BULLETIN OF THE CALIFORNIA INSECT SURVEY

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CALIFORNIA WASPS OF THE SUBFAMILY PHILANTHINAE

(Hymenoptera: Sphecidae)

BY

R. M. BOHART and E. E. GRISSELL

UNIVERSITY OF CALIFORNIA PRESS

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CONTENTS

| Introduction | 1 |
|--|----------|
| Biology | 1 |
| Taxonomic methods | 1 |
| Acknowledgments | 2 |
| Systematics | 3 |
| Key to the North American genera of Philanthinae | 3 |
| Genus Philanthus | 4 |
| Genus Aphilanthops | , 9 |
| Genus Clvpeadon | 2 |
| Genus Listropygia | 6 |
| Genus Eucerceris | 6 |
| Genus Cerceris | 4 |
| Literature Cited | 5 |
| Figures | õ |
| Index to species and subspecies names in Philanthinge | 1 |
| Theory to species and subspecies names in rindantianat | 1 |

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INTRODUCTION

THE PHILANTHINAE, with well over 1,000 species, is one of the largest subfamilies of the Sphecidae. These wasps are mostly medium to large and practically all are colorfully ornamented with spots and bands of yellow and red. Subfamily characteristics are the rather broad separation of the eyes below, the absence of a carina (the omaulus) along the forward bulge of the mesopleuron, a single midtibial spur, and three submarginal cells in the forewing. At least in the North American species the ocelli are well formed, the antennal sockets are somewhat above the clypeal margin, and the mandibles are unnotched externoventrally.

Six genera occur in California and 65 species have been recorded. A majority of these are in *Cerceris* and *Philanthus*, members of which are among the commonest larger wasps. This state has more than its share of philanthines and this is presumably due to the multiplicity of ecological niches. Desert conditions appear to be unusually suitable for these wasps and our xeric areas east of the Sierran crest and south of the Tehachapi range harbor many of them.

The subfamily Philanthinae has been divided into as few as two or as many as six tribes, depending upon the author. The three North American tribes are Philanthini, Aphilanthopsini and Cercerini. These are readily distinguished since Cercerini have the hindfemora distally truncate and Philanthini have the compound eyes emarginate within. Aphilanthopsini have the eye margins entire but the hindfemora are simple. All of the seven genera of these tribes occur in California except *Trachypus* which is the Neotropical counterpart of *Philanthus*.

BIOLOGY

As the subfamily name implies, the philanthines are often found on or about flowers. Here, they may inadvertently pick up considerable amounts of pollen which adheres to the body hairs.

All of the philanthine species are predaceous and nest in the ground. They tend to be gregarious and often form rather loose-knit colonies. The Philanthini provision their nests with bees or other wasps and the Aphilanthopsini with ants. On the other hand, the Cercerini use beetles, especially weevils. More details are given under the individual tribes and genera.

TAXONOMIC METHODS

In keys and discussions the abdominal terga and sterna are referred to by Roman numeral, numbering from the base without regard to the propodeum. Thus, males have seven visible terga and females have six. Mouthparts are not particularly useful from the taxonomic viewpoint. However, the teeth or other structures on the free edge of the clypeus are often obscured unless the mandibles are spread. In Cercerini the mandibular dentition offers some features of value.

Keys have been based on structural characters as much as possible but considerable use has been made of color pattern even though the relative amounts of yellow, white, red, and black vary with altitude, longitude, and latitude. The nature of punctation, particularly on the scutum and abdominal dorsum, is a most useful key character at the group or species level.

Genitalic slide mounts were prepared of all the species considered, but the differences between species are mostly of small consequence.

Plant names in floral visitation records have been corrected to agree with Munz and Keck (1959). The distribution maps are based on a total of 29,595 philanthine wasps studied. Of these, 18,872 were males and 10,723 were females, reflecting a preponderance of males in collections. Some details of the map insets, showing overall range, are based on records published by Strandtmann (1946) and Scullen (1965, 1968).

Illustrations were made by the authors, Figures 1-145 by R. M. Bohart and 146-151 by E. E. Grissell.

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We acknowledge our debt to the systematics classes of 1970 and 1971 at the University of California, Davis, who by their intensive study of California *Philanthus* and *Cerceris* stimulated the present effort.

SYSTEMATICS

The philanthines are among the most colorful wasps. It is not surprising, therefore, that much of their taxonomy has been based on color shades and pattern. Markings are still useful for species or group differentiation but there are several pitfalls for the unwary taxonomist. In females and sometimes in males there may be a white phase as well as a yellow phase. Generally, the white phase is more frequent in drier regions. In some Cerceris the presence or absence of red on the first tergum and nearby areas is of specific value. In others it is not. As in other wasps, the red shades are generally lighter in arid regions and darker in humid ones. This circumstance may afford a differentiating character between localized species or merely a color range in a widely distributed form. The presence or absence of yellow or light red on the inner ventral surface of the male antenna seems to be more reliable than most other color features.

Punctation is not as easily observed as color pattern but it is much more constant within a species. The density, evenness of distribution, and size of punctures are all quite useful.

Some species in the Philanthini and in the Aphilanthopsini have a lamellate extension over the cavity behind the posterior wing base. This may be obvious or more often is visible only in posterolateral view. However, it is a constant feature in those species which have it. The function of this metapleural flange is unknown.

Forewing venation is relatively constant below the generic level (except in *Cerceris*) but the point of diver-

gence of the hindwing media seems to be rather variable, even within a species. This is contrary to the situation in most other Sphecidae.

Two proportional features of the head are often useful in species discrimination. These are the ocellocular distance and the malar space. The latter is especially pertinent in males of *Philanthus*. Another head character of particular value in males of *Cerceris* and *Philanthus* is the shape and color of the clypeal brushes.

KEY TO THE NORTH AMERICAN GENERA OF PHILANTHINAE

| 1. | Hindfemur with an apical flattened plate, appearing truncate; |
|----|---|
| | mesopleuron with a longitudinal furrow at level of scrobe |
| | and reaching to prothorax, but no episternal sulcus (tribe |
| | Cercerini) |
| | Hindfemur simple at apex; mesopleuron without a complete |
| | longitudinal furrow, but an episternal sulcus 3 |
| 2. | Outer veinlet of third submarginal cell meeting marginal cell |
| | before its outer third; terga without median or submedian |
| | transverse depressions |
| | Outer veinlet of third submarginal cell meeting marginal cell |
| | well beyond its outer third; terga with median or |
| | submedian transverse depressions Eucerceris Cresson |
| 3. | Eyes emarginate within, females without a defined pygidium |
| | (tribe Philanthini) |
| | Eyes entire within, females with a well-defined pygidium |
| | (tribe Aphilanthopsini) 5 |
| 4. | Abdominal segment I rather broad, not forming a narrow |
| | petiole Philanthus Fabricius |

Abdominal segment I more than twice as long as its greatest width, forming a narrow petiole (Neotropical) Trachypus Klug

- - Listropygia R. Bohart Ocellocular distance about 2 lateral ocellus diameters or more; male flagellomeres not unusually flattened; female
- - toward apical middle..... Aphilanthops Patton An angular metapleural lamella behind wing base; female pygidium quadrate, surface concave; female clypeus not toothed toward apical middle Clypeadon Patton

Tribe Philanthini Genus Philanthus Fabricius

About 135 species of Philanthus are known. They are distributed over all continents except South America, where its place is filled by Trachypus, and Australia. In North America we recognize 32 species and of these 18 occur in California. In this country there were only local or regional keys until the publication by Strandtmann (1946). This excellent and comprehensive work on North American *Philanthus* is now difficult to obtain. Furthermore, it is somewhat out-of-date as a result of recently discovered synonymy and a number of newly described species. Also, known distribution limits have been greatly extended in many cases. In Strandtmann's paper many poorly understood forms were treated as subspecies, particularly in the so-called "politus group" centered around Philanthus politus Say. We recognize most of these as species since their structural differences, though slight, seem to be constant, even when ranges overlap. We have seen no evidence of introgression among these closely related species.

Philanthus have relatively few interspecific characters. Male genitalia differ only slightly and apparently not at all where closely related species are concerned. Most definite differences are seen in the degree of convergence of the inner eye margins toward the vertex (figs. 44, 45), development and color of clypeal brushes in the male (figs. 7, 9), formation of the clypeal apex in the female (figs. 10, 11), presence or absence of a metapleural lamella behind the base of the hindwing, and the shape of the posterior ridge of the pronotum. Less obvious but quite useful is the nature of punctation, particularly on the clypeus, scutum (figs. 18, 19), and abdominal terga (figs. 17, 20). Coloration is subject to considerable variation, but color pattern can be used to a minor extent, at least in a limited geographical area. Thus, the pattern of many species occurring in California is relatively stable within the state borders but may become radically altered in specimens to the north by extension of black markings and replacement of yellow with white, or to the east and southeast by extension of yellow or red. This variability in markings on a geographical basis, as well as customary differences between sexes, has resulted in a number of synonyms.

We have attempted to form phylogenetic groups for the North American species and these bear only a partial resemblance to the arrangement given by Strandtmann. The chief agreements are with the zebratus group in which the inner eye margins converge above, and the ventilabris and solivagus groups, each with a single species. Our arrangement into seven groups with the essential characteristics and included species is given below. Unless otherwise stated it should be assumed that the compound eyes are rather widely separated above, the body is mostly covered by several sizes of separated punctures, the pronotal ridge is rounded, and there is no metapleural lamella. Of course, exceptions to one or more of these commoner features may form the basis for a group.

The nesting habits of about ten species of North American Philanthus are known in some detail. Six of these are Californian, but only one of them (pacificus) has actually been studied in California. Philanthus usually nest in aggregations in level to slightly sloping bare, sandy soil. A few species (e.g., gibbosus) nest primarily in vertical banks but may occasionally use flat areas. Of those which nest in flat areas, only pacificus, politus, and pulcher level the tumulus which accumulates about the entrance as excavation proceeds (Powell and Chemsak, 1959; Evans, 1966). Burrow length depends largely upon the size of the wasp, and depths of 10 cm to 85 cm have been reported for different species (Evans and Lin, 1959). Prey, again determined by the size of the female wasp, consist primarily of numerous species of Halictidae, but other bees in the Colletidae, Andrenidae, Megachilidae, Anthophoridae, and Apidae are taken as well. More rarely Scelionidae, Eumenidae, Masaridae, Sphecidae, Ichneumonidae, Braconidae, or Chrysididae may be used. Several of the larger species of *Philanthus*, such as *bicinctus*, *crabron*iformis, and sanbornii, as well as the European triangulum Fabricius, are known to provision their nests with the honeybee.

Nests of a single female may have individual cells filled with a mixture of bees or with the same bee species. Captured prey is stung between the forecoxae and is carried to the nest by the wasp's middle legs. Since the known Californian species of *Philanthus* close the nest entrance

while hunting, the wasp must alight and dig the nest open with its forelegs. Several other species (sanbornii and solivagus) do not close the nest while absent. Several bees (or wasps) may be captured and stored midway in the burrow until the wasp begins to excavate cells. Most nests contain four to seven or more cells and each cell may be provisioned with six to 18 prey. An egg is laid on the ventral surface of one of the last prey to be placed in a cell, and the cell is sealed off from the main burrow by a soil plug. Completed nests take from five to ten days and a single female may make one or several nests per season depending upon the species of Philanthus.

Numerous parasites have been recorded about the nesting sites of *Philanthus*, but only two species in North America have actually been reared from Philanthus cells. Reinhard (1924) reared the sarcophagid Senotainia trilineata Wulp from P. gibbosus, and Evans (1966) reared the same fly from P. zebratus. Another sarcophagid, Phrosinella pilosifrons Allen, was reared from crabroniformis, pulcher and zebratus by Evans (1970).

Species groups of North American Philanthus

I, P. zebratus group. Interocular distance at midocellus greatly reduced; anterior margin of pale band on terga IV and/or V not bi-emarginate. Included species: bicinctus (Mickel) (fig. 37), gloriosus Cresson, sanbornii Cresson, ventralis (Mickel), and zebratus Cresson.

II, P. ventilabris group. Pronotal ridge transversely grooved; metapleural lamella present; punctures of abdominal terga coarse and mostly contiguous; anterior margin of pale band on terga IV or V not bi-emarginate. Included species: ventilabris Fabricius.

III, P. gibbosus group. Anterior margin of pale band or terga IV and/or V rarely bi-emarginate; markings usually yellow to orange yellow. Included species: arizonicus R. Bohart, banabacoa Alayo, barbatus F. Smith (fig. 38), crabroniformis F. Smith, crotoniphilus Viereck and Cockerell, gibbosus (Fabricius), inversus Patton, multimaculatus Cameron, and occidentalis Strandtmann.

