

**A NEW SPECIES OF *PULVINARIA* TARGIONI-TOZZETTI
(HOMOPTERA: COCCIDAE) ATTACKING
ICE PLANT IN CALIFORNIA**

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In 1971, specimens of *Pulvinaria mesembryanthemi* (Vallot) were collected for the first time in California from ice plant, *Carpobrotus edulis*, by Napa County Agricultural personnel Henry Stabo and Aldo Delfino. This soft scale, commonly referred to as ice plant scale in California, is known to cause moderate to severe injury to various plant species in the family Aizoaceae (Brain, 1920 and Quintana, 1956). A possible 1949 California record of this species is known from Berkeley on ice plant but the specimens are in too poor condition to be positive about their identity.

Because of the localized infestation of *P. mesembryanthemi* and because of its potential for damage to ice plant used as a ground cover along the State highway system, officials of the California Department of Food and Agriculture considered initiation of an eradication program against the scale. In February 1973, Jerry Vettel and Carl Macguire of that Department visited Berkeley to locate and delimit the infestation supposedly collected there in 1949. They found an identically appearing soft scale on ice plant and on several plants in the family Crassulaceae which proved to be morphologically and biologically distinct from *P. mesembryanthemi* and other known species of *Pulvinaria*. This new soft scale species is described here as *Pulvinaria delottoi* Gill, new species.

***Pulvinaria delottoi* new species**

Suggested common name.—DeLotto iceplant scale.

Etymology.—This species is named in honor of Mr. Giovanni DeLotto of the Plant Protection Research Institute in Pretoria, South Africa, who has contributed so much toward our understanding of African Coccoidea. Mr. DeLotto knew about this new species long before it was discovered in California but graciously suggested that I describe it.

Type material.—Holotype adult female, Oakland, Alameda County, California, 7 November 1973, collected from *Mesembryanthemum* sp., R. Dunkle. Paratype adult females, 50 on 38 slides, from above location and from the following locations: San Leandro, Alameda Co., California, XI-74, on ice plant, Haines; San Leandro, Alameda Co., California, III-20-73, on *Mesembryanthemum* sp., K. Meehan; Berkeley, Alameda Co., California, III-

6-73, on *Sedum* sp., W. Sibray and N. Jones; Berkeley, Alameda Co., California, III-14-73, on *Lampranthus* sp., N. Jones; Berkeley, Alameda Co., California, II-28-73, on *Mesembryanthemum* sp., J. Vettel and C. Macguire; San Leandro, Alameda Co., California, XI-8-78, on ice plant, W. Moore; Oakland, Alameda Co., California, IX-13-77, on ice plant, W. Moore; South Africa, VI-3-53, on *Cheiridopsis inaequalis*, Kamper; Transvaal, Pretoria, South Africa, VIII-31-59, on *Crassula lycopodioides*, H. K. Munro; Capitola, Santa Cruz Co., California, XI-29-73 on ice plant, Lombard and Hancock; San Leandro, Alameda Co., California, III-28-73, on ice plant, F. Hollensteiner; Seaside, Monterey Co., California, IV-2-78, on ice plant, K. S. Hagen; Marina, Monterey Co., California, XI-2-78, on ice plant, B. Oliver; Rancho Santa Fe, San Diego Co., California, XII-1-78, on succulents, N. Buskirk. Paratype nymphal stages from which the descriptions and illustrations were made: first instar, Oakland Airport, Alameda Co., California, V-13-78, on ice plant, W. Moore; second instar, Oakland Airport, Alameda Co., California, VI-30-77, on ice plant, W. Moore; third instar, Oakland, Alameda Co., California, IX-13-77, on ice plant, W. Moore.

The holotype will be deposited in the U.S. National Museum, Natural History, Beltsville, Maryland. Paratypes will be deposited in the following collections: U.S. National Museum, Beltsville; the California Department of Food and Agriculture, Sacramento; the University of California, Davis; Virginia Polytechnic Institute and State University, Blacksburg; the Florida State Collection of Arthropods, Gainesville; the University of Hawaii, Honolulu; Auburn University, Auburn, Alabama; University of Georgia, Experiment, Georgia; British Museum (Natural History), London; the Zoological Institute, Academy of Sciences, Leningrad; and the National Collection of Insects, Plant Protection Research Institute, Pretoria.

