BULLETIN OF THE CALIFORNIA INSECT SURVEY

VOLUME 9

THE POLLEN-COLLECTING BEES OF THE ANTHIDIINI OF CALIFORNIA

(Hymenoptera: Megachilidae)

BY

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CONTENTS

THE POLLEN-COLLECTING BEES OF THE ANTHIDIINI OF CALIFORNIA

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INTRODUCTION

This survey of the pollen-collecting anthidiine bees is the second bulletin of the California Insect Survey that deals with the family Megachilidae. The reader is referred to *The Megachiline Bees* of California by Hurd and Michener (1955) for a discussion of the family as well as for keys to the subfamilies and tribes.

The tribe Anthidiini occurs on all the major continents and is represented by numerous genera in the Old and New worlds. Michener (1948) listed 22 genera of the tribe whose members collected pollen and discussed 14 of these that occurred in the Americas. Six of the 14 are found in California. The reader is referred to Michener's work in 1948 for information on the phylogenetic relationships of these genera and a key to the New World genera.

BIOLOGY

Species of this tribe are solitary in that each female builds her own nest and provisions it with pollen. Some species are rather gregarious in the choice of nesting sites. In the case of *Dianthidium curvatum* more than one female was observed to utilize the same entrance hole, but there is no evidence of a division of labor upon the actual cell construction. The nests of some genera are constructed in the soil, others utilize existing cavities below or above the soil, while others build exposed nests. Members of the *Dianthidium* utilize all of these types of nest sites, but species of the other genera exhibit more generic uniformity in the selection of a nest site. The nests are constructed with various vegetable or mineral products, or a combination of both in some instances. All the genera in California except *Anthidium* have species that utilize plant resins either in the construction of the cell or the cap. One or several cells may be built.

When the larvae mature they spin a brown mammillate cocoon, and those species that have only one generation a year may overwinter one or several years before emerging as an adult in the spring.

These generalizations concerning the biology of the tribe Anthidiini are rather brief, but the habits of individual species are taken up in more detail in later text along with complete references to known biologies. An example of the nest of each of the genera occuring in California is shown in figures 212 to 218. Known parasitoids of the various species are also given in the discussion of each species.

FLORAL RELATIONSHIPS

Over 100 different species of flowering plants, distributed in 35 different families, are associated with anthidiine bees in this survey, but reliable generalizations must await further studies. Most of these associations are merely taken from labels on the specimens, and there is no way of knowing if the bees were gathering pollen, nectar, or resin; looking for fibers (as in *Anthidium* and *Callanthidium*) or leaves (as in *Trachusa*); or whether the capture of a bee at some plant was fortuitous. A special study of this subject is needed both from the standpoint of understanding the bee behavior as well as evaluating their importance to the pollination needs of the native flora. Identification of pollen on the scopa would be of considerable value.

In general the assembled data suggest that most species are polylectic. Possible examples of monolectic species are *Heteranthidium bequaerti* on *Dalea spinosa* (smoke tree) and *Dianthidium implicatum* on *Gutierrezia microcephala*. There appears to be no one favored flower color, with yellow, white, blue, and purple flowers being abundantly represented in the records. However, few red flowers are visited by the bees. The favorite anthidiine plants as based on the number of species of bees are *Lotus scoparius*

(deerweed) (14 spp.), *Phacelia ramosissima* (14 ssp.), *P. distans* (8 spp.), *Eriogonum fasciculatum* (flattop, California buckwheat) (8 spp.), *Lotus Davidsonii* (7 spp.), and *Larrea divaricata* (creosote bush) (7 spp.). The most frequented plant families of the species of *Anthidium* and *Callanthidium* were Leguminosae and Hydrophyllacea; the *Dianthidium* species appeared to prefer Compositae, but there were a number of exceptions to these observations.

The plant species and visitation by the various species of Anthidiini of California are listed under plant family beginning on page 68. The reader is referred to the treatment of the individual species of bee for quick reference to the plants it may visit.

DISTRIBUTION

Approximately 70 nonparasitic species of Anthidiini occur in North America north of Mexico. California is represented by 42 of these, 7 of which appear to be endemic to the state. The large number in California is undoubtedly attributed to its ecological diversity. Five of the six genera in California contain species found in both the Boreal and Austral regions. The number of species found in these two regions in California is presented in Table 1. The species are divided on the basis of the biotic areas outlined by Miller (1951) and modified by Hurd and Michener (1955). The latter authors diagrammed these biotic areas to study the distribution of the Megachilini of California, and we have used their map for the assignment of the anthidiine species in Table I.

All the genera except the most primitive genus *Trachusa* have species represented in most biotic areas. Of the larger genera, *Heteranthidium* and *Dianthidium* are principally Austral in distribution, whereas *Anthidium* is about equally divided between Austral and Boreal. The greatest number of species (Table 1) occurs in the Californian area, and the smallest number are found in the Great Valley. This frequency, in addition to the ratio of species found in the other biotic areas, follows rather closely what was reported for the Megachilini by Hurd and Michener. More specific information concerning the distribution of the various genera and their species is presented with their individual treatments. A California Insect Survey map is included with each species. The map designations indicate collections observed by the authors. The comments on distribution outside of California may be based either on data from specimens or that taken from literature.

Members of this tribe are usually large, showy, and favorites of general collectors. As a consequence, the distributional information presented in this survey represents the examination of over 10,000 specimens borrowed from the major museums of California, several institutions from out of state, and private collections. Most species have sufficient locality records so that the accompanying map adequately indicates the extent of their distribution in the state. However, since four of the six genera of this well-known tribe have had new species from California added to them since 1963, there is still considerable information to be sought concerning the complete fauna as well as additional data on distribution patterns.

The California records listed are generally limited to different localities, the earliest and latest times of the year collected at these localities, and the inclusion of biological or ecological information that became known between these periods. All records observed were not included because of limitations of time and space.

TABLE I

Distribution in California of Species of the Pollen-Gathering Anthidiini
(Numbers indicate the number of species in each area)

				Boreal (in Calif.)				Austral (in Calif.)				
Genera	Species in N. A.	Species in California	Sp. Endemic to Calif.	North Coast	Sierran	So. Calif. Montane	Great Basin Montane	Great Basin	Mojave Desert	Colorado Desert	Californian	Great Valley
Trachusa	3	2	2								2	
Heteranthidium	11	4	2	1	1	1	1	1	1	3	1	
Anthidium	23	19	2	7	10	12	6	11	5	5	13	3
Callanthidium	2	2		1	2	2	1	1		1	1	1
Dianthidium	19	13	1	3	7	5	2	9	4	5	7	4
Anthidiellum	3	2		1	1	1	1	2	2	2	2	1
Totals	61	42	7	13	21	21	11	24	12	16	26	9

ACKNOWLEDGMENTS

The writers are grateful for the assistance of numerous individuals who cooperated in the preparation of this bulletin. Dr. E. R. Jaycox of the University of Illinois has been of invaluable assistance in comparing types and providing distributional information, photographs, and biological data on *Anthidium*. Drs. R. W. Thorp and F. D. Parker of the University of California at Davis kindly provided photographs and biological information on several genera. We wish to thank Miss Judy Jay for illustrating the full lateral views of the various genera of bees. Determinations of meloid larvae were made by Dr. J. W. MacSwain.

We express our appreciation to the following individuals and institutions for generous loans of types and material for distribution records. The records were compiled primarily from the first four institutions, but our general knowledge of the tribe and out-of-state distribution patterns were greatly enhanced by the other loans.

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E. I. Schlinger, P. H. Timberlake—University of California, Riverside . . . . . (UCR)
P. D. Hurd, Jr., J. A. Powell—California Insect Survey, University of California, Berkeley (CIS)
R. M. Bohart, A. T. McClay—University of California, Davis . . . . . (UCD)
R. R. Snelling, G. I. Stage—personal collection (SS)
F. S. Truxal, R. R. Snelling—Los Angeles County Museum . . . . . (LACM)
J. G. Rozen, Jr.—American Museum Natural History . . . . . (AMNH)
W. E. LaBerge—formerly of the University of Nebraska State Museum . . . . . (UN)
H. J. Grant, Jr.—Academy of Natural Sciences of Philadelphia . . . . . (ANSP)
R. C. Bechtel—Nevada Insect Survey . . (NIS)
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L. K. Gloyd—Illinois Natural History Survey . . . . . (INHS)
W. F. Barr—University of Idaho . . . . (UI)
J. Schuh—personal collection . . . . . (JS)
R. W. Thorp—personal collection . . . . (RT)
H. L. McKenzie—personal collection . . (HM)

TAXONOMIC METHODS

The terminology applied to general structure is for the most part that adopted by Michener (1944). The propodeum is bypassed in numbering the terga so that the true morphological second abdominal segment, or first metasomal segment of Hurd and Michener (1955), begins the numbering system. Thus, there are six visible metasomal terga in females and seven terga in males. The terga and sterna beyond VI in the female and VII in the male are reduced or modified and associated with the sting and the genitalia. The terga and sterna are assigned Roman numerals, and any use of them will refer only to the metasoma or third apparent division of the body.

The keys presented in this paper were designed to make maximum use of morphological structures with minimum effort in preparation to observe these structures. On occasion gross morphological similarities were not always present, and it became necessary to use color alone or structures not readily visible without relaxing the specimen. The morphological characters used for the various genera can best be observed when the metasoma is extended in the horizontal plane. In this position the apical portion of the genitalia as well as the apices of the terminal sterna can generally be observed without dissection. The mandibles of the females may have to be spread if the teeth are not visible or if it becomes necessary to see the surface of the labrum. It is frequently advantageous to observe both mandibles, as one may be worn or the teeth broken in the process of nest construction.

The apical margin of tergum VI of the females has been of considerable value in distinguishing species and has been used extensively in the keys. The configuration of this margin is best viewed with the light directed from the posterior to the anterior of the specimen, with the observer facing the light. The margin outline and apical flange of *Dianthidium* are figured approximately at a 45 degree angle to the surface of the segment. The females of *Anthidium* have the apical margin of tergum VI divided into a median and paired lateral areas. The margin of the median section begins at the sting emargination and extends to each side until it passes under the lateral borders. It may be necessary to turn the specimen and look directly into the cavity of the sting to follow the apical border of tergum VI, but the relationship used in the key and figures is made at a 90 degree angle to the upper surface of the segment.

The color of various maculations is generally used only as the second or third character of a couplet, but occasionally it is used alone. The color and extent of the maculations show some variability, particularly with respect to geography, and the reader is advised that the reference to color is limited to material from California. The variations in color and pattern are discussed for each species.

SYSTEMATICS

A limited synonymy, including type locality and repository, important taxonomic references, and known biological references, are presented with each species. A considerable amount of new synonomy is presented in this paper.

The Anthidiini may be distinguished from other tribes in the Megachilidae by the following combination of characteristics: a jugal lobe less than one-half the vannal lobe of the posterior wing; finely spiculate tibiae; the absence of a pygidial plate; a short quadrate pterostigma; and a cleft female claw. The parasitic members of the tribe are separated from the pollen-gathering members by the absence of scopae on the females and by a rounded seventh metasomal tergum or the presence of a spine on the metanotum on the males (except for the males of some species of *Heterostelis*). The parasitic genera found in North America are listed by Michener (1948) as *Dioxys, Chelynia, Melanostelis, Protostelis,* and *Heterostelis.*

California is represented by six of the seven pollen-gathering Nearctic genera of Anthidiini. The genus *Paranthidium* extends throughout the eastern and central United States and south into Mexico, but westward only as far as Arizona.

KEY TO GENERA OF POLLEN-COLLECTING ANTHIDIINI OF CALIFORNIA AND THEIR NESTS

1 Arolium absent (fig. 4); mandibles of female with 5 or more close-set conical teeth (figs. 97–100); nests constructed in cavities; nest may have resin cap; cells surrounded by plant fibers 2

Arolium present (fig. 1); mandibles of female with no more than 4 teeth, usually widely spaced; nests constructed in cavities or on open surfaces with plant resins only, or resin combined with mineral matter or leaves . . 3

2 (1) Penis valves of male genitalia about twice as long as gonostylus, valves extended anteriorly over sternum VI nearly to setal brush of sternum V (fig. 110); tergum VI of female with large median emargination (figs. 102, 107); nest with resin in cap *Callanthidium* (p. 35)

Penis valves of male genitalia subequal to or shorter than gonostylus, rarely more than apex visible without dissection (fig. 69); tergum VI of female without large median emargination (figs. 70–89); nest without resin . . *Anthidium* (p. 10)

3 (1) Preoccipital ridge rounded above; maxillary palpi with 3 or more segments; nest site in soil 4

Preoccipital ridge carinate above; maxillary palpi with 2 segments; nest site in soil, cavity above ground, or on open surface 5

4 (3) Maxillary palpi 4-segmented; mesosoma and metasoma black; nest constructed of leaves and resin . . . . . *Trachusa* (p. 4)

Maxillary palpi 3-segmented; mesosoma and metasoma with yellow or cream maculations; nest constructed of resin and fine mineral material . . . . . *Heteranthidium* (p. 6)

5 (3) Pronotal lobes carinate; mesoscutellum sharply margined and truncate; hind coxa without spur; nest of resin only, on open surface . . *Anthidiellum* (p. 58)

Pronotal lobes lamellate; mesoscutellum rounded; hind coxa with spur; nests constructed with resin, with or without mineral and other vegetable material, in cavities above or below soil, nests on open surface always with resin and fine gravel . . . . . *Dianthidium* (p. 38)

Genus *Trachusa* Panzer

This genus is represented in the Palearctic Region by the type species *(serratulae)* = *byssina* and in the Nearctic Region by three species. *T. perdita* and *gummifera* are found in California and *manni* from Arizona and Sonora, Mexico. Michener presented a synopsis of the genus in 1941; Thorp included a new species and key to the four species of the genus in 1963; and the genus was reviewed in 1964 by Popov without knowledge of *gummifera.*

Popov split the genus, placing the Nearctic species in *Trachusomimus.* Thorp (1966, in a footnote) did not agree that the morphological or biological differences were of generic magnitude when considering the added species *Trachusa gummifera* and suggested the retention of the name *Trachusa* for the New World species. The authors of this bulletin concur with Thorp.

This genus is unique in the tribe in having four-segmented maxillary palpi. The females are entirely black whereas the males have cream- to white-colored facial maculations, varying with the species. Characteristics of the sixth and seventh metasomal terga of the males and the sixth tergum of the females aid in separating the species.

The nesting habits of all the species of *Trachusa* have been observed with the exception of *manni*. They commonly select a hillside of sandy soil on a gradual slope facing westerly or southerly. The sloping tunnels constructed may be single or branched. The cells (figs. 212, 213), generally in a series, are constructed of pieces of leaves stuck together by gum or pitch. Reports of parasitism have been limited to *perdita*.

KEY TO THE CALIFORNIA SPECIES OF TRACHUSA

MALES

1 Tergum VII with median emargination subequal in size to lateral lobe, emargination enclosing depressed brown plate (fig. 133); labial palpus with segments III and IV subequal in length; clypeus (fig. 132) and adjacent lateral facial maculations cream colored . . *perdita* (p. 5)

Tergum VII with weak median emargination (fig. 130), without apical plate; labial palpus with segment III longer than IV; with lateral facial maculations absent or greatly reduced and those of clypeus (fig. 129) reduced by one-third near frons . . . *gummifera* (p. 5)

FEMALES

1 Tergum VI with basal elevation extended into median, posterior projection (fig. 134); labial palpus with segments III and IV subequal in length . . . . . *perdita* (p. 5)

Tergum VI with basal elevation shallowly emarginate medially (fig. 131); labial palpus with segment III longer than IV . *gummifera* (p. 5)

Trachusa gummifera Thorp

(Figs. 1, 129, 131; Map 1)

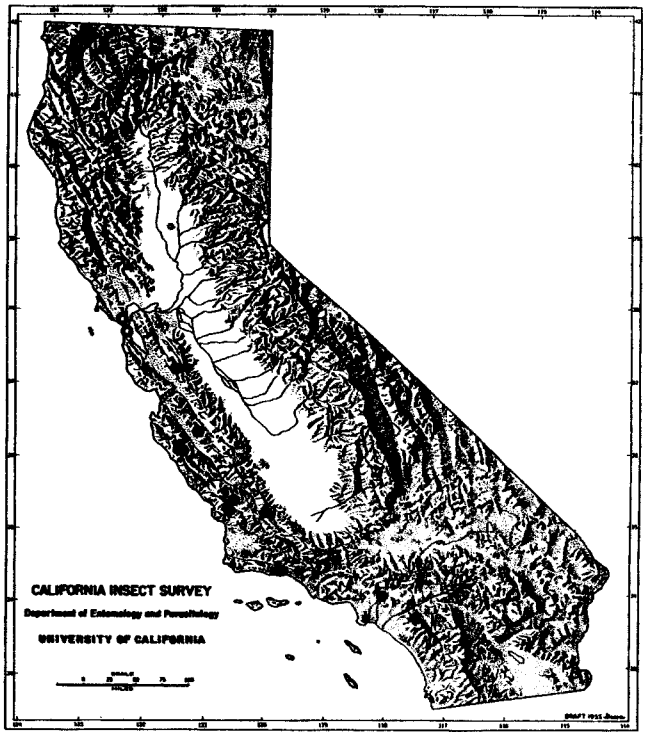
Trachusa gummifera Thorp, 1963. Pan-Pac. Ent., 39(1):56, ♀, ♂. Holotype ♀, Carson Ridge, Marin County, California (CAS).

Geographic range.—Central California Coast Range.

California records.—MARIN CO.: Carson Ridge, 1 ♂, 2 ♀, V–30–59 (C. O'Brien, J. Powers, SS); 4 ♂, 31 ♀, VI–II–60 (J. Lawrence, J. Powers, CAS, CIS, SS); 3 ♀, VI–15–62, at nest site (P. Hurd, R. Thorp, CIS, RT); 2 ♀, VI–30–62 (R. Thorp, RT). SAN FRANCISCO CO.: San Francisco, 1 ♀, VI–22–57 (D. Rentz, SS).

The species is black except for the cream-colored maculation of the clypeus of the male. This mark covers approximately the anterior two-thirds of the clypeus and extends on the median line to the frons. The heavy pubscence is whitish except for a reddish cast to that of the scutum and vertex.

Both sexes are separated from *perdita* by having the third segment of the labial palpus longer than the fourth, whereas they are subequal in *perdita*. Tergum VII of the male of *gummifera* (fig. 130) is without the median, platelike extension of the apex as in *perdita*. The sixth tergum of the female of *gummifera* has a basal elevation that is medially emarginate (fig. 131), but this area is a produced median fold in *perdita*.



Map 1. Distribution of (●) *Trachusa perdita* Cockerell and (○) *Trachusa gummifera* Thorp

T. gummifera is infrequently collected: only 5 males and 39 females have been observed and these have been limited to the area west of San Francisco Bay.

Unpublished observations by Thorp indicate a similarity of nesting habits to those of *perdita*, but they differ in a number of respects; for instance, the nest entrance of *gummifera* was associated with a tumulus and some tunnels were branched (fig. 212) one or several times.

Trachusa perdita Cockerell

(Figs. 132–134; Map 1)

Trachusa perdita Cockerell, 1904. Bull., South. Calif. Acad. Sci. 3:159. Holotype ♂, Tehachapi, California (AMNH).

Biology.—Michener, 1941, Pan-Pac. Ent., 17(3):123–125. Thorp, 1966, Jour. Kans. Ent. Soc. 39(1):131–146.

Taxonomy.—Michener, 1941, Pan-Pac. Ent., 17(3):122–123, ♀; 1953. Kans. Univ. Sci. Bull., 35:1041–1043, larva.

Geographic range.—California, Baja California.

California records.—LOS ANGELES CO.: Tanbark Flat, 1 ♀, VI–19–56 (G. Stage, SS). 1 ♀, VI–19–56; 2 ♀, VII–2–56; 3 ♂, 3 ♀, collected cells VII–18–56 emerged 1957 (R. Bechtel, CIS). MONTEREY CO.: Hastings Natural History Reserva-

tion, near Jamesburg, Santa Lucia Mountains, 1 ♀, VI–14–38, on *Brodiaea lutea* (C. Michener). RIVERSIDE CO.: The Gavilan, 1 ♂, V–29–46; 8 ♂, 5 ♀, V–31–37, on *Penstemon antirrhinoides* (P. Timberlake, UCR). Lake Matthews Rd., 1 mi. E Hwy. 71, 2 ♂, 3 ♀, IV–14–60, at nest site (P. Timberlake, UCR). SAN BENITO CO.: Gonzales, 15 mi. E. 1 ♀, V–12–62 (D. Rentz, CIS). Pinnacles, 1 ♂, V–4–41; 2 ♂, V–19–41; 1 ♀, V–25–41 (J. MacSwain, CIS). SAN BERNARDINO CO.: Deep Creek Public Camp, 1 ♂, VI–15–57 (LACM). San Bernardino Mts., nr. Strawberry, 1 ♀, VII–7–17 (R. May, CIS). San Jacinto River Cyn., San Jacinto Mts., 1 ♂, V–30–40 (CIS). SAN LUIS OBISPO CO.: *Pozo,* 3 mi. E, 3 ♂, 38 ♀, V–1–62, on *Lupinus nanus;* 1 ♀, on *Layia platyglossa* ssp. *campestris* (P. Hurd, R. Thorp, CIS); 12 mi. NE at La Panza Campground, 1 ♀, IV–29–62, *Lupinus nanus* (R. Thorp, CIS); 3 ♀, IV–29–62, on *Eriophyllum confertiflorum, Salvia Columbariae* (P. Hurd, CIS). San Luis Obispo, 2 ♂, 3 ♀, VI–38, on *Clarkia* (I. McCracken, CAS). Santa Margarita, 1 ♂, 5 ♀, VI–22–58 (E. Linsley, CIS); 5 mi. NE, 4 ♂, 3 ♀, V–5–62 (R. Langston, J. Powell, CIS); 6 ♂, 13 ♀, VI–9, 10–62, nest site (P. Hurd, CIS). Simmler, 10 mi. W, 1 ♂, V–5–62, on thistle sage (R. Thorp, RT); 8 ♂, 10 ♀, V–5–62, nest site (P. Hurd, R. Thorp, CIS); 9 ♂, 37 ♀, V–6–62, nest site (P. Hurd, J. Powell, CIS). SANTA BARBARA CO.: Santa Barbara, 1 ♂, V–7–36, on morning glory (I. McCracken, CAS). SANTA CLARA CO.: Mt. Hamilton, 1 ♂, 1 ♀, V–30–50, on *Eriodictyon* (J. MacSwain, CIS).

Discussion: These bees are black with extensive whitish pubescence. The male has a cream-colored clypeus and lateral facial markings. *T. perdita* differs morphologically from *gummifera* in the labial palpus and tergal characters discussed under *gummifera*. The clypeus of the male of *perdita* (fig. 132) is entirely cream colored, whereas the markings partially cover the clypeus of *gummifera* (fig. 129).

This species is known from 56 males and 156 females collected in the south Coastal, Transverse, and Peninsular ranges of California. Specimens have been collected on members of four plant families, but most of the collections have been in association with nesting sites.

Michener (1941) observed the habits of *perdita* at a site in Monterey County. About a dozen nests were found in sandy soil on a hillside sloping south and west. No turrets or tumescences were observed at the entrance holes. The tunnels sloped downward in a broad curve five or six inches long and remained unbranched. Cells were located end to end in the lower part of the tunnel, separated by thin intracellular partitions. The cells were made from irregular pieces of thick leaves of the shrub, *Rhamus crocea*. The leaves were cemented together (as in fig. 213) with a gum to form the cell walls. The gum later hardened and was of the odor of pine pitch when burned, but no conifers were nearby. Mature larvae were found in the first cell of a series of four, while the last was still under construction. The larvae enclosed themselves in a parchmentlike brown cocoon with a nipple at the interior end, and over-wintered as prepupae.

Thorp (1966) reported that the megachilid *Heterostelis hurdi* parasitized *perdita*. Unpublished records of Thorp also show triungulins of *Nemognatha scutellaris* to be found on adults of *perdita* and adults of *N. scutellaris* were reared from *perdita* nests.

Genus *Heteranthidium* Cockerell

Members of this genus are limited to the New World. They are found in the United States and extend as far south as the state of Veracruz in Mexico. Ten species are described from the United States, four of which occur in California.

Heteranthidium is quite similar in body structure to *Trachusa* but differs primarily in having three instead of four segments of the maxillary palpi. The presence of pulvilli, a sixth metasomal tergum overhanging the seventh of the male, the broadened middle and hind tibiae (fig. 2), and the absence of metacoxal spines serve to separate *Heteranthidium* from other genera found in California.

Bees of this genus are moderate to large in size and all species in California have showy yellow or cream maculations. Some eastern species have greatly reduced maculations, as in *Trachusa*. The maculations of the metasomal terga are bands that may be straight, sloped medially, and occasionally interrupted laterally. The general pattern of the maculations is fairly consistent for a species, but the extent of this pattern may vary considerably. The last two terga of both sexes are generally the most diagnostic for separation of the species. Schwarz revised the genus in 1926.

Biological information concerning the nesting habits of *Heteranthidium* is limited to observations on *larreae* by MacSwain (1946). He reported the females to excavate individual burrows in the soil which lead to a larger cavity from which individual cells of resin and soil radiate. This is somewhat similar to the nesting habits reported for *Dianthidium curvatum* by Custer and Hicks (1927) and Fischer (1951). None of these authors observed the females actually excavating the main entrance tunnels, although Fischer implied that *Dianthidium* built them.

KEY TO THE CALIFORNIA SPECIES OF HETERANTHIDIUM

MALES

1 Tergum VII with a longitudinal median carina extending to an apical, median projection . 2
Tergum VII without a longitudinal median

carina, apex medially emarginate (fig. 115) . *larreae* (p. 8)

2 (1) Tergum VI concave in lateral aspect (fig. 112); clypeus covered with dense pubescence . . *bequaerti* (p. 7)

Tergum VI relatively straight or slightly convex in lateral aspect (figs. 120, 124); clypeus with sparse pubescence 3

3 (2) Leading edge of pronotal lobe with lammella-like margin; sternum V with simple median emargination (fig. 128); metasomal bands enclosing lateral black spots . *autumnale* (p. 7)

Leading edge of pronotal lobe with carina; sternum V with posterior projection on midline of median emargination (fig. 127); metasomal bands usually entire . . . *timberlakei* (p. 9)

FEMALES

1 Basal two-thirds of tergum VI convex or straight in lateral aspect; apical margin of tergum V unmodified; clypeus yellow or cream . . . 2

Tergum VI strongly concave in lateral aspect (fig. 114); apical margin of tergum V with prominent median projection (fig. 113); clypeus predominantly black . . . . . *bequaerti* (p. 7)

2 (1) Apical one-fifth of tergum VI strongly concave (figs. 122, 126); clypeus weakly convex in lateral aspect; scutum black with yellow or cream margins 3

Entire tergum VI convex in lateral aspect (fig. 118); clypeus weakly concave; scutum with yellow margins and pair of thin, longitudinal, yellow, parapsidal lines . . . *larreae* (p. 8)

3 (2) Basal two-thirds of tergum VI convex in lateral aspect (fig. 126); apical margin of clypeus with teeth . . . . . *timberlakei* (p. 9)

Basal two-thirds of tergum VI relatively straight (fig. 122); apical margin of clypeus simple . *autumnale* (p. 7)

Heteranthidium autumnale Snelling

(Figs. 119–122, 128; Map 2)

Heteranthidium autumnale Snelling, 1966. Contributions in Sci. by L.A.C.M., No. 97:1; ♂, ♀.

Holotype ♂, 3 miles northeast of Desert Hot Springs, Riverside County California (LACM).

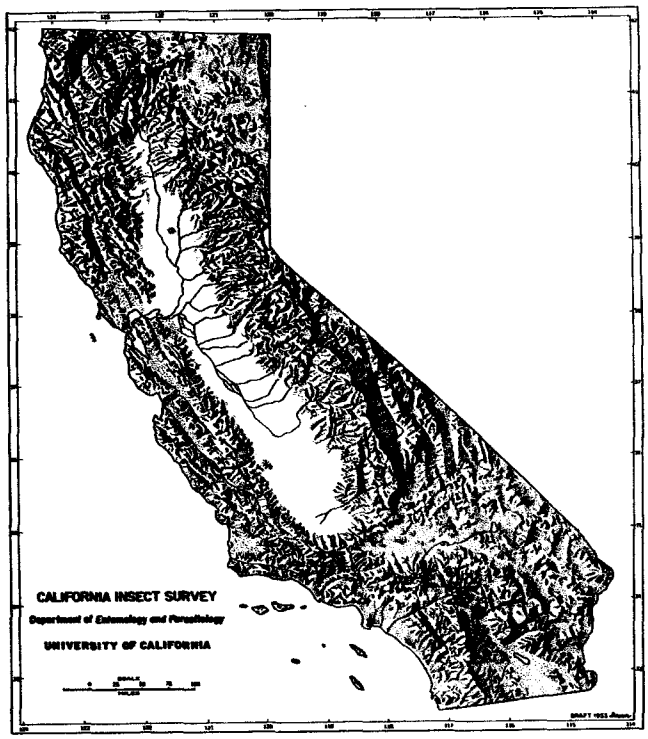
Geographic range.—Southern California, Colorado Desert.

California records.—RIVERSIDE CO.: Desert Hot Springs, 3 mi. NE, 1 ♂, 1 ♀, XI–8–63 (R. McDiarmid, LACM).

The color of both sexes of this species is black with pale yellow maculations. The metasomal bands are closed to form a black spot more typical of other genera of the tribe.

H. autumnale exhibits a number of morphological characteristics similar to *H. timberlakei* and *H. zebratum*. The females of *autumnale* are distinguished with a clypeus with a relatively smooth apical margin and a tergum VI that is nearly straight when viewed from the side (fig. 122), contrasted to the toothed clypeus and convex tergum VI of *timberlakei* (fig. 126). Both sexes of *autumnale* have more strongly developed forecoxal projections and carinae on the leading edge of the pronotal lobes than *timberlakei*.

No information is known of the biology of this rare species. Its scarcity may be attributed to the infrequency of collections in the fall season.



Map 2. Distribution of *Heteranthidium autumnale* Snelling

Heteranthidium bequaerti Schwarz

(Figs. 111–114; Map 3)

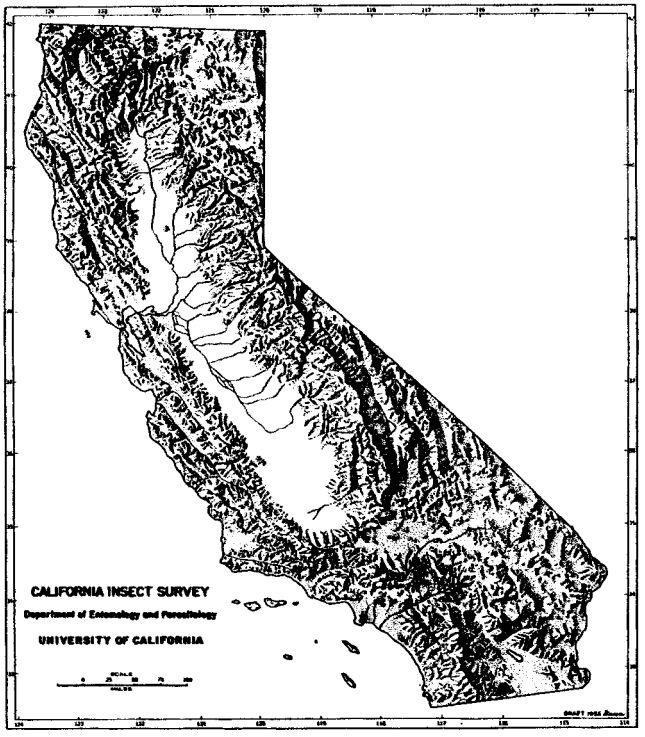
Heteranthidium bequaerti Schwarz, 1926. Amer. Mus. Novitates, 218:6–7.

Holotype ♀, Redondo, California (AMNH).

Geographic range.—Southern California, Colorado Desert.

California records.—IMPERIAL CO.: Coyote Wells, 4.5 mi. E, 1 ♂, VI–10–56 (R. Snelling, SS). RIVERSIDE CO.: Indio, 20 mi. E, 17 ♂, 3 ♀, VI–21–58 (C. MacNeill, CAS). Palm Springs, 1 ♂, V–3–39 (SS); 1 ♂, V–24–34, on *Dalea* (T. Laningham, SS); 1 ♂, VI–12–54 (J. Hall, UCD); 22 ♂, 3 ♀, VI–24–52, on *Dalea spinosa* (P. Timberlake, CIS); 30 ♂, 14 ♀, VI–25 to 28–41, on smoke bush flowers (E. Van Dyke, CAS); 3 mi. S, 1 ♂, 1 ♀, VI–28–41, on *Dalea spinosa* (P. Timberlake, CIS); 3.4 mi. S, 31 ♂, 11 ♀, VI–28–41, on *Dalea spinosa* (P. Timberlake, UCR). SAN BERNARDINO CO.: Needles, 8 mi. SE, 2 ♀, 13 mi. SE, 2 ♀, VI–5–38, on *Dalea spinosa* (P. Timberlake, UCR).

The markings of the face and abdomen of this



Map 3. Distribution of *Heteranthidium bequaerti* Schwarz

species are cream but the remainder of the maculations are pale yellow on a black background. The metasomal bands are slightly V-shaped, angling posteriorly. Color patterns vary somewhat in extent and may be present or absent on such structures as the scutellum of the males. The females of *bequaerti* are readily separated from the other species of *Heteranthidium* in California by a prominent median projection of the apical margin of the fifth tergum (fig. 113). This projection is present but not as prominent on the males. The wide median projection of tergum VII and concave tergum VI distinguish the males from the other species.

H. bequaerti is infrequently collected, but long series are generally taken when they are found in association with flowers of *Dalea spinosa*, the smoke tree. One hundred and ten males and 39 females were recorded, all within 40 miles of Palm Springs except a male from Imperial Co., four females from San Bernardino Co. and the type from Redonde. The type label shows the locality ending in an e, but Schwarz listed it as Redondo.

Heteranthidium larreae (Cockerell)
(Figs. 2, 115–118; Map 4)

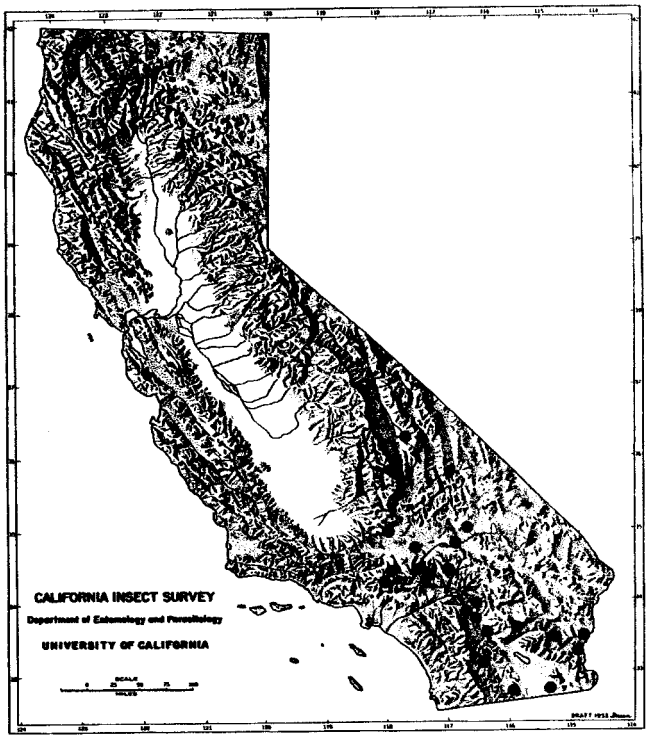
Anthidium larreae Cockerell, 1897. Can. Ent., 29(8):220; ♀, ♂. Holotype ♀, Las Cruces, Messilla Valley, New Mexico. (USNM).

Heteranthidium larreae (Cockerell). Schwarz, 1926. Amer. Mus. Novitates, 218:7.

Biology.—MacSwain, 1946, Pan-Pac. Ent. 22(4):159–160.

Geographic range.—Arizona, California, Nevada, New Mexico, Texas.

California records.—IMPERIAL CO.: Coyote Wells, 1 ♀, IV–12–38 (E. Van Duzee, CAS). Holtville, 8 mi. E, 1 ♂, 2 ♀, IV–8–63; 2 ♂, 1 ♀, IV–19–62 (R. Westcott, UCD). Palo Verde, 3 mi. S, 2 ♂, IV–9–63, *Larrea divaricata* (J. Powell, CIS). INYO CO.: Inyo Mts., 1 ♂, 1 ♀, VI–1–37 (E. Van Dyke, CAS). Keeler-Darwin, 1 ♂, V–22–37 (E. Van Dyke, CAS). Little Lake, 1 ♀, VI–2–17 (C. Fox, CAS). Mazourka Canyon, 1 ♀, VII–2–53 (H. Nakakihara, UCR). KERN CO.: Mojave, 1 ♂, VI–1–17 (C. Fox, CAS); 5 mi. N,



Map 4. California distribution of *Heteranthidium larreae* (Cockerell)

1 ♂, VI–2–57 (J. Lawrence, CIS). LOS ANGELES CO.: Little Rock, 1 ♂, IV–7–55 (P. Opler, SS). Mojave Desert, Highway 138, 3 ♂, 2 ♀, V–13–44, on *Salvia Dorrii* (P. Timberlake, UCR). RIVERSIDE CO.: Blythe, 18 mi. W, 1 ♀, IV–2–63 (M. Irwin, UCD); 2 ♂, 2 ♀, IV–16–37, on *Larrea divaricata* (P. Timberlake, UCR). Chino Canyon, nr. Palm Springs, 1 ♂, IV–21–60, on *Larrea divaricata* (J. Powers, CIS). Cottonwood Springs, 1 ♂, 1 ♀, IV–26–49 (J. Gillaspy, CIS). Hopkins Well, 1 ♀, IV–16–58, on *Baileya* (J. Powell, CIS); 9 ♂, 2 ♀, IV–29–52, on *Larrea divaricata* (P. Hurd, G. Marsh, J. Rozen, CIS). Palm Canyon, 1 ♂, IV–5–25 (P. Timberlake, UCR). Palm Springs, 1 ♂, III–30–16 (C. Fox, CAS); 2 ♀, IV–9–32, on *Larrea divaricata* (P. Timberlake, UCR); 9 mi. NE, 1 ♂, IV–19–57, on *Larrea divaricata* (R. Snelling, M. Stage, SS); 6 mi. W, 2 ♀, V–6–46, on *Larrea divaricata* (P. Timberlake, UCR). Whitewater Canyon, 1 ♂,

IV–26–36, on *Larrea divaricata* (P. Timberlake, UCR). SAN BERNARDINO CO.: Adelanto, 1 ♂, V–23–45 (A. Melander, UCR). Apple Valley, 2 ♂, 1 ♀, V–26–41, on *Larrea divaricata* (P. Timberlake, UCR). Kramer Hills, 1 ♀, IV–18–62, on *Machaeranthera tortifolia* (P. Timberlake, UCR). Manix, 22 mi. N, 5 ♂, 1 ♀, IV–26–53, *Larrea divaricata* (P. Hurd, G. Marsh, R. Schuster, CIS). Morongo Valley, 2 ♂, 1 ♀, V–26–41 (E. Van Dyke, CAS). Ord Mt., 1 ♀, IV–19–60, on *Senecio Douglasii* (J. Powell, CIS). Victorville, 4 mi. SW, 1 ♂, 3 ♀, V–4–39, on Larrea divaricata (P. Timberlake, UCR). Yermo, 1 ♀, VI–7–41 (E. Van Dyke, CAS). SAN DIEGO CO.: Borrego, 13 ♂, 6 ♀, V–1 to 2–52, on *Larrea divaricata* (P. Hurd, G. Marsh, J. Rozen, CIS). Coyote Creek, 1 ♂, III–26–59 (A. Grigarick, UCD).

The color pattern of this bee is yellow maculations on black. The metasomal bands are nearly straight and uninterrupted except for a slight tendency toward dorso-lateral emarginations. The concave tergum VI of the female, median emargination of the male tergum VII, and all yellow markings easily separate *larreae* from the other species in California.

This desert species is collected in southern California in the spring. It is most frequently found on creosote bush but has also been recorded on three species of Compositae and one Labiatae. Sixty males and 40 females have been examined.

The nesting habits of *H. larreae* were observed by MacSwain (1946) in New Mexico. Several dozen nests were found in a bare mound of hand-packed reddish-brown silt. He reported that individual burrows were excavated which penetrated 10 to 16 cm to a cavity from which vasiform cells (10 mm by 6–7.5 mm) radiated as numerous fingers. The cells (fig. 229) were constructed of plant resin and soil. The larvae spun brown mammilate cocoons, overwintered, and transformed to adults the following spring. No parasites were recovered.

Heteranthidium timberlakei Schwarz

(Figs. 123–127; Map 5)

Heteranthidium timberlakei Schwarz, 1928. Jour. New York Ent. Soc., 36:409–412, ♂, ♀. Holotype ♂, Riverside, California (UCR).

Heteranthidium subtimberlakei Schwarz, 1928. Jour. New York Ent. Soc., 36:414–415. Holotype ♀, Nevada Co., California (UCR).

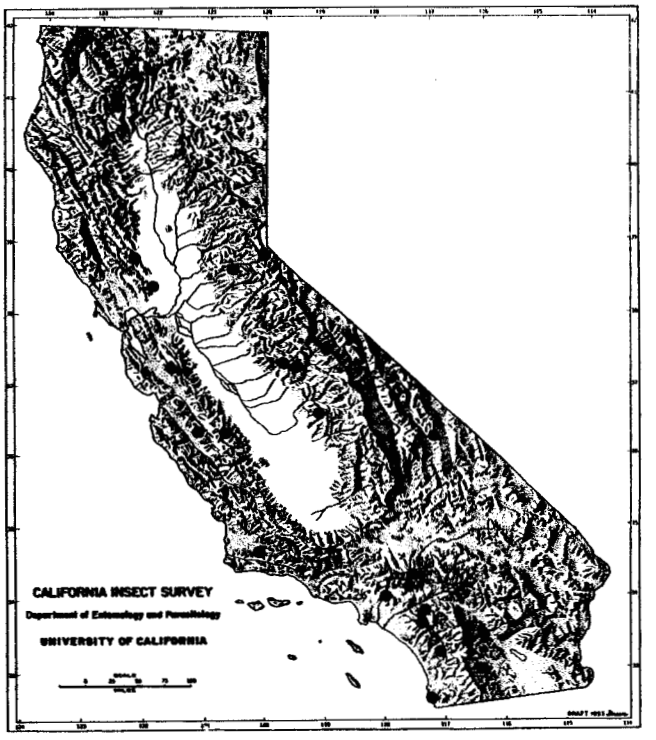
Heteranthidium zebratum timberlakei Schwarz. Michener, 1951, U.S.D.A. Agric. Mono. No. 2, p. 1138.

Heteranthidium zebratum subtimberlakei Schwarz. Michener 1951, U.S.D.A. Agric. Mono. No. 2, p. 1138.

Heteranthidium zebratum zebratum, Stephen and Torchio (not Cresson), 1961 Pan-Pac. Ent., 37(1):41–43.

Geographic range.—California, western Nevada, Oregon.

California records.—EL DORADO CO.: Bass Lake, 2 ♂, VI–10–37 (B. White, CAS). Kyburz, 1 ♀, IX–1–63 (UCD). Meyers, 2 mi. S, 1 ♂, VII–24–55 (E. Schlinger, UCD).



Map 5. California distribution of *Heteranthidium timberlakei* Schwarz

FRESNO CO.: Pinehurst, 2 mi. E, 9 ♂, VI–24–60, on *Cirsium* (R. Snelling, SS). Tollhouse, 1.5 mi. NW, 1 ♀, VI–20–63, on *Clarkia cylindrica* (J. Chemsak, CIS). INYO CO.: Panamint Mt., Wild Rose Cn., 1 ♂, 1 ♀, VI–19–37, on *Chaenactis Douglasii* (C. Michener, UCR). LOS ANGELES CO.: Big Dalton Dam, 1 ♀, VI–25–50 (J. MacSwain, CIS). MADERA CO.: Bass Lake, 1 ♂, VI–7–38 (N. Hardman, CIS). Nipinnawasee, 1 ♂, V–24–36 (E. Ross, CAS). MARIPOSA CO.: Mariposa Co., 1 ♀, VI–13–38 (N. Hardman, CIS). Bagby, 4.2 mi. N, 1 ♂, VI–19–63, (J. Chemsak, CIS); 2 ♀, on *Clarkia biloba* (R. Thorp, CIS). MONO CO.: Mammoth, 1 ♀, VII–8–38 (R. & G. Bohart, CIS). NAPA CO.: Rutherford, 14 mi. E, V–23–65, 5 ♂, on *Cirsium;* 3 ♀, on *Clarkia gracilis*, V–26–65, 1 ♂, 5 ♀, on *Clarkia gracilis*, 7 ♂, 5 ♀, (R. Thorp, RT). NEVADA CO.: Nevada Co., 1 ♀ (Hort. Com., UCR). RIVERSIDE CO.: The Gavilan, 1 ♂, V–31–37, 1 ♀, VI–9–56, on *Helianthus gracilentus* (P. Timberlake, UCR). Herkey Creek, San Jacinto Mts., 1 ♀, VI–10–40, sweeping (CIS). Keen Camp, 8 mi. W. San Jacinto Mts., 1 ♂, V–16–39, on *Cirsium* (E. Linsley, CIS). Piñon Flat, San Jacinto Mts., 1 ♂, V–21–39, on *Encelia* (E. Linsley, CIS); 1 ♂, VI–21–41 (E. Van Dyke, CAS). Riverside, 1 ♀, IV–28–28, on *Chaenactis glabriuscula;* 1 ♂, IV–30–28, 2 ♂, V–3 & 5–28, on *Encelia farinosa*, 1 ♂, V–25–32, on *Coreopsis lanceolata* (P. Timberlake, UCR); 2 ♀, VI–19–33 (C. Dammers, UCR). San Jacinto River, 2 ♂, V–30–40, on Compositae (LACM). Santa Rosa Mt., 8,000, 1 ♀, VI–20–40 (E. Van Dyke, CAS). SAN BENITO CO.: Idria, 14 ♂, 4 ♀, VI–14 to 15–55 (D. Burdick, C. MacNeill, M. Wasbauer, CIS); 2 ♂, 1 ♀, VI–15–55, on *Cirsium* (D. Burdick, CIS). Pinnacles, 1♂, V–25–41 (CIS); 3 ♂, V–28 to 29–60 (D. Rentz, SS). SAN BERNARDINO CO.: Cajon Pass,

3 ♂, 1 ♀, VI–24–41 (E. Van Dyke, CAS). Phelan, 1 ♂, VI–27–52 (Beamer, Liang, LaBerge, SS); 2 mi. W, 1 ♂, VI–7–58 (J. Hall, UCD). SAN DIEGO CO.: Coronado, 1 ♂, V–5–40 (F. Blaisdell, CAS). Mt. Laguna, 1 ♂, VII–5–63 (J. Powell, CIS). Warner Springs, 1 ♂, VI–10–56 (E. Schlinger, UCD). SAN LUIS OBISPO CO.: Santa Margarita, 5 mi. NE, 1 ♀, VI–15–63, on *Clarkia cylinqdrica* (R. Thorp, CIS). SANTA BARBARA CO.: Figueroa Mtn., 1 ♂, 1 ♀, IV–7–39 (C. Norland, LACM). Sunset Valley, 2 ♂, VII–4–38 (B. White, CAS). SANTA CLARA CO.: San Antonio Valley, 2 ♂, VI–13–50 (W. Barr, UI). TRINITY CO.: Carrville, 10 mi. N, 1 ♀, VII–15–55 (J. Jessen, UCD). Coffee Creek Ranger Station, 10 mi. N, 1 ♀, VII–14–55 (J. Wells, UCD). TULARE CO.: Kings Canyon National Park, 5,000 feet, 1 ♂, VI–21–60 (G. Fullerton, SS). YOLO CO.: Rumsey, 4 mi. NE, 1 ♂, VI–3–60 (R. Schuster, UCD). Winters, 1 ♂, VI–10–50 (J. Gillaspy, CIS).

Heteranthidium timberlakei is closely related to *H. autumnale* and *H. zebratum*. *H. zebratum* is widely distributed east of the Rocky Mountains, and several workers have considered *timberlakei* a subspecies of *zebratum*. Snelling reelevated *timberlakei* to the species level and discussed this group in 1966. The males of *timberlakei* are most readily separated from those of *zebratum* by having the apical margin of tergum VII uniformly convex (fig. 123) except for the extension of the median carina, whereas tergum VII of *zebratum* is prominently trilobed. The emargination of sternum V of the male of *timberlakei* (fig. 127) contains a posteriorly directed projection, but this emargination is simple in *autumnale* (fig. 128) and *zebratum*. A carina is present on the anterodorsal edge of the pronotal lobe of all three species but it is produced into a lamellate margin on *autumnale*.

The males of *timberlakei* have cream facial markings and the remainder of the maculations of the male and all of those of the female are yellow on black. Considerable variation has been observed in the extent of maculations of *timberlakei* with the trend toward reduction with an increase in latitude. The species *H. subtimberlakei* falls about midway within the range of this variation, and there appears to be little value in retaining this name. Specimens of *timberlakei* are generally considerably larger than *larreae* and *bequaerti*, although this is also subject to variation.

H. timberlakei is infrequently collected in long series and only 76 males and 35 females have been examined. It is widespread in the foothills of major mountain ranges of California and has also been observed from western Nevada and southern Oregon.

Genus *Anthidium* Fabricius

The genus *Anthidium* is widespread in both North and South America as well as in the Old World. Michener (1948) has discussed the included subgenera and relationships with other genera. All of the California species belong to the nominate subgenus. *Anthidium* is obviously most closely allied with *Callanthidium* in North America. Both genera differ from the other anthidiine genera in lacking the arolium and possessing a multidentate female mandible which is used in scraping tomentum from plants. Members of *Anthidium* are usually moderate-sized bees with yellow bands on the metasomal terga. Tergum VII of the male is always trilobed with the median lobe being much smaller and usually more or less spiniform.

The *Anthidium* fauna of California is rich. Nineteen species are here recorded from California, which contrasts with only two species known from the eastern United States according to Mitchell (1962). Three-fifths of the specimens examined for this survey were *Anthidium*. The majority of species are rather widespread, although most were absent from desert regions. However, five species (*cockerelli, palmarum, sonorense, dammersi,* and *paroselae*) are fairly restricted to the Mojave and Colorado Deserts. These species are all spring or early summer forms. A sixth species, *jocosum*, has penetrated into the desert areas to some extent. *A. palliventre* is nearly restricted to coastal sand-dune areas although a few specimens are known from east of the Sierras in the Great Basin, a rather odd distributional pattern. Several species (*clypeodentatum* and *tenuiflorae*) are principally high altitude species. *A. rodecki* has been collected in Washoe County, Nevada, and may eventually be found in the Great Basin areas of northeastern California. We have given comparative figures of the male and female sterna and terga of *rodecki* (figs. 52–54, 84) although we have not placed it in the key to species.

Species are usually easily distinguished in the male by the combination of the shape of the tergum VII and sterna VI and VIII. Figures of these structures are given for each species which should be used in conjunction with the key for identification. Additionally, the specialized setal area of sternum IV (termed here the setal brush) is of importance at the specific level, differing in color and extent. The shape of tergum VI of the females, especially the form and extent of the posterior marginal band, provides differentiating characters for nearly every species. However, the differences in the band are often subtle, and the figures should be studied carefully. All the drawings are of the dorsal view, but a ventral and often lateral view may aid in interpretation. Additionally, the clypeal shape and mandibular teeth are

significant characters in some cases. Although the extent of maculation is highly variable, especially between different environmental conditions, the color of the mandible, clypeus, and pronotal lobe is often quite stable and has been used as secondary or, in a few cases, primary couplet characters.

The majority of species have been described by Cresson, Cockerell, Schwarz, and Swenk. Unfortunately, these authors have relied upon coloration to a great extent in defining species. Consequently, considerable new synonymy has been discovered. There have been about 82 names proposed, either as species or subspcies, for the nineteen species now recognized. Twenty-nine of these are new synonyms. There appears to be little justification at this time for dividing the species into subspecies, especially on the basis of slight changes in extent of maculation or coloration. There are some recurring color trends of species found both in northern and southern California. Populations of *atripes, tenuiflorae, mormorum,* and especially *emarginatum* have much yellower maculations in southern California. These markings tend to be less extensive and paler in more northern latitudes. The clypeus of *emarginatum* is yellow in southern California and nearly all black in northern California.

The biology of the North American species of *Anthidium* has not been studied extensively. Hicks (1926*a*, 1928, 1929*a*, *c*) has provided some information on four species (*collectum, mormonum, tenuiflorae, palliventre*), and Newberry (1900) presented a brief note on *paroselae*. Ferguson (1962) has provided some interesting information on *collectum*, especially on natural enemies; and Jaycox (1966) has given some information on *utahense*. Parker and Bohart (1966) recorded a parasite of *maculosum* in the course of their studies of twig nesting Hymenoptera. A summary of the nesting sites reported by these six authors showed that five species of *Anthidium* utilize abandoned burrows of insects or spiders, but female *palliventre* apparently excavate their own nests in sand. Individuals of *mormonum* utilize deserted beetle burrows in oak stumps and yucca stalks, and a nest of *maculosum* was found in an elderberry stem. Females of *collectum* use other bee nests or spider nests in the ground. Also, the few observations on *paroselae* and *utahense* indicate that they nest in the ground; whereas in at least one instance, a female *tenuiflorae* made its nest between two rocks.

Present knowledge indicates that the females always gather cottonlike plant fibers from various plants which they use to line the cells and sometimes, at least, to fashion the plug. The multidentate mandible of the female is an excellent tool to scrape the tomentum from plants which is then carried by the legs. Source plants for the tomentum have been *Lepidospartum squamatum (A. mormonum), Cirsium (A. utahense),* and *Artemisia (A. collectum, A. utahense)*. In *mormonum, collectum,* and *utahense,* the maximum number of cells per burrow is four with the mean number being one or two. A pollen ball is provided for the larvae, and the space between the topmost cell and the exit hole is filled with pebbles and dirt *(mormonum,* and *utahense)* or pebbles, bits of vegetation, and sand *(collectum)*.

Many natural enemies are now known for *Anthidium*. Various authors reported parasitoids from the hymenopterous families Mutillidae, Chalcididae, Chrysididae, Megachilidae (Ferguson, 1962), and Leucospidae (Graenicher, 1906). The various species of these families will be discussed with the species of bees with which they have been associated.

KEY TO THE CALIFORNIA SPECIES OF ANTHIDIUM

MALES

1 Sternum IV with conspicuous black setal brush, usually occupying more than one-third width of sternum (fig. 69) 2

Sternum IV with or without setal brush, often inconspicuous; color of brush may be yellowish, orange-red, or occasionally dark brownish-red; brush generally occupies less than one-third width of sternum IV (figs. 67, 68) . . 8

2 (1) Sternum VI with median and lateral lobe broader at median width than long (figs. 20, 41, 65) 3

Sternum VI with median lobe longer than median width, lateral lobe broadly truncate or longer than median width (figs. 26, 32, 35, 38) 5

3 (2) Median width of lateral lobe of tergum VII over one-half distance separating it from center spine (figs. 19, 40); tegula generally yellow and dark brown to black 4

Median width of lateral lobe of tergum VII one-half or less distance separating it from center spine (fig. 64); tegula usually reddish-yellow . . . . . *palmarum* (p. 29)

4 (3) Lateral lobes of tergum VII, particularly on inside margin, strongly diverge from median spine (fig. 40); tergum VI often black; sternum VIII bifurcate at apex (fig. 42) . . *atripes* (p. 13)

Lateral lobes of tergum VII nearly parallel to median spine (fig. 19); tergum VI maculated; sternum VIII with single apex (fig. 21) . *collectum* (p. 16)

5 (2) Lateral lobe of tergum VII broadly curved laterally to apex (figs. 31, 34, 37); sternum VI with lateral lobe longer than mean width (fig. 32, 35, 38) 6

Lateral lobe of tergum VII spiniform, outer

margin relatively straight or slightly concave (fig. 25); sternum VI with lateral lobe broadly truncate (fig. 26) . . . *banningense* (p. 14)

6 (5) Media lobe of sternum VI with sides converging toward emarginate or entire apex, lobe appearing conical (figs. 32, 35), dark brown to black; southern California montane and northern California 7

Median lobe of sternum VI with sides nearly parallel to emarginate apex, lobe appearing truncate (fig. 38), usually reddish-brown; southern California deserts . *dammersi* (p. 19)

7 (6) Tergum VII with mean width of lateral lobe about one and one-half distance separating it from center spine (fig. 31); apical lobe of sternum VIII longer than broad (fig. 33); apex of median lobe of sternum VI usually emarginate (fig. 32) . . . . *tenuiflorae* (p. 32)

Tergum VII with mean width of lateral lobe subequal to distance separating it from center spine (fig. 34); apical lobe of sternum VIII nearly as broad as long (fig. 36); apex of median lobe of sternum VI usually entire (fig. 35) . . . . . *emarginatum* (p. 21)

8 (1) Sternum VI without apical tuberculate process . 9

Sternum VI with apical tubercular process directed anteriorly (fig. 14) . *sonorense* (p. 32)

9 (8) Sternum VI without differentiated median lobe (figs. 8, 11); labrum without submedian protuberances, or with only weak swellings . . 10

Sternum VI with distinct median lobe (figs. 17, 29, 59, 62); labrum with prominent submedian protuberances 11

10 (9) Antennal segment III as long as IV and V combined; frons dually punctured with large sparse punctures superimposed on dense minute ones . . . . . *maculosum* (p. 23)

Antennal segment III shorter than IV and V combined; frons with subequal punctation . . *paroselae* (p. 30)

11 (9) Tergum VII with mean width of lateral lobe three-fourths or less than distance separating it from center spine (figs. 28, 49) 12

Tergum VII with mean width of lateral lobe subequal to or greater than distance separating it from center spine 13

12 (11) Tergum VII with outer margin of lateral lobe nearly straight or weakly concave (fig. 49) . *edwardsii* (p. 19)

Tergum VII with outer margin of lateral lobe broadly convex (fig. 28) . . *palliventre* (p. 28)

13 (11) Sternum VI with lateral lobe at least as long as broad; sternum IV with prominent setal brush 14

Sternum VI with lateral lobe undeveloped or much broader than long; setal brush with setae usually not much differentiated from surrounding setae 17

14 (13) Tergum VII with emarginations extending one-half or more into segment length; lateral lobe with mean width usually less than twice the distance separating it from center spine (figs. 34, 43, 46) 15

Tergum VII with emarginations extending one-third or less segment length; lateral lobe with mean width usually more than twice distance separating it from center spine (fig. 55) . . *utahense* (p. 33)

15 (14) Setal brush of sternum IV orange-red; sternum VI with lateral lobes converging toward median lobe (figs. 44, 47); sternum VIII with apical lobe much longer than wide (figs. 45, 48) 16

Setal brush of sternum IV reddish-black; sternum VI with lateral lobes diverging from median lobe (fig. 35); apical lobe of sternum VIII about as broad as long (fig. 36) . . . . *emarginatum* (p. 21)

16 (15) Sternum VI with apex of median lobe incised, about one-half as broad as mean width of lobe (fig. 47); tergum VII with mean width of lateral lobe greater than distance separating it from center spine (fig. 46) . *placitum* (p. 30)

Sternum VI with apex of median lobe entire, nearly as wide as mean width of lobe (fig. 44); tergum VII with mean width of lateral lobe subequal or less than distance separating it from center spine (fig. 43) . *mormonum* (p. 25)

17 (13) Sternum VI with dense hairs; sternum VIII with single apex on median lobe, or evenly rounded 18

Sternum VI with sparse hairs; sternum VIII bifurcate at apex 19

18 (17) Median lobe of sternum VI entire at apex, longer than mean width (fig. 17) . . . *clypeodentatum* (p. 15)

Median lobe of sternum VI emarginate at apex, shorter than mean width (fig. 62) . . . *cockerelli* (p. 16)

19 (17) Sternum VI with median lobe gradually rounded at apex; lateral lobes distinct (fig. 59) . . *jocosum* (p. 23)

Sternum VI with truncate apex, lateral lobes flattened (fig. 23) . . . *pallidiclypeum* (p. 27)

Females

1 Posterior marginal band of tergum VI restricted in dorsal view to median one-third or less of segment width before passing under dorsolateral border of segment (figs. 70–73) . . 2

Posterior marginal band extending across nearly one-half or more segment width before passing under dorsolateral border of segment (figs. 74–89); posterior marginal band may be narrow, indistinct 5

2 (1) Median apical margin of clypeus smooth (fig. 90); posterior side of antennal segment I without covering of short dense pile 3

Median apical margin of clypeus with prominent teeth (fig. 91); posterior side of antennal segment I covered by short dense pile . . . *clypeodentatum* (p. 15)

3 (2) Antennal segment III shorter than IV and V combined; frons with subequal punctation; dorsolateral border of tergum VI broadly angulate (figs. 72, 73) 4

Antennal segment III as long as IV and V combined; frons dually punctured with large,

sparse punctures imposed on dense, minute ones; dorsolateral border of tergum VI with prominent tooth (fig. 71) . *maculosum* (p. 23)

4 (3) Preapical teeth of mandibles nearly congruent (fig. 100); yellow maculations of mesonotum on margins only . . . . . *paroselae* (p. 30)

Preapical teeth of mandibles strongly unequal in shape (fig. 99); mesonotum with marginal bands and usually with two longitudinal, submedian yellow stripes . . . *sonorense* (p. 32)

5 (1) Basitarsus of foreleg with all setae subequal to or shorter than greatest tarsal width 6

Basitarsus of foreleg with row of elongate setae on posterior margin about twice as long as greatest width of tarsus . *palliventre* (p. 28)

6 (5) Dorsolateral border of tergum VI rounded or forming angled projection broader than long 7

Dorsolateral border or tergum VI forming acute tooth curved medianly, longer than broad (fig. 86) . . . . . *banningense* (p. 14)

7 (6) Apical margin of clypeus in facial aspect with continuous or slightly sinuate, wide emargination from anteriormost projections to midline (figs. 93, 94) 8

Apical margin of clypeus transverse between anteriormost projections, margin may be straight (fig. 92) or sinuate with short median emargination 10

8 (7) Posterior marginal band of tergum VI subtruncate or sinuate, prominent at cross-under point with dorsolateral border of segment (figs. 76, 78) 9

Posterior marginal band of tergum VI narrow, strongly angled to midline, relatively obscure at cross-under point with dorsolateral border of segment (fig. 79) . . . *edwardsii* (p. 19)

9 (8) Clypeus, in profile, weakly convex; in facial view, lateral margin with prominent acute teeth (fig. 93) . . . . . *placitum* (p. 30)

Clypeus, in profile, prominently convex; in facial view, lateral margin with obtuse teeth (fig. 94) . . . . . *pallidiclypeum* (p. 27)

10 (7) Mandibles predominantly black 11

Mandibles with extensive yellow maculation . 14

11 (10) Posterior marginal band of tergum VI broadly sinuate (fig. 77); terga V and VI typically all black . . . . . *atripes* (p. 13)

Posterior marginal band of tergum VI not sinuate (figs. 87–89); terga V and VI usually with maculations 12

12 (11) Clypeus, in profile, prominently convex (fig. 95); sting emargination of tergum VI usually as long as broad (figs. 87, 89) 13

Clypeus, in profile, weakly convex (fig. 96); sting emargination absent or weakly sinuate (fig. 88) . . . . . *tenuiflorae* (p. 32)

13 (12) Tergum VI, in profile, prominently convex; pronotal lobe generally black . *dammersi* (p. 19)

Tergum VI, in profile, relatively straight or weakly convex; pronotal lobe generally cream *emarginatum* (p. 21)

14 (10) Clypeus predominantly black 15

Clypeus with extensive yellow maculation . 16

15 (14) Mandible with five teeth (fig. 98); pronotal lobe yellow . . . . . *jocosum* (p. 23)

Mandible with six teeth (fig. 97); pronotal lobe black . . . . . *cockerelli* (p. 16)

16 (14) Posterior marginal band of tergum VI with broad lateral lobes (fig. 74); tegula and tibia typically light reddish-brown . *palmarum* (p. 29)

Posterior marginal band of tergum VI weakly sinuate or straight (figs. 80, 81, 83, 87); tegula yellow and dark brown 17

17 (16) Posterior marginal band of tergum VI obscure in dorsal view (fig. 87), appears to be touching dorsolateral border in ventral view . . . . *emarginatum* (p. 21)

Posterior marginal band of tergum VI prominent (figs. 80, 81, 83); separated from dorsolateral border in ventral view by at least one thickness of band 18

18 (17) Tooth of dorsolateral border of tergum VI extending nearly to same plane as posterior marginal band; tooth separated from band by about one-sixth width of band (figs. 81, 83) . 19

Tooth of dorsolateral border of tergum VI anterior to transverse plane of posterior marginal band, tooth separated from band by about one-third width of band (fig. 80) . . *mormonum* (p. 25)

19 (18) Surface of basitarsus obscured by dense white pile; posterior marginal band of tergum VI angled posteriorly from dorsolateral border to sting emargination (fig. 83) . . . . *collectum* (p. 16)

Surface of basitarsus without white pile; posterior marginal band of tergum VI nearly transverse from dorsolateral border to sting emargination (fig. 81) . . . *utahense* (p. 33)

Anthidium atripes Cresson

(Figs. 40–42, 77; Map 6)

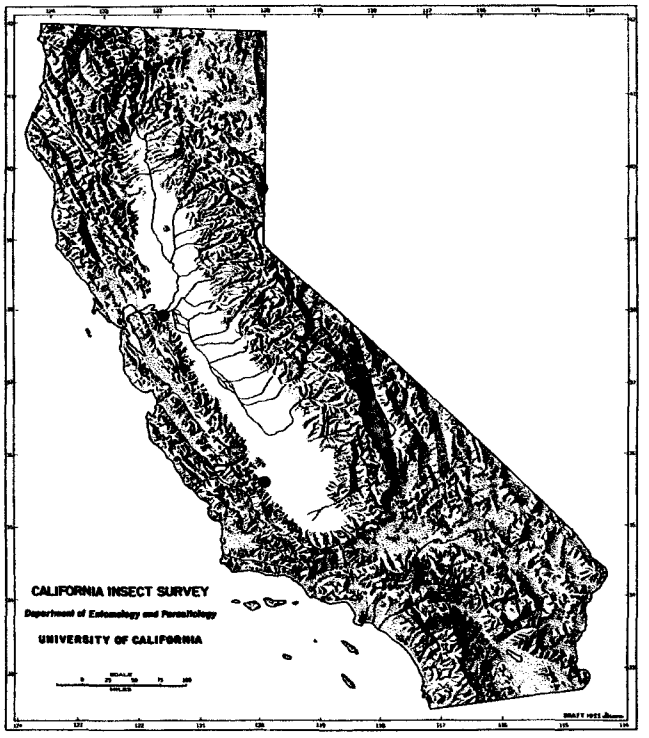
Anthidium emarginatum var. *atripes* Cresson, 1879. Trans. Amer. Ent. Soc., 7:205. Holotype ♂, Nevada (ANSP).