IV, P. pacificus group. Anterior margin of pale band on terga IV and/or V bi-emarginate; markings usually whitish or very pale yellow. Included species: barbiger Mickel, levini R. Bohart, michelbacheri R. Bohart, nasalis R. Bohart, neomexicanus Strandtmann, pacificus Cresson, pulcher Dalla Torre, schusteri R. Bohart, and serrulatae Dunning.

V, P. politus group. Anterior margin of pale band on terga IV and/or V bi-emarginate; metapleural lamella present. Included species: albopilosus Cresson, politus Say, psyche Dunning, siouxensis Mickel, and tarsatus H. Smith.

VI, P. lepidus group. Punctation of abdominal terga mostly absent: anterior margin of pale band on terga IV and/or V usually not bi-emarginate. Included species: bilunatus Cresson and lepidus Cresson (figs. 32, 33).

VII, P. solivagus group. Punctation of abdominal terga fine and contiguous; anterior margin of pale band on terga IV and/or V rarely bi-emarginate. Included species: solivagus Say (fig. 34).

KEY TO THE NORTH AMERICAN SPECIES OF PHILANTHUS

| 1. Antenna with 13 articles, abdomen with 7 visible terga; | 2 |
|--|----------|
| Induces | - |
| Antenna with 12 articles, abdomen with 6 visible terga, | 2 |
| Cinares | 3 |
| 2. Interocular distance at indocends about han or less than | <u>,</u> |
| hair that at oroadest part of clypeus (lig. /) | 3 |
| Interocular distance at midoceinus much more than half that | _ |
| at broadest part of clypeus (ligs. 1, 3) | / |
| 3. Ocellocular distance a little more or less than diameter of | |
| lateral ocellus | 4 |
| Ocellocular distance not more than half a lateral ocellus | |
| diameter (fig. 45) | 5 |
| 4. Tergum IV with punctures about as coarse as those on | |
| scutum; moderately large species, body length often | |
| about 15 mm (Alta. to Tex. and centr. Mex., west to | |
| Calif.) | n |
| Tergum IV with punctures averaging finer than those on | |
| scutum; large species, usually about 17 mm long | |
| (Mont., Wyo., Utah) bicinctus (Mickel |) |
| 5. Tergum I with pale band angularly incised posteromedially, | |
| or divided, or all dark | 6 |
| Tergum I with pale band complete, not angularly incised | |
| posteromedially (U.S. and so. Canada west of 100th | |
| meridian) zebratus Cressor | n |
| 6. Tergum I with pale band incised or narrowly divided; | |
| scutellum and tergum IV with very uneven distribution | |
| of moderately small punctures (Br. Col., Wash., Oreg., | |
| Nev., Calif.) |) |
| Tergum I with widely separated spots or all dark; scutellum | |
| and tergum IV with a rather even distribution of | |
| moderately small punctures (so. Canada and U.S. west | |
| to Alta., Kans., N. Mex.) sanbornii Cressor | n |
| 7. Punctures on tergum III, or many of them, larger than those | |
| on scutum | 8 |
| Punctures on tergum III not larger than those on scutum 18 | 8 |
| 8, Pronotal ridge transversely grooved; last antennal article | |
| compressed; with an angular metapleural lamella just | |
| posterior to base of hindwing (best seen in semilateral | |
| view) (transcontinental in so, Canada and U.S., also in | |
| Hdgo, Mex.) ventilabris Fabriciu | s |
| Pronotal ridge rounded: last antennal article not com- | |
| pressed: no metapleural lamella | , |
| 9. Clypeal brush black |) |
| Clypeal brush vellowish to whitish | 3 |
| 10. Punctures of tergum III much larger than those of IV | |
| man more | |

| | rueola, Mex.) Darbatus t. Smith | |
|---|--|--|
| | Punctures of tergum IV similar in size to those of III 11 | |
| 11. | Scutal punctures rather evenly spaced (Utah Tex and | |
| | Could west to Calif and Rain Calif.) | |
| | | |
| | crotonipnius viereck and Cockereli | |
| | Scutal punctures very unevenly spaced | |
| 12. | Punctures of tergum IV numerous, fairly close and mostly | |
| | deeply impressed (transcontinental, so, Canada to | |
| | Centr. Amer.) gibbosus (Esbricius) | |
| | Punctures of terring IV shallow and well encented (Cuke) | |
| | i unctures of terguin iv shahow and wen separated (Cuba). | |
| | <i>Danabacoa</i> Alayo | |
| 13. | Anterior margin of paic band on tergum V bi-emarginate 14 | |
| | Anterior margin of pale band on tergum V not bi-emarginate 16 | |
| 14. | Abdominal venter with yellow bands on sterna II-IV (Calif.) | |
| | | |
| | Abdominal venter mostly dark, without complete pale | |
| | bands; markings whitish or vellow | |
| 15 | Setigerous nunctures toward have of clyneus (adjacent to | |
| | from irregularly and rather energy model (C-16) | |
| | nons) aregularly and rather sparsely spaced (Call.) | |
| | nasalis R. Bohart | |
| | Setigerous punctures toward base of clypeus closely and | |
| | evenly spaced (Nebr. to Calif.) barbiger Mickel | |
| 16. | Sternum III with a semi-erect row of fimbriate hairs along | |
| | its apex (Sask, and Nebr, west to Brit, Col, and Calif) | |
| | archroniformis E Smith | |
| | Starnum III without special hoirs along its appy | |
| 17 | Overlagende alle and the second many along its apex | |
| 17. | Oceliocular distance about two lateral ocellus diameters; | |
| | frontal line not depressed just above level of antennal | |
| | sockets (Calif.) occidentalis Strand tmann | |
| | Ocellocular distance four to five lateral ocellus diameters | |
| | (fig. 44); frontal line distinctly although not deeply | |
| | impressed (Alta to Kans and w Jowa west to B C and | |
| | Colif) | |
| 19 | Targum II poliched and provide the without supervision 10 | |
| 10. | Terguin it poissied and practically without punctation | |
| • • | lergum II with obvious punctation | |
| 19. | | |
| | Ocellocular distance about two lateral ocellus diameters; | |
| | Ocellocular distance about two lateral ocellus diameters; sternum VI without a median hair tuft; spots on | |
| | Ocellocular distance about two lateral ocellus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. | |
| | Ocellocular distance about two lateral ocellus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. west to Alta., Idaho, N. Mex.) bilunatus Cresson | |
| | Occilocular distance about two lateral occillus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. west to Alta., Idaho, N. Mex.) bilunatus Cresson Occilocular distance only slightly more than a lateral occillus | |
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| 20 | Occilocular distance about two lateral occillus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. west to Alta., Idaho, N. Mex.) bilunatus Cresson Occilocular distance only slightly more than a lateral occillus diameter; sternum VI with a median hair tuft; spots on tergum II not turning backward within (so. Canada and U.S. west to Man., Colo. and Tex.) lepidus Cresson | |
| 20. | Occllocular distance about two lateral occllus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. west to Alta., Idaho, N. Mex.) bilunatus Cresson Occllocular distance only slightly more than a lateral occllus diameter; sternum VI with a median hair tuft; spots on tergum II not turning backward within (so. Canada and U.S. west to Man., Colo. and Tex.) lepidus Cresson With an angular metapleural lamella just posterior to base of | |
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| 20. 21. 22. | Occllocular distance about two lateral occllus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. west to Alta., Idaho, N. Mex.) bilunatus Cresson Occllocular distance only slightly more than a lateral occllus diameter; sternum VI with a median hair tuft; spots on tergum II not turning backward within (so. Canada and U.S. west to Man., Colo. and Tex.) lepidus Cresson With an angular metapleural lamella just posterior to base of hindwing (best seen in semilateral view) | |
| 20. 21. 22. | Ocellocular distance about two lateral ocellus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. west to Alta., Idaho, N. Mex.) bilunatus Cresson Ocellocular distance only slightly more than a lateral ocellus diameter; sternum VI with a median hair tuft; spots on tergum II not turning backward within (so. Canada and U.S. west to Man., Colo. and Tex.) lepidus Cresson With an angular metapleural lamella just posterior to base of hindwing (best seen in semilateral view) | |
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| 20.21.22.23. | Ocellocular distance about two lateral ocellus diameters; sternum VI without a median hair tuft; spots on tergum II turning backward within (so. Canada and U.S. west to Alta., Idaho, N. Mex.) bilunatus Cresson Ocellocular distance only slightly more than a lateral ocellus diameter; sternum VI with a median hair tuft; spots on tergum II not turning backward within (so. Canada and U.S. west to Man., Colo. and Tex.) lepidus Cresson With an angular metapleural lamella just posterior to base of hindwing (best seen in semilateral view) | |
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| | Mesopleural punctures separated by polished areas of about a puncture diameter |
|-----|--|
| 24. | Markings very pake to whitish, especially on legs (S. Dak. to w. Tex. west to Utah and Ariz.; centr. Mex. south to |
| | Zac.) siouxensis Mickel |
| | N. Dak.) politus Say |
| 25. | Malar space at middle considerably longer than either length |
| | or width of pedicel, whichever is greater (fig. 16) 26 Malar space at middle at most a little longer than length or width of medical (fig. 14, 15) |
| 26. | Scutal punctures very unevenly distributed, leaving large |
| | smooth areas |
| 27 | Scutal punctures medium small and fairly evenly distributed 28 |
| 21. | frontal line rather deeply impressed just about level of antennal sockets; legs black and yellow (Alta. to Tex., |
| | west to Br. Col., Calif. and w. Mex.) |
| | Ocellocular distance about three lateral ocellus diameters (fig. 46); frontal line faintly impressed; legs extensively |
| 28 | red (Ariz.) |
| 20. | lobe); clypeal brush tawny to blackish (N. Mex. to Calif., Sonora to Baja Calif.) <i>neomexicanus</i> Strandtmann |
| | No pale spot on mesopleuron; clypeal brush whitish (so. Calif., Ariz.) schusteri R. Bohart |
| 29. | Tergum II with contiguous, granulate punctation (se. Cana- da and n. U.S. west to Sask. and N. Dak.) solivagus Say |
| 20 | Tergum II polished between distinct punctures |
| 30. | Clypeal brush yellowish to white |
| 31. | Malar space at middle about half as long as pedicel or less |
| | of lateral occilius (fig. 43) (Wyo. to N. Mex. west to |
| | Brit. Col. and Calif.; w. Mex.) pacificus Cresson |
| | (fig. 15); ocellocular distance 1.2 or more lateral ocellus |
| 32. | Forewing costa whitish from base to near stigma; clypeal |
| | brush whitish; abdominal markings whitish (Wyo., Colo. and N. Mex. west to Calif.; Sonora and Baja Calif.) |
| | Econying costs raddish brown from here to court stimul |
| | clypcal brush yellowish, abdominal markings nearly always yellow (Manitoba to Kans. and N. Mex., west to |
| | Br. Col. and Calif.) pulcher Dalla Torre |
| 33. | Lines drawn from apex of angle of eye emargination to outer edge of clypeus plainly converging above (fig. 12) 34 |
| | Lines drawn from apex of angle of eye cmargination to outer edge of elypeus essentially parallel or diverging |
| 34. | Ocelli forming an acute triangle |
| | Ocelli forming an obtuse triangle; body often extensively red |
| 35. | Punctures of scutum sparse, separated by many large |
| | Punctures of scutum abundant and well spaced except |
| | toward midline |