Habit.—All female stages are oval or elliptical in outline, relatively convex, and occur randomly on the fleshy leaves of the host. The color of all stages is yellow-green to light-green. Eyespots are black. Late instars and adults are devoid of any noticeable wax secretions except for small, thin, transparent wax platelets on the dorsum that are arranged randomly except for several platelets which are arranged longitudinally along the median line. About the time that oviposition begins the adults produce a sparse dorsal covering of white powdery wax. During oviposition the females first develop a yellow, tan or red color along the body margin, but later become completely brownish as oviposition nears completion. The ovisac is white and is usually irregular in construction with many loose striations. Length of the ovisac is about equal to the length of the adult female before oviposition. Male stages are unknown.

Pulvinaria delottoi is univoltine with oviposition beginning in December and January. More detailed biological studies of both *P. delottoi* and *P. mesembryanthemi* have been published by Donaldson et al. (1978).

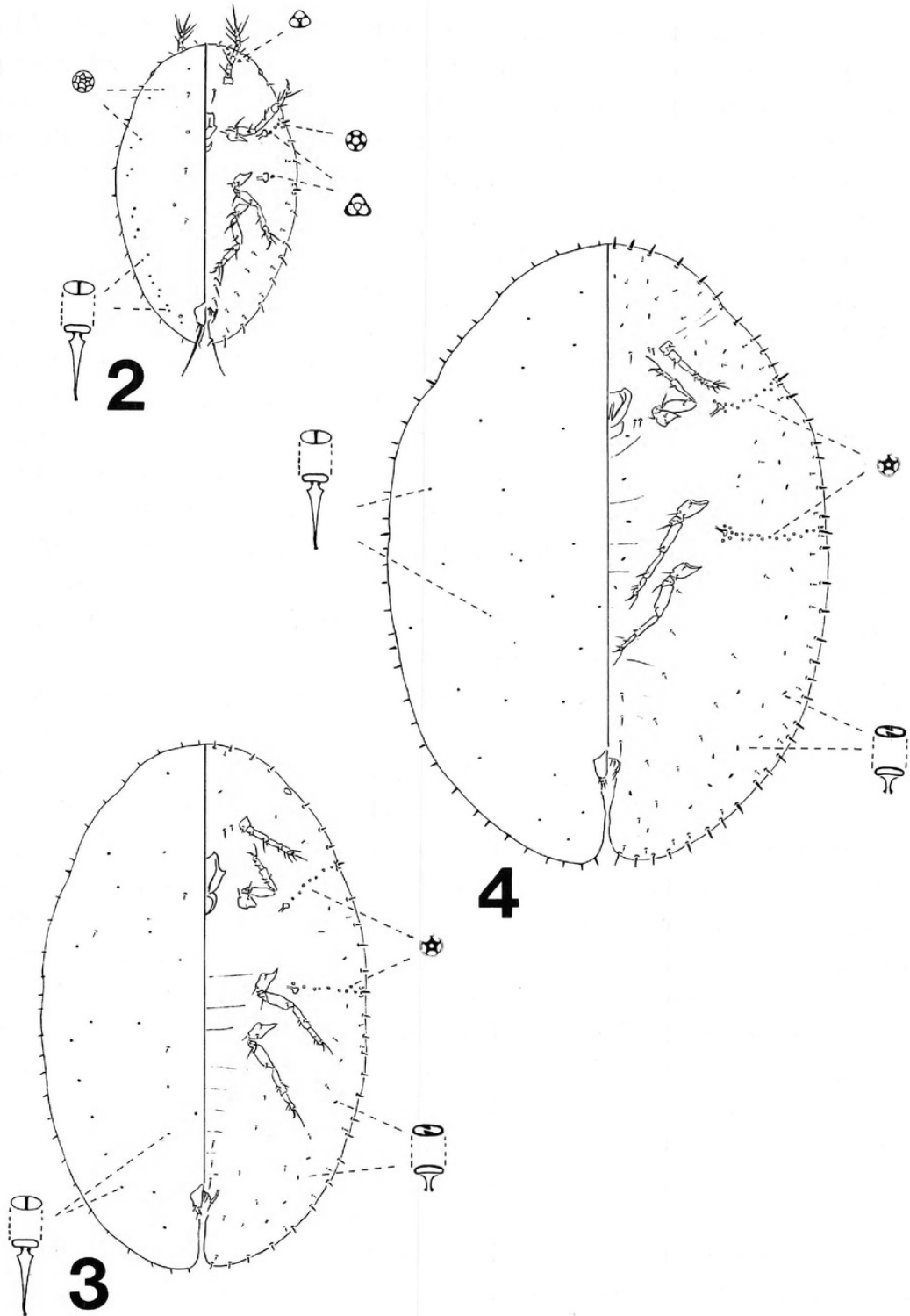
Adult female.—(Fig. 1). Oval to almost circular in outline, bluntly pointed anteriorly and broadly rounded posteriorly; slide mounted holotype female 2.5 mm long (paratypes 1.8–5.0 mm), 2.0 mm wide (paratypes 1.2–4.5 mm). DORSUM—Derm membranous. Eyespots round, convex, on lateral margins of head. Submarginal duct tubercles absent. Dorsal setae spinelike, bluntly pointed; 7–10 μ in length and randomly distributed. Dorsal tubular ducts short, less than 5 μ in length, randomly distributed but absent in the marginal areas. Bilocular microducts common, randomly distributed but absent near margin. Minute disc pores common, their diameter slightly larger than that of the microducts, randomly distributed except for a single row along the margin. Preopercular pores 7–10 μ in diameter, 11 (paratypes 10–20) extending in loose groups anteriorly of 4th abdominal segment. Anal opercula on caudal $\frac{1}{5}$ of body; caudolateral margin longer than cephalolateral