Anthidium polingae Schwarz, 1931. Jour. New York Ent. Soc., 39:315–316; ♀, ♂. Holotype ♀ (Oregon State). NEW SYNONYMY.

Taxonomy.—Schwarz, 1928, Jour. New York Ent. Soc., 36:388, ♀; 1937, Jour. New York Ent. Soc. 45:377–379.

Geographical range.—California, Colorado, Nevada, Texas.

California records.—CONTRA COSTA CO.: Antioch, 1 ♂, IV–21–34 (G. and R. Bohart, CIS); 1 ♀, VI–18–36 (CIS). INYO CO.: Big Pine Creek, 1 ♀, VI–11–27, on *Astragalus Douglasii var. Parishii* (P. Timberlake, UCR). Westgard Pass, summit, 2 ♂, 4 ♀, V–27 to VI–15–37, on *Astragalus* (C. Michener, UCR); 3 mi. W, 10 ♂, 19 ♀, VI–19–53, on *Astragalus* (J. MacSwain, CIS). KERN CO.: Devils Den, 1 ♀, IV–8–51, on *Astragalus* (P. Hurd, CIS). MONO CO.: Blanco's Corral, White Mts., 10,000 ft., 1 ♀, VII–14–53 (D. Linsdale, CIS). ORANGE CO.: Upper Santa Ana River, 1 ♂, V–29–46 (A. Melander, UCR). RIVERSIDE CO.: Idyllwild, 1 ♂, 1 ♀, V–25–39, on *Astragalus* (E. Linsley, CIS); 1 ♀, VI–4–39, on *Astragalus* (E. Ross, CIS); 6 ♂, 2 ♀, VI–9–40, on *Astragalus Douglassi* var. *Parishii* (P. Timberlake, UCR). Keen Camp, San Jacinto Mts., 4 ♂, 1 ♀, V–10–37 (E. Linsley, E. Ross, CIS). Pine Cove, San Jacinto Mts., 1 ♂, VI–3–39, on *Astragalus Douglasii* var. *Parishii* (P. Timberlake, UCR). Pine



Map 6. California distribution of *Anthidium atripes* Cresson

Flat, San Jacinto Mts., 6 ♂, 4 ♀, VI–15–40, on *Astragalus* (C. Michener, UCR). Santa Rosa Mt., San Jacinto Mts., 2 ♂, 2 ♀, V–31–40, on *Astragalus* (C. Michener, CIS); 2 ♂, 2 ♀, VI–18–40, on *Lotus Davidsonii* (C. Michener, CIS). SAN BERNARDINO CO.: Barton Flats, San Bernardino Mts., 1 ♂, VII–21–36 (CAS). SAN DIEGO CO.: Mt. Laguna, 1 ♂, VI–21–63 on *Lotus strigosus* var. *hirtellus* (P. Hurd, CIS).

The males can be distinguished from other *Anthidium* in California except *collectum* and *palmarum* by the combination of a prominent black setal brush and the shape of sternum VI, which has the median and lateral lobes broader than long (fig. 41). The broader lateral lobe of tergum VII (subequal to distance separating it from the center spine) and lack of pale reddish maculation on the tegula are features which distinguish male *atripes* from *palmarum*. From *collectum*, the much broader median lobe of sternum VI and bifurcate sternum VIII are differentiating characters. The females have a rather distinctive posterior marginal band (fig. 77) which extends over one-half the width of the tergum and is sinuate. Also, female *atripes* are usually quite dark with no maculation on the mandible and clypeus, and both sexes typically have the posterior terga all black. This latter feature is seldom found in other species, although occasionally specimens of *emarginatum*, *tenuiflorae*, and *palliventre* may approach this condition. There is a tendency for fuller cream or yellow maculations, especially on tergum IV, in southern California.

The majority of 233 specimens (101 ♂, 132 ♀) examined from this state were from the Southern California Mountains. *A. atripes* was also collected on the east slope of the southern part of the Sierras and rarely in the Coast Range as far north as San Francisco Bay.

Biological information is limited to plant visitations in the family Leguminosae.

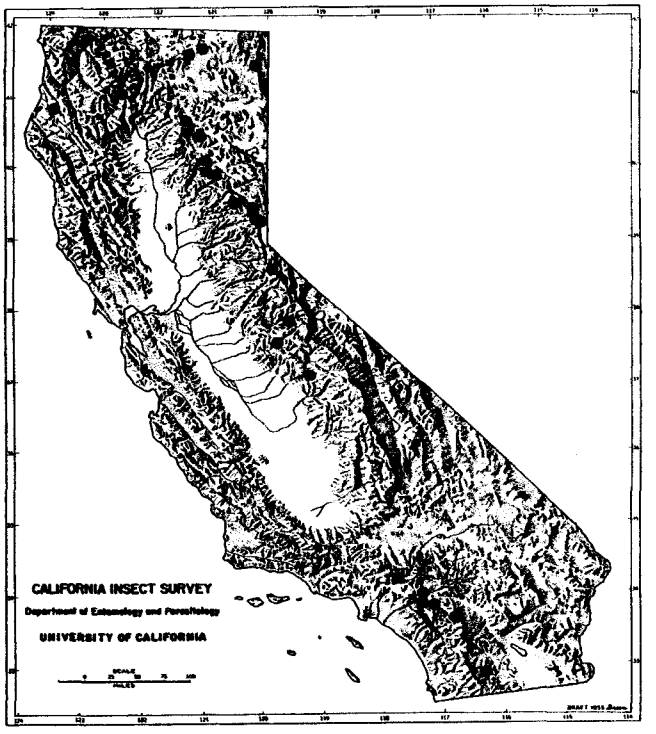
Anthidium bannigense Cockerell

(Figs. 25–27, 86; Map 7)

Anthidium banningense Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:58. Holotype ♂, Banning, California (USNM).

Anthidium plumarium Cockerell, 1925. Proc. Calif. Acad. Sci., Series IV, 14:356. Holotype ♂, Meadow Valley, Plumas Co., California (CAS).

Anthidium longispinum Schwarz, 1927. Amer. Mus. Novitates, 253:6. Holotype ♀, San Bernardino Co., California (USNM).



Map 7. California distribution of *Anthidium bannigense* Cockerell

Geographic range.—California, Oregon, Utah, Washington.

California records.—ALPINE CO.: Hope Valley, 1 ♂, 1 ♀, VII–18–48 (J. MacSwain, CIS). Blue Lakes, 2 ♀, VII and

VIII (F. Blaisdell, CAS). FRESNO CO.: Huntington Lake, 5 ♂, 6 ♀, VII–1917, (I. McCracken, CIS). LASSEN CO.: Hallelujah Junction, 1 ♀, VI–27–49 (J. MacSwain, CIS). Snag Lake, 1 ♀, VII–5–57 (R. Schoeppner, UCD). LOS ANGELES CO.: Big Pine Camp, 2 ♂, VII–12–57, on *Phacelia heterophylla* (P. Timberlake, UCR). MARIPOSA CO.: Yosemite National Park, 1 ♀, V–23–58 (CIS). MODOC CO.: Cedarville, 6 mi. NW, 1 ♂, VII–4–62 (J. Buckett, UCD). Hackamore, 5 ♀, VII–12–47 (F. Thatcher, CIS). NEVADA CO.: Baxter, 1 ♂, VIII–25–48 (P. Hurd, CIS). Boca, 4 ♀, 6 ♂, VII–3–54 (P. Hurd, R. Goodwin, CIS). Fuller Lake, 2 ♂, 1 ♀, VII–15–61 (A. Menke, L. Stange, UCD). Sagehen Creek, near Hobart Mills, 1 ♂, 5 ♀, on *Phacelia* (P. Hurd, CIS); 1 ♀, VI–29–62, on *Trifolium Wormskioldii* (M. Irwin, UCD); 1 ♀, VII–4–59, on *Phacelia* (P. Hurd, CIS). Truckee, 2 ♂, 1 ♀, VII–10–54 (J. Powell, CIS). PLUMAS CO.: Johnsonville, 2 ♀, VII–8–54 (J. Powell, CIS). Meadow Valley, 21 ♂, 16 ♀, VI–30–54 (E. Van Dyke, CAS). Quincy, 4 mi. W, 2 ♂, 3 ♀, VI–21–49, on *Phacelia* (P. Hurd, CIS). Lake Almanor, 1 ♂, VII–13–34 (E. Van Dyke, CAS). RIVERSIDE CO.: Banning, 1 ♂, 1 ♀, V–28–28 (E. Van Dyke, CAS). Herkey Creek, San Jacinto Mts., 1 ♂, VI–7–42, on *Chaenactis glabriuscula* (P. Timberlake, UCR); 1 ♀, VI–8–37, on *Cryptantha* (P. Timberlake, UCR). Riverside, 1 ♂, 2 ♀, V–15–29, on *Phacelia ramosissima* (P. Timberlake, UCR). SAN BERNARDINO CO.:Crestline, 1 ♀, V–23–36, on *Lotus Davidsonii* (P. Timberlake, UCR). SAN DIEGO CO.: Mt. Laguna, 2 ♂, 3 ♀, VII–4–63 (W. Reische, UCD). SANTA CRUZ CO.: Mission Springs, 1 ♂, VI–30–56, on *Clarkia amoena* (R. Snelling, SS). SHASTA CO.: Hat Creek, 1 ♂, VI–21–55 (K. Bowers, UCD). Old Station, 7 ♀, VII–4–55, on *Phacelia* (P. Hurd, CIS). SIERRA CO.: Independence Lake, 2 ♀, VII–27–56 (R. Bohart, UCD). Gold Lake, 4 ♂, VII–18–21 (C. Fox, CAS). SISKIYOU CO.: Macdoel, 8 ♂, 6 ♀, VII–2–63, on *Phacelia* (J. Schuh, JS). Valentine Caves, Lava Beds National Mon., 1 ♂, 1 ♀, VI–30–63 (V. Vesterby, UCD). TRINITY CO.: Coffee Creek, 1♀, VII–14–55 (J. Jessen, UCD). TULARE CO.: Mineral King, 1 ♂, VIII–1–25 (G. Bohart, SS).

These bees are predominately black with rather narrow pale yellow or cream maculations. The broadly truncate posterolateral margin of sternum VI (fig. 26) is distinctive for the males. Also, the spiniform lateral lobe of tergum VII is an important key character, as this extreme condition is found only in *maculosum* and *edwardsii*. The females have a distinctive tergum VI (fig. 86) with the dorsolateral extension forming an acute tooth curved medianly. This is duplicated only in *maculosum* which has sparse macropunctation of the frons and a restricted posterior marginal band on tergum VI.

A. banningense is moderately abundant in California collections (85 ♂, 110 ♀), and shows a preference for montane environments. Plant visitations include five families with a slightly greater frequency indicated in the Hydrophyllaceae. The chrysidid *Chrysis florissanticola* was reared from a *banningense* nest in Utah by Jaycox (*in litt.*).

Anthidium clypeodentatum Swenk

(Figs. 16–18, 68, 70, 91; Map 8)

Anthidium clypeodentatum Swenk, 1914. Nebr. Univ. Studies, 14:12. Holotype ♀, Sioux Co., Nebraska (NU).

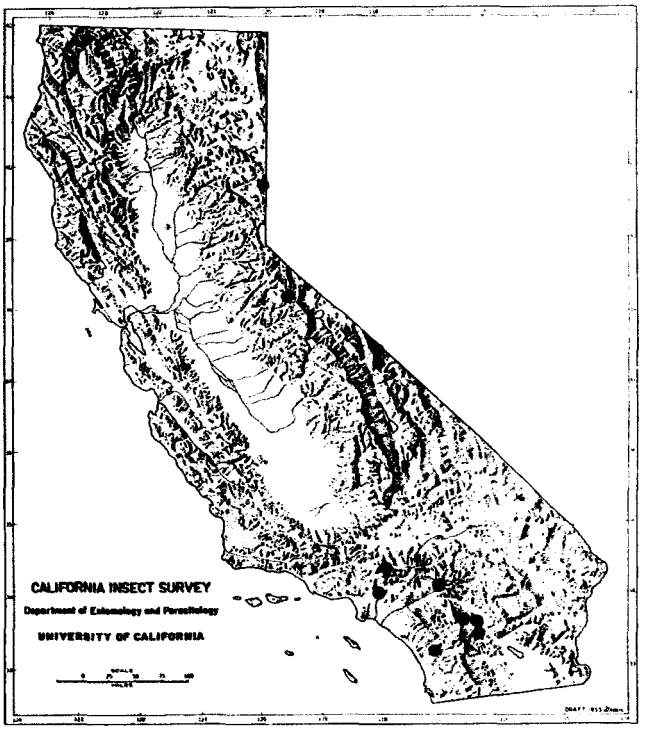
Anthidium incurvatum Swenk, 1914. Nebr. Univ. Studies, 14:22. Holotype ♂, Ute Creek, Costilla Co., Colorado (NU). NEW SYNONYMY.

Anthidium emarginatum bilineatum Schwarz, 1927. Amer. Mus. Novitates, 252:4. Holotype ♂, Cascade, Colorado (AMNH). NEW SYNONYMY.

Anthidium clypeodentatum var. *lutzi* Schwarz, 1928. Jour. New York Ent. Soc., 36:380; ♀, ♂. Holotype ♀, "W" (? Mt. Wilson) (UCR). NEW SYNONYMY.

Geographic range.—Canada (Manitoba to British Columbia), Nebraska, Colorado, California.

California records.—INYO CO.: Schulman Grove, White Mts., 1 ♀, VII–6–61 (G. Stage, CIS). Wyman Canyon, White Mts., 1 ♀, VI–27–61 (J. Powell, CIS). LASSEN CO.: Hallelujah Junction, 1 ♂, VI–28–62 (F. Parker, UCD). LOS ANGELES CO.: Pearblossom, 4 mi. S, 1 ♀, IV–14–60 (R. Snelling, SS). San Dimas Canyon, 1 ♀, V–19–35 (K. Holland, LACM). MONO CO.: Blanco's Corral, White Mts., 10,000 ft., 1 ♀, VII–15–53 (J. MacSwain, CIS). Sonora Pass, 10,000 ft., 1 ♂, 1 ♀, VII–11–57 (W. Crites, A. Menke, UCD); 1 ♀, VIII–13–60, on *Lupinus* (R. Thorp, RT). White Mts., 10,000 ft., 1 ♂, VIII–4–61 (J. Buckett, UCD). RIVERSIDE CO.: Dark Creek, San Jacinto Mts., 1 ♂, V–16–37, on *Lotus scoparius* (P. Timberlake, UCR); 1 ♀, VI–21–40, on *Lotus Davidsonii* (P. Timberlake, UCR). Herkey Creek, San Jacinto Mts., 1 ♀, VI–14–40 (C. Michener, CIS). Idyll-



Map 8. California distribution of *Anthidium clypeodentatum* Swenk

wild, San Jacinto Mts., 1 ♀, on *Astragalus Douglasii* var. *Parishii* (P. Timberlake, UCR); 1 ♀, VI–17–40, on *Lotus oblongifolius* (C. Michener, CIS); 2 ♂, V–10 to VI–16–39, on *Lotus* (E. Linsley, CIS); Santa Rosa Peak, Santa Rosa Mts., 1 ♀, VI–8–40, on *Lotus Davidsonii* (P. Timberlake, UCR). SANTA BARBARA CO.: Bluff Camp, San Rafael Mts., 1 ♂, VI–29–59 (A. Menke, UCD). SAN BERNARDINO CO.: San Bernardino Mts., 3,800 ft., 1 ♂, V–15–37, on *Ceanothus* (E. Linsley, CIS). TUOLUMNE CO.: Sonora Peak, 11,000–12,000 ft., 1 ♂, VIII–10–57 (J. Powell, CIS).

The moderate yellow maculations of *clypeodentatum* tend to become somewhat fuller in southern California but exceptions to this occur. The female is easily identified by the densely pilose scape. The male has, in addition to a distinctive tergum VII and sternum VI, a characteristic setal "brush" (fig. 68). The species is infrequently collected (32 ♂, 22 ♀) in California, and it has not been taken in long series. Typically it is a mountain species preferring legume flowers, particularly the genus *Lotus*.

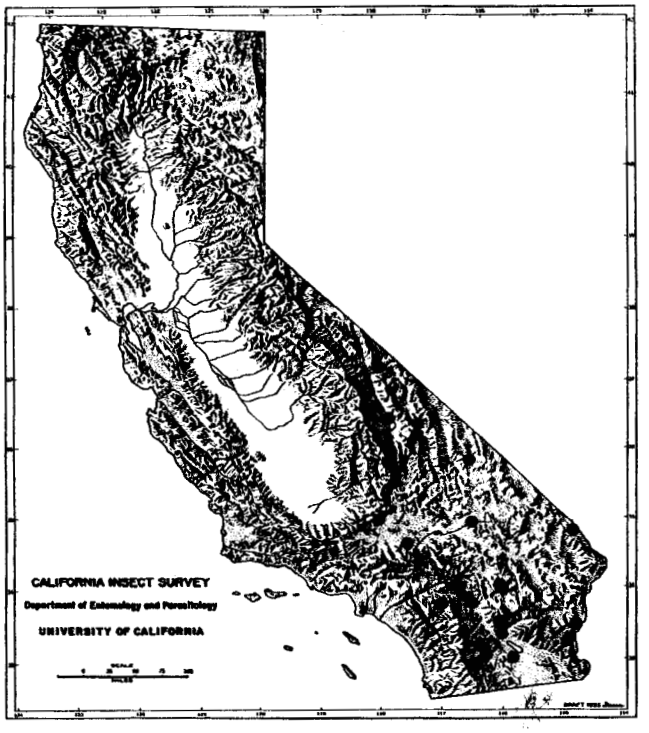
Anthidium cockerelli Schwarz

(Figs. 61–63, 67, 75, 97; Map 9)

Anthidium cockerelli Schwarz, 1928. Jour. New York Ent. Soc., 36:386. Holotype ♂, near Oasis, California (UCR).

Taxonomy.—Cockerell, 1937, Amer. Mus. Novitates, 948:6; ♀.

Geographic range.—Baja California, southern California, southern Nevada, western Texas, New Mexico.



Map 9. California distribution of *Anthidium cockerelli* Schwarz

California records.—IMPERIAL CO.: Kane Springs, 24 mi. W, 1 ♂, III–25–33, on *Lupinus* (P. Timberlake, UCR). Palo Verde, 3 mi. S, 1 ♂, IV–9–63, on *Oenothera clavaeformis* var. *aurantiaca* (G. Tamaki, CIS). INYO CO.: Darwin, 1 ♀, IV–28–59 (R. Allen, SS). Emigrant Springs, 1 ♀, IV–27–50 (D. Davis, CIS). Little Lake, 1 ♀, VI–2–17 (C. Fox, CAS). Lone Pine, 1 ♀, V–24–37 (E. Van Dyke, CAS). North end Owens Lake, 1 ♀, VI–4–37, on *Trifolium* (C. Michener, UCR). Shoshone, 3 mi. NW, 1 ♀, IV–13–63 (D. Miller, UCD). Surprise Canyon, Panamint Mts., 1 ♂, 1 ♀, V–9–58 (R. Bohart, UCD). Mazourka Canyon, Inyo Mts., 2 ♂, V–25–57, on *Phacelia* (C. Michener, UCR). KERN CO.: Mojave, 1 ♂, IV–25–50 (R. Howell, CIS). RIVERSIDE CO.: Andreas Canyon, 1 ♂, IV–2–55, on *Larrea divaricata* (D. Clark, UCR). Blythe, 6 mi. S, 2 ♀, IV–12–44, on *Phacelia* (P. Timberlake, UCR); 18 mi. W, 1 ♂, IV–16–51, on *Phacelia* (P. Timberlake, UCR). Desert Center, 12 mi. W, 1 ♀, V–5–36, on *Dalea Emoryi* (R. Snelling, LACM). Eden, 4 mi. E, 1 ♀, IV–17–37, on *Chaenactis carphoclinia* (P. Timberlake, UCD). Indio, 1 ♂, IV–5–51, on *Geraea canescens* (E. Linsley, CIS). Oasis, 2 mi. S, 1 ♂, IV–8–36, on *Palafoxia linearis* (P. Timberlake, UCR). Near Oasis, 1 ♂, IV–19–25, on *Cercidium* (P. Timberlake, UCR). Palm Canyon, 1 ♀, IV–6–63 (R. Macdonald, UCD). Palm Desert, 8 ♂, 3 ♀, IV–11–50 (P. Hurd, L. Quate, CIS). Palm Springs, 3 ♀, III–27 to IV–1–16 (C. Fox, CAS). Whitewater, 1 ♂, IV–26–36, on *Dalea californica* (P. Timberlake, UCR). SAN BERNARDINO CO.: Joshua Tree Nat'l Mon., 1 ♂, 1 ♀, on *Larrea divaricata* (R. Snelling, L. Stange, UCD). Kramer Hills, 1 ♀, IV–25–57, on *Phacelia* (P. Hurd, CIS). Manix, 22 mi. N, 14 ♂, 12 ♀, on *Larrea divaricata* (P. Hurd, G. Marsh, R. Schuster, CIS). Morongo Valley, 1 ♂, IV–21–57, on *Phacelia distans* (R. Snelling, M. Stage, SS). Needles, 3 ♂, IV–3–51 (P. Hurd, CIS). SAN DIEGO CO.: Borrego Valley, 1 ♂, 1 ♀, IV–28–54, on *Malacothrix* (P. Hurd, CIS); 1 ♂, 1 ♀, IV–11–51, on *Phacelia* (J. MacSwain, CIS); 1 ♀, III–26–33, on *Abronia villosa* (P. Timberlake, UCR).

A. cockerelli is distinctively marked with yellow metasomal bands that are usually interrupted and reddish tegulae. The males can be distinguished by the combination of an inconspicuous yellowish setal brush (fig. 67) on sternum IV and the shape of sternum VI (fig. 62). The latter has no significant development of lateral lobes, and the median lobe is about as long as broad with the apex emarginate. The females are often confused with *A. jocosum*, since both species have a black clypeus contrasted with yellow mandibles. The dentation of the female mandible (figs. 97, 98) provides a reliable criterion for separating these two species. The species is found mostly in the Mojave and Colorado deserts and is apparently a strictly vernal species. It has associated with numerous plant species in at least seven different families. Records are based on 63 males and 56 females.

Anthidium collectum Huard

(Figs. 19–21, 83; Map 10)

Anthidium compactum Provancher, 1896. Nat. Canad., 23:9.

Lectotype ♂, Los Angeles, California (Quebec). Preoccupied.

Anthidium collectum Huard, 1896. Nat. Canad., 23:124. New name for *A. compactum* Provancher 1896.

Anthidium angelarum Titus, 1906. Proc. Ent. Soc. Wash., 7: 164. Holotype ♀, Los Angeles County, California (USNM).

Anthidium transversum Swenk, 1914. Nebr. Univ. Studies, 14:19. Holotype ♀, Pacific Grove, California (NU). NEW SYNONYMY.

Anthidium puncticaudum Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:360. Holotype ♂, Colton, California (CAS).

Anthidium collectum bilderbacki Cockerell, 1938. Trans. San Diego Soc. Nat. Hist., 9:38. Holotype ♀, Santa Barbara Island, Calif. (San Diego SNH). NEW SYNONYMY.

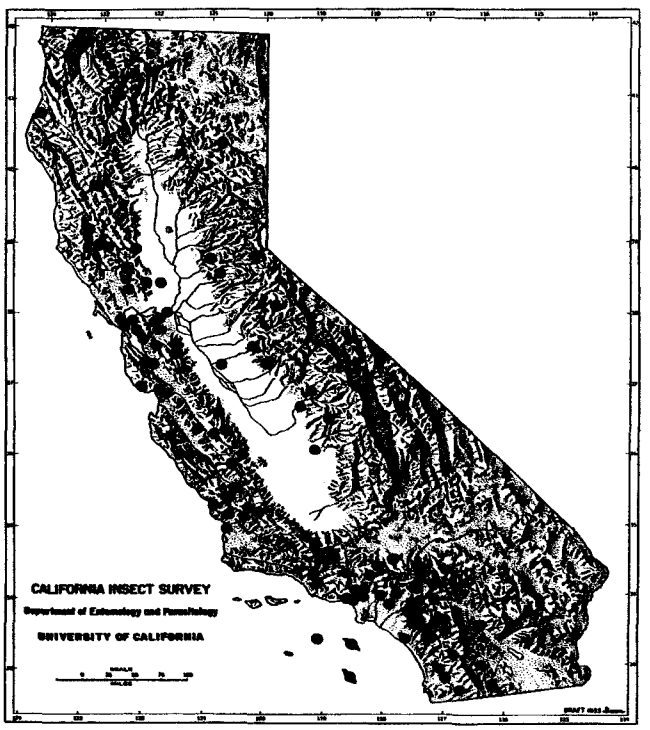
Anthidium catalinense Cockerell, 1939. Proc. Calif. Acad. Sci., Series 4, 23:433 ♂, ♀. Holotype ♂, Fisherman's Cove, Santa Catalina Island (UCR). NEW SYNONYMY.

Anthidium clementinum Cockerell, 1939. Bull. South. Calif. Acad. Sci., 38:138. Holotype ♀, San Clemente Island (UCR). NEW SYNONYMY.

Taxonomy.—Titus, 1906, Proc. Ent. Soc., Wash., 7:163.

Biology.—Hicks, 1929, Can. Ent., 61:84–86. Ferguson, 1962. Univ. Calif. Publ. Ent., 27(1):1–92.

Geographic range.—California.



Map 10. Distribution of *Anthidium collectum* Huard

California records.—ALAMEDA CO.: Berkeley, 1 ♂, VI–11–33 (G. and R. Bohart, CIS). Oakland, 2 ♂, 1 ♀, V–8–15–10 (E. Van Dyke, CAS). Tesla, 1 ♂, IV–27–56 (W. Ehrhardt, CIS). Piedmont, 1 ♂, VI–19–12 (F. Nunenmacher, CIS). COLUSA CO.: Williams, 21 mi. SW, 1 ♀, VI–1–63 (D. Miller, UCD). CONTRA COSTA CO.: Antioch, 23 ♂, 8 ♀, V–24–49, on Lotus (E. Linsley, J. MacSwain, J. Rozen, CIS). Clayton, 1 ♂, V–24–58 (W. Simonds, UCD). Mt. Diablo, 1 ♂, VI–14–33, on *Lotus scoparius* (P. Timberlake, UCR). Pt. Richmond, 1 ♂, VI–1–55 (J. Rozen, CIS). EL DORADO CO.: El Dorado, 1 ♀, V–26–35, on *Lupinus* (I. McCraken, CAS). Pilot Hill, 1 ♀, VI–14–53 (R. Bohart, CIS). Snowline Camp, 1 ♀, VII–17–48, on *Phacelia* (P. Hurd, CIS). FRESNO CO.: Orange Cove, 4 mi. N, 2 ♂, IV–4–57, on *Phacelia distans* (SS). Panoche Canyon, 1 ♂, IV–29–22 (E. Van Dyke, CAS). Pine Flat, 1 ♂, VI–22–56, on *Lotus* (R. Snelling, SS). HUMBOLDT CO.: Eureka, 1 ♀, VI–11–35 (CIS). INYO CO.: Lone Pine Canyon, 2 ♂, 1 ♀, VI–16–28, on *Lotus scoparius* (P. Timberlake, UCR). KERN CO.: Frazier Park, 1 ♂, V–18–40 (R. Bohart, CIS). Mill Potrero, 1 ♀, VII–6–59 (P. Paige, UCD). Tejon Canyon, 1 ♂, V–12–27 (E. Van Dyke, CAS). LAKE CO.: Hopland Grade, 1 ♂, 1 ♀, V–23–61 (S. Fidel, UCD). Kelseyville, 2 ♂, 1 ♀, VI–3–61 (S. Fidel, UCD). LASSEN CO.: Bridge Creek Camp, 1 ♂, VII–9–49 (I. Isaak, CIS). LOS ANGELES CO.: Acton, 1 ♀, III–19–36, on *Salix* (E. Linsley, CIS). Altadena, 2 ♂, IV–19–36, V–23 to VI–26–35, on *Lotus scoparius* (C. Michener, UCR); 1 ♂, IV–8–36, on *Phacelia tenacetifolia* (C. Michener, CAS). Big Dalton Dam, 1 ♀, VI–25–50 (J. Hall, CIS). Claremont, 1 ♀, V–4–46, on *Lotus scoparius* (P. Timberlake, UCR). Eagle Rock, 2 ♀, V–5–35, on *Lotus scoparius* (P. Timberlake, UCR). Glendale, 2 ♂, 5 ♀, VI–3 to 17–56 (E. Schlinger, UCD). Griffith Park, 1 ♂, 3 ♀, IV–5–36, on *Nemophila* (E. Linsley, CIS); 3 ♂, 3 ♀, IV–12–36, on *Phacelia* (E. Linsley, CAS). Glendora, 1 ♂, VI–22–56 (G. Stage, SS). Green Valley, 1 ♀, VIII–23–54, on *Lotus scoparius* (R. Snelling, SS). La Crescenta, 1 ♂, 1 ♀, VI–19–36, on *Cryptantha* (E. Linsley, CIS; C. Michener, UCR). Pasadena, 1 ♀, VI–3–55 (R. Doane, CIS). Puente Hills, 1 ♂, 3 ♀, V–10–26, on *Lotus scoparius* (P. Timberlake, UCR); 1 ♀, III–14–26, on *Phacelia distans* (P. Timberlake, UCR). Santa Monica, 1 ♀, (CAS). San Clemente Island, 5 ♂, 2 ♀, IV–3 to 31–39 (LACM). San Dimas Canyon, 7 ♂, 6 ♀, V–19–35 (K. Holland, SS). Santa Catalina Island, 1 ♂ (UCR). Tanbark Flat, 2 ♂, 1 ♀, VI–22–50, on *Lotus* (P. Hurd, CIS). Valyermo, 4 mi. SE, 1 ♀, IV–13–60 (R. Snelling, SS). MARIN CO.: Alpine Lake, 1 ♀, IV–6–56 (J. Herring, CIS). Fairfax, 2 ♂, 1 ♀, V–22–51 (C. Fox, CAS). Lagunitas, 1 ♀, IV–28–18 (C. Fox, CAS). Mill Valley, 1 ♀, V–14–61 (D. Cavagnaro, UCD). Mt. Tamalpais, 1 ♂, V–30–32 (C. Fox, CAS). MARIPOSA CO.: Exchequer Dam, 1 ♂, 2 ♀, V–25–57 (R. Snelling, G. Stage, SS). MENDOCINO CO.: Calpella, 1 ♂, VI–16–59 (S. Fidel, UCD). Hopland, 1 ♂, V–9–26 (E. Van Duzee, CAS). MERCED CO.: Hilmar, 2 mi. S, 1 ♀, V–5–37, on *Phacelia distans* (R. Snelling, SS). MONTEREY CO.: Arroyo Seco, 1 ♀, V–16–58 (E. Linsley, CIS). King City, 9 mi. E, 1 ♂, IV–1–59 (C. O'Brien, RT). Stone Canyon, 1 ♀, IV–21–19 (E. Van Duzee, CAS). Tassajara Hot Springs, 1 ♀, V–26–54 (D. Bryant, CAS). NAPA CO.: Berryessa, 21 mi. NW, 1 ♀, V–12–61 (F. Parker, UCD). Monticello Dam, 1 ♂, 1 ♀, V–30–63 (M. Irwin, R. Westcott, UCD). Samuel Springs, 6 ♂, 6 ♀, V–22–56 (R. Bechtel, E. Schlinger, UCD). Oakville, 2 mi. N, 1 ♂, V–5–60 (T. Haig, UCD). RIVERSIDE CO.: Banning, 1 ♂, V–29–28 (E. Van Dyke, CAS). Colton, 1 ♂, V–27–17 (E. Van Duzee, UCR). Corona, 2 ♀, IV–19–12 (CIS). Dark Canyon, San Jacinto Mts., 1 ♂, VI–21–40 on *Lotus Davidsonii* (P. Timberlake, UCR). Hemet, 1 ♂, 1 ♀, IV–26–54 (N. Browne, UCD). Idyllwild, 1 ♀, VI–9–40, on *Lotus scoparius* (C. Michener, CIS; P. Timberlake, UCD). Keen Camp, San Jacinto Mts.,

1 ♂, VI–10–39 (E. Ross, CIS). Lake Elsinore, 5 mi. S, 1 ♂, VI–24–56 (A. Menke, UCD). Lake Mathews, 1 ♂, IV–14–60, on *Phacelia hispida* (P. Timberlake, UCR). Marion Mt. Camp, San Jacinto Mts., 1 ♀, VII–1–52 (J. MacSwain, CIS). Perris, 5 mi. W, 1 ♀, III–21–36, on *Lotus scoparius* (E. Linsley, CIS); 2 mi. W, 1 ♀, IV–13–36, on *Cryptantha intermedia* (P. Timberlake, UCR). Pinyon Flat, 1 ♂, VI–18–41 (E. Van Dyke, CAS). Riverside, 1 ♂, IV–14–36 on *Phacelia ramosissima* (P. Timberlake, UCR); 1 ♂, IV–24–35, on *Lotus scoparius* (P. Timberlake, UCR); 5 ♂, IV–30–25, on *Lotus scoparius* (P. Timberlake, UCR); 1 ♂, III–26–34, on *Phacelia distans* (P. Timberlake, UCR); 1 ♂, 3 ♀, V–16–33, on *Cryptantha intermedia* (P. Timberlake, UCR); 1 ♂, V–14–28, on *Encelia farinosa* (P. Timberlake, UCR). The Gavilan, 1 ♂, 4 ♀, IV–18–37, on *Sambucus, Oenothera* (E. Linsley, CIS); 2 ♀, IV–20–37, on *Lotus scoparius, Astragalus* (P. Timberlake, UCR). SAN BENITO Co.: Bitterwater, 5 mi. S, 1 ♀, III–31–59 (C. O'Brien, RT). Idria, 4 ♂, VI–29–55, on *Phacelia* (P. Hurd, CIS). Pinnacles Nat. Mon., 1 ♀, IV–24–48, on *Nemophila* (P. Hurd, CIS). SAN BERNARDINO Co.: Cajon Valley, 1 ♂, VII–4–33, on *Trichostema lanatum* (P. Timberlake, UCR); 1 ♀, VII–4–33, on *Lotus scoparius* (P. Timberlake, UCR). Devore, 1 ♀, VI–23–35, on *Eriastrum pluriflorum* (P. Timberlake, UCR); 1 ♂, VI–23–36, on *Phacelia ramosissima* (P. Timberlake, UCR). Yucaipa, 1 ♂, VII–10–57 (J. Gillaspy, UCD). SAN DIEGO Co.: Barrett Springs, 1 ♀, IV–20–50 (J. MacSwain, CIS). La Mesa, 1 ♀, IV–16–53 (F. Williams, CAS). Mt. Laguna, 7 ♂, 6 ♀, VI–21–63 on *Lotus strigosus* (P. Hurd, CIS). Mt. Palomar, 2 ♂, 1 ♀, VI–28–63 (T. Bolton, I. Pogojeff, UCD). Newtown, 3 mi. W, 1 ♂, IV–14–34 (A. Basinger, UCR). Poway, 1 ♂, 1 ♀, III–10 to V–16–86 (F. Blaisdell, CAS). Warner Springs, 3 ♂, 2 ♀, VI–12–58 (J. Hall, UCD). SAN LUIS OBISPO Co.: Creston, 2.5 mi. S, 1 ♂, 4 ♀, IV–10–61 (R. Thorp, CIS). Grover City, 1 ♂, 2 ♀, VII–4–56, on *Phacelia* (P. Hurd, CIS). Morro Rock, 1 ♀, V–4–62 (J. Powell, CIS). Pozo, 4 ♂, 3 ♀, IV–28–62 on *Amsinckia intermedia, Lupinus nanus* (P. Hurd, CIS). Santa Margarita, 5 mi. NE, on *Chaenactis glabriuscula* (P. Hurd, CIS). Shandon, 7 mi. W, 1 ♂, 2 ♀, IV–10–61, on *Cryptantha* (J. MacSwain, CIS). Simmler, 10 mi. W, 1 ♂, 1 ♀, IV–29–62 (J. Powell, CIS). SANTA CLARA Co.: Alum Rock Park, 2 ♂, VI–18–56 (D. Burdick, CIS). Mt. Hamilton, 3 ♂, 1 ♀, V–25–50 (P. Hurd, J. MacSwain, CIS). Santa Clara, 2 ♀, V–7–28 (C. Duncan, CIS). SANTA CRUZ Co.: Mission Springs, 1 ♀, VII–6–56 (M. Stage, SS). Mt. Berman, 1 ♀, VII–7–30 (F. Blaisdell, CAS). SOLANO Co.: Rio Vista, 5 ♂, 2 ♀, V–24–49, on *Lotus* (E. Linsley, J. MacSwain, CIS). TRINITY Co.: Coffee Creek, 1 ♂, VI–11–25, on *Lotus scoparius* (P. Timberlake, UCR). TULARE Co.: Kaweah, 1 ♂, VI–1–39 (F. Scott, SS). Lemoncove, 4 mi. NE, 1 ♀, V–13–63 (J. Powell, CIS). Three Rivers, 2 ♂, 1 ♀, V–11–62 (A. Menke, UCD). TUOLUMNE Co.: Strawberry, 1 ♀, VIII–4–60 (A. Menke, UCD). VENTURA Co.: Hungry Valley, 5 mi. S, Gorman, V–6–59 (C. O'Brien, CIS). Santa Paula, 2 ♂, 1 ♀, VI–5–27, on *Phacelia ramosissima* (P. Timberlake, UCR). Sespe Creek, 1 ♀, VII–10–59 (C. Campbell, CIS). YOLO Co.: Putah Creek, 1 ♀, VII–5–46 (H. Cott, CIS).

Both sexes of this species have rather restricted yellow maculations. The males are distinguished from other species except *atripes* and *palmarum* by the combination of the prominent black setal brush and the shape of sternum VI (fig. 20) which has the median and lateral lobes broader than long. The apical lobe of sternum VIII provides a key character for the males of *A. collectum* since it is entire and reflexed (fig. 21). Tergum VII (fig. 19) is about the same as in *A. atripes,* whereas the lateral lobe of the tergum is much broader than in *palmarum. A. collectum* females are most easily confused with *pallidiclypeum* and *utahense.* The females of *collectum* have a wide posterior marginal band (fig. 83) that is curved near the dorsolateral extension and the basitarsus with dense white pile. These features, together with the nearly all yellow clypeus, which has the apical margin nearly transverse although wavy, will distinguish this sex.

A. collectum is the second most abundantly collected species of this survey (386 ♂, 360 ♀). It is a fairly widespread species in California and has a similar distributional pattern to *edwardsii* except that *collectum* is much less frequent in the Central Valley. It is found in the Sierra Nevada Mountains, especially in foothill areas, and along the Coast Range into southern California. Three specimens have been collected near Lone Pine, Inyo Co., which represent the only known records from the east side of the Sierra Nevada. *A. collectum* is the only species of *Anthidium,* except for *palliventre,* which is known from the Channel Islands.

Collections show this species to be associated with nine plant families, but the majority of the records were in the Leguminosae, Hydrophyllaceae, and Boraginaceae, in that order. Preferred genera of these families were *Lotus, Phacelia,* and *Cryptantha.*

Hicks (1929c) reported on the nesting habits of *collectum* at Pasadena and Sierra Madre, California, from March 31 to April 15, 1929. The females selected a deserted tunnel of some other insect or spider nests in the soil. The cells were constructed from down from the leaves and along the stem of *Artemisia tridentata.* One to two cells were constructed, depending on the cavity, and each cell was provisioned with pollen and honey. The bees filled the nest from the down to the surface with small pebbles, and at times pieces of leaves and stems, averaging 10 pebbles each minute. Copulation on the ground was observed, and resting and sleeping sites are discussed.

Ferguson (1962) reported on the habits of *collectum* in conjunction with a study of mutillids at Antioch, California. The females used other ground bee nests, lined the cells with down, and made overlays of pebbles and sand. Mutillid parasitoids included *Sphaeropthalma (Photopsis) unicolor (Cresson), S. (P.) orestes (Fox),* and *S. (P.) blakeii (Fox).* Other

parasitic insects associated with *collectum* by Ferguson were the chalcid *Monodontomerus montivagus* Ashmead and the megachilid *Dioxys productus cismontanicus* Hurd. Also a species of chrysidid, *Chrysis coloradica* Bohart (= *C. pulcherrima* Cresson), was reared from *collectum* by Ferguson. This species belongs to the *lauta* group as recently defined by Bohart (1964); and according to records made available to us by Bohart, *Chrysis tripartita* is also a parasitoid of *collectum*. At least one other member of the *lauta* group, *C. florissanticola*, is a parasitoid of the *Anthidium* as it was reared from *A. banningense* nest in Utah by Jaycox *(in litt)*.

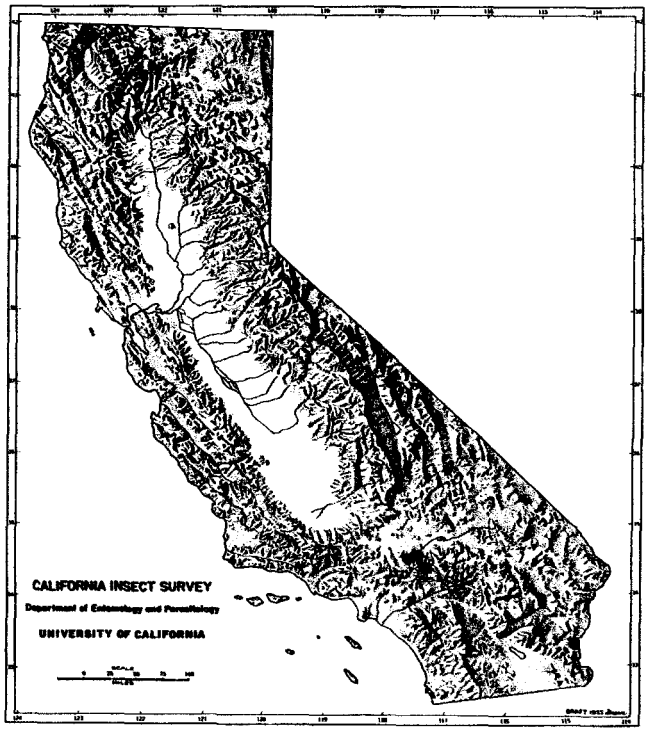
Anthidium dammersi Cockerell

(Figs. 37–39, 89; Map 11)

Anthidium dammersi cockerell, 1937. Amer. Mus. Novitates, 948:6; ♂, ♀. Holotype ♂, Adelanto, 9 mi. N, California (AMNH).

Geographic range.—California deserts, Nevada.

California records.—IMPERIAL CO.: Palo Verde, 3 mi. S, 1 ♂, IV–9–63 (J. Powell, CIS). INYO CO.: Mazourka Canyon, Inyo Mts., 1 ♀, V–25–37, on *Dalea fremontii* (C. Michener, UCR). RIVERSIDE CO.: Hopkins Well, 1 ♂, IV–16–58 (P. Hurd, CIS). SAN BERNARDINO CO.: Adelanto, 9 mi. N, 7 ♂, 1 ♀, IV–20–37, on *Astragalus lentiginosus* var. *fremontii* (C. Dammers, AMNH, LACM, UCR). Apple Valley, 1 ♂, V–9–58, on *Phacelia distans* (P. Timberlake, UCR). Victorville, 5 mi. SW, 1 ♂, V–6–39, on *Dalea Fremontii* var. *Saundersonii* (P. Timberlake, UCR); 3.5 mi. SW, 1 ♀, V–3–39, on *Astragalus lentiginosus* var. *Fremontii* (P. Timberlake, UCR).



Map 11. California distribution of *Anthidium dammersi* Cockerell

The restricted markings of this black bee are cream to pale yellow. *A. dammersi* appears to be the desert counterpart of *emarginatum*. The differences between these two species are very slight, especially in the females. The median lobe of sternum VI of the male of *A. dammersi* is typically reddish-brown and has nearly parallel sides (fig. 38). Also, the apex of sternum VIII (fig. 39) is somewhat broader in *dammersi* than in *emarginatum*. For the females, the more convex tergum VI (in profile) and the lack of maculations will distinguish *dammersi*. The pronotal lobe is black in *dammersi*, usually yellow in *emarginatum*. Also, the southern California populations of *emarginatum* have a yellow clypeus in the female, whereas the clypeus is nearly all black in *dammersi*.

The distribution of this infrequently collected species (27 ♂, 17 ♀) is almost completely in the Colorado and Mojave deserts. No sympatry with *emarginatum* is known, since in southern California *emarginatum* is found in mountainous and coastal areas. The few host associations are from the leguminose genera *Astragalus* and *Dalea;* or *Phacelia* of the Hydrophyllaceae.

Anthidium edwardsii Cresson

(Figs. 3, 49–51, 79; Map 12)

Anthidium edwardsii Cresson, 1878. Trans. Amer. Ent. Soc., 7:112. Holotype ♂, California (ANSP).

Anthidium 3-cuspidum Provancher, 1896. Nat. Canad., 23:10. Holotype ♂, Los Angeles County, California (Quebec).

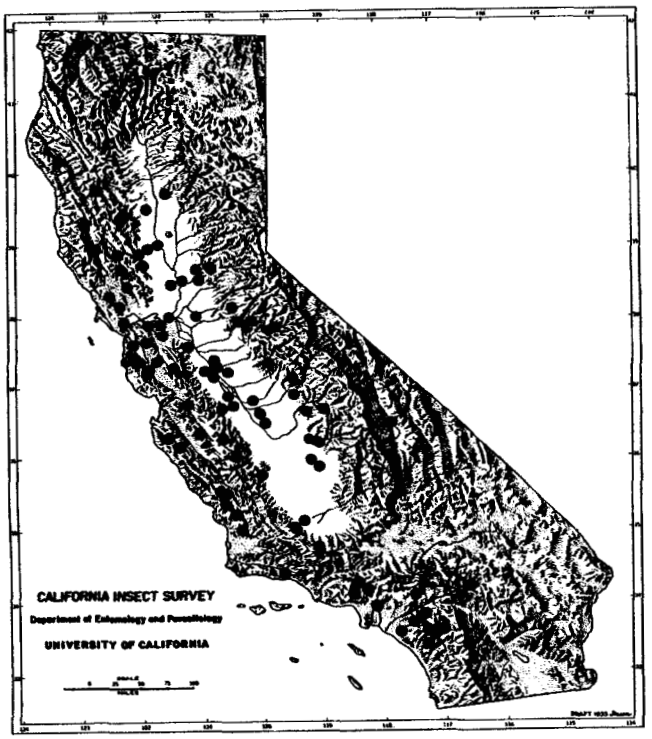
Anthidium tricuspidum Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:59. Emend.

Anthidium hesperium Swenk, 1914. Nebr. Univ. Studies, 14: 18. Holotype ♀, Palo Alto, California (UN).

Anthidium depressum Schwarz, 1927. Amer. Mus. Novitates, 253:4. Holotype ♂, Coulee City, Washington (USNM).

Geographical range.—California, Idaho, Oregon, Washington, Utah.

California records.—ALAMEDA CO.: Coyote Creek, 1 ♂, 1 ♀, IV–15–59, with cells (C. W. O'Brien, SS); 1 ♀, IX–20–58 (J. Powell, CIS). Oakland Hills, 1 ♂, VI–15–49 (L. Jensen, CIS). Redwood Park, 2 ♂, on *Trichostema lanceolatum* (R. Stinchfield, CIS). BUTTE CO.: Richardson Springs, 1 ♂, V–22–44 (E. Van Dyke, CAS). CALVERAS CO.: Mokelumne Hill, 1 ♂, VII–28–21 (F. Blaisdell, CAS). Murphys, 32 ♂, 1 ♀, IX–9–37 (F. Blaisdell, CAS). COLUSA CO.: Arbuckle, 1 ♀, VIII–8–56 (S. Fidel, UCD). Colusa, 2 ♀, VIII–15–55 (R. Schuster, CIS). Tule, 1 ♂, 1 ♀, VI–17–16 (R. Stinchfield, CIS). CONTRA COSTA CO.: Antioch, 2 ♂, V–24–49, on *Lotus* (P. Hurd, CIS). Mitchell Canyon, 1 ♂, VIII–31–60 (R. Langston, SS). Mt. Diablo, 1 ♂, VI–14–33, on *Lotus scoparius* (P. Timberlake, UCR). Pacheo, 1 ♀, VII–2–37 (E. Van Dyke, CAS). FRESNO CO.: Coalinga, 12 mi. SW,



Map 12. California distribution of *Anthidium edwardsii* Cresson

8 ♂, VIII–23–63, on *Trichostema* (J. Powell, CIS). Helm, 3 mi. N, 1 ♂, VII–26–60, on *Wislizenia refracta* (R. Snelling, SS). Firebaugh, 2 ♂, 1 ♀, VIII–16–49 (A. Telford, CIS). Kerman, 1 ♀, VIII–31–60, on *Wislizenia refracta* (R. Snelling, SS). Mercy Hot Springs, 1 ♂, X–7–61 (R. Montanucci, UCD). Oro Loma, 2 ♂, VI–4–45, Japanese Beetle trap (L. Atkinson, UCD). Oxalis, 1 ♂, VIII–21–47 (V. Stern, CIS). Prather, 2 ♂, VI–29–56 (R. Schuster, CIS). Pinehurst, 21 mi. E, 1 ♂, VI–24–60, on *Cirsium* (R. Snelling, SS). San Joaquin, 1 ♂, VI–23–60 (R. Snelling, SS). Squaw Valley, 1 ♀, VI–18–57 (R. Snelling, SS). Watts Valley, 14 ♂, 3 ♀, VI–23–56 (R. Schuster, CIS). GLENN CO.: Artois, 1 ♀, V–24–52, on *Trifolium repens* (J. MacSwain, CIS). Elk Creek, 11 mi. S, 1 ♂, VI–4–61 (C. MacNeill, CAS). HUMBOLDT CO.: Meyers, 1 ♀, VII–7–37 (E. Van Dyke, CAS). INYO CO.: Lone Pine, 2 ♂, 2 ♀, VI–5–37, on *Astragalus* (C. Michener, UCR). Owens Lake, VI–4–37, on *Trifolium* (C. Michener, UCR). KERN CO.: Buttonwillow, 2 ♂, VII–25–57 (P. Opler, SS). McKittrick, 10 mi. E, 1 ♀, VI–16–54 (P. Opler, SS). Mill Potrero, 1 ♂, VII–8–59 (J. Russell, UCD). KINGS CO.: Kettleman City, 9 mi. E, 1 ♂, VI–27–59 (R. Snelling, SS). LAKE CO.: Lower Lake, 1 ♀, VIII–12–49 (J. Gillaspy, CIS). Middletown, 14 ♂, 5 ♀, IX–11–48 (P. Hurd, CIS). LOS ANGELES CO.: Lancaster, 1 ♂, VIII–17–54 (R. Snelling, SS). San Fernando Valley, 1 ♂, VIII–2–17 (R. May, CIS). Whittier, 1 ♀, X–15–11 (P. Timberlake, UCR). MADERA CO.: Madera, 1 ♀, V–5–42 (E. Linsley, CIS). Nipinnawasee, 1 ♂, VII–4–60 (R. Snelling, SS). MARIN CO.: San Rafael, 1 ♀ (F. Williams, UCR). MARIPOSA CO.: Mariposa, 1 ♀, VI–13–38 (N. Hardman, CIS). MENDOCINO CO.: Hopland Field Station, 1 ♂, 2 ♀, VII–13–55 (J. Rozen, CIS). Willits, 2 ♂, 1 ♀, VII–4–52 (W. Bentinck, CIS). MERCED CO.: Dos Palos, 1 ♂, IX–8–49, on *Solidago* (J. Gillaspy, CIS). Hilmar, 3 ♂, 1 ♀, VI–3–55, on *Phacelia distans* (P. Hurd, CIS). Livingston, 2 mi. S, 1 ♂, VIII–15–56 (R. Snelling, SS). MONTEREY CO.: Jamesburg, 1 ♂, 2 ♀, VI–10–38 (C. Michener, UCR). Mill Creek, Santa Lucia Mts., 1 ♂, VIII–8–62 (R. Van den Bosch, UCR). NAPA CO.: Mt. St. Helena, 5 ♂, IX–11–48, on *Trichostema laxum* (J. Gillaspy, CIS). ORANGE CO.: Irvine Park, 1 ♂, 2 ♀, IX–3–62 (M. Irwin, UCD). PLACER CO.: Roseville, 5 ♀, VIII–9–57 (W. Travioli, UCD). RIVERSIDE CO.: The Gavilan, 5 ♂, 1 ♀, VI–24–31 on *Lotus scoparius* (P. Timberlake, UCR). Hemet, 5 ♂, 5 ♀, VIII–17–46, on *Trichostema* (J. MacSwain, CIS). Idyllwild, 1 ♂, VI–15–40 (H. Reynolds, CIS). Perris, 1 mi. W, 2 ♂, 1 ♀, VII–2–31, on *Lotus scoparius* (P. Timberlake, UCR). Riverside, 8 ♂, 2 ♀, V–3–40, on *Phacelia ramosissima* (P. Timberlake, UCR); 2 ♂, VI–21–29, on *Lotus scoparius* (P. Timberlake, UCR); 1 ♀, VI–13–27, on *Lotus Purshianus* (P. Timberlake, UCR); 1 ♂, V–5–28, on *Marrubium vulgare* (P. Timberlake, UCR); 1 ♀, VII–18–38, on *Eriogonum gracile* (P. Timberlake, UCR); 1 ♂, VII–20–28, on *Stephanomeria exigua* (P. Timberlake, UCR); 1 ♂, VIII–8–30, on *Trichostema lanceolatum* (P. Timberlake, UCR). Temecula, 1 mi. S, 1 ♂, VII–15–63 (J. Powell, CIS). SACRAMENTO CO.: Folsom, 3 ♂, 1 ♀, V–30–52 (T. Haig, CIS). Sacramento, 1 ♀, X–24–35 (H. Keifer, UCD). SAN BENITO CO.: Idria, 8 ♂, 4 ♀, VII–5–54, on *Achillea millefolium* (E. Linsley, R. Smith, CIS). Paicines, 12 mi. S, 1 ♂, VI–15–63 (R. Langston, CIS). Pinnacles, 2 ♂, VII–2–56, on *Heliotropium curassavicum* (P. Hurd, E. Linsley, CIS). SAN BERNARDINO CO.: Big Bear Valley, 1 ♂, VIII–6–33 (P. Timberlake, UCR). Devore, 3 ♂, VI–23–35, on *Phacelia ramosissima* (P. Timberlake, UCR). SAN JOAQUIN CO.: Tracy, 2 ♂, 2 ♀, VI–25–45 (E. Linsley, CIS). SAN LUIS OBISPO CO.: Atascadero, 8 mi. W, 2 ♀, VII–3–56, on *Clarkia speciosa* (P. Hurd, E. Linsley, CIS). Nipomo, 1 ♀, VII–4–56 (P. Hurd, CIS). Paso Robles, 1 ♀, V–22–28 (L. Slevin, CAS). Santa Margarita, 5 mi. NE, 4 ♂, 1 ♀, VI–10–62, on *Trifolium obtusiflorum* (P. Hurd, CIS). Shandon, 7 mi. SW, 1 ♂, VII–4–56 (P. Hurd, CIS). SAN MATEO CO.: Crystal Lake, 1 ♂, VI–25–16 (E. Van Duzee, CAS). Milbrae, 1 ♀, IX–1–12 (F. Blaisdell, CAS). Menlo Park, 2 ♂, 2 ♀, VII–29–37 (F. Williams, UCR). SANTA BARBARA CO.: Carpinteria, 1 ♂, 1 ♀, VII–27–37 (B. White, CAS). SANTA CLARA CO.: Livermore, 20 mi. S, 1 ♂, 1 ♀, IX–14–48 (P. Hurd, CIS). Palo Alto, 3 ♂, 1 ♀, VIII–25–15, on *Cordylanthus tenius* (R. Stinchfield, CIS); 1 ♂, 3 ♀, IX–24–16, on *Verbena lasiostachys* (R. Stinchfield, CIS); 3 ♂, X–26–15, on *Trichostema lanceolatum* (R. Stinchfield, CIS). Stephens Creek, 5 ♂, 1 ♀, VIII–5–15, *Cordylanthus tenuis* (R. Stinchfield, CIS). Uvas Creek, 1 ♂, VIII–3–24 (C. Guggan, CIS). SOLANO CO.: Rio Vista, 2 ♂, V–24–49, on *Lotus* (P. Hurd, CIS); 2 ♀, VIII–9–50 (J. Gillaspy, CIS). SONOMA CO.: Monte Rio, 1 ♀, X–8–12 (UCR). Petaluma, 1 ♂, VII–6–60 (UCD). STANISLAUS CO.: Newman, 1 ♀, VII–12–57 (C. Moore, UCD). Turlock, 1 ♀, VI–3–53, on *Trifolium repens;* 1 ♀, VII–26–52, on *Wislizenia refracta;* 1 ♀, VIII–4–52, with cocoon and down from inside bamboo cane; 10 mi. SW, 1 ♂, VIII–6–51, on *Heliotropium curassavicum* (R. Snelling, SS). TRINITY CO.: Coffee Creek, 1 ♀, VI–25–29, on *Trifolium variegatum* (P. Timberlake, UCR). TULARE CO.: Porterville, 1 ♂, VI–10–59 (E. Ball, JS). Strathmore, 1 ♀, IX–30–35, on *Trichostema lanceolatum* (P. Timberlake, UCR). Three Rivers, 2 ♂, VI–10–25, on *Trifolium variegatum* (P. Timberlake, UCR). Wood Lake, 1 ♀, V–3–47 (N. Frazier, CIS).

TUOLUMNE CO.: Pinecrest, 2 ♂, VII–25–51 (R. Snelling, G. Stage, SS). Rawhide, 2 ♂, 1 ♀, VIII–10–15, on *Cordylanthus tenuis* (R. Stinchfield, CIS). Sonora, 4 mi. E, 1 ♀, V–24–53 (J. Rozen, CIS). YOLO CO.: Davis, 1 ♂, VI–12–53, on *Lathyrus splendens* (R. Snelling, SS); 10 ♂, 2 ♀, VII–31 to IX–3–61 (A. McClay, UCD); 2 ♂, 1 ♀, X–3–59 (P. Paige, UCD). Rumsey, 1 ♀, V–30–56 (R. Bohart, UCD).

The spiniform lateral lobe of tergum VII (fig. 49) distinguish the males except from *maculosum* and *bannigense* which have sternum VI differently shaped. The deeply emarginate female clypeus of *edwardsii* is found only in *placitum* and approached by pallidiclypeum. Both of the latter species have a prominent posterior marginal band on tergum VI which contrasts with the weakly defined band of *edwardsii* (fig. 79).

The coloration of the males is usually quite distinctive. The metasomal terga are typically reddish-brown with complete bright yellow bands. This reddish color varies to dark brown and less commonly black, but tergum VII is generally reddish-brown. The females have the usual black base color with yellow bands.

This species has been associated with numerous plant families and no strong preference was indicated. The only information concerning the nesting habits was the rearing of one female from inside a bamboo cane lined with down, collected at Turlock, Stanislaus Co., California.

A. edwardsii is one of the commonest species in the Central Valley of California and is also found along the Coast Range into southern California. The California records total 341 males and 185 females. About a dozen specimens have been secured near Lone Pine, Inyo Co., which represents the only known record from California for this species east of the Sierra Nevada.

Anthidium emarginatum (Say)
(Figs. 34–36, 87, 95; Map 13)

Megachile emarginata Say, 1824. In Keating, Narr. Long's 2nd Exped., 2:352 1825, appendix, 83. Type ♀, Missouri (type lost).

Anthidium atrifrons Cresson, 1868. Trans. Amer. Ent. Soc., 1:387. 4 ♀ Syntypes, New Mexico, Colorado (ANSP).

Anthidium atriventre Cresson, 1878. Trans. Amer. Ent. Soc., 7:111. Holotype ♀, California (ANSP). NEW SYNONYMY.

Anthidium saxorum Cockerell, 1904. Bull. South. Calif. Acad. Sci. 3:72. Holotype ♂, "rc" (Rock Creek, California) (AMNH). NEW SYNONYMY.

Anthidium collectum ultrapictum Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:73. Holotype ♂, Tehachapi, California (AMNH). NEW SYNONYMY.

Anthidium titusi Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:73. Holotype ♂, Fort Collins, Colorado (AMNH). NEW SYNONYMY.

Anthidium bernardinum aridum Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:76. Holotype ♂, "rc" (Rock Creek, California) (AMNH). NEW SYNONYMY.

Anthidium astragali Swenk, 1914. Nebr. Univ. Studies, 14:16; ♂, ♀. Holotype ♂, Sioux Co., Nebraska (UN). NEW SYNONYMY.

Anthidium fresnoense Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:347. Holotype ♀, Huntington Lake, Fresno Co., California (CAS). NEW SYNONYMY.

Anthidium angulatum Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:357. Holotype ♂, Huntington Lake, Fresno Co., California (CAS). NEW SYNONYMY.

Anthidium hamatum Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:358. Holotype ♂, Mt. Timpanogos, Utah (CAS). NEW SYNONYMY.

Anthidium spinosum Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:359. Holotype ♂, Fallen Leaf Lake, California (CAS). NEW SYNONYMY.

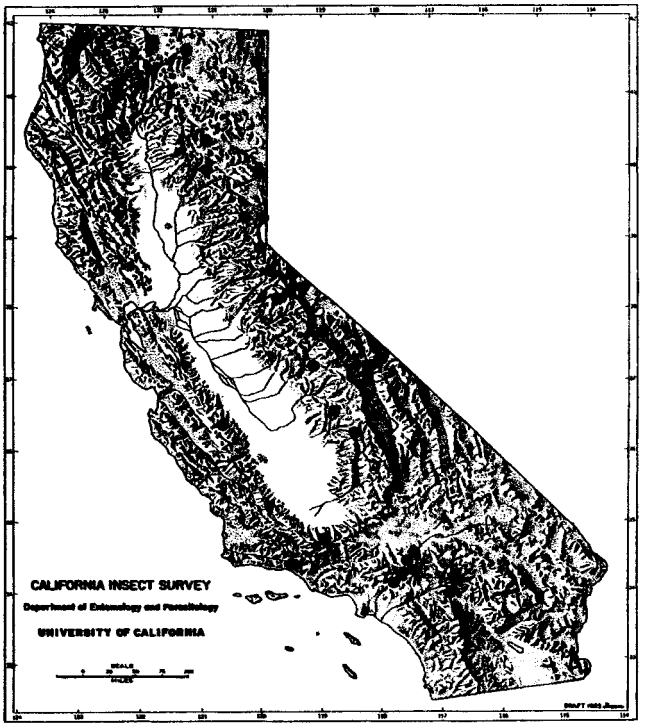
Anthidium lucidum Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:361. Holotype ♂, Huntington Lake, Fresno Co., California (CAS). NEW SYNONYMY.

Anthidium rhodophorum Cockerell, 1925. Ann. Mag. Nat. Hist., Series 9, 16:623. Holotype ♀, Colorado (AMNH). NEW SYNONYMY.

Anthidium sculleni Schwarz, 1930. Jour. New York Ent. Soc., 38:10. Holotype ♂, Wallowa Lake, Oregon (OSU). NEW SYNONYMY.

Biology.—Hicks, 1926*a*, Colo. Univ. Studies, 15:247.

Geographic range.—British Columbia, Nebraska, and Kansas, west to Washington and California.