| 36. | Scutum very unevenly punctate, large polished areas be- tween punctures; tergum II yellow, III-VI all or nearly all black (fig. 37) bicinctus Mickel |
|-------|---|
| | Scutum with many rather evenly spaced punctures; color pattern quite different |
| 37. | Tergum I in dorsal view somewhat bell-shaped, about 1.5 times as broad as long; abdomen mostly yellow and partly black in California specimens, red and yellow in other localities |
| | Tergum I in dorsal view rather transverse, about 2.0 times as broad as long; abdomen black and yellow or black with |
| 38. | red and yetlow sanbornii Cresson Punctures of tergum II absent or when present, not much |
| | larger than those of scutum (sometimes a few on II a |
| | Punctures of tergum II, or at least many of them, distinctly |
| 39. | larger than those of scutum (figs. 19-22) |
| - | (best seen in semiprofile) |
| 40. | Metanotum with abundant long white hair; lateral ocelli |
| | separated by about 3 diameters <i>albopilosus</i> Cresson Metanotum with moderate to short, inconspicuous hair; |
| 41 | lateral ocelli separated by about 2 diameters |
| • • • | distance about equal to width of midocellus |
| | Wing veins brown or reddish toward base where there may |
| | be a small amount of reddish yellow, or legs extensively red; ocellocular distance greater than width of midocel- |
| | lus |
| 42. | Mesopleuron coarsely and closely punctate, interspaces densely microsculptured; hindtarsi black |
| | Mesopleuron with distinct punctures, interspaces shiny or |
| 43 | lightly microsculptured; hindtarsi yellowish to red 43 Femora black and whitish or yellow |
| 15. | Femora black and red |
| 44. | Terga polished, practically apunctate (figs. 32, 33) 45 |
| A.F. | Terga with obvious punctation (figs. 17, 20) |
| 43. | Spots of tergum if recurved (fig. 33); from without a deep furrow from middeellus to interantennal prominence |
| | |
| | Spots of tergum II not recurved (fig. 32); frons with a deep |
| | furrow from midocellus to interantennal prominence . |
| 46. | Tergum III, as well as many other areas, with moderately fine and essentially contiguous punctation (fig. 34) |
| | Tergum III with punctures obviously separated by polished areas |
| 47. | Wing veins rust red to base neomexicanus Strandtmann |
| 48. | Wing veins whitish or brown toward base |
| | Malar space at middle no more than half as long as pedicel . 49 |
| 49. | Femora black or dark mahogany, marked with white or yellow (Nevada females have red on femora) |
| | pacificus Cresson |
| | Femora black, rcd and white or all red (not recorded from Novada), serrulatae Dunning |

| | Punctures abundant on outer one-third of scutum, rather regularly spaced and without large and polished inter- |
|---|--|
| | spaces (ligs. 19, 22) |
| | runctures sparse or very irregularly spaced on outer one- third of scutum, leaving large polished interspaces figs. |
| 51 | 18,20) |
| 51. | diameter essentially contiguous (figs. 19.22) 52 |
| | Most scutal nunctures excent those in grooves senarated by |
| | at least a puncture diameter 53 |
| 52 | Pronotal ridge transversely grooved <i>ventilabris</i> Eabricius |
| 52. | Pronotal ridge not transversely grooved face often with |
| | numerous black spots (fig. 13) inversus Patton |
| 52 | Targum III with scattered large nunctures but targum IV |
| 55. | nractically anunctate (fig. 38) harbatus F Smith |
| | Torgum III with punctation similar to that on IV 54 |
| 5 4 | Punctume of forum I mostly considerably lumar than these |
| 34. | of souture of control in the state of souture of soutur |
| | Disculution |
| | runchules of leight i mostly about as large as mose on |
| 55 | Mesonleuron all dark femore extensively rather bright red |
| 55. | mesopheuron an uark, temora extensively father organ real . |
| | Mesonleuron at least with a nale snot behind proportal lobe 56 |
| 56 | Propodeal enclosure with some closely nunctured and/or |
| 50. | closely ridged areas in addition to the area of the |
| | median furrow |
| | Propodeal enclosure (except median furrow) without obvi- |
| | ous close ridging or crenulation, often mostly polished, |
| | either with a few well separated punctures or on each |
| | side with a patch of punctures separated by about a |
| | puncture diameter |
| 57. | Vertex with a discrete polished swelling behind ocellar |
| | triangle (fig. 10) gibbosus (Fabricius) |
| | Vertex usually polished overall but without a discrete |
| | sweiling |
| 58. | l'lagellomere i slightly shorter than scape; scutal punctures |
| | only a little smaller than those on tergum II; clypeal lip |
| | Finally always lightly longer than sound sound nunctures |
| | TANKET AND TANKET A SUMATION DATE AND AND AN AND A DESCRIPTION A |
| | averaging much smaller than those on termin II' clunes |
| | averaging much smaller than those on tergum II; clypeal lip usually black |
| 59 | averaging much smaller than those on tergum II; clypeal lip usually black |
| 59 . | averaging much smaller than those on tergum II; clypeal lip usually black |
| 59 . | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 0ccidentalis Strandtmann Pronotal ridge not unusually narrowed 60 |
| 59 . 60. | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 59 |
| 59 . 60. | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 59 Coccidentalis Strandtmann 60 Tergum I smooth and polished but with large, well separated punctures; femora red 60 |
| 59 . 60. | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 59 Pronotal ridge not unusually narrowed 60 Tergum I smooth and polished but with large, well separated punctures; femora red 60 Tergum I rough, punctures mostly close or contiguous |
| 59 . 60. | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 59 Pronotal ridge not unusually narrowed 60 Tergum I smooth and polished but with large, well separated punctures; femora red 60 Tergum I rough, punctures mostly close or contiguous (fig. 35); femora mostly black and yellow 61 |
| 59 . 60. | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 59 Pronotal ridge not unusually narrowed cccidentalis Strandtmann Pronotal ridge not unusually narrowed 60 Tergum I smooth and polished but with large, well separated punctures; femora red banabacoa Alayo Tergum I rough, punctures mostly close or contiguous (fig. 35); femora mostly black and yellow crabroniformis F. Smith |
| 59 . 60. 61. | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 59 Pronotal ridge not unusually narrowed, especially toward middle 60 Tergum I smooth and polished but with large, well separated punctures; femora red 60 Tergum I rough, punctures mostly close or contiguous (fig. 35); femora mostly black and yellow 61 Punctation of terga unusually shallow; markings yellow; |
| 59 . 60. 61. | averaging much smaller than those on tergum II; clypeal lip usually black 59 Pronotal ridge unusually narrowed, especially toward middle 59 Pronotal ridge not unusually narrowed, especially toward middle 60 Tergum I smooth and polished but with large, well separated punctures; femora red 60 Tergum I rough, punctures mostly close or contiguous (fig. 35); femora mostly black and yellow 61 Punctation of terga unusually shallow; markings yellow; scutal punctation very fine; pale bands on terga III and |
| 59 . 60. 61. | Pronotal ridge unusually narrowed, especially toward middle |
| 59 . 60. 61. | Pronotal ridge unusually narrowed, especially toward middle |
| 59 . 60. 61. | Image of the second |
| 59 . 60. 61. | Image of the second |
| 59 . 60. 61. | Image of the second |
| 59 . 60. 61. | Image of the second |
| 59.60.61.62. | Image of the second |
| 59.60.61.62. | Promotal ridge unusually narrowed, especially toward middle |

Philanthus barbiger Mickel (Map 1)

Philanthus barbiger Mickel, 1916:405. Male holotype, Harrison, Nebraska; Univ. Nebraska, State Mus., Lincoln.

Geographic range. – Nebraska, Wyoming, Idaho, Colorado, Arizona, and California (map 1). In California it seems to be restricted to Great Basin areas.

California records. – INYO CO.: Lone Pine, 5dd, X-15-67 (D. S. Horning, R. M. Bohart, UCD), 2 mi. e., 4dd, 799, X-12-71 (R. M. Bohart, C. Goodpasture, E. E. Grissell, UCD), 3 mi. w., 1d, IX-22-71 (E. A. Kane, EAK). MONO CO.: Benton Station, 3dd, VIII-5-60 (R. P. Allen, CSDA). 8 mi. s. Crestview, 1d, VIII-13-59 (J. A. Chemsak, CIS); Mammoth, 1d, VIII-5-36 (R. M. and G. E. Bohart, UCD); Whitmore Tub, 1d, VIII-9-52 (UCD).

P. barbiger is here recorded for the first time from California. Among the species of the *pacificus* group it is the only one with dense setigerous punctures on the upper



Map 1. California distribution of *Philanthus barbiger* Mickel and *P. levini* R. Bohart. Inset: overall distribution of *P. barbiger*.

median part of the clypeus. Other significant features are (1) scutal punctures averaging much smaller than those on terga I, II, or III; (2) wing veins whitish toward the base; (3) propodeal enclosure polished but with a patch of well-separated punctures on either side. In the male the clypeal brush is long and whitish or creamy. Also, the malar space at its middle is longer than the pedicel. The breadth of the apical truncation of the female clypeus is about two-thirds the length of flagellomere I.

Typical specimens have the pale markings whitish and this seems to be the rule everywhere except in California. In material we have seen from Mono and Inyo counties about half the individuals of both sexes have the markings yellow. Furthermore, the pale tergal bands are nearly always complete in our material but may be broken into spots elsewhere. We have seen a total of 39 males, including two paratypes from Harrison, Nebraska, and 12 females.

No biological information has been published. We have taken specimens of both sexes at flowers of *Chrysothamnus*. The species appears to be strictly autumnal.

Philanthus crabroniformis F. Smith (Fig. 35; map 2)

Philanthus crabroniformis F. Smith, 1856:474. Male holotype, California; Brit. Mus. Nat. Hist., London.

Philanthus flavifrons Cresson, 1865:102. Female lectotype, Rocky Mts., Colorado; Acad. Nat. Sci., Philadelphia.

- Philanthus californicus Cresson, 1879:xxxii. Male holotype, California; Acad. Nat. Sci., Philadelphia.
- Philanthus sublimis Cresson, 1879:xxxii. Male lectotype, California; Acad. Nat. Sci., Philadelphia.
- Liris magnifica Provancher, 1895:130. Male holotype, Los Angeles, California; Laval Univ., St. Foy, Quebec, Canada.

Geographic range. - Saskatchewan and North Dakota west to British Columbia and California, and south to Arizona (map 2).

California records. – Occurring generally throughout the state except in the Great Valley and in the southeastern desert regions. We have seen a total of 1,280 males and 611 females. Seasonal data extend from early May to mid September with a peak from late June to late July. It can be inferred that there are overlapping broods.

P. crabroniformis is one of the most abundant western species. It has been named several times and comparisons have been made with types of all the synonyms listed. The male is readily distinguished by the row of stiff hairs across the apex of sternum II. The female can be separated from others in its species group (except occidentalis) by the combination of the coarsely punctate terga I-II (fig. 35), moderately and unevenly punctate scutum, completely

Philanthus crotoniphilus Viereck and Cockerell (Figs. 4, 5; map 3)

Philanthus crotoniphilus Viereck and Cocketell, 1904b:145. Male holotype, Las Cruces, New Mexico; Acad. Nat. Sci., Philadelphia.

Geographic range. – Utah and Texas west to California; Coahulla and Baja California in Mexico (map 3).

California records.-CONTRA COSTA CO.: Antioch, 1d, IX-15-35 R. M. Bohart, UCD). FRESNO CO.: Fresno, 2dd, VI-Herlong, 1d, IX-4-69 (R. P. Allen, CSDA). LOS ANGELES CO.: Palmdale, 1d, VI-14-63 (UCR). SAN BERNARDINO CO.: Morongo Valley, 1d, Solidago, IX-29-44 (P. H. Timberlake, UCR). SANTA Valley, 1d, Solidago, IX-29-44 (P. H. Timberlake, UCR). SANTA STANISLAUS CO.: New Cuyama, 3dd, IX-17-68 (E. A. Kane, UCD). STANISLAUS CO.: Montpeliet, 1d, VIII-2-50 (H. E. Cott, UCD).

We have seen a total of 92 males and 24 females. The collection dates from June 14 to September 29 indicate the probability of two generations a year in California.

Philanthus gibbosus (Fabricius) (Figs. 9, 10, 17, 18, 42; map 4)

Vespa gibbosa Fabricius, 1775:370. Male holotype (headless), America, Univ. Mus. (Kiel Coll.), Copenhagen.

Philanthus punctatus Say, 1824:342. Male holotype, Pennsylvania; destroyed.



Map 3. California distribution of Philanthus crotoniphilus Viereck and Cocketell. Inset: overall distribution.



Map 2. California distribution of Philanthus crabrontjormis F. Smith. Inset: overall distribution.

sculptured propodeal enclosure (except anterolaterally) and flagellomere I longer than the scape. The rare occidentalis is not easy to separate from crabroniformis in the female. A close comparison shows that the pronotal ridge of the latter is rather rounded toward the middle and less sharp than in occidentalis. The markings of crabroniformis are generally black with much yellow but there is a tendency toward whitish among males from the northeastern part of its range in Canada.

The biology of P. crabroniformis has been reported only once in the literature. In a Wyoming study, Evans (1970) found this species nesting in diffuse aggregations in hard, atony soil. As in P. gibbosus, cells were made at everincreasing depths in the soil so that the furst to be constructed were nearest the entrance. The longest burrow encountered by Evans was 70 cm. Females of crabroniformis made only one nest per season with up to 15 cells per nest. Twelve to 24 bees or wasps were found per cell. Prey consisted of Sphecidae (three species), colletidae (one species), Andrenidae (three species), and Halictidae (12 species). The sarcophagids Senotainia trilineata Wulp and Phrosinella pilosifrons Allen were reared from cells of crabroniformis.



