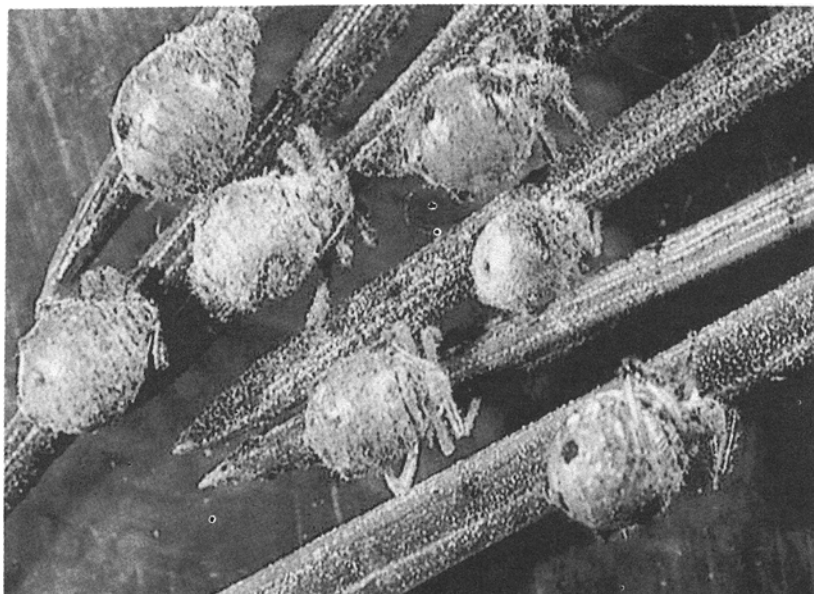


Fig. 7. Mummies of *Cinara cedri* on needles of *Cedrus atlantica* after emergence of *Pauesia anatolica*.

palpi 3-segmented. The antennae are 18-19 segmented, filiform, and the apical antenomer is longer and slightly enlarged; it presumably resulted from fusion of two flagellomeres. The antennae have semierect and adpressed setae which are shorter than the diameters of the segments. Flagellomeres 1 and 2 (= F<sub>1</sub>, F<sub>2</sub>) (Fig. 1) are each approximately twice as long as the median width. F<sub>1</sub> slightly shorter than F<sub>2</sub>. The middle flagellomeres are up to approximately twice as long as the median width. F<sub>1</sub> has six and F<sub>2</sub> has seven longitudinal placodes.

Mesosome The mesoscutum is highly raised above the prothorax but does not cover it laterally; it is sparsely haired, shiny and smooth (Fig. 2). The central and lateral lobes of the mesoscutum are sparsely haired. The notaulices are deep and rugose in the fore part, slightly marked posteriorly. The scutellum is triangular and slightly prominent.

Propodeum (Fig. 3) The central areole is concave, and its central and longitudinal keels are well marked and complete. The lateral zones of the base of the central areole are finely clustered.

Forewing (Fig. 4) The pterostigma is 3.2-3.5 times as long as wide and 1.2-1.4 times as long as the metacarpus. Radial abscissa 1 (R1) is slightly longer than radial abscissa 2 (R2) and similar to the pterostigma width.

Metasome Metasomal tergum 1 (Fig. 5) is long, slightly broadened and crumpled toward its rear end; it has a convex profile with setae close to the hind corners. There are distinct spiracular tubercles situated at the middle of the tergite; they are approximately 3.2-3.3