Map 13. California distribution of *Anthidium emarginatum* (Say)

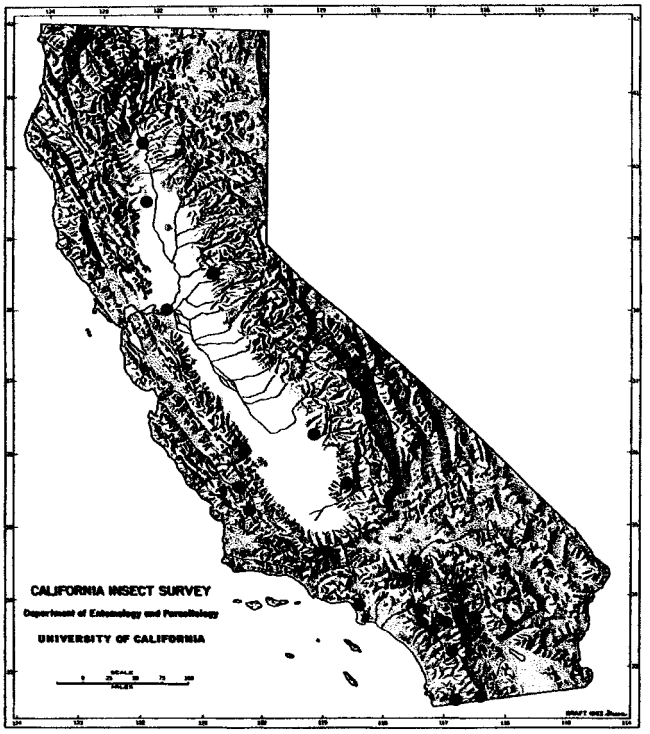
California records.—ALPINE CO.: Hope Valley, 1 ♀, VII–18–48 (P. Hurd, CIS). Kinney Reservoir, 1 ♂, VI–8–60 (G. Stage, CIS). Silver Creek, 2 ♀, VII–13–48 (R. Bohart, CIS). DEL NORTE CO.: Little Grayback Pass, 1 ♂, VII–9–58 (J. Powell, CIS). EL DORADO CO.: Echo Lake, 1 ♀, VI–21–61 (W. Middlekauff, UCR). Fallen Leaf Lake, 1 ♂, VI–11–15 (E. Van Dyke, CAS). FRESNO CO.: Huntington Lake, 2 ♂, 3 ♀, VII–1917, on *Phacelia* (I. McCracken, CIS). INYO CO.: Big Pine, 1 ♀, VI–23–37 (E. Van Dyke, CAS). Lone Pine, 10 ♂, 2 ♀, VI–5–37, on *Astragalus Bolanderi* (C. Michener, UCR). Mammoth, 1 ♀, VII–1933 (E. Linsley, UCR). Mazourka Canyon, Inyo Mts., 1 ♂, VI–1–37, on *Phacelia* (C. Michener, UCR). Westgard Pass, 1 ♂, V–17–37, on *Dalea Fremontii* (C. Michener, UCR). Wyman Canyon, White Mts., 4 ♀, VI–21–61 (J. Buckett, LACM); 3 ♀, VI–27–61, on Penstemon (J. Powell, CIS). KERN CO.: Mill Potrero, 16 ♂, 6 ♀, VII–8–59 (R. Bohart, P. Marsh, A. Menke, UCD). Searles Station, 1 ♂, V–25–49 (E. Linsley, CIS). LASSEN CO.: Hallelujah Junction, 1 ♀, VI–28–62 (M. Irwin, UCD). Snag Lake, 1 ♀, VII–5–57 (R. Schoeppner, UCD). LOS ANGELES CO.: Big Pine Camp, 15 ♂, 13 ♀, VII–17–27, on *Phacelia heterophylla, Phacelia ramosissima, Lotus argyraeus* ssp. *multicaulis, Erigeron foliosus* var. *stenophyllus* (P. Timberlake, UCR). Camp Baldy, 1 ♀, VI–26–50 (H. Hansen, CIS). Crystal Lake, 1 ♀, VI–29–50, on *Eriodictyon* (P. Hurd, CIS). MODOC CO.: Cedar Pass, 1 ♀, VI–29–58 (R. Browning, UCD). MONO CO.: Blanco's Corral, White Mts., 1 ♂, 4 ♀, VII–7–53 (J. MacSwain, CIS). Crooked Creek, White Mts., 5 ♂, 1 ♀, VI–23–61 (J. Powell, CIS). Elory Creek, 1 ♂, VII–31–58 (J. Jesson, UCD). June Lake, 1 ♂, VI–30–49 (H. Cott, UCD). Monitor Pass, 4 mi. E, 1 ♂, VI–24–62 (J. Powell, CIS). McKay Creek, Sonora Pass, 1 ♂, 2 ♀, VIII–18–60 (C. Toschi, CIS). Poison Creek, White Mts., 1 ♀, VI–26–61 (D. Miller, UCD). Rock Creek, 1 ♀, VI–23–57, on *Phacelia* (C. Michener, UCR). Sonora Pass, 7 ♀, VIII–10–60 (M. Irwin, UCD). Walker Lake, 1 ♂, VII–23–05 (CIS). NEVADA CO.: Sagehen Creek, near Hobart Mills, 1 ♂, VII–5–62 (J. Powell, CIS). PLUMAS CO.: Quincy, 4 mi. W, 3 ♂, 7 ♀, VI–26–49 (R. Bechtel, CIS). RIVERSIDE CO.: Idyllwild, 1 ♂, 1 ♀, VII–3–30, on *Phacelia californica* (P. Timberlake, UCR). SAN BENITO CO.:Idria, 1 ♂, VI–29–55, on *Phacelia* (P. Hurd, CIS). SAN BERNARDINO CO.: Big Bear Lake, 1 ♂, VII–4–34 (I. McCracken, CAS). Big Pines, 1 ♂, VI–16–25, on *Phacelia heterophylla* (P. Timberlake, UCR); 1 ♀, VII–12–37, on *Phacelia ramosissima* (P. Timberlake, UCR). Camp Baldy, 2 ♂, 3 ♀, VI–30–56 (L. Stange, LACM). Cajon Pass, 2 mi. W, 1 ♀, VI–7–58 (E. Schlinger, UCD). Forest Home, 1 ♀, VII–5–36, on *Cryptantha intermedia* (P. Timberlake, UCR). Wrightwood, 1 ♂, VI–14–59 (J. Hall, UCD). SANTA BARBARA CO.: Carpinteria, 1 ♂, VII–21–37 (B. White, CAS). SISKIYOU CO.: Mt. Shasta, 1 ♀, VIII–1–50 (LACM). Lava Beds Nat'l Mon., 2 ♀, VIII–6–63, on *Phacelia* (J. Schuh, JS). TRINITY CO.: Big Flat, Coffee Creek, 1 ♀, VI–21–34 (T. Aitken, UCR). Coffee Creek, 10 mi. N, 1 ♂, VII–15–55, on *Symphoricarpos* (J. MacSwain, CIS). TULARE CO.: Mineral King, 1 ♀, VIII–4–22 (C. Fox, CAS). TUOLUMNE CO.: Blue Canyon, Sonora Pass, 3 ♂, 1 ♀, VIII–18–60 (A. Menke, UCD). Sonora Pass, 1 ♀, VII–11–51 (J. MacSwain, CIS).

A. emarginatum is one of the most difficult species to distinguish in California since it presents a considerable amount of variation. The setal brush of the males varies in color from nearly all black to reddish-black. However, the presence of a well-developed lateral and median lobe on sternum VI (fig. 35) together with the lateral lobe of tergum VII (fig. 34, mean width subequal to distance from center spine) will serve to separate the males from all other species except *dammersi* and *mormonum*. The median lobe of sternum VI is much narrower than in *mormonum* and not parallel-sided as in *dammersi*. In addition, the setal brush of *emarginatum* is always darker than in *mormonum*.

The females of *emarginatum, tenuiflorae,* and *dammersi* also pose problems in recognition. The convex clypeus of *emarginatum* (fig. 95) separates it from the rather flat clypeus of *tenuiflorae* (fig. 96), and the convex tergum VI of *emarginatum* differs from the relatively straight one of *dammersi*. The key utilizes color, and *emarginatum* is conspicuously variable in this regard. To overcome the difficulty, *emarginatum* is keyed out twice. This is necessary since *emarginatum* in southern California has much larger pale maculations including a nearly all yellow clypeus as opposed to the dark clypeus in northern California. In addition, the southern California populations are bright yellow in contrast to the paler northern California populations. The color patterns of the two extremes are conspicuously different when compared; however, since sufficient intergradation in intermediate localities (Inyo Co.) exists, division into subspecies does not appear to be warranted. This increase of maculation in southern California is found in several other species, such as in *tenuiflorae* and *atripes*, although not as extreme.

A. emarginatum is a fairly common species as indicated by widespread records of 148 males and 156 females. The species prefers montane environments and is found in nearly all the major mountain ranges of California except the north-central part of the Coast Range.

A. emarginatum has been recorded visiting plants in six families but was most frequently collected on *Phacelia* in the Hydrophyllaceae. Hicks (1926a) observed a female of *emarginatum* collecting down from stems of *Cirsium undulatum* in Colorado. Down nests and larvae collected by E. Jaycox are shown in figure 214. The only record of parasitism of *emarginatum* was by *Leucospis affinis* Say according to Graenicher (1906).



Map 14. California distribution of *Anthidium jocosum* Cresson

Anthidium jocosum Cresson

(Figs. 58–60, 82, 98; Map 14)

Anthidium jocosum Cresson, 1878. Trans. Amer. Ent. Soc., 7:111. Holotype ♂, Colorado (ANSP).

Anthidium xanthognathum Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:347. Holotpe ♀, Mokelumne Hill, California (CAS). NEW SYNONYMY.

Anthidium fontis Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:348, ♂, ♀. Holotype ♂, Soboba Springs, Riverside Co., California (CAS). NEW SYNONYMY.

Geographic range.—Sonora (Mexico), California, Colorado, Montana.

California records.—EL DORADO CO.: El Dorado, 1 ♀, VI–2–63 (R. Westcott, UCD). FRESNO CO.: Borroughs Valley, 1 ♂, VI–22–56, on *Penstemon* (R. Snelling, SS). Coalinga, 4 mi. W, 2 ♀, V–11–38, on *Hemizonia* (P. Timberlake, UCR). GLENN CO.: Artois, 2 ♂, 3 ♀, VI–12–52, on *Lotus* (J. MacSwain, CIS); 1 ♀, VI–12–52, on *Trifolium repens* (J. MacSwain, CIS). KERN CO.: Glennville, 1 ♂, IV–22–50 (R. Bohart, UCD). Kernville, 11 mi. SW, 1 ♀, V–5–36, on *Haplopappus Cooperi* (E. Linsley, CIS). LOS ANGELES CO.: Griffith Park, 1 ♀, IV–5–36, on *Baeria* (E. Linsley, CIS). MADERA CO.: Millerton Lake, 1 ♂, 1 ♀, V–15–65 (A. Menke, L. Stange, UCD). RIVERSIDE CO.: Andreas Canyon, 1 ♂, IV–14–46, on *Eriogonum fasciculatum* (P. Timberlake, UCR). Cabazon, 1 ♂, 1 ♀, V–1 to VI–1–44 (E. Van Dyke, CAS). Chino Canyon, 1 ♂, IV–20–60, on *Eriogonum fasciculatum* (J. Powell, UCD). Gilman Hot Springs, 1 ♂, VI–10–41 (E. Van Dyke, CAS). Keen Camp, 8 mi. W, San Jacinto Mts., 4 ♂, V–16–39, on *Lotus, Eriodictyon* (E. Linsley, R. Smith, CIS). Lake Mathews, 1 ♀, IV–14–60, on *Phacelia* (P. Timberlake, UCR). Palm Springs, 1 ♀, III–29–26 (C. Fox, CAS). Riverside, 1 ♂, V–25–25, on *Gutierrezia californica* (P. Timberlake, UCR); 1 ♀, V–8–34, on *Marrubium vulgare* (P. Timberlake, UCR); 1 ♂, 1 ♀, V–11–29, on *Eriogonum fasciculatum* (P. Timberlake, UCR); 1 ♂, 3 ♀, V–24–29, on *Phacelia ramosissima* (P. Timberlake, UCR); 7 ♂, VI–15–33, on *Eriastrum plurifolium* (P. Timberlake, UCR); 20 ♂, 6 ♀, VI–24–32, on *Lotus scoparius* (P. Timberlake, UCR). Soboba Springs, 1 ♂, VI–1–17 (E. Van Duzee, UCR). Tahquitz Canyon, 1 ♂, 1 ♀, IV–22–63 (F. Parker, L. Stange, UCD). The Gavilan, 1 ♂, IV–18–37, on *Oenothera* (E. Linsley, CIS); 1 ♀, VI–21–38, on *Lotus scoparius* (P. Timberlake, UCR). SAN BERNARDINO CO.: Adelanto, 10 mi. S, 1 ♀, V–28–32, on *Eriogonum fasciculatum* (P. Timberlake, UCR). Cajon Pass, summit, 1 ♀, V–26–38 (C. Dammers, UCR). Phelan, 2 mi. W, 1 ♀, VI–7–58 (E. Schlinger, UCD). Victorville, 8 mi. S, 1 ♀, V–22–32, on *Larrea divaricata* (P. Timberlake, UCR). SAN DIEGO CO.: Jacumba, 1 ♀, V–13–56 (R. Snelling, SS). Mt. Palomar, 1 ♀, VI–19–50 (F. Williams, CAS). Tecate Peak, 1 ♀, VII–10–63 (R. Langston, CIS). SAN LUIS OBISPO CO.: Shandon, 7 mi. W, 1 ♀, IV–24–60 (J. Chemsak, CIS). Simmler, 10 mi. W, 2 ♂, V–3–62 (J. Powell, CIS). SHASTA CO.: Anderson, 1 ♂, V–29–52 (J. Rozen, SS). SOLANO CO.: Rio Vista, 1 ♂, V–24–49, on *Lotus* (E. Linsley, CIS). TULARE CO.: Wood Lake, 1 ♂, 3 ♀, IV–13 to V–3–47 (N. Frazier, CIS). VENTURA CO.: Hungry Valley, 5 mi. S Gorman, 1 ♂, 1 ♀, V–6–59, on *Haplopappus Cooperi* (P. Hurd, CIS); 1 ♀, V–4–57, on *Salvia pachyphylla* (J. Powers, CIS).

These small bees have a base color that is dark brown to black and markings that are yellow. The very broad lateral lobe of the male tergum VII (fig. 58) with the posterior margin subtruncate is diagnostic for the males except for *utahense*. The weakly developed lateral lobe of sternum VI (fig. 59) and weakly differentiated yellowish setal brush provides characteristics to separate it from *utahense*. The females have the clypeus nearly all black with contrasting yellow mandibles. Except for *cockerelli*, this combination is fairly distinctive for females. The five-toothed mandible of *jocosum* (fig. 98) differentiates is from *cockerelli* and most other species of *Anthidium* in California.

The California distribution of *jocosum* is mainly along the foothills of the Sierra Nevada and Coast ranges, and southern California. Collections totaling 70 males and 70 females show it to be associated with a wide variety of plants with no strong preference indicated.

Anthidium maculosum Cresson

(Figs. 7, 9, 71; Map 15)

Anthidium maculatum Smith, 1854. Cat. Hym. Brit. Mus., 2:216. Holotype ♂, Mexico (BMNH). Preocc.

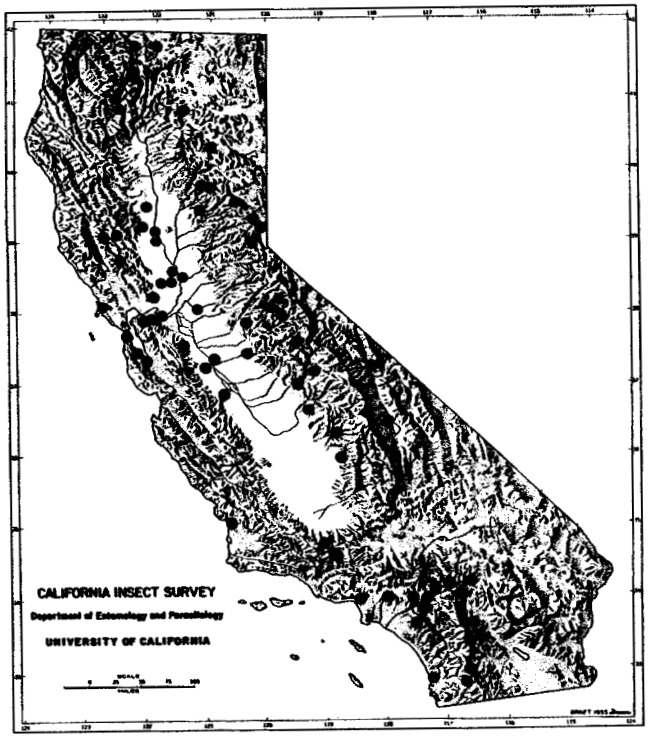
Anthidium maculosum Cresson, 1878. Trans. Amer. Ent. Soc., 7:110. Holotype ♀, Utah (ANSP).

Anthidium lupinellum Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:58. Holotype ♂, Pecos, New Mexico (AMNH).

Anthidium americanum Friese, 1911. Das Tierreich, 28:395; n.n. for *A. maculatum* Smith.

Biology.—Parker and Bohart, 1966, Pan-Pac. Ent. 44(2):95.

Geographic range.—South Dakota, Colorado, Texas, west to Oregon, California, Mexico.



Map 15. California distribution of *Anthidium maculosum* Cresson

California records.—BUTTE Co.: Clipper Mills, 1 ♀, VIII–21–57 (T. Haig, UCD). COLUSA Co.: Colusa, 1 ♀, VIII–15–55 (R. Schuster, CIS). Ladoga, 2 ♀, VII–12–55 (H. Moffitt, UCD). Sycamore, 6 ♂, 1 ♀, VII–16, on *Stachys* (R. Stinchfield, CIS). CONTRA COSTA Co.: Antioch, 6 ♂, 11 ♀, V–24 to IX–25 (CAS, CIS, UCD, UCR, SS). Pittsburg, 4 mi. S, 1 ♀, VII–8–55 (P. Opler, SS). Pleasant Hill, 1 ♂, IX–12–55 (P. Opler, SS). EL DORADO Co.: Kyburz, 5 ♂, 1 ♀, VIII–23–50 (W. Ehrhardt, CIS). FRESNO Co.: Huntington Lake, 2 ♂, VII–27–19 (Van Duzee, CAS); 1 ♂, VII–17, on *Phacelia* (I. McCracken, CIS). Friant, 1 ♂, 1 ♀, X–11–56 (E. Louis, SS). GLENN Co.: Artois, 1 ♂, VII–20–52 (H. Hansen, CIS). INYO Co.: Bishop, 10 mi. NW, 1 ♀, VI–30–61 (J. Powell, CIS). Lone Pine, 1 ♂, 1 ♀, VI–7–37 (E. Van Dyke, CAS). Whitney Portal, 1 ♂, VII–3–54 (H. Nakahara, UCR). KERN Co.: Frazier Park, 2 ♀, VII–15–61 (C. O'Brien, LACM). LAKE Co.: Bartlett Springs, 1 ♀, VII–12–55 (W. Lange, UCD). Lakeport, 1 ♂, VIII–23–57 (S. Fidel, UCD). Middletown, 1 ♀, IX–11–48, on *Trichostema* (I. Gillaspy, CIS). Soda Bay, 2 ♂, 3 ♀, IX–29–40 (E. Van Dyke, CAS). LASSEN Co.: Bridge Creek Camp, 1 ♀, VII–12–54 (A. Grigarick, UCD). LOS ANGELES Co.: Gorman, 4 ♂, 2 ♀, VII–13–56, on *Stachys bullata* (P. Hurd, CIS). Tanbark Flat, 1 ♂, VI–29–52 (J. Menn, CIS). West Hollywood, 1 ♂, VIII–15–49 (R. Howell, CIS). MARIN Co.: Inverness, 1 ♀, VI–21–54 (C. Toschi, CIS). MARIPOSA Co.: Yosemite Valley, 1 ♂, 2 ♀, VI–27–36, on *Lotus nevadensis* (P. Timberlake, UCR). MERCED Co.: Dos Palos, 1 ♀, IX–4–48 (CIS). Merced Falls, 1 ♂, IX–3–55, (R. Bohart, UCD). ORANGE Co.: Trabuco Canyon, 1 ♀, VII–13–58 (M. Irwin, UCD). PLACER Co.: Carnelian Bay, 1 ♀, VIII–22–55 (R. Bohart, UCD). Lake Forest, 1 ♀, VIII–25–55 (E. Linsley, CIS). Squaw Valley, 1 ♀, VI–20 (G. Butler, SS). PLUMAS Co.: Meadow Valley, 3 ♀, VII–6–24 (Van Dyke, CAS). Quincy, 4 mi. W, 4 ♂, 3 ♀, VII–3 to 30–49 (D. Cox, J. MacSwain, P. Hurd, CIS). RIVERSIDE Co.: Banning, 1 ♂, VIII–5–24 (E. Van Duzee, CAS). Corona, 1 ♂, X–17–60 (UCR). Dark Creek, San Jacinto Mts., 2 ♂, 1 ♀, on *Lotus Davidsonii* (P. Timberlake, UCR). Idyllwild, 1 ♀, VI–9–40, on *Lotus scoparius* (C. Michener, CIS); 1 ♂, V–29–40, on *Arctostaphylos* (CIS). Pinyon Flat, 1 ♂, VI–18–41 (E. Van Dyke, CAS). Riverside, 2 ♂, 11 ♀, VI–14–36, on *Phacelia ramosissima* (P. Timberlake, UCR). Santa Rosa Peak, San Jacinto Mts., 1 ♀, VI–8–40, on *Lotus Davidsonii* (C. Michener, CIS). Saunders Meadows, San Jacinto Mts., 1 ♀, VI–9–40, on *Astragalus Douglasii* var. *Parishii* (P. Timberlake, UCR); 2 ♂, VI–9–40, on *Lotus Davidsonii* (P. Timberlake, UCR). SACRAMENTO Co.: Sacramento, 1 ♀, X–21–35 (H. Keifer, UCD). SAN BERNARDINO Co.: Barton Flats, 1 ♂, 1 ♀, VIII–3–42 (A. Melander, UCR). Big Bear Valley, 1 ♂, VIII–8–33, on *Lotus argophyllus* (P. Timberlake, UCR). Forest Home, 1 ♀, VIII–20–44 (A. Melander, UCR). Lake Arrowhead, 4 ♂, 1 ♀, VIII–19–60 (P. Page, UCD). Mill Creek, San Bernardino Mts., 6 ♂, 2 ♀, IX–1–47, on *Chrysopsis villosa* (P. Timberlake, UCR). Oak Glen, 1 ♀, VII–6–60 (D. Miller, UCD). Upper Santa Ana River, 1 ♂, 1 ♀, VIII–30–46, on *Senecio conophyllus* (G. & J. Sperry, CIS). SAN DIEGO Co.: Del Mar, 2 ♀, VII–1–63 (R. Langston, CIS). Julian, 1 ♂, 1 ♀, VII–10–62 (D. Miller, UCD). Mt. Laguna, 1 ♂, 1 ♀, VI–21–63, on *Lotus strigosus* var. *hirtellus* (P. Hurd, CIS). SAN FRANCISCO Co.: San Francisco, 1 ♀, VII–17–50 (R. Sommer, UCD). SAN JOAQUIN Co.: Tracy, 8 mi. SW, 1 ♀, VI–9–59 (M. Wasbauer, CIS). SAN LUIS OBISPO Co.: Grover City, 3 ♂, VII–4–56, on *Phacelia* (P. Hurd, CIS). SAN MATEO Co.: Redwood City, 2 ♂, 2 ♀, VIII–18–56 (R. Snelling, SS). SANTA CLARA Co.: Palo Alto, 1 ♀, VI–6–59, on *Verbena hastata* (P. Arnaud, SS). SHASTA Co.: Cassel, 1 ♀, VII–15–55, on *Aster* (J. MacSwain, CIS). SIERRA Co.: Gold Lake, 1 ♀, VII–8–54 (G. Schaefers, CIS). SISKIYOU Co.: Gazelle, 7 mi. W, 1 ♂, VII–25–54 (J. Powell, CIS). Macdoel, 1 ♀, VII–23–63, on *Cirsium* (J. Schuh, JS). Montague, 1 ♀, VII–12–63, on *Lotus* (J. Schuh and P. Irwin, JS). SOLANO Co.: Green Valley, 1 ♀, VI–18–53 (R. Bechtel, UCD). STANISLAUS Co.: Newman, 1 ♀, VIII–8–56 (C. Moore, UCD). Turlock, 1 ♂, 1 ♀, IX–15–51, on *Antirrhinum* (R. Snelling, SS). TRINITY Co.: Carrville, 1 ♀, VI–29–31 (E. Van Dyke, CAS). Trinity Center, 7 mi. S, 1 ♀, VII–26–54 (J. Powell, CIS). TULARE Co.: Porterville, 1 ♂, 3 ♀, VI–29–59 (E. Ball, JS). Three Rivers, 2 ♀, VII–29–23 (C. Fox, CAS). TUOLUMNE Co.: Dardanelle, 1 ♀, VII–19–61 (J. Powell, CIS). Kennedy Meadows, 2 ♂, VII–30–54 (A. Grigarick, UCD). Rawhide, 1 ♀, VII–25–15, on *Stachys albens* (R. Stinchfield, CIS). Strawberry, 1 ♀, VII–15–53, 2 ♂, VIII–3–60 (J. Rozen, C. Toschi, CIS). YOLO Co.: Davis, 21 ♂, 28 ♀, VI–7 to X–22, 1928 to 1962 (numerous collectors, CIS, UCD). Woodland, 1 ♀, VII–17–55 (A. McClay, UCD).

A. maculosum is the most distinctive species of the

genus in California. The sparse macropunctation of the frons and elongate antennal segment III are diagnostic, as are the female tergum VI (fig. 71) and male sterna VI and VIII (figs. 8, 9). The shape of the male tergum VII (fig. 7) is somewhat similar to *bannigense*. *A. maculosum* is frequently collected (109 ♂, 134 ♀), and the distribution in California is widespread although the species is not found in desert regions. It occurs as far south as southern Mexico.

Records of *maculosum* show an association with many species in seven plant families, with a slight preference indicated for the legume genus *Lotus*.

Parker and Bohart (1966) found the nest of this species (fig. 217) in an elderberry stem near Verdi, Nevada. The parasitoid *Leucospis affinis* Say was reared from the nest.

Anthidium mormonum Cresson

(Figs. 43–45, 80, 92; Map 16)

Anthidium mormonum Cresson, 1878. Trans. Amer. Ent. Soc., 7:110. Holotype ♂, Utah (ANSP).

Anthidium blanditum Cresson, 1879. Trans. Amer. Ent. Soc., 7:206. 2 Syntype ♀, Nevada (ANSP).

Anthidium pondreum Titus, 1902, Ent. News 13:169. Holotype ♂, Fort Collins, Colo. (Purdue U.) NEW SNNONYMY.

Anthidium pecosense Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:74. Holotype ♂, Pecos, New Mexico (UCR). NEW SYNONYMY.

Anthidium bernardinum var. *wilsoni* Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:75. Holotype ♂, Mt. Wilson, California (AMNH). NEW SYNONYMY.

Anthidium bernardinum var. *fragariellum* Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:76. Holotype ♂, Strawberry Valley, California (AMNH). NEW SYNONYMY.

Anthidium blanditum praedentatum Cockerell, 1907. Entomologist, 40:99. Holotype ♀, Boulder, Colorado (AMNH).

Anthidium wallisi Cockerell, 1913. Can. Ent., 45:13. Holotype ♀, Peachland, British Columbia (Can. Nat. Coll., Ottawa). NEW SYNONYMY.

Anthidium praedentatum trianguliferum Swenk, 1914. Nebr. Univ. Studies, 14:18. Holotype ♀, Fort Garland, Costilla County, Colorado (UN).

Anthidium nebrascense Swenk, 1914. Nebr. Univ. Studies, 14:14, ♂, ♀. Holotype ♂, Sowbelly Canyon, Sioux County, Nebraska (UN). NEW SYNONYMY.

Anthidium flavicaudum Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:359. Holotype ♂, Sisson, California (CAS). NEW SYNONYMY.

Anthidium wyomingense Schwarz, 1927. Amer. Mus. Novitates, 252:20. Holotype ♀, Jackson, Wyoming (AMNH). NEW SYNONYMY.

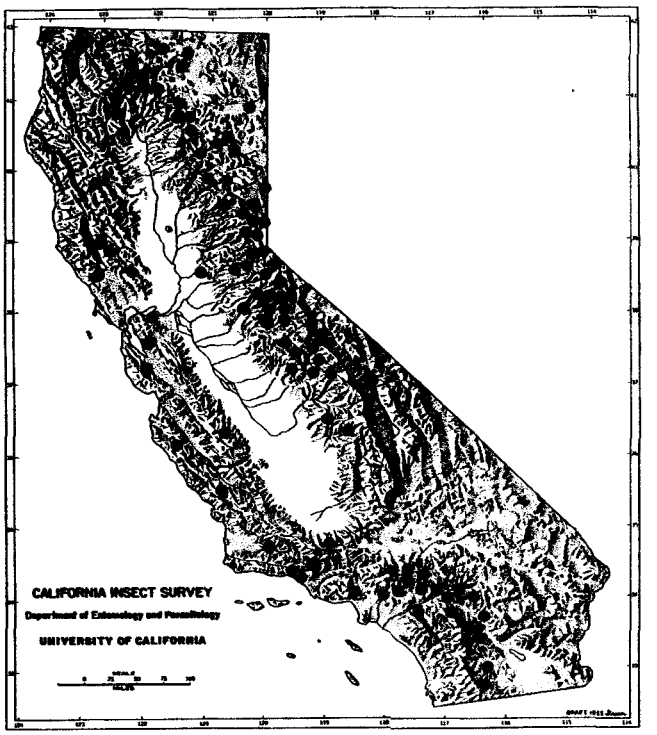
Anthidium mormonum hicksi Schwarz, 1934. Amer. Mus. Novitates, 743:4. Holotype ♀, Pasadena, California (AMNH). NEW SYNONYMY.

Anthidium wallisi wallowana Schwarz, 1940. Amer. Mus. Novitates, 1058:5. Holotype ♀, Wallowa National Forest, Oregon (OSU). NEW SYNONYMY.

Biology.—Hicks, 1929, Ent. News, 40:105–110.

Geographic range.—British Columbia, south to Baja California, east to New Mexico, Colorado, Nebraska, Wyoming, and Montana.

California records.—ALAMEDA CO.: Piedmont, 1 ♀, VI–19–12 (F. Nunenmacher, CIS). ALPINE CO.: Fredericksburg, 1 ♂, VI–18–58 (W. Middlekauff, CIS). Lake of the Woods, 1 ♀, VI–26–39 (R. Bohart, CIS). Red Lake, 1 ♂, VII–16–62 (M. Irwin, UCD). Woodfords, 1 ♂, 1 ♀, VI–9–60 (F. Strong, UCD). BUTTE CO.: Jarboe Pass, 1 ♀, V–12–49 (P. Hurd, CIS). CALAVERAS CO.: Dorrington, 1 ♀, VI–11–52, on *Libocedrus decurrens* (B. Adelson, H. Ruckes, CIS). Murphys, 1 ♂, VI–16–35 (SS). CONTRA COSTA CO.: Antioch, 1 ♂, V–24–49, on *Lotus* (P. Hurd, CIS). DEL NORTE CO.: Smith River Camp, 1 ♂, VII–22 (CIS). EL DORADO CO.: Echo Summit, 1 ♂, VIII–4–57 (T. Haig, UCD). Fallen Leaf



Map 16. California distribution of *Anthidium mormonum* Cresson

Lake, 1 ♀, VI–26–15 (E. Van Dyke, CAS). Kyburz, 1 ♂, VII–10–50 (W. Ehrhardt, CIS). Meyers, 2 ♂, VII–24–55 (E. Schlinger, UCD). Pollock Pines, 1 ♀, V–31–54 (E. Schlinger, UCD). Snowline Camp, 11 ♂, 3 ♀, VI–27 to VII–7–58, on *Phacelia* (P. Hurd, CIS). FRESNO CO.: Florence Lake, 1 ♂, VIII–29–52 (E. Schlinger, UCD). Huntington Lake, 4 ♂, 1 ♀, VII–19–17 (I. McCracken, CIS). Shaver Lake, 1 ♂, VIII–8–56 (R. Schuster, CIS). INYO CO.: Big Pine Creek, 1 ♀, V–19–47 (R. Bohart, UCD). KERN CO.: Mill Potrero, 8 ♂, 4 ♀, VII–6–59 (R. Bohart, F. Parker, A. Menke, UCD). LAKE CO.: Hopland Grade, 1 ♀, V–23–61 (S. Fidel, UCD). Mt. Konocti, 1 ♂, VI–9–55 (R. Bohart,

UCD). LASSEN CO.: Bridge Creek Camp, 46 ♂, 24 ♀, VII–4–49 (numerous coll., CIS, UCD, UCR). Hallelujah Junction, 1 ♂, VII–4–49 (R. Sisson, CIS). Splaudings, 1 ♀, VI–28–49 (E. Atkinson, CIS). Susanville, 1 ♀, VII–15–11 (CIS). Termo, 1 mi. W, 1 ♀, VI–10–60 (R. Thorp, CIS). LOS ANGELES CO.: Big Pines Camp, 7 ♂, 2 ♀, VI–12–27, on *Lotus Davidsonii, Phacelia ramosissima* (P. Timberlake, UCR). Camp Baldy, 1 ♀, VII–11–50 (A. McClay, UCD). Crystal Lake, VI–28–56, (R. Bohart, UCD). Pearblossom, 5 mi. S, 1 ♀, IV–28–56, on *Stenotopsis linearifolius* (E. Linsley, CIS). San Dimas Canyon, 1 ♂, V–19–35 (K. Holland, SS). Swarthout Canyon, 1 ♀, VI–3–28, on *Phacelia heterophyllus* (P. Timberlake, CIS). Tanbark Flat, 3 ♂, 1 ♀, VIII–13–52 (A. McClay, UCD). Westwood Hills, 1 ♂, 1 ♀, V–24–39 (SS). MADERA CO.: Agnew Meadows, 1 ♀, VIII–30–60 (R. Bohart, CIS). Bass Lake, 2 ♂, 2 ♀, VI–6–38 (N. Hartman, CIS). Nipinnawasee, 2 mi. N, VII–4–60 (R. Snelling, SS). MARIPOSA CO.: Yosemite Valley, 2 ♂, 1 ♀, VI–27–26, on *Lotus nevadensis* (P. Timberlake, UCR). MENDOCINO CO.: Twin Rocks, 1 ♂, VII–40–29 (E. Van Dyke, CAS). MODOC CO.: Buck Creek, 1 ♂, 1 ♀, VII–25–22 (C. Fox, CAS). Davis Creek, 1 ♂, VII–14–22 (C. Fox, CAS). Newell, 1 ♂, VII–13–63, on alsike clover (J. Schuh, JS). MONO CO.: Crooked Creek, White Mts., 9500 ft., 1 ♂, VII–4–61, (R. Thorp, CIS). Lee Vining, 1 ♀, VII–2–57 (E. Jessen, UCD). June Lake, 1 ♀, VI–30–49 (H. Cott, UCD). Sonora Pass, 1 ♀, VIII–10–60 (M. Irwin, UCD). NAPA CO.: Samuel Springs, 2 ♂, V–18–55 (E. Schlinger, UCD). NEVADA CO.: Boca, 3 ♂, VII–18–62 (M. Irwin, F. Parker, UCD). Fuller Lake, 2 ♂, VII–15–61, on *Phacelia* (A. Menke, UCD). Sagehen Creek, 1 ♂, 2 ♀, VI–29–62, on *Phacelia Pringlei* (M. Irwin, UCD). PLACER CO.: Bear Valley, 2 ♂, 1 ♀, VII–4–56 (R. Snelling, LACM). Carnelian Bay, Lake Tahoe, 1 ♂, 1 ♀, VII–8–59 (R. Bohart, UCD). PLUMAS CO.: Bucks Lake, 1 ♀, VII–1–49 (E. Schlinger, UCD). Chester, 8 mi. NW, 1 ♀, VIII–18–56, on *Chrysothamnus* (E. Lindquist, CIS). Johnsville, 1 ♂, 1 ♀, VII–8–54 (R. Bohart, UCD). Lake Almanor, 1 ♂, VII–8–49 (R. Bechtel, UCD). Meadow Valley, 3 ♂, 1 ♀, VI–14–28 (E. Van Dyke, CAS). Quincy, 4 mi. W, VI–20 to VII–16–49, 36 ♂, 12 ♀, on *Phacelia* (P. Hurd, CIS). RIVERSIDE CO.: Dark Canyon, San Jacinto Mts., 5 ♂, 1 ♀, VI–21–40, on *Lotus Davidsonii* (C. Michener, UCR). Fern Basin, San Jacinto Mts., 2 ♂, VI–15–40, on *Lotus Davidsonii* (C. Michener, CIS). Gilman Hot Springs, 1 ♀, III–9–63 (P. Marsh, UCD). Hemet Reservoir, 1 ♂, VI–13–39, on *Cryptantha* (E. Ross, CAS). Idyllwild, 5 ♂, 1 ♀, VI–9–40, on *Lotus Davidsonii* (P. Timberlake, UCR); 2 ♂, VI–9–40, on *Lotus scoparius* (P. Timberlake, UCR); 5 ♂, 4 ♀, VII–22–33, on *Lotus argophyllus* (P. Timberlake, UCR). Keen Camp, San Jacinto Mts., 3 ♂, 1 ♀, VI–10–39 (E. Ross, E. Linsley, CIS). Pine Cove, San Jacinto Mts., 6 ♂, 1 ♀, VI–3–39, on *Lotus Davidsonii* (P. Timberlake, UCR); 1 ♂, VI–4–39, on *Ceanothus* (E. Ross, CIS). Riverside, 1 ♀, VI–4–36, on *Phacelia ramosissima* (P. Timberlake, UCR); 3 ♂, V–21 to VI–33, on *Lotus scoparius, Phacelia ramosissima* (P. Timberlake, UCR). Santa Rosa Peak, 7,500 ft., 2 ♂, 1 ♀, VI–8–40, on *Lotus Davidsonii* (P. Timberlake, UCR). Tahquitz Canyon, 1 ♀, VI–30–28 (E. Van Dyke, CAS). Santa Rosa Mt., 2 ♂, 1 ♀, VI–18–40, on *Lotus Davidsonii* (C. Michener, CIS). SACRAMENTO CO.: Folsom, 2 ♂, 2 ♀, V–18–52 (T. Haig, UCD). SAN BENITO CO.: Idria, 2 ♂, VI–2–62 (M. Irwin, A. Menke, UCD). SAN BERNARDINO CO.: Barton Flats, 1 ♀, VIII–3–47 (A. Melander, UCR). Big Bear Valley, 6 ♂, 2 ♀, VII–7–34, on *Lotus argophyllus* (P. Timberlake, UCR); 1 ♂, IX–14–34, on *Phacelia heterophylla* (P. Timberlake, UCR). Crestline, 1 ♂, V–23–36 (E. Linsley, CIS). Forest Home, 2 ♂, VII–5–36, on *Cryptantha intermedia* (P. Timberlake, UCR). Cajon Pass, 2 mi. W, 1 ♂, 1 ♀, VI–7–38 (J. Hall, E. Schinger, UCD). Lake Arrowhead, 1 ♂, VII–16–33, on *Lotus argophyllus* (P. Timberlake, UCR). Lytle Creek, 1 ♀, VII–4–28, on *Eriogonum fasciculatum* (P. Timberlake, UCR). Morongo Valley, 1 ♂, IV–12–60, on *Lotus* (R. Snelling, SS). Wildwood Canyon, 2 ♀, VII–13–57 (J. Hall, UCD). Wrightwood, 4 ♂, 7 ♀, VI–14–59 (J. Hall, UCD). SAN DIEGO CO.: Mt. Laguna, 4 ♂, 2 ♀, VI–21–63, on *Lotus strigosus* (P. Hurd, CIS). SAN LUIS OBISPO CO.: Creston, 2 mi. S, 1 ♂, IV–10–61 (J. Chemsak, CIS). SANTA BARBARA CO.: Carpinteria, 3 ♂, VII–21–37 (B. White, CAS). SANTA CRUZ CO.: Mt. Hermon, 1 ♂, VII–30–32 (F. Blaisdell, CAS). SHASTA CO.: Burney, 5 mi. E, 1 ♂, 1 ♀, V–9–41 (C. Michener, CIS). Hat Creek, 3 mi. N, 2 ♂, VI–4–41, on *Phacelia* (C. Michener, CIS). Moose Camp, 2 ♂, 1 ♀, VII–6–53 (A. Grigarick, UCD). Snow Mt. Road, 1 ♂, VII–14–55 (C. Hanson, CIS). Vida, 1 ♂, VI–27–47 (C. Hanson, CIS). SIERRA CO.: Sierraville, 1 ♀, VIII–26–48 (R. Smith, CIS). Independence Lake, 2 ♂, 1 ♀, VI–26–59 (L. Stange, UCD). Gold Lake, 4 ♂, VII–13–21 (C. Fox, CAS). Sardine Lakes, 1 ♂, VII–31–58 (F. Strong, UCD). Webber Lake, 1 ♀, VII–2–59 (E. Linsley, CIS). SISKIYOU CO.: Macdoel, 2 ♂, 1 ♀, VII–2–63, on *Phacelia* (J. Schuh, JS); 2 ♂, VII–23 to 30–63, on *Trifolium repens* (J. Schuh, JS). McCloud, 1 ♀, VI–22–14 (E. Van Dyke, CAS). Medicine Lake, 3 mi. N, 1 ♀, VIII–6–63 (J. Schuh, JS). Montague, 2 ♀, VIII–11–63 (J. Schuh, JS). Mt. Bradley, 1 ♂, VI–18–20 (J. Schuh, JS). Valentine Caves, Lava Bed National Mon., 2 ♂, 2 ♀, VI–30–63 (V. Vesterby, UCD). SONOMA CO.: Guerneville, 1 ♀, V–30–10 (E. Van Dyke, CAS). TRINITY CO.: Carrville, 1 ♂, VI–17–13 (E. Van Dyke, CAS). Coffee Creek, 1 ♂, VII–14–55 (J. MacSwain, CIS). Scott Mt., 5350 ft., 2 ♂, VII–15–35 (R. Bohart, UCD). Trinity Center, 1 ♀, VII–10–53 (A. McClay, UCD). TULARE CO.: Giant Forest, 1 ♂, VII–22–33 (C. Fox, CAS). Wood Lake, 1 ♀, IV–13–47 (N. Frazier, CIS). TUOLUMNE CO.: Chipmunk Flat, 2 ♂, VIII–9–60 (C. Toschi, E. Jessen, CIS). Columbia, 5 mi. N, 1 ♀, IV–29–52, on *Penstemon* (R. Snelling, SS). Dardanelle, 1 ♀, VIII–26–51 (A. McClay, UCD). Dodge Ridge, 1 ♂, VII–13–61 (E. Schlinger, UCD). Lake Tenaya, 1 ♂, 2 ♀, VII–20–58 (A. Telford, UCD). Tuolumne Meadows, 1 ♂, 1 ♀, VIII–21–58 (A. Telford, UCD). Leland Meadow, 1 ♂, 1 ♀, VIII–5–60 (E. Jessen, CIS). Mather, 2 ♂, 3 ♀, VI–8–61 (M. Irwin, UCD). Pinecrest, 5 mi. W, 1 ♂, VI–30–57, on *Lotus* (R. Snelling, SS). Strawberry, 1 ♂, VII–10–53, on *Lotus* (J. Rozen, CIS); 1 ♂, VI–27–51, on *Phacelia* (E. Linsley, J. MacSwain, CIS). Sonora Pass, 1 ♀, VII–11–15 (J. MacSwain, CIS). Twain-Harte, 1 ♀, VII–37 (F. Blaisdell, CAS). Yosemite National Park, 1 ♀, VII–7–47 (A. Melander, UCR). VENTURA CO.: Foster Park, 2 ♀, VII–1–59 (F. Parker, P. Paige, UCD). Lockwood Valley, 1 ♀, V–5–59, on *Phacelia ciliata* (P. Timberlake, UCR).

The females of *mormonum* have a distinctive tergum VI which consists of a prominent truncate posterior marginal band that is posterior to, and widely separated from, the dorsolateral border (fig. 80). There is no single character for identifying the males; but the combination of a reddish setal brush and the

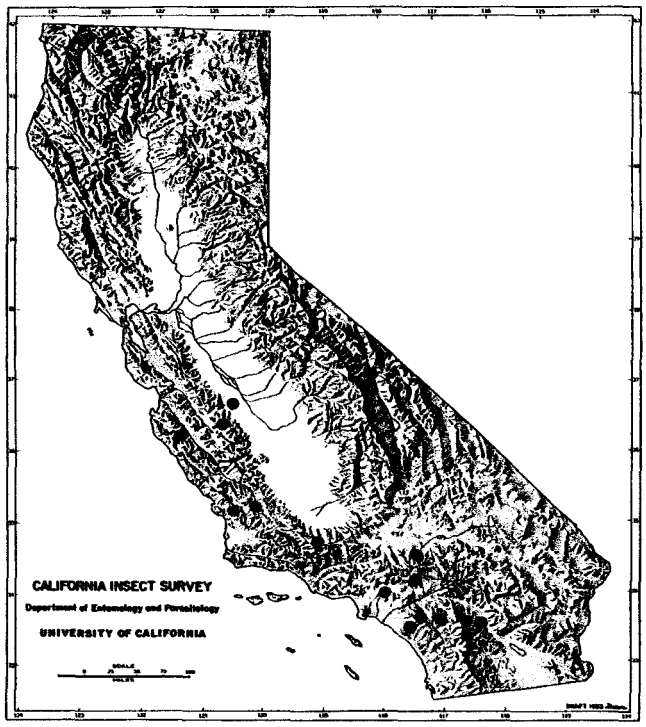
pronounced lateral lobe of sternum VI (fig. 44) and tergum VII (fig. 43), which has the mean width of the lateral lobe subequal to the distance separating it from the center spine, will serve to distinguish this sex.

Although many varieties have been described as "species" on the basis of coloration within *mormonum*, the variation that exists is not extreme within California. The females usually have more yellow than the males. In extreme northern California, *mormonum* individuals are noticeably darker with less yellow on the thorax, abdomen, and pronotal lobe. This color pattern decreases even more in Washington and Montana. The darkest specimen was from northwestern Montana; it had a completely dark clypeus and mandible.

This is the second most common species in California as indicated by an examination of 491 males and 290 females. It is found in all the major mountain ranges of California.

Hicks (1929*a*) has published relatively extensive notes on the biology of *mormonum* in a study of populations from southern California. Females were found nesting in deserted beetle burrows in old yucca flower stalks and oak stumps. The cells (numbering from 1 to 4, average 1.4) were lined with down with an overlay of pebbles and fine soil. The down was gathered from the hairy leaves and stems of *Lepidospartum squamatum*. The nest was plugged with down. Hicks listed the megachilid *Chelynia leucotricha* Cockerell as a probable parasitoid. Examples of the nests of *mormonum* reared in studies by E. Jaycox and F. Parker are presented in figures 218 to 220.

The survey of *mormonum* showed an association with eight plant families, but records were predominantly from the Leguminosae *(Lotus)* and Hydrophyllaceae *(Phacelia)*.



Map 17. Distribution of *Anthidium pallidiclypeum* Jaycox

Anthidium pallidiclypeum Jaycox
(Figs. 22–24, 76, 94; Map 17)

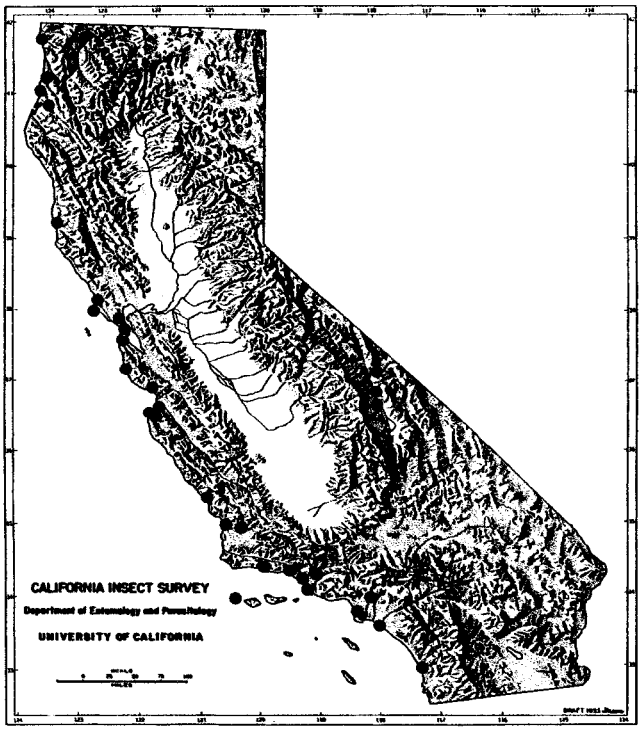
Anthidium pallidiclypeum Jaycox, 1963. Pan-Pac. Ent., 39(4):267. Holotype ♂, San Bernardino Mts., California (CAS).

Geographic range.—California.

California records.—INYO Co.: Big Pine, 3 mi. W, 1 ♀, VI–20–62 (A. Grigarick, UCD). FRESNO Co.: Coalinga Springs, 1 ♀, VI–13–38, on *Lotus* (I. McCracken, CAS). LOS ANGELES Co.: Tanbark Flat, 2 ♂, 1 ♀, VI–20–50, on *Lotus* (P. Hurd, CIS). KERN Co.: Mt. Pinos, 1 ♂, VI–11–61 (C. O'Brien, LACM). MONTEREY Co.: Jamesburg, 2 ♂, VI–11–38, on *Collinsia concolor* (C. Michener, UCR). RIVERSIDE Co.: Deep Creek, 2 ♂, V–16–37, on *Lotus scoparius* (P. Timberlake, UCR). Gilman Hot Springs, 1 ♂, V–14–41 (E. Van Dyke, CAS). Lake Elsinore, 5 mi. S, 1 ♂, VI–24–56 (A. Menke, UCD). Piñon Flat, 2 ♂, VI–18–41 (E. Van Dyke, CAS). The Gavilan, 2 ♂, VI–10–35 (C. Dammers, UCR). SAN BENITO Co.: Idria, 1 ♂, VI–5–55 (M. Wasbauer, CIS). SAN BERNARDINO Co.: Adelanto, 10 mi. S, 1 ♂, V–28–32 (P. Timberlake, UCR). Cajon Pass, summit, 12 ♂, 2 ♀, VI–27–41 (E. Van Dyke, CAS). San Bernardino Mts., 1 ♂, V–15–37, on *Ceanothus* (E. Linsley, CAS). SAN LUIS OBISPO Co.: La Panza, 12 mi. N Pozo, 1 ♂, VI–29–62, on *Trifolium variegatum* (P. Hurd, CIS). VENTURA Co.: Camp Ozena, 11 mi. E, 8 ♂, 1 ♀, VII–2–65 (J. Buckett, M. Garner, UCD).

These bees have bright yellow body and cream-colored facial markings. The males of *pallidiclypeum* can be distinguished by the shape of sternum VI which has no significant development of a lateral lobe and the apex of the median lobe is essentially truncate (fig. 23). In addition, the inconspicuous yellowish setal brush together with the broad lateral lobe of tergum VII (fig. 22) are useful in identifying this species. *A. jocosum* and *cockerelli* are similar in these latter respects. The females have the apical margin of the clypeus (fig. 94) with a shallower emargination between the submedian projections than the emargination of *edwardsii*, and have wider teeth on the margin than *placitum* (fig. 93).

A. pallidiclypeum is not commonly collected, particularly the females, since only 11 were examined compared to 47 males. The distribution of the species is primarily limited to the lower elevations of the south coast, Transverse, and Peninsular ranges and the Owens Valley.



Map 18. California distribution of *Anthidium palliventre* Cresson

Anthidium palliventre Cresson

(Figs. 28–30, 85; Map 18)

Anthidium palliventre Cresson, 1878. Trans. Amer. Ent. Soc., 7:114. Holotype ♀, California (ANSP).

Anthidium pallidiventre Dalla Torre, 1896. Cat. Hym., 10:468. Emendation.

Anthidium californicum Cresson, 1879. Trans. Amer. Ent. Soc., 7:206. Holotype ♂, California (ANSP).

Anthidium palliventre vanduzeei Cockerell, 1937. Pan-Pac. Ent., 13:150, ♂, ♀. Holotype ♂, Cuyler's Cove, San Miguel Island (CAS). NEW SYNONYMY.

Biology.—Hicks, 1928, Pan-Pac. Ent., 5:51-52.

Geographic range.—Coastal California to British Columbia, Utah, eastern California.

California records.—DEL NORTE CO.: Crescent City, 3 ♂, 2 ♀, VII–13–37 (E. Van Dyke, CAS). HUMBOLDT CO.: Big Lagoon, 18 ♂, 9 ♀, (E. Van Dyke, CAS, UCR); 1 mi. S Blue Lake, 1 ♀, VI–12–59 (T. Haig, UCD). INYO CO.: Kearsarge, 8 ♂, 9 ♀, V–25–37 (E. Van Dyke, CAS). Lone Pine, 1 ♂, 1 ♀, V–24–37 (E. Van Dyke, CAS). Westgard Pass, 5 ♂, VI–3–33 (E. Van Dyke, CAS). LOS ANGELES CO.: Arcadia, 10 mi. N, 1 ♀, VI–17–58 (T. Haig, UCD). El Segundo Sand Dunes, 2 ♂, 3 ♀, V–30–59 (L. Stange, UCD). Redondo Beach, 3 ♂, 1 ♀, VI–16–38 (CIS). MARIN CO.: Alpine Lake, 1 ♂, 1 ♀, VII–26–56 (J. Herring, C. MacNeill, CAS). Inverness, 6 mi. W, 4 ♂, 9 ♀, VII–28–63, on *Lotus Heermannii* (M. Irwin, L. Stange, UCD). McClure's Beach, 1 ♂, VII–7–61 (H. Leech, CAS). Lagunitas, 1 ♀, VI–25–24 (E. Van Dyke, CAS). Point Reyes, 4 ♂, 1 ♀, IV–11–59 (R. Thorp, RT); 1 ♂, 2 ♀, V–24–56 (J. Powell, CIS). MENDOCINO CO.: Mouth of Navarro River, 49 ♂, 40 ♀, V–30–58 (E. Linsley, CIS). MONTEREY CO.: Asilomar, 1 mi. SW, 33 ♂, 14 ♀, VI–18–47 (A. Melander, UCR). Carmel, 1 ♀, VII–6 (S. Keen, CIS). Monterey, 2 ♂, VI–19–49 (H. Cott, UCD). Pacific Grove, 1 ♂, 1 ♀, VI (W. Mann, CIS); 18 ♂, 17 ♀, VI–31–54 (M. Wasbauer, CIS). Pt. Pinos, 2 ♂, 2 ♀, VIII–17–35, on *Horkelia* (P. Timberlake, UCR). Seaside, 1 ♀, VII–4–59 (J. Powell, CIS). ORANGE CO.: Balboa Island, 1 ♀, IV–29–17 (R. May, CIS). SAN DIEGO CO.: Solano Beach, 2 ♂, 1 ♀, VI–19–63 (T. Bolton, W. Reische, UCD). SAN FRANCISCO CO.: Laguna Puerca, 9 ♂, 3 ♀, V–13–60 (D. Rentz, CAS). Lobos Creek, 6 ♂, 6 ♀, VI–18–60 (G. Stage, SS). Presidio, 1 ♀, VI–11–43 (K. Frick, CIS). San Francisco, 9 ♂, 7 ♀, VI–5–54, on *Phacelia distans* (P. Raven, CAS). SAN LUIS OBISPO CO.: Arroyo Grande, 1 ♂, V–20–54, on *Phacelia* (P. Hurd, CIS). Grover City, 2 ♂, 3 ♀, VII–4–56, on *Phacelia* (P. Hurd, E. Linsley, CIS). Oso Flaco Lake, 6 ♂, 5 ♀, VII–13–59 (A. Menke, P. Paige, J. Russell, UCD). Morro Bay, 1 ♂, 1 ♀, V–2–62, on *Abronia maritima* (P. Hurd, CIS). SAN MATEO CO.: Colma, 1 ♀, VIII–15–11 (J. Kusche, CAS). Pescadero, 1 ♂, V–9–54 (M. Wasbauer, CIS). SANTA BARBARA CO.: Carpinteria, 9 ♂, 2 ♀, VII–21–37 (B. White, CAS). Goleta, 20 ♂, 10 ♀, VI–22–59 (A. Menke, P. Marsh, P. Paige, F. Parker, UCD). San Miguel Island, Channel Islands, 1 ♀, V–20–19 (E. Van Duzee, CAS). SANTA CRUZ CO.: Aptos, 1 ♂, VI–31 (E. Ross, CAS). VENTURA CO.: Foster Park, 5 ♀, VII–1–59 (R. Spore, UCD). Santa Paula, 1 ♂, 1 ♀, VI–5–27, on *Phacelia ramosissima* (P. Timberlake, UCR). Ventura, 4 ♀, II–7 to VII–1–59 (W. Steffan, CIS, J. Russell, UCD). Point Mugu, 1 ♀, VII–5–38 (D. Dow, UCD).

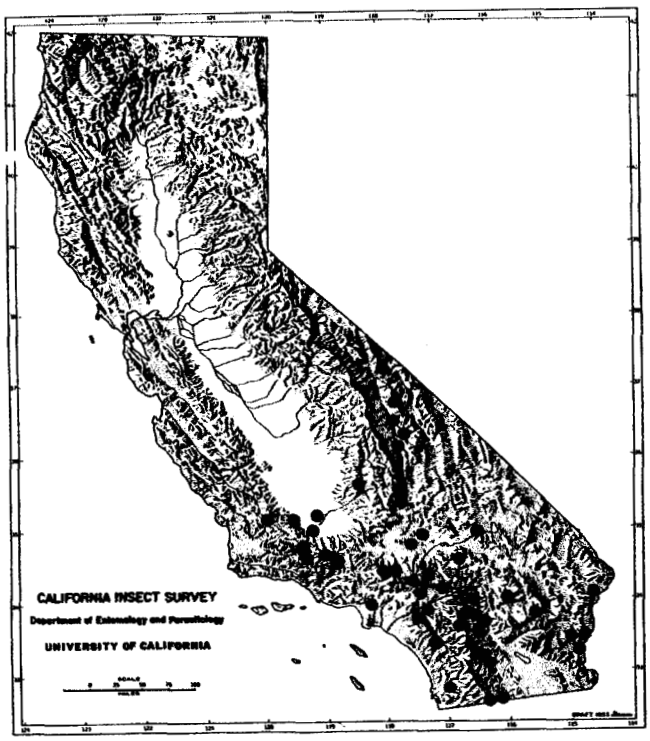
A. palliventre is a fairly large, black bee with narrow cream or pale yellow maculations. Elongate setae twice the width of the foretarsus immediately distinguish the females. The males are less easily separated, but the short, dark-reddish setal brush of sternum V and broadly curved lateral lobe of tergum VII (fig. 28), which is widely separated from the median lobe, will distinguish them. The shape of sternum VI (fig. 29) is similar to that found in *emarginatum* and allies.

The distribution of *palliventre* is exceptional. In California, the species is mostly confined to marine sand dune areas. However, specimens have been collected in the Great Basin, including some from Inyo County, California. The species is quite commonly collected as indicated by records of 293 males and 206 females.

Hicks (1928) observed female *palliventre* excavating their own nests in sand, using the foreleg in the digging. This is of considerable interest, not only because it is the only species known to excavate its own nest, but also because it is the only species where the females have a row of long setae on the forebasitarsus.

The survey showed *palliventre* to be associated with four plant families and most frequently on

Phacelia of the Hydrophyllaceae, but plant association records are quite sparse in comparison with other species found in the same abundance. This may be attributed to the sandy costal habitat.



Map 19. California distribution of *Anthidium palmarum* Cockerell

Anthidium palmarum Cockerell

(Figs. 64–66, 69, 74; Map 19)

Anthidium palmarum Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:59. Holotype ♂, Palm Springs, California (AMNH).

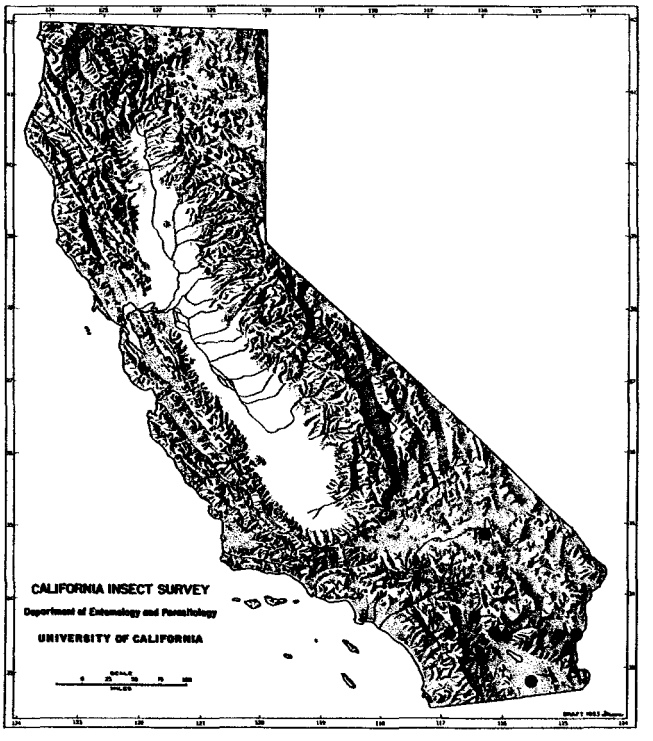
Anthidium palmarum micheneri Schwarz, 1957. Jour. Kansas Ent. Soc., 30:132 ♂, ♀. Holotype ♂, Quemado, Texas (AMNH). NEW SYNONYMY.

Geographic range.—Western Texas, New Mexico, Arizona, southern Nevada, southern California, and northern Baja California.

California records.—IMPERIAL CO.: Palo Verde, 3 ♂, IV–24–63 (F. Parker, L. Stange, UCD). INYO CO.: Inyo Mountains, 1 ♂, 1 ♀, V–25–37 (E. Van Dyke, CAS). Kearsarge, 8 ♂, 4 ♀, V–25–37 (E. Van Dyke, CAS). Lone Pine, 1 ♂, 1 ♀, V–24–37 (E. Van Dyke, CAS). Mazourka Canyon, Inyo Mts., 8 ♂, 6 ♀, V–25–37, on *Phacelia* (C. Michener, UCR). Morongo Pass, 1 ♂, IV–13–35 (P. Timberlake, UCR). Olancha, 13 mi. NE, 1 ♂, V–2–24, on *Phacelia cicutaria* var. *hispida* (P. Timberlake, UCR). Rose Canyon, Panamint Mts., 6 ♂, 1 ♀, on *Phacelia* (C. Michener, UCR). Westgard Pass, 3 ♂, 1 ♀, V–27–37, on *Phacelia, Astragalus* (C. Michener, UCR). KERN CO.: Bakersfield, 18 mi. E, 1 ♂, 2 ♀, IV–2–59 (G. Stage, J. Powers, CIS). Glenville, 1 ♀, IV–26–50 (E. Schlinger, UCD). McKittrick, 3 mi. N, 11 ♂, 1 ♀, V–11–38, on *Phacelia distans* (P. Timberlake, UCR). Searles Station, 1 ♂, IV–25–49 (E. Linsley, R. Smith, J. MacSwain, CIS). LOS ANGELES CO.: Little Rock, 1 mi. W, 1 ♂, V–13–56 (E. Linsley, J. MacSwain, CIS). Llano, 7 mi. W, 1 ♂, 3 ♀, on *Phacelia distans, Salvia carduacea* (P. Timberlake, UCR). Pearblossom, 4 mi. S, 1 ♀, V–13–56 (E. Linsley, CIS). RIVERSIDE CO.: Andreas Canyon, near Palm Springs, 1 ♂, 1 ♀, IV–10–52, on *Phacelia distans* (P. Timberlake, UCR). Banning, 1 ♂, V–3–29, on *Phacelia hispida* (P. Timberlake, UCR). Blythe, 1 ♂, V–8–48 (J. MacSwain, E. Linsley, CIS). Chino Canyon, 1 ♂, IV–21–60 (J. Powell, CIS). The Gavilan, 2 ♂, 1 ♀, IV–18–37 on *Oenothera* (E. Linsley, CIS); 1 ♂, IV–27–38, on *Phacelia hispida* (P. Timberlake, UCR). Hemet, 1 ♂, 1 ♀, IV–26–54 (N. Browne, UCD). Hopkins Well, 1 ♂, 1 ♀, IV–16–58 (P. Hurd, E. Linsley, CIS). Palm Desert, 6 ♂, 3 ♀, IV–6–63 (R. Westcott, UCD). Palm Springs, 1 ♀, IV–2–27, on *Phacelia crenulata* (P. Timberlake, UCR); 2 ♂, 9 ♀, IV–2–27, on *Phacelia distans* (P. Timberlake, UCR); 2 ♂, 2 ♀, III–24–53, on *Phacelia distans* (H. McKenzie, CIS). Riverside, 3 ♂, 1 ♀, III–21 to IV–6–1938, on *Phacelia distans* (P. Timberlake, UCR); 13 ♂, III–21–36, on *Phacelia ramosissima* (P. Timberlake, UCR). Tahquitz Canyon, 1 ♀, VI–8–57 (A. Menke, L. Stange, LACM). Temecula, 2 ♂, IV–24–51 (R. Bechtel, E. Schlinger, UCD). Whitewater Canyon, 2 ♀, III–31–63 (M. Irwin, UCD). SAN BERNARDINO CO.: Adelanto, 1 ♂, IV–20–37 (C. Dammers, LACM). Apple Valley, 1 ♀, V–20–41 on *Acamptopappus sphaerocephalus* (P. Timberlake, UCR). Near Avawatz Mts., 1 ♂, IV–30–27, on *Aster torifolius* (P. Timberlake, UCR). Cajon Pass summit, 12 ♂, V–13–44, on *Phacelia distans* (P. Timberlake, UCR). Earp, 6 mi. N, 1 ♂, V–22–57 (F. Parker, L. Stange, UCD). Joshua Tree National Mon., 1 ♂, 1 ♀, IV–10–63 (M. Irwin, UCD). Kramer Hills, 2 ♂, IV–26 to V–1–53, on *Phacelia distans* (P. Timberlake, UCR). Morongo Valley, 5 ♂, 7 ♀, IV–12–57 on *Phacelia distans* (R. Snelling, SS); 1 ♀, IV–12–60, on *Lotus* (R. Snelling, SS). Ord Mountain, 4 ♀, IV–19–60, on *Senecio Douglasii* (J. Powell, CIS). Phelan, 2 mi. W, 1 ♂, V–22–57 (J. Hall, UCD). Victorville, 1 ♀, V–5–56 (J. Powell, CIS). SAN DIEGO CO.: Borrego, 2 ♀, IV–11–52, on *Phacelia* (E. Linsley, CIS); 1 ♂, 1 ♀, VI–20–54, on *Phacelia distans* (P. Timberlake, UCR). Campo, 4 mi. E, 1 ♀, IV–3–61, on *Lotus scoparius* (P. Timberlake, UCR). Culp Canyon, 1 ♀, V–5–59 (E. Schlinger, UCD). Coyote Creek, 3 ♂, 2 ♀, IV–5–63 (R. Bohart, UCD). Jacumba, 1 ♂, IV–26–50 (S. Bailey, UCD). Lakeside, 2 mi. NE, 1 ♂, III–29–61, (W. Steffan, CIS). Palm Canyon, Borrego, 26 ♂, 7 ♀, IV–9–63 (M. Irwin, UCD). SAN LUIS OBISPO CO.: Simmler, 10 mi. W, 2 ♂, V–3–62 (C. Toschi, CIS). VENTURA CO.: Gorman, 5 mi. S, 1 ♂, V–4–59, burrow in dry stalk of *Yucca Whipplei* (G. Stage, CIS). Lockwood Valley, 3 ♂, 3 ♀, V–5–59, on *Phacelia ciliata* (P. Timberlake, UCR); 1 ♂, V–2–59, on *Haplopappus linearifolius* (J. Powers, CIS). Quatal Canyon, 2 ♂, V–9–59, on *Encelia virginensis* ssp. *actoni* (P. Hurd, CIS).