Map 4. California distribution of *Philanthus gibbosus* (Fabricius). Inset: overall distribution (dots omitted except for peripheral or critical localities).

- Cheilopogonus punctiger Westwood, 1835:441. Syntypes, "New Harmony," Indiana; "Mus. Soc. Hist. Nat. Belfast," types apparently destroyed.
- Anthophilus nodosus "(Vespa F.)" Klug, 1846; in error for gibbosus Fabricius.
- Philanthus xanthostigma Cameron, 1891:131. Female letotype, present designation, Chilpancingo, Guerrero, Mexico. New synonymy.
- Philanthus punctatus cockerelli Dunning, 1897:69. Male holotype, presumably from Las Cruces, New Mexico; Acad. Nat. Sci., Philadelphia.
- Philanthus punctatus chilopsidis Cockerell, 1898:141. Female syntypes, Las Cruces and Rincon, New Mexico; depository unknown. New synonymy.
- Anthophilus melanaspis Cameron, 1905:377. Female holotype, Mexico; Brit. Mus. Nat. Hist., London. New synonymy.
- Anthophilus maculiventris Cameron, 1905:377. Female holotype, Mexico; Brit. Mus. Nat. Hist., London. New synonymy.

Geographic range. – Transcontinental from southern Canada to Central America (map 4).

California records. – Occurring widely in the State but unknown from the floor of the Great Valley except in the lower drainage of the Sacramento River.

We have seen 932 males and 2,067 females of this common species. There appear to be overlapping broods in

California during the period from March to November. Numbers reach a peak in midsummer.

P. gibbosus has more synonyms than any other North American member of the genus. Presumably responsible are the wide distribution, the considerable number of color forms, and the relative abundance of the species. The holotype male at Copenhagen was studied by the senior author in 1960. We have confirmed some previous synonymy and have added new synonymy based on an examination of types at the British Museum of Natural History. The types of *punctiger* appear to be destroyed according to correspondence with Mr. Robert Nash of the Ulster Museum in Belfast, Ireland, the supposed final repository of the type material. Cockerell's *chilopsidis* appears to have been a varietal name missed by previous workers.

Recognition of gibbosus in both sexes is usually made simple by the broad black band across the apex of tergum II and the base of III (fig. 17). However, there are more extensively pale color forms which do not present this pattern. Both sexes, but particularly the female, have a large and mostly smooth swelling at the top of the vertex (fig. 10). Some other species may have a small polished spot but there is no obvious swelling. Other points of significance within the species group are (1) the black male clypeal brush (fig. 9); (2) the coarse tergal punctation compared with the moderate and uneven punctation of the scutum (figs. 17, 18); (3) the rather long malar space in the male (fig. 9); (4) the mostly sculptured propodeal enclosure but with small polished areas submedially and laterally. Legs may be marked with red, and wing veins are brownish red basally.

P. gibbosus has been studied perhaps more than any other Philanthus in North America. Reinhard worked on its biology for two years, giving a rather complete summary in his 1924 paper. He reported seeing nearly 100 nests between uncemented bricks in a 35-yard walkway in Maryland. Evans and Lin (1959) in New York reported nine out of the ten nests they examined were dug into vertical sand banks. The first cell is constructed 17 to 30 cm from the nest entrance and subsequent cells are dug at everincreasing depths. The ultimate cell may be 55 cm or more from the nest entrance. Each cell had from eight to 16 prey and up to seven cells were recorded from one nest (Evans and Lin, 1959). Prey records kept by Reinhard (1924) for two years showed that of 331 bees collected by gibbosus, 325 were Halictidae and six were Panurgidae. Reinhard gave developmental times for gibbosus as follows: egg, three days; larva, seven days; first generation prepupa (mid-June), seven days; pupa, 15 to 19 days; second generation prepupa (mid-July), eight months; pupa, 28 days. The sarcophagid

fly Senotainia trilineata (Wulp) was reared by Reinhard (1924).

Philanthus gloriosus Cresson (Map 5)

Philanthus gloriosus Cresson, 1865:86. Female lectotype, "Colorado Territory"; Acad. Nat. Sci., Philadelphia.

Philanthus insignatus Banks, 1913:421. Female holotype, Alpine, Texas, Am. Mus. Nat. Hist., New York.

Geographic range. – Alberta to Texas and west to California; central Mexico from Chihuahua to Durango and Michoacán (map 5).

California records. – LOS ANGELES CO.: Palmdale, 1d. X-15-55 (R. Schick, LACM). SAN BERNARDINO CO.: Cajon Pass, 4300', 19, VI-9-61 (H. F. Howden, CNC). Deep Creek Public Camp, 1d, VI-15-56 (A. S. Menke, L. Stange, LACM); Ivanpah, 1d, 1X-12-36 (C. Dammers, LACM). SAN DIEGO CO.: Warner Springs, 1d, VI-12-58 (E. I. Schlinger, UCD).

P. gloriosus is a wide-ranging species which is relatively uncommon as judged by collection records. California specimens seem to be on the fringe of the distribution and are particularly rare. Also, our material is colored somewhat differently from typical material. More typical gloriosus have abundant rust-red markings, especially toward the



Map 5. California distribution of *Philanthus gloriosus* Cresson. Inset: overall distribution.

center of terga I-II. Our specimens tend to be either dark in this area (females) or have continuous yellow bands (males). More critically, *gloriosus* belongs to the *zebratus* species group with eyes converging above, and is distinguished in the male by having the ocellocular distance about equal to one lateral ocellus diameter and the punctation on tergum IV about as coarse as on the scutum. In the female it has the ocelli in an obtuse triangle, a rather evenly punctate scutum, and a bell-shaped tergum I in dorsal view. Other significant features are the yellow male clypeal brush, the rather well-spaced and moderate punctures of terga I-III which average slightly larger than those of the scutum, and the rather general but well-spaced punctation of the propodeal enclosure.

This is the largest species in California and varies in length from 13-17 mm. We have studied 65 males and 33 females. From the few California records, which extend from June 9 to October 15, it seems likely that there are two broods.

Philanthus inversus Patton (Figs. 13, 19, 20, 44; map 6)

Philanthus inversus Patton, 1879:355. Female holotype, northwestern Kansas; Acad. Nat. Sci., Philadelphia.

Geographic range. – Alberta to Kansas and western Iowa, west to California, and south to western Texas (map 6).

California records. -- LOS ANGELES CO.: 3 mi. sw. Pearblossom, 1d, IX-28-70 (D. P. Levin, UCD). RIVERSIDE CO.: Whitewater, 1d, XI-8-49 (UCD). SAN BERNARDINO CO.: Morongo Valkey, 19, Eriogonum, X-5-34 (P. H. Timberlake, UCR). SAN LUIS OBISPO CO.: Shandon, 1d, IX-10-68 (E. A. Kane, UCD).

P. inversus differs from all other North American *Philanthus* in the long ocellocular distance which ranges from 4 to 5 lateral ocellus diameters (fig. 13). Also significant within the *gibbosus* species group are (1) male clypeal brush golden; (2) facial markings broken up into spots, 5-7 spots in males, 9-11 in females (fig. 13); (3) vertex usually with a V-shaped yellow mark; (4) punctures of terga I-III averaging much larger than those of scutum (figs. 19, 20), which are rather evenly spaced; (5) propodeal enclosure mostly sculptured and punctate; and (6) male malar space at middle at least twice a pedicel length. Specimens most often have a pair of longitudinal yellow stripes on the scutum (fig. 19).

This black and yellow, medium-sized species is rare in California which appears to be on the edge of its range. We have seen a total of 45 males and 18 females. The few California records indicate that the species is an autumnal one in this state.



Map 6. California distribution of *Philanthus inversus* Patton and *P. schusteri* R. Bohart (enclosed in solid line). Inset: overall distribution of *P. inversus*.

Philanthus levini R. Bohart (Fig. 40; map 1)

Philanthus levini R. Bohart, 1972:398. Male holotype, near Pearblossom, Los Angeles County, California; Univ. California, Davis.

Geographic range. – Southern California as far north as Ventura County (map 1).

California records. - LOS ANGELES CO.: Big Rock Creek, s. fork, 4,500 ft., Eriogonum, 10, 19, IX-30 to X-1-65 (R. R. Snelling, C. Henne, LACM); Palmdale, 19, VI-14-63 (UCR); Juniper Hills, 3 mi. sw. Pearblossom, Lepidospartum squamatum, 3200, 399, IX-28 to X-14-70 (D. P. Levin, C. Henne, DPL, UCD, UCR, USNM); 3.3 mi. s. Little Rock Creek Ranger Station, 19, X-9-65 (A. Hardy, LACM); RIVERSIDE CO.: Coahuila Creek, 1d, V-27-21 (T. Craig, CAS); Riverside, 19, V-21-30 (P. H. Timberlake, UCR); Whitewater Canyon, Lepidospartum squamatum, 13, IX-11-35 (P. H. Timberlake, UCR). SAN BERNARDINO CO.: Cajon Junction, 299, VIII-5-63 (E. I. Schlinger, UCR), 1s, X-9-53 (A. L. Melander, UCR), 2dd, 399, VIII-15 to IX-13-36 (P. H. Timberlake, UCR); Deep Creek Canyon, Chrysothamnus nauseosus, 10, X-25-53 (P. H. Timberlake, UCR); Morongo Valley, Solidago, 900, IX-26 to 27-44 (P. H. Timberlake, UCR); 5 mi. se. Pinyon Hills, 200, X-3-67 (P. A. Rude, CIS); Yucca Valley, Gutierrezia lucida (= microcephala), 19, IX-28-44 (P. H. Timberlake, UCR). VENTURA CO.: Apache Canyon,

22 air mi. nnw. Ojai, 3dd, 19, IX-12-64 (R. L. Langston, J. Powell, CIS).

P. levini is a member of the pacificus species group. It is a medium-sized, extensively yellow-marked species, which in the male shares with nasalis and barbiger the relatively large punctures of tergum III as compared with those of the scutum. The clypeal punctation is not dense as in barbiger, and the sterna are extensively yellow rather than black as in nasalis. In the female the punctures of tergum II (fig. 40) average larger than the fine ones of the scutum where they are irregularly spaced around smooth areas. The propodeal enclosure is smooth with a patch of punctures on either side of the middle. These features also occur in barbiger and nasalis but the finer scutal punctures of levini together with the weak bi-emargination of the pale bands on terga III-IV are distinguishing. Additionally, the very narrow clypeal apex of nasalis is distinctive for that species.

Seasonal data suggest the presence of a small brood in May to June and a larger one in September to October.

Philanthus multimaculatus Cameron (Figs. 6, 36, 150; map 7)

- Philanthus multimaculatus Cameron, 1891:133. Male holotype, Atoyac, Veracruz, Mexico; Brit. Mus. Nat. Hist., London.
- Philanthus anna Dunning, 1897:68. Female lectotype, present designation, Colorado ("Colo."): Acad. Nat. Sci., Philadelphia.
- Philanthus multiannulatus Dalla Torre, 1897:488. Lapsus.
- Philanthus annae Dunning, 1898b:154. Emendation.
- Philanthus cleome Dunning, 1898b:152. Female lectotype, present designation, San Bernardino County, California; Acad. Nat. Sci., Philadelphia.
- Philanthus subversus Banks, 1915:405. Female holotype, Palmerlee, Arizona; Mus. Comp. Zool., Cambridge.
- Philanthus yakima Banks, 1919:85. Female holotype, Yakima, Washington; Mus. Comp. Zool., Cambridge.

Geographic range. -Alberta to western Texas, west to British Columbia and California, and south in Mexico to Zacatecas and San Luis Potosi (map 7).

California records. - Widespread in the state, especially at low to moderate elevations.

We have seen a total of 2,455 males and 1,033 females. According to seasonal data shown in a histogram (fig. 150), there appear to be overlapping broods from March to October, with a peak in midsummer.

The identity of *multimaculatus* and the synonymy of *cleome* and *anna* have been checked by examination of the type specimens. The rest of the synonymy follows Strandtmann (1946). *P. multimaculatus* is probably the commonest western species of the genus. It often occurs with



Map 7. California distribution of *Philanthus multimaculatus* Cameron. Inset: overall distribution.

crabroniformis which it resembles in a general way. However, *multimaculatus* is smaller and yellower. Also, the male has nonfimbriate sterna.