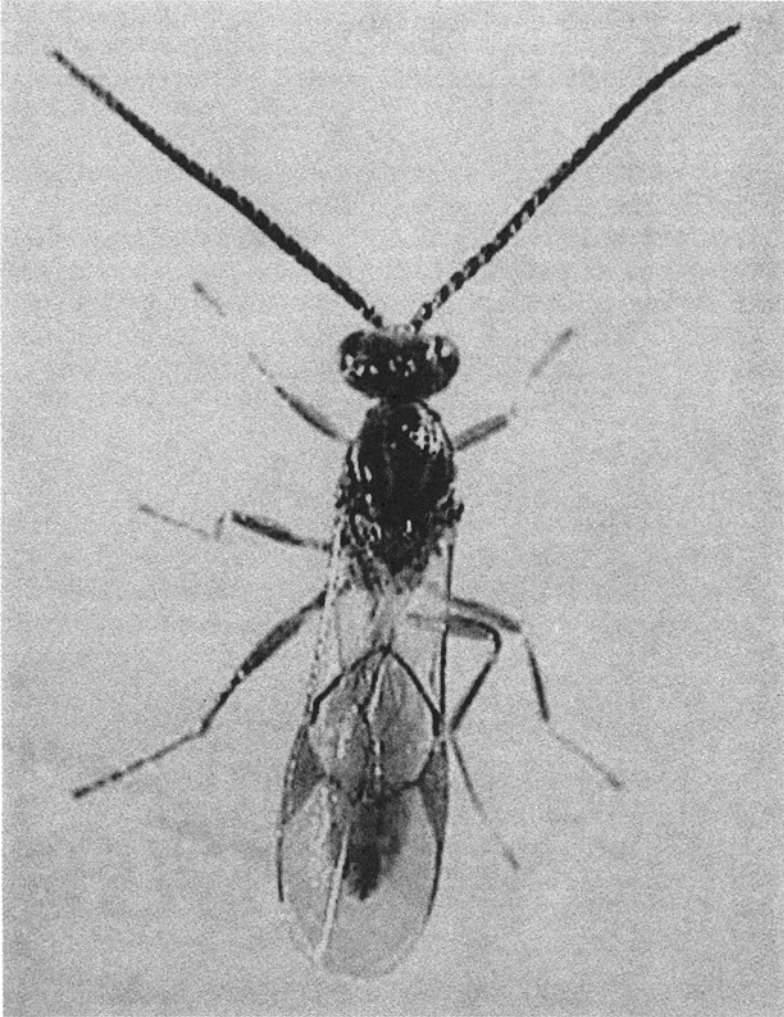


Fig. 8. Adult male of *Pauesia anatolica*.

times as long as wide at the spiracle level. The following tergites are smooth, shiny, and sparsely haired. The ovipositor sheath (Fig. 6) tapers sharply toward the apex and is upwardly curved.

**Coloration** The head is yellowish amber, similar in color to the face and clypeus although these may be lighter. The mandibles are darker at the apex, and the maxillary and labial palpi are also slightly darker. The eyes are black. The scape has a yellowish ventral surface and a darker dorsal surface; the pedicel and the rest of the antennae are dark brown. The propleuron, pronotum and mesopleuron are yellowish amber. The lateral and central lobes of the mesonotum are yellowish amber, and the central lobe sometimes has slightly darker longitudinal bands. The wings are hyaline with brown venation. The legs are yellowish

amber. The tarsus is brown. Metasomal tergum 1 is amber-brown. The rest of metasome, the metasomal tergum anterior and final are darker. Genitalia are dark brown. The cocoon is brown. Figure 7 is a photograph of the mummies of *C. cedri* after emergence of *P. anatolica*.

**Measurements** (in mm) Head: width, 0.67-0.70; transfacial distance, 0.37-0.40; facial distance, 0.41-0.45; clypeoantennal distance, 0.23; inter-tentorial distance, 0.14-0.16; tentorium-ocular distance, 0.12-0.13. Antenna: 1st flagellar segment (F1), 0.09-0.10; 2nd flagellar segment (F2), 0.10-0.11; apical segment length, 0.17-0.20. Thorax: width at tegulae, 0.50-0.54. Forewing: pterostigma width, 0.12-0.14; pterostigma length, 0.40-0.46; metacarpus length, 0.27-0.35; 1st abscissa of radial (R1), 0.15-0.17; 2nd abscissa (R2), 0.12-0.15. Metasoma: width at spiracles tergum 1, 0.13-0.14; length of tergum 1, 0.43-0.47. Valvae 3 of ovipositor, 0.18. Body length: ca 2.5 mm.

### Male

Antennae 21-22 segments (rarely 23). Tergum 1 similar to that of the female. General color similar to that of the female, with more extensive dark areas. Eyes black. Antennae black. Wings as in the female. Tegulae, mesoscutum and propodeum slightly darker than those of the female. Otherwise like the female, except for sexual differences. Figure 8 is a photograph of the adult male.

### DIAGNOSIS

The new species, *Pauesia (Pauesia) anatolica*, is closely related to *Pauesia (P.) laricis* (Haliday, 1834) and *Pauesia (P.) cedrobii* Starý et Leclant, 1977. Female antennae in *P. anatolica* have 19 antennomers, female antennae in *P. laricis* have 20-21 and in *P. cedrobii* have 17. The propodeum, with a concave central areole and well marked longitudinal keels, is similar to that of *P. laricis* but different from that of *P. cedrobii*. The female genitalia of the three species all differ: valvae 3 are conspicuously shorter in *P. anatolica* than in *P. laricis* and distally more curved than those of *P. laricis* and *P. cedrobii*.