The reduced lobes of sternum VI (fig. 65) and widely separated lateral lobes of tergum VII (fig. 64), together with the prominent black setal brush, are characteristic for the males. The peculiar sinuate configuration of the posterior marginal band of tergum VI (fig. 74) of the females is a key character for this sex. In California, the species has a distinctive facies since the tegula and often the legs are pale

reddish, the thorax is black, and the yellow abdominal bands are generally interrupted. This coloration is approached only by some *cockerelli* and *dammersi*. The distribution of palmarum is principally in the southern California deserts, but some peripheral areas such as the lower San Joaquin Valley are also inhabited. This appears to be the commonest species of *Anthidium* in the Colorado and Mojave Deserts, as 321 males and 235 females were examined from this part of California. Scattered records of *palmarum* visitations occur on species of six plant families, but over two-thirds were on several species of *Phacelia* in the Hydrophyllaceae.



Map 20. California distribution of *Anthidium paroselae* Cockerell

Anthidium paroselae Cockerell
(Figs. 10–12, 73, 100; Map 20)

Anthidium paroselae Cockerell, 1898. Bull. Denison Sci. Labs., 11:62. Holotype ♀, Mesilla, New Mexico (Univ. Kansas).

Taxonomy.—Cockerell, 1900, Ann. Mag. Nat. Hist., (7) 5:412 ♂.

Biology.—Newberry, 1900, Psyche, 9:94.

Geographic range.—Texas, New Mexico, Arizona, southern California, and Sonora, Mexico.

California records.—IMPERIAL CO.: Palo Verde, 2 ♀, IV–24–63 (F. Parker, L. Stange, UCD). INYO CO.: Lone Pine, 1 ♀, VI–4–37 (W. Reeves, CIS); 1 ♀, VI–15–37, on *Malacothrix* (C. Michener, UCR). RIVERSIDE CO.: Blythe, 12 mi. N, 5 ♂, 3 ♀, V–8–47 on *Palafoxia linearis* (E. Linsley, CIS); 20 mi. W, 1 ♀, X–17–59 (J. MacSwain, CIS); 18 mi. W, 1 ♀, X–24–51 (P. Timberlake, UCR); 1 ♀, IV–3–63 (F. Parker, UCD). Cathedral City, 1 ♀, X–8–45, on *Palafoxia linearis* (P. Timberlake, UCR). Coachella, 2 ♂, V–24–28 (E. Van Dyke, CAS). Hopkins Well, 1 ♂, IV–29–52, on *Baileya* (P. Hurd, CIS); 1 ♂, 3 ♀, IV–16–58, on *Palafoxia linearis* (P. Hurd, CIS); 2 ♀, IV–16–58, on *Baileya multiradiata* (J. Powell, CIS). Indio, 1 ♀, IV–5–51 (P. Hurd, CIS); 5 mi. W, 1 ♂, IV–9–36, on *Prosopis* (E. Linsley, CIS); 6 mi. W, 2 ♀, IV–30–49, on *Melilotus* (E. Linsley, J. MacSwain, CIS); 5.5 mi. NW, 9 ♂, 8 ♀, IV–9–36, on *Prosopis* (P. Timberlake, UCR). Palm Springs, 1 ♀, IV–10–36 (C. Michener, UCR); 4 mi. S, 1 ♂, V–6–46, on *Cryptantha barbigera* (P. Timberlake, UCR); 5 mi. S, 1 ♀, V–6–46, on *Larrea divaricata* (P. Timberlake, UCR). Ripley,5 mi. W, 1 ♂, 1 ♀, IV–24–63, on *Prosopis* (L. Stange, F. Parker, UCD). SAN BERNARDINO CO.: Cronise Valley, 3 ♂, 1 ♀, IV–29–56, on *Prosopis* (J. Powell, M. Wasbauer, CIS). SAN DIEGO CO.: Borrego, 1 ♀, V–2–52 (P. Hurd, CIS); 1 ♀, IV–30–54, on *Croton californicus* (M. Wasbauer, CIS); 1 ♀, IV–26–55, on *Helianthus petiolaris* var. *canescens* (P. Timberlake, UCR); 1 ♀, IV–29–54, on *Bebbia juncea* (M. Wasbauer, CIS).

A. paroselae is a small- to moderate-sized species with extensive yellow maculations. It is related to *sonorense* in having sternum VI (fig. 11) with ventrally directed lateral lobes in the male. Females of both species have a labrum without submedian protuberances and the posterior marginal band of Tergum VI is restricted to the median one-third. Both *paroselae* and *sonorense* are restricted to the desert. The male of *paroselae* lacks the conspicuous apical process on sternum VI so characteristic of *sonorense*. The female is also very distinct from *sonorense* in having the preapical teeth of the mandible (figs. 99, 100) nearly congruent and in lacking the submedian yellow stripes on the mesonotum. *A. maculosum* has certain of the above mentioned characteristics in common with both species, but the sparse punctation of the frons and elongate flagellomere I of *maculosum* are obvious differences.

A. paroselae is infrequently collected (37 ♂, 47 ♀) in the Colorado and Mojave deserts and the Owens Valley of California. It has been associated with species of five plant families and most frequently with members of the Compositae.

Newberry (1900) reported that *paroselae* females nest in hard sand and that down is used in lining the cells and closing the nest.

Anthidium placitum Cresson
(Figs. 46–48, 78, 93; Map 21)

Anthidium placitum Cresson, 1879. Trans. Amer. Ent. Soc., 7:206. Holotype ♀, Nevada (ANSP).

Anthidium bernardinum Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:74. Holotype ♂, Strawberry Valley, California (AMNH).

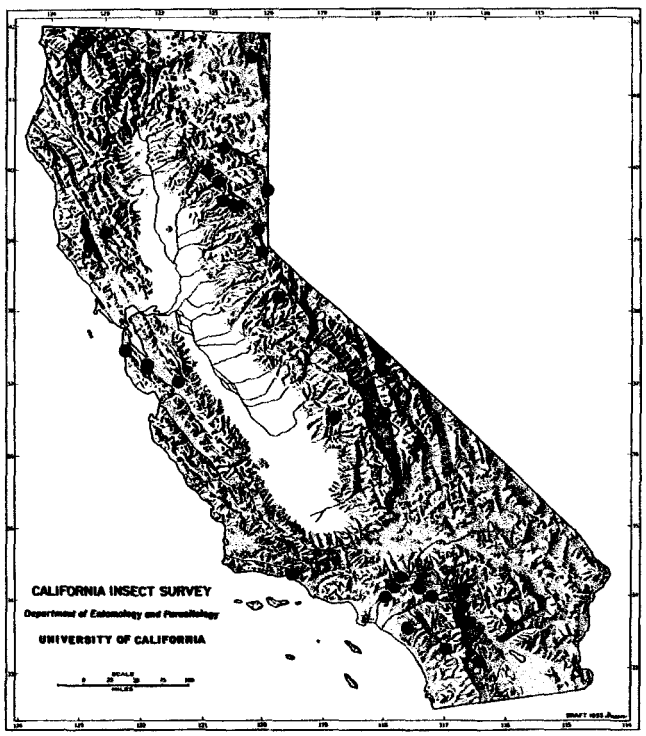
Anthidium hesperium dentipygum Swenk, 1914. Nebr. Univ. Studies, 14:19. Holotype ♀, Laramie, Wyoming (UN). NEW SYNONYMY.

Anthidium permaculatum Cockerell, 1925. Proc. Calif. Acad. Sci., series 4, 14:349. Holotype ♀, Sparta, Baker Co., Oregon (CAS). NEW SYNONYMY.

Anthidium bernardinum mesaverdense Schwarz, 1927. Amer. Mus. Novitates, 252:15. Holotype ♀, Mesa Verde, Colorado (AMNH). NEW SYNONYMY.

Anthidium niveumtarsum Schwarz, 1927. Amer. Mus. Novitates, 252:18, ♀, ♂. Holotype ♀, Jackson, Wyoming (AMNH). NEW SYNONYMY.

Geographic range.—Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Wyoming.



Map 21. California distribution of *Anthidium placitum* Cresson

California records.—EL DORADO CO.: Fallen Leaf Lake, 1 ♀, VII–14–15 (E. Van Dyke, CAS). INYO CO.: Lee Flat, 6 ♀, VIII–29–58 (A. Menke, L. Stange, UCD). Lone Pine, 1 ♀, V–6–37 (SS). Westgard Pass, 1 ♀, VI–15–37 (C. Michener, UCR). LAKE CO.: Upper Lake, 1 ♀, VIII–9–59 (S. Fidel, UCD). LASSEN CO.: Hallelujah Junction, 1 ♂, VI–27–49 (H. Hunt, UCD). LOS ANGELES CO.: Big Pine Camp, 2 ♂, 2 ♀, VII–17–27, on *Cordylanthus Nevinii* (P. Timberlake, UCR). Mt. Baldy, 2 ♂, VIII–22–20, on *Cordylanthus rigidus* ssp. *brevibracteatus* (P. Timberlake, UCR). Tanbark Flat, 2 ♀, VII–16–56 (H. Moffitt, UCD). MODOC CO.: Davis Creek, 1 ♂, VII–13–22 (C. Fox, CAS). MENDOCINO CO.: Hopland, 1 ♀, VII–15–37 (S. Fidel, UCD). MONO CO.: Crooked Creek, White Mts., 10,150 ft., 1 ♂, 1 ♀, VI–26–61 (J. Buckett, UCD). Tom's Place, 1 mi. S, 2 ♀, VIII–8–62 (A. Menke, L. Stange, UCD). ORANGE CO.: Santiago Canyon, Santa Ana Mts., VII–25–60 (M. Irwin, UCD). PLACER CO.: Carnelian Bay, Lake Tahoe, 1 ♀, VII–22–57 (R. Bohart, UCD). PLUMAS CO.: Quincy, 4 mi. W, 1 ♀, VII–6–49 (H. Hunt, UCD). Meadow Valley, 1 ♂, VII–4–24 (E. Van Dyke, CAS). RIVERSIDE CO.: Idyllwild, 4 ♂, 1 ♀, VII–29–38 (E. Van Dyke, CAS). Whitewater Canyon, 7 ♂, 6 ♀, IX–11–33, on *Cordylanthus filifolius* (P. Timberlake, UCR). SAN BERNARDINO CO.: Big Bear Valley, 1 ♂, 2 ♀, VIII–6–33, on *Solidago confinis, Cordylanthus Nevinii* (P. Timberlake, UCR). Forest Home, 1 ♂, VI–1–28 (E. Van Dyke, CAS). Mill Creek Canyon, 4 ♂, 7 ♀, VIII–11–35, on *Cordylanthus Nevinii* (P. Timberlake, UCR); 1 ♀, VIII–2–46, on *Monardella* (P. Timberlake, UCR); 1 ♀, VIII–11–35, on *Chrysopsis villosa* (P. Timberlake, UCR). SAN DIEGO CO.: Mt. Palomar, 1 ♂, 1 ♀, VI–28–63, on *Cryptantha intermedia* (P. Hurd, CIS). Warner Springs, 1 ♂, X–11–43 (UCR). SANTA BARBARA CO.: Carpinteria, 1 ♂, VIII–21–37 (B. White, SS). SANTA CLARA CO.: Palo Alto, 1 ♀, VIII–25–15 (P. Stinchfield, CIS). SANTA CRUZ CO.: Highland District, 2 ♂, IX–2–56 (S. Fidel, UCD). SIERRA CO.: Gold Lake, 1 ♀, VII–19–21 (C. Fox, CAS). Sardine Lakes, 3 ♀, VII–31–58 (A. Grigarick, UCD). TULARE CO.: Mineral King, 1 ♀, VII–30–23 (C. Fox, CAS). TUOLUMNE CO.: Dardanelles, 2 ♀, VII–13–51 (E. Schlinger, UCD).

A. placitum is structurally similar to *A. edwardsii*, since both species have the entire apical margin of the female clypeus emarginate and the clypeus of the males has a slight apical indentation on the midline. The clypeal emargination of the females is not as strong in *placitum* as in *edwardsii*, and this feature is more obscure in specimens examined from Nevada. Tergum VII of the males is distinctive since the lateral lobe is broad in *placitum* (fig. 46) and spiniform in *edwardsii* (fig. 49). Similarly, the female tergum VI of these two species provides taxonomic differences. In *placitum* (fig. 78), the posterior marginal band is prominent as contrasted to the nearly obscure band of *edwardsii* (fig. 79). *A. pallidiclypeum* also has the apical margin of the clypeus emarginate, but in this case the emargination is directed distally from the clypeus whereas in *placitum* it is directed proximally. Also, the female clypeus of *placitum* is nearly flat, whereas it is more convex in *pallidiclypeum*. *A. placitum* is also confused with *mormonum* since the male tergum VII (figs. 43, 46) is similar and the coloration comparable. However, the lateral lobe of the tergum VII is narrower in *mormonum*. *A. placitum* is one of the largest species in California with well-developed yellow bands on the abdomen. The female clypeus is typically marked with a median dark stripe as in *edwardsii*. The maculations are somewhat reduced in the Great Basin states.

The distribution of *placitum* appears to be centered in the Great Basin. In California, *placitum* is found in all the major mountain ranges and Great Basin areas of eastern California. Judging from the known plant associations, *Cordylanthus* of the Scrophulariaceae is a favored host, although records are sparse

and scattered in five families. Material examined from California included 90 males and 85 females.

Anthidium sonorense Cockerell

(Figs. 13–15, 72, 90, 99; Map 22)

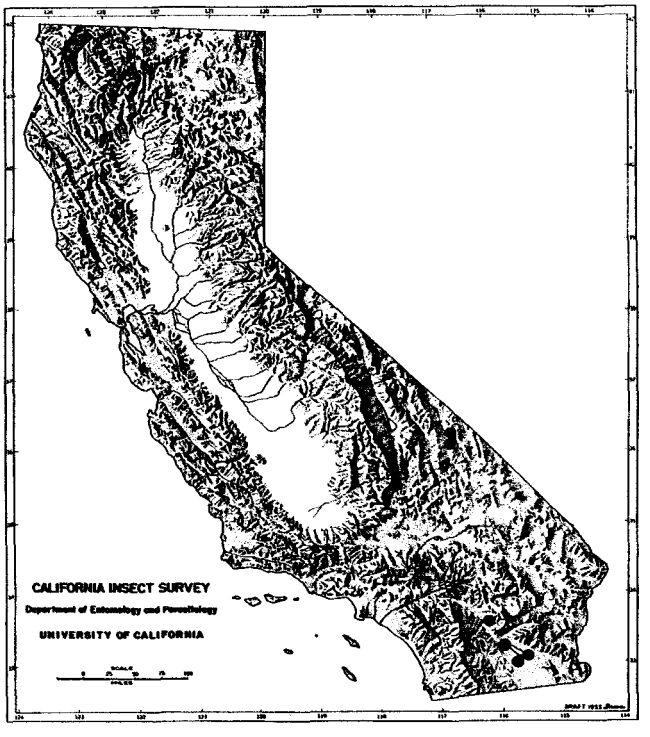
Anthidium sonorense Cockerell, 1923. Proc. Calif. Acad. Sci., series 4, 12:91. Holotype ♂, Guaymas, Mexico (CAS).

Anthidium sonorense productum Cockerell, 1923. Proc. Calif. Acad. Sci., series 4, 12:92. Holotype ♀, San Jose Island, Gulf of California (CAS). NEW SYNONYMY.

Anthidium rohweri Schwarz, 1927. Amer. Mus. Novitates, 253:7. Holotype ♂, Sacatan, Arizona (USNM). NEW SYNONYMY.

Geographic range.—Arizona, southern Nevada, southern California, northern Baja California, Sonora, Mexico.

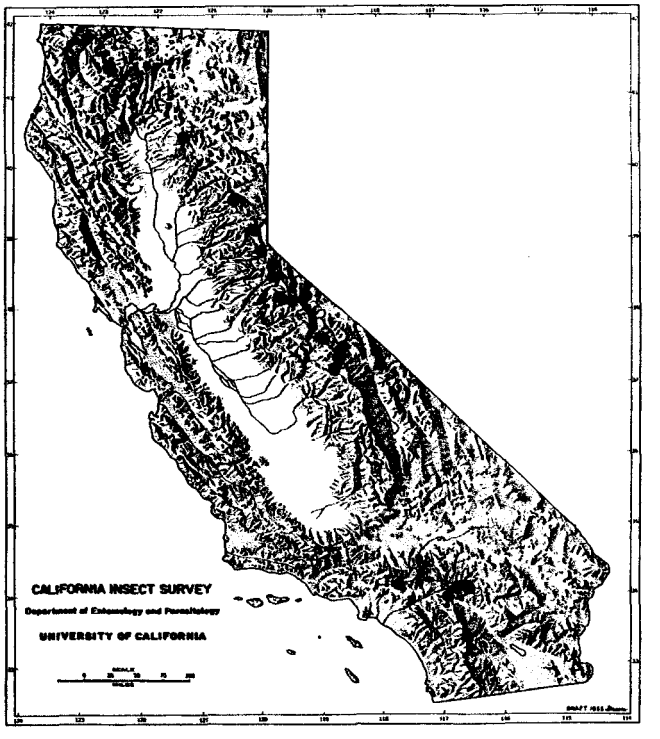
California records.—IMPERIAL CO.: Calipartria, 10 mi. NW, 1 ♀, V–23–56 (T. Haig, UCD). Niland, 3 ♀, IV–27–49, on *Larrea divaricata* (J. Gillaspy, CIS). Salton Sea near Fish Spring, 2 ♂, VI–15–28 (W. Thorbe, UCR). Westmorland, 1 ♂, 3 ♀ (M. Cazier, CIS, CAS). INYO CO.: Furnace Creek, 1 ♂, IV–27–56 (R. Bohart, UCD); 20 mi. S, 1 ♀, IV–8–39, on *Prosopis* (E. Linsley, UCR). RIVERSIDE CO.: Near Indio, 1 ♂, VI–23–27 (P. Timberlake, UCR). SAN DIEGO CO.: Borrego Valley, 1 ♀, IV–18–57 (H. Moffit, UCD).



Map 22. California distribution of *Anthidium sonorense* Cockerell

California specimens of this bee are moderate in size and show extensive yellow maculations. The apical toothlike process on sternum VI (fig. 14) provides an easy means for recognizing the males of *sonorense*. The females from California have two longitudinal submedian yellow stripes on the mesonotum, which is unique for this species. There is some reduction of these stripes, as well as a reduction in the yellow metasomal bands, as the species extends southward, and the type of *sonorense productum* lacks the stripes completely. Tergum VI on the female (fig. 72) is similar to that segment of *paroselae*, but differences in the dentition of the mandibles (figs. 99, 100) separate them.

This species is restricted to hot desert regions and is sympatric with *paroselae, dammersi, cockerelli,* and *palmarum* but is less common (6 ♂, 9 ♀). Specimens have been collected at the flowers of two desert shrubs, *Larrea* and *Prosopis*.



Map 23. California distribution of *Anthidium tenuiflorae* Cockerell

Anthidium tenuiflorae Cockerell

(Figs. 31–33, 88, 96; Map 23)

Anthidium tenuiflorae Cockerell, 1907. Can. Ent., 39:135 ♀, ♂. Holotype ♀, Boulder, Colorado (UCR).

Anthidium tenuiflorae yukonense Cockerell, 1926. Ann. Mag. Nat. Hist., (9) 18:622 ♂, ♀. Holotype ♂, Carcam, Yukon Terr. (AMNH). NEW SYNONYMY.

Biology.—Hicks, 1926, Colo. Univ. Studies, 15:248–249.

Geographic range.—Northwest Canada south through the Pacific, Great Basin, and Rocky Mountain states to New Mexico, Arizona, and southern California.

California records.—ALPINE CO.: Ebbett's Pass, 1 ♂, VII–30–59 (L. Campos, UCD). EL DORADO CO.: Fallen Leaf Lake, 1 ♂, 1 ♀, VII–19–20 (I. McCracken, CIS). FRESNO CO.: Florence Lake, 1 ♀, VIII–29–52 (E. Schlinger, UCD). INYO CO.: Mono Pass, 12,000 ft., 3 ♂, 2 ♀, VIII–13–57 (J. Powell, CIS). Wyman Canyon, White Mts., 1 ♂, 3 ♀, VI–21–61 (J. Buckett, D. Miller, UCD). LOS ANGELES CO.: Big Pine Camp, 1 ♂, VII–13–27, on *Epilobium adenocaulum* var. *Parishii* (P. Timberlake, UCR); 2 ♂, 1 ♀, VII–11–27, on *Lotus Davidsonii* (P. Timberlake, UCR). MONO CO.: Blanco's Corral, White Mts., 7 ♂, 10 ♀, VII–8 to 23 (J. MacSwain, CIS). Blue Canyon, Sonora Pass, 3 ♂, 1 ♀, VIII–30–60 (C. Toschi, CIS). Convict Lake, 1 ♂, VIII–6–38 (R. & G. Bohart, UCR). Cottonwood Creek, 9,300 ft., VII–10–61 (G. Stage, CIS). Crooked Creek Lab., White Mts., 1 ♀, VII–21–61 (P. Hurd, CIS). Fales Hot Springs, 1 ♂, VIII–18–60 (G. Colliyen, CIS). Gem Lake, 1 ♂, 1 ♀, VII–24–15 (CIS). Leavitt Meadows, 1 ♀, VI–23–51 (J. MacSwain, CIS). McKay Creek, Sonora Pass, 2 ♂, 2 ♀, VIII–18–60 (E. Jesson, CIS). Schulman Grove, White Mts., 1 ♀, VII–6–61 (G. Stage, CIS). Sonora Pass, 2 ♀, VIII–10–60 (C. Toschi, CIS). RIVERSIDE CO.: Herkey Creek, 1 ♀, VI–24–34 (K. McCracken, CAS). SAN BERNARDINO CO.: Big Bear Valley, 38 ♂, 22 ♀, VII–7–34, on *Lotus argophyllus* (P. Timberlake, UCR); 2 ♂, 1 ♀, VIII–11–33, on *Aster* (P. Timberlake, UCR); 2 ♀, VII–4–35, on *Phacelia heterophylla, Lupinus confertus* (P. Timberlake, UCR); 1 ♂, VII–4–35, on *Solidago confinis* (P. Timberlake, UCR). Dollar Lake Trail, San Bernardino Mts., 1 ♂, 1 ♀, VIII–10–56 (R. Bohart, H. Moffitt, UCD). SHASTA CO.: Lassen Pass, 7500 ft., 1 ♂, 1 ♀, VII–18–49 (C. Smith, W. Wade, CIS). SIERRA CO.: Gold Lake, 1 ♂, 1 ♀, VII–16–21 (E. Van Dyke, CAS). SISKIYOU CO.: Summit Lake, Marble Mts., 3 ♂, 2 ♀, VIII–24–62 (E. Mezger, UCD). TUOLUMNE CO.: Blue Canyon, Sonora Pass, 3 ♂, VIII–30–60 (M. Irwin, UCD). Chipmunk Flat, 4 ♂, 2 ♀, VIII–9–60 (J. MacSwain, CIS; M. Irwin, UCD). Sonora Pass, 1 ♂, 1 ♀, VIII–15–59, on *Aster foliaceous* (R. Snelling, G. Stage, SS).

This species is rather difficult to distinguish from the closely related *emarginatum*. Males of both species have a large blackish setal brush, sternum VI (figs. 32, 35) with the lateral and median lobes longer than wide, and tergum VII (figs. 31, 34) with rather broad lateral lobes. However, *tenuiflorae* males usually have the lateral lobes of tergum VII much broader than in *emarginatum*. Additionally, the medial lobe of sternum VI is usually weakly emarginate in *tenuiflorae* (versus entire in *emarginatum*), and the apex of sternum VIII (fig. 33) is relatively narrower in *tenuiflorae*. The females of *tenuiflorae* usually have the sting emargination either absent or weakly developed; however, this character shows some variation. Additionally, in contrast to *emarginatum*, the female clypeus of *tenuiflorae* is flatter in profile (figs. 95 and 96). This character is also subject to variation.

A. tenuiflorae is found at the higher elevations of California's major mountain ranges but is absent in the Coast Range. Its markings are cream colored in northern California, but they become more yellowish in the mountains of southern California.

A few observations on the habits of this species were contributed by Hicks (1926*a*) who studied it in Colorado. He observed the females carrying pebbles and found a nest which had been constructed between two rocks which, typical for the genus, was richly embellished with down.

The records taken from an examination of 112 males and 145 females showed a relatively few plant associations to be scattered in four families with no discernible preference indicated.

Anthidium utahense Swenk
(Figs. 55–57, 81; Map 24)

Anthidium utahense Swenk, 1914. Nebr. Univ. Studies, 14:23. Holotype ♂, Logan, Utah (NU).

Anthidium sagittipictum Swenk, 1914. Nebr. Univ. Studies, 14:20. Holotype ♀, Pullman, Washington (NU). NEW SYNONYMY.

Anthidium divisum Cockerell, 1925. Proc. Calif. Acad. Sci., series 4, 14:350. Holotype ♀, Parley Canyon, Salt Lake City, Utah (CAS). NEW SYNONYMY.

Anthidium divisum nanulum Cockerell, 1925. Proc. Calif. Acad. Sci., series 4, 14:350. Holotype ♀, Bryson, Monterey Co., California (CAS). NEW SYNONYMY.

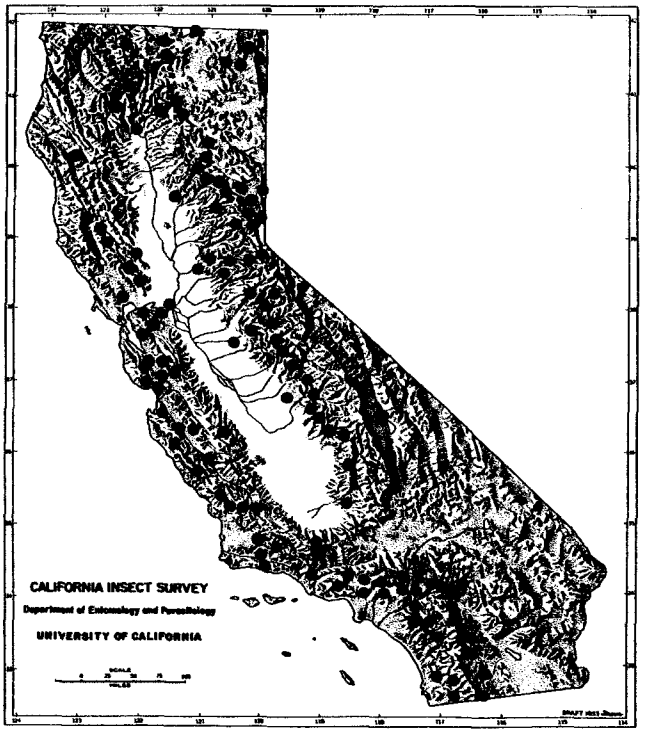
Anthidium divisum ornatifrons Cockerell, 1925. Proc. Calif. Acad. Sci., series 4, 14:350. Holotype ♀, Meadow Valley, Plumas Co., California (CAS). NEW SYNONYMY.

Anthidium brachyurum Cockerell, 1925. Proc. Calif. Acad. Sci., series 4, 14:357. Holotype ♂, Cisco, California (CAS). NEW SYNONYMY.

Biology.—Jaycox, 1966, Pan-Pac. Ent., 42 (1): 18–20.

Geographic range.—British Columbia south through the northwestern states to Arizona, Nevada, and California.

California records.—ALAMEDA CO.: Redwood Park, 1 ♂, VI–10–47 (C. McNeill, CIS). ALPINE CO.: Red Lake, 1.5 mi. NE, 1 ♀, VII–25–55 (E. Schlinger, UCD). BUTTE CO.: Yankee Hill, 1 ♀, V–12–49 (P. Hurd, CIS). CALAVERAS CO.: Big Tree, 1 ♂, IX–13–37 (F. Blaisdell, CAS). CONTRA COSTA CO.: Antioch, V–24–49, on *Lotus* (P. Hurd, E. Linsley, J. MacSwain, CIS). Mt. Diablo, 3 ♀, V–23–40 (J. MacSwain, CIS). EL DORADO CO.: Camino, 3 mi. S, 1 ♀, VI–26–48, on *Phacelia* (P. Hurd, CIS). Kyburz, 1 ♂, VII–10–50 (W. Ehrhardt, CIS). Meyers, 1 ♂, VII–24–55 (E. Schlinger, UCD). Pilot Hill, 1 ♂, VI–14–52 (R. Bohart, UCD). Webber Creek, 1 ♂, 1 ♀, VI–25–60 (D. Linsdale, CIS). El Dorado, 1 ♂, 2 ♀, VI–2–63 (R. Westcott, UCD). FRESNO CO.: Academy, 5 mi. E, 1 ♀, VI–21–56 (R. Snelling, SS). Pine Flat Reservoir, 1 ♀, VI–22–56, on *Lotus* (R. Snelling, SS). Pinehurst, 2 ♀, VI–28–60 (R. Snelling, SS). Shaver Lake, 2 ♀, VII–19–60 (R. Snelling, SS). Watts Valley, 1 ♀, VI–22–56, or *Artemisia* (R. Snelling, SS). INYO CO.: Lone Pine, 41 ♂, 21 ♀, VI–5–37, on *Astragalus Bolanderi* (C. Michener) UCR). KERN CO.: Bakersfield, 22 mi. NE, 1 ♂, VI–18–61 (R. Macdonald, UCD). Frazier Mt., 1 ♀, VII–14–46 (F. Ehrenford, CIS); Mill Potrero, 1 ♂, VII–6–59 (F. Parker,



Map 24. California distribution of *Anthidium utahense* Swenk

UCD). LAKE CO.: Kelseyville, 1 ♂, VI–20–59 (S. Fidel, UCD). Midlake, 1 ♀, V–30–55 (E. Schlinger, UCD). LASSEN CO.: Bridge Creek Camp, 46 ♂, 37 ♀, VII–9–49 (many collectors, CIS, UCD). Hallelujah Junction, 1 ♀, VII–12–54 (R. Bohart, UCD). Susanville, 1 ♀, VII–12–34 (E. Van Duzee, CAS). LOS ANGELES CO.: Glendora, 1 ♀, VI–22–56 (R. Bechtel, UCD). Newhall, 1 ♀, VI–22–39 (R. Bohart, UCD). Tanbark Flat, 8 ♂, 2 ♀, VI–20–50, on *Lotus* (P. Hurd, CIS); 1 ♀, VI–20–50, on *Cryptantha* (P. Hurd, CIS); 1 ♀, VI–20–50, on *Eriogonum* (W. Bentinck, CIS). MARIPOSA CO.: Big Oak Flat, 1 ♂, 2 ♀, VIII–12–52 (R. Bechtel, UCD). Mormon Bar, 6 mi. E, 2 ♂, VII–4–60 (G. Stage, R. Snelling, SS). MENDOCINO CO.: Potter Valley, 2 ♂, VI–8–55 (R. Bohart, UCD). MODOC CO.: Alturas, 14 mi. N, 2 ♂, VI–27–63 (V. Vesterby, UCD). Cedarville, 6 mi. NW, 2 ♂, 1 ♀, VII–4–62 (J. Buckett, UCD). Davis Creek, 11 ♂, 2 ♀, VIII–15–22 (C. Fox, CAS). Lake City, 1 ♂, VII–28–22 (C. Fox, CAS). Tule Lake, 1 ♀, VII–19–54 (P. Hurd, CIS). MONTEREY CO.: Arroyo Seco, 1 ♂, 3 ♀, VI–6–57, on *Clarkia unguiculata* (G. Stage, SS). Bryson, 1 ♀, V–18–20 (E. Van Duzee, CAS). Ft. Ord, 1 ♂, VII–15–57 (H. Court, UCD). Paraiso Spring, 1 ♂, V–26–50 (R. Bohart, UCD). San Ardo, 4 mi. S, 1 ♂, VII–2–60 (P. Paige, UCD). NAPA CO.: Monticello Dam, 20 mi. W, 1 ♂, V–12–61, on *Brodiaea laxa* (J. Buckett, UCD). Samuel Springs, 2 ♂, 1 ♀, V–8–55 (E. Schlinger, UCD). NEVADA CO.: Boca, 2 ♂, 8 ♀, VI–28 to VII–5–54 (numerous coll., UCD). Cisco, 1 ♀, VII–1920 (H. Ricksalee, CAS). Grass Valley, 1 ♀, VII–5–56 (J. Powell, CIS). Fuller Lake, 1 ♀, VII–15–61 (L. Stange, UCD). Jackson Lake, 1 ♀, VII–15–61 (L. Stange, UCD). Hobart Mills, 4 ♂, 1 ♀, VI–29–62, on *Calyptridium umbellatum* (M. Irwin, UCD). Sagehen Creek, 1 ♂, 1 ♀, VII–4–54 (P. Hurd, CIS). PLACER CO.: Carnelian Bay, Lake Tahoe, 2 ♂, 8 ♀, VII–9 to IX–56 (R. Bohart, UCD). PLUMAS CO.: Blairsden, 1 ♂, VII–2–54 (R. Bohart, UCD). Keddie, 1 ♂, VII–4–51 (E. Schlinger, UCD). Lake Almanor, 4 ♂, VII–13–34 (E. Van Duzee, CAS). Portola, 1 ♂, VII–2–54 (R. Bohart, UCD). Quincy, 4 mi. W, 7 ♂, 2 ♀, VI–22–49, on *Phacelia* (P. Hurd, CIS). Meadow Valley, 1 ♂, VI–30–34 (E. Van Dyke, CAS). Mohawk, 1 ♀, VII–11–57 (D. Rentz, SS). RIVERSIDE CO.: Anza, 2 mi. E, 1 ♂, VII–7–56, on *Eriogonum fasciculatum* (P. Hurd, CIS). Banning, 2 ♂, V–30–28 (E. Van Dyke, CAS). Hemet, 8 mi. W, 1 ♂, VI–29–46 (J. MacSwain, CIS). Idyllwild, 3 ♂, 1 ♀, VII–22–33, on *Lotus argophyllus*, and *Lotus Purshianus* (P. Timberlake, UCR); 1 ♂, VII–22–33, on *Horkelia Bolanderi* ssp. *Clevelandii* (P. Timberlake, UCR); 2 ♂, VI–9–40, on *Lotus Davidsonii* (P. Timberlake, UCR). Keen Camp, San Jacinto Mts., 2 ♂, 1 ♀, VI–13–39 (E. Linsley, CIS); 8 mi. W, 1 ♂, V–16–39, on *Cirsium* (E. Linsley, CIS). Perris, 1.5 mi. W, 6 ♂, 2 ♀, VI–21–38, on *Lotus scoparius, Lotus Purshianus* (P. Timberlake, UCR). Riverside, 14 ♂, 6 ♀, V–17–29, on *Lotus scoparius, Phacelia ramosissima* (P. Timberlake, UCR); 1 ♂, 1 ♀, V–21–30, on *Eriastrum pluriflorum* (P. Timberlake, UCR). The Gavilan, 1 ♂, VI–18–37, on *Oenothera* (E. Linsley, CIS); 5 ♂, 1 ♀, VI–24–38, on *Lotus scoparius* (P. Timberlake, UCR). SACRAMENTO CO.: Folsom, 1 ♀, V–19–55, on *Cryptantha* (P. Hurd, CIS). Fair Oaks, 1 ♂, VI–24–44 (C. Hamsher, UCD). SAN BENITO CO.: Idria, 1 ♂, 1 ♀, VI–29–54 (C. MacNeill, CIS). Pinnacles, 1 ♀, VII–2–56, on *Hemizonia Lobbii* (P. Hurd, CIS). SAN BERNARDINO CO.: Big Bear Valley, 3 ♂, 1 ♀, VI–18–34, on *Lotus argophyllus* (P. Timberlake, UCR). Cajon Wash, 2 ♂, 1 ♀, VI–16–38, on *Lotus scoparius* (P. Timberlake, UCR). Devore, 1 ♀, VI–23–35, on *Antirrhinum Coulterianum* (P. Timberlake, UCR). Green Valley, 1 ♀, VI–9–38, on *Lotus scoparius* (P. Timberlake, UCR). Lake Arrowhead, 1 ♂, 1 ♀, VII–9–56, on *Horkella Bolanderi* (E. Linsley, CIS); 1 ♂, VI–7–35, on *Lotus Davidsonii* (P. Timberlake, UCR). Lytle Creek, 1 ♀, VII–1–41 (C. Dammers, SS). Phelan, 2 mi. W, 1 ♂, VI–7–58 (J. Hall, UCD). San Bernardino Mts., 2 ♂, V–15–37, on *Ceanothus* (E. Linsley, CIS). SAN DIEGO CO.: Alpine, 1 ♂, VI–1–36, on *Lotus scoparius* (P. Timberlake, UCR). Barrett Springs, 1 ♀, IV–20–50 (E. Linsleey, J. MacSwain, CIS). Boulevard, 2 mi. SW, 2 ♂, 3 ♀, VI–10–56, on *Lotus* (R. Snelling, SS). Mt. Laguna, 13 ♂, 8 ♀, VI–21–63, on *Lotus strigosus* (P. Hurd, CIS). Poway, 1 ♂, 1 ♀, V–16–86 (F. Blaisdell, CAS). Warner Springs, 2 mi. N, 1 ♂, VII–8–56, on *Croton californicus* (R. Bechtel, UCD). SAN LUIS OBISPO CO.: Atascadero, 8 mi. W, 2 ♀, VII–3–56, on *Clarkia speciosa* (E. Linsley, CIS). Creston, 5 mi. S, 2 ♂, VI–20–59 (P. Marsh, UCD). La Panza, 12 mi. NE Pozo, 1 ♂, 1 ♀, IV–29–52 (R. Thorp, CIS). Santa Margarita, 5 mi. NE, 2 ♂, V–4–62, on *Lupinus nanus* (P. Hurd, CIS); 1 ♂, 1 ♀, V–2–62, on *Chaenactus glabriuscula* (P. Hurd, CIS). Simmler, 10 mi. W, 1 ♀, IV–29–62 (P. Hurd, CIS). SANTA BARBARA CO.: Bluff Camp, San Rafael Mts., 2 ♂, 1 ♀, VI–29–59 (F. Parker, UCD). Cachumaco Park, 1 ♂, VII–5–56 (P. Hurd, CIS). Figueroa Mt., 1 ♂, VII–3–59 (W. Steffan, UCD). Santa Ynez Mts., 3 ♀, VI–24–59 (P. Marsh, F. Parker, UCD). SANTA CLARA CO.: Alum Rock Park, 1 ♀, V–27–50 (S. Bailey, R. Bohart, UCD). Mt. Hamilton, 1 ♀, V–25–50, on *Eriodictyon* (E. Linsley, CIS). SANTA CRUZ CO.: Mission Springs, 1 ♀, VI–30–56, on *Clarka amoena* (R. Snelling, SS). Mt. Hermon, 2 ♂, VII–7–22 (C. Fox, CAS); Soquel, 9 mi. E, VI–4–56 (S. Fidel, UCD). SHASTA CO.:

Cassel, 1 ♀, VII–5–55, on *Aster* (J. MacSwain, CIS). Cayton, 1 ♀, VII–13–18 (E. Van Duzee, UCR). Hat Creek, 5 ♂, 2 ♀, VI–26–55 (W. Middlekauff, CIS). Moose Camp, 1 ♂, 1 ♀, VII–14–55 (E. Schlinger, UCD). Redding, 1 ♂, VII–7–18 (E. Van Duzee, UCR). SIERRA Co.: Independence Lake, 2 ♂, 1 ♀, VII–27–56 (R. Bohart, UCD). Sierraville, 5 ♂, VII–6–62 (M. Irwin, UCD); 15 mi. SE, 1 ♂, VII–4–60 (F. Parker, UCD). Weber Lake, 1 ♂, VII–5–51 (E. Schlinger, UCD). SISKIYOU Co.: Macdoel, 1 ♀, VII–27–63, on *Grindelia* (J. Schuh, JS). Mt. Hebron, 9 mi. S, 1 ♂, IX–3–63, on *Cirsium vulgare* (J. Schuh, JS). Walker, 1 ♀, VI–3–20 (C. Fox, CAS). SOLANO Co.: Rio Vista, 35♂, 8♀, V–24–49, on *Lotus* (P. Hurd, E. Linsley, J. MacSwain, CIS). SONOMA Co.: Sonoma, 1 ♂, VII–1–10 (J. Kusche, CAS). STANISLAUS Co.: La Grange, 3 ♂, 1 ♀, V–28–61 (R. Snelling, LACM). TRINITY Co.: Carrville, 1 ♂, VI–27–31 (E. Van Dyke, CAS). Coffee Creek, 9 ♂, 3 ♀, VI–8–25, on *Lotus scoparius* (P. Timberlake, UCR); 10 mi. W, 2 ♂, 4 ♀, VII–14–55 (R. Bohart, E. Lindquist, CIS, UCD). Trinity Center, 1 ♂, VII–18–53, on *Penstemon* (A. McClay, UCD). TULARE Co.: Badger, 1 ♂, VI–26–29, on *Lotus nevadensis* (P. Timberlake, UCR). Mineral King, 1 ♀, VIII–4–39 (CIS). Sequoia National Park, 1 ♀, VI–9–52 (R. Bohart, UCD). TUOLUMNE Co.: Dardanelles, 1 ♀, VI–26–51 (J. MacSwain, CIS). Dodge Ridge, 2 ♂, VIII–7–60 (A. Menke, UCD). Mather, 1 ♀, VII–12–29 (E. Zimmerman, CAS). Pinecrest, 5 mi. W, 1 ♀, VI–30–57, on *Lotus* (R. Snelling, SS). Strawberry, 1 ♀, VII–15–53 (J. Rozen, CIS). VENTURA Co.: Santa Susana Pass, 1 ♂, VI–14–61 (M. Irwin, UCD). YOLO Co.: Rumsey, 1 ♀, V–30–56 (R. Bohart, UCD).

The males of *utahense* can be distinguished by the shape of tergum VII (fig. 55) which has the lateral lobe truncate posteriorly and about twice as wide as the distance between it and the median spine. The shape of tergum VII is similar for *jocosum* (fig. 58), but the latter species differs by having weakly produced lateral lobes of sternum VI (figs. 56, 59) and a poorly differentiated setal brush. Females of *utahense* have a distinctive tergum VI which has the posterior marginal band nearly truncate (fig. 81), and in contrast to *mormonum* (fig. 80) the dorsolateral border is close to the cross-under point of the band. The absence of fine white pile on the basitarsus distinguishes *utahense* from *collectum* females. Typically, the clypeus and mandible of the females are nearly all yellow, with the clypeus frequently having a dark median band.

This small- to moderate-sized species is one of the most commonly collected (696 ♂, 451 ♀) and most widespread *Anthidium* in California, but it is notably absent from the Mojave and Colorado deserts and Great Valley. There is slight geographic variation in color pattern, although specimens from southern California tend to have slightly fuller yellow markings.

According to Jaycox (1966) female *utahense* nest in the ground by utilizing cavities made by other insects and animals, and will accept artificial nest cavities (such as in straws inserted in wooden blocks) when placed in sandy areas. Pollen was gathered from *Phacelia* and *Melilotus* plants. Presumably the same female gathered a load of pollen in 10 to 27 minutes. Completed nests contained 1 to 4 cells (averaging 2.1 cells per nest). The cells were lined with down gathered from *Cirsium* and *Artemisia* plants, and the top of the cell series was packed with gravel. Individuals of *Dioxys productus productus* (Cresson) were observed as parasitoids or depredators of larval food.

Plant visitations taken from California records include species in 25 genera and numerous families. Most frequently visited were species of the legume *Lotus*.

Genus *Callanthidium* Cockerell

This genus contains only two species, which are restricted in distribution to temperate western North America. Both are large bees similar in coloration with extensive yellow markings. As Michener (1948) pointed out, there is a close relationship of *Callanthidium* with the genus *Anthidium*. The multidentate female mandible and absence of an arolium are common to both genera and distinguish them from all other anthidiine genera in California. The chief difference between the two genera are the enlarged penis valves of the male and a large median emargination of the female tergum VI in *Callanthidium* (figs. 102, 107).

According to information provided by Johnson (1904) and later augmented by the studies of Hicks (1929*b*), *Callanthidium* has habits similar to *Anthidium* in that they appropriate ready-made burrows of other insects and line their cells with tomentum scraped from plants. However, Hicks states that *C. illustre* uses resin in the construction of the cap, which is not true of the few known nesting habits of the species of *Anthidium*.

KEY TO THE CALIFORNIA SPECIES OF CALLANTHIDIUM COCKERELL

MALES

1 Tergum VII with mesal margin of lateral lobe strongly curved (fig. 101), center spine reaching nearly to posterior margin of lateral lobe; sternum VI without median spinelike lobe (fig. 105); apical process of sternum VIII expanded crestlike at right angle to flat plane of sternum (figs. 103, 104) . *formosum* (p. 36)

Tergum VII with mesal margin of lateral lobe relatively straight, center spine short, blunt (fig. 106); sternum VI with median spinelike lobe (fig. 109); apical process of sternum VIII small, simple (fig. 108) . . . *illustre* (p. 36)

FEMALES

1 Tergum VI raised along midline, usually without sublateral spot (fig. 102) . . *formosum* (p. 36)
Tergum VI not raised along midline, usually with large sublateral spot (fig. 107) . *illustre* (p. 36)

Callanthidium formosum (Cresson)

(Figs. 101–105; Map 25)

Anthidium formosum Cresson, 1878. Trans. Amer. Ent. Soc., 7:112. Holotype ♂, Colorado (ANSP).

Anthidium conspicuum Cresson, 1879. Trans. Amer. Ent. Soc., 7:207. Holotype ♀, Nevada (ANSP).

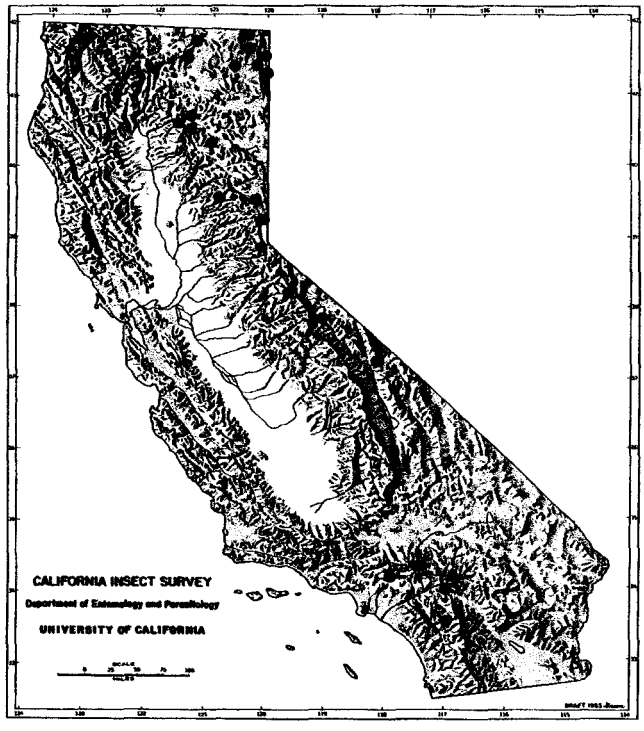
Anthidium illustre var. *consonum* Cresson, 1879. Trans. Amer. Ent. Soc., 7:207. Holotype ♀, Nevada (ANSP).

Dianthidium balli Titus, 1902. Ent. News., 13:170. Holotype ♀, Ridgeway, Colorado.

Callanthidium formosum pratense Cockerell, 1925. Proc. Calif. Acad. Sci., Series 4, 14:366. Holotype ♂, Meadow Valley, Plumas Co., California (CAS).

Geographic range.—Arizona, California, Colorado, Montana, Nevada, Oregon, Utah.

California records.—EL DORADO CO.: Fallen Leaf Lake, 1 ♀, VIII–19–20 (I. McCracken, CIS). LOS ANGELES CO.: Big Pine Creek, 1 ♂, 1 ♀, VII–14–27, on *Castilleja* (P. Timberlake, UCR). RIVERSIDE CO.: Herkey Creek, 1 ♂, VI–24–34 (I. McCracken, CAS). SAN BERNARDINO CO.: Big Bear Valley, 8 ♂, 2 ♀, VIII–6–33, on *Monardella linoides* (P. Timberlake, UCR); 5 ♂, 9 ♀, VII–7–34, on *Lotus argophyllus* (P. Timberlake, UCR). INYO CO.: Westgard Pass, 3 mi. N, 1 ♂, VI–26–53 (J. MacSwain, CIS). LASSEN CO.: Bridge Creek Camp, 4 ♂, 1 ♀, VII–14–54 (R. Bohart, R. Goodwin, UCD, CIS). MODOC CO.: Cedarville, 1 mi. N, 1 ♀, VII–9–46, on *Medicago sativa* (P. Hurd, R. Smith, CIS). Davis Creek, 8 ♂, 1 ♀, VII–11–22 (C. Fox, CAS). Goose Lake, 2 ♂, VII–24–22 (C. Fox, CAS). Newell, 1 ♂, VII–13–63, on *Astragalus* (J. Schuh, JS). Tule Lake, 1 ♂, VI–25–63, on *Astragalus* (J. Schuh, JS). MONO CO.: Crooked Creek, White Mts., 1 ♂, VII–19–61 (G. Stage, CIS). McKay Creek, Sonora Pass, 1 ♀, VIII–18–60 (C. Toschi, CIS). NEVADA CO.: Truckee, 1 ♂, VII–7–27 (E. Van Duzee, CAS). SAN BERNARDINO CO.: Dollar Lake Trail, 2 ♂, 3 ♀, VII–11–56 (R. Bohart, UCD). SHASTA CO.: Hat Creek, 1 ♂, VI–21–55 R. Bechtel, UCD). Lake Eiler, 1 ♂, VII–22–47 (C. Hanson, CIS). Old Station, 1 ♂, VI–22–55 (J. Jessen, UCD). SIERRA CO.: Gold Lake, 1 ♀, VIII–13–63 (R. Wescott, LACM). Sierraville, 3 ♂, 1 ♀, VIII–26–48, on *Phacelia* (J. MacSwain, CIS). SISKIYOU CO.: Valentine Caves, Lava Beds National Mon., 2 ♀, VI–30–63 (V. Vesterby, UCD). TUOLUMNE CO.: Blue Canyon, 1 ♀, VIII–30–60 (G. Colliver, CIS). Sonora Pass, 3 ♂, VII–10–57 (D. Flaherty, UCR).



Map 25. California distribution of *Callanthidium formosum* (Cresson)

C. formosum is less commonly collected (61 ♂, 37 ♀) than *illustre* and its distribution is limited in California to the Cascade, Sierra Nevada, and southern California mountains. The last tergum (figs. 101, 102) furnishes diagnostic characters to distinguish both sexes of *formosum*. Also, male sternum VI (fig. 105) differs considerably in *formosum* by lacking the median spinelike projection of *illustre* (fig. 109). The form of sternum VIII (fig. 103, 104) is of considerable interest because of the expanded crestlike plate at a right angle to the flat plane of the sternite.

Nothing is known of the nest construction, and sparse records of plant associations show collections from four families with slightly over one-half being from the Leguminosae.

Callanthidium illustre (Cresson)

(Figs. 4, 106–110; Map 26)

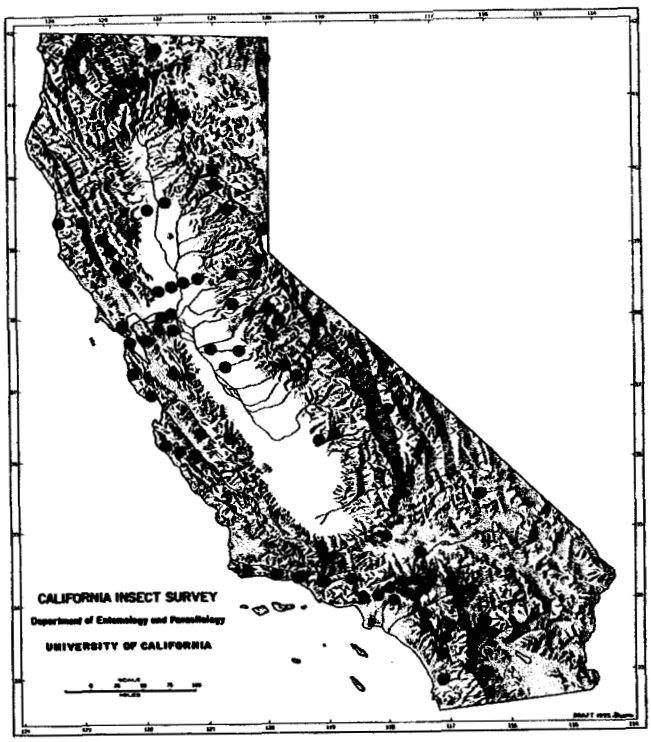
Anthidium illustre Cresson, 1879. Trans. Amer. Ent. Soc., 7:206. Holotype ♀, Nevada (ANSP).

Anthidium serranum Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:24. Holotype ♂, Rock Creek, California.

Biology.—Johnson, 1904, Ent. News 15:284. Hicks, 1929, Can. Ent., 61:1–8. Parker and Bohart, 1966, Pan-Pac. Ent. 44(2):96.

Geographic range.—Northern Baja California, Arizona, California, Nevada, New Mexico, Oregon, Utah.

California records.—ALAMEDA CO.: Oakland, 1 ♂, VI–15–47 (L. Jensen, CIS). BUTTE CO.: Chico, 1 ♂, V–1920 (V. Stevens, CIS). CALAVERAS CO.: Mokelumne Hill, 1 ♂, 1 ♀, VI–28–21 C. Fox, CAS); Murphys, 1 ♂, VI–1938 (F. Blaisdell, CAS). COLUSA CO.: Lodoga, 1 ♀, VII–12–55 (W. Lange, UCD).CONTRA COSTA CO.: Antioch, 2 ♂, 2 ♀, V–24–49, on *Lotus* (J. MacSwain, P. Hurd, E. Linsley, CIS). Clayton, 6 mi. E, 2 ♂, V–27–50 (T. Leigh, CIS). Mt. Diablo,



Map 26. California distribution of *Callanthidium illustre* (Cresson)

1 ♀, V–3–53, on *Cirsium* (R. Snelling, SS). EL DORADO CO.: Camino, 3 mi. S, 1 ♂, 1 ♀, VI–26–48 (P. Hurd, CIS). Kyburz, 1 ♂, VII–11–50 (W. Ehrhardt, CIS). Snowline Camp, 1 ♂, VI–27–48, on *Phacelia* (P. Hurd, CIS). FRESNO CO.: Watts Valley, 3 ♂, VI–22–56 (R. Schuster, CIS). GLENN CO.: Artois, 1 ♂, VI–13–52, on *Lotus* (J. MacSwain, CIS). INYO CO.: Independence, 1 ♂, 1 ♀, VI–1–37 (W. Reeves, CIS). KERN CO.: Mill Potrero, 9 ♂, 3 ♀, VII–6–59 (R. Bohart, UCD). Mojave, 12 mi. W, 1 ♂, VI–14–61, on *Penstemon* (R. Thorp, CIS). LAKE CO.: Blue Lakes, 1 ♂, V–20–59 (S. Fidel, UCD). Cobb Mt., 1 ♀, VI–9–55 (R. Bohart, UCD). Kelseyville, 1 ♂, V–23–57 (S. Fidel, UCD). LOS ANGELES CO.: Arroyo Seco, 2 ♂, 1 ♀, VI–25–40, on *Turricula Parryi* (J. MacSwain, CIS). Camp Baldy, 1 ♂, VI–26–50 (W. Bentinck, CIS). Crystal Lake, 10 ♂, 2 ♀, VI–28–56 (A. Menke, L. Stange, LACM). Castaic, 10 mi. W, 1 ♂, VI–19–52 (G. Stage, SS). Glendale, 1 ♀, VI–11–49 (E. Schlinger, UCD). Tanbark Flat, 2 ♀, VI–21 and 30–50 on *Lotus* and *Helianthus* (P. Hurd, CIS). San Francisquito Canyon, 1 ♂, 1 ♀, III–31–53 (A. Menke, LACM). Big Pines Canyon, 2 ♂, 1 ♀, VII–16–27, on *Phacelia heterophylla* (P. Timberlake, UCR). MADERA CO.: Bass Lake, 1 ♂, VI–6–38 (N. Hardman, CIS). Nipinnawasee, 1 ♂, 2 ♀, V–24–36 (E. Ross, CAS). MARIN CO.: Mt. Tamalpais, 1 ♀, V–25–52 (G. Stage, SS). MARIPOSA CO.: Wawona, 1 ♂, VII–7–46 (H. Chandler, CAS). MENDOCINO CO.: Fort Bragg, 1 ♀, V–20–36, on *Calochortus* (I. McCracken, CAS). Willits, 1 ♀, VII–4–52 (W. Bentinck, CIS). MERCED CO.: Hilmar, 2 mi. S, 1 ♀, V–5–57, on *Phacelia distans* (R. Snelling, G. Stage, SS). MODOC CO.: Lake City, 4 mi. S, 1 ♂, VI–9–46, on *Medicago sativa* (P. Hurd, R. Smith, CIS). Newell, 1 ♀, VIII–2–63, on *Medicago sativa* (J. Schuh, JS). MONTEREY CO.: *Arroyo Seco*, 7 ♂, 4 ♀, VII–1962 (F. Parker, UCD). Big Sur, 1 ♂, VIII–23–51 (W. Lange, UCD). Tassajara Hot Springs, 5 ♀, V–26–54 (O. Bryant, CAS). MONO CO.: Mono Lake, 1 ♀, VII–8–34 (G. Englehardt, CAS). NAPA CO.: Samuel Springs, 1 ♀, V–5–55 (A. Telford, UCD). NEVADA CO.: Boca, 1 ♀, VII–3–54, on *Phacelia* (P. Hurd, CIS). PLUMAS CO.: Greenville, 1 ♀, VII–11–59 (L. Stange, UCD). Meadow Valley, 1 ♀, VI–30–24 (E. Van Dyke, CAS). Quincy, 4 mi. W, 5 ♂, VI–26–49, on *Phacelia* (P. Hurd, CIS). RIVERSIDE CO.: Anza, 1 ♂, V–24–56, (L. Stange, LACM). Dark Canyon, 1 ♂, VI–31–40, on *Lotus oblongifolius* (C. Michener, CIS). Idyllwild, 1 ♂, 1 ♀, VI–4–39, on *Astragalus* (E. Linsley, E. Ross, CIS). The Gavilan, 1 ♂, VI–24–38, on *Lotus scoparius* (P. Timberlake, UCR). Palm Springs, Andreas Canyon, 2 ♂, V–15–32, on *Eriodictyon crassifolium* (P. Timberlake, UCR). Pine Flat, 4 ♂, 1 ♀, VI–14–40, on *Astragalus* (C. Michener, CIS). Riverside, 12 ♂, 4 ♀, IV–VI, on *Lotus scoparius, Phacelia ramosissima, Lathyrus odoratus* (P. Timberlake, UCR). SACRAMENTO CO.: *Folsom*, 7 ♂, 1 ♀, V–30–52 (T. Haig, CIS). Sacramento, 1 ♂, V–27–35 (I. McCracken, CAS). SAN BENITO CO.: Idria, 2 ♂, 1 ♀, VI–29–55, on *Phacelia* (P. Hurd, M. Wasbauer, CIS). Pinnacles, 1 ♀, V–3–46 (J. MacSwain, CIS). SAN BERNARDINO CO.: Big Bear Lake, 1 ♂, 1 ♀, VII–4–34 (I. McCracken, CIS). Cajon Pass, VI–25–49 (H. Cott, UCD). Mentone, 12 mi. E, 1 ♀, VII–11–56 (A. Menke, LACM). Lake Arrowhead, 2 ♂, VII–16–33, on *Lotus argophyllus* (P. Timberlake, UCR). Stockton Flat, 1 ♂, VII–2–36 (C. Dammers, UCR). SAN DIEGO CO.: Mt. Laguna, 1 ♂, VIII–5–63, on *Eriodictyon trichocalyx* var. *lantum* (P. Hurd, CIS). Mt. Palomar, 1 ♂, VI–19–50 (F. Williams, CAS); Pala, 1 ♀, VI–21–59 (M. Irwin, UCD). Poway, 1 ♀, V–24–35 (E. Van Duzee, CAS). Warner Springs, 8 mi. S, 1 ♂, VII–4–56 (A. Menke, LACM). SAN FRANCISCO CO.: San Francisco, 1 ♀, IV–28–32 (Bryant, CAS). SANTA BARBARA CO.: Bluff Camp, San Rafael Mts., 2 ♂, VI–29–59 (F. Parker, UCD). Carpinteria, 2 ♂, VII–21–37 (B. White, CAS). SANTA CLARA CO.: Mt. Hamilton, 1 ♂, V–30–50, on *Eriodictyon* (J. MacSwain, CIS). SANTA CRUZ CO.: Highland District, 1 ♂, VI–17–56 (S. Fidel, UCD). Mission Springs, 2 ♂, VI–30–52, on *Artemisia californica* (R. Snelling, SS). SHASTA CO.: Burney, 5 mi. E, 1 ♂, VI–9–41 (C. Anderson, CIS). Cassel, 1 ♂, VII–5–55 (A. Mueller, UCD). Cayton, 1 ♂, 1 ♀, VII–13–18 (E. Van Duzee, CAS). Lake Britton, 1 ♀, VI–29–47 (C. Hanson, CIS). SIERRA CO.: Gold Lake, 1 ♀, VIII–13–63 (R. Wescott, LACM). SISKIYOU CO.: Finlay Camp, 1 ♂, VII–7–58 (J. Powell, CIS). Montague, 4 ♂, VII–12–63, on *Lotus* (J. Schuh, JS). Mt. Shasta City, 1 ♂, VI–23–58 (J. Powell, CIS). SOLANO CO.: Rio Vista, 4 ♂, 1 ♀, V–24–49, on *Lotus* (P. Hurd, CIS). STANISLAUS CO.: La Grange, 1 ♀, V–28–61 (R. Snelling, LACM). Turlock, 1 ♂, V–8–51, on *Phacelia distans* (R. Snelling, SS). TRINITY CO.: Carrville, 1 ♀, V–21–34 (R., G. Bohart, CIS). Coffee Creek, 1 ♂, 3 ♀, VI–8–25, on *Lotus scoparius* (P. Timberlake, UCR). Trinity Center, 1 ♀, VII–18–53, on *Penstemon* (A. McClay, UCD). TULARE CO.: Lemoncove, 1 ♀, IV–14–50, on *Lupinus* (J. MacSwain, CIS). Sequoia National Park, 1 ♂, VI–9–52 (R. Bechtel, UCD). Wood Lake, 1 ♂, IV–20–47, (N. Frazier, CIS). TUOLUMNE CO.: Mather, 1 ♂, VI–8–61 (M. Irwin, UCD). Pinecrest, 1 ♀, VII–2–52 (J. Stage, SS). Strawberry, 1 ♂, VII–15–51 (D. Lawfer, UCD). VENTURA CO.: Frazier Mt., 2 ♂, VII–14–46 (F. Ehrenford, CIS). YOLO CO.: Davis, 1 ♂, 2 ♀, V–20–50 (R. Bechtel, UCD).

The males of *illustre* are easily separated from those of *formosum* by the shape of sterna VI and VIII, and tergum VII. Tergum VI of the female provides the only easily used character to distinguish *illustre* from *formosum* as was discussed for that species.

C. illustre is the most commonly collected species of the genus, as shown by California records of 403 males and 205 females. The distribution of the two species is similar, but *C. illustre* is found further south and apparently is more tolerant of drier conditions. *C. illustre* extends throughout the varied environments of California, but its occurrence is somewhat marginal in the Colorado and Mojave deserts. Plant visitations were recorded in five plant families, but over half the records were from Leguminosae (Lotus) and Hydrophyllaceae (Phacelia).

Females have been found nesting in dead flower stalks of *Yucca Whipplei* and stumps of oak in southern California by Hicks (1929*b*). The species has also been found using deserted burrows of the bee *Anthophora occidentalis* in clay banks in Colorado by Johnson (1904), and trap nests by Parker and Bohart (1966). The number of cells per burrow ranges from two to ten and the cells are in one or two columns. The cells and cocoons (fig. 216) are separated by cottony down (fig. 215). From the observations of Hicks, the females search many plants to find a suitable material, and at least three types of fibers were found in one nest. Johnson found both white and brown fibers in the same nest and speculated that the sources were pappus from composite flowers (brown) and trypetid galls (white). Hicks found one female to fly 103 feet from her nest to a source plant, *Lepidospartum squamatum*. The female uses her mandibles to scrape the tomentum from the plant and carries it back as a ball under her legs. The nesting burrows were closed by caps consisting of small pieces of old stems, seeds, and pebbles held together by a small amount of resin. The pollen ball was derived from *Lotus scoparius* in southern California. It took eighteen days from pupation to the emergence of the adult in one case. Mating was observed by Hicks around the pollen source plants. He found a cerambycid larva, *Tragidion armatum*, in one nest that was probably responsible for the mechanical destruction of two cells. Birds destroyed some cells by forcing their beaks into the nest.

Genus *Dianthidium* Cockerell

This genus is represented in the New World and Old World but is most abundant in the Americas. The Nearctic subgenus *Dianthidium* is distinguished from three Neotropical subgenera (Michener, 1948) by having a large apical spine on the hind coxa of the male and very large lamellae of the posterior lobes of the pronotum. These lamellae lie nearly flat and project forward beyond the anterior margin of the pronotum. The seventh metasomal tergum of the male is trilobed with the lateral lobes being broad and rounded and the median one being smaller, sometimes spinelike, and blunt. The bees of this subgenus are black or brownish-black with white or yellow markings and with varying amounts of red in some species.

Morphological characters of greatest value in distinguishing species of this genus include the last visible tergum and sternum and to some extent punctation on both sexes. The metasoma may have to be relaxed and straightened to observe the sterna, and it may be necessary to brush the pollen from the apex of the sixth female sternum. The structure of the female mandible is quite diagnostic, but the teeth of this appendage may be somewhat worn in the process of nest construction. The apices of the penis valves of the males show valuable specific characters, and these can be observed without removal of the genitalia although relaxing and adjustment may be necessary. Size and coloration are of limited value. The pubescence and pattern of maculation only rarely show specific differences. The early stress on morphological differences in this genus has prevented the development of a complex synonymy like that which occurs in such genera as *Anthidium*. As in the case of some other genera of Anthidiini, the females of *Dianthidium* show less specific differences than the males, and their misidentification has led to some synonymy.