It belongs in the P. gibbosus species group but differs from many of these by having the punctures of tergum III (fig. 36) not or only slightly larger on the average than the irregularly distributed ones of the scutum. In the male the malar space at the middle is considerably longer than the pedicel (fig. 6) and the ocellocular distance is about 2.5 lateral ocellus diameters. California males nearly always have the abdomen mostly yellow and have a pair of prominent discal yellow stripes on the scutum. In material from farther north the stripes may be reduced. The yellow tergal bands in females are generally broken medially on tergum I and sometimes on following terga in a rather characteristic way (fig. 36). The propodeal enclosure has some closely punctate or ridged areas, and flagellomere I is slightly shorter than the scape. The last-named character is useful for distinguishing females from those of crabroniformis. Another feature which is nearly invariable is the pale red clypeal lip in multimaculatus as opposed to the black one in crabroniformis.

Philanthus nasalis R. Bohart (Figs. 11, 30; map 8)

Philanthus nasalis R. Bohart, 1972:401. Male holotype, Antioch, California; Univ. California, Davis.

Geographic range. – Sacramento-San Joaquin delta of California (map 8).

California records. - CONTRA COSTA CO.: Antioch, 16, 299, X-24-48 (P. D. Hurd, CIS, UCD); 399, Eriogonum, X-15-53 (M. Wasbauer, CIS, UCD); 266, 899, Croton californicus, X-14-54 (A. M. Barnes, P. D. Hurd, M. Wasbauer, CIS, UCD, UCR, LACM, CAS); 19, X-25-55 (D. Burdick, CIS); 266, Eriogonum, X-3-58 (G. I. Stage, CIS); 19, IX-25-59 (E. E. Lindquist, USNM).

P. nasalis is a member of the *pacificus* group and has pronouncedly white, anteriorly bi-emarginate bands on the abdomen (fig. 30). In the female it is readily separated from others in its group by the narrow and unusually protruding median clypeal lobe (fig. 11). In the male it agrees with *barbiger* in having the punctures of tergum III larger than those of the scutum. From white-marked *barbiger* it differs by the rather sparse setigerous punctures on the clypeus.

The species seems to be quite restricted in distribution, and commercial developments in the region of the Sacra-



Map 8. California distribution of *Philanthus neomexicanus* Strandtmann and *P. nasalis* R. Bohart (enclosed in solid line). Inset: overall distribution of *P. neomexicanus*.

mento Delta threaten its existence. It seems to occur exclusively in the fall.

Philanthus neomexicanus Strandtmann (Figs. 16, 39, 146; map 8)

Philanthus neomexicanus Strandtmann, 1946:53. Male holotype, Mesilla Park (Las Cruces), New Mexico; U.S. Natl. Mus., Washington.

Geographic range. – West Texas to California; Sonora to Baja California (map 8).

California records. -- IMPERIAL CO.: Kane Spring. INYO CO.: 5 mi. s. Death Valley Junction, Deep Springs, 5 mi. w. Panamint Springs, Surprise Canyon, Wildrose Station. RIVERSIDE CO.: Andreas Canyon, Boyd Desert Research Center, Chino Canyon, Hopkins Well, 20 mi. e. Indio, 10 mi. s. Mecca, Palm Springs, Thousand Palms, Whitewater. SAN BERNARDINO CO.: 14 mi. s. Baker, Camp Angelus, Morongo Valley. SAN DIEGO CO.: Borrego Springs, Scissors Crossing.

P. neomexicanus is one of the larger members of the pacificus group, most specimens measuring about 12 mm in length. In the male it is distinguished by having (1) the punctures on tergum III not larger than the rather evenly distributed ones on the scutum, (2) the malar space is longer than the pedicel (fig. 16), and (3) the clypeal brush is tawny to blackish. In the female the punctures of tergum II (fig. 39) are not larger than those of the scutum and the wing veins are rather brightly rust-red toward the base instead of whitish, yellowish, or brownish. Also, in the female the legs are characteristically marked with bright red, but this feature occurs in several other xerophilic species.

We have seen 71 males and 61 females of *neomexicanus*. Seasonal data, which are depicted in a histogram (fig. 146), place this as a spring and early summer, one-brooded species.

Philanthus occidentalis Strandtmann (Map 9)

Philanthus occidentalis Strandtmann, 1946:66. Male holotype, Lone Pine, Inyo Co., California; Calif. Acad. Sci., San Francisco.

Geographic range. - California (map 9).

California records. --INYO CO.: Big Pine, 1d, VI-141 (R. M. Bohart, LACM); Independence, 19, VI-7-39 (UCD); Lone Pine, 1d, 19, V-23-37 (E. C. Van Dyke; from Strandtmann, 1946). KERN CO.: Mojave, 19, VI-1-17 (C. L. Fox; from Strandtmann, 1946); 1 mi. e. Woody, 1d, V-3-64 (J. Powell, CIS). LOS ANGELES CO.: Hungry Valley, 5 mi. s. Gorman, 2dd, V-6-S9 (J. R. Powers, CIS, G. I. Stage, UCD); 2.5 mi. ssw. Valyermo, 19, *Eriodictyon*, VI-14-59 (N. MacFarland, CIS). RIVERSIDE CO.: Gavilan, 1d, V-31-37



Map 9. California distribution of *Philanthus zebratus* Cresson and *P. occidentalis* Strandtmann (enclosed in solid line). Inset: overall distribution of *P. zebratus*.

(P. H. Timberlake, UCR); Keen Camp, San Jacinto Mts., 1d, Cryptantha, V-17-39 (E.G. Linsley, CIS); 1 mi. n. Murrieta, 1d, IV-18-50 (E.G. Linsley, CIS), Perris, 299, Anthirrhinum, Eriogonum, IV-12, 18-39 (P. H. Timberlake, UCR); Pinyon Flat, San Jacinto Mts., 3dd, 19, Adenostoma, V-18 to 27-39 (CIS, UCD). SAN BENITO CO.: New Idria, 1d, IV-24-64 (J. Doyen, CIS). SAN BERNARDINO CO.: 10 mi. s. Adelanto, 19, Larrea divaricata, V-28-37 (P. H. Timberlake, UCR); Mill Creek, 1d, IV-17-52 (LACM); Morongo Valley, 299, V-7-39 (P. H. Timberlake, UCR), 19, V-24-41 (E.G. Van Dyke, CAS). SAN DIEGO CO.: Scissors Crossing, 2240-2800 ft., V-4-69 (E. I. Schlinger, UCR). VENTURA CO.: 18 mi. e. Camp Ozena, 1d, VII-2-65 (J. Powell, UCD).

P. occidentalis is quite similar to *crabroniformis*, differing in the male by the absence of a row of fimbriae across the apex of sternum II. The female is more difficult to distinguish and close attention must be paid to the thinner pronotal ridge of *occidentalis*. Otherwise, essential characters are as follows: (1) punctures of terga II-III larger than the irregularly spaced ones of the scutum, (2) male clypeal brush straw yellow, (3) male ocellocular distance about two lateral ocellus diameters, and (4) propodeal enclosure rather extensively punctate. The species is uncommon and known only from the southern half of California. Presumably there

is a single brood which occurs from the middle of April to early July.

Philanthus pacificus Cresson (Figs. 3, 14, 25, 26, 43, 149; map 10)

Philanthus pacificus Cresson, 1879:xxxii. Male lectotype, Nevada, Acad. Nat. Sci., Philadelphia.

- Philanthus arizonae Dunning, 1898b:155. Male holotype, Phoenix, Arizona; Acad. Nat. Sci., Philadelphia.
- Philanthus hirticeps Cameron, 1905:376. Male holotype, Mexico; Brit, Mus. Nat. Hist., London, New synonymy.

Philanthus assimilis Banks, 1913:422. Female holotype, "Shasta," California; Am. Mus. Nat. Hist., New York.

Geographic range. – Wyoming to New Mexico west to British Columbia and California; western Mexico (map 10).

California records. - Widespread in the state, mostly at moderate to low elevations.

We have seen 1,320 males and 1,070 females of this species. The seasonal histogram (fig. 149) indicates a series of overlapping broods with a peak in numbers in midsummer.

The synonymy of hirticeps has been checked with the type at the British Museum. This wide-ranging western species is one of our smaller ones, averaging 9 to 10 mm in length. It is also one of the most abundant. The male is the only one of its species group (and the only one we have seen outside the zebratus group) with the ocellocular distance about equal to a lateral ocellus diameter (fig. 3). It further differs from serrulatae and pulcher by having the malar space hardly half as long as the pedicel (fig. 3). In the female the bi-emarginate pale bands of terga III-IV (a group character), the relatively small punctures of terga II-III (fig. 25), and the whitish or brown wing veins toward the base characterize three related California species, pacificus, serrulatae, and pulcher. The very short malar space of female *pacificus* is distinguishing from *pulcher*. With respect to the other two, serrulatae females always have the femora extensively red whereas those of pacificus from practically all of California do not. However, if serrulatae should be found in Nevada, the leg color difference in females would break down.

Since leg color in *pacificus* females has a geographical connotation, it might be used to defend the establishment of subspecies. Distribution of the red-legged color form is mostly represented by the dots in Nevada on map 10. Typical *pacificus*, based on Cresson's male from Nevada, is presumably of this sort and seems to occur only in Nevada, southern Idaho, and far eastern California where we have collected both color forms at Deep Springs, Inyo County. Both forms have been found also near Marsing, Owyhee



Map 10. California distribution of *Philanthus pacificus* Cresson. Inset: overall distribution.

County, Idaho, and at Patrick, west of Reno, Nevada. If a subspecies concept were formalized, the appropriate name for the dark-legged form would be *pacificus arizonae* Dunning, with *hirticeps* and *assimilis* as synonyms. Since males are indistinguishable and there is considerable geographical overlap, we prefer not to use subspecies.

Another color variation has some geographical connotation. The markings of females are whitish in most arid regions but there is an increasing number of yellow-marked individuals in populations toward the Pacific coast.

P. pacificus is the only *Philanthus* on which studies of nesting have been reported in California. Powell and Chemsak (1959) described the digging and provisioning process of *pacificus* (given as *politus pacificus*) but could not find distinct cells. The main burrows were simple tunnels, 7 to 22 cm long and 8 to 12 cm below the soil surface. Although Powell and Chemsak suggested that *pacificus* females dig a new burrow for each cell, it is more likely that a number of cells radiate from the terminus of the main burrow as Evans (1970) showed for *pacificus* in Wyoming. Up to three cells were found per nest and each female probably makes several nests per season (Evans, 1970). Prey, taken from California nest sites, was composed

of six species of wasps (Ichneumonidae, Braconidae, Sphecidae, Vespidae) and eight species of bees (Andrenidae, Halictidae).

> Philanthus pulcher C. Dalla Torre (Figs. 15, 29; map 11)

Philanthus pulchellus Cresson, 1865:93, nec Spinola, 1842. Male lectotype, Rocky Mts., Colorado; Acad. Nat. Sci., Philadelphia. Philanthus pulcher Dalla Torre, 1897:489. New name for pulchellus. Philanthus clarconis Viereck, 1906:206. Female holotype, Lawrence, Kansas; Univ. Kansas, Lawrence.

Geographic range. – Manitoba to Kansas and New Mexico, west to British Columbia, California, and Baja California (map 11).

California records. -- Widespread in mountainous areas of the state except in the Coast Ranges to the west of the Great Valley.

We have seen 385 males and 408 females of this species. Records extend from mid-April to early September but the bulk of the material was taken in June and July. Presumably, there is one main brood in California with a peak in numbers toward the end of June.

P. pulcher belongs to that section of the *pacificus* group which has the punctures of terga II-III not averaging larger than those of the scutum. The small but significant malar space in both male (fig. 15) and female of *pulcher* differentiates it from *pacificus*. Also, the tergal punctures are a little larger and more widely spaced as a rule (compare figs. 25, 29). The relatively dark forewing costa of *pulcher* separates it from *serrulatae*.

Evans (1966, 1970) has studied the nesting habits of *pulcher* in Jackson Hole, Wyoming. Burrows of this species were dug to a vertical depth of 4 to 8 cm (length 8-10 cm). The maximum number of cells was six with six to 14 prey per cell. The female wasp was reported to close the nest both before prey gathering and while inside the nest. Females make more than one nest during an approximate 30-day nesting period. Evans presented a list of 25 species of wasps (Scelionidae, Chrysididae, Eumenidae, Sphecidae) and 23 species of bees (Colletidae, Andrenidae, Halictidae, Megachilidac, Anthophoridae) taken from *pulcher* cells, and noted that many of these prey nested in proximity to *pulcher* nests. The sarcophagid *Phrosinella pilosifrons* Allen was reared from one cell of *pulcher*.