margin; each operculum 145 μ long (paratypes 123–172 μ), 98 μ wide (paratypes 60–103 μ), with 4 apical setae and 3 subapical setae. MARGIN—Marginal setae stout, straight or slightly bent, bluntly pointed, 30–50 μ long (paratypes 25–55 μ), 5 μ wide at base; setae 13 (paratypes 5–15) between anterior and posterior spiracular clefts on each side, 40 (paratypes 20–40) between anterior spiracular clefts. Spiracular clefts each with three setae; median seta 51 μ long (paratypes 37–56 μ), lateral setae smaller, 17–22 μ long (paratypes 12–24 μ). VENTER—Derm membranous. Antennae well developed, normally 8-segmented, sometimes with 7 segments, 335 μ long (paratypes 278–358 μ). Interantennal setae 3–4 (usually 4) pairs, medial pair 44–64 μ (paratypes 37–86 μ), usually twice as long or longer than the lateral pairs. Preulvar setae 3 pairs. Anal fold with 2 pairs of fringe setae. Legs well developed, lengths: prothoracic, 680 μ (paratypes 495–755 μ); mesothoracic, 710 μ (paratypes 556–835 μ); metathoracic, 710 μ (paratypes 558–835 μ). Tibia and tarsus freely articulated with well developed articulatory sclerosis; claw with or without tiny denticle; claw digitules 2, of equal size. Spiracular furrow with quinquelocular pores in 3–4 irregular rows; 55–63 pores (paratypes 26–80) in anterior furrow, 80–95 pores (paratypes 33–145) in posterior furrow. Tubular ducts of 2 types arranged as follows: ducts with simple inner filament comprising most of the distal area of submarginal duct band; ducts with complex inner filament occupying more mediolateral areas of submarginal duct band and randomly occupying most median areas of head, thorax, and abdomen. Bilocular microducts randomly located throughout submarginal duct band and in median areas of the head, thorax and abdomen. Multilocular pores with 10–11 (normally 10) loculi, in loose single or multiple rows on all abdominal segments; occasional pores on thorax.

First instar nymph.—(Fig. 2). Mounted specimens elliptical in outline, widest at middle near posterior spiracular cleft; 1.0–1.2 mm in length and 0.5–0.7 mm in width. DORSUM—Derm membranous. Dorsal setae sparse,