Cresson, Cockerell, Schwarz, and Timberlake have been the most prominent workers in this group in North America, and revisions of the genus were made by Schwarz in 1926*(b)* and Timberlake in 1943. Taxonomists working on this genus were cautious in the use of color for specific discrimination but did not hesitate to name subspecies based on single specimens when differences were noted in color, extent of maculation, or pubescence.

In a number of widely distributed species, particularly on the Pacific slope, a clinal effect can be observed with an increase in the extent of maculation from north to south with the most highly maculated forms occurring in southern California. This trend may be reversed in some species with the maculations being reduced as the species extends further south into Baja California. This cline has been split

up into three and sometimes four subspecies; and when collections of the species became more abundant and widespread, the characters so intergraded that the named subspecies could no longer be separated. Such variation is not recognized as subspecific differences in this paper.

A reddish color occurs on various parts of some species, such as the legs and areas of certain metasomal segments. This color may be diagnostic at the species level, consistent for some subspecies but highly variable for others and associated with no apparent morphological or geographical pattern. Reddish coloration is used to distinguish subspecies in this paper when it is consistent and has a geographical basis.

A third form of color difference is white vs. yellow maculations. White maculations are most frequently observed on species occurring east of the Sierra and the southwestern United States, but this is not consistent with all species. White vs. yellow is recognized as a subspecific difference in this paper, since it is generally associated with definite geographic boundries. This color difference is clear-cut in some subspecies and is associated with consistent minor morphological differences; but existing names are hesitantly recognized for the division of a few species into subspecies where additional differences have not been observed.

The distribution of *Dianthidium, sensu stricto,* extends from Canada into Mexico, with most of the species being limited to western North America. However, *curvatum* and *simile* are represented east of the Mississippi River, with the latter species being restricted to the eastern United States. California is included in the distribution of 13 of the 19 species found in the United States and Canada. *Dianthidium* is next to the *Anthidium* in number of species inhabiting California, and collections of *Dianthidium* represent one-fifth of the total specimens studied.

Biological information concerning this genus is rather limited, since observations on the nest construction or natural enemies of less than one-half of the species of North America have been published. All reported information or personal observations reveal plant resins to be the common bonding material in nest construction. Habits of the various species may vary considerably. *D. curvatum sayi* nests gregariously by constructing burrows in the soil, whereas *ulkei* utilizes existing burrows or cavities in the soil or wood. Five other species construct their nests on twigs, leaves, or the surface of rocks with no apparent specificity. A nest may consist of an individual cell or multiples of cells in close contact. Small pebbles or grains of sand and less frequently bits of wood or plant materials are utilized with the resin in nest construction for most species, but cavities utilized by *D. ulkei* have been observed with no sand or pebbles. A parchmentlike membrane lining the cell has been observed in a number of nests. The nest is provisioned with pollen on which an egg is deposited, and the cell is capped with resin. The larva spins a mammillate cocoon before pupation. An air space of varying size is found between the mammilla and resin cap. Apparently some individuals of a nest may remain in the cells at least two years before emergence.

Hurd and Linsley (1950) reported the orders Coleoptera, Diptera, and Hymenoptera to be associated with the nests of *Dianthidium.* They reported the following families of Hymenoptera: *Callimomidae, Chrysididae, Leucospidae, Megachilidae, Multi*lidae, Sapygidae, and Vespidae. The dipteran families found were the Bombyliidae and Sarcophagidae, whereas the Coleoptera is represented by the families Cleridae and Meloidae. The various species of these orders will be taken up with the species of bees with which they were associated.

KEY TO THE CALIFORNIA SPECIES OF DIANTHIDIUM

Males

1 Tergum VII trilobed or nearly truncate; median lobe straight, extending toward apical margin of lateral lobes 2
Tergum VII trilobed; median lobe curved or extended ventrally below plane of lateral lobes 10

2 (1) Sides of terga II to V not inflated; small species, about 10 mm long or less 3
Sides of terga II to V inflated (fig. 203); large species, about 12 mm long . *singulare* (p. 54)

3 (2) Tergum VII with lateral lobes separated from median lobe by prominent, rounded emarginations, with inner margin of lateral lobes at right angle to apical margins and parallel to median lobe (figs. 153, 156) 4
Tergum VII with lateral lobes indistinctly separated from median lobe (fig. 162, 168), or if prominently emarginate, inner margin of lateral lobes obliquely angled from median lobe (figs. 159, 171) 5

4 (3) Tergum VII with distance between inner margin of apex of lateral lobe and median lobe 1 and one-half to 2 or more times width of apex of median lobe (fig. 153); penis valve gradually tapered to median apex (fig. 155) . . . *parvum* (p. 47)
Tergum VII with distance between inner margin of apex of lateral and median lobe subequal to width of apex of median lobe (fig. 156); penis valve transverse subapically, except for acute, median apex (fig. 158) . . . . *subparvum* (p. 54)

5 (3) Punctures of frons subequal to those of mesos-

cutum; penis valve with single apex . . . 6
Punctures of frons at least twice at large and one-half as dense as those of mesoscutum; penis valve with dorsal and ventral apex (fig. 152) . . . . . *implicatum* (p. 46)

6 (5) Forecoxa unarmed; maculations of legs and thorax yellow or cream 7
Forecoxa armed at apex with short, prominent spine; maculations of legs and thorax generally reddish-brown . . . . . *curvatum* (p. 41)

7 (6) Lateral lobes of tergum VII may be indistinctly separated from median lobe or well separated by emarginations; median lobe truncate or rounded at apex, two or more times as wide as thick 8
Lateral lobes of tergum VII separated from triangular-shaped median lobe by prominent emarginations, apex of median lobe acute (fig. 159), as wide as thick . . . *heterulkei* (p. 45)

8 (7) Punctures on either side of longitudinal median line of tergum VII dense, near touching, with numerous setae; penis valve fringed with long setae laterally, gonostylus with fine pile . . 9
Punctures on either side of longitudinal median line of tergum VII sparse, 2 to 3 widths apart, setae sparse; penis valve with fine pile only, gonostylus with long hairs mesially . . . *desertorum* (p. 42)

9 (8) Apex of sternum VI (fig. 163) about twice as wide as opposed apices of penis valves; apex of gonostylus obliquely angled in lateral aspect, tip extending beyond longitudinal plane of gonostylus about equal to its width . . . *ulkei* (p. 56)
Apex of sternum VI (fig. 166) subequal to width of apposed apices of penis valves; apex of gonostylus nearly right angled in lateral aspect, tip extending beyond longitudinal plane of gonostylus nearly twice its width . . . . *platyurum* (p. 48)

10 (1) Frontal area between antennal sockets relatively flat; sternum VI broadly rounded or gradually tapered to apex 11
Frontal area with paired, impunctate, crescent-shaped protuberances arising between antennal sockets (fig. 187); sternum VI narrowly tapered to apex, (fig. 148) . *marshi* (p. 46)

11 (10) Apex of sternum VI reddish-brown, evenly rounded or with weak emargination (figs. 139, 145); apex of penis valve distally directed, narrowly tapered or bluntly rounded (figs. 140, 146) 12
Apex of sternum VI with wide transparent margin, prominently incised (fig. 142); apex of penis valve acute, mesially directed (fig. 143) *pudicum* (p. 51)

12 (11) Penis valve distally tapered to narrow apex (fig. 140); metasomal terga with or without red-brown bands adjacent to impunctate marginal bands . . . . . *dubium* (p. 42)
Penis valve bluntly rounded (fig. 146); terga without red-brown bands adjacent to marginal bands . . . . . *plenum* (p. 50)

FEMALES

1 Sides of terga II–IV not inflated; 10 mm or less in length 2
Sides of terga II–IV inflated (fig. 203); approximately 12 mm long . . . . *singulare* (p. 54)

2 (1) Mandible, in profile, with preapical tooth absent or indistinct, cutting edge relatively straight (figs. 174–176) 3
Mandible with distinct preapical tooth followed by more or less concave cutting edge (figs. 178–186) 5

3 (2) Punctures of frons close, separated by less than their diameter; tergum I predominantly black with yellow or cream maculations 4
Punctures of frons separated by their diameters or more; tergum I predominantly reddish-brown with cream maculations . . . . . *implicatum* (p. 46)

4 (3) Interstitial lines separating punctures of frons with prominent sculpture, appearing dull; base of tergum VI with weakly developed, longitudinal carina noted by absense of punctures on midline (fig. 193) . *plenum* (p. 50)
Interstitial lines separating punctures of frons smooth or minutely sculptured, appearing shiny; base of tergum VI without trace of longitudinal carina (fig. 191) . *pudicum* (p. 51)

5 (3) Frontal area between antennal sockets relatively flat 6
Frontal area with paired, impunctate, crescent-shaped protuberances (fig. 187) . *marshi* (p. 46)

6 (5) Forecoxa unarmed; maculations of thorax and legs predominantly cream or yellow . . . 7
Forecoxa armed at apex with short prominent spine; maculations of thorax and legs predominantly reddish-brown . *curvatum* (p. 41)

7 (6) Tergum VI with apical margin angled posteriorly to form narrow flange occupying median two-thirds of segment width (figs. 192–196) . . 8
Apical margin of tergum VI without flange or limited to median flange of less than one-half segment width (figs. 198, 200) 12

8 (7) Interstitial lines separating punctures of mesoscutum prominently sculptured, mesoscutum dull 9
Punctures of mesocutum well separated by predominantly smooth interstitial lines, mesoscutum appears shiny 10

9 (8) Mandible with space between apical and preapical teeth one-half or less width of preapical tooth (fig. 185); cutting edge of mandible double or single; punctures of mesoscutum fine; apical flange of tergum VI curved from segment . . . . . *dubium* (p. 42)
Mandible with space between teeth subequal to inverted preapical tooth (fig. 181); cutting edge of mandible single; punctures of mesoscutum coarse; apical flange of tergum VI sharply angled from segment . *heterulkei* (p. 45)

10 (8) Sternum VI moderately to prominently convex, never depressed medianly; inner apical margin weakly to prominently ovate (fig. 188) . . 11
Sternum VI relatively flat, may appear slightly

depressed medianly; inner apical margin broadly rounded (fig. 189) . *subparvum* (p. 54)

11 (10) Mandible with prominent, acute, preapical tooth (fig. 183) . . . . . *parvum* (p. 47)

Mandible with low, blunt, preapical tooth (fig. 184), uncommon . . . . *desertorum* (p. 42)

12 (7) Interstitial lines separating punctures of mesoscutum and frons prominently sculptured, appearing dull; mandibles nearly always with yellow maculations . . . . . *ulkei* (p. 56)

Interstitial lines separating punctures of mesocutum and frons with very light sculpture or without, appearing polished; mandibles black . . . . . *platyurum* (p. 48)

Dianthidium curvatum sayi Cockerell

(Figs. 171–173, 178, 197; Map 27)

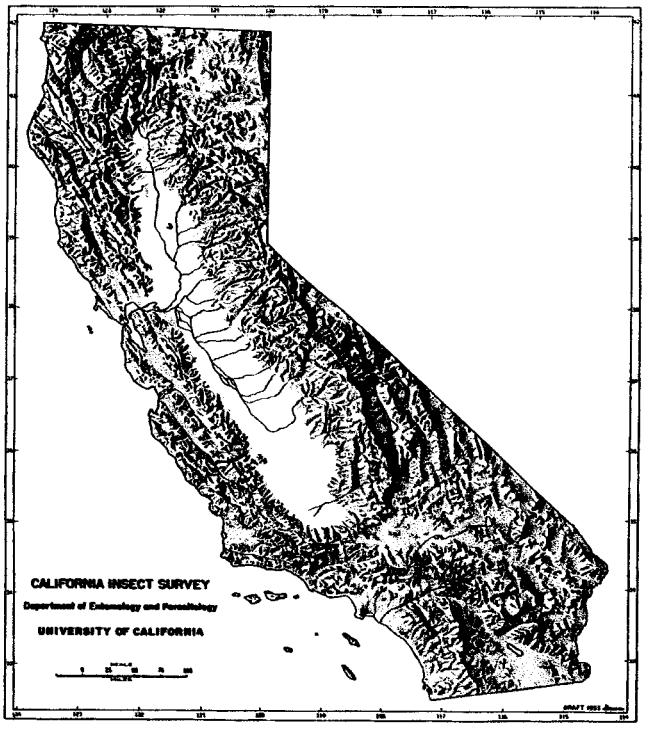
Megachile interrupta Say, 1824. In Keating, Narr. Long's 2d Exped., Vol. 2, p. 350, ♂, ♀, 1825, appendix, 82–83. Holotype ♂ Missouri (destroyed). Preocc.

Dianthidium sayi Cockerell, 1907. Can. Ent., 39:136. Proposed to replace *interrupta* Say.

Dianthidium curvatum sayi Cockerell, 1907. Michener, 1951. Hymen. Amer. North of Mex. Cat., p. 1143.

Biology.—Hicks, 1926*a*, Colo. Univ. Studies, 15:249–50; Custer and Hicks, 1927, Biol. Bull., 52:268; Custer, 1928, Ent. News, 39:123; Mickel, 1928, U.S. Nat. Mus. Bull., 143:61; Fischer, 1951, Jour. Kan. Ent. Soc., 24(2):47–49.

Taxonomy.—Michener, 1953, Kans. Univ. Sci. Bull., 35: 1045 (larval morphology).



Map 27. California distribution of *Dianthidium curvatum sayi* Cockerell

Geographic range.—Alberta, Great Basin and plains states, and eastern California.

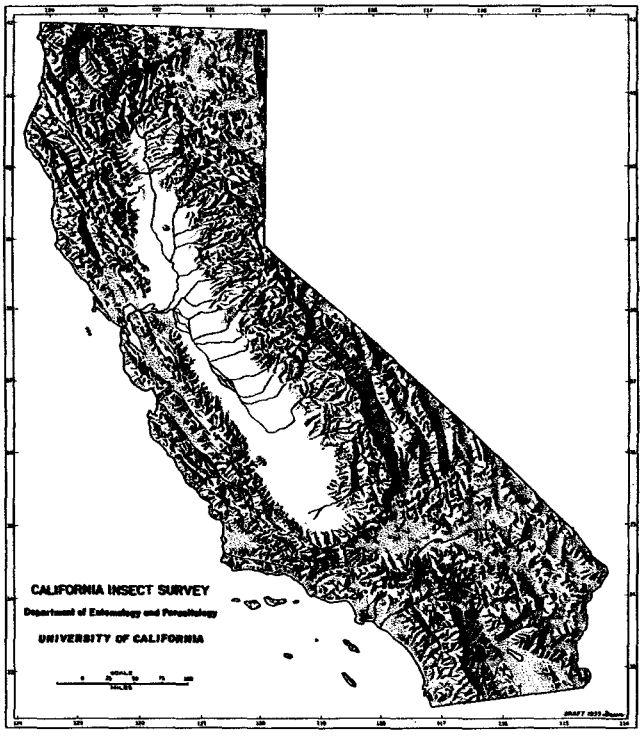
California records.—INYO CO.: Big Pine, 1 ♀, VIII–24–60 (E. Armburst, UCD). Bishop, 1 ♀, VIII–17–63 (J. Froebe, UCD). MONO CO.: Bishop, 15 mi. N, 1 ♂, 1 ♀, VIII–5–48 (P. Hurd, J. MacSwain, CIS).

Dianthidium curvatum is the most widely distributed species of this genus in North America. It has been separated into four subspecies. In the east it is represented by c. *curvatum* (Smith) and c. *floridense* Schwarz, both of which are separated from the western subspecies by having coarser punctation on the frons of both sexes, and sparser and shorter pubscence on the metasomal sterna of the male. *D. curvatum sayi* has yellow and reddish-brown maculations, the latter color being prominent on the head, thorax, legs, and margins of the terga. The amount of reddish-brown marking may vary considerably on specimens from a single locality (Hicks, 1926*b*). *D. c. sayi* differs from *curvatum xerophilum Cockerell,* occurring in the southwestern United States, only by having less reddish-brown maculation on the head than the desert subspecies. *D. c. curvatum* has very little red in its color pattern, but c. *floridense* is nearly all reddish-brown. This species is distinguished from all others of the genus by having a small spine on the forecoxa of both sexes.

Collections of *D. curvatum sayi* have been uncommon in California and have been limited to the east side of the Sierra Nevada Mountains.

The biology of *sayi* has been studied much more extensively than other *Dianthidium* of North America. This is probably due to the habit of nesting in aggregations in the soil which possibly offers more opportunity to find and observe them. Nesting sites were found in Colorado by Hicks (1926*a*) with as many as 250 cells in a radius of three feet. The cells extended two to four inches below the ground and were often attached to plant roots. These nests frequently had communal entry tunnels from which secondary tunnels, containing the cells, radiated. One female may have been constructing several nests at the same time, but there was no evidence indicating that more than one female worked on the same cell. Custer and Hicks (1927) pointed out that this was the only known member of the genus that nested in the soil. The materials used for its nest construction were pebbles or grains of sand held together by plant resins, as is the case with other members of the genus. These authors also noted that a female of this species was observed to mate more than once.

Hicks (1926a), Custer (1928), and Fischer (1951) reported the following parasites on *sayi:* mutillids, *Sphaerophthalma uro* ssp. *melanderi* (Baker), *Dasymutilla harmonia* (Fox), *Dasymutilla asopus* (or *D. hector*); a sapygid, *Eusapyga rubripes* Cresson; and a bombyliid fly, *Villa (Anthrax)* sp. (=*Spogostylum daphne* [Osten Sacken]).



Map 28. Distribution of *Dianthidium desertorum* Timberlake

Dianthidium desertorum Timberlake

(Figs. 168–170, 184, 196; Map 28)

Dianthidium desertorum Timberlake, 1943. Jour. New York Soc., 51:84, ♂, ♀. Holotype ♂, Palm Springs, 2 mi. N, Riverside Co., California (UCR).

Geographic range.—Southern California deserts.

California records.—RIVERSIDE CO.: Palm Springs, 2 mi. N, 1 ♂, 1 ♀, III–7–36, on *Hyptis Emoryi* (P. Timberlake, UCR). SAN DIEGO CO.: Palm Canyon, Borrego Valley, 1 ♀, V–21–41 (R. Dickson, UCR); 1 ♂, IV–19–57 (R. Bohart, UCD).

This species is marked with a bright yellow pattern on black. Tergum VII (fig. 168) of the male is similar in outline to those of *ulkei* and *platyurum* but differs by having less setae and sparser punctation. The male genitalia also shows distinct differences in setation of the gonostylus and the penis valves. The female of *desertorum* resembles *parvum* and *subparvum;* but the females of *parvum* and *subparvum* have an acute preapical tooth on the mandible, whereas this tooth is low and blunt on *desertorum*.

This species is known only from four specimens limited to the western margin of the Colorado Desert.

Dianthidium dubium Schwarz

(Figs. 138–140, 185, 195)

Dianthidium dubium Schwarz, 1928. Jour. New York Ent. Soc., 36:405.

Geographic range.—Southern Oregon, California.

The male of *Dianthidium dubium* has a prominent tridentate tergum VII (fig. 138) similar to that of *pudicum, plenum, marshi* of California and *parkeri* of the southwestern states. This character places it in the *pudicum* group of Timberlake (1943). The combination of the shape of the narrow tip of the penis valve of the genitalia (fig. 140) and the rounded sternum VI (fig. 139) of the males separates it from the closest related species, *plenum* and *pudicum*. The females of these species are not as easily distinguished, but a combination of the curved and double cutting edge of the mandible of *dubium* and the presence of a longitudinal carina on tergum VI of *dubium* and *plenum* will separate them.

KEY TO SUBSPECIES OF *DIANTHIDIUM DUBIUM*

1 Metasomal terga with red-brown bands adjacent to impunctate marginal bands . . . . *dubium*
Metasomal terga without red-brown bands . . 2
2 (1) Maculations of thorax and abdomen bright yellow; found west of Sierra Nevada Range and southern California . . . . . *dilectum*
Maculations of thorax and abdomen pale yellow to cream; found east of Sierra Nevada Range *mccrackenae*

Dianthidium dubium dilectum Timberlake

(Map 29)

Dianthidium dubium dilectum Timberlake, 1948. Jour. New York Ent. Soc., 56:152–153, ♀, ♂. Holotype ♀, Camp Baldy, San Gabriel Mts., California (UCR).

Biology.—Hurd and Linsley, 1950, Jour. New York Ent. Soc., 58:247–250.

Geographic range.—California (southern California mountains, Coast Range north to San Francisco Bay).

California records.—ALAMEDA CO.: Arroyo Mocho, 20 mi. S Livermore, 1 ♀, VI–6–54 (D. Burdick, SS). CONTRA COSTA CO.: Clayton, 1 ♂, V–22–54 (W. Lange, UCD). Mt. Diablo, 1 ♂, V–7–34 (J. MacSwain, CIS); 4 ♂, 1 ♀, VI–25–39 (E. Van Dyke, CAS); 2 ♀, IX–22–12 (UCR). FRESNO CO.: Coalinga Mineral Springs, 1 ♀, VII–6–60, on *Eriogonum* sp. (R. Snelling, SS). Coalinga, 18 mi. W, VII–26–60, *Eriogonum fasciculatum* (R. Snelling, SS). KERN CO.: Frazier Park, 1 ♀, VIII–23–58 (J. Hall, UCD). LOS ANGELES CO.: Arroyo Seco, 1 ♂, VI–25–40 (J. MacSwain, CIS). Bouquet Canyon, 3 ♂, 2 ♀, VIII–23–54, on *Erigeron* (R. Snelling, SS). Camp Baldy, 1 ♂, VI–26–50, on *Eriodictyon* (P. Hurd, CIS); 3 ♂, 2 ♀, VII–11–50 (A. and M. McClay, UCD). Crystal Lake Rd., 4,700 ft., 1 ♂, VII–9–52 (D. Barcus, UCD). Llano, 5.5 mi. W, 1 ♂, VIII–21–54, on *Erigeron* (R.

Snelling, SS). Mt. Wilson Rd., 1 ♂, 1 ♀, VII–24–39, on *Erigonum fasciculatum* (R. Bohart, UCD). Palmdale, Mojave Dessert, 1 ♂, X–6–35 (E. Linsley, CIS). Paratena, San Gabriel Mts., 1,750 ft., 1 ♂, VII–15–29 (F. Grinnell Jr., UCR). Tanbark Flat, 1 ♂, VI–18–56 (R. Bohart, UCD); 1 ♂, VI–26–50, on *Eriodictyon* (P. Hurd, CIS); 1 ♀, VI–30–50, on *Helianthus* (P. Hurd, CIS); 3 ♂, 4 ♀, VII–2–50, on *Lotus* (E. Linsley, CIS); 1 ♂, VII–14–56, on *Turricula Parryi* (P. Timberlake, UCR). Three Point, 1 ♀, VIII–25–58 (J. Hall, UCD). Westwood Hills, 1 ♀, VIII–11–35 (E. Linsley, CIS). MONTEREY CO.: Arroyo Seco, 1 ♂, V–8–60 (R. Snelling, SS); 1 ♀, VIII–15–57 (H. Court, UCD). Fort Ord, 1 ♀, VII–6–57 (H. Court, UCD). RIVERSIDE CO.: Anza, 1 ♂, VI–5–56 (R. Bohart, UCD); 2 mi. E, 4 ♀, VII–7–56, on *Encelia californica* (E. Linsley, CIS). Beaumont, 8 mi. W, 1 ♂, VII–3–57 (J. Gillaspy, UCD); 3 mi. W, 1 ♂, VII–19–57 (H. Moffitt, UCD). Corona, 1 ♀, VI–(?)–13 (CIS). Hemet Reservoir, San Jacinto Mts., 1 ♂, 1 ♀, VI–12–39, on *Chenopodium* (E. Ross, CIS). Herkey Creek, San Jacinto Mts., 1 ♂, VII–11–39 (E. Ross, CIS). Idyllwild, 1 ♂, VI–16–40 (E. Van Dyke, CAS). Keen Camp, San Jacinto Mts., 1 ♀, VI–10–39, on *Penstemon* (E. Ross, CIS). Millard Canyon, Kitchen Peak Rd., 1 ♀, VI–20–63 (E. Schlinger, UCR). San Jacinto R., San Jacinto Mts., 2,500 ft., 2 ♂, VI–13–40, on *Trichostema* (C. Michener, CIS). Soboba Springs, 1 ♂, VI–1–17 (E. Van Duzee, CAS). Tahquitz Canyon, nr. Palm Springs, 1 ♂, VI–22–63 (F. Parker, L. Stange, UCD). SAN BENITO CO.: Idria (Gem Mine), 1 ♂, 2 ♀, VI–29–54 (C. MacNeill, CIS); 2 ♂, VII–5–54, on *Achillea millefolium* (R. Smith, E. Linsley, CIS). SAN BERNARDINO CO.: Cajon, 1 ♂, VI–28–45 (A. Melander, UCR). Cajon Jct., 1 ♂, IX–15–53 (J. Hall, UCD). Camp Bady, 1 ♂, 1 ♀, VI–26–56, 1 ♂, VII–27–56 (R. Bohart, R. Bushing, UCD). Little Mojave Valley, 1 ♂, VII–7–17 (CIS). Mill Creek, 1 ♂, V–3–38, on *Eriodictyon trichocalyx*; 1 ♀, VI–20–54, on *Phacelia* (P. Timberlake, CAS, CIS). Mill Creek Canyon, 1 ♂, IX–24–22 (CAS). SAN DIEGO CO.: Chihuahua Valley, 1 ♂, VIII–17–58 (E. Schlinger, UCD). Mt. Laguna, 3 ♂, 3 ♀, VII–5–63, on *Viguiera multiflora;* 3 ♂, 1 ♀, VII–5–63, on *Eriodictyon trichocalyx* var. *lanatum* (P. Hurd, CIS). Sunshine Summit, 1 ♂, 2 ♀, VII–17–58 (E. Schlinger, UCD). Warner Springs, 1 ♂, 1 ♀, VI–10–56 (E. Schlinger, UCD); 9 mi. S, 1 ♂, VII–8–56, on *Eriogonum fasciculatum* (R. Bohart, UCD). SAN LUIS OBISPO CO.: Creston, 5 mi. S, 1 ♂, VI–20–59 (P. Marsh, UCD). San Luis Obispo, 1 ♀, VI–38 on *Clarkia* (I. McCracken, CAS). SANTA BARBARA CO.: Bluff Camp, 4 ♂, 3 ♀, VI–29–59 (R. Bohart, P. Marsh, F. Parker, UCD). Santa Ynez Mts., 5 ♂, 5 ♀, VI–24–59 (R. Bohart, P. Marsh, R. Spore, UCD). SANTA CLARA CO.: San Antonio Ranger Station, 7 mi. S, 3 ♂, VI–27–53 (R. Schuster, C. MacNeill, CIS). San Antonio Valley, 1 ♂, IX–14–48, on *Eriogonum* (P. Hurd, CIS). STANISLAUS CO.: Adobe Creek, 4 ♂, IX–14–48, on *Compositae* (P. Hurd, CIS). VENTURA CO.: Lookwood Creek, nr. Stauffer P.O., 1 ♂, V–5–59, on *Hespirochiron californicus* (G. Stage, CIS). Sespe Canyon, 1 ♂, VII–10–59 (F. Parker, UCD).

The markings of *D. dubium dilectum* are usually bright yellow and extensive on a black background; some specimens from Monterey County, however, are somewhat pale and show a reduction of maculations. The apex of the penis valve of *dilectum* is more pointed than that of the other two subspecies; and the mandible of the female has a double cutting edge common to *dubium dubium* but not *dubium mccrackenae*.

The distribution of *dilectum* is primarily montane, extending up the mountains of southern California and Coast Range as far north as Mt. Diablo in Contra Costa County. It is possible that future collections may show it to extend southward into Baja California. The species is well represented in most collections; 148 males and 96 females have been recorded.

A nest of a single cell of gravel and resin on a leaf (Tanbark Flat, Los Angeles Co., VI–23–52, CIS) was determined by P. H. Timberlake to belong to *D. dubium dilectum*. He also assigned a series of nests collected on exposed clay shales (upper Sulfur Creek, Santa Clara Co., IX–14–48, CIS) to the same subspecies. The insects reared from these latter nests were reported by Hurd and Linsley (1950) as follows: *Amobia (Pachyophthalmus) floridensis* (Townsend), *Chrysis (Chrysis) coerulans* Fabricius, *Sapyga nevadica* Cresson, *Stenodynerus cochisensis* (Viereck), and *Toxophora pellucida* Coquillett. A summary of host plant visitations by *dilectum* shows eight families to be represented, with the majority occurring in the families Compositae, Hydrophyllaceae, and Polygonaceae.

Dianthidium dubium dubium Schwarz

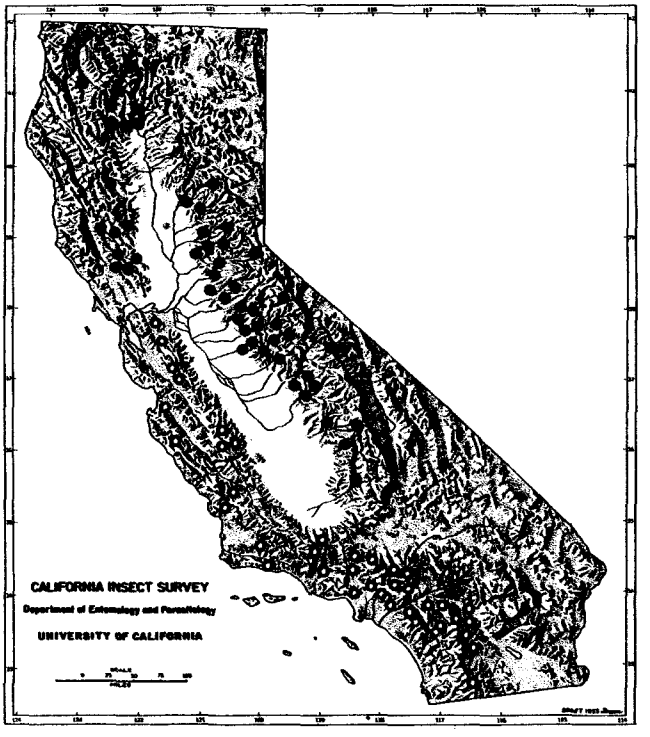
(Fig. 5; Map 29)

Dianthidium dubium Schwarz, 1928. Jour. New York Ent. Soc., 36:405; ♂, ♀. Holotype ♂, Dutch Flat, Placer Co., California (UCR).

Dianthidium consimile dubium Timberlake, 1943. Jour. New York Ent. Soc., 51:103.

Geographic range.—Southern Oregon, northern California mountains (Coast Range, north of San Francisco; Cascade Range; and western slope of Sierra Nevada Range).

California records.—AMADOR CO.: Ione, 2 ♂, VI–6–53 (H. Clarke, CIS). BUTTE CO.: Forbestown, 1 ♂, VII–19–57 (T. Haig, UCD). Yankee Hill, 2 ♂, V–12–49 (P. Hurd, CIS). CALAVERAS CO.: Mokelumne Hill, 2 ♂, VI–6–96 (F. Blaisdell, CAS). Murphys, 7 ♂, 1 ♀, IX–8 to 19–37, on Compositae; 1 ♂, 1 ♀, IX–19–37, on *Bigelovia* (F. Blaisdell, CAS). COLUSA CO.: Ladoga, 1 ♂, VII–12–55 (H. Moffitt, UCD). EL DORADO CO.: Camino, 3 mi. S, 2 ♂, VI–23–48, on *Eriodictyon;* 1 ♀, VI–26–48, on *Vicia;* 2 ♂, 1 ♀, VII–3–48, on *Phacelia* (P. Hurd, CIS). Chile Bar, 2 ♂, VII–5–48 (P. Hurd, CIS). El Dorado, 10 mi. W, 1 ♂, VI–2–63 (R. Westcott, UCD). Placerville, 4 ♂, 1 ♀, III–20–57, reared from individual nests of resin and pebbles (L. Hasbrook, UCD). Pollock Pines, 3 ♂, 2 ♀, VI–16–52; 3 ♀, VIII–19–53 (E. Schlinger, UCD). Shingle Springs, 1 ♂, V–6–52 (R. Snelling, LACM). Snowline Camp, 1 ♂, 1 ♀, VI–25–48 (J. MacSwain, P. Hurd, CIS); 17 ♂, 5 ♀, VII–3 to 7–48, on *Phacelia;* 2 ♂, 1 ♀, VII–19–48, on *Grindelia camporum* (P. Hurd, CIS). FRESNO CO.: Cascada, 1 ♂, 1 ♀, VII–29–19 (E. Van Duzee, CAS). Pine Ridge, 5 ♂, 5 ♀, VII–19–60,



Map 29. Distribution of (○) *Dianthidium dubium dilectum* Timberlake, (◉) *Dianthidium dubium mccrackenae* Timberlake, and California distribution of (●) *Dianthidium dubium dubium* Schwarz

on *Eriogonum* (R. Snelling, SS). Shaver Lake, 1 ♀, VIII–8–56 (R. Schuster, CIS). Tollhouse, 23 mi. E, 1 ♂, VI–24–62, on *Clarkia unguiculata* (G. Stage, R. Snelling, LACM). Watts Valley, 2 ♂, 1 ♀, VI–23–56 (R. Schuster, CIS). KERN Co.: Kernville, 1 ♂, VIII–10–52 (T. Haig, CIS). LAKE Co.: Bartlett Springs, 1 ♂, 2 ♀, VII–12–55 (E. Kurtz, W. Lange, UCD). Middletown, 24 ♂, 3 ♀, IX–11–48, on *Trichostema laxum* (P. Hurd, CIS). Upper Lake, 1 ♀, VIII–9–57 (S. Fidel, UCD). MADERA Co.: Nipinnawasee, 1 ♂, VII–4–60 (G. Stage, R. Snelling, SS). MARIPOSA Co.: El Portal, 1 ♂, V–30–38 (R. Bohart, UCD). Exchequer Dam, 1 ♂, 1 ♀, IX–5–55, on *Lotus;* Hornitos, 11 mi. S, 1 ♂, IX–7–56; Mariposa, 1 ♀, VII–4–59 (R. Snelling, J. Stage, SS). Miami Ranger Station, 1 ♀, V–11–42, reared from cell (E. Linsley, CIS). Mormon Bar, 6 mi. E, 1 ♀, VII–4–60 (R. Snelling, G. Stage, SS). Yosemite Valley, 1 ♂, VI–24–26, on *Lotus* (P. Timberlake, UCR). MERCED Co.: Merced Falls, 1 ♂, IX–5–55 (R. Bohart, UCD). NAPA Co.: Knoxville, 11 ♂, 3 ♀, IX–1–53 (A. Grigarick, E. Schlinger, UCD). Mt. St. Helena, 3 ♂, IX–11–48, on *Trichostema laxum* (J. Gillaspy, CIS). Pope Valley, 1 ♀, VI–11–39 (E. Van Duzee, CAS). Samuel Springs, 16 ♂, 6 ♀, V–7 to 29–55 (R. Bechtel, E. Schlinger, UCD). NEVADA Co.: Grass Valley, 1 ♂, VII–5–56 (J. Powell, CIS). Tyler, 1.5 mi. W, 3 ♂, on *Trichostema lanceolatum;* 1 ♀, on *Hemizonia Fitchii;* 4.5 mi. W, 1 ♂, 1 ♀, on *Haplopappus arborescens,* IX–28–56 (P. Timberlake, UCR). PLACER Co.: Applegate, 3 ♂, VI–24–51 (J. Hall, UCD). Auburn, 39 ♂, 9 ♀, VIII–22 to 28–16 (L. Bruner, UN). Colfax, 1 ♂, 1 ♀, V–20–52 (R. Bohart, UCD). Dutch Flat, 1 ♂, 1 ♀, V–19–12, Ex. nest on sweet birch (Branigan, UCR). Forest Hill, 1 ♀, VI–23–60 (J. Wilson, W. Wiard, UCD). Weimar, 1 ♀, VI–10–62 (R. Westcott, UCD). PLUMAS Co.: Quincy, 4 mi. W, 6 ♂, 3 ♀, VI–25 to VII–16–49 (P. Hurd, CIS). SHASTA Co.: Delta, 10 mi. S, 1 ♀, V–29–52 (J. Rozen, SS). Old Shasta, 1 ♂, VIII–16–52 (R. Bechtel, UCD). Redding, 1 ♂, 1 ♀, VII–10–53 (A. Grigarick, UCD). Shasta Lake, 1 ♂, 2 ♀, VI–19–55 (R. Bohart, UCD); 2 ♀, VIII–16–52 (R. Bechtel, UCD). SISKIYOU Co.: Gazelle, 7 mi. W, 1 ♀, VII–25–54 (J. Powell, CIS). Somesbar, 2 ♂, VII–8–58, on *Lotus Purshianus* (J. Powell, CIS). TEHAMA Co.: Mud Flat Camp, 35 mi. W Orland, 1 ♀, V–13–61 (D. Miller, UCD). TRINITY Co.: Eagle Creek, 1 ♀, VII–13–49; Trinity Center, 1 ♂, VII–18–53, on *Penstemon* (A. McClay, UCD). Trinity River Camp, 1 ♂, VII–17–53 (M. McClay, UCD). Trinity River, E Fork, 1 ♂, VII–13–55 (R. Bohart, UCD). TULARE Co.: Camp Nelson, 1 ♀, VI–15–29, on *Lotus Purshianus* (P. Timberlake, UCR). Sequoia National Park, Potwisha, 1 ♂, VI–29–29 (E. Van Dyke, CAS). Sequoia National Park, Ash Mt. R., 3 ♂, 1 ♀, VI–23–51 (R. Bechtel, UCD). Seq. Nat. Pk., Hospital Rock, 2 ♂, IX–4–33 (C. Michener, UCR). Three Rivers, 1 ♀, VI–28–57, on *Clarkia* (R. Snelling, SS). TUOLUMNE Co.: Groveland, 1 ♂, 1 ♀, VIII–8–54 (R. Goodwin, CIS). Long Barn, 1 ♀, VIII–16–61, on *Penstemon,* (R. Snelling, LACM). Mather, 1 ♂, 1 ♀, VI–8–61 (M. Irwin, UCD). Rawhide, 1 ♀, on *Marrubium vulgare* (R. Stinchfield, CIS). Sonora Pass, 2 mi. NE, 1 ♂, 1 ♀, VIII–14–60 (R. Thorp, J. Lawrence, CIS). Tuolumne, 2 mi. W, 1 ♀, VIII–1–61 (J. Powell, CIS). Twain Harte, 11 ♂, 8 ♀, VII–37, on *Grindelia* (F. Blaisdell, CAS).

D. dubium dubium is black with a color pattern varying from cream to yellow. It also shows reddish-brown bands on the metasomal terga of both sexes. These bands are adjacent to the impunctate marginal bands and readily separate it from the other two subspecies, *dilectum* and *mccrackenae.*

D. dubium dubium is the more frequently collected subspecies of this species, and a total of 266 males and 118 females have been examined. It has a well-defined distribution that appears to be nearly limited to the slopes of the ranges bordering the Great Valley except in the north. Its southernmost limit on the west is San Francisco Bay and on the east, the Tehachapi Mountains.

Little is known of the biology of *dubium dubium* except that the nests are made of resin and gravel and are constructed externally on vegetation or rocks. This subspecies has been found on host plants in seven families with the collections being most numerous on the Compositae, Labiatae, and Leguminosae.

Dianthidium dubium mccrackenae Timberlake

(Map 29)

Dianthidium consimile mccrackenae Timberlake, 1943. Jour. New York Ent. Soc., 51:104–105, ♀, ♂. Holotype ♀, Glacier Lodge, Big Pine Creek, 8,000 to 11,000 ft., Inyo Co., California (CAS).

Dianthidium plenum convictorum Timberlake, 1943. Jour. New York, Ent. Soc., 51:108. Holotype ♀, Convict Lake, Mono Co., California (AMNH). NEW SYNONYMY.

Dianthidium dubium mccrackenae Timberlake, 1948, Jour. New York Ent. Soc., 56:152.

Geographic range.—California (eastern slope of Sierra Nevada Mts.).

California records.—INYO CO.: Big Pine, 5 mi. W, 1 ♂, 3 ♀, VIII–10–62, on *Eriastrum densifollium* (A. Menke, L. Stange, UCD); 1 ♀, VI–20–62 (A. Grigarick, UCD). Glacier Lodge, Big Pine Creek, 8,000 to 11,000 ft., 1 ♂, 1 ♀, VIII–1929 (I. McCracken, CAS). Glacier Lodge, Big Pine, 1 ♂, VI–20–37 (W. Reeves, CIS); 5 ♂, 3 ♀, VII–30–53 (J. Rozen, CIS). Whitney Portal, 2 ♂, VII–3–53 (H. Nakakihara, UCR); 7 ♂, 5 ♀, VIII–6–48 (P. Hurd, J. MacSwain, CIS). MONO CO.: Convict Lake, 1 ♀, VII–17–33 (G. and R. Bohart, AMNH). Tom's Place, 1 mi. S, 1 ♀, VIII–8–62 (A. Menke, UCD).

D. dubium mccrackenae is black with pale yellow to cream markings. The penis valve shows very slight differences from that of the other subspecies, but it is readily distinguished as *dubium*. The mandible of the female of *mccrackenae* does not possess the double cutting edge present in the two other subspecies. The single cutting edge of *mccrackenae* may not be as curved (in profile) as in *dubium* and *dilectum* and has been confused with *plenum*, which has a straight cutting edge. The female does agree with *dubium* in other respects.

The distribution of *mccrackenae* is limited to the east side of the Sierra Nevada in Inyo and Mono counties. This subspecies is known from the collections of 17 males and 15 females from five localities.

Dianthidium heterulkei heterulkei Schwarz

(Figs. 159–161, 181, 194; Map 30)

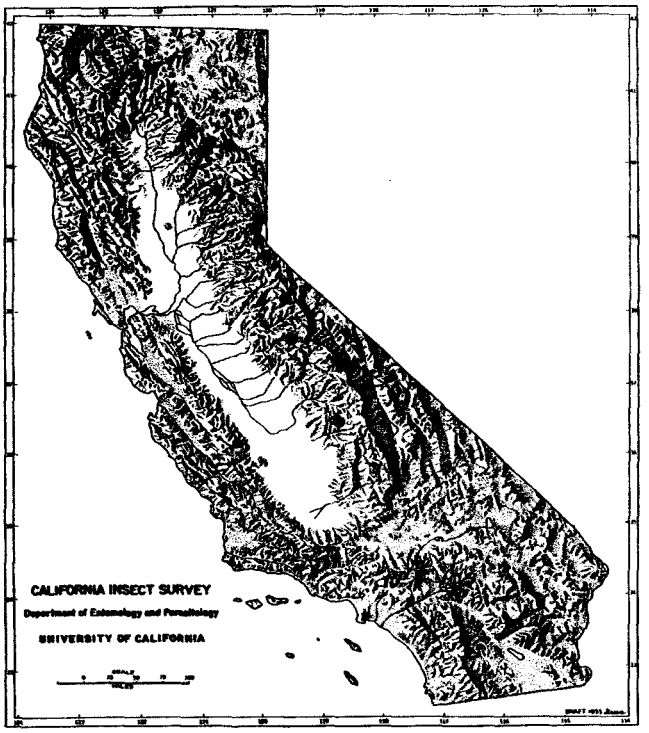
Dianthidium heterulkei Schwarz, 1940. Amer. Mus. Novitates, 1058:6–7, ♂, ♀. Holotype ♂, Elk Lake, Deschutes National Forest, Oregon (UCR).

Dianthidium heterulkei var. *cornucopiana* Schwarz, 1940. Amer. Mus. Novitates, 1058:8. Holotype ♂, Cornucopia, Oregon (Oregon State).

Dianthidium fraternum hirtulum Timberlake, 1943. Jour. New York Ent., Soc., 51:94–95, ♂, ♀. Holotype ♂, Mineral King, Tulare Co., California (CAS).

Geographic range.—California, Nevada, Oregon, Utah.

California records.—EL DORADO CO.: Lake Tahoe, 1 ♀, VII–14–49, on *Solidago* (E. Linsley, CIS). Echo Lake, 2 ♂, 1 ♀, VI–19 to 22–55 (W. Middlekauff, CIS). INYO CO.: Nr. Mono Pass, 12,000 ft., 1 ♀, VIII–9–61 (C. MacNeill, CAS). Ruby Lake, 11,250 ft., 1 ♀, VIII–13–57 (C. MacNeill, CAS). LASSEN CO.: Bridge Creek Camp, 3 ♂, 6 ♀, VII–9–49 (J. MacSwain and others, CIS, UCD). Susan River Camp, 2 ♂, 2 ♀, VII–10–49 (J. Gillaspy, E. Schlinger, CIS, UCD). MARIPOSA CO.: Yosemite Valley, 1 ♂, VII–12–21 (E. Van Dyke, CAS). MONO CO.: Sardine Creek, 8,500, 1 ♂, VI–28–51 (R. Morgan, CIS). Sonora Pass, 1 ♂, 1, ♀, VII–20–39,



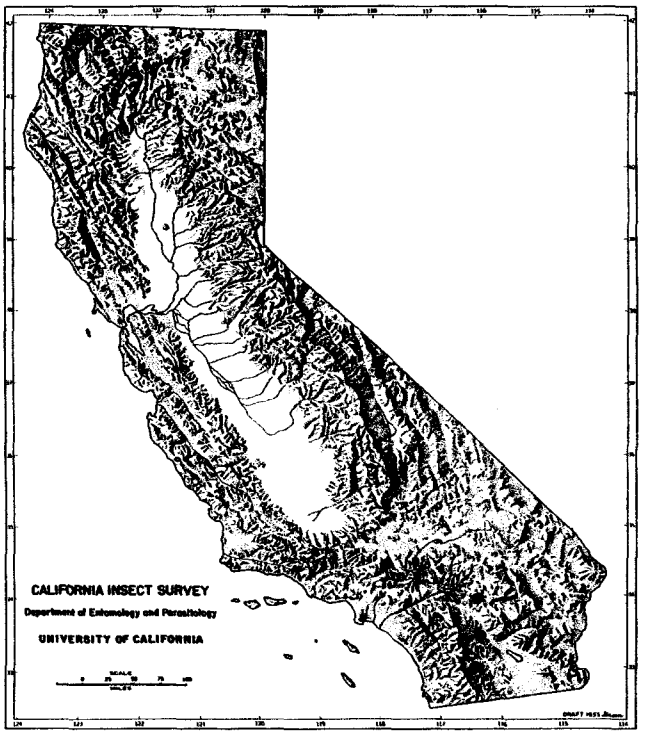
Map 30. California distribution of *Dianthidium heterulki heterulkei* Schwarz

on *Aster* (I. McCracken, CAS); 1 ♀, VIII–13–60, on *Haplopappus suffruticosus* (R. Thorp, RT). NEVADA CO.: Boca, 1 ♂, 1 ♀, VII–3–54, on *Aster* (P. Hurd, CIS); 5 ♂, 6 ♀, VI–28 to VII–6–54 (R. Bohart and others, CIS, UCD). Hobart Mills, 7 mi. N, 1 ♂, VIII–26–48, on *Chrysothamnus* (E. Linsley, CIS). Sagehen Creek, nr. Hobart Mills, 1 ♂, 1 ♀, VII–16, 21–54 (R. Goodwin, J. Powell, CIS). Truckee, 1 ♂, VI–21–27 (E. Van Duzee, CAS). PLACER CO.: Carnelian Bay, 1 ♀, VIII–15–63 (R. Bohart, UCD). PLUMAS CO.: Chester, 8 mi. NW, 1 ♀, VIII–17–58 (J. Powell, CIS). Onion Valley, 1 ♀, VII–7–49 (R. Bechtel, UCD). SHASTA CO.: Manzanita Lake, 3 mi. N, 1 ♂, VII–15–55 (J. Downey, UCD). Old Station, 1 ♀, VII–4–55 (P. Hurd, CIS); 6 mi. S, 1 ♂, VI–26–63 (V. Vesterby, UCD). TULARE CO.: Mineral King, 1 ♂, VIII–4–23 (C. Fox, CAS).

D. heterulkei heterulkei is characterized by bright yellow markings. *D. heterulkei fraternum* Timberlake, 1943, the only other subspecies, has cream to white maculations. Tergum VII (fig. 159) of the male of *heterulkei* is somewhat truncate as in *ulkei* and *platyurum*, but the emarginations separating the median lobe are generally deeper and the apex of the median lobe more acute in *heterulkei*. The female of *heterulkei* is distinguished from the similar females of *parvum* and *subparvum* by having the interstitial lines between punctures of the mesoscutum deeply sculptured and thus appearing dull.

Thirty-six males and 28 males of *D. heterulkei heterulkei* were found distributed in California from the Cascade Mountains down the Sierra Nevada to Tulare County. *D. heterulkei fraternum* is found in the mountains of Arizona, New Mexico, and Texas.

No nests of *D. heterulkei* have been observed and infrequent host plant records are limited to the Compositae.



Map 31. California distribution of *Dianthidium implicatum* Timberlake

Dianthidium implicatum Timberlake

(Figs. 150–152, 174, 199; Map 31)

Dianthidium implicatum Timberlake, 1948. Jour. New York Ent. Soc., 56:150–151. Holotype ♀, Morongo Valley, San Bernardino Co., California (UCR).

Taxonomy.—Grigarick and Stange, 1964, Pan-Pac. Ent., 40:52, ♂.

Geographic range.—Arizona, California, Nevada, New Mexico, Texas, and Mexico.

California records.—INYO CO.: Antelope Springs, 2 ♀, VII–10–61 (R. Bohart, UCD). Mazourka Canyon, 1 ♂, VII–2–53 (W. McLellan, UCD). LOS ANGELES CO.: Pearblossom, 4 mi. SE, 1 ♂, 1 ♀, VIII–21–54, on *Gutierrezia microcephala* (R. Snelling, UCR). RIVERSIDE CO.: Deep Canyon, 1 ♀, IV–19–63, reared from nest on *Dalea* twig (E. Schlinger, UCR); 2 ♂, IX–9 to 24–63 (M. Irwin, E. Schlinger, UCR). SAN BERNARDINO CO.: Morongo Valley, 1 ♀, IX–27–41, on *Gutierrezia microcephala* (P. Timberlake, UCR). Windmill Station, 1 ♀, V–28–50 (C. MacNeill, CAS). SAN DIEGO CO.: Scissors Crossing, 2 ♀, VII–4–56 (A. Menke Jr., SS; R. Bohart, UCD).

A white on black color pattern is characteristic for this species, with the first to fourth metasomal terga containing marginal reddish-brown bands. The entire dark area may be red on tergum I, and this segment is consistently marked with red in both sexes; but the number of terga with red following the first is variable. The male of *D. implicatum* has a short median lobe on tergum VII (fig. 150). In this respect it resembles species in the *curvatum* and *parvum* groups characterized by Timberlake (1943). *D. implicatum* differs from these groups by having widely spaced punctures on tergum VII. Both sexes of *implicatum* have the frons distinguished with widely spaced punctures.

This species extends across the southwestern United States and northern Mexico, but it is not common, as only 17 males and 20 females have been observed with about half of these being from California.

Biological information is limited to the rearing of a single specimen from Deep Creek, Riverside Co., by E. I. Schlinger. It emerged from a pebble and resin nest consisting of a single cell on the crotch of a twig of *Dalea*. The only other plant association was with the composite *Gutierrezia microcephala*.

Dianthidium marshi Grigarick and Stange

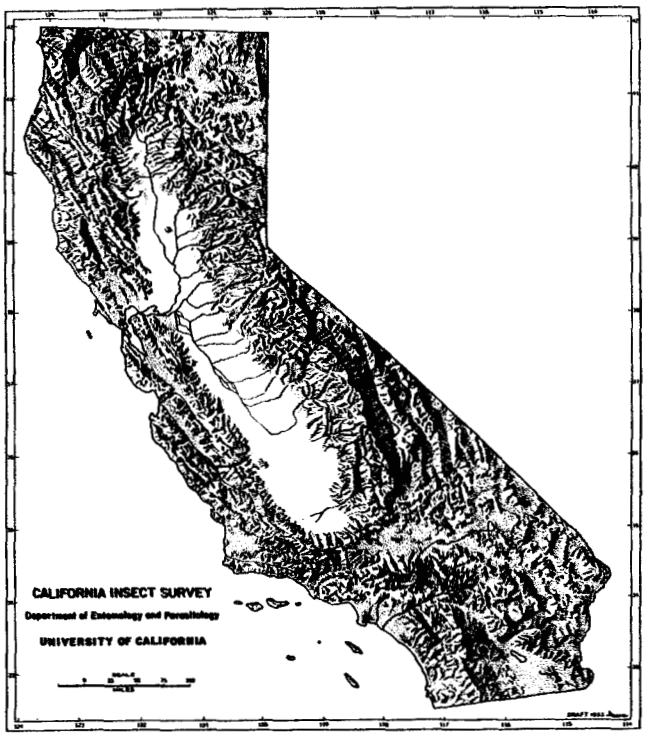
(Figs. 147–149, 186–187, 201; Map 32)

Dianthidium marshi Grigarick and Stange, 1964. Pan-Pac. Ent., 40:149, ♂, ♀. Holotype ♂, Big Pine, 5 mi. W, Inyo Co., California (CAS).

Geographic range.—Arizona, California.

California records.—INYO CO.: Big Pine, 5 mi. W, 1 ♂, VII–10–61 (P. Marsh, CAS); 1 ♀, VII–10–62, on *Eriastrum densifolium* (L. Stange, UCD). RIVERSIDE CO.: Deep Canyon, 1 ♂, 1 ♀, IX–24–63 (M. Irwin, UCR, UCD); 2 ♂, X–13–63, on *Bebbia* (M. Irwin, UCD, UCR).

The maculations of this species are predominantly pale yellow. The specimens from Inyo County have reddish submarginal bands on the first two metasomal terga similar to those found on *d. dubium*. These bands extend to three segments on a male specimen from Riverside County, but are limited to the first segment on the female. The tridentate tergum VII (fig. 147) of the male and rather transverse apical margin of the female tergum VI (fig. 201) associate this species with those assigned to the group of *Dianthidium pudicum* (Cresson) by Timberlake (1943). *D. marshi* is readily distinguished from all species in North America by the presence of pro-



Map 32. Distribution of *Dianthidium marshi* Grigarick and Stange

tuberances between the antennal sockets on both sexes (fig. 187) and the unique male genitalia (fig. 149).

This uncommon species was discovered only recently, but its limited and separate distribution suggest that it may now exist only as isolated remnants of a southern species. One specimen has been collected from the Catalina Mountains of Arizona.

Dianthidium parvum (Cresson)

(Figs. 153–155, 183, 188, 190)

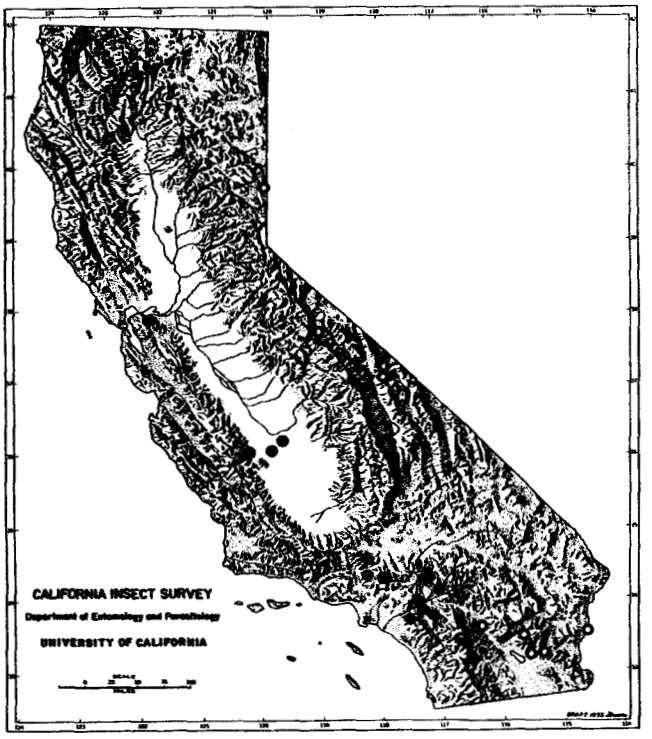
Anthidium parvum Cresson, 1878. Trans. Amer. Ent. Soc., 7:114.

Geographic range.—Mexico, Baja California, Arizona, California, Colorado, Nevada, New Mexico, and Utah.

Dianthidium parvum exhibits a number of morphological similarities to *D. subparvum*. The males are separated by the shape of tergum VII (fig. 153) in which the median lobe of *parvum* is narrower than that of *subparvum* (fig. 156). A number of differences are also present on the penis valve of the genitalia of these species (figs. 155, 158). The females of these species are not easily separated. It may be necessary to clear pollen from the scopa of sternum VI (fig. 188) to view the apical margin and surface of the sternum. The posterior half of the ventral surface of this sternum is slightly convex on parvum whereas it is flat or slightly concave on *subparvum*.

KEY TO SUBSPECIES OF *DIANTHIDIUM PARVUM*

1 Maculations of thorax and abdomen pale yellow to white . . . . . *parvum*
Maculations of thorax and abdomen bright yellow . . . . . *schwarzi*



Map 33. California distribution of (○) *Dianthidium parvum parvum* (Cresson) and distribution of (●) *Dianthidium parvum schwarzi* Timberlake

Dianthidium parvum parvum (Cresson)

(Map 33)

Anthidium parvum Cresson, 1878. Trans. Amer. Ent. Soc., 7: 114, ♀, ♂. Holotype ♀, Ridings, Colorado (ANSP).

Dianthidium profugum Cockerell, 1923. Calif. Acad. Sci. Proc., (4) 12:90–91. Holotype ♀, Puerto Refugio, Angel de la Guardia Island, Gulf of California (CAS). NEW SYNONYMY.

Dianthidium parvum heteropoda Schwarz, 1934. Amer. Mus. Novitates, 743:4. Holotype ♀, Boulder Co., Colorado (AMNH).

Dianthidium parvum basingeri Timberlake, 1943. Jour. New York Ent. Soc., 51:97–98. Holotype ♂, 12 miles west of Rillito, Arizona (UCR). NEW SYNONYMY.

Geographic range.—Northern and central Mexico, Baja California, Arizona, California, Colorado, Nevada, New Mexico, and Utah.

California records.—IMPERIAL CO.: Beal Wells, 2 mi. SW, 1 ♂, (R. Dickson, UCD); 11 mi. E, 1 ♂, X–24–51, on

Hyptis Emoryi (P. Hurd, UCR). INYO CO.: Antelope Springs, 1 ♀, VI–15–61 (C. Toschi, UCR). Big Pine Creek, 1 ♂, VI–13–65 (F. Parker, UCD). LASSEN CO.: Hallelujah Jct., 1 ♀, VII–11–61 (R. Bohart, UCD). MONO CO.: Grant Lake, 1 ♂, VIII–5–48, on *Chrysothamnus* (P. Hurd, J. MacSwain, CIS). RIVERSIDE CO.: *Anza*, 2 mi. E, 1 ♂, VII–7–56, on *Senecio Douglasii* (E. Linsley, CIS). Blythe, 12 mi. E, 1 ♂, 1 ♀, V–8–47 (J. MacSwain, UCR). Desert Center, 4 mi. W, 1 ♂, IX–16–61, on *Palafoxia linearis* (P. Hurd, CIS). Tahquitz Canyon, nr. Palm Springs, 1 ♂, VI–20–63 (F. Parker, L. Stange, UCD).

D. parvum parvum was described from a specimen having pale yellow markings and is designated in this paper to include all populations with color varying from pale yellow to nearly white. About three-fourths of the specimens of this species have some form of reddish markings. The most common of these markings occur on the apical tergal margins, but the red color may become quite extensive and include the usual black area of the legs and metasomal terga. The reddish background color occurs in association with the other color markings of yellow to white but is more extensive on the lighter specimens and the most frequently observed on the males. The extent of the pale yellow to white pattern of *p. parvum* also shows considerable variation.

Seven males and three females of *p. parvum* have been observed from collections in California east of the Sierra Nevada and in the Colorado Desert. The biology of this sub-species is unknown. The few records of plant visitations are primarily from the Compositae.

Dianthidium parvum schwarzi Timberlake
(Map 33)

Dianthidium parvum schwarzi Timberlake, 1943. Jour. New York Ent. Soc., 51:96, ♀, ♂. Holotype ♀, Riverside, Riverside Co., California (UCR).

Geographic range.—California; south Coast Range foothills, San Joaquin Valley, and Transverse and Peninsular ranges.

California records.—CONTRA COSTA CO.: Antioch, 1 ♀, V–21–49, on *Lotus* (P. Hurd, CIS). FRESNO CO.: Jacolitos Canyon, 1 ♂, VII–25–56, on *Lepidospartum squamatum* (R. Schuster, CIS). KERN CO.: Red Rock Canyon, 1 ♂, X–14–58, on *Chrysothamnus* (R. Thorp, CIS). KINGS CO.: Hanford, 1 ♀, VII–17–50 (E. Schlinger, UCD). Stratford, 1 ♀, X–19–59, on *Grindelia* (R. Snelling, SS). LOS ANGELES CO.: Lancaster, 2 mi. N, 1 ♂, IX–8–56, on *Chrysothamnus nauseosus* ssp. *mohavensis* (P. Hurd, CIS). Pearblossom, 4 mi. SE, 3 ♂, 1 ♀, VIII–19 to 21–54, on *Eriogonum;* 3 ♂ 2 ♀, VIII–19 to 21–54, on *Gutierrezia microcephala* (R. Snelling, SS). Vincent, 3 mi. W, 12 ♂, 4 ♀, XI–14–52, on *Gutierrezia* (P. Timberlake, UCR). RIVERSIDE CO.: Anza, 2 ♂, 1 ♀, VII–3–56 (L. Stange, LACM); 2 mi. E, 2 ♂, 2 ♀, VII–7–56, on *Encelia californica* (P. Hurd, E. Linsley, CIS); 1 ♂, VII–7–56, on *Croton californicus*; 1 ♀, VII–7–56, on *Senecio Douglasii* (E. Linsley, CIS). Gavilan Hills, 1 ♀, VII–3–38 (C. Dammers, LACM). Riverside, 50 ♂, 31 ♀, V–29 to XI–26, on *Corethrogyne, Gutierrezia californica, Heterotheca grandiflora, Lotus scoparius, Stephanomeria exigua* (P. Timberlake, UCR); 1 ♂, V–26–33, on *Erigeron foliosus* var. *stenophyllus* (P. Timberlake, HM). SAN BERNARDINO CO.: Colton, 1 ♂, VII–6–57 (J. Gillaspy, UCD). Mojave River, nr. mouth Deep Creek, 1 ♀, VIII–14–36, on *Eriogonum gracile* (P. Timberlake, UCR). Mouth of Deep Creek, 1 ♀, VIII–11–56 (E. Schlinger, UCD). SAN DIEGO CO.: Warner Springs, 1 ♂, VII–4–56, on *Asclepias erosa* (P. Hurd, CIS); 2 mi. N, ♂, ♀, "mating pair" (A. Menke Jr., UCD), 3 ♂, 5 ♀, VIII–8–56, on *Croton californicus* (R. Bechtel, R. Bohart, UCD); 1 ♀, VII–8–56, on *Eriogonum fasciculatum* ssp. *polifolium* (P. Hurd, CIS).

D. parvum schwarzi is characterized by full, bright-yellow maculations. The metasomal bands are usually wide and without emarginations, but the width of these bands is somewhat variable. The reddish markings discussed under *p. parvum* are also present on specimens of *p. schwarzi* but not as frequently. Representatives of both subspecies have been collected at Anza, Riverside Co., California.

D. parvum schwarzi is known from 92 males and 61 females collected mainly from the Peninsular and Transverse ranges of southern California, but it is also found in the foothills of the south coast range and in the San Joaquin Valley. The distribution and color pattern of *parvum* show a number of similarities to *platyurum*. Plant visitations are recorded in 14 genera belonging to five families with 10 of the genera from the Compositae.

Dianthidium platyurum Cockerell
(Figs. 165–167, 180, 200)

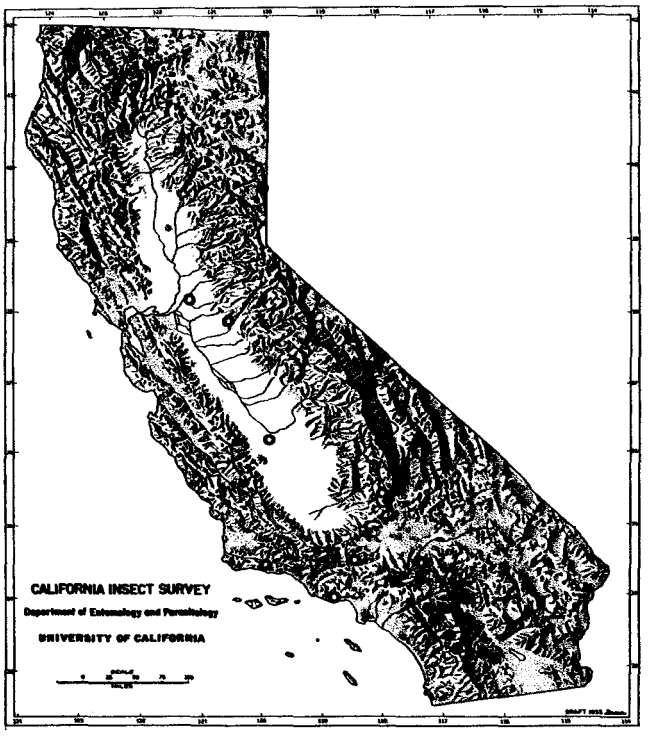
Dianthidium platyurum Cockerell, 1923. Calif. Acad. Sci. Proc., Series 4, 12(7):90.

Geographic range.—Baja California, Arizona, California, western Nevada, Texas.

D. platyurum is morphologically very close to *ulkei* and *desertorum*. The punctation of tergum VII of the male of *platyurum* is denser than that of *desertorum*, and the apex of sternum VI (fig. 166) is narrower than *ulkei*. The apex of the gonostylus of the genitalia is nearly right angled on *platyurum* as contrasted to the oblique angle of this structure on *ulkei*. The interstitial lines of the mesoscutum of the female of *platyurum* appear polished, which contrasts with the heavily sculptured lines of *ulkei*.