Philanthus schusteri R. Bohart (Fig. 31; map 6)

Philanthus schusteri R. Bohart, 1972:402. Male holotype, Palo Verde, Imperial Co., California; Univ. California, Davis.



Map 11. California distribution of *Philanthus pulcher* Dalla Torre. Inset: overall distribution.

Geographic range. – Colorado Desert of southern California and Arizona.

California records. – IMPERIAL CO.: Palo Verde, 299, Baileya pleniradiata, IV-8 to 9-63 (D. E. Bright, P. D. Hurd, CIS); 13, IV-3-66 (R. O. Schuster, UCD); 13, 1099, IV-1 to 2-68 (R. M. Bohart, R. O. Schuster, UCD, CAS, USNM, LACM). RIVERSIDE CO.: 18-19 mi. w. Blythe, 299, IV-15-58 (P. H. Timberlake, UCR); 13, 699, IV-3-66 (R. M. Bohart, R. L. Brumley, UCD); 13, III-22-67 (C. R. Kovacic, UCD); 13, 19, III-26-67 (J. C. Hall, UCR); Hopkins Well, 699, IV-14 to 16-58 (P. D. Hurd, E. G. Linsley, CIS, LACM); SAN BERNARDINO CO.: Carson's Well, 19, IV-3-68 (R. M. Bohart, UCD).

The all dark mesopleuron is unique within the *pacificus* group. Other features are in the male: (1) punctures of tergum III not larger than the rather evenly distributed ones of the scutum, (2) malar space considerably longer than the pedicel, and (3) the clypeal brush long and whitish. In the female other significant characters are: (1) punctures of tergum II larger than the rather unevenly distributed ones of the scutum (fig. 31), (2) wing veins white to creamy toward the base, and (3) the femora extensively red.

The species is one-brooded and rare but it may be locally abundant in the desert if there are many spring flowers. We have seen 6 males and 33 females, half of which were collected in Arizona during April.

Philanthus serrulatae Dunning (Figs. 27, 28; map 12)

Philanthus serrulatae Dunning, 1898b:154. Male holotype, Denver, Colorado; Acad. Nat. Sci., Philadelphia.

Geographic range. --Wyoming, Colorado, and New Mexico west to California, Sonora, and Baja California (map 12).

California records. - IMPERIAL CO.: 12 mi. w. and 5 mi. w. Glamis, Kane Spring, Palo Verde, 15 mi. n. Plaster City, Westmorland. INYO CO.: Lone Pine. KERN CO.: Boron, Brown, Last Chance Canyon (El Paso Mountains), Mojave, Muroc, Scarles. LOS ANGELES CO.: Llano, Palmdale, Pcarblossom, MONO CO.: 23 mi. n. Tom's Place. RIVERSIDE CO.: 18 mi. w. Blythe, Cathedral City, Hopkins Well, Indian Wells, Indio, Palm Springs, Pinyon Flat, Thousand Palms. SAN BERNARDINO CO.: Adelanto, Apple Valley, 24 mi. w. Barstow, Granite Pass, 5 mi. se. Hesperia, 25 mi. s. Ivanpah, Kramer Junction, Manix, Old Woman Springs, 6 mi. w. Pinyon Hills, Salt Wells, Seven Oaks, Victorville. SAN DIEGO CO.: Borrego.

P. serrulatae is a frequently seen species in the southern deserts where we have collected it in numbers around flowers of mesquite. It is rather small, averaging about 9 to



Map 12. California distribution of *Philanthus serrulatae* Dunning. Inset: overall distribution.

10 mm in length and is closely related to *pacificus* as discussed under that species. In the male the small size, basally whitish wing veins and short but significant malar space are generally sufficient to identify the species within its group. In addition to the longer malar space, the slightly greater ocellocular distance will help separate *serrulatae* males from those of *pacificus*. The females of *serrulatae* seem to be practically identical to the red-legged form of *pacificus*, although there may be a slight average difference in tergal punctation (compare figs. 25, 28). Fortunately, the ranges of the two seem to be exclusive (compare maps 10 and 12).

We have studied 282 males and 267 females from various states in the west. Although specimens have been collected from mid-March to mid-November, there is apparently only one main brood which peaks toward the middle of April.

Philanthus ventilabris Fabricius (Figs. 1, 2, 21, 22, 41, 151; map 13)

Philanthus ventilabris Fabricius, 1798:268. Female holotype, "Carolina"; Mus. Hist. Nat. (Bosc. Coll.), Paris.
 Philanthus vertilabris Fabricius, 1804:303. Emendation.



Map 13. California distribution of *Philanthus ventilabris* Fabricius. Inset: overall distribution (dots omitted except for peripheral or critical localities).

Philanthus frontalis Cresson, 1865:99. Male lectotype, "Colorado, Territory"; Acad. Nat. Sci., Philadelphia.

Philanthus ventralis Howard, 1901: plate 3, fig. 33. In error.

Philanthus vertilabris completus Banks, 1915:406. Male holotype, San Diego Co., California; Mus. Comp. Zool., Cambridge.

Geographic range. - Transcontinental in southern Canada and United States; Mexico (map 13).

California records. -- Widespread in the Great Valley, along the coast from the San Francisco Bay area south, in the Owens Valley, and in southern California at lower elevations.

We have seen a total of 1,073 males and 385 females. The female holotype was examined by the senior author at the Paris Museum in 1960.

Seasonal data are summarized in a histogram (fig. 151). Although specimens have been taken in April, the peak of numbers seems to occur in the fall. Undoubtedly, there are several overlapping broods.

This peculiar species appears to have no close relatives. It is abundant, widespread, and varies considerably in color. The furrowed and bicarinate pronotal ridge is diagnostic. Another oddity is the somewhat hatchet-shaped antennal apex in the male (fig. 2). The presence of a metapleural lamella is distinctive among the California *Philanthus*, but the lamella occurs outside the state in the *politus* group. Another oddity is the coarse and mostly contiguous punctation over much of the body (fig. 21). This is reminiscent of the similarly close but much finer punctation of *solivagus* (fig. 34). The size is moderate (12-14 mm in length) and the markings vary from black and yellow to red and yellow. The femora in females are often but not always largely red.

Although a common species, little is known about its biology. Rau and Rau (1918) and Evans and Lin (1959) both gave only meager details of nesting activity. Only one nest in Austin, Texas, was excavated by Evans and Lin who found a single cell 15 cm beneath the soil surface at a distance of 38 cm from the burrow entrance. Prey of the cell which was still being provisioned consisted of five bees in the families Halictidae and Andrenidae.

Philanthus ventralis Mickel (Fig. 148; map 14)

Ococletes ventralis Mickel, 1918:329. Female holotype, Sacramento, California; Univ. Nebraska, State Mus., Lincoln.

Philanthus strandtmanni Burks, 1951:1002. Unnecessary new name for ventralis.

Geographic range. – British Columbia, Washington, Oregon, Nevada, and California (map 12).

California records. – ALAMEDA CO.: Tesla. BUTTE CO.: Chico. CONTRA COSTA CO.: Antioch. INYO CO.: Little Lake,



Map 14. California distribution of *Philanthus ventralis* Mickel. Inset: overall distribution.

Lone Pine, Olancha. KERN CO.: Walker Pass. LASSEN CO.: Hallelujah Junction, Jonesville, 6 mi. ne. Litchfield, Milford, Standish. LOS ANGELES CO.: Pearblossom. MODOC CO.: Willow Ranch. MONO CO.: Grant Lake, Hot Creek. PLUMAS CO.: Johnsville. SACRAMENTO CO.: Michigan Bar. SAN BERNAR-DINO CO.: Morongo Valley, Victorville, Yucca Valley. SAN LUIS OBISPO CO.: Chandon. SIERRA CO.: Sierraville. SISKIYOU CO.: Lava Beds National Monument, Macdoel. TUOLUMNE CO.: Kennedy Meadow.

This far-western species is superficially similar to the more common zebratus. However, the rather regularly spaced scutal punctures and details of the markings on tergum I in the male will separate them as indicated in the key. Although these two large (13-14 mm long), black and yellow species have overlapping ranges (maps 9, 12), ventralis is primarily a fall species whereas zebratus occurs in the summer (figs. 147, 148). We have seen 112 males and 59 females of this species.

> *Philanthus zebratus* Cresson (Figs. 7, 8, 12, 23, 24, 45, 147; map 9)

Philanthus zebratus Cresson, 1879:xxxiii. Male holotype, Nevada; A cad. Nat. Sci., Philadelphia.

- Philanthus basilaris Cresson, 1879:xxxiii. Female lectotype, Colorado: Acad. Nat. Sci., Philadelphia. New synonymy.
- Oclocletes nitens Banks, 1913:423. Female (not male) holotype, Princeton, British Columbia; Mus. Comp. Zool., Cambridge. New synonymy.
- Ococletes illustris Mickel, 1918:327. Female holotype, American River, Placer Co., California; Univ. Nebraska, State Mus., Lincoln.

Geographic range. -United States and western Canada west of the 100th meridian (map 9).

California records. -An abundant Sierran species in the northern half of the state.

We have seen 341 males and 228 females of zebratus, of which about 15 males and 10 females have been the more eastern whitish form. Seasonal data are shown in a histogram (fig. 147). There seems to be a single brood which peaks in midsummer.

This species is representative of the zebratus group in which the eyes converge above, slightly in the female (fig. 12) and strongly in the male (figs. 7, 45). Also, the male antennae are somewhat more swollen toward the apex than in other groups (fig. 8). These features led Banks (1913) to erect a new genus, Oclocletes with sanbornii Cresson as the type. Even though the group has rather definite limits, the degree of convergence of the eyes and the corresponding interocular distance near the vertex varies among the species. Strandtmann (1947) did not think that this character warranted generic distinction and we agree.

Of the three Californian species in the group (*zebratus*, *gloriosus*, and *ventralis*) *zebratus* is much the commonest. The male differs from *ventralis* by having a complete pale band on tergum I, unmarked by a posteromedian incision. The female of *zebratus* has the punctation of the scutum much more irregular, leaving large polished areas (fig. 23). All specimens we have seen from the Pacific Coast states have had yellow markings.

In more eastern material, there is a strong tendency toward white markings. Females may be mostly white and males may have the abdomen white-marked except basally. Evans (1966) found both whitish and yellow females in the same population in Wyoming. We prefer not to recognize subspecies, but if this were done, the name to be used for the whitish phase is *basilaris* Cresson and *nitens* Banks is a synonym.

P. zebratus has not been studied in California, but Evans (1966, 1970) has excavated nests in Wyoming. As in *crabroniformis*, *zebratus* appears to make but one nest per season. Cells are constructed progressively farther from the entrance as in *gibbosus* and *crabroniformis*. Up to 17 cells were found with depths of 8 to 18 cm. Three to nine bees or wasps were stored per cell. Twenty-five species of wasps (Ichneumonidae, Eumenidae, Masaridae, Sphecidae) and 20 species of bees (Colletidae, Andrenidae, Halictidae, Megachilidae, and Anthophoridae) were recorded as prey for zebratus. The sarcophagid flies Senotainia trilineata Wulp and Phrosinella pilosifrons Allen were reared from zebratus cells.

Tribe Aphilanthopsini

This tribe with its three genera differs from the Philanthini by having the inner eye margins nearly straight and the terminal antennal article not at all polished. The Aphilanthopsini has been reviewed by Bohart (1966). We have given a condensation of that review with improvements in the keys, added distribution records, and illustrations.

Biological studies have been summarized by Evans (1962). All known forms provision their ground nests with ants. Aphilanthops use only winged queen ants, the antennae of which are grasped first by the wasp's mandibles and then during flight supported additionally by the wasp's middle legs. Clypeadon and Listropygia, on the other hand, use only agricultural worker ants which are grasped in a special abdominal clamp, thus freeing the wasp's legs and mandibles completely. Nests of all three genera are primarily constructed in level to sloping sandy soil. No distinct mound is formed around the nest opening since the wasp kicks the accumulating soil away.

Parasitism of Aphilanthopsini appears to be rather greater than normal. This may be due in large part to miltogrammine sarcophagids which larviposit on ants as they are being transported by provisioning wasps. Ristich (1956) found as many as nine maggots on some ants taken from *Aphilanthops* females.