3 μ long or less, in barely discernible medial row on each side. Minute bilocular pores present 1 per body segment in single submarginal row on each side. Discoidal pores associated singly with bilocular pores, occasional elsewhere on dorsum. Each anal operculum 50 μ long, 25 μ wide; three apical setae, two less than 15 μ long; apical seta longer, up to 155 μ . MARGIN—Spiracular setae 3 in each spiracular cleft; middle setae longest, 7.5–10.0 μ long and 2.5 μ thick; lateral setae pegshaped, 2.5 μ long. Marginal setae slender, curved, 7.5–12.5 μ long; 8 on abdomen, 2 between anterior and posterior spiracular clefts, 12 between anterior spiracular clefts. VENTER—Body setae less than 5 μ long; on abdomen in submedial row and in submarginal row associated with marginal setae; random along submargin of cephalothoracic region. One pair of interantennal setae. Three pairs of preanal setae. Venter without discernible pores except 1 small trilocular pore on submargin of head on each side laterad of cephalic submarginal seta, 1 larger trilocular pore laterad of each thoracic spiracle, and 1 or 2 quinquelocular pores in each anterior spiracular furrow near spiracular setae. Antennae 6-segmented, 125–135 μ long. Legs 198–210 μ long; claw with 2 digitules of subequal length, one slightly thicker than other; two tarsal digitules, smaller one arising more distally on tarsus than larger one; claw denticle not apparent.

Second instar nymph.—(Fig. 3). Mounted specimens oval to elliptical, widest in thoracic region; 1.3–1.5 mm long and 0.7–0.9 mm wide. DORSUM—Derm membranous. Dorsal setae apparently absent. Minute bilocular pores in a submarginal row on the abdomen and a few randomly located medially. Anal opercula quadrate; each operculum 75–80 μ long, 28–30 μ wide; 4 apical setae 10–15 μ long, 1 subapical seta. MARGIN—Spiracular setae 3 in each spiracular cleft; middle seta largest, 12–22 μ long, 3 μ thick; lateral setae pegshaped, 5 μ long. Marginal setae straight or slightly curved, 14–22 μ long; 12–15 on abdomen, 4–5 between spiracular clefts, 12–18 between anterior spiracular clefts. VENTER—Most body setae similar, 5.0–7.5 μ long; in 3 rows on abdomen, 1 row adjacent to marginal setae, 2 rows located more medially; a few setae scattered on submargin of head and thorax, and near legs. Two pairs of interantennal setae, 3 pairs of preanal setae, and 2 pairs of fringe setae. Microducts present in a submarginal series on abdomen and in random order elsewhere. Quinquelocular pores in loose single or partial double rows in each spiracular furrow; 7–10 in anterior furrow, 7–10 in posterior furrow. Antennae 6-segmented, 150–160 μ long. Legs 266–278 μ long; claw with 2 digitules subequal in length, unequal in thickness; 2 tarsal digitules of subequal length and thickness; tibia and tarsus not freely articulated.

Third instar nymph.—(Fig. 4). Mounted specimens oval to elliptical in outline, widest in thoracic region; 1.5–2.5 mm long, 1.0–1.5 mm wide. DOR-