KEY TO SUBSPECIES OF *DIANTHIDIUM PLATYURUM*

1 Maculations of thorax and abdomen pale yellow to cream . . . . . *platyurum*
Maculations of thorax and abdomen bright yellow . . . . . *mohavense*



Map 34. California distribution of (●) Dianthidium *platyurum platyurum* Cockerell and distribution of (○) *Dianthidium platyurum mohavense* Timberlake

Dianthidium platyurum mohavense Timberlake

(Map 34)

Dianthidium platyurum mohavense Timberlake, 1943. Jour. New York Ent. Soc., 51:87. Holotype ♀, Mojave River, near mouth of Deep Creek, San Bernardino Co., California (UCR).

Geographic range.—California (San Joaquin Valley, western foothills of Sierra Nevada, Transverse ranges).

California records.—Calaveras Co.: Copperopolis, 1 mi. S, 1 ♂, VIII–20–64 (A. Menke, UCD). KERN Co.: Walker Pass, 1 ♀, IX–26–57 (E. Schlinger, UCD). KINGS Co.: Hanford, 3 ♂, 1 ♀, VII–17–50 (E. Schlinger, UCD). LOS ANGELES Co.: Agoura, 1 ♂, 1 ♀, VII–16–50 (UCR). Bouquet Canyon, Los Angeles National Forest, VIII–23–54, on *Erigeron* (R. Snelling, SS). SACRAMENTO Co.: Galt, 1 ♂, VII–27–52 (E. Schlinger, UCD). SANTA BARBARA Co.: Santa Ynez Mts., 1 ♀, VI–24–59 (R. Robart, UCD). SAN BERNARDINO Co.: Mojave River, nr. mouth Deep Creek, 1 ♀, VIII–14–36, on *Eriogonum fasciculatum* (Timberlake, UCR).

Full, orange-yellow maculations separate *mohavense* from the lighter colored and less maculated nominate subspecies. Intergradation of color and pattern of these subspecies occurs in Inyo and Kern counties and future collections may suggest a change in subspecific designation. The extent of maculations within this species exhibits a reversal of the north to south clinal pattern of more extensive maculations shown in other species.

D. playturum mohavense is known from seven males and seven females from the Transverse ranges, western foothills of the Sierra Nevada Range and San Joaquin Valley of California.

Dianthidium platyurum platyurum Cockerell

(Map 34)

Dianthidium platyurum Cockerell, 1923. Calif. Acad. Sci. Proc., Series 4, 12(7):90, ♂, ♀. Holotype ♂, San Francisquito Bay, Lower California (CAS).

Dianthidium parvum bacilifrons Cockerell, 1925. Calif. Acad. Sci. Proc., Series 4, 14(15):365. Holotype ♀, Soboba Springs, Riverside Co., California (CAS). NEW SYNONYMY.

Dianthidium ulkei riparii Schwarz, 1928. Jour. New York Ent. Soc., 36:400, ♂, ♀. Holotype ♂, Riverside, California (UCR). NEW SYNONYMY.

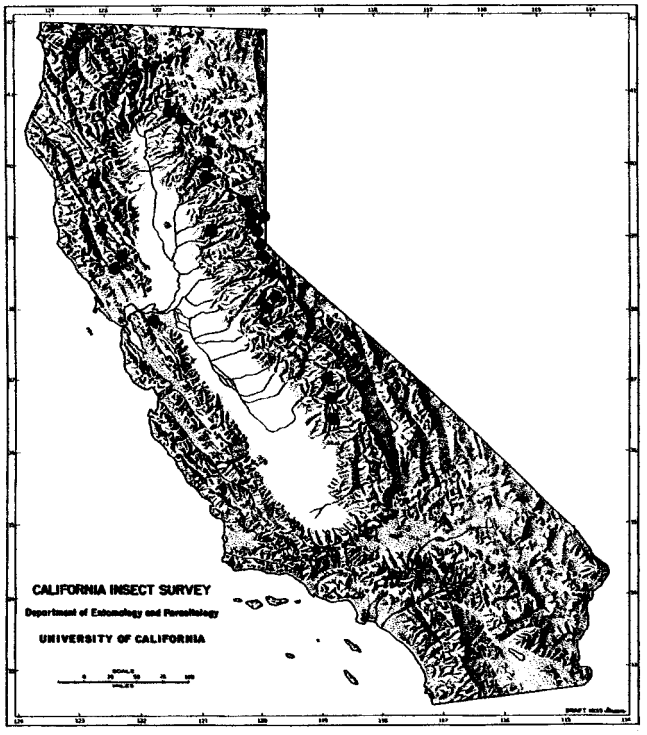
Geographic range.—Baja California, Arizona, California, western Nevada, Texas.

California records.—IMPERIAL Co.: Hesse Well, 1 mi. E, 1 ♀, V–25–49 (R. Dickson, UCR). INYO Co.: Bishop, 1 ♀, VI–21–29 (E. Van Duzee, CAS). Big Pine, 3 mi. W, 1 ♂, 2 ♀, VIII–10–62 (A. Menke, UCD); 1 ♂, 1 ♀, VIII–10–62, on bush *Eriogonum* (L. Stange, UCD); 5 mi. W, VIII–10–62, on *Eriastrum densifolium* (A. Menke, L. Stange, UCD). LASSEN Co.: Hallelujah Jct., 1 ♀, VII–17–53 (E. Schlinger, UCD). LOS ANGELES Co.: Voltaire, 1 ♂, IX–5–23 (J. Gunder, CAS). RIVERSIDE Co.: Andreas Canyon, nr. Palm Springs, 1 ♀, IV–25–56 (R. Bohart, UCD). Anza, 2 mi. E, VII–7–56, on *Encelia californica* (P. Hurd, E. Linsley, CIS). Beaumont, 9 mi. W, 1 ♂, VII–29–57 (J. Gillaspy, CIS). Deep Canyon, 3 ♂, 3 ♀, IX–24 to X–15–63, on *Bebbia* (E. Schlinger, M. Irwin, UCR). Palm Springs, 1 ♀, IX–6–36 (C. Dammers, LACM). Riverside, 1 ♂, V–14–28, on *Erigeron foliosus* var. *stenophyllus;* 1 ♀, V–22–29, on *Phacelia ramosissima;* 1 ♂, V–29–29, on *Lotus scoparius;* 3 ♂, 5♀, V–29 to VII–2–25, on *Gutierrezia californica;* 1 ♀, VI–1–26, on Malacothrix; 1 ♀, VI–15–37, on *Eriastrum pluriflorum*; 1 ♀, VII–26–17, on *Senecio Douglasii*; 1 ♀, VIII–11–36, on *Stephanomeria exigua;* 1 ♂, 1 ♀, VIII–21–25, on *Heterotheca grandiflora*; 1 ♂, IX–28–34, on *Gutierrezia californica* (P. Timberlake, UCR). Snow Creek, 1 ♀, IX–6–36 (C. Dammers, LACM). Soboba Springs, 1 ♀, V–5–17 (E. Van Duzee, CAS). Tahquitz Canyon, nr. Palm Springs, 1 ♂, VI–20–63 (F. Parker, L. Stange, UCD). SAN DIEGO Co.: Banner, 6 mi. E, 1 ♀, VI–26–63 (J. Powell, CIS). Borrego, 1 ♀, IV–27–50 (C. MacNeill, SS). Oak Grove, 3 mi. S, 1 ♂, VII–3–56 (H. Ruckes, B. Adelson, CIS). Ocotillo, 1 ♀, X–12–39 (P. Timberlake, UCR). "San Diego Co.," 1 ♀, X–4–13 (E. Van Duzee, CIS).

The species was described from a pale yellow form in Baja California. The subspecies *p. platyurum* is designated in this paper to include those populations having cream to pale yellow maculations which includes the pale yellow *p. bacilifrons*. A reddish-brown color is occasionally present on the subapical margins of the terga I to III on both sexes, but there

is no observed correlation between this color and geography. The extent of maculation varies within this species, with the most extensive pattern being associated with the bright yellow subspecies *p. mohavense*.

Eighteen males and 42 females of *p. playturum* were examined from collections in California south of the Transverse ranges and east of the Sierra Nevada. The biology of this species is unknown; but because of its morphological similarity to *ulkei*, one could speculate that it would build a nest utilizing natural cavities. *D. p. platyurum* has been collected on species in five plant families but primarily on members of the Compositae.



Map 35. California distribution of *Dianthidium plenum* Timberlake

Dianthidium plenum Timberlake
(Figs. 144–146, 175, 193; Map 35)

Dianthidium plenum plenum Timberlake, 1943. Jour. New York Ent. Soc., 51:106, ♂, ♀. Holotype ♂, Yosemite Valley, above Vernal Falls, Mariposa Co., California (UCR).

Dianthidium plenum williamsi Timberlake, 1943. Jour. New York Ent. Soc., 51:107 ♂. Holotype ♂, Tahoe, California (UCR). NEW SYNONYMY.

Geographic range.—California, western Nevada, southern Oregon.

California records.—ALPINE CO.: Hope Valley, 1 ♂, 1 ♀, VII–9 to 18–48 (P. Hurd, CIS). CONTRA COSTA CO.: Mt. Diablo, east side, 1 ♂, V–12–62 (R. Velez, UCD). EL DORADO CO.: Echo Lake, 1 ♀, VII–23–49 (W. Middlekauff, CIS). Tallac, 1 ♂, (W. Giffard, UN). Glen Alpine Cr., Tahoe, 1 ♂, VII–28–15 (E. Van Duzee, CIS). FRESNO CO.: Florence Lake, 1 ♂, VIII–29–52 (E. Schlinger, UCD). South Fork Kings River, 1 ♂, VII–8–10 (E. Van Dyke, CAS). LAKE CO.: Blue Lakes, 1 ♀, VI–1–60 (S. Fidel, UCD). Middletown, 1 ♂, VII–22–34 (E. Van Duzee, CAS). Mt. St. Helena, 1 ♀, V–12–26 (M. Van Duzee, CAS). LASSEN CO.: Bridge Creek Camp, 1 ♂, 1 ♀, VII–9–49 (J. Gillaspy, E. Schlinger, CIS, UCD). MARIPOSA CO.: Yosemite Valley, above Vernal Falls, 1 ♂, 1 ♀, VI–27–26, on *Monardella lanceolata* (P. Timberlake, UCR). MENDOCINO CO.: Ryan Creek, 1 ♂, 3 ♀, IV–29–54 (P. Hurd, CIS). Twin Rocks, 3 ♂, 1♀, VII–10–29 (E. Van Dyke, CAS). MODOC CO.: Buck Creek, 1 ♂, 1 ♀, VII–25–22 (C. Fox, CAS). NEVADA CO.: Baxter, 2 ♀, VIII–25–48 (P. Hurd, CIS). Boca, 4 ♂, 3 ♀, V–28 to VII–3–54 (R. Bohart, R. Goodwin, E. Schlinger, CIS, UCD). Fuller Lake, 1 ♀, VII–15–61, on *Phacelia* (A. Menke, UCD). Sagehen Creek, nr. Hobart Mills, 4 ♂, VII–16 to 21–54 (R. Bohart, J. Powell, CIS, UCD). Truckee, 1 ♂, VI–1925 (F. Williams, UCR). PLACER CO.: Carnelian Bay, Lake Tahoe, 1 ♂, IX–24–56 (R. Bohart, UCD). PLUMAS CO.: Lake Almanor, 1 ♀, VII–8–49 (J. MacSwain, CIS). Quincy, 4 mi. W, 1 ♂, VII–2–49 (J. MacSwain, CIS). SHASTA CO.: Hat Creek P.O., 4 ♂, VI–12 to VII–12–55 (J. Jessen, J. MacSwain, UCD, CIS). Moose Camp, 1 ♂, 1 ♀, VII–14–55 (R. Bechtel, W. Lange, UCD). SIERRA CO.: Sierraville, 2 ♂, 1 ♀, VII–24–56 (R. Bohart, UCD). SONOMA CO.: Maacama Creek, 1 ♂, VIII–24–53 (A. Telford, UCD). TULARE CO.: Giant Forest, 1 ♂, VII–22–33 (C. Fox, CAS). TUOLUMNE CO.: Kennedy Meadows, 1 ♀, VII–30–54 (J. Downey, UCD). Strawberry, 1 ♂, VI–22–51 (E. Linsley, J. MacSwain, CIS).

The variation found in this species appears mainly as extent of maculation, although the usual bright yellow is somewhat paler on one male from Mt. Diablo. The color patterns from the males of the northern end of the Sierra Nevada Range are generally the most reduced. The yellow pattern enlarges further south and west, with the Coast Range specimens being the most heavily maculated, although an occasional exception is noted. *D. plenum* closely resembles *pudicum* and *dubium* in both sexes. The male is best separated by the broad, rounded appearance of the apex of the penis valve (fig. 146) and sternum VI (fig. 145). The cutting edge of the mandible of the female is straight in *plenum* (fig. 175) and *pudicum* (fig. 176), but curved in *dubium* (fig. 185). The shape, color pattern, and presence (*plenum*, fig. 193) or absence (*pudicum*, fig. 191) of a faint, median, longitudinal carina on tergum VI of the female separates these species. The close similarity of the females of these three species has led to the naming of two subspecies of *plenum*, one each belonging to *pudicum* and *dubium*.

This montane species is found predominantly in California, although a few collections have been made in southern Oregon and western Nevada. It is dis-

tributed in the Coast, Cascade, and Sierra Nevada ranges in northern California and extends as far south as Tulare County in the Sierra Nevada. Forty-six males and 22 females were observed. Biological information on *plenum* is limited to the rearing of one male and three females from a resin and gravel nest (fig. 225) by P. D. Hurd. The nest was constructed on a branch at Ryan Creek, Mendocino County.

Dianthidium pudicum (Cresson)
(Figs. 141–143, 176, 191)

Anthidium pudicum Cresson, 1879. Amer. Ent. Soc. Trans., 7:208.

Geographic range.—Alberta, British Columbia, Baja California, Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming.

The male of *pudicum* has the median lobe of tergum VII (fig. 141) curved downward and well separated from the lateral lobes. This places it in a group with *dubium, marshi,* and *plenum.* It is readily distinguished from these by the shape of sternum VI (fig. 142) which is prominently incised at the apex. The mandible of the female of *pudicum* (fig. 176) has a straight cutting edge at the base similar to *plenum* (fig. 175), and they are separated with difficulty by the sculpture on the frons and punctation on the midline of tergum VI (figs. 191, 193), which is weakly carinate on *plenum.*

KEY TO SUBSPECIES OF *DIANTHIDIUM PUDICUM*

1 Maculations of thorax and metasoma cream to white . . . . . *pudicum*
Maculations of thorax and metasoma yellow *consimile*

Dianthidium pudicum consimile (Ashmead)
(Map 36)

Anthidium consimile Ashmead, 1896. Ent. News, 7:25–26. Holotype ♀, Los Angeles, California (USNM).

Dianthidium provancheri Titus, 1906. Proc. Ent. Soc. Wash., 7:165. Holotype ♂, Los Angeles Co., California (USNM).

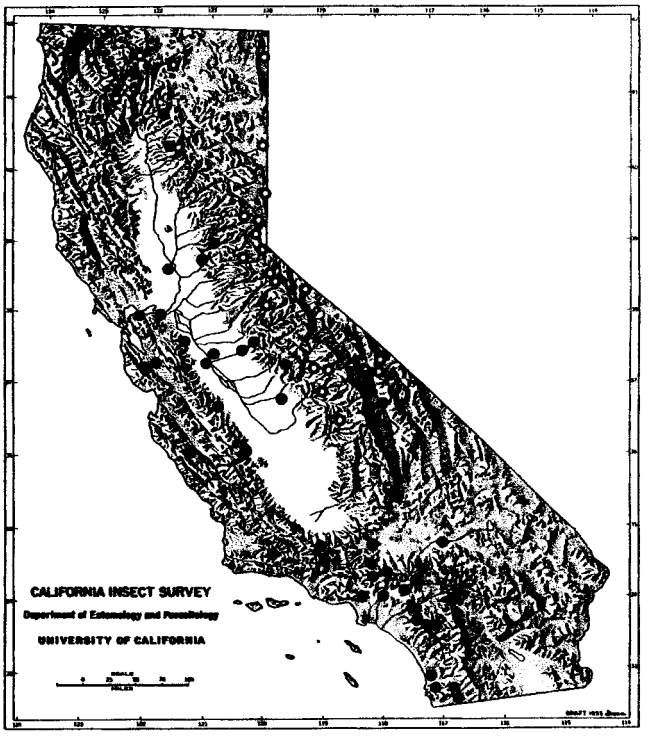
Dianthidium pudicum provancheri Timberlake, 1943. Jour. New York Ent. Soc., 51:102.

Dianthidium plenum australe Timberlake, 1943. Jour. New York Ent. Soc., 51:108. Holotype ♀, Andreas Canyon, nr. Palm Springs, Riverside Co., California (UCR). NEW SYNONYMY.

Dianthidium macswaini Timberlake, 1943. Jour. New York Ent. Soc., 51:109. Holotype ♀, Mt. Diablo, Contra Costa Co., California (CAS). NEW SYNONYMY.

Dianthidium pudicum peninsulare Timberlake, 1949. Pan.-Pac. Ent., 25(3):130. Holotype ♂, Comondu, Baja California (CAS). NEW SYNONYMY.

Biology.—Davidson, 1896, Ent. News, 7:22–26; Hicks, 1934, Univ. Colorado Studies, 21(4):268; Linsley, 1942, Bull. So. Cal. Acad. Sci., 41:164–166; Linsley and MacSwain, 1943, Ann. Ent. Soc. Amer., 36:589–601.



Map 36. California distribution of (○) *Dianthidium pudicum pudicum* (Cresson) and of (●) *Dianthidium pudicum consimile* (Ashmead)

Geographic range.—Arizona, Baja California, California.

California records.—CONTRA COSTA CO.: Antioch, 2 ♀, V–4–54 (P. Hurd, CIS); 1 ♀, X–1–49 (C. MacNeill, CIS). Martinez, 1 ♂, 1 ♀, III–22–45, nest on apricot (CIS). Mt. Diablo, 1 ♀, V–9–39, ex. nest (J. MacSwain); 2 ♀, VI–25–39 (E. Van Dyke, CAS). FRESNO CO.: Clovis, 1 ♀, VIII–30–39, on orange (T. Gallion, CAS). Coalinga, 11 mi. SE, 1 ♀, VIII–5–59, on *Haplopappus* (R. Snelling, SS). Mercy Hot Springs, 1 ♀, IX–21–63 (R. Westcott, UCD). INYO CO.: Big Pine, 3 mi. W, 1 ♂, VIII–10–62, on bush *Eriogonum* (L. Stange, UCD); 5 mi. W, 1 ♂, VIII–10–62, on *Eriastrum densifolium* (L. Stange, UCD). Independence, 1 ♂, IV–29–59 (R. Allen, UCD). Whitney Portal, 1 ♀, VIII–6–48 (P. Hurd, J. MacSwain, CIS). KERN CO.: Inyokern, 6.5 mi. NW, 1 ♀, IV–15–54, ex. nest (J. MacSwain, UCR), Mill Potrero, 1 ♂, VII–6–59 (A. Menke, UCD). Rosamond, 2 ♂, 1 ♀, IV–19–60, ex. sandgrain nest in crotch of desert sage (G. Beevor, UCD). Walker Pass, 2 ♂, VII–8–56 (J. Hall, UCD). LOS ANGELES CO.: Big Dalton Dam, 1 ♂, VII–12–50, nest in twig (R. Schuster, CIS). Big Rock Canyon, 1 ♀, VI–22–49 (H. Cott, UCD). Glendale, 1 ♂, VII–12–41, gravel and resin nest on leaf (E. Schlinger, UCD). Hollywood Hills, 3 ♂, VIII–21–49 (R. Howell, CIS). La Crescenta, 1 ♂, VII–21–39 (R. Bohart, UCD). Pallatt Creek, 1 ♀, VI–22–50 (C. MacNeill, CAS). Palmdale, 9 mi. S, 1 ♀, VIII–15–63 (R. Westcott, UCD). Pearblossom, 4 mi. SE, 2 ♂, on *Eriogonum inflatum;* 1 ♀, on *Gutierrezia microcephala,* VIII–19–54 (R. Snelling, SS). Piute Butte, V –11–44, nest on *Larrea,* VI–26–44, 1 ♂,

4 ♀, emerged, X–45, 1 ♀ emerged (P. Timberlake, UCR). Puente Hills, nr. Whittier, 1 ♀, V–11, on *Phacelia distans* (P. Timberlake, UCR). San Gabriel River, Irmindale, 2 ♂, VII–4–63 (R. Snelling, LACM). Tanbark Flat, 1 ♀, VI–22–52 (J. Hall, UCD). Vincent, 1 ♂, VIII–4–32, on *Eriastrum pluriflorum* (P. Timberlake, UCR). MADERA CO.: Oakhurst, 1 ♀, V–26–42, on *Eriodictyon* (E. Linsley, CIS). MARIPOSA CO.: Exchequer Dam, 1 ♂, 2 ♀, VIII–5–51, on *Melilotis indica;* 1 ♂, VIII–5–51, on *Melilotus albus;* 1 ♂, IX–5–54, on *Lonicera hispidula* var. *vacillans* (R. Snelling, SS). MERCED CO.: Snelling, 3 mi. E, 1 ♂, VIII–5–51 (R. Snelling, SS). MONTEREY CO.: Mill Creek, Santa Lucia Mts., 1 ♂, VIII–8–62 (E. Schlinger, UCR). PLACER CO.: Colfax, 1 ♀, V–20–52 (E. Schlinger, UCD). Loomis, 1 ♂, VII–24–51 (E. Schlinger, UCD). RIVERSIDE CO.: Andreas Canyon, nr. Palm Springs, 1 ♀, IV–24, on *Krameria Grayi;* 1 ♀, V–15–32, on *Eriodictyon crassifolium* (P. Timberlake, UCR). Anza, 2 mi. E, 2 ♀, VII–7–56, on *Encelia californica* (E. Linsley, CIS). Corona, 1 ♀, V–(?)–13 (CIS). Herkey Creek, San Jacinto Mtns., 1 ♀, VI–11–39 (E. Ross, CIS). Perris, 1.5 mi. W, 2 ♂, 1 ♀, ex. gravel nest, coll. VI–21–38, emerged VII–22 to IX–15–38 (P. Timberlake, UCR). Riverside, 1 ♂, IV–22–26, on *Lotus scoparius;* 1 ♀, V–22–29, on *Phacelia ramosissima;* 1 ♂, VIII–13–36, on *Stephenomeria exigua;* 1 ♂, 1 ♀, VIII–26–32, on *Trichostema lanceolatum,* 1 ♂, IX–26–37, on *Corethrogyne* (P. Timberlake, UCR); 1 ♂, X–17–33, on *Gutierrezia california* (H. McKenzie, HM). Mocking Bird Canyon, 1 ♂, 1927, resin and pebble nest (P. Timberlake, UCR). The Gavilan, 2 ♂, V–17–51 (R. Bechtel, E. Schlinger, UCD). SAN BERNARDINO CO.: Cajon Jct., 1 mi. N, 1 ♂, III–24–58 (E. Schlinger, UCD). Camp Baldy, 1 ♂, 2 ♀, VIII–21–39, on *Stephanomeria cichoriacea* (P. Timberlake, UCR). Hesperia, 2 ♂, 1 ♀, reared from gravel nest, coll. VI–10–52, emerged VII–24 to 29–52 (L. Andrews, UCR). Mill Creek, 1 ♂, V–30–31, on *Cryptantha intermedia* (P. Timberlake, UCR); 1 ♀, VIII–22–53 (J. Hall, UCD). Mojave Desert, nr. Barstow, 1 ♂, 1 ♀, VI–14–29, reared from gravel nest (H. Fawcett, UCR). Victorville, 1 ♀, XII–28–42, reared from nest (C. Barnhart, UCR); 3 mi. N, 1 ♀, XI–14–52, on *Guierrezia microcephala* (P. Timberlake, UCR). SAN DIEGO CO.: Alpine, 1 ♂, IV–10–15 (M. Van Duzee, CAS). Del Mar, 1 mi. S, 1 ♂, VII–1–63, on *Eriogonum fasciculatum;* 2 mi. E, 1 ♂, 1 ♀, VII–17–63 (P. Hurd, CIS). La Mesa, 1 ♀, V–30–52 (F. Williams, CAS); 1 ♀, VII–14–56 (F. Williams, UCR). Mt. Laguna, 1 ♀, VII–5–63, on *Eriodictyon trichocalyx* var. *lanatum* (P. Hurd, CIS). SAN JOAQUIN CO.: Corral Hollow, 8 mi. SW Tracy, 1 ♂, VI–9–59 (M. Wasbauer, CIS). SANTA BARBARA CO.: Bluff Camp, San Rafael Mts., 1 ♀, VI–29–59 (F. Parker, UCD). SANTA CLARA CO.: Alum Rock Park, 1 ♀, VII–31–56, on *Eriogonum latifolium* ssp. *nudum* (D. Burdick, CIS). Stanford University, 1 ♀, VII–5–10 (CIS). SHASTA CO.: Round Mt., 1 ♂, V–22–49 (R. Bohart, UCD). STANISLAUS CO.: Del Puerto Canyon, 1 ♂, V–30–59 (C. Moore, UCD). Overtimber, Newman, 1 ♂, VIII–8–56 (C. Moore, UCD). Turlock, 1 ♀, VIII–16–52, collecting resin on *Grindelia* (R. Snelling, SS). TEHAMA CO.: Manton, 1 ♂, VII–12–55 (R. Bohart, UCD). Tehama Co., 1 ♀, IV–27–15 (F. Nunenmacher, CIS). VENTURA CO.: Lockwood Valley, nr. Stauffer P.O., 1 ♀, V–2–59 (G. Stage, CIS). YOLO CO.: Knights Landing, 2 ♂, IX–5–30, from 8-cell nest on willow branch (UCD).

The color pattern of *pudicum consimile* is yellow on black but may vary from a pale yellow to an orange-yellow. The subspecific name *pudicum peninsulare* was given the form having somewhat reduced maculations from Baja California, but such reduction occasionally occurs throughout much of the range of *pudicum consimile* in California. The punctures of the frons of *pudicum* are generally well separated and the interstitial lines between them with weak sculpture or without sculpture. These punctures will, on occasion, be closer together; and thus, the females have been confused with those of *plenum* or have been described as new species (*macswaini* known only from two females). *D. plenum australe* was named as the southern California form of that species, but males of *plenum* have not been collected from southern California and the females named from there as *plenum* belong to *pudicum consimile.*

Sixty-seven males and 56 females of *pudicum consimile* have been observed from collections in California ranging from Shasta County to San Diego County. It is present in the south Coast Range, Sacramento, and San Joaquin valley, Transverse ranges, Peninsular ranges, and the western slope of the Sierra Nevada Range and extends from the Mojave Desert up the eastern slope of the Sierra Nevada Range to Inyo County, where it can be found with *p. pudicum.*

Biological information on *pudicum consimile* in San Bernardino and Los Angeles counties was first reported by Davidson (1896). He discussed the nest construction of resin and large grains of sand either in the crotches of the terminal branches of shrubs or in depressions, or angles of stones or boulders lying on the ground. A bee from one cell emerged an estimated three years from time of oviposition. Davidson reared the following insects from the nests: *Alcidamea producta* Cresson, *Monodontomerus montivagus* Ashmead, *Leucospis affinis* Say, *Torymus anthidii* Ashmead, and *Trichodes ornatum tenellus* LeConte. *Eusapyga verticalis* Cresson and *Sapyga minor* were reared from cells of what appeared to be nests of *pudicum consimile* from southern California by Hicks (1934). Linsley and MacSwain (1943) reared *Trichodes ornatus ornatus* Say from cells of *pudicum consimile* (*p. provancheri,* on twigs; *macswaini,* on sandstone) in Contra Costa County.

Collections of *pudicum consimile* have been made on members of 12 diverse plant families which included 18 genera. One-third of these genera belonged to the Compositae.

Dianthidium pudicum pudicum (Cresson)

(Map 36)

Anthidium pudicum Cresson, 1879. Amer. Ent. Soc. Trans., 7:208. Holotype ♂, Nevada (ANSP).

Anthidium pudens Cresson, 1879. Amer. Ent. Soc. Trans., 7:208. Holotype ♀, Nevada (ANSP).

Dianthidium pudicum decorum Timberlake, 1943. Jour. New York Ent. Soc., 51:100, ♀, ♂. Holotype ♀, Lewiston, Idaho (CAS). NEW SYNONYMY.

Dianthidium pudicum inyoense Timberlake, 1943. Jour. New York Ent. Soc., 51:101, ♀, ♂. Holotype ♀, Independence, Inyo Co., California (CAS). NEW SYNONYMY.

Biology.—Hicks, 1927, Psyche, 34(6):193–198; Hicks, 1931, Can. Ent., 63(8):173; Hicks, 1934, Univ. Colo. Studies, 21:268; Hurd and Linsley, 1950, Jour. New York Ent. Soc., 58:248.

Geographical range.—Alberta, British Columbia, Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming.

California records.—ALPINE Co.: Hope Valley, 1 ♂, 3 ♀, VII–9 to 18–48 (J. MacSwain, R. Smith, CIS). Winnemucca Lake, 3 ♂, VIII–30–57 (P. Marsh, UCD). EL DORADO Co.: Echo Lake, 1 ♂, VI–13–60; 1 ♀, VII–9–54 (W. Middlekauf, CIS). Fallen Leaf Lake, 1 ♂, VII–17–15 (E. Van Dyke, CAS). Strawberry Valley, 1 ♀, VIII–14–12 (E. Van Dyke, CAS). FRESNO Co.: Huntington Lake, 1 ♀, VII–4, (E. Van Duzee, CAS). Lone Indian Lake, 1 ♂, VIII–20–49 (E. Schlinger, UCD). Marie Lake, 10,500 ft., 1 ♀, VIII–30–52; Pioneer Basin, 10–11,000 ft., 1 ♀, VIII–19–56; Salie Keys Lake, 9,000 ft., 1 ♀, IX–1–52 (E. Schlinger, UCD). INYO Co.: Antelope Springs, 2 ♂, 1 ♀, VI–15–61 (C. Toschi, CIS); 1 ♀, VII–10–61 (R. Bohart, UCD); 8 mi. SW, 1 ♂, VI–15–61 (C. Toschi, CIS). Big Pine, 3 mi. E, 1 ♀, VI–10–53 (J. Brooks, CIS); 5 mi. W, 1 ♂, 1 ♀, VIII–10–62, on *Eriastrum densifolium* (L. Stange, A. Menke, UCD). Westgard Pass, 1 ♂, VI–26–53 (J. MacSwain, CIS); 3 mi. N, 1 ♀, VI–26–53 (W. McLellan, UCD). Cedar Flat, 7,310 ft., Westgard Pass, 1 ♀, VIII–19–63, ex. gravel and resin nest on under side of rock (H. Leech, CAS). KERN Co.: Walker Pass, 1 ♂, IX–26–56 (E. Schlinger, UCD). LASSEN Co.: Hallelujah Jct., 1 ♀, VII–11–57 (R. James, UCD). Hot Springs, 1 ♀, VII–13–54 (R. Bohart, UCD). MODOC Co.: Lake City, 4 mi. S, 1 ♀, VII–9–46, sweeping alfalfa (P. Hurd, R. Smith, CIS). MONO Co.: Coleville, 1 ♀, VI–21–62 (R. Wescott, LACM). Sardine Creek, 1 ♂, VII–29–59 (W. Lange, UCD). Topaz Lake, 1 ♀, VI–26–57 (D. Flaherty, UCR). NEVADA Co.: Boca, 1 ♀, VII–5–54 (R. Bechtel, UCD). Hobart Mills, 1 ♀, VII–5–62 (R. Westcott, UCD). PLACER Co.: Carnelian Bay, Lake Tahoe, 1 ♀, VIII–15–63 (R. Bohart, UCD). Squaw Valley, 1 ♀, VIII–31–55, on *Chrysothamnus* (E. Linsley, CIS). SIERRA Co.: Gold Lake, 2 ♀, VII–8–54 (R. Bohart, UCR). Independence, 1 ♀, VI–26–59 (L. Stange, UCD). SISKIYOU Co.: Montague, 1 ♀, VIII–11–63 (J. Schuh, JS). Mt. Hebron, 1 ♀, IX–3–63, on *Cirsium vulgare* (J. Schuh, JS). Summit Lake, Marble Mts., 1 ♂, VIII–23–62 (E. Mezger, UCD). TRINITY Co.: Coffee Creek Ranger Station, 10 mi. N, 1 ♀, VII–14–55 (R. Bohart, UCD); 2 ♂, VII–15–55, on *Symphoricarpos* (J. MacSwain, CIS). TULARE Co.: Giant Forest, 1 ♂, VII–14–23 (C. Fox, CAS). TUOLUMNE Co.: Chipmunk Flat, 3 ♀, VIII–9–60 (M. Irwin, UCD). Dodge Ridge, 1 ♂, VII–13–57 (E. Schlinger, UCD). McCabe Lakes, Yosemite Nat. Park, 1 ♂, VIII–2–39 (R. Usinger, CIS). Sonora Pass, 1 ♀, VI–27–51 (J. MacSwain, CIS); 1 ♀, IX–5–60 (C. MacNeill, SS). Strawberry, 1 ♂, VII–8–57 (W. Crites, UCD). Tuolumne Meadows, 1 ♀, VIII–5–58 (A. Telford, UCD).

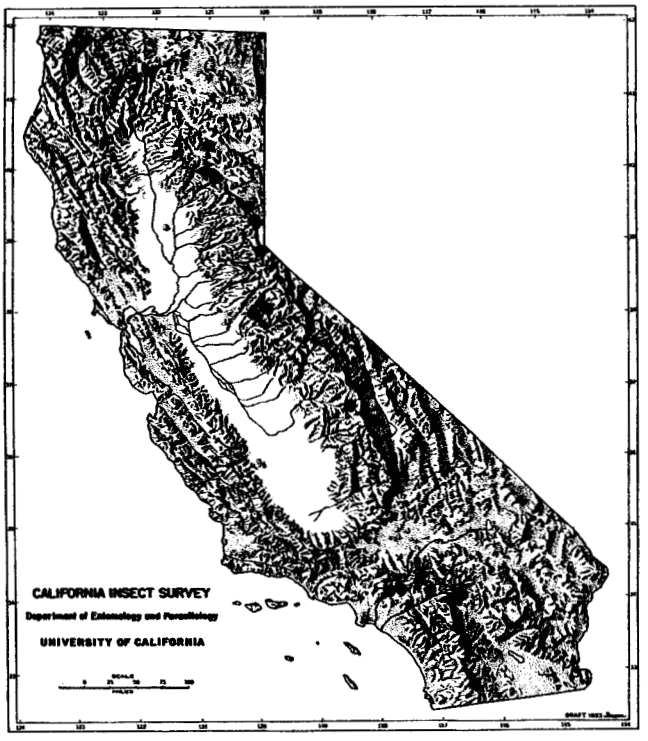
D. p. pudicum is black with a white or cream-colored pattern. An occasional male has been observed with reddish markings on the first two metasomal terga. The species has previously been separated into subspecies based on color, extent of maculation, and degree of pubescence. The length and amount of pubescence was found to be quite variable. The extent of the color pattern tended to be reduced in the Klamath and Cascade ranges and at higher altitudes but became more extensive on the eastern slope of the Sierra Nevada Range. *D. p. pudicum* is designated in this paper as including members of the species with a white to cream-colored marking of the thorax and abdomen. Specimens of this subspecies have been collected at Inyo and Kern Counties that are intermediate in color with the yellow and black subspecies *pudicum consimile*.

D. p. pudicum is most frequently collected above 5,000 feet in California. It is found in the Klamath and Cascade ranges, northeastern California, the Sierra Nevada as far south as Walker Pass, Kern County, and the White Mountains of Inyo County. It is represented in the collections examined by 28 males and 44 females.

The nest construction of *p. pudicum* was first reported at Boulder, Colorado by Hicks (1927). Nests of resin and pebbles with two to eight cells were attached to the sides of rocks or filled in depressions of the rocks. Parasites reared from these cells included *Odynerus (Stenodynerus)* sp., *Monodontomerus montivagus* Ashmead, and *Eusapyga proxima* (Cresson). *Eusapyga rubripes* (Cresson) and *Sapyga sp.* were also reared from cells of *p. pudicum* in Colorado by Hicks (1934). First instar meloid larvae of the genus *Zonitis* were found attached to the pubescence of a male of *p. pudicum* collected at Eastgate, Churchill Co., Nevada, VIII-24-62, by R. Bohart. A gravel and resin nest of four cells of this species was found by H. B. Leach in Inyo County on the underside of a rock and would not have been visible if the rock had not been turned over. The fact that the nesting site is not limited to rocks was shown by the collection of a nest of three resin and gravel cells in the crotch of a small fruit tree by F. D. Parker at Reno, Nevada. Three males of *p. pudicum* emerged from the cells.

Very limited host plant records show this sub-

species to be collected on members of the Compositae, Leguminosae, and Polemoniaceae.



Map 37. California distribution of *Dianthidium singulare* (Cresson)

Dianthidium singulare (Cresson)

(Figs. 135–137, 177, 202–203; Map 37)

Anthidium singulare Cresson, 1879. Amer. Ent. Soc. Trans., 7:207–208. Holotype ♀, Nevada (ANSP).

Dianthidium singulare var. *perluteum* T. & W. Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3:23. Holotype ♀, Wilson's Peak, Strawberry Valley, California (AMNH). NEW SYNONYMY.

Dianthidium singulare melanognathum Cockerell, 1925. Proc. Calif. Acad. Sci., (4) 14:363. Holotype ♀, Huntington Lake, Fresno Co., California (CAS). NEW SYNONYMY.

Biology.—Michener, 1935, Pan-Pac. Ent., 11:23–24; Timberlake, 1943, Jour. New York Ent. Soc., 51:75.

Geographic range.—California, Nevada.

California records.—EL DORADO CO.: Echo Lake, 3 ♂, VII–21–48 (P. Hurd, CIS). FRESNO CO.: S. Fork Kings River Canyon, 1 ♂, 2 ♀, VII–5–10 (E. Van Dyke, CAS). Huntington Lake, 1 ♀, VII–7–19 (E. Van Duzee, CAS). INYO CO.: Whitney Portal, 1 ♀, VI–19–58 (M. Irwin, UCD). LASSEN CO.: Bridge Crk., Camp, 1 ♂, VII–12–54 (R. Bechtel, UCD). LOS ANGELES CO.: Camp Baldy, 1 ♂, VI–26–50 (W. Bentinck, CIS); 1 ♂, VII–11–50 (M. Stebbins, UCD). Crystal Lake, 2 ♂, 2 ♀, VI–29–50 (S. Daniels, J. MacSwain, K. Whitesell, J. Hall, CIS, UCD). NEVADA CO.: Hobart Mills, 7 mi. N, 1 ♂, VIII–26–48, on *Chrysothamnus* (R. Smith, CIS). Sageheen Cr., nr. Hobart Mills, 2 ♀, VII–9–54 (R. Goodwin, CIS). PLUMAS CO.: Meadow Valley, 1 ♂, VI–13–24 (E. Van Dyke, CAS). Quincy, 4 mi. W, 1 ♂, 4 ♀, VI–30 to VII–14–49 (P. Hurd, CIS, UCR). RIVERSIDE CO.: Idyllwild, San Jacinto Mts., 1 ♂, VI–22–41 (E. Van Dyke, CAS). Santa Rosa Pk., 1 ♀, VI–22–40 (E. Van Dyke, CAS). SAN BERNARDINO CO.: Barton Flats, 1 ♂, VII–4–36 (CAS). Bear Valley, 1 ♂, VIII–10–35, on *Perideridia* (P. Timberlake, UCR). Camp Baldy, 1 ♀, VI–26–56 (G. Stage, SS). Dollar Lake Trail, 1 ♀, VII–10–56 (L. Stange, UCD). Forest Home, 1 ♀, VII–5–35, on *Cirsium* (P. Timberlake, UCR); 1 ♂, X–4–36, on *Chrysanthemum* (I. McCracken, CAS). Lake Arrowhead, 1 ♂, VII–25–44 (G. McKenzie, UCR). Mill Creek, 2 ♂, 1 ♀, IX–7–35, with nest (P. Timberlake, UCR); 1 ♀, VI–21–36, on *Erysimum* (P. Timberlake, UCR). SAN DIEGO CO.: Mt. Laguna, 1 ♂, VII–5–63, on *Viguiera multiflora* (P. Hurd, CIS). SIERRA CO.: Sierraville, 1 ♀, VIII–26–48, on *Chrysothamnus* (E. Linsley, CIS). TUOLUMNE CO.: Pinecrest, Camp Bob MacBride, 1 ♀, VII–8–52, on flowers of *Solidago california* (G. Stage, SS). Strawberry, 1 ♀, VII–17–57 (J. Burns, SS). Strawberry, 11 mi. N, 1 ♀, VI–24–51 (E. Schlinger, UCD).

This is the largest species of this genus found in California. The bright yellow maculations of *singulare* become more extensive from northern to southern California, particularly on the metasomal bands. Two other subspecies were created on this basis, but the variation of color pattern does not warrant subspecific designation. The apical margins of the terga show a tendency to be reddish, but this is also variable. Both sexes of *D. singulare* have the lateral margins of the terga decreasingly inflated from II to V (fig. 203). *D. cressonii* (Dalla Torre) is very closely related to *singulare* but has the sides of the terga less inflated in both sexes and the apical margin of tergum VI of the female is less transverse than *singulare*. *D. cressonii* occurs in Colorado and Nevada and may eventually be found in eastern California.

D. singulare is limited in its California distribution to the mountains of the eastern and southern part of the state. Although described from Nevada the species has been collected more frequently in California, with 25 males and 24 females being observed from this state.

The nest of this species has been observed by Michener and Timberlake on the side or face of a rock. They were built with resin and pebbles and consisted of a single cell. The limited host records of this bee fall mainly in the family Compositae.

Dianthidium subparvum Swenk

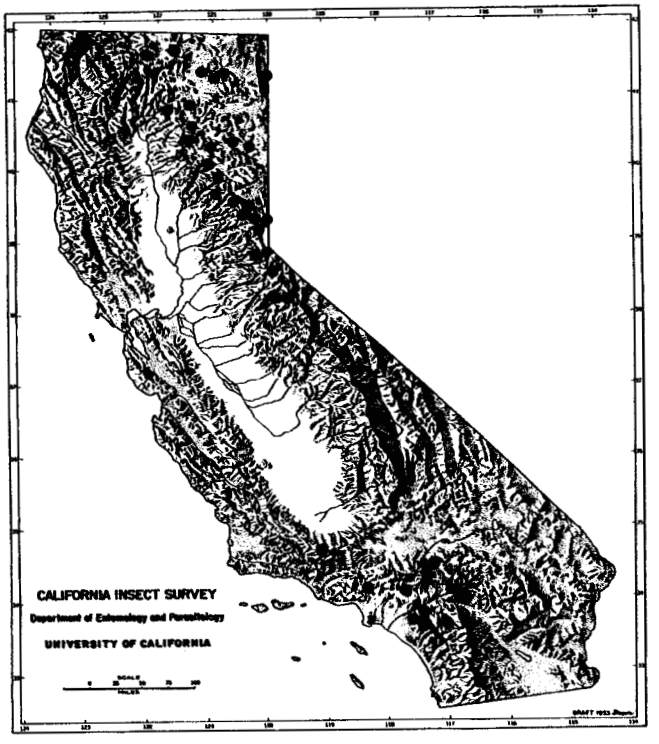
(Figs. 156–158, 182, 189, 192; Map 38)

Dianthidium subparvum Swenk, 1914. Nebr. Univ. Studies, 14(1):30, ♀, ♂. Holotype ♀, Pullman, Washington (UN).

Dianthidium semiparvum Schwarz, 1926. Amer. Mus. Novitates, 226:12. Holotype ♂, Huntsville, Utah (AMNH). NEW SYNONYMY.

Dianthidium semiparvum gallatinae Schwarz, 1927. Amer. Mus. Novitates, 277:6, ♂, ♀. Holotype ♂, Gallatin Co., Montana (AMNH). NEW SYNONYMY.

Dianthidium parvum var. *swenki* Schwarz, 1928. Jour. New York Ent. Soc., 36:402, ♂ (♀ misdet.). Holotype ♂, Riverside, California (USNM). NEW SYNONYMY.



Map 38. California distribution of *Dianthidium subparvum* Swenk

Geographic range.—British Columbia, California, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.

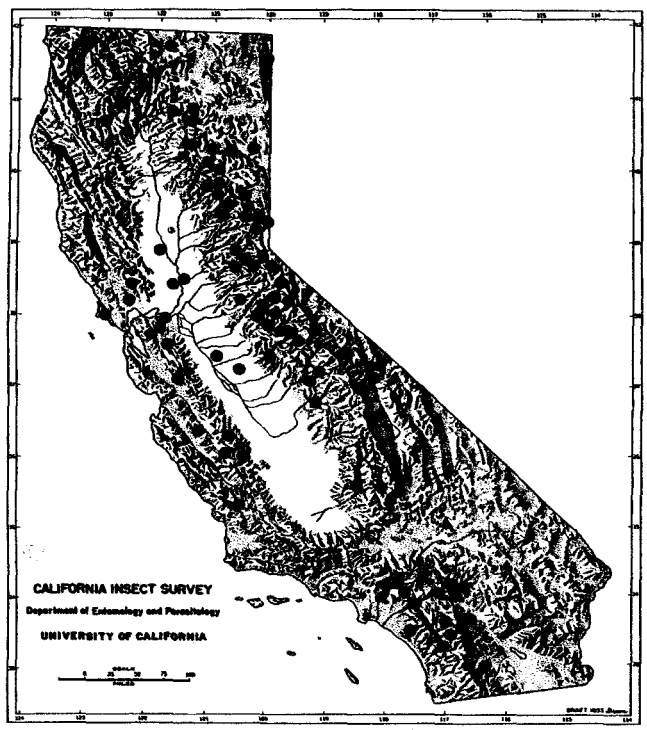
California records.—ALPINE Co.: Highland Lake, 1 ♂, VII–30–59 (R. Bohart, UCD). Winnemucca Lake, 2 ♀, VI–30–54 (R. Bohart, UCD). EL DORADO Co.: Echo Lake, 1 ♂, VII–9–54 (W. Middlekauff, CIS). INYO Co.: Whitney Portal, 1 ♀, VII–3–53 (H. Nakakihara, UCR); 2 ♂, 3 ♀, VIII–6–48 (P. Hurd, J. MacSwain, CIS). KERN Co.: Frazier Park, 4 mi. W, 1 ♂, VII–20–63 (J. Powell, CIS). LASSEN Co.: Bridge Creek Camp, 1 ♂, 2 ♀, VII–9–49 (R. Bechtel, W. Ehrhardt, W. Schreader, UCD). Litchfield, 1 ♀, IX–7–57, on *Chrysothamnus viscidiflorus* (B. Adelson, CIS). LOS ANGELES Co.: Big Pines Camp, San Gabriel Mts., 1 ♂, 2 ♀, VII–13–37, on *Erigeron foliosus* var. *stenophyllus* (P. Timberlake, UCR). Big Tujunga Canyon, 1 ♂, V–24–51 (E. Jaycox, UCD). MODOC Co.: Canby, 7 ♂, 2 ♀, X–12–52 (J. Hall, E. Schlinger, UCD). Cedarville, 5 mi. S, 1 ♂, VII–11–59 (J. Powers, CIS); 6 mi. NW, 1 ♂, 4 ♀, VII–4–62 (J. Buckett, UCD). Hackmore, 1 ♂, 1 ♀, VII–12–47 (C. Hanson, CIS, SS). Lake City, 1 ♂, VIII–28–22 (C. Fox, CAS). MONO Co.: Cottonwood Creek, White Mts., 9,300 ft., 1 ♀, VII–10–61 (D. Miller, LACM). Hot Creek, 1 ♂, VIII–2–36 (G. and R. Bohart, UCR). Leavitt Landing, 1 ♀, VI–26–37 (UCR). Sardine Creek (8,500 ft.), 1 ♂, VI–28–57 (S. Kappos, UCD). Tom's Place, 1 mi. SW, 1 ♀, VIII–13–63 (M. Tauber, C. Toschi, CIS). Sonora Pass, 1 ♂, VIII–13–60, on *Haplopappus suffruticosus* (R. Thorp, RT). NEVADA Co.: Boca, 1 ♀, VII–3–54, on *Aster* (P. Hurd, CIS). Hobart Mills, 7 mi. N, 1 ♂, VIII–26–48, on *Chrysothamnus sp.* (R. Smith, CIS). Sagehen Creek, nr. Hobart Mills, 1 ♀, VII–2–54 (E. Schlinger, UCD); 1 ♂, VII–21–54 (J. Powell, CIS). PLACER Co.: Carnelian Bay, Lake Tahoe, 2 ♂, 1 ♀, VII–22–57, 1 ♂, IX–24–56 (R. Bohart, UCD). PLUMAS Co.: Chester, 8 mi. NW, 1 ♀, VIII–5–59 (E. Linquist, CIS). Lake Almanor, 1 ♀, VIII–8–49 (P. Hurd, CIS). Onion Valley, 1 ♂, VII–7–49 (W. Ehrhardt, UCD). Quincy, 4 mi. W, 2 ♀, VII–3 and 8–49 (P. Hurd, J. MacSwain, CIS). RIVERSIDE Co.: Anza, 2 mi. E, 1 ♂, VII–7–56, on *Senecio Douglasii* (E. Linsley, CIS). Anza, 1 ♂, VII–3–56 (H. Moffitt, UCD). Hemet Reservoir, San Jacinto Mts., 2 ♂, 2 ♀, VI–13–39, on *Chenopodium* (E. Ross, CIS). Herkey Creek, 1 ♂, VI–24–34 (I. McCracken, CAS). Idyllwild, San Jacinto Mts., 1 ♂, VI–3–39, on *Chaetopappa aurea;* 1♂, 1♀, VII–22–33, on *Erigeron stenophyllus* (P. Timberlake, UCR). Keen Camp, 3 ♂, 1 ♀, VI–10–39 (E. Ross, E. Linsley, CIS). Riverside, 1 ♂, V–25–25, 1 ♂, VII–11–29, 1 ♀, VI–25–49, on *Gutierrezia californica;* 1 ♂, VIII–1–29, 2 ♀, X–5–29, on *Corethrogyne filaginifolia* (P. Timberlake, UCR). South Fork Santa Ana River, 1 ♀, VIII–15–45 (A. Melander, UCR). Upper Santa Ana River, 1 ♀, V–31–47 (A. Melander, UCR). Vandevanter Flat, San Jacinto Mts., 9 ♂, 11 ♀, VI–13–39 (E. Linsley, CIS). SAN BERNARDINO Co.: Bear Valley, 1 ♂, 1 ♀, VIII–13 (F. Clark, CAS). Big Bear Lake, 1 ♀, VIII–17–37 (C. Michener, UCR). Big Bear Valley, 2 ♀, VIII–11–33, on *Machaeranthera tephrodes* (P. Timberlake, UCR). Cajon, 7.7 mi. N, 1 ♂, VII–4–63, on *Eriogonum fasciculatum* (R. Snelling, LACM). Dollar Lake Trail, 1 ♂, VII–11–56, on *Erigeron divergens* (R. Bechtel, UCD). Upper Santa Ana River, 3 ♂, VIII–5, 23–46, IX–7–46, on *Clematis pauciflora, Linum, Aster alpigenus* (G. and J. Sperry, CIS). SAN DIEGO Co.: Mt. Laguna, 1 ♀, VI–21–63, on *Lotus strigosus* var. *hirtellus* (P. Hurd, CIS). SHASTA Co.: Cassel, 1 ♀, VII–15–55 (R. Bohart, UCD). Lassen National Park, 1 ♀, IX–9–41 (E. Van Dyke, CAS). Manzanita Lake, 3 mi. N, 1 ♂, VII–15–55 (E. Schlinger, UCD). Moose Camp, 1 ♀, VII–14–55 (J. Downey, UCD). Mt. Lassen, 6,000–8,000 ft., 1 ♀, VIII–2–38 (E. Van Dyke, CAS). Old Station, 1 ♂, VII–16–52 (R. Bechtel, UCD). SIERRA Co.: Gold Lake, 1 ♀, VII–8–54 (R. Bohart, UCD); 1 ♂, 1 ♀, VIII–13–63 (R. Westcott, LACM). Independence Lake, 2 ♂, VI–29–54, 3 ♀, VII–27–56 (R. Bohart, UCD). Sierraville, 3 ♂, 1 ♀, VII–2–54 (R. Goodwin, CIS). Weber Lake, 2 ♂, 1 ♀, VIII–4–51 (E. Schlinger, UCD). SISKIYOU Co.: Lava Beds National Monument, S edge, 2 ♀, VIII–6–63, on *Phacelia* sp; Macdoel, 1 ♂, 2 ♀, VII–27–63, on *Grindelia* sp; Montague, 1 ♂, IX–5–63, at bee board (J. Schuh, JS). TUOLUMNE Co.: Dardanelles, 1 ♀, VII–4–48 (P. Hurd, J. MacSwain, CIS). Sonora Pass, 1 ♂, 1 ♀, VIII–16–59, on *Aster foliaceous;* 1 ♀, VIII–21–59, on *Haplopappus* (G. Stage, R. Snelling, SS).

This species was previously divided into four subspecies on the basis of extent of yellow coloration. These yellow markings exhibit the north-to-south clinal pattern typical of several other species. *D. subparvum subparvum* and *gallatinae* show the least color while *swenki* of southern California is the most highly maculated. The black areas may be somewhat brownish, as is the case with the type of *galla-*

tinae. Specimens having white maculations have been observed from British Columbia and Nevada and with the addition of future collections, these specimens may warrant a subspecific name. Tergum VII (fig. 156) of the male of *subparvum* shows similarities to that of *parvum* (fig. 153) but is distinguished from it by having a wider median lobe and a blunt appearing penis valve (fig. 158). The female of *subparvum* is separated from *parvum* only by subtle differences of the sternum VI. This sternum is generally larger, more rounded apically than *parvum* (figs. 188, 189) and the surface of *subparvum* appears slightly depressed if the pollen is cleared from the scopa.

D. subparvum is fairly common in the mountains of eastern and southern California, but in the Coast Range it is limited to the extreme southern end. Specimens observed from California total 94 males and 88 females.

Biological information on this species is limited to the recording of visitations on members of several diverse plant families. The majority of these were found on the Compositae.



Map 39. California distribution of *Dianthidium ulkei ulkei* (Cresson)

Dianthidium ulkei ulkei (Cresson)

(Figs. 162–164, 179, 198; Map 39)

Anthidium ulkei Cresson, 1878. Trans. Amer. Ent. Soc., 7:115. Holotype ♀, Utah (ANSP).

Anthidium davidsoni Cockerell, 1904. Bull. South. Calif. Acad. Sci., 3(1):5. Holotype ♂, Bear Valley, California (USNM). NEW SYNONYMY.

Dianthidium ulkei reductum Timberlake, 1943. Jour. New York Ent. Soc., 51:82–83, ♀, ♂. Holotype ♀, Longmire, Ranier National Park, Washington (CAS). NEW SYNONYMY.

Biology.—Hicks, 1926*a*, Colo. Univ. Studies, (A) 15:217–52; 1933, Ent. News, 44:75–78. Parker and Bohart, 1966, Pan-Pac. Ent. 44(2):96.

Geographic range.—British Columbia, Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, Oregon, South Dakota, Utah, and Washington.

California records.—ALAMEDA CO.: Arroyo Mocho, S of Livermore, 1 ♀, X–8–54 (C. MacNeill, CIS). ALPINE CO.: Highland Lake, 1 ♀, VII–20–59 (P. Marsh, UCD). CALAVERAS CO.: San Andreas, 1 ♀, VIII–8–34 (J. Dubois, SS). COLUSA CO.: College City, 1 ♀, VII–10–16, on *Grindelia* (CIS). CONTRA COSTA CO.: Antioch, 1 ♀, VIII–21–48 (P. Hurd, CIS); 1 ♂, IX–22–54, on *Grindelia* (C. MacNeill, CIS). Danville, 1 ♂, 1 ♀, IX–19–51 (F. Williams, CAS). Mt. Diablo, 1 ♂, VII–17–51 (W. Bentinck, CIS). Russelmann Park, 1 ♀, VI–24–56 (P. Opler, SS). EL DORADO CO.: Chile Bar, 1 ♀, VII–5–48 (P. Hurd, CIS). Echo Summit, 1 ♂, VIII–4–57 (T. Haig, UCD). Kyburz, 2 ♂, 1 ♀, VII–23–50 (W. Ehrhardt, CIS). Pollock Pines, 1 ♀, IV–24–38 (A. McClay, UCD); 3 ♂, 4 ♀, VIII–19–53 (A. Grigarick, E. Schlinger, UCD). Snowline Camp, 4 ♂, 5 ♀, VII–19–48; 1 ♂, VII–22–48, on *Grindelia camporum* (P. Hurd, CIS). Strawberry, 1 ♀, VII–28–50 (M. Gardner, UCD). FRESNO CO.: Cascade, 2 ♀, VII–29–19 (E. Van Duzee, CAS). Coalinga, 8 mi. W, 1 ♀, IX–28–59, on *Haplopappus* (R. Snelling, SS). Huntington Lake, 2 ♂, VII–27–19 (E. Van Duzee, CAS). Pine Ridge, 1 ♀, VII–19–60, on *Eriogonum* sp. (R. Snelling, SS). Shaver Lake, 2 ♂, VII–19–60, on *Solidago* (R. Snelling, SS); 1 ♂, 2 ♀, VIII–8–56 (R. Schuster, CIS). HUMBOLDT CO.: Myers, 3 ♂, 1 ♀, VII–7–37 (E. Van Dyke, CAS). INYO CO.: Big Pine, 5 mi. W, 2 ♀, VIII–10–62, on *Eriastrum densifolium* (L. Stange, UCD). Big Pine Creek, Glacier Lodge, 1 ♀, VIII–29 (I. McCracken, CAS). Bishop, 1 ♂, IX–4–56 (R. Bohart, UCD). Whitney Portal, 1 ♂, VII–7–61 (J. Powell, CIS). KERN CO.: Glenville, 17 mi. E, Greenhorn Mts., 1 ♂, 1 ♀, VIII–20–61 (R. Macdonald, UCD). Walker Pass, 2 ♂, 1 ♀, IX–26–57 (E. Schlinger, UCD). LASSEN CO.: Bridge Creek Camp, 1 ♂, 1 ♀, VII–9–49 (H. Hunt, CIS). Litchfield, 1 ♂, 1 ♀, IX–8–57, on *Chrysothamnus viscidiflorus* (E. Linsley, CIS). LOS ANGELES CO.: Big Pines Camp, 1 ♂, 6 ♀, VII–14 to 17–27, on *Erigeron foliosus* (P. Timberlake, UCR). Camp Baldy, 1 ♂, VI–26–50 (H. Robinson, UCD). Crystal Lake, 1 ♀, VI–29–50, on *Eriodictyon* (P. Hurd, CIS). Tanbark Flat, 1 ♀, VII–14–50 (W. Bentinck, CIS). MARIN CO.: Bolinas, 1 ♀, III–7–44 (D. Cox, CIS). MARIPOSA CO.: Big Oak Flat, Entrance Station, 1 ♀, VIII–12–52 (R. Bechtel, UCD). Mariposa, 1 ♂, VII–4–59 (G. Stage, R. Snelling, SS). Miguel Meadows, Yosemite National Park, 1 ♂ (A. Applegarth, SS). Yosemite, 4,000 ft., 2 ♂, 2 ♀, VII–13–33, on *Helenium Bigelovii* (H. McKenzie, HM). Yosemite Valley, 7 ♂, 4 ♀, VIII–1 to 12–54 (R. Goodwin, CIS). MERCED CO.: Merced, 15 mi. S, 1 ♀, VIII–12–60 (R. Snelling, SS). MODOC CO.: Buck Creek, 2 ♀, VI–21–22 (C. Fox, CAS). Cedarville,

5 mi. S, 1 ♂, VIII–11–59 (J. Chemsak, CIS); 6 mi. NE, IX–5–62 (J. Buckett, UCD). Lake City, 4 mi. S, 1 ♀, VII–9–46, sweeping alfalfa (P. Hurd, R. Smith, CIS). MONO Co.: Grant Lake, 1 ♂, VII–28–59 (R. Thorp, CIS); 1 ♂, VIII–5–48, on *Chrysothamnus* sp. (P. Hurd, J. MacSwain, CIS). Hwy. 120–395 Jct., 12 mi. E, 1 ♂, VIII–7–58 (A. Telford, UCD). Tom's Place, 1 mi. S, 1 ♂, VIII–8–62 (L. Stange, UCD). MONTEREY Co.: Priest Valley, 1 ♂, IX–22–59, on *Solidago californica* (R. Snelling, SS). NAPA Co.: St. Helena, 1 ♀, IX–11–48, on *Solidago sp.* (P. Hurd, CIS). NEVADA Co.: Boca, 2 ♂, 2 ♀, VII–3–54, on *Aster* (P. Hurd, CIS). Hobart Mills, 1 ♂, X–11–52 (J. Hall, UCD); 7 mi. N, 1 ♀, VIII–26–48, on *Chrysothamnus* sp. (J. MacSwain, CIS); 2 mi. S, 1 ♂, VIII–23–56, on *Chrysothamnus* (E. Linsey, CIS). Sagehen Creek, 1 ♂, 1 ♀, VII–6 and 16–54 (R. Bohart, UCD). Truckee, 1 ♂, VIII–17–55, on Compositae (J. Linsley, CIS). ORANGE Co.: Santiago Cyn., 1 ♂, 1 ♀, VII–26–62 (D. Miller, UCD). PLACER Co.: Carnelian Bay, Lake Tahoe, 2 ♂, 3 ♀, VII–22–57; 1 ♂, VIII–25–55 (R. Bohart, UCD). Lake Forest, Lake Tahoe, 1 ♀, VII–14–49 (E. Linsley, CIS). Forest Hill, 13 mi. E, 1 ♂, VI–24–62 (R. and M. Snelling, LACM). PLUMAS Co.: Almanor Dam, 1 mi. NW, 1 ♂, VII–17–47 (T. Leigh, CIS). Big Spring, 3 mi. SE, 1 ♂, 1 ♀, VII–17–47 (T. Leigh, CIS). Blairsden, 1 ♂, VIII–23–52 (R. Bohart, UCD). Bucks Lake, 2 ♂, VII–1 and 14–49 (E. Schlinger, UCD). Chester, 8 mi. NW, 2 ♂, 1 ♀, VII–18–46, on *Chrysothamnus viscidiflorus* (E. Lindquist, CIS). Greenville, 1 ♂, VIII–1–52 (W. Bentinck, CIS). Onion Valley, 1 ♂, 1 ♀, VII–7–49 (W. Ehrhardt, E. Schlinger, UCD). Quincy, 4 mi. W, 9 ♂, 3 ♀, VI–25 to VII–6–49 (P. Hurd, J. MacSwain, CIS). RIVERSIDE Co.: Anza, 1 ♂, 1 ♀, VII–5–56 (R. Bohart, UCD); 2 mi. E, 3 ♂, 1 ♀, VII–7–56, on *Encelia californica* (P. Hurd, E. Linsley, CIS); 1 ♂, VII–7–56, on *Senecio Douglasii* (E. Linsley, CIS). Dark Canyon, San Jacinto Mts., 1 ♂, VI–21–40, on *Lotus Davidsonii* (C. Michener, CIS). Idyllwild, San Jacinto Mts., 1 ♂, VI–17–40, on *Eriogonum* (E. Ross, CIS); 2 ♂, 2 ♀, VII–22–33, on *Erigeron foliosus*, on *Chaetopappa aurea* (P. Timberlake, UCR); 1 ♂, VIII–16–44 (C. Michener, CIS). Keen Camp, San Jacinto Mts., 2 ♂, 2 ♀, VI–10–39 (E. Ross, CIS). Piñon Flat, San Jacinto Mts., 1 ♀, V–24–39 (E. Ross, CIS). Vandevanter Flat, San Jacinto Mts., 1 ♂, VI–11–39, on *Helianthus* (E. Ross, CIS). Santa Ana River, 1 ♀, IX–21–48 (A. Melander, UCR). SACRAMENTO Co.: Sacramento, 1 ♂, V–20–50 (H. Robinson, UCD); 1 ♂, VI–15–57, on *Melilotus albus*, 1 ♀, VI–15–57, on *Centaurea* (D. Stevens, CIS). SAN BENITO Co.: Idria (Gem Mine), 2 ♂, VII–5–54, on *Achillea Millefolium* (R. Smith, E. Linsley, CIS). Pinnacles, 1 ♂, VIII–17–33 (J. Howell, L. Rose, CAS). SAN BERNARDINO Co.: Barton Flat, S Fork Camp, 1 ♂, IX–21–44 (A. Melander, UCR). Big Bear Valley, 2 ♂, 4 ♀, VIII–11–33, on *Machaeranthera tephrodes* (P. Timberlake, UCR). Big Bear Lake, 1 ♂, VIII–24–57 (E. Schlinger, UCD). Camp Baldy, 1 ♂, 1 ♀, VIII–21–29, on *Stephanomeria cichoriacea* (P. Timberlake, UCR). Dollar Lake Trail, 2 ♀, VII–10–56 (H. Moffitt, UCD); 1 ♂, VII–11–56, on *Erigeron divergens* (R. Bechtel, UCD). Falls Public Camp, 2 ♀, VII–11–56 (R. Bechtel, W. Lange, UCD). Forest Home, 5 ♀, VII–23–44, on *Solidago californica* (P. Timberlake, UCR). Mill Creek Canyon, 1 ♂, 3 ♀, VIII–23–53 (J. Hall, UCD). Mountain Home, 1 ♂, IX–12–53 (J. Hall, UCD). Upper Santa Ana River, 1 ♂, VIII–23–46, on *Senecio ionophyllus* (G. and J. Sperry, CIS). Valley of the Falls, Mill Creek, 8 ♂, 6 ♀, VIII–11–37; 8 ♂, 7 ♀, IX–7–35, on *Chrysopis villosa;* 1 ♂, 1 ♀, VIII–12–45, on *Eriogonum* (P. Timberlake, UCR). Vivian Creek Trail, 1 ♂, 5 ♀, VII–21–35, on *Erigeron foliosus* (P. Timberlake, UCR). SAN DIEGO Co.: Julian, 2 ♂, VI–26–58, VIII–8–52 (R. Bohart, H. Moffitt, UCD). Mt. Laguna, 3 ♂, 6 ♀, VII–5–63, on *Viguiera multiflora* (P. Hurd, CIS). Mt. Palomar, 5,500 ft., 2 ♀, IX–15–53 (F. Williams, CAS). Pala, 1 ♂, VI–21–59 (M. Irwin, UCD). Warner Springs, 2 mi. N, 1 ♀, VII–4–56 (C. Wiley, CIS). SAN LUIS OBISPO Co.: Santa Margarita, 5 mi. NE, 1 ♂, VI–9–62, on *Lotus scoparius* (P. Hurd, CIS). SANTA CLARA Co.: San Antonio Valley, 1 ♂, 1 ♀, VII–31–49; 1 ♀, IX–14–48, on *Eriogonum* (J. Gillaspy, P. Hurd, CIS). SHASTA Co.: Cassel, 2 ♀, VII–5–55, on *Aster* (J. MacSwain, CIS). Clayton, 2 ♂, 1 ♀, VII–13–18 (E. Van Duzee, CAS). Hat Creek P.O., VII–12–55 (J. MacSwain, CIS). Moose Camp, 1 ♂, VII–14–55 (A. Grigarick, UCD). Mt. Lassen, 6,000 to 8,000 ft., 2 ♀, VIII–2–38 (E. Van Dyke, CAS). Snow Mt. Rd., 1 ♂, VII–14–55 (W. Lange, UCD). SIERRA Co.: Calpine, 3 ♂, 4 ♀, VIII–27–48, on *Solidago* sp. (E. Linsley, P. Hurd, CIS); 1 ♂, VIII–27–48, *Chrysothamnus* sp. (R. Smith, CIS). Dog Valley, 1 ♀, VII–2–51 (CAS). Goodyear's Bar, 2 ♀, VIII–11–63 (R. Wescott, LACM). Independence Lake, 1 ♂, VI–29–54 (R. Bohart, UCD). Sierraville, 1 ♂, 1 ♀, VII–2–54 (R. Goodwin, J. Powell, CIS); 2 ♂, 1 ♀, IX–6–58 (R. Bohart, UCD). Weber Lake, 2 ♂, VII–4–51; Yuba Pass, 1 ♀, VIII–20–53 (E. Schlinger, UCD). SISKIYOU Co.: Hebron Summit, 1 ♂, 3 ♀, VIII–7–58, on *Chrysothamnus viscidiflorus* (J. Powell, CIS). Montague, 1 ♂, 3 ♀, VIII–11 to IX–5–63 (Schuh, Peters, Irwin, JS). Shasta, 1 ♂, VIII–8–58 (D. Cavagnaro, UCD). SONOMA Co.: Sonoma, 1 ♀, VIII–9–34 (J. Dubois, SS). Maacama Creek, 1 ♂, VIII–24–53 (E. Schlinger, UCD). STANISLAUS Co.: Adobe Creek, 6 ♂, IX–14–48, Compositae (P. Hurd, CIS). Del Puerto Canyon, 1 ♂, 2 ♀, IX–8–56, on *Solidago californica* (R. Snelling, M. Stage, SS); 1 ♂, 1 ♀, X–3–56 (R. Snelling, SS). Turlock, 1 ♀, VI–3–53; 3 ♂, 2 ♀, VIII–31–51; 2 ♂, 4 ♀, VII–12 and VIII–23–52 on *Heterotheca grandiflora;* 1 ♂, VI–9–53, 1 ♀, VI–24–54, on *Helianthus petiolaris;* 1 ♀, VI–19–24, on *Solidago californica;* 1 ♀, VI–15–54, reared from old beetle burrow in almond limb (R. Snelling, SS). TRINITY Co.: Trinity River Camp, 1 ♂, VII–17–53 (M. McClay, UCD). Weaverville, 1 ♂, 1 ♀, VI–20–37 (F. Williams, CAS). TUOLUMNE Co.: Browns Meadow, 1 ♀, VIII–13–60 (A. Menke, UCD). Chipmunk Flat, 1 ♀, VIII–8–60, on *Chrysothamnus nauseosus;* 1 ♂, VIII–9–60, on *Ranunculus* (J. MacSwain, CIS). Dardanelles, 1 ♂, 1 ♀, VIII–8–59 (R. Snelling, G. Stage, SS). Dodge Ridge, 2 ♀, VIII–7–60, VIII–19–51 (A. Menke, A. McClay, UCD). Leland Meadows, 10 ♂, 10 ♀, VIII–5–60 (J. MacSwain, CIS). Long Barn, 1 ♂, VII–15–61, 1 ♀, VII–30–61 (R. Snelling, LACM). Mather, VIII–5–54 (R. Goodwin, CIS). Pinecrest, 1 ♀, VII–25–51, on *Solidago californica,* (G. Stage, SS); 13 ♂, 1 ♀, VIII–4–48, on *Solidago* sp. (J. MacSwain, P. Hurd, CIS). Sonora, 2 mi. NE, 1 ♂, 4 ♀, VIII–14–60 (R. Thorp, RT). Sonora Pass, 8 mi. W, 1 ♂, VIII–23–60 (R. Thorp, CIS). Strawberry, 1 ♂, VII–15–51 (J. MacSwain, CIS); 6 ♂, 2 ♀, VIII–27–60, on *Haplopappus Bloomeri* (P. Hurd, CIS). Twain-Harte, 13 ♂, 39 ♀, VII–37, on *Grindelia* (F. Blaisdell, CAS). YOLO Co.: Davis, 1 ♂, VI–23–61, 1 ♀, VIII–21–55 (L. Nault, J. Downey, UCD).