Genus Aphilanthops Patton

All of the four species of *Aphilanthops* occur in California although we have only a single record of *frigidus*. Members of the genus are recognized by the essentially straight inner eye margin (figs. 54-56), absence of a metapleural lamina overhanging the dorsolateral propodeal sinus, the free clypeal margin dentate in both sexes, and the female pygidium (fig. 53) and sternum VI relatively simple. There are two fairly distinctive groups of two species each. In *frigidus* and *subfrigidus* the terga are distinctly punctate toward the middle, the subalar carina is angled or produced downward over the subalar fossa (figs. 50, 51), and the female clypeus has about five well-formed teeth along its free margin (figs. 56, 57). In *hispidus* and *foxi* tergum II, at least, is smooth toward the middle, the subalar carina is wavy but rather straight overall (fig. 52) and the female clypeus usually has only three well-formed teeth along its free margin (figs. 54, 55).

Biological data have been reported for two species of this genus, *frigidus* and *subfrigidus*. Prey consists exclusively of ants in the genus *Formica*.

KEY TO THE NORTH AMERICAN SPECIES OF APHILANTHOPS

- Tergum II with obvious dense punctation toward dorsal middle, subalar carina (beneath tegula) angled downward over subalar fossa (figs. 50, 51) 2 Tergum II without obvious punctures toward dorsal middle, subalar carina somewhat sinuate but nearly straight overall along upper edge of subalar fossa (fig. 52) . . . 3
- - Flagellum all black; hypoepimeron punctate rather than shiny between carinulae; female face usually with an incomplete X-shaped black mark (fig. 56) or mostly yellow; transcontinental subfrigidus Dunning
- Distance from antennal socket to clypeus less than 2 socket diameters (fig. 55); flagellomere II depressed beneath toward base, especially in male; Arizona, California, and Baja California, Mexico, south to the Cape hispidus W. Fox

Aphilanthops foxi Dunning (Fig. 54; map 15)

Aphilanthops foxi Dunning, 1898a:21. Male lectotype, San Diego Co., California; Acad. Nat. Sci., Philadelphia.

Geographic range. – Southern California and southwestern Arizona.

California records. – IMPERIAL CO.: Kane Spring, 1d, IV-16-62 (R. L. Westcott, LACM). RIVERSIDE CO.: Hopkins Well, 19dd, 4dd, IV-29-52 (J. E. Gillaspy, P. D. Hurd, J. G. Rozen, CIS). Indian Wells, 15dd, 599, V-I-52 (LACM). Indio, 1d, IV-25-53 (A. Durbin, LACM); 6 mi. w., 67dd, 11899, *Melliotus*, IV-30-49 (E. G. Linsley, J. W. MacSwain, R. F. Smith, CIS). Magnesia Spring Canyon, 19, VI-28-52 (M. V. Garner, UCD). Thousand Palms, 7dd, 299, IV-7 to 23-55 (W. R. Mason, J. D. Martin, W. R. Richards, CNC). Palm Desert, 19, V-8-62 (A. E. Michelbacher, CIS). SAN BERNARDINO CO.: Bagdad, 299, Asclepias, IV-24-60 (J. Powell, CIS). Cronise Valley, 1d, V-5-60 (A. Menke, UCD). SAN DIEGO CO.: Borrego Valley, 10dd, Eriogonum, IV-18 to 20-57 (R. C. Bechtel, R. M. Bohart, and R. Bushing).



Map 15. California distribution of *Aphilanthops frigidus* (F. Smith) and *A. foxi* Dunning (enclosed in solid line). Inset: overall distribution of *A. frigidus*.

Generally speaking, A. foxi is rarely encountered and then only at oases in the Coachella Valley. However, large collections have been made occasionally. The species superficially resembles *hispidus* but is consistently more yellow. From a more structural standpoint, foxi has the antennae inserted higher on the face, more than two antennal socket diameters above the clypeus. Also, flagellomere II has no obvious depressed areas.

We have studied a total of 127 males and 133 females. There appears to be a single spring brood which peaks in late April.

Aphilanthops frigidus (F. Smith) (Figs. 50, 57; map 15)

- Philanthus frigidus F. Smith, 1856:475. Male holotype, Nova Scotia; Brit. Mus. Nat. Hist., London.
- Aphilanthops bakeri Dunning, 1896:203. Male lectotype, Colorado; U.S. Natl. Mus., Washington.
- Nomada dawsoni Swenk, 1912:83. Male holotype, Harrison, Nebraska; Univ. Nebraska, Lincoln.

Geographic range. - Transcontinental in southern Canada and United States as far south as Virginia, Michigan, northern New Mexico, Utah, and central California (map 15).

California records. - SANTA CRUZ CO.: Felton, 1d, VI-1952 (C. H. Winer, UCD).

With only a single Californian record, there may be some doubt that the species occurs in this state. Considering the overall distribution of *frigidus*, we are inclined to accept the Santa Cruz County capture. Obviously, the species is much more common to the north and east. A close relationship to subfrigidus is indicated by the tergal punctation and the nature of the projection of the upper mesopleuron over the subalar fossa. The more pronounced angle and development of this projection is a separational feature from subfrigidus (compare figs. 50, 51). Also, the ridges beneath the fossa in *frigidus* are separated by shiny grooves. The simplest method of distinguishing the two species is to consider the flagellum: all black in subfrigidus but brownish red beneath toward the base in frigidus. A less obvious difference is that flagellomere I is somewhat shorter and stouter in *frigidus*. Customary facial patterns of females are contrasted in figures 56 and 57. Pale markings vary from white to yellow, sometimes in the same population. The whitish tendency is accentuated in the more arid areas of western North America. We have studied 107 males and 115 females.

Habits of this species have been reported by Wheeler (1913) and Evans (1962). General nesting behavior has been summarized under the subtribe section of this paper. *A. frigidus* apparently has but one generation per year. In New York the nesting season was from late June to mid-August with presumably only one nest per female. A storage cell is first excavated to a depth of 12 to 25 cm from the soil surface. Winged queen ants are stored here until one or more brood cells is constructed. These cells may vary in depth from 23 to 45 cm and contain two or three ants per cell. The number of cells constructed by each female is not known, but evidence suggests they may only lay one egg per day (Evans, 1962). The nest entrance may be open or closed while the female is hunting or while she is in the nest.

The only parasite known to attack *frigidus* was reported by Ristich (1956) as the miltogrammine fly *Senotainia trilineata* (Wulp).

Aphilanthops hispidus W. Fox (Figs. 52, 55; map 16)

Aphilanthops hispidus W. Fox, 1894:106. Male holotype, San José del Cabo, Baja California Sud; Calif. Acad. Sci., San Francisco.



Map 16. California distribution of *Aphilanthops hispidus* W. Fox. Inset: overall distribution,

Geographic range. – Arizona, California, and Baja California (map 16).

California records. -- FRESNO CO.: Coalinga. IMPERIAL CO.: Beal Well (and 11 mi. e.), Fish Creek Mtns., Glamis, Palo Verde, Plaster City. INYO CO.: Cartago, Darwin Falls, Death Valley Junction (and 13 mi. s.), Deep Springs. LOS ANGELES CO.: Acton, Three Points. RIVERSIDE CO.: Berdoo Canyon, Blythe (and 18 mi. w.), Box Canyon, Boyd Desert Research Center, Coachella, Deep Canyon, 5 mi. n. and 33 mi. ne. Desert Center, Desert Hot Springs, Hurkey Creek, Hopkins Well, Indio, Idyllwild, Oasis, Palm Springs, Pinto Basin (Joshua Tree National Monument), Thousand Palms, Valerie Jean, Whitewater. SAN BERNARDINO CO.: Afton Canyon, 6 mi. w. Amboy, Camp Angelus, Cronise Valley, Kramer Junction, Lucerne Valley, Morongo Valley, Needles, 14 mi. w. Rice, Verdemont, Vidal Junction. SAN DIEGO CO.: Borrego Valley, El Monte, Oak Park, Lakeside, The Narrows, Palm Canyon, Yaqui Canyon.

As indicated in the discussion of foxi, these two species are similar. Both are extensively yellow, and punctation of the abdominal terga is almost entirely replaced by an obscure microreticulation. Both sexes of *hispidus*, but especially the male, have flagellomere II depressed beneath. In addition the antennae are conspicuously lower on the face in relation to the clypeus than in *foxi* (compare figs. 54, 55). A. hispidus is the most commonly encountered desert Aphilanthops. We have found it abundant at times at flowers of Baccharis.

Material studied has totaled 165 males and 95 females. Seasonal data indicate a large Spring brood in April and May with a peak about May 15. Five specimens taken from late October to mid-November in Riverside and Imperial counties show that there is at least a small second brood in the Coachella Valley.

Aphilanthops subfrigidus Dunning (Figs. 51, 56; map 17)

Aphilanthops subfrigidus Dunning, 1898a:21. Female lectotype, Nevada; Acad. Nat. Sci., Philadelphia.

Aphilanthops elsiae Dunning, 1898a:23. Female holotype, California; A cad. Nat. Sci., Philadelphia.

Geographic range. – Transcontinental in northern United States; British Columbia (map 17).

California records. - Widespread in the state except in the Great Valley.

A. subfrigidus is perhaps the most abundant species of the genus in western North America where it is especially to be found in mountainous areas at moderate elevations. We have seen 276 males and 152 females of subfrigidus, the majority of these from California. The wasps were collected from early May to mid-August with the largest numbers in June and early July. This suggests two overlapping broods.

Generally speaking, subfrigidus has more extensive pale markings than frigidus. However, this does not apply to the flagellum which is all dark in subfrigidus but partly fulvous in the other species. Also, males of frigidus (in Colorado and New Mexico) may have thin pale discal stripes on the scutum. A pale lateral spot on the scutum is less frequent in subfrigidus (about 10 percent) than in frigidus (about 50 percent). Pale bands on the abdominal terga may be complete or interrupted medially in either species but are usually thinner in frigidus, especially the females. In some areas, such as northern Nevada to eastern Wyoming, either species may have white-marked rather than yellow-marked forms. The only such whitish specimens known from California are male subfrigidus collected in Siskiyou and Modoc counties.

The customary female facial pattern in *subfrigidus* includes a black mark in the form of a modified X and extending along the clypeus to the tentorial pits (fig. 56). Some females are not as dark as this. Males may also have a slender black X on the face. In contrast female *frigidus* nearly always have the face divided longitudinally by two black bands (fig. 57). Sometimes, they have the face mostly



Map 17. California distribution of Aphilanthops subfrigidus Dunning. Inset: overall distribution.

black, or rarely with X-like markings as in *subfrigidus*. Males of *frigidus* generally have an X-shaped mark which stops short of the clypeal apex but occasionally (in the eastern seaboard states) makes a complete tripartite division as in the females.

Habits of *subfrigidus* have been reported only briefly by Evans (1970). One burrow was excavated to 10 cm where the storage chamber containing six queen ants was found. No brood cells were discovered.

Genus Clypeadon Patton

The genus is strictly limited to western North America and Bohart (1966) recognized eight species. Five of these are known from California. Characteristics are the essentially straight inner eye margins in company with an angular metapleural lamina back of the hindwing base and overhanging the dorsolateral propodeal sinus. The form of the female pygidium and the corresponding sternum give immediate generic recognition to specimens of this sex. The pygidium is scoop-shaped with lateral lobes formed by incisions (figs. 47, 48) and is opposed by a greatly prolonged and divided sternum VI, the two lobes of which are evenly rounded distally. All of the species have the same sort of structures but the pygidium differs in slight details, particularly along the apical rim.

The free clypeal margin of the female has a simply rounded flange (fig. 58) although the male has three teeth on the margin as in *Aphilanthops*. The absence of teeth in the female may be a reflection of the method of prey capture which is explained below.

Evans (1962) called attention to the mechanics of prey capture and carriage, a feature unique among the wasps with the exception of the related genus, *Listropygia*.

Agricultural ant workers of the genus *Pogonomyrmex* seem to be used exclusively as prey by *Clypeadon*. There is some evidence for host-prey specificity but this may sometimes be more of a geographical nature than a biological relationship.

The circumstances of prey capture are interesting aside from the use of the pygidium and hypopygium of the wasp as an "ant clamp." Several observers have reported that the female *Clypeadon* alights near an ant nest and waits quietly until an ant comes by, at which time it is seized, stung, and carried away. However, sometimes the female *Clypeadon* will rush at the ant nest opening as if to "entice" ants out in pursuit. An ant in the forefront of the charge will be taken as prey.