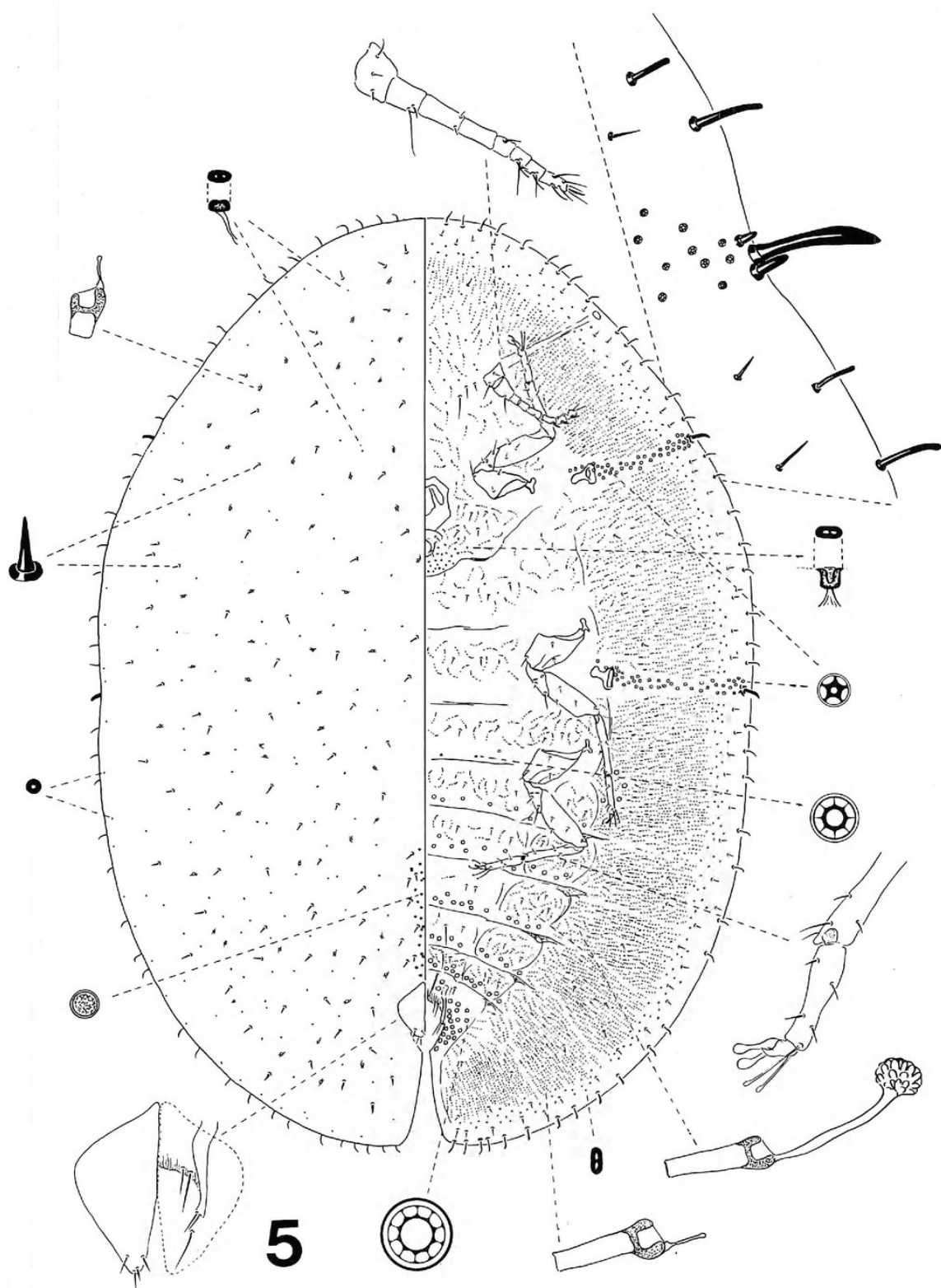
Figs. 2-4. Fig. 2. *Pulvinaria delottoi*, 1st instar nymph. Fig. 3. *Pulvinaria delottoi*, 2nd instar nymph. Fig. 4. *Pulvinaria delottoi*, 3rd instar nymph.

SUM—Derm membranous. Dorsal setae apparently absent. Micropores dispersed evenly over dorsal surface, each pore surrounded by a circular clear area. Anal operculum quadrate; each operculum 105–112 μ long, 50–55 μ wide; 4 apical setae 10–15 μ long, 2 pairs of subapical setae. MARGIN—Spiracular setae 3; middle seta largest, slightly curved, 22–37 μ long, 3 μ thick, lateral setae 3–7 μ long. Marginal setae straight or slightly curved, 17–32 μ long; 17–24 on abdomen, 5–7 between anterior and posterior spiracular clefts, 20–22 between anterior spiracular clefts. VENTER—Most body setae 5–10 μ long; in three submarginal to submedial rows on the abdomen and dispersed randomly along submargins of head and thorax. Three pairs of interantennal setae, 3 pairs of preanal setae and 2 pairs of fringe setae. Microducts randomly dispersed in broad submarginal band on abdomen and randomly dispersed in more medial areas of body. Quinquelocular pores in 2 loose rows in each spiracular furrow; 14–20 in the anterior spiracular furrow, 17–24 in the posterior furrow. Antennae usually 7-segmented, occasionally 6-segmented; 198–216 μ long. Legs 340–370 μ long; claw usually with tiny denticle, digitules 2, of unequal size; tarsi with 2 subequal digitules; tibia and tarsus not freely articulated.

Notes.—Three specimens from Transvaal on *Crassula lycopopioides* have considerably fewer marginal setae than all of the other specimens of *P. delottoi*, but they appear to be identical in all other respects.