D. ulkei ulkei is a yellow and black subspecies with the extent of yellow maculations varying considerably. These variations were formerly distinguished as subspecies, and the form with the most reduced

yellow marking was named *reductum*. The most highly maculated specimens occur in southern California and were named *davidsoni*. A clinal effect of increased maculation can be observed from north to south. The color pattern also increases in the Coast Range and Central Valley, but intergradation is so complete that a geographical separation is not possible. *D. ulkei perterritum* Cockerell (1913b) is found in the southwestern United States and is readily distinguished from *ulkei ulkei* by having cream or white markings, being somewhat larger than *ulkei*, and exhibiting slight morphological differences in the male genitalia and tergum VI in the female. *D. ulkei cooleyi* Schwarz (1927c), was described as a variation of *ulkei* having reddish-brown legs. An observation of the type female showed that it did not belong to *ulkei*, but its aged and worn condition precluded a positive assignment to another species.

D. ulkei is closely related to the species *desertorum* and *platyurum*. The male is distinguished from *desertorum* by the setation of the genitalia and punctation of tergum VII and from *platyurum* by sternum VI (fig. 163) and the angle of the gonostylus of the genitalia. The female of *ulkei* has a frons and mesoscutum that is so sculptured as to appear dull, whereas these areas of *platyurum* appear polished.

D. ulkei is one of the most frequently collected species in California, and one may expect to find it in most of California except the Mojave and Colorado deserts. Collections totaling 274 males and 283 females have been observed from California, with the majority being from the Sierra Nevada and the mountains of southern California.

Hicks (1926*a*) reported *ulkei* nesting in an old cell of *Anthophora neomexicana* Cockerell and natural (?) cavities or short tunnels in the soil (1933). Specimens of *u. ulkei* and *u. perterritum* have been reared from domicile-type, trap nests, and elderberry stems (similar to those of Medler and Fye, 1956) by Parker and Bohart (1966). These trap nests were placed approximately four feet off the ground in bushes. Hicks presented a detailed description of nest construction and contents in 1926*a* and 1933. Various combinations of resin alone or in combination with pebbles and bits of vegetation were used. The nests were single or double celled, with one above the other. Cells three deep have been observed in a single tunnel of the trap nests. Hicks estimated the building, provisioning, and attempted concealment of the nest required about 1,000 trips based on the number of articles used in construction. The plant records taken in this survey show *ulkei* to be found on members of the family Compositae about three-fourths of the time, but they have also been collected on plants of five other families.

Genus *Anthidiellum* Cockerell

This genus is well represented in the Old World, where it extends to Siberia, South Africa, and Australia. In the New World three species are found in the Nearctic Region and two species in the Neotropical Region.

The small robust bees are black, generally with yellow, white, and/or reddish-brown color patterns. The genus is readily distinguished from other genera of the tribe by having subantennal sutures which are strongly curved outward and a sharply produced scutellum that overhangs the metanotum and propodeum. *Anthidiellum* does not have the expanded pronotal lobes or a spur on the hind coxa as the *Dianthidium*, which is somewhat similar in size and color pattern.

Schwarz revised the North American species in 1926*(b)* and in 1928 relegated several of Cockerell's species to subspecies. Early workers relied mostly on color to separate species, but tergal, clypeal, and genitalic differences were noted in the males and clypeal differences observed in the females. Pubescence of the forelegs of the males also shows specific differences. The extent of the color pattern shows considerable variation in both of the species found in California.

The two species occurring in California have single-cell nests of resin attached to twigs or flat pieces of wood (figs. 227, 228). Mitchell (1962) reports that the cells of this group are attached to rocks or vegetation. Schwarz (1928), citing several authors, reviewed the nesting habits of the European species *A. strigatum* Panzer which arranged several cells in a row on stone.

KEY TO THE CALIFORNIA SPECIES OF ANTHIDIELLUM

MALES

1 Apical margin of tergum VII with weak or without single median projection (fig. 205); fore- and mid-tibiae with setae twice as long as segment width; median apical margin of clypeus evenly rounded (fig. 204) . . . . *notatum* (p. 60)

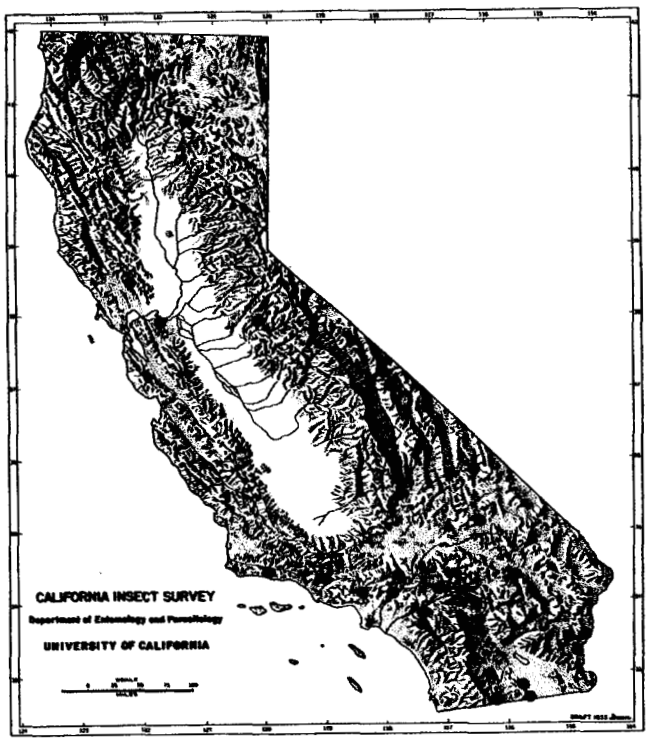
Apical margin of tergum VII with two median, fingerlike projections (fig. 209); fore- and mid-tibiae with setae shorter than segment width; median apical margin of clypeus with a

shallow emargination (fig. 208) . . . . *ehrhorni* (p. 59)

FEMALES

1 Apical margin of tergum VI with median extension one-half as wide as segment width (fig. 207); clypeus entirely convex in lateral aspect, apical margin not extended (fig. 206) . . . *notatum* (p. 60)

Apical margin of tergum VI with median extension about one-third as wide as segment width (fig. 211); clypeus concave near apex in lateral aspect, apical margin with median extension (fig. 210) . . . *ehrhorni* (p. 59)



Map 40. California distribution of *Anthidiellum ehrhorni* (Cockerell)

Anthidiellum ehrhorni (Cockerell)

(Figs. 208–211; Map 40)

Anthidium (Dianthidium) ehrhorni Cockerell, 1900. Ann. Mag. Nat. Hist., (7) 5:414. Holotype ♂, Mojave Desert, California (USNM).

Biology.—Schwarz, 1928, Jour. New York Ent. Soc., 36: 397.

Taxonomy.—Michener, 1953, Kans. Univ. Sci. Bull., 35: 1044–1046 (larval morphology); Schwarz, 1928, Jour. New York Ent. Soc., 36:392–393, ♀.

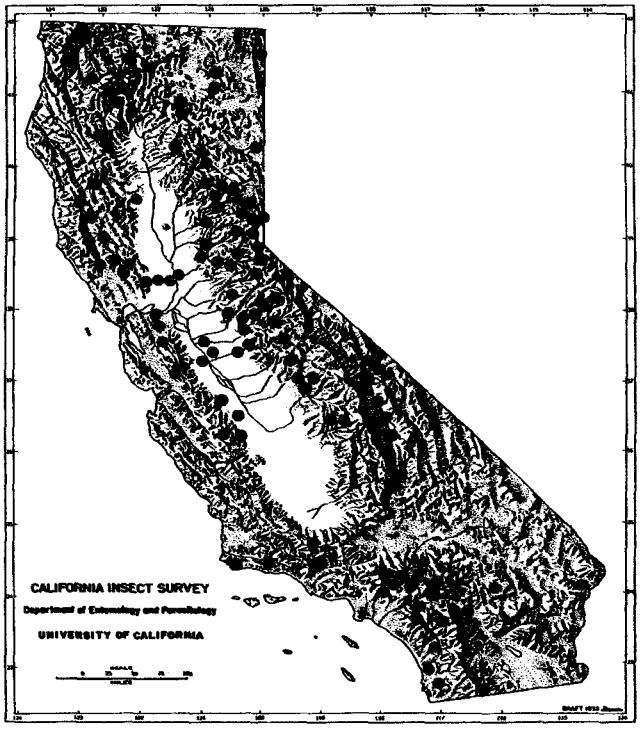
Geographic range.—Baja California, Arizona, California, Nevada.

California records.—CONTRA COSTA CO.: Antioch, 1 ♀, IV–54, ex. nest (E. Ross, CAS); 1 ♂, 1 ♀, V–24–49, on *Lotus* (E. Linsley, J. MacSwain, CIS). IMPERIAL CO.: Calexico, 14 mi. E, 1 ♀, V–6–56, on *Pluchea sericea* (R. Snelling, SS). Imperial, 4 mi. NE, 1 ♂, IV–20–56 (R. Snelling, SS). Palo Verde, 3 mi. S, 1 ♀, IV–9–63, on *Geraea canescens* (C. Toschi, CIS); 2 ♂, IV–9–63 (P. Hurd, CIS). INYO CO.: Furnace Creek, Death Valley, 9 ♂, III–30 to IV–1–53 (J. MacSwain, CIS); 1 ♀, IV–1–51, with nest; 1 ♂, on *Larrea* (J. MacSwain, P. Hurd, CIS); 1 ♀, IV–27–56 (R. Bohart, UCD). Salsbury Summit, 1 mi. E, 1 ♂, V–4–60 (J. MacSwain, CIS). Warm Sulphur Spr., 1 ♂, 1 ♀, V–6–61 (M. Irwin, P. Marsh, UCD). Westgard Pass, 1 ♀, VI–26–63, 7 mi. W, 1 ♂, VI–24–53 (J. MacSwain, CIS). LOS ANGELES CO.: La Crescenta, 1 ♂, V–16–10 (F. Grinnell Jr., LACM). Llano, 1 ♂, VI–1–57 (W. Simonds, UCD). San Gabriel River, Inwindale, 2 ♂, 1 ♀, VII–4–63 (R. Snelling, LACM). NAPA CO.: Samuel Springs, 1 ♀, V–21–55 (H. Moffitt, UCD). RIVERSIDE CO.: Andreas Canyon, 1 ♀, IV–4–32, on *Trixis californica* (P. Timberlake, UCR). Blythe, 1 ♂, V–18–47, on *Prosopis* (E. Linsley, CIS); 1 ♀, VIII–19–46 (J. MacSwain, SS); 18 mi. W, 1 ♂, IV–3–63 (M. Irwin, UCD). Boyd Desert Research Station, 4 mi. S, Palm Desert, 1 ♂, IV–7–63, on *Dalea Schottii* (P. Hurd, CIS). The Gavilan, 1 ♂, V–18–51 (E. Schlinger, UCD). Hopkins Wells, 1 ♂, VI–29–52, on *Geraea canescens;* 1 ♀, on *Baileya* (P. Hurd, CIS). Kitchen Peak Rd., Millard Cyn., 1 ♀, VI–20–63 (E. Schlinger, UCR). Morongo Valley, 3 ♂, 1 ♀, V–23–41 (E. Van Dyke, CAS). Palm Springs, 3 ♂, 1 ♀, IV–24 to V–24–32, on *Encelia* (P. Timberlake, UCR). Riverside, 2 ♂, 4 ♀, V–22–29, on *Lotus scoparius;* 2 ♀, VI–16–37, on *Phacelia ramossisima* (P. Timberlake, UCR). SAN BERNARDINO CO.: Bagdad, 1 ♀, IV–24–60, on *Asclepias* (J. Powell, CIS). Manix, 22 mi. N, 3 ♂, 2 ♀, IV–26–53, on *Larrea* (P. Hurd, G. Marsh, R. Schuster, CIS). Mouth of Deep Creek, 4 ♂, VI–24–58 (E. Schlinger, UCD). SAN DIEGO CO.: Banner, 6 mi. E, 1 ♂, 1 ♀, VI–26–63 (P. Hurd, R. Langston, CIS). Borrego, 1 ♀, III–31–53, on *Eriogonum inflatum*; 1 ♂, 1 ♀, IV–27–54, on *Chaenactis Fremontii* (P. Hurd, CIS). Palm Canyon, 1 ♀, IV–5–25, on mesquite (P. Timberlake, UCR). Boulevard, 7 mi. SW, 2 ♂, VI–10–56, on *Lotus* (R. Snelling, SS). SAN JOAQUIN CO.: Corral Hollow, 1 ♀, VII–16–46, on *Prosopis* (P. Hurd, CIS). SANTA BARBARA CO.: Santa Ynez Mts., 1 ♂, VI–24–59 (R. Bohart, UCD). SHASTA CO.: Hat Creek P.O., 1 ♂, VI–21–55 (J. Jessen, UCD); 1 ♂, VII–16–55 (J. MacSwain, CIS). STANISLAUS CO.: Del Puerto Canyon, 1 ♂, V–30–59 (F. Parker, UCD). TUOLUMNE CO.: Tuolumne City, 1 ♀, VI–13–53 (J. Rozen, CIS). VENTURA CO.: Sespe Canyon, 2 ♂, VII–10–59 (F. Parker, UCD).

This species is marked with a pale cream to bright yellow pattern on black. The extent of this pattern shows considerable variation. *A. ehrhorni* is readily distinguished from *notatum* in the male by having tergum VII (fig. 209) with two lateral lobes and two median, fingerlike projections, and the female by having a clypeus (fig. 210) with the apical margin slanted obliquely from the head. The general body size and wingspan of *ehrhorni* is somewhat smaller than *notatum*. *A. ehrhorni* was collected much less frequently than *notatum;* only 60 males and 39 females were observed in the course of this study, with but 10 of them having been collected in northern California. The species exhibits a rather extensive but somewhat discontinuous distribution in California. It

has not been found in the Great Valley, higher Sierra Nevada elevations or the uppermost north Coast Range. The survey records show plant visitations to members of 13 genera in 6 families, with about one-half of the genera belonging to the Compositae.

Nests of this species were observed from Antioch, Contra Costa County and Furnace Creek, Inyo County. Both of these nests were constructed of resin without mineral material. They were single cells that were built on a twig of about their own diameter and were formed at an oblique angle to the twig. A female had chewed anterolaterally from each cell. The cell from Furnace Creek was dull, the resin was somewhat coarse, and a fingerlike projection was located at the top (fig. 227). The nest from Antioch was somewhat shiny and without an apical projection. Schwarz (1928) examined a nest of *ehrhorni* from Arizona and noted its similarities to two nests of *Anthidiellum notatum rufimaculatum*. Both nests of *notatum* were figured in the publication.



Map 41. California distribution of *Anthidiellum notatum robertsoni* (Cockerell)

Anthidiellum notatum robertsoni (Cockerell)

(Figs. 204–207; Map 41)

Dianthidium robertsoni Cockerell, 1904. Bull. South. Calif. Acad., 3:4–5, ♀, ♂. Holotype ♀, Rock Creek (?), California (USNM).

Anthidiellum robertsoni (race) *citrinellum* Cockerell, 1925. Proc. Calif. Acad. Sci. (4) 14:362. Holotype ♂, Huntington Lake, Fresno Co., California (CAS).

Anthidiellum notatum robertsoni (Cockerell). Schwarz, 1928. Jour. New York Ent. Soc., 36:395.

Biology.—Leech, 1947, Proc., Ent. Soc. Brit. Col., 44:39, 2 fig.

Taxonomy.—Michener, 1953, Kan. Univ. Sci. Bull., 35:1046 (larval morphology).

Geographic range.—British Columbia, Arizona, California, Colorado, Idaho, Nevada, Oregon, Utah, Mexico, Baja California.

California records.—ALAMEDA Co.: Tesla Rd., 10 mi. E Livermore, 1 ♀, VIII–9–59 (G. Stage, SS). AMADOR Co.: Buckhorn, 2 ♂, 1 ♀, VII–25–55 (E. Schlinger, UCD). Silver Lake, 1 ♂, VII–26–54 (L. Stange, UCD). CALAVERAS Co.: Copperopolis, 1 ♂, VIII–29–60 (A. Menke, UCD). Mokelumne Hill, 1 ♂, 1 ♀ (F. Blaisdell, CAS). CONTRA COSTA Co.: Antioch, 1 ♀, V–24–49, on *Lotus* (E. Linsley, CIS); 1 ♂, X–24–48, on *Eriogonum* (P. Hurd, CIS). EL DORADO Co.: Coloma, 2 ♀, VIII–19–53 (E. Schlinger, UCD). Fallen Leaf Lake, 1 ♀, VII–10–35 (F. Blaisdell, CAS). Kyburz, 1 ♂, VII–10–50 (W. Ehrhardt, CIS). Pollock Pines, 6 ♂, 3 ♀, VIII–19–53 (E. Schlinger, UCD). Snowline Camp, 3 ♂, VII–7–48, on *Phacelia* (P. Hurd, CIS). Uncle Tom's Cabin, 3 mi. E, 1 ♂, VII–9–61 (L. Nault, UCD). Webber Crk, nr. Camino, 1 ♂, VI–25–60 (D. Lindsdale, CIS). FRESNO Co.: Coalinga Mineral Springs, on *Eriogonum fasciculatum*, 1 ♀, VIII–4–56, 1 ♂, IX–14–59 (R. Snelling, SS). Huntington Lake, 1 ♂, VII–17 (I. McCracken, CIS). Indian Basin, Kings Cyn. Nat. Park, 1 ♂, VIII–23–52 (J. Hall, UCD). Pine Ridge, 2 ♀, VII–19–60, on *Eriogonum* (R. Snelling, SS). Shaver Lake, 4 ♂, 5 ♀, VIII–8–56 (R. Schuster, CIS). Tranquility, 1 ♂, VII–14–60, on *Melilotus albus* (R. Snelling, SS). GLENN Co.: Artois, 1 ♂, VI–16–54, on *Salvia* (M. Wasbauer, CIS). INYO Co.: Antelope Springs, 1 ♂, VII–17–53, on *Chrysothamnus* (J. MacSwain, CIS). Big Pine, 4 ♂, 2 ♀, VI–17–29 (Van Duzee, CAS); 3 mi. E, 1 ♀, VII–10–53, on *Melilotus* (W. McLellan, UCD); 3 mi. W, 1 ♀, VIII–10–62, on *Eriogonum* (L. Stange, UCD). Bishop, 1 ♀, VI–20–29 (E. Van Dyke, CAS). Cartago, 2 mi. N, 2 ♂, VII–15–53 (E. Schlinger, UCD). Deep Springs, 1 ♂, VII–16–53 (R. Bohart, UCD). Independence, 1 ♂, VI–11–37 (W. Reeves, CIS). Lone Pine, 40 ♂, 28 ♀, VI–6–37 (E. Van Dyke, CAS); 3 mi. N, 1 ♂, VII–6–61 (D. Miller, LACM). Olancha, 8 ♂, VII–15–53 (E. Schlinger, UCD). Surprise Cyn., 1 ♂, V–9–58 (R. Bohart, UCD). Westgard Pass, 1 ♂, VII–10–53 (H. Nakakihara, UCR); 3 mi. W, 1 ♂, VI–19–53, on *Astragalus* (J. MacSwain, CIS); 7 mi. W, 4 ♂, 1 ♀, VI–26–53, on *Dalea* (J. MacSwain, CIS). Whitney Portal, 1 ♀, VI–16–58 (M. Irwin, UCD). KERN Co.: Mill Portero, 1 ♂, VII–8–59 (R. Bohart, UCD). Walker Pass, 8 mi. W, 3 ♂, 2 ♀, VII–23–61 (C. O'Brien, LACM). LAKE Co.: Clear Lake, 2 ♂, VII–21–34 (Van Duzee, CAS). Lakeport, 1 ♂, VIII–23–57 (S. Fidel, UCD). Middletown, 1 ♂, VII–22–34 (Van Duzee, CAS). St. Helena Creek, 1 ♀, III–11–51, reared from nest on bark (H. Leech, CAS). LASSEN Co.: Wendel, 2 ♂, VII–13–54 (R. Goodwin, CIS). LOS ANGELES Co.: Camp Baldy, 1 ♂, VI–26–50 (W. Marshall, UCD). Crystal Lake, 1 ♀, VI–29–50 (J. MacSwain, CIS). San Gabriel River, Irwindale, 1 ♂, VII–4–63, on *Phacelia distans* (R. Snelling, LACM). Tanbark Flat, 3 ♂, 1 ♀, VI–20–50, on *Lotus* (P. Hurd, CIS); 2 ♂, VII–14–52, on *Eriodictyon, Lotus scoparius*

(P. Timberlake, UCR). MADERA CO.: Oakhurst, 1 ♂, VI–29–46 (H. Chandler, CAS). MARIPOSA CO.: Chilnalna, Yosemite Nat. Park, 1 ♀, VII–17–46 (H. Chandler, CAS). Exchequer Dam, 2 ♀, IX–5–55, on *Lotus* (G. Stage, SS); 1 ♂, IX–5–54, on *Lonicera hispidula* var. *vacillans* (R. Snelling, SS). Moraitas, 11 mi. S, 1 ♀, IX–7–56 (R. Snelling, SS). Willow Slough, 26 mi. W Madera, 1 ♂, VIII–9–61 (R. Thorp, CIS). Yosemite Valley, 3 ♂, VI–24–26, on *Eriogonum latifolium* ssp. *nudum;* 11 ♂, 8 ♀, VI–27–26, on *Lotus nevadensis* (P. Timberlake, UCR). MENDOCINO CO.: Hopland, 2 ♂, VII–15–52 (S. Fidel, UCD); 10 mi. S, 1 ♀, IX–30–59 (T. Haig, UCD). Longvale Creek, 1 ♀, VII–27–38 (E. Van Dyke, CAS). Potter Valley, 2 ♂, 1 ♀, VII–1–51 (W. Bentinck, CIS). Twin Rocks, 2 ♂, VII–10–29 (E. Van Dyke, CAS). MERCED CO.: Snelling, 16 mi., W, 1 ♂, V–30–59, on *Grindelia* (G. Stage, SS). MODOC CO.: Adin, 5 mi. N, 1 ♂, VII–8–46, on *Eriogonum* (P. Hurd, R. Smith, CIS). Canby, 1 ♂, X–12–52 (E. Schlinger, UCD). Lake City, 1 ♂, VII–21–32 (C. Fox, CAS). NAPA CO.: Knoxville, 2 ♂, 1 ♀, IX–1–53 (A. Grigarick, E. Schlinger, UCD). Pope Valley, 1 ♂, VI–11–39 (E. Van Dyke, CAS). Samuel Springs, 1 ♂, V–30–53 (J. Hall, UCD). St. Helena, 1 ♂, IX–11–48, on *Solidago* (P. Hurd, CIS). NEVADA CO.: Hobart Mills, 7 mi. N, 1 ♀, VIII–26–48, on *Chrysothamnus* (R. Smith, CIS). Floriston, 1 ♀, VII–26–49, on *Melilotus* (E. Linsley, CIS). Fuller Lake, 1 ♂, 1 ♀, VII–15–61 (L. Stange, A. Menke, UCD). North San Juan, 1 ♂, 1 ♀, VIII–26–53 (E. Schlinger, UCD). PLACER CO.: American River, 2 ♀, VIII–20–16 (L. Bruner, UN). Auburn, 16 ♂, 6 ♀, VII–27 to IX–20–26 (L. Bruner, UN). Carnelian Bay, Lake Tahoe, 2 ♂, VIII–22–55 (R. Bohart, UCD). French Meadows, 1 ♂, VIII–20–56 (R. Darby, UCD). Weimar, 1 ♀, VI–10–62 (R. Westcott, UCD). PLUMAS CO.: Blairsden, 1 ♂, VIII–10–61 (J. Buckett, UCD). Chester, 6 mi. E, 1 ♀, VII–14–54 (R. Bohart, UCD); 8 mi. NW, 1 ♀, VIII–5–59 (E. Lindquist, CIS). Elephant Butte, 1 mi. N, 1 ♂, VI–14–60 (J. Buckett, UCD). Johnsville, 1 ♂, VII–26–56 (R. Bohart, UCD). Lake Almanor, 1 ♀, VII–8–49 (P. Hurd, CIS). Meadow Valley, 3 ♂, 3 ♀, VII–11–24 (E. Van Dyke, CAS). Quincy, 4 mi. W, 1 ♂, VI–22–49 (E. Schlinger, UCD). RIVERSIDE CO.: Andreas Canyon, 1 ♂, IV–24–54 (J. Hall, UCD). The Gavilian, 3 ♂, 1 ♀, VI–24–38, on *Lotus scoparius* (P. Timberlake, UCR). Hemet, 1 ♂, 2 ♀, VII–28–48, on *Melilotus* (J. MacSwain, CIS). Idyllwild, San Jacinto Mts., 2 ♂, 1 ♀, VI–9–40, on *Lotus scoparius* (C. Michener, CIS); 1 ♀, VI–17–40, on *Lotus oblongifolius* (E. Linsley, CIS); 1 ♂, VII–27–33, on *Lotus angophyllus* (P. Timberlake, HM); 1 ♂, VIII–22–33, on *Lotus Purshianus* (P. Timberlake, HM). Palm Springs, 1 ♂, X–7–44 (P. Timberlake, UCR). Piñyon Flat, San Jacinto Mts., 1 ♂, 1 ♀, VI–18–41 (E. Van Dyke, CAS). Riverside, 1 ♂, IV–30–28, on *Cryptantha intermedia*; 2 ♂, 1 ♀, VI–10–30, on *Phacelia ramosissima;* 1 ♂, VI–11–34, on *Guterrezia californica;* 11 ♂, 5 ♀, VI–15–34 to VIII–1–27, on *Lotus scoparius;* 1 ♂, VI–19–35, nest on branch of *Corethrogyne;* 14 ♂, 2 ♀, VIII–15–34, on *Gutierrezia californica;* 2 ♂, VIII–23–29, on *Marrubium vulgare*; 1 ♀, IX–9–26, on *Trichostema lanceolatum;* 1 ♀, IX–16–42, on *Lippia*; 1 ♂, 1 ♀, IX–19–32, on *Stephanomeria exigua* (P. Timberlake, UCR). Vandervanter Flat, San Jacinto Mts., 1 ♂, VI–13–39 (E. Linsley, CIS). Whitewater Canyon, 2 ♂, 4 ♀, IX–11–35 (P. Timberlake, UCR). SACRAMENTO CO.: Sacramento, 1 ♀, IX–29–16, on *Melilotus albus* (L. Bruner, UN). SAN BENITO CO.: Idria (Gem Mine), 1 ♀, IV–29–54 (C. MacNeill, CIS). SAN BERNARDINO CO.: Cajon Valley, 1 ♂, VII–4–23, on *Amorpha californica* (P. Timberlake, UCR). Camp Baldy, 1 ♀, VI–20–56 (R. Bechtel, UCD). Fallen Leaf, San Bernardino Mts., 1 ♀, VII–?–31 (O. Swezey, UCR). Lake Arrowhead, 10 mi. N, 1 ♂, VIII–17–60 (P. Paige, UCD). Mill Creek, 2 ♂, 2 ♀, VIII–12 to 23–45, on *Eriogonum* (P. Timberlake, UCR). Mouth of Deep Creek, 1 ♂, VI–24–58 (E. Schlinger, UCD). Twenty-nine Palms, 1 ♀, VII–9–46, on *Wislizenia refracta* (P. Timberlake, UCR). Upper Santa Ana River, 1 ♀, VIII–5–46, on *Clematis pauciflora;* 1 ♀, VIII–11–46, on *Aster adscendens;* 1 ♂, VIII–26–46, on *Stellaria longipes* (J. and G. Sperry, CIS). Valley of the Falls, San Bernardino Mts., 1 ♀, VIII–11–35 (P. Timberlake, UCR). SANTA BARBARA CO.: Cachuma Lake, 3 mi. W, 1 ♀, VII–6–59 (R. Bohart, UCD). Santa Ynez Mts., 1 ♀, VI–24–59 (W. Steffan, CIS). SAN DIEGO CO.: Del Mar, 2 mi. NE, 1 ♀, VII–17–63, on *Hemizonia fasciculata* (P. Hurd, CIS). La Mesa, 1 ♀, VI–28–58 (F. Williams, CAS). Mt. Palomar, 1 ♂, 2 ♀, VI–28–63 (W. Reiche, I. Pogojeff, UCD). SANTA CLARA CO.: San Antonio Valley, 1 ♂, IX–14–48, on *Eriogonum* (P. Hurd, CIS). SHASTA CO.: Burney, 2 ♂, 1 ♀, VII–22–46 (CIS). Cassell, 20 ♂, 13 ♀, VII–15–55 (R. Bechtel, J. Downey, A. Grigarick, W. Lange, E. Schlinger, UCD). Hat Creek P.O., 2 ♀, VII–12–55 (J. MacSwain, CIS). Platina, 1 ♀, VI–18–60 (SS). Shasta, 1 ♂, 3 ♀, VIII–16–52 (G. and R. Bechtel, UCD). Shasta Lake, 1 ♂, VI–19–55 (R. Bohart, UCD). SIERRA CO.: Calpine, 1 ♂, 2 ♀, VIII–27–53, on *Solidago* (P. Hurd, E. Linsley, R. Smith, CIS). Downieville, 3 ♂, 1 ♀, VIII–20–53 (A. Grigarick, E. Schlinger, UCD). Gold Lake, 3 ♂, 2 ♀, VIII–13–63 (R. Wescott, LACM). Goodyear's Bar, 12 ♂, 8 ♀, VIII–11–63 (R. Wescott, UCD). Sardine Lakes, 2 ♂, 1 ♀, VII–31–58 (A. Grigarick, UCD). Sierraville, 1 ♂, VIII–26–48 (J. MacSwain, CIS); 3 mi. NW, 1 ♀, IX–9–51, on *Chrysothamnus* (E. Linsley, CIS). Weber Lake, 1 ♂, VII–21–51 (E. Schlinger, UCD). Yuba Pass, 1 ♂, 1 ♀, VIII–20–53 (A. Grigarick, UCD). SISKIYOU CO.: Gazelle, 7 mi. W, 1 ♂, 1 ♀, VII–25–54. Happy Camp, 1 ♀, VII–8–58. Sawyer's Bar, 8 mi. W, 1 ♀, VII–7–58. Somesbar, 6 ♂, VII–8–58, on *Lotus Purshianus* (J. Powell, CIS). SONOMA CO.: Geyersville, 1 ♂, IV–20–57 (S. Fidel, UCD). STANISLAUS CO.: Empire, 2 ♀, IX–15–58 (R. Allen, SS). Turlock, 1 ♀, VI–3–55 (P. Hurd, CIS); 1 ♂, VIII–15–51, on *Heliotropium curassavicum* (R. Snelling, SS); 10 mi. SW, 1 ♀, VI–1–55, on *Sida*, 2 ♂, IX–1–61 (R. Snelling, LACM). TEHAMA CO.: Maton, 2 ♂, VII–12–55 (R. Bohart, UCD). TRINITY CO.: Carrville, 1 mi. N, 1 ♀, VII–15–55. Coffee Creek Ranger Station, 1 ♀, VII–14–55 (J. Jessen, UCD). Eagle Creek, 2 ♂, 6 ♀, VII–13–49 (A. McClay, UCD). East Fork Trinity River, 2 ♂, VII–13–55 (R. Bohart, UCD). Trinity Center, 1 ♀, VII–10–53, on *Penstemon* (A. McClay, UCD). Trinity River Camp, 1 ♂, 2 ♀, VII–18–53 (A. McClay, UCD). TULARE CO.: Giant Forest, 1 ♂, VI–15–58. Redwood Meadows, 1 ♂, VIII–3–23 (C. Fox, CAS). TUOLUMNE CO.: Browns Meadow, 2 ♂, 2 ♀, VIII–12–60 (A. Menke, UCD). Buck Meadow, 1 ♂, VIII–17–52 (J. and E. Hall, UCD). Camp Bob MacBride, Pinecrest, 1 ♀, VIII–1–52, on *Solidago californica* (G. Stage, SS). Chinese Camp, 5 mi. SE, 1 ♂, V–20–56 (E. Schlinger, UCD). Dardanelles, 1 ♂, VIII–19–51 (E. Schlinger, UCD). Dodge Ridge, 1 ♀, VII–13–51 (R. Bechtel, UCD). Long Barn, 3 ♂, 1 ♀, VIII–19–51 (E. Schlinger, UCD); 2.5 mi. W, 1 ♀, VII–29–60, on *Eriogonum* (R. Thorp, CIS). Rawhide, 1 ♂, VIII–10–13, on *Marrubium vulgare* (R. Stinchfield, CIS). Sonora, 2 mi. E, 1 ♀, VIII–14–60 (J. Lawrence, CIS). Strawberry, 2 ♂, VI–21–51, on *Phacelia* (E. Linsley, CIS); 2 ♂, VIII–21–60, on *Eriogonum latifolium* var. *nudum* (P. Hurd, CIS). Twain-

Harte, 5 ♂, 7 ♀, VII–19–37 (F. Blaisdell, CAS). Yosemite Nat. Park, north entrance, 1 ♀, VIII–17–52 (J. and E. Hall, UCD). VENTURA CO.: Sespe Cyn., 2 ♂, 6 ♀, VII–10–52 (R. Bohart, A Menke, F. Parker, UCD). YOLO CO.: Davis, 1 ♂, VI–23–61 (L. Nault, UCD); 1 ♀, X–1–50 (R. Bechtel, UCD). Putah Cyn., 1 ♂, X–20–56 (W. Lange, UCD). Winters, 5 mi. W, ♂, 1 ♀, VIII–16–62 (J. Powell, CIS).

Anthidiellum notatum is represented by five subspecies extending from the east to the west coast of the United States and from British Columbia into Mexico. The subspecies are separated primarily on the basis of color and somewhat on size, although there is considerable variation in both of these characteristics. *A. n. robertsoni* differs from the other subspecies by lacking prominent reddish-brown markings. The yellow maculations of *n. robertsoni* are generally the most extensive of the species, although this varies and these patterns are quite reduced on specimens from Mexico. The maculations of *n. rufimaculatum* from Florida are nearly entirely reddish-brown while this red coloration is limited to the legs of *n. gilense* in the southwestern United States. The nominate subspecies usually has the reddish-brown markings in conjunction with the yellow pattern of most of the body and extends from the east coast to the midwest. *A. n. boreale* has the same color pattern as *n. notatum,* but the male bears a medium longitudinal carina on the last two metasomal terga. Such a carina has been observed on some specimens of *n. notatum* and most specimens of *n. robertsoni. A. n. robertsoni* tends to be the smallest of the subspecies.

The males of *n. robertsoni* are easily distinguished from those of *ehrhorni* by tergum VII and the presence of pubescence on the forelegs twice as long as the leg width on *n. robertsoni* but subequal in length for *ehrhorni.*

A. n. robertsoni is widely distributed throughout most of California, from sea level to nearly 7,000 feet. Collections of 435 males and 267 females have been observed from the state.

This subspecies has been collected on members of 28 genera in 13 plant families, with one-third of the visitations being on genera in the Compositae. The most frequent visits were recorded in the Leguminosae and Polygonaceae, particularly on species of the genera *Lotus* and *Eriogonum.* The nest of *n. robertsoni* was first reported from British Columbia by Leech in 1947 as a single cell on the flat underside of a piece of douglas fir wood. It was 13 mm long with an apical spike, appeared somewhat warty, and was greenish black with a vitreous surface. The nest and emerged bee were drawn. Leech also collected a single-celled nest of *n. robertsoni* attached to the flat surface of a chip of wood from Lake County, California (fig. 228). The resin nest is dark brown, shiny, and relatively smooth, although magnification reveals a fine granular surface and several wartlike irregularities. The cell is approximately 19 mm long with the apical projection broken.

First instar meloid larvae of the genus *Nemognatha* were found attached to the pubescence of a male of *n. robertsoni* collected at Blairsden Plumas Co., California, VII–10–61, by J. Buckett.

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INDEX TO THE POLLEN-GATHERING CALIFORNIA ANTHIDIINI

(Synonyms are in italics)

LIST OF PLANT VISITATIONS

(Plant names based on Munz & Keck, 1959)

(A. = Anthidium; A. = Anthidiellum)*

RANUNCULACEAE

Clematis
pauciflora—A. notatum robertsoni, D. subparvum*
Delphinium
Parishii—A. pallidiclypeum
Ranunculus
sp.—*D. u. ulkei*

MALVACEAE

Sida
sp.—*A.* notatum robertsoni*

LINACEAE

Linum
sp.—*D. subparvum*

ZYGOPHYLLACEAE

Larrea
divaricata—A*. ehrhorni, A. cockerelli, A. jocosum, A. *paroselae, A. sonorense, D. pudicum consimile, H. larreae*

EUPHORBIACEAE

Croton
californicus—A. paroselae, A. utahense, D. parvum schwarzi
Eremocarpus
setigerus—A. edwardsii

PAPAVERACEAE

Platystemon
californicus—A. collectum

CAPPARIDACEAE

Cleome
sp.—*A. placitum*
Wislizenia
refracta—A. notatum robertsoni, A. edwardsii*

CRUCIFERAE

Erysimum
sp.—*D. singulare*

CARYOPHYLLACEAE

Stellaria
*longipes—A.*notatum robertsoni*

PORTULACEAE

Calyptridium
umbellatum—A. utahense

CACTACEAE

Opuntia
echinocarpa—A. jocosum

POLYGONACEAE

Eriogonum
sp.—*A.* notatum robertsoni, D. dubium dilectum, D. d. dubium, D. parvum schwarzi, D. p. platyurum, D. pudicum consimile, D. u. ulkei*
fasciculatum—A. notatum robertsoni, A. jocosum, A. mormonum, A. utahense, D. dubium dilectum, D. platyurum mohavense, D. pudicum consimile, D. subparvum*
ssp. *polifolium—D. parvum schwarzi*
gracile—A. edwardsii, D. parvum schwarzi
inflatum—A. ehrhorni, A. jocosum, D. pudicum consimile*
latifolium—ssp. *nudum—A.* notatum robertsoni, D. pudicum consimile*

CHENOPODIACEAE

Chenopodium

sp.—*D. dubium dilectum, D. subparvum*

NYCTAGINACEAE

Abronia
maritima—*A. palliventre*

ERICACEAE

Arctostaphylos
sp.—*A. maculosum*

ASCLEPIDACEAE

Asclepias
sp.—*A.* ehrhorni*
erosa—*D. parvum schwarzi*

CONVOLVULACEAE

sp.—*T. perdita*

POLEMONIACEAE

Eriastrum
densifolium—*D. dubium mccrackenae, D. marshi, D. p. platyurum, D. p. pudicum, D. pudicum consimile, D. u. ulkei*
pluriflorum—*D. pudicum consimile, D. p. platyurum*
Gilia
sp.—*A. jocosum*

HYDROPHYLLACEAE

Eriodictyon
sp.—*A.* notatum robertsoni, A. emarginatum, A. jocosum, A. mormonum, A. utahense, D. dubium dilectum, D. d. dubium, D. pudicum consimile, D. u. ulkei, T. perdita*
crassifolium—A. jocosum, C. illustre, D. pudicum consimile
trichocalyx—*D. dubium dilectum*
var. *lanatum*—C. illustre, D. dubium dilectum, D. pudicum *consimile*
Hesperochiron
californicus—*D. dubium dilectum*
Nemophila
sp.—*A. collectum*
Phacelia
sp.—*A.* notatum robertsoni, A. banningense, A. cockerelli, A. edwardsii, A. emarginatum, A. jocosum, A. maculosum, A. paroselae, A. teniflorae, A. utahense, C. illustre, C. formosum, D. dubium dilectum, D. d. dubium, D. subparvum*
californica—*A. emarginatum*
ciliata—*A. mormonum, A. palmarum*
cicutaria var. *hispida*—*A. palmarum*
crenulata—*A. palmarum*
distans—*A.* notatum robertsoni, A. collectum, A. dammersi, A. edwardsii, A. jocosum, A. palliventre, A. palmarum, D. pudicum consimile*
frigida—*A. tenuiflorae*
heterophylla—*A. banningense, A. emarginatum, A. mormonum, A. tenuiflorae, C. illustre*
Pringlei—*A. mormonum*
ramosissima—*A.* ehrhorni, A.* notatum robertsoni, A. banningense, A. collectum, A. edwardsii, A. emarginatum, A. jocosum, A. maculosum, A. mormonum, A. palliventre, A. palmarum, D. pudicum consimile, D. p. platyurum.*
tanacetifolia—*A. collectum*
Turricula
Parryi—*C. illustre, D. dubium dilectum*

BORAGINACEAE

Amsinckia
intermedia—*A. collectum*
Cryptantha
sp.—*A. collectum*
intermedia—*A.* notatum robertsoni, A. collectum, A. emarginatum, A. mormonum, D. pudicum consimile*
Heliotropium
curassavicum—*A.* notatum robertsoni, A. edwardsii*

SCROPHULARIACEAE

Antirrhinum
sp.—*A. maculosum*
Coulterianum—*A. utahense*
Castilleja
sp.—*C. formosum*
Collinsia
concolor—*A. pallidiclypeum*
Cordylanthus
filifolius—*A. placitum*
Nevinii—*A. placitum*
rigidus ssp. *brevibracteatus*—*A. placitum*
tenuis—*A. edwardsii*
Penstemon
sp.—*A.* notatum robertsoni, A. emarginatum, A. jocosum, A. mormonum, A. utahense, C. illustre, D. d. dubium, D. dubium dilectum*
antirrhinoides—*T. perdita*

VERBENACEAE

Lippia
sp.—*A.* notatum robertsoni*
Verbena
hastata—*A. maculosum*
lasiostachys—*A. edwardsii*

LABIATAE

Hyptis
Emoryi—*D. desertorum, D. parvum*
Marrubium
vulgare—*A.* notatum robertsoni, A. edwardsii, A. jocosum, D. d. dubium*
Monardella
sp.—*A. placitum*
lanceolata—*D. plenum*
linoides—*C. formosum*
Salvia
sp.—*A.* notatum robertsoni*
apiana—*A. collectum*
carduacea—*A. palmarum*
Columbariae—*T. perdita*
Dorrii—*H. larreae*
pachyphylla—*A. jocosum*
Stachys
albens—*A. maculosum*
bullata—*A. maculosum*
Trichostema
sp.—*A. edwardsii, A. maculosum, D. dubium dilectum*
lanatum—*A. collectum*
lanceolatum—*A.* notatum robertsoni, A. edwardsii, D. d. dubium, D. pudicum consimile*
laxum—*A. edwardsii*
rubisepalum—*D. d. dubium*

ROSACEAE

Horkelia
sp.—*A. palliventre*
Bolanderi ssp. *Clevelandii*—*A. utahense*
ssp. *Parryi*
glandulosa—*A. utahense*
Prunus
armeniaca—*D. pudicum consimile*
Rubus
lecuodermis—*A. mormonum*

LEGUMINOSAE

Amorpha
californica—A.* *notatum robertsoni*
Astragalus
sp.—*A.*notatum robertsoni, A. atripes, A. clypeodentatum, A. collectum, A. edwardsii, A. mormonum, A. palmarum, C. formosum, C. illustre*
Bolanderi—*A. utahense*
Douglasii var. *Parishii*—*A. atripes, A. clypeodentatum, A. maculosum*
lentiginosus var. *fremontii*—*A. dammersi*
Cercidium
sp.—*A. cockerelli*
Dalea
sp.—*A.* notatum robertsoni, H. bequaerti*
californica—*A. cockerelli*
Emoryi—*A. cockerelli*
Fremontii—*A. dammersi*
var. *Saundersonii*—*A. dammersi*
Schottii—*A.* ehrhorni*
spinosa—*H. bequaerti*
Lathyrus
odoratus—*C. illustre*
splendens—*A. edwardsii*
Lotus
sp.—*A.* ehrhorni, A.* notatum robertsoni, A. clypeodentatum, A. collectum, A. edwardsii, A. mormonum, A. pallidiclypeum, A. placitum, A. utahense, C. illustre, D. dubium dilectum, D. d. dubium, D. parvum schwarzi*
argophyllus—*A.* notatum robertsoni, A. maculosum, A. mormonum, A. tenuiflorae, A. utahense, C. illustre, C. formosum*
argyraeus ssp. *multicaulis*—*A. emarginatum*
Davidsonii—*A. atripes, A. banningense, A. clypeodentatum, A. maculosum, A. mormonum, A. tenuiflorae, D. u. ulkei*
Douglasii—*A. palmarum, A. utahense*
Heermannii—*A. palliventre*
nevadensis—*A.* notatum robertsoni, A. maculosum, A. mormonum, A. utahense*
oblongifolius—*A.* notatum robertsoni, A. clypeodentatum, C. illustre*
Purshianus—*A.* notatum robertsoni, A. edwardsii, A. utahense, D. d. dubium*
scoparius—*A.* ehrhorni, A.* notatum robertsoni, A. clypeodentatum, A. collectum, A. edwardsii, A. maculosum, A. mormonum, A. palmarum, A. placitum, C. illustre, D. parvum schwarzi, D. p. platyurum, D. pudicum consimile, D. u. ulkei*
strigosus—*A. mormonum, A. utahense*
var. *hirtellus*—*A. atripes, D. subparvum*
Lupinus
sp.—*A. collectum*
confertus—*A. tenuiflorae*
nanus—*A. collectum, A. utahense, T. perdita*
Medicago
sativa—C. formosum, C. illustre, D. p. pudicum, D. u. ulkei
Melilotus
sp.—*A.* notatum robertsoni, A. paroselae*
albus—*A.* notatum robertsoni, D. pudicum consimile, D. u. ulkei*
indicus—*D. pudicum consimile*
Prosopis
sp.—*A.* ehrhorni, A. paroselae, A. sonorense*
Trifolium
sp.—*A. cockerelli*
obtusifolium—*A. edwardsii*
repens—*A. edwardsii, A. jocosum, A. mormonum*
variegatum.—*A. edwardsii, A. pallidiclypeum*
Wormskioldii—*A. banningense*
Vicia
sp.—*D. d. dubium*

KRAMERIACEAE

Krameria
Grayi—*D. pudicum consimile*

SALICACEAE

Salix
sp.—*A. collectum*

ONAGRACEAE

Clarkia
sp.—*D. dubium dilectum, D. d. dubium, T. perdita*
amoena—*A. bannigense, A. utahense*
biloba—*H. timberlakei*
cylindrica—*H. timberlakei*
gracilis—*H. timberlakei*
speciosa—*A. edwardsii, A. utahense*
unguiculata—*A. utahense, D. d. dubium*
Epilobium
andenocaulon—var. *Parishii*—*A. tenuiflorae*
Oenothera
sp.—*A. collectum, A. jocosum, A. palmarum, A. utahense*
clavaeformis var. *aurantiaca*—*A. cockerelli*

RHAMNACEAE

Ceanothus
sp.—*A. clypeodentatum, A. jocosum, A. mormonum, A. utahense*
Rhamnus
crocea—*T. perdita*

UMBELLIFERAE

Perideridia
sp.—*D. singulare*

CAPRIFOLIACEAE

Lonicera
hispidula var. *vacillans*—*A.* notatum robertsoni, D. pudicum consimile*
Sambucus
sp.—*A. collectum*
Symphoricarpos
sp.—*A. emarginatum, D. p. pudicum*

COMPOSITAE

Acamptopappus
sphaerocephalus—*A. palmarum*

Achillea
Millefolium—*A. edwardsii, D. dubium dilectum, D. u. ulkei*
Artemisia
sp.—*A. utahense*
californica—*C. illustre*
Aster
sp.—*A. maculosum, A. tenuiflorae, A. utahense, D. h. heterulkei, D. subparvum, D. u. ulkei*
adscendens—*A.* notatum robertsoni*
alpigenus—*D. subparvum*
foliaceus—*A. tenuiflorae, D. subparvum*
Baeria
sp.—*A. jocosum*
Baileya
sp.—*A.* ehrhorni, H. larreae*
multiradiata—*A. paroselae*
Bebbia
sp.—*D. marshi, D. p. platyurum*
juncea—*A. paroselae*
Centaurea
sp.—*D. u. ulkei*
Chaenactis
carphoclinia—*A. cockerelli*
Douglasii—*H. timberlakei*
Fremontii—*A.* ehrhorni*
glabriuscula—*A. banningense, A. collectum, A. utahense, H. timberlakei*
Chaetopappa
aurea—*D. subparvum, D. u. ulkei*
Chrysanthemum
sp.—*D. singulare*
Chrysopis
villosa—*A. maculosum, A. placitum, D. u. ulkei*
Chrysothamnus
sp.—*A.* notatum robertsoni, A. mormonum, A. utahense, D. h. heterulkei, D. p. parvum, D. parvum schwarzi, D. p. pudicum, D. singulare, D. u. ulkei*
nauseosus—*D. u. ulkei*
ssp. *mohavensis*—*D. parvum schwarzi*
viscidiflorus—*D. subparvum, D. u. ulkei*
Cirsium
sp.—*A. maculosum, A. tenuiflorae, A. utahense, C. illustre, D. singulare, H. timberlakei*
vulgare—*A. utahense, D. p. pudicum*
Coreopsis
lanceolata—*H. timberlakei*
Corethrogyne
sp.—*A.* notatum robertsoni, D. parvum schwarzi, D. pudicum consimile*
filaginifolia—*D. subparvum*
Encelia
sp.—*A.* ehrhorni, H. timberlakei*
californica—*D. dubium dilectum, D. parvum schwarzi, D. p. platyurum, D. pudicum consimile, D. u. ulkei*
farinosa—*A. collectum, H. timberlakei*
virginensis ssp. *actoni*—*A. palmarum*
Erigeron
sp.—*D. dubium dilectum, D. platyurum mohavense*
divergens—*D. subparvum, D. u. ulkei*
foliosus—*D. u. ulkei*
var. *stenophyllus*—*A. emarginatum, D. parvum schwarzi, D. p. platyurum, D. subparvum*
Eriophyllum
confertiflorum—*T. perdita*
Geraea
canescens—*A.* ehrhorni, A. cockerelli*
Grindelia
sp.—*A.* notatum robertsoni, A. utahense, D. d. dubium, D. parvum schwarzi, D. pudicum consimile, D. subparvum, D. u. ulkei*
camporum—*D. d. dubium, D. u. ulkei*
Gutierrezia
californica—*A.* notatum robertsoni, A. jocosum, A. placitum, D. parvum schwarzi, D. p. platyurum, D. pudicum consimile, D. subparvum*
microcephala—*D. implicatum, D. parvum schwarzi, D. pudicum consimile*
Haplopappus
sp.—*D. dubium, D. pudicum consimile, D. subparvum, D. u. ulkei*
arborescens—*D. d. dubium*
Bloomeri—*D. u. ulkei*
Cooperi—*A. jocosum*
linearifolius—*A. mormonum, A. palmarum*
suffruticosus—*D. h. heterulkei, D. subparvum*
Helenium
Bigelovii—*D. u. ulkei*
Helianthus
sp.—*C. illustre, D. dubium dilectum, D. u. ulkei*
gracilentus—*H. timberlakei*
petiolaris—*D. u. ulkei*
var. *canescens*—*A. paroselae*
Hemizonia
sp.—*A. jocosum*
fasiculata—*A.* notatum robertsoni*
Fitchii—*D. d. dubium*
Lobbii—*A. utahense*
Heterotheca
grandiflora—*D. parvum schwarzi, D. p. platyurum, D. u. ulkei*
Hulsea
callicarpha—*A. maculosum*
Layia
platygossa ssp. campestris—*T. perdita*
Lepidospartum
squamatum—*D. parvum schwarzi*
Machaeranthera
tephrodes—*D. subparvum, D. u. ulkei*
tortifolia—*H. larreae*
Malacothrix
sp.—*A. paroselae, D. p. platyurum*
californica—*A. emarginatum*
Palafoxia
linearis—*A. cockerelli, A. paroselae, D. p. parvum*
Pluchea
sericea—*A.* ehrhorni*
Senecio
Douglasii—*D. p. parvum, D. parvum schwarzi, D. p. parvum, D. subparvum, D. u. ulkei, H. larreae*
ionophyllus—*A. maculosum, D. u. ulkei*
Solidago
sp.—*A.* notatum robertsoni, A. edwardsii, D. h. heterulkei, D. u. ulkei*
californica—*A.* notatum robertsoni, A. utahense, D. singulare, D. u. ulkei.*
confinis—*A. placitum, A. tenuiflorae*

Stephanomeria
cichoriacea—*D. pudicum consimile, D. u. ulkei*
exigua—*A.* notatum robertsoni, A. edwardsii, D. parvum schwarzi, D. p. platyurum, D. pudicum consimile*

Trixis
californica—*A.* ehrhorni*

Viguiera
multiflora—*D. dubium dilectum, D. singulare, D. u. ulkei*

LILIACEAE

Calochortus
sp.—*C. illustre*
luteus—*A. edwardsii*

AMARYLLIDACEAE

Brodiaea
lava—*A. utahense*
lutea—*T. perdita*

FIGURES

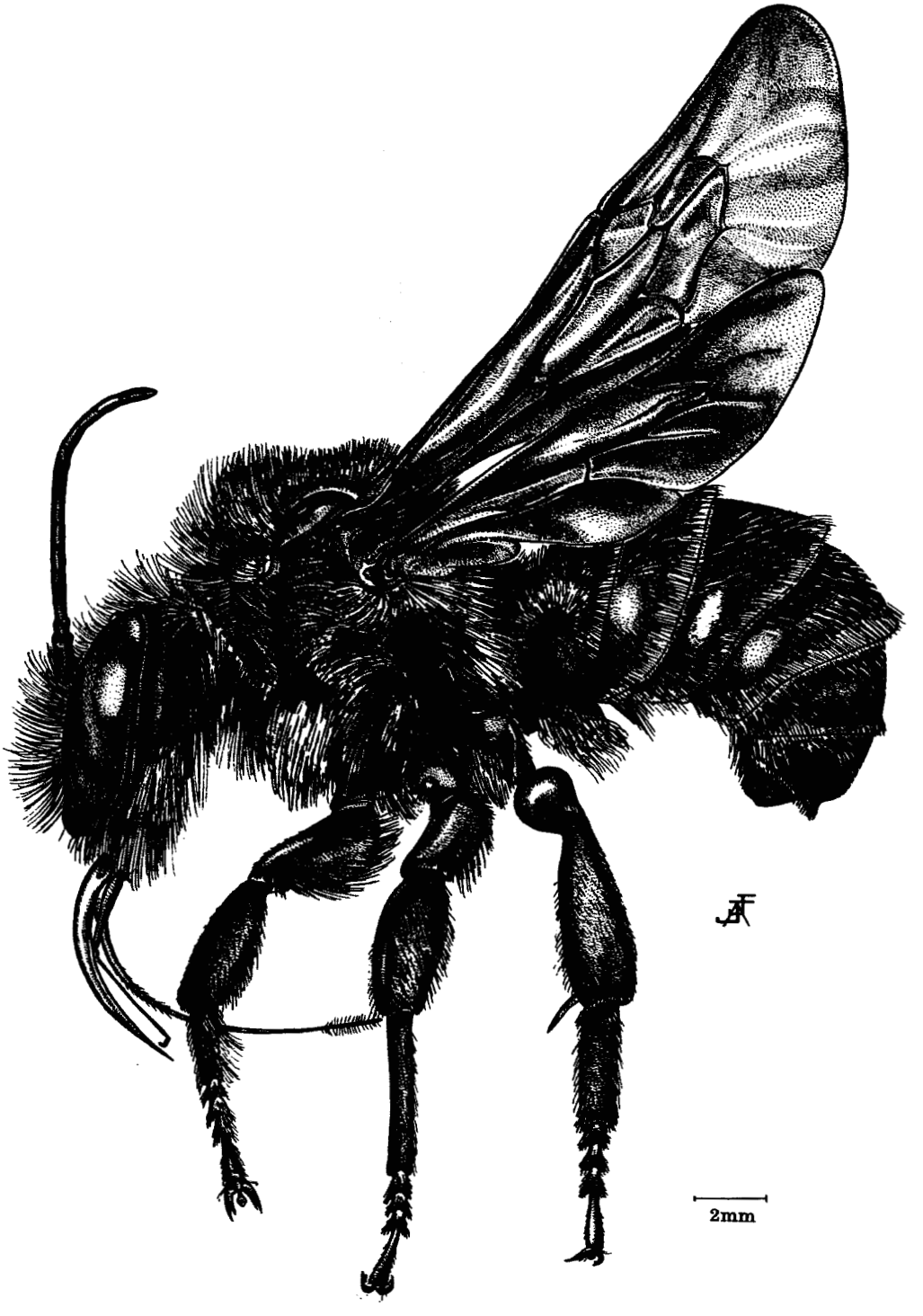


Fig. 1 *Trachusa gummifera* Thorp, male.

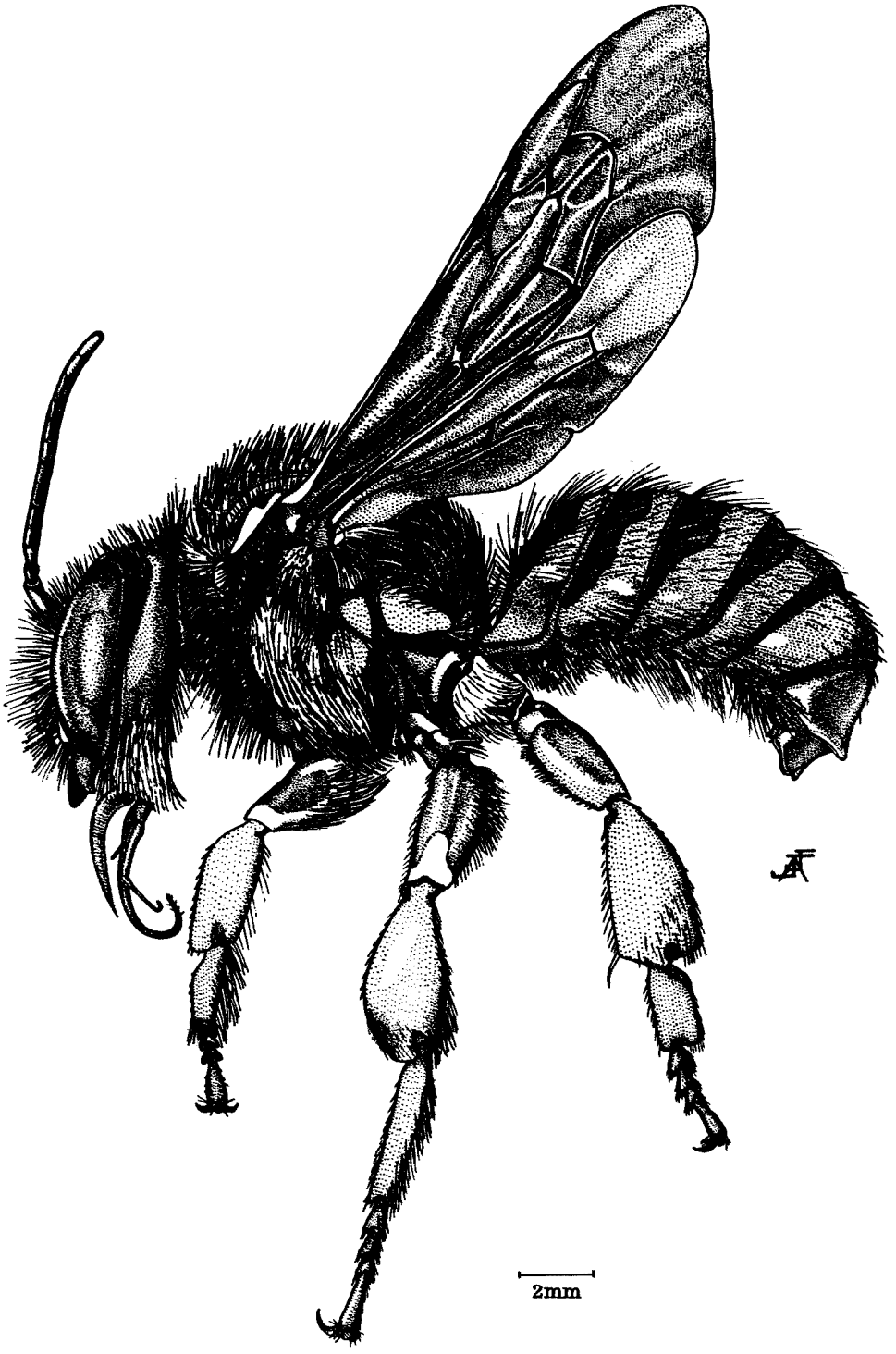


Fig. 2. *Heteranthidium larreae* (Cockerell), male.