### DISTRIBUTION AND ETYMOLOGY

The natural distribution of *P. anatolica* is in the cedar forests of southern Anatolia in Turkey. The parasitoid has become established in cedar plantations in the Golan Heights in Israel. The name of the new species is derived from Anatolia (Turkey, Asia Minor).

**Material Examined.** All specimens emerged from *Cinara cedri* on *Cedrus libani*, unless otherwise stated.

Type Series. Holotype, ♀, Turkey, Hacialani (Izer), 15.VII.2003, deposited in collection of the Laboratory of Entomology, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Spain; Paratypes 1♂ and 3♀♀, Israel, Golan Heights, En Ziwan, 10.VIII.2003, *Cinara cedri* on *Cedrus atlantica*; 1♂, Turkey, Hacialani, 9.VII.2003; in collection of the Department of Entomology, Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel; 1♂ and 1♀, Israel, En Ziwan, Golan Heights,

10.VIII.2003. *Cinara cedri* on *Cedrus atlantica*; 1♂, Turkey, Hacialani, 15.VII.2003; in collection of the Laboratory of Entomology, Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia, Spain.

*Material examined but not included in type series:* 1♀, Turkey, Hacialani, 15.VII.2003; 3♀♀, Israel, Golan Heights, En Ziwan, 28.VII.2003; 5♀♀, Israel, Golan Heights, Merom Golan village, 10.VIII.2003; 4♂♂, rearing laboratory, Israel, Bet Dagan, 19.VII.2003; 2♂♂, Israel, En Ziwan, 28.VII.2003; 1♂, Israel, En Ziwan, VIII.2003. In alcohol: 1♀, 1♂, Turkey, Çamalan, 16.V.2002. The material was deposited in the above mentioned collections.

## DISCUSSION

*Pauesia anatolica* is included in the subgenus *Pauesia* following morphological criteria (mainly the shape of ovipositor valvae). Recent molecular contributions support the monophyletic character of the subgenus. In this group are closely related species such as *P.(P.) laricis* and *P.(P.) cedrobii*, as well as others not so closely related, such as *P.(P.) unilachni* Gahan, 1926 and *P.(P.) goidanichi* Starý, 1966. Morphological features indicated in the diagnosis as well as host range allow clear discrimination of all these species.

The new species is similar to other members of the genus *Pauesia* Quilis, 1931. The characters they share include confluent radial and median cells distinctly separated on the lower margin by fused intermedian and median veins, the metacarp is longer than the width of the pterostigma, carinae on propodeum form a large wide pentagonal areole, and the ovipositor sheaths are slightly curved upwards with sparse hairs. The genus *Pauesia* includes three subgenera: *Pauesia*, *Paraphidius* Starý, 1960, and *Pauesiella* Sedlang and Starý, 1980. The discrimination between the subgenera is based on the shape of valvae 3 in the ovipositor. Recent molecular surveys based on rDNA 18S (10) and elongation factor EF-1 $\alpha$  (11) confirm the identity of the subgenus *Pauesia* but are at variance with the split of *Paraphidius*. The new taxon belongs to *Pauesia* s. str. and more strictly to the *laricis* group, characterized by longer ovipositor valves.

Cedar trees from the natural distribution area of the species have been introduced into many countries for ornamental and afforestation purposes (e.g. 3,4). Early introductions of cedar trees may have been accompanied by *Cinara* (*Cinara*) *cedri* Mimeur, 1936 and *Cinara* (*Cupressobium*) *laportei* (4,8,12), but the latter were free of their principal parasitoids. *Pauesia cedrobii* Starý & Leclant, 1977 was described from material collected in the natural area of the Atlantic cedar in Morocco when the host *Cinara* (*Cedrobium*) *laportei* (9) had already been reported to be affecting cedars in Italy and France. Something similar has happened in the case of the aphid *C. cedri*, already recorded from some European countries: Spain, France, Italy, Belgium, Denmark, etc. In Spain it is frequently found in parks and gardens and has been recorded in 14 provinces (7). It is a holocyclical species although it may develop into an anholocyclical one (7). As in the case of *C. (C.) laportei*, aphidiine parasitoids did not accompany the spread of *C. cedri* in Europe.

The discovery of a specific parasitoid of *C. (Cedrobium) laportei* in *Cedrus atlantica* areas in North Africa opened the possibility of biological control of this aphid (15). In 1981 *P. cedrobii* was introduced in cedar populations of southeast France (5), and 12 years later it was found in the forests of Vincennes, 600 km away from where it had been introduced (9).

The situation of *P. anatolica* with respect to *C. cedri* may be considered to be similar. The strict aphid-parasitoid relationships indicate the possibility of another biological control project in the countries of southern Europe and the Mediterranean Basin.

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