In North America, adult females of *Pulvinaria delottoi* are readily distinguishable from most species of *Pulvinaria* because of the stout, straight marginal setae which are nearly subequal in size to the large spiracular setae. *Pulvinaria innumerabilis* (Rathvon) is the only other North American congener with similar marginal setae, but differs as follows: *P. innumerabilis* has medial spiracular setae more than twice as long as the marginal setae, lateral spiracular setae which are more than $\frac{1}{2}$ the length of the marginal setae; an almost total absence of tubular ducts on the medial areas of the head; and no denticle on the claw. *P. delottoi* has the medial spiracular setae nearly subequal in length to the marginal setae; lateral spiracular setae which are less than $\frac{1}{2}$ the length of the marginal setae; usually a denticle on the claw; and an extension of the tubular duct band onto the medial areas of the head.

Pulvinaria delottoi differs from its nearest North American relative, *P. mesembryanthemi* (Vallot) as follows: *P. mesembryanthemi* has marginal setae which are blunt, strongly curved and much smaller than the medial spiracular setae; about 50 preopercular pores; ventral bilocular microducts which are clustered mainly along the submargin between the tubular duct band and the body margin; and apparently is restricted to the plant family Aizoaceae. *P. delottoi* has marginal setae which are more pointed, nearly straight and nearly as long as the median spiracular setae; less than 20 preopercular pores; bilocular microducts which are randomly distributed



mainly within the tubular duct band; and can be found on plants in the Aizoaceae and Crassulaceae. Since *P. delottoi* and *P. mesembryanthemi* are usually found on the same hosts and are nearly identical in their appearance in the field, an illustration of *P. mesembryanthemi* (Fig. 5) has been provided to facilitate their identification. Descriptions of *P. mesembryanthemi* can be found in DeLotto (1967) and Hodgson (1967) which will also be useful in separating the two species.

In the key to North American *Pulvinaria* species provided by Steinweden (1946), *P. delottoi* will key by changing the couplets as follows:

1. Marginal setae all long, stout, spike-like and thick throughout their length except for the pointed apex 1A
- Marginal setae of various forms, but never this thick and spike-like 2
- 1A. Marginal setae ½ the length of the medial spiracular setae; lateral spiracular setae more than ½ the length of the marginal setae; tubular ducts normally absent from the median areas of head; usually restricted to deciduous hosts *innumerabilis*
- Marginal setae length nearly subequal to that of medial spiracular setae; lateral spiracular setae much less than ½ the length of the marginal setae; tubular ducts relatively numerous on the median areas of the head; restricted to hosts in the Aizoaceae and Crassulaceae *delottoi*

Both *P. mesembryanthemi* and *P. delottoi* n. sp. cause moderate injury to ice plant along the State highway system in the San Francisco Bay region of California. Injury to the ice plant has been severe enough to prompt the California Department of Transportation to contract with the University of California at Berkeley to study the two species and to recommend methods of control. The two species are thought to be native to southern Africa, and Dr. Richard Tassan from the U. C. Berkeley, Parasite Introduction Laboratory was sent there to locate and introduce natural enemies.

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SCIENTIFIC NOTE

FIRST RECORD OF BOMBYLIIDAE FROM SANTA BARBARA ISLAND, CALIFORNIA (DIPTERA)

On May 24, 1976, three specimens of *Lepidanthrax* were observed in flight, resting, and feeding behaviors on Santa Barbara Island, California. One specimen, a male, was collected and determined as *Lepidanthrax bori* Hall. All specimens observed were on the eastern side of the island near a quonset hut. The specimens observed alighted on flowers of the ice plant, *Mesembryanthemum nodiflorum* L., and either rested on the plant or fed on the nectar and/or pollen. Resting periods lasted from a few seconds to less than half a minute, whereupon the bee fly would fly to another section of the plant and hover for a few seconds before alighting. The ice plant appeared to be the only suitable source for nourishment for the bombyliids; hence they did not stray from the small patch from which the observations were made. Hall (1977, Trans. Am. Entomol. Soc. 102:289-371) records this species from Riverside, San Diego, San Luis Obispo, Siskiyou, Trinity and Tuolumne counties in California. This is the first record of Bombyliidae from Santa Barbara Island and the first insular record of this species; most other records of *L. bori* are from montane habitats. There is only one other record of a species of *Lepidanthrax* from an insular habitat (*L. diamphus* Hall was recorded from Cedros Island off the west coast of Baja California).

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