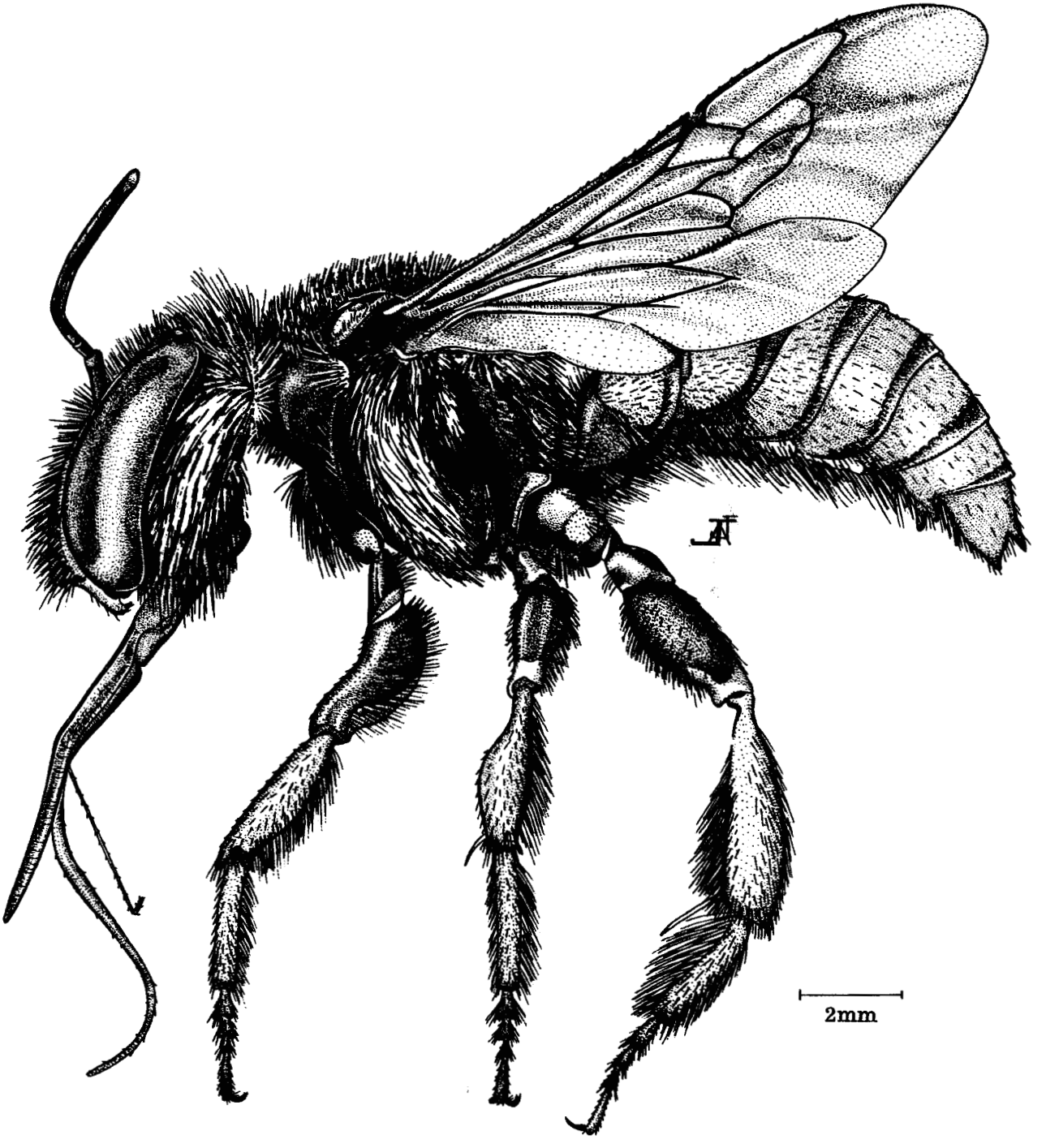


Fig. 3. *Anthidium edwardsii* Cresson, male.

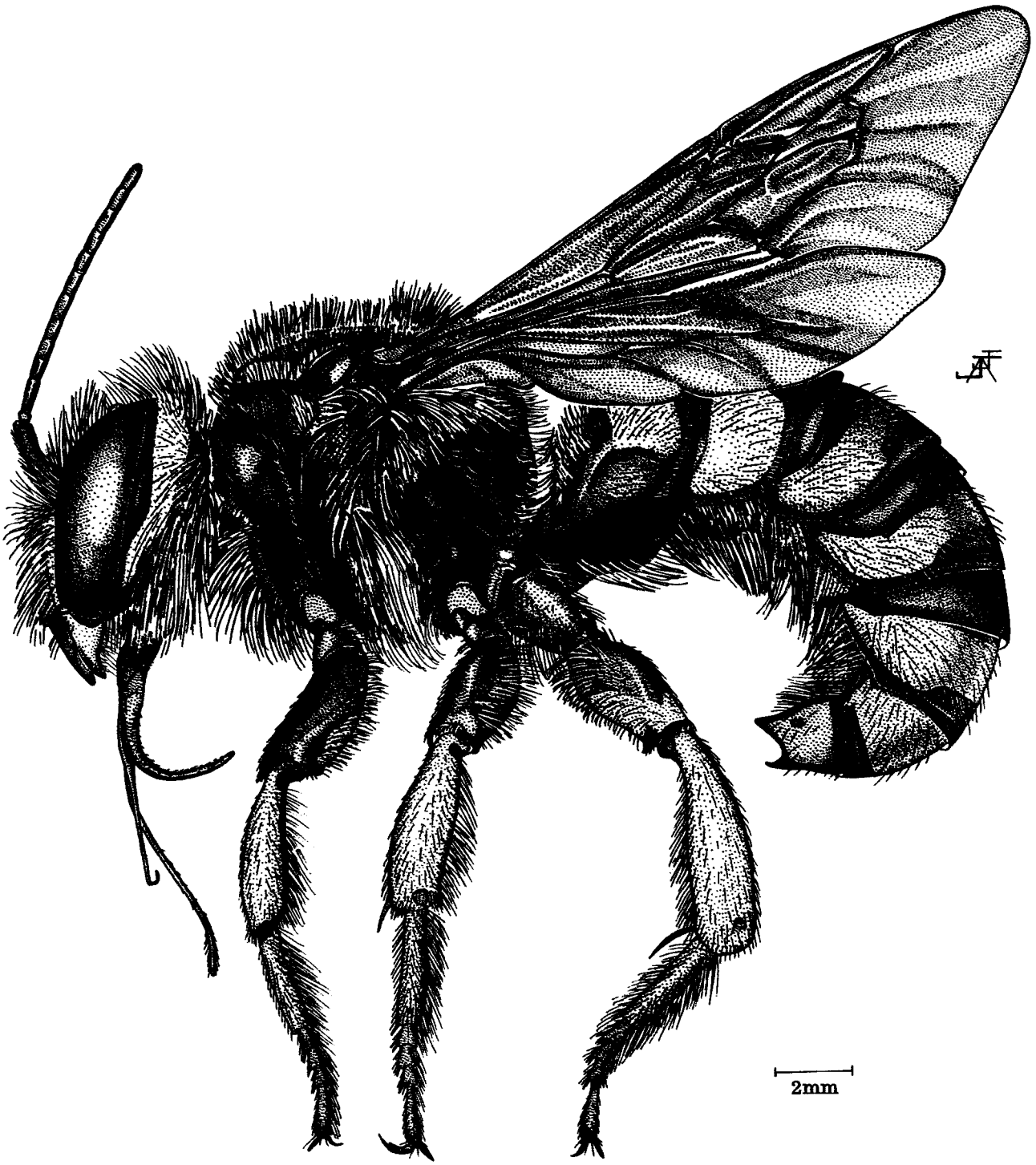


Fig. 4. *Callanthidium illustre* (Cresson), male.

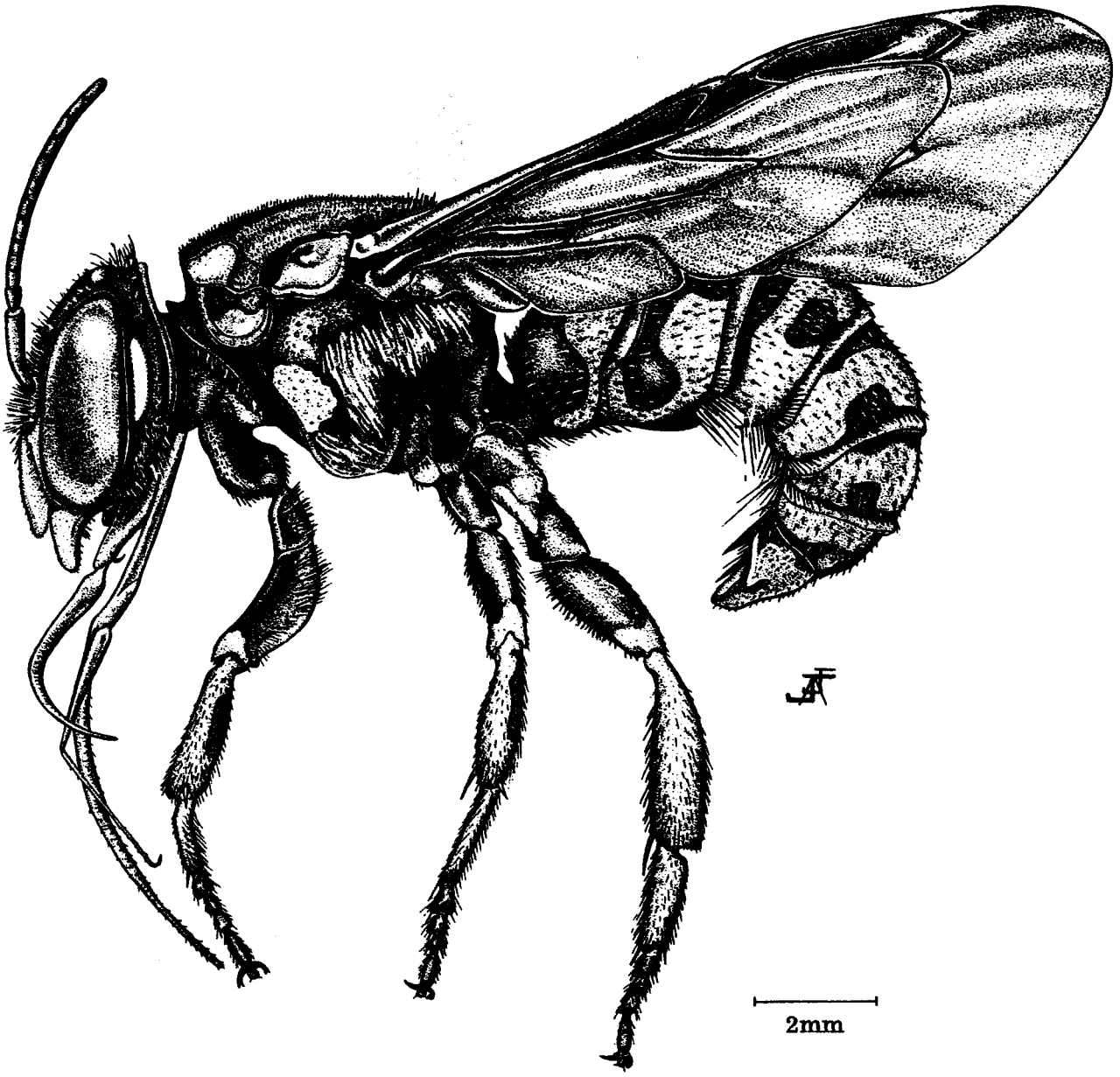


Fig. 5. *Dianthidium dubium dubium* Schwarz, male.

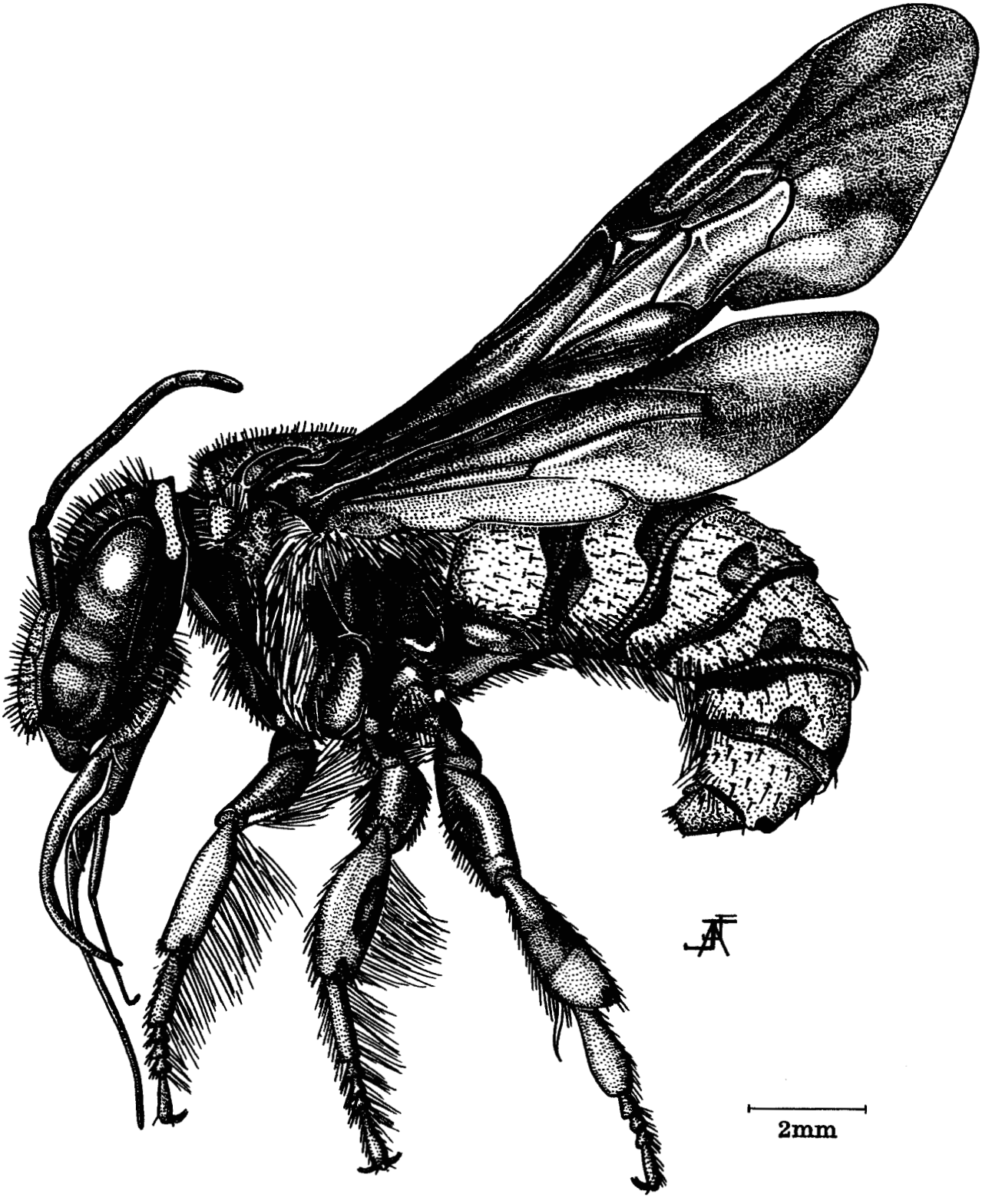
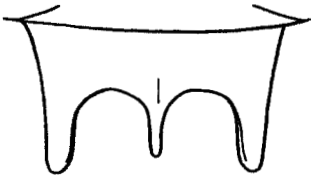


Fig. 6. *Anthidiellum notatum robertsoni* (Cockerell), male.

Figs. 7-18. *Anthidium.*

Figs. 7, 10, 13, 16: male tergum VII. Figs. 8, 11, 14, 17: male sternum VI. Figs. 9, 12, 15, 18: male sternum VIII.



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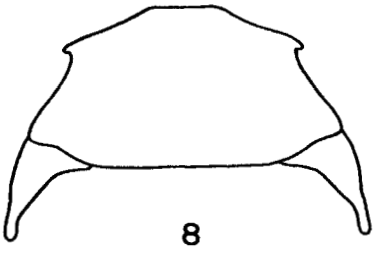

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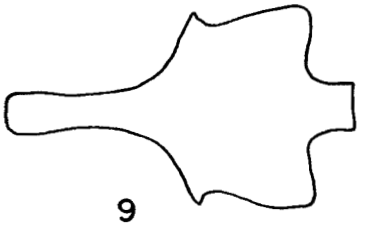
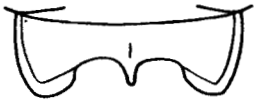


9

maculosum



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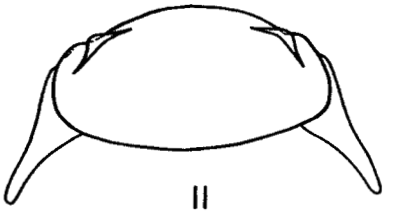

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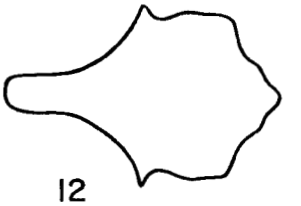
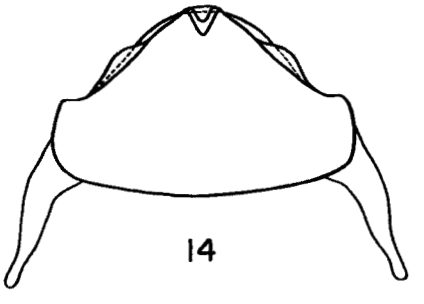


12

paroselae

13



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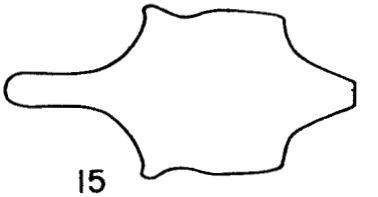

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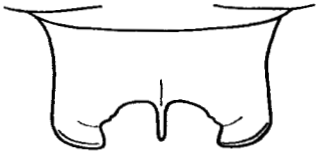
sonorense



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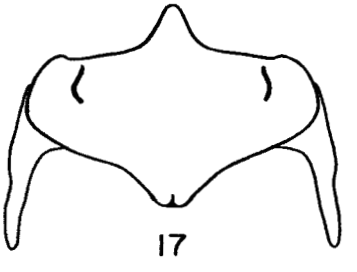


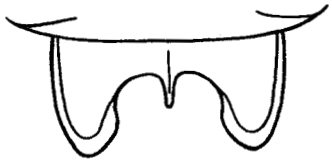
17

18

clypeodentatum

Figs. 19-30. *Anthidium.*

Figs. 19, 22, 25, 28: male tergum VII. Figs. 20, 23, 26, 29: male sternum VI. Figs. 21, 24, 27, 30: male sternum VIII.



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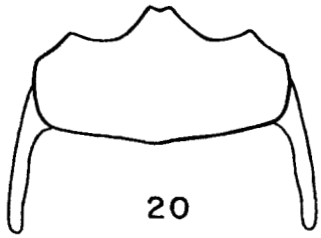

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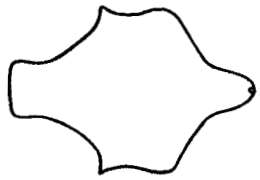
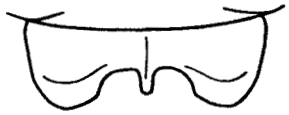


21

collectum



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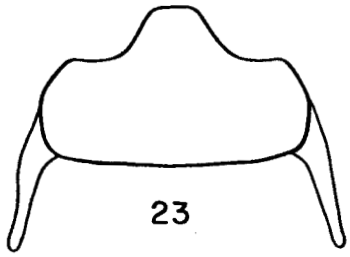

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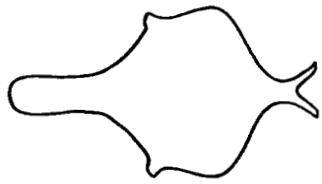
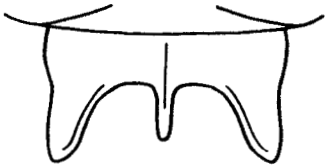


24

pallidiclypeum



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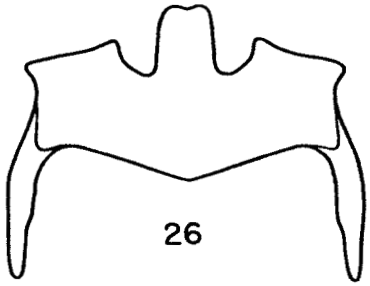

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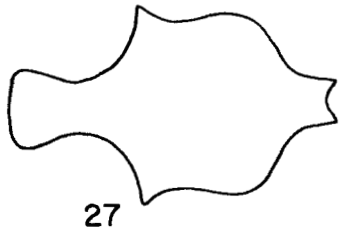
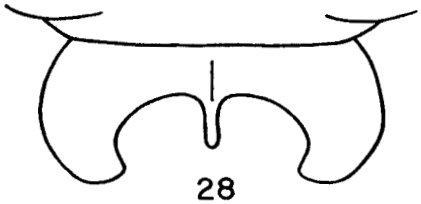


27

banningense



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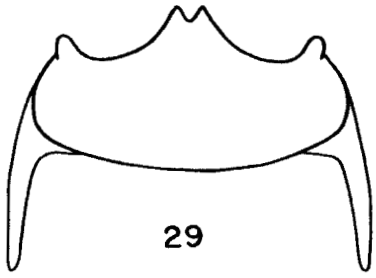

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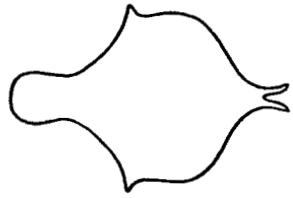
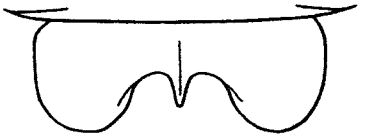


30

palliventre

Figs. 31-42. *Anthidium.*

Figs. 31, 34, 37, 40: male tergum VII. Figs. 32, 35, 38, 41: male sternum VI. Figs. 33, 36, 39, 42: male sternum VIII.



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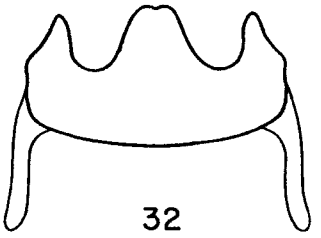

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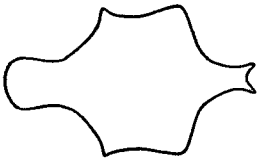
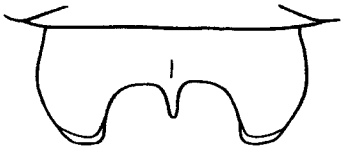


33

tenuiflorae



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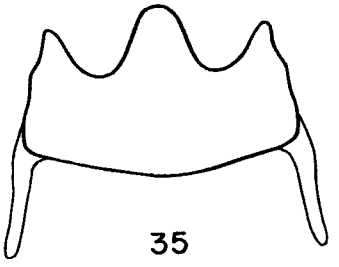

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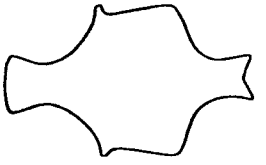
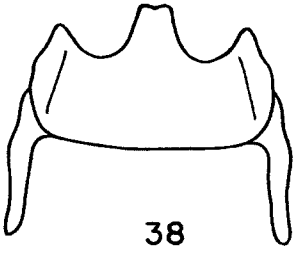


36

emarginatum

37



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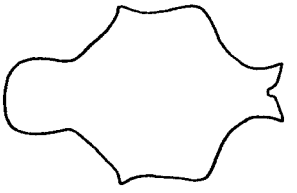
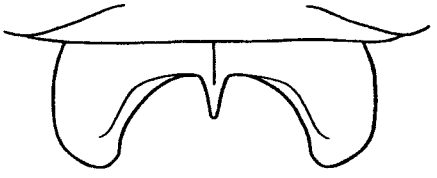


39

dammersi



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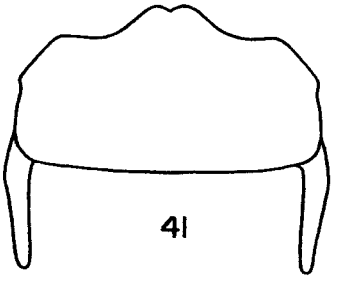

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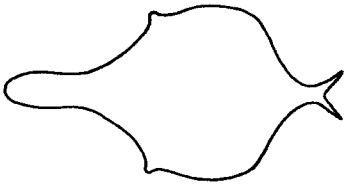
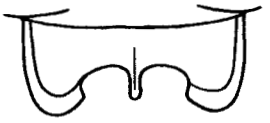


42

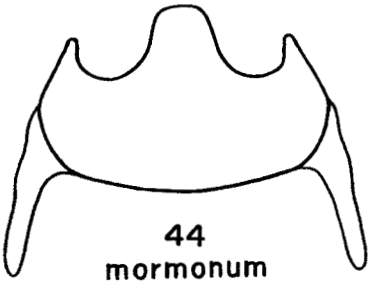
atripes

Figs. 43-54. *Anthidium.*

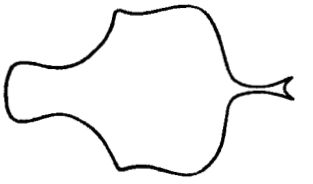
Figs. 43, 46, 49, 52: male tergum VII. Figs. 44, 47, 50, 53: male sternum VI. Figs. 45, 48, 51, 54: male sternum VIII.



43



44
mormonum



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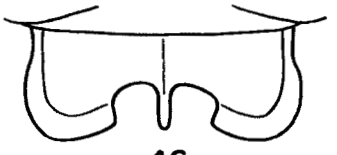

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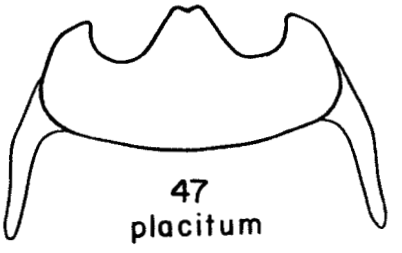
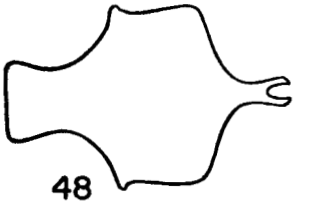


47
placitum



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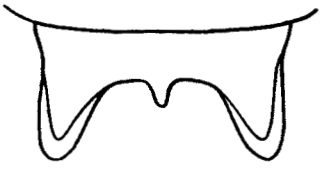
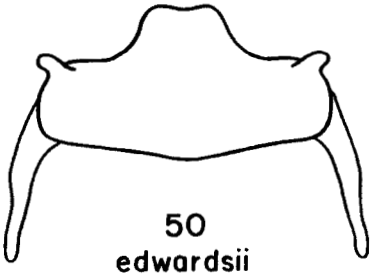
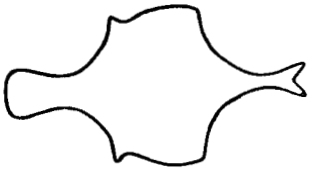


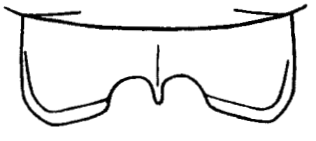
49



50
edwardsii



51



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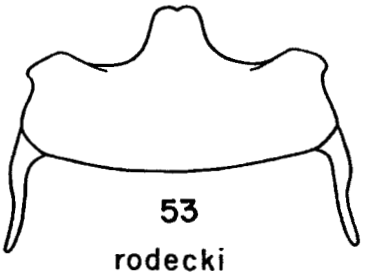
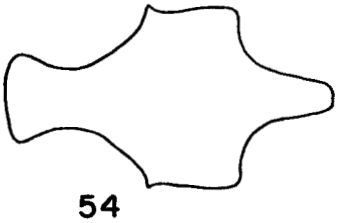


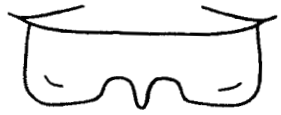
53
rodecki



54

Figs. 55-69. ***Anthidium.***

Figs. 55, 58, 61, 64: male tergum VII. Figs. 56, 59, 62, 65: male sternum VI. Figs. 57, 60, 63, 66: male sternum VIII. Figs. 67, 68: male sternum IV showing setal brush. Fig. 69: ventral view of posterior half of male abdomen.



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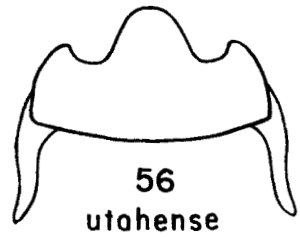
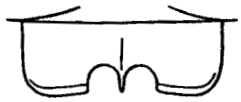
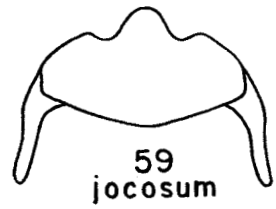


56
utahense

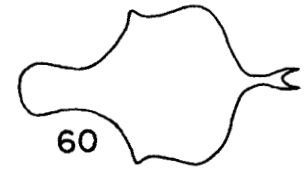
57



58



59
jocosum



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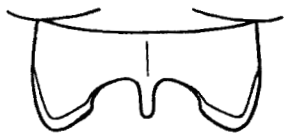

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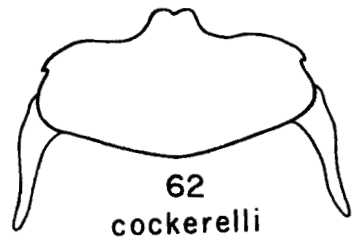
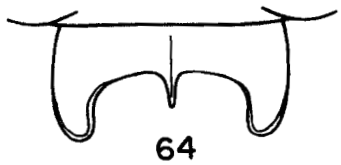
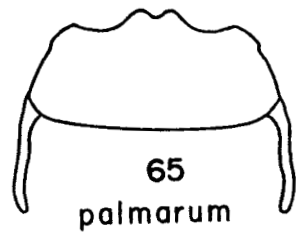


62
cockerelli

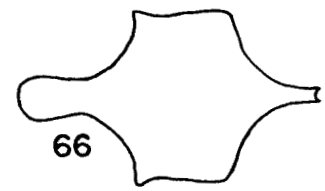
63



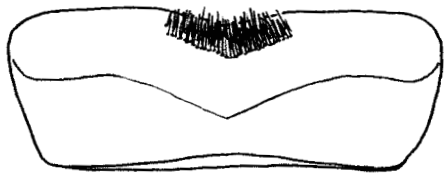
64



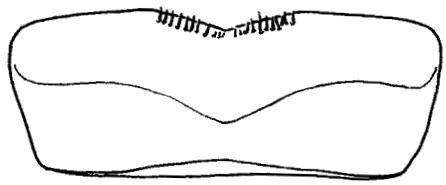
65
palmarum



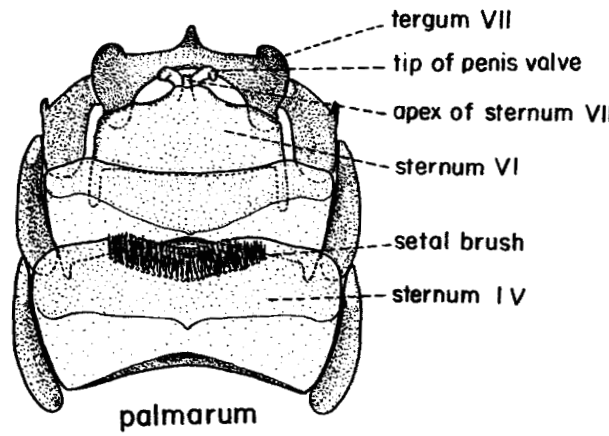
66



67 cockerelli



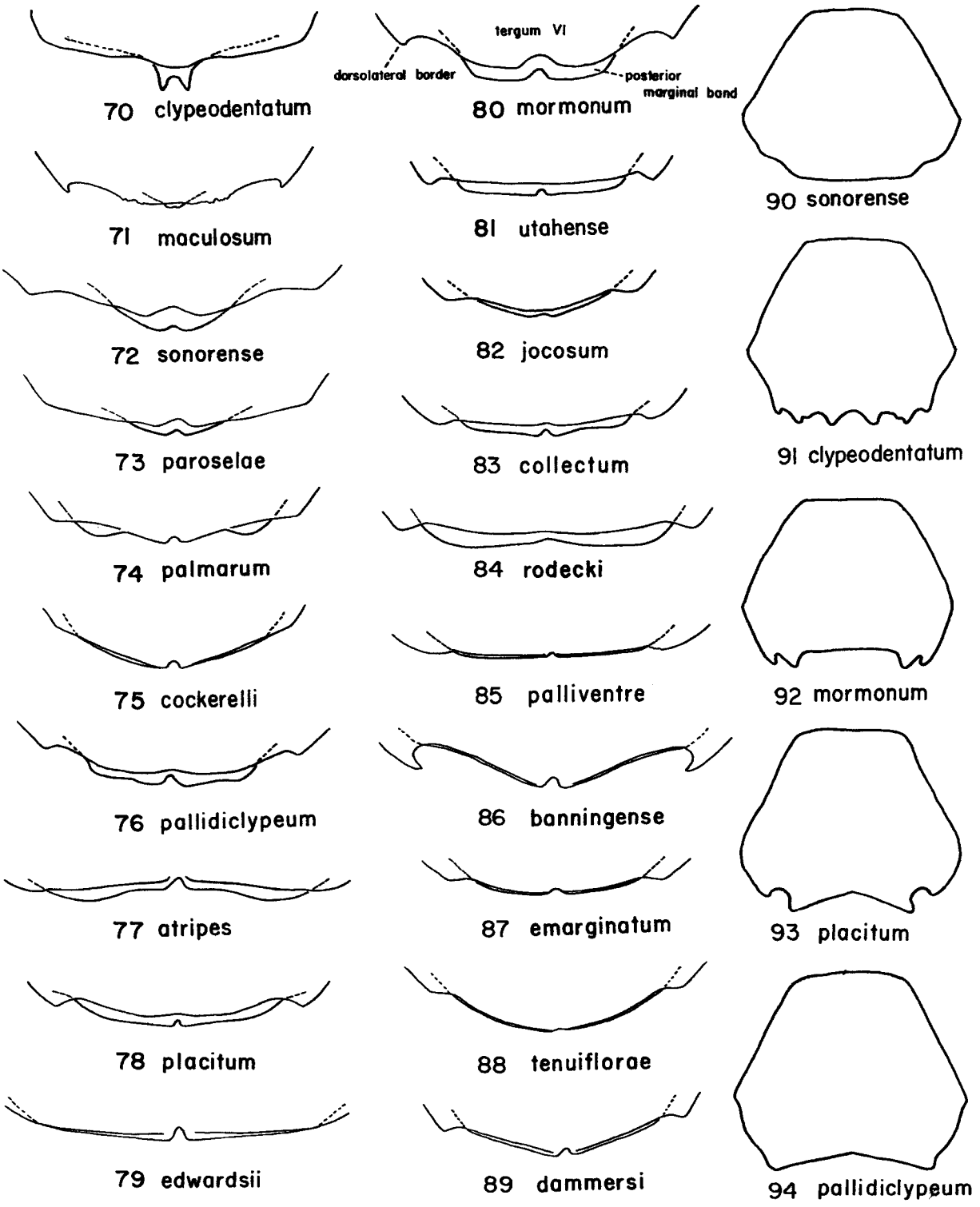
68 clypeodentatum



palmarum
69

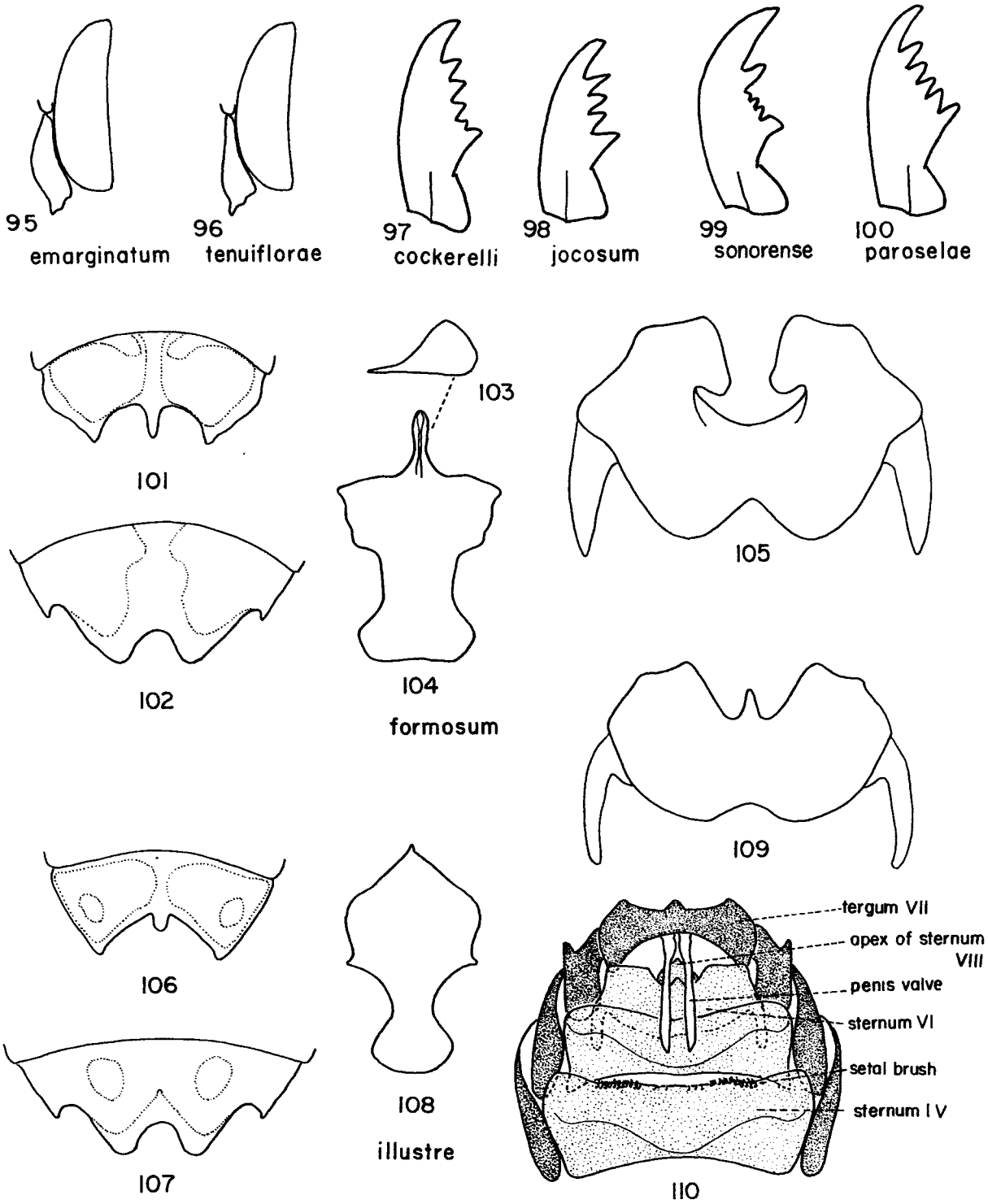
Figs. 70-94. *Anthidium.*

Figs. 70–89: posterior margin of female tergum VI, dorsal view. Figs. 90–94: front view of female clypeus.


70 clypeodentatum
71 maculosum
72 sonorense
73 paroselae
74 palmarum
75 cockerelli
76 pallidiclypeum
77 atripes
78 placitum
79 edwardsii
tergum VI
dorsolateral border
posterior marginal band
80 mormonum
81 utahense
82 jocosum
83 collectum
84 rodecki
85 palliventre
86 banningense
87 emarginatum
88 tenuiflorae
89 dammersi
90 sonorense
91 clypeodentatum
92 mormonum
93 placitum
94 pallidiclypeum

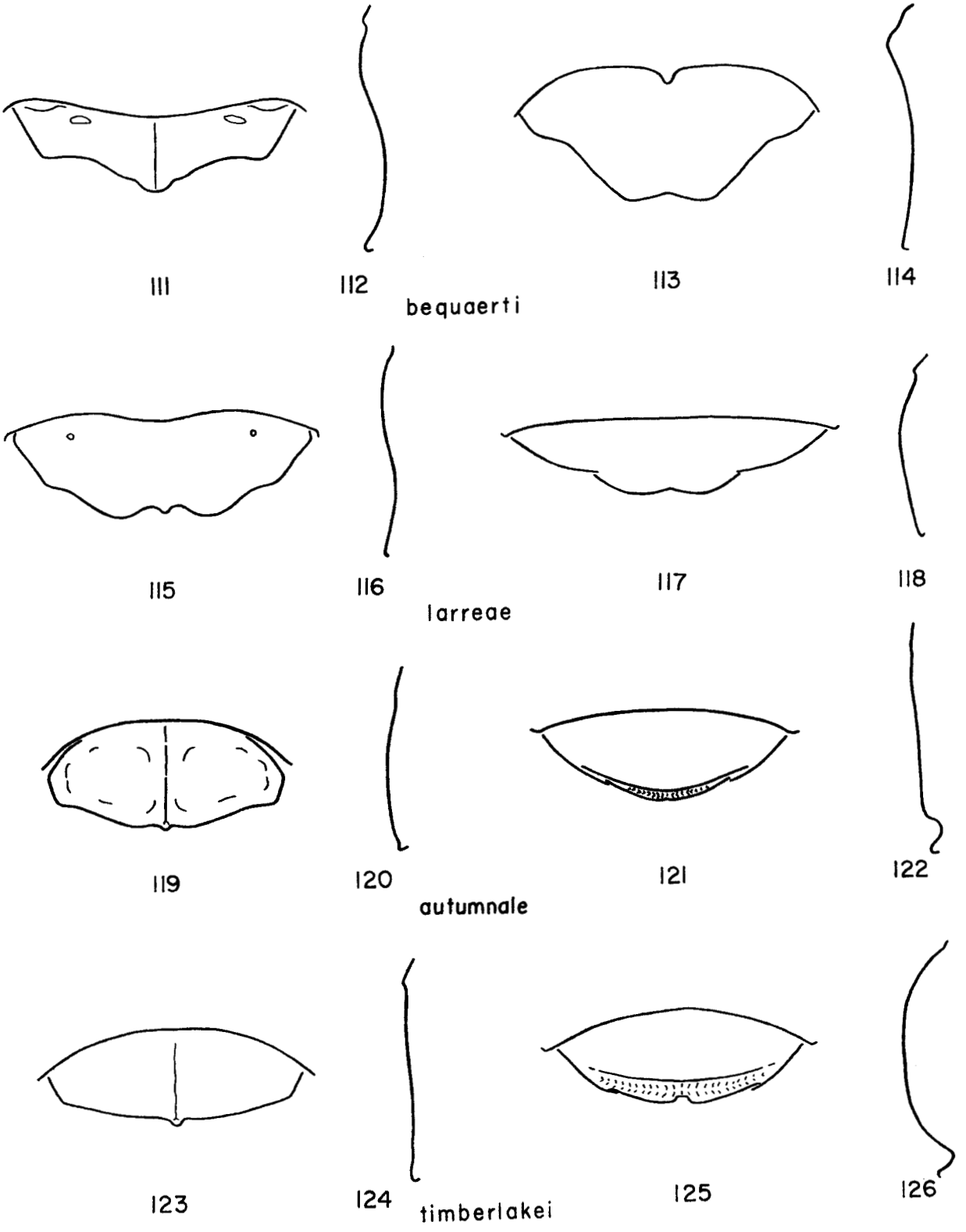
Figs. 95-100. *Anthidium;* Figs. 101-110. *Callanthidium.*

Figs. 95–96: profile of female clypeus and compound eye. Figs. 97–100: frontal view of left mandible of female. Figs. 101, 106: male tergum VII. Figs. 102, 107: female tergum VI. Fig. 103: side view of apex of male sternum VIII. Figs. 104, 108: male sternum VIII. Figs. 105, 109: male sternum VI. Fig. 110: ventral view of posterior half of male abdomen.


95
emarginatum
96
tenuiflorae
97
cockerelli
98
jocosum
99
sonorense
100
paroselae
101
102
103
104
formosum
105
106
107
108
illustre
109
110
tergum VII
apex of sternum VIII
penis valve
sternum VI
setal brush
sternum IV

Figs. 111-126. *Heteranthidium.*

Figs. 111, 115, 119, 123: male tergum VII, dorsal view. Figs. 112, 116, 120, 124: male tergum VI, in profile. Figs. 113, 117, 121, 125: female tergum VI, dorsal view. Figs. 114, 118, 122, 126: female tergum VI, in profile.


111
112
113
114
bequaerti
115
116
117
118
larreae
119
120
121
122
autumnale
123
124
125
126
timberlakei

Figs. 127, 128. *Heteranthidium* male sternite V.

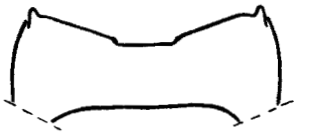
Figs. 129—134: *Trachusa.*

Figs. 129, 132; male clypeus. Figs. 130, 133: male tergum Vii. Figs. 131, 134: female tergum VI.

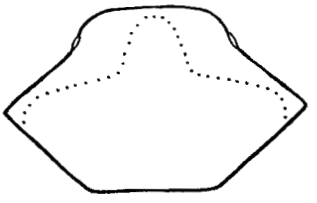
Figs. 135—137: *Dianthidium.*

Fig. 135: male tergum VII. Fig. 136: male sternum VI. Fig. 137: male genitalia.

127
timberlakei



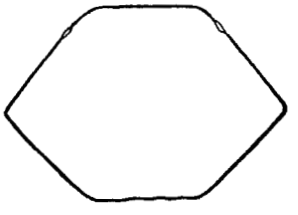
128
autumnale



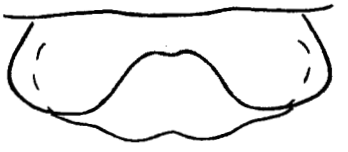
129

130
gummifera

131

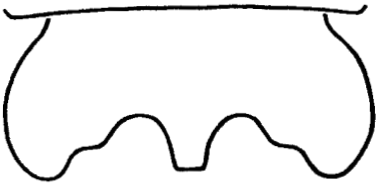


132

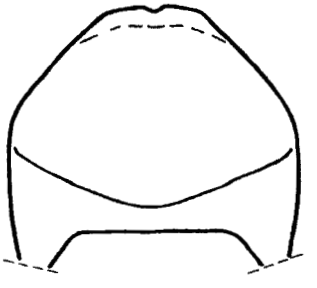


133
perdita

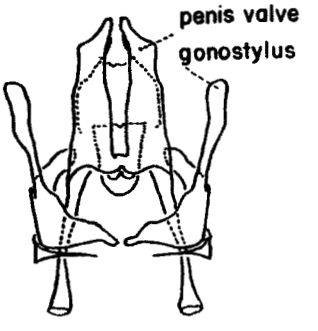
134



135



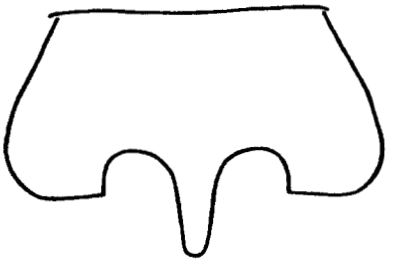
136
singulare



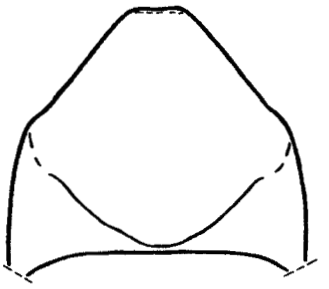
137

Figs. 138-149. *Dianthidium.*

Figs. 138, 141, 144, 147: male tergum VII. Figs. 139, 142, 145, 148: male sternum VI. Figs. 140, 143, 146, 149: male penis valve and gonostylus.

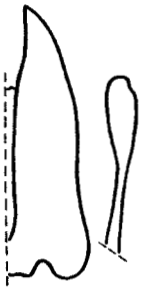


138

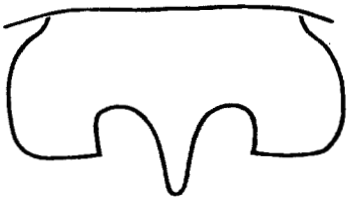


139

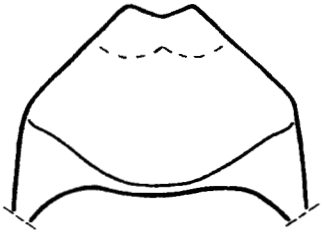
dubium



140



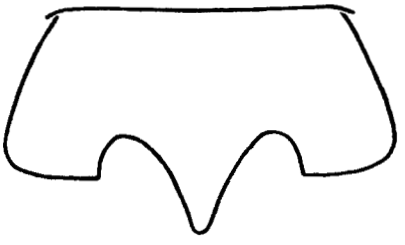
141



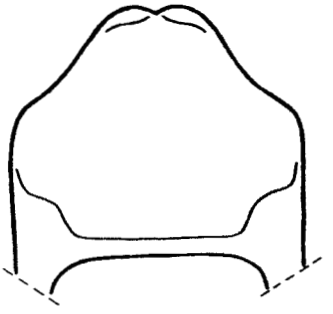
142

pudicum

143

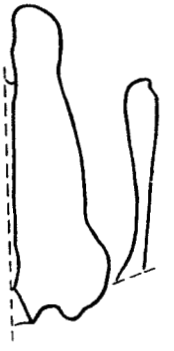


144

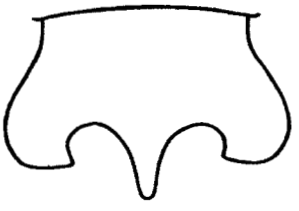


145

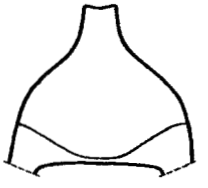
plenum



146



147



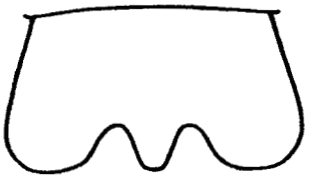
148

marshi

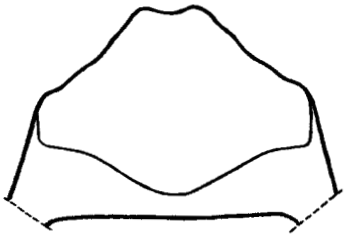
149

Figs. 150-161. *Dianthidium.*

Figs. 150, 153, 156, 159: male tergum VII. Figs. 151, 154, 157, 160: male sternum VI. Figs. 152, 155, 158, 161: male penis valve and gonostylus.



150



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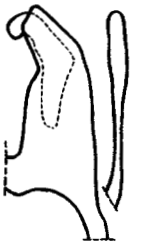
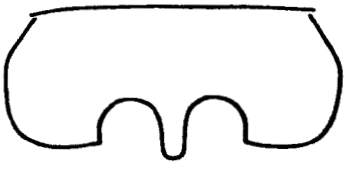


152

implicatum



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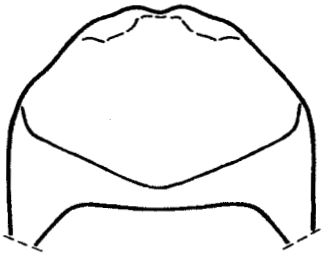
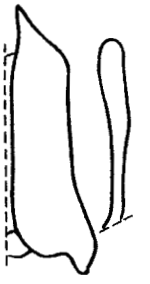
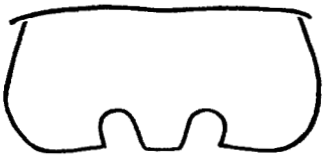


154

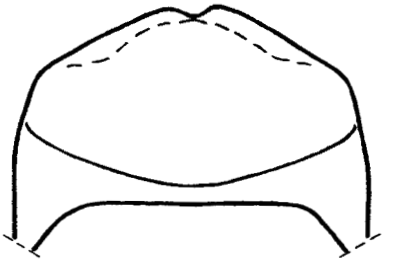


155

parvum



156



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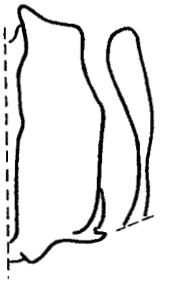
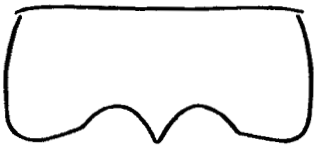
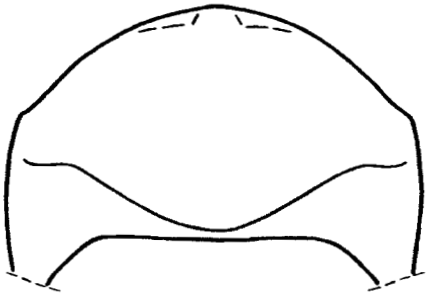


158

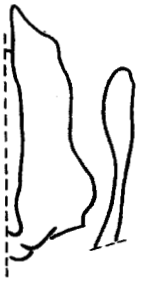
subparvum



159



160

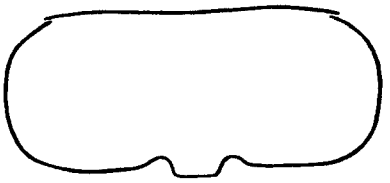


161

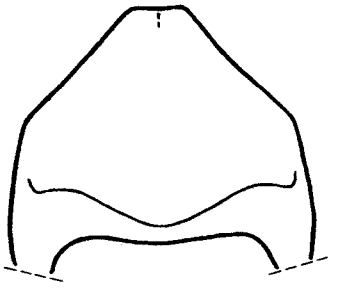
heterulkei

Figs. 162-173. *Dianthidium.*

Figs. 162, 165, 168, 171: male tergum VII. Figs. 163, 166, 169, 172: male sternum VI. Figs. 164, 167, 170, 173: male penis valve and gonostylus.

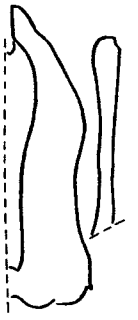


162

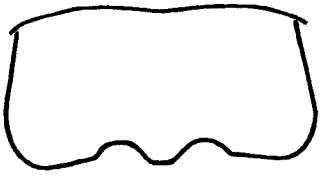


163

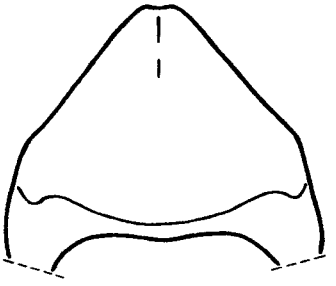
ulkei



164

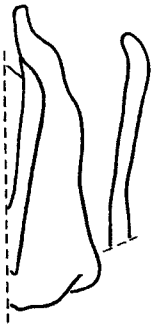


165

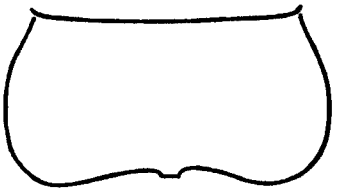


166

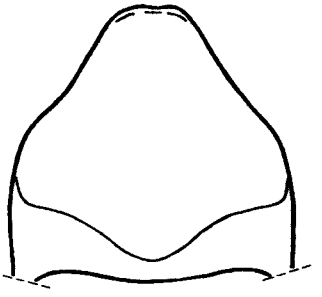
platyurum



167

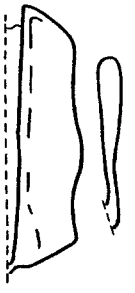


168

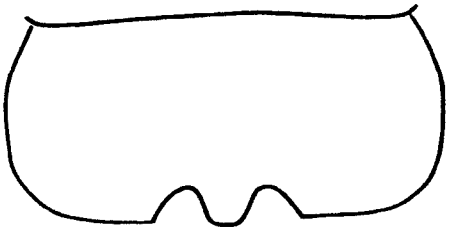


169

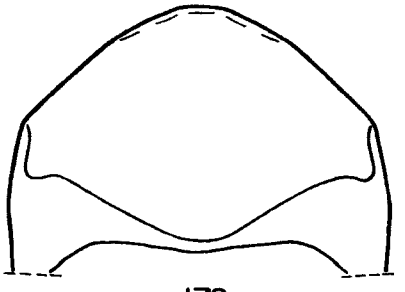
desertorum



170

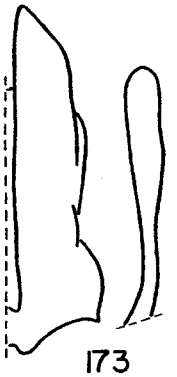


171



172

curvatum



173

Figs. 174-189. *Dianthidium.*

Figs. 174–186: left mandible of female. Fig. 187: frons and base of antenna. Figs. 188, 189; female sternum VI.

174
implicatum

175
plenum

176
pudicum

177
singulare

178
curvatum

179
ulkei

180
platyurum

181
heterulkei

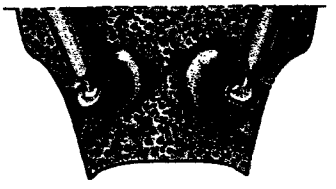
182
subparvum

183
parvum

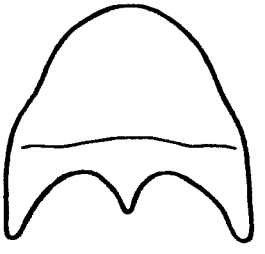
184
desertorum

185
dubium

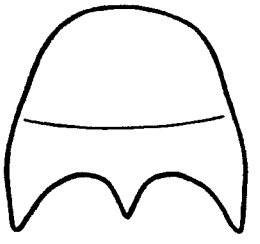
186



187
marshi



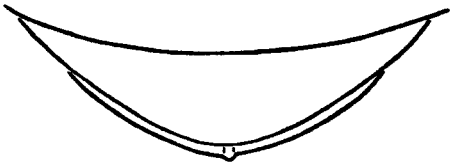
188
parvum



189
subparvum

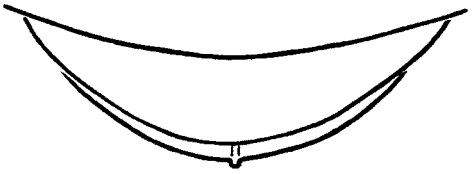
Figs. 190-203. *Dianthidium.*

Figs. 190–202: female tergum VI, from dorsal aspect. Fig. 203: lateral margins of terga IV and V of female.

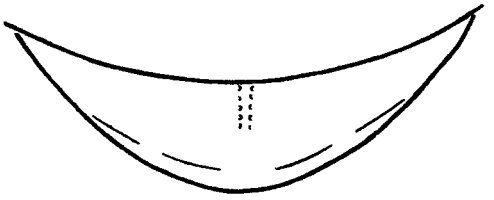


190 parvum

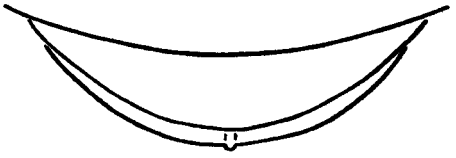
191 pudicum



192 subparvum



193 plenum

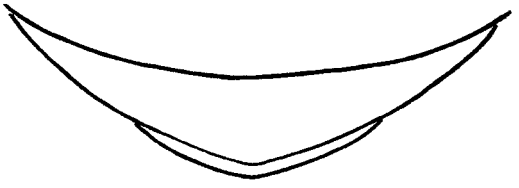


194 heterulkei

195 dubium

196 desertorum

197 curvatum

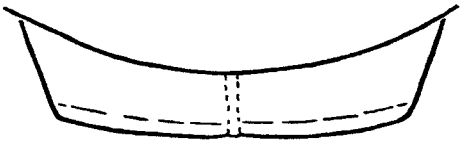


198 ulkei

199 implicatum

200 platyurum

201 marshi

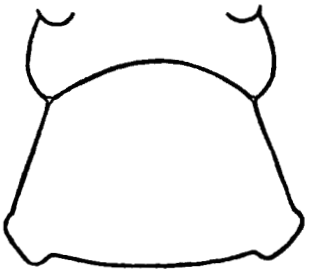


202 singulare

203

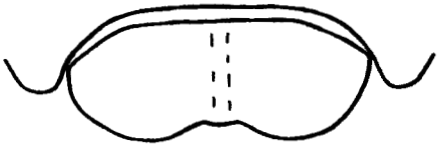
Figs. 204-211. *Anthidiellum.*

Figs. 204, 208: male clypeus. Figs. 205, 209; male tergum VII. Figs. 206, 210: female clypus. Figs. 207, 211: female tergum VI.



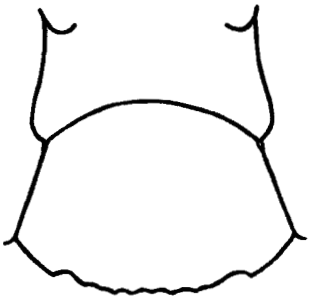
204

208

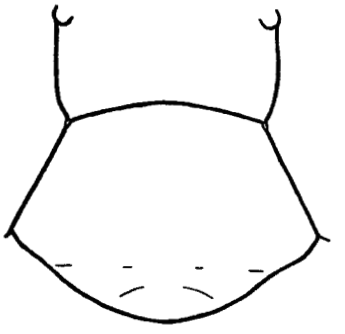


205

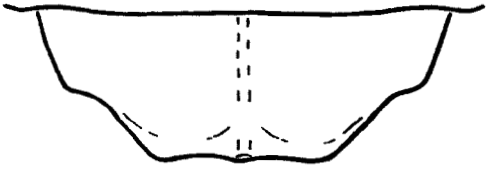
209



206

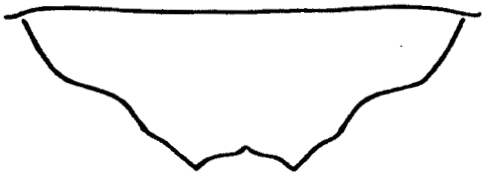


210



207

notatum



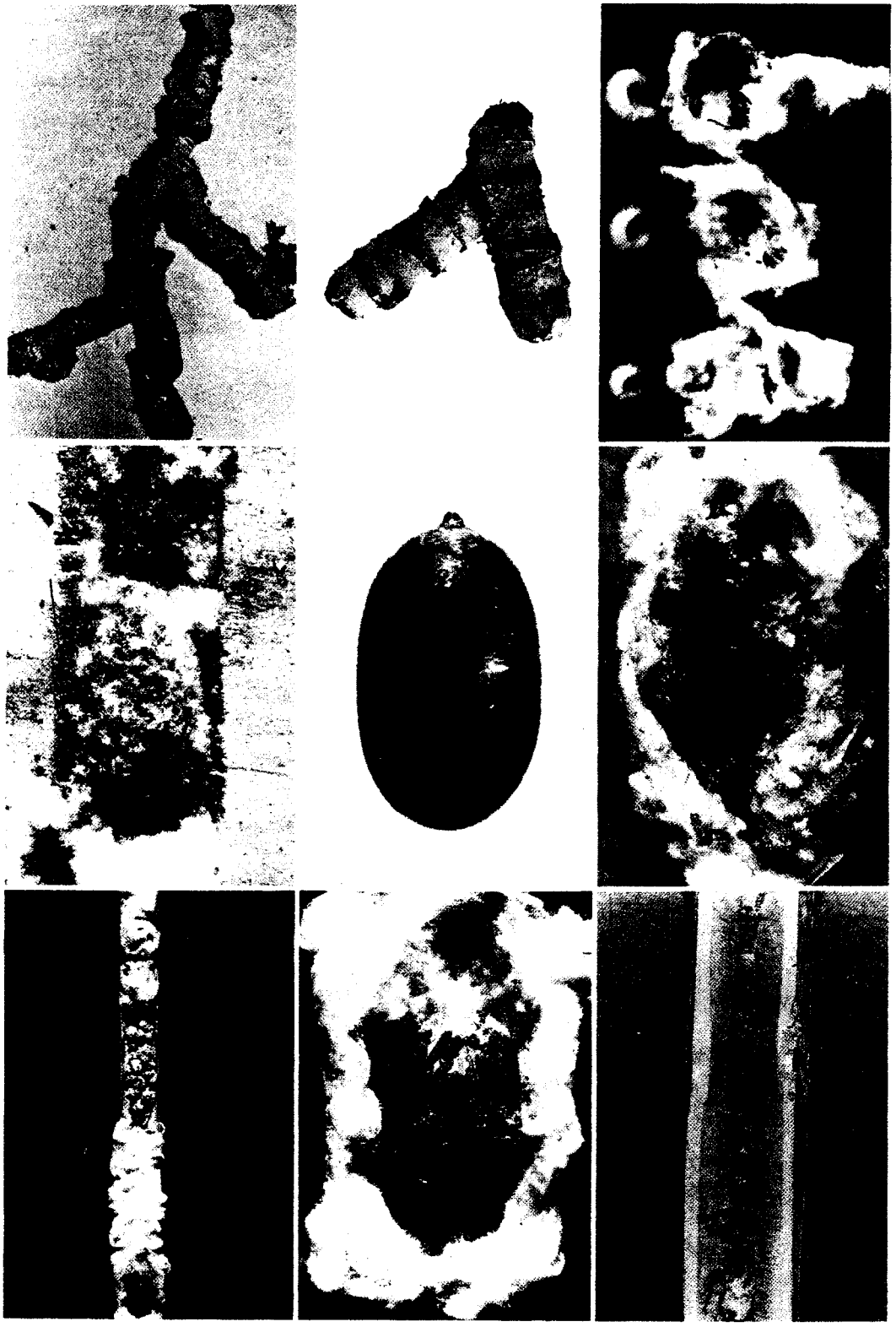
211

ehrhorni

TOP ROW. Left—fig. 212. Nest of *Trachusa gummifera* (Photograph by R. Thorp). Center—fig. 213. Nest of *Trachusa perdita* (Photograph by J. MacSwain). Right—fig. 214. Down cells and larvae of *Anthidium emarginatum* (Photograph by E. Jaycox).

MIDDLE ROW. Left—fig. 215. Nest of *Callanthidium illustre* in cavity in wood (Photograph by F. Parker). Center—fig. 216. Cocoon of *Callanthidium illustre* (Photograph by F. Parker). Right—fig. 217. Cell and cocoon of *Anthidium maculosum*.

BOTTOM. ROW. Left—fig. 218. Nest of *Anthidium mormonum* in "soda straw" (Photograph by E. Jaycox). Center—fig. 219. Close-up of exposed cocoon of fig. 218, showing fecal pattern (Photograph by E. Jaycox). Right—fig. 220. Nest of *Anthidium mormonum* in stem.



TOP ROW. Left—fig. 221. Nest of *Dianthidium ulkei* in hollowed board (Photograph by F. Parker). Center—fig. 222. Cocoon of *Dianthidium ulkei* (Photograph by F. Parker). Right—fig. 223. Single cell of *Dianthidium* on leaf.

MIDDLE ROW. Left—fig. 224. Two cells of *Dianthidium* (possibly *dubium* or *pudicum*). Center—fig. 225. Nest of *Dianthidium plenum* with multiple cells, two with emergence holes. Right—fig. 226. Sincle cell of *Dianthidium* (similar to *implicatum*) (photograph by P. Hurd).

BOTTOM ROW. Left—fig. 227. Cell of *Anthidellum ehrhorni*. Center—fig. 228. Cell of *Anthidiellum notatum robertsoni*. Right—fig. 229. Opened cell of *Heteranthidium larreae*.