KEY TO THE NORTH AMERICAN SPECIES OF *CLYPEADON*

| 1. | Male with clypeus laterally and mandible basally black; |
|----|---|
| | female with pygidial margin almost evenly incurved |
| | medially |
| | Male with pale markings on clypeus laterally or mandible |
| | basally, or on both; female with pygidial concave |
| | margin interrupted medially by a perceptible convexity |
| | (figs. 47, 48) |
| 2. | Male civpeus all black: female civpeus usually all black |
| | female pygidium not evenly incurved posteriorly: Colo- |
| | rado Oklahoma Texas and Mavico |
| | draithachi (D. Dohort) |
| | Mole eluments with submedian interviewets on a modian line. |
| | male clypeus with submedian lvory spots of a median line; |
| | temate crypeus macutate, temate pygicium eventy in- |
| | curved posteriorly; western lexas to southeastern |
| | California haigi (R. Bohart) |
| 3. | Vertex closely punctate along dorsoposterior margin of eye, |
| | smooth median vertex tubercle small or absent; clypeus |
| | in male practically all pale 4 |
| | Vertex unevenly punctate and partially smooth along |
| | dorsoposterior margin of eye, or if not (some males), |
| | |

ings and with a complete pale band on tergum III; southern Oregon, California and southwestern Arizona

Wing membrane clear; male terga rather coarsely and closely punctate, male femora and tibiae usually extensively red; female terga extensively red, tergum III usually with two well separated spots; western U.S.

- - Male clypeus without discrete lateral spots, either all pale or banded transversely; male femora extensively red; female clypeus without horn-like projections, apicomedian lobe of pygidium nearly as prominent as lateral lobes (fig. 47); western U.S. to Utah and western Texas, south into Sonora, Mexico utahensis (Baker)

7. Male with prominent dark shiny spots at tentorial pits, polished median area of vertex smaller than corresponding area opposite dorsoposterior margin of eye; female with pale tergal spots sparsely punctate, frons and scutum red; Arizona, New Mexico, Colorado, western Texas, and Chihuahua, Mexico sculleni (R. Bohart)

Male without definite spots at tentorial pits, polished median area of vertex at least as large as either corresponding lateral area; female pale tergal spots well punctate, frons and scutum black; western New Mexico to eastern California evansi R. Bohart

Clypeadon californicus (R. Bohart) (Fig. 58; map 18D)

Aphilanthops californicus R. Bohart, 1959:108. Male holotype, Davis, California; Calif. Acad. Sci., San Francisco.

Geographic range. -- Upper and Lower Sonoran localities west of the Sierra in California; southern Oregon, southwestern Arizona (map 18D).

California records. – CONTRA COSTA CO.: Antioch, Mt. Diablo. FRESNO CO.: Fresno. KERN CO.: Kern River State Park, Shafter. LOS ANGELES CO.: Claremont, Huntington Park, Saugus. MONTEREY CO.: Jamesburg, San Ardo, San Lucas. RIVERSIDE CO.: Pinyon Flat, Riverside. SACRAMENTO CO.: Sacramento. SAN BERNARDINO CO.: Colton, Loma Linda. SAN DIEGO CO.: 5 mi. sw. Boulevard, Carrizo Creek, Jacumba, Oceanside, Scissors Crossing. SAN LUIS OBISPO CO.: Black Lake Canyon, Creston, Oso Flaco Lake. SANTA BARBARA CO.: Lake Cachuma, Lompoc, Solvang. SANTA CLARA CO.: "Santa Clara Co.". SANTA CRUZ CO.: Bear Valley, Ben Lomond, Mt. Harmon. SHASTA CO.:



Map 18. Overall distribution of (A) Clypeadon evansi R. Bohart, (B) Listropygia bechteli R. Bohart, (C) Clypeadon haigi R. Bohart, (D) Clypeadon californicus R. Bohart.

Redding. SISKIYOU CO.: Macdoel, Orr Lake. VENTURA CO.: Foster Park, Saticoy. YOLO CO.: Davis.

We have seen 158 males and 85 females of *californicus*. Specimens have been collected from May 24 to October 5 which suggests more than one generation. Largest numbers have been taken from mid-June to mid-July.

The somewhat dusky wing membrane is unusual in the genus. In addition the male has the clypeus all pale or nearly so, no shiny vertex tubercle and the vertex closely punctate along the dorsoposterior eye margin. In the female the punctation is the same except rarely for a very small median vertex tubercle, and tergum III has a complete pale band. Red markings on the abdomen of either sex are absent or slight.

Except for details of color, tergal punctation, and wing membrane clarity, *Clypeadon californicus* is much like *laticinctus*, and it may be just a subspecies. Since both forms occur together in Riverside County, California, and seem to maintain their individuality, we are treating them as separate species (compare maps 18D, 19).

Clypeadon evansi R. Bohart (Map 18 A)

Clypeadon evansi R. Bohart, 1966: 163. Male holotype, Rodeo, New Mexico, Calif. Acad. Sci., San Francisco.

Geographic range. – Western New Mexico to eastern California (map 18 A).

California records. - INYO CO.: 20 mi. s. Darwin, 19, Sphaeralcea ambigua, VI-4-39 (R. M. Bohart, UCD). MONO CO.: Hot Creek, 1d, VIII-7-36 (R. M. and G. E. Bohart, UCD). Mammoth, 1d, VIII-7-36 (R. M. and G. E. Bohart, UCD). SAN DIEGO CO.: Scissors Crossing, 2240-2800 feet, 1d, V-4-69 (E. E. Schlinger, UCR).

Clypeadon evansi is apparently rare in California but it is abundant at times in eastern Arizona and western New Mexico. Its recognition features are the presence of polished areas laterally and especially medially on the vertex; clypeus and mandible ornamented with red or yellow but frons and scutum black; male without obvious tentorial spots on the face; male with a divided hair tuft on sternum V; and female with a small median tubercle on the apical rim of the pygidium. Among the three California species with considerable polished areas on the vertex, it differs from *haigi* by the ornamented mandible and clypeus as well as by the subtuberculate rim of the female pygidium. From utahensis it differs by the divided hair tuft of sternum V in the male and by the less developed tubercle of the pygidial rim in the female (difference about as in figs. 47-48).

The few records of capture in California suggest that there may be two broods, one in May to June, the other in August. We have seen a total of 101 males and 69 females of *evansi*.

Clypeadon haigi (R. Bohart) (Map 18 C)

Aphilanthops haigi R. Bohart, 1959:106. Male holotype, Sonoita, Arizona, Calif. Acad. Sci., San Francisco.

Geographic range. - Western Texas to eastern California (map 18 C).

California records. - SAN BERNARDINO CO.: 4 mi. nw. Cima, 36d, Eriogonum, IX-16-70 (D. P. Levin, UCD).

Clypeadon haigi is a rarity in California. It is easily distinguished from our other species by having the mandi-

ble of the male all black toward the base. Also, the female pygidium is evenly incurved apically; that is, without a median tubercle. In August and September it is a relatively common species in southeastern Arizona. We have seen a total of 160 males and 80 females but only a single capture of three males from California.

Evans (1962) excavated four nests of this species. One to four brood cells were found per nest at a depth between 16 to 25 cm. Cells contained between 14 and 16 worker ants.

Clypeadon laticinctus (Cresson) (Map 19)

Philanthus laticinctus Cresson, 1865:91. Male holotype, Colorado; Acad. Nat. Sci., Philadelphia.

Aphilanthops quadrinotatus Ashmead, 1890:7. Female holotype, Colorado; U.S. Natl. Mus., Washington.

Geographic range. – Utah, Colorado, and western Texas to Idaho, Oregon, and California (map 19).

California records. – INYO CO.: Deep Springs, Lone Pine. LASSEN CO.: Hallelujah Junction, Johnstonville. LOS ANGELES CO.: 8 mi. e. Lancaster, Llano, Palmdale. MONO CO.: 11 mi. n. Bridgeport, Grant Lake, Hot Creek, Mammoth, Mono Lake, Pickel Meadow, Tom's Place. RIVERSIDE CO.: Anza, Box Spring Mountains, 18 mi. w. Blythe, The Gavilan, Mockingbird Canyon, Pinyon Flat, Riverside, Temecula, Whitewater. SAN BERNARDINO CO.: Atolia, Cajon, Cima, 25 mi. s. Ivanpah, Morongo Valley, Rialto. SAN DIEGO CO.: Borrego, 5 mi. sw. Boulevard, Mason Valley, Scissors Crossing, Warner Springs.

In addition to being one of the most widespread species of the genus, Clypeadon laticinctus is also one of the most frequently encountered. Males can sometimes be taken in large numbers flying around blooming Baccharis or Tetradymia, particularly if females are present on these flowers. In California it is the most abundant species but its range is restricted to desert or semidesert areas. As discussed under californicus, it is related to that species, and both have dense punctation extending right to the dorsoposterior margin of the eye. Furthermore, the ranges of the two forms overlap in southern California, even though intermediate specimens have not been taken. We have seen 695 males and 248 females of this species. Collection dates are from late May to late September, indicating several overlapping broods. The population peaks between late May and mid-July.

Biology of *laticinctus* has been reported by Hicks (1927, 1933, as *quadrinotatus*) and by Evans (1962). Females apparently may excavate more than one nest, with about three cells per nest. Brood cells were found between 10 to 21 cm from the soil surface and contained from 15 to 26 ants.



Map 19, California distribution of *Clypeadon laticinctus* (Cresson). Inset: overall distribution.

Clypeadon utahensis (Baker) (Fig. 47; map 20)

Aphilanthops utahensis Baker, 1895:335. Male holotype, southwestern Utah; U.S. Natl. Mus., Washington.

Aphilanthops concinnulus Cockerell, 1896:221. Male lectotype, Rincon, New Mexico, U.S. Natl. Mus., Washington.

Geographic range. – Southwestern Utah to southwestern Texas west to Nevada and California; Sonora and Queretaro, Mexico (map 20).

California records. - IMPERIAL CO.: 5 mi. e. Bonds Corner, Glamis, 7 mi. se. Ocotillo, Palo Verde. INYO CO.: 5 mi. e. Big Pine, Deep Springs, Lone Pine. KERN CO.: Johannesburg, Red Rock Canyon, Walker Pass. LOS ANGELES CO.: 8 mi. n. Llano, Palmdale, Santa Catalina Island. RIVERSIDE CO.: 18 mi. w. Blythe, Chino Canyon, Desert Center, Hopkins Well, Indio, Mira Loma, Palm Canyon, Palm Springs, Thousand Palms, Whitewater. SAN BERNARDINO CO.: 25 mi. e. Barstow, Colton, Cronise Valley, 13 mi. e. Ludlow, Morongo Valley, Rialto, Victorville, Vidal, Yermo. SAN DIEGO CO.: Borrego.

Clypeadon utahensis is rather easily recognized in the female by the distinct median tubercle of the pygidial rim which produces a trilobed effect (fig. 47). Differences in the male are more subtle. Close scrutiny of the area



Map 20. California distribution of *Clypeadon utahensis* (Baker). Inset: overall distribution.

adjacent to the dorsoposterior corner of the eye will show in *utahensis* a separation of punctures with appreciable intervening polished integument. This will distinguish the species from *laticinctus*, with which it is often collected, and from *californicus*. In the other California species, *haigi* has an all black mandible, and *evansi* has a definitely bi-tufted sternum V. This is one of our more common and widespread species, frequently taken on or around blooming bushes such as *Baccharis, Tamarix*, and *Tetradymia*.

We have seen 468 males and 102 females, most of which were taken between late April and early July. Overlapping broods apparently produce a few specimens in August and September and somewhat more in early October.

Genus Listropygia R. Bohart

The generic features are based on the single known species. They are the scoop-shaped and terminally knobbed female pygidium (fig. 49), the subcapitate antennae in both sexes, a broadly concave and hairy trough on sterna III and following in the male, edentate clypeal rim in both sexes, and a slightly projecting but not angular lamina over the dorsolateral propodeal sinus.

Listropygia bechteli (R. Bohart) (Figs. 49, 59; map 18 B)

Aphilanthops bechteli R. Bohart, 1959:106. Male holotype, Borrego Valley, San Diego Co., California; Calif. Acad. Sci., San Francisco.

Geographic range. – Southern California and western Arizona (map 18 B).

California records. – IMPERIAL CO.: Fish Creck Mts., Palo Verde. RIVERSIDE CO.: 18 mi. w. Blythe, Box Canyon, 4 mi. s. Palm Desert, 33 mi. e. Desert Center, Hopkins Well, Thousand Palms. SAN DIEGO CO.: Borrego Valley.

This is one of the prettiest of the philanthine wasps. The head is all black except for a basal mandibular spot. The reflectivity so essential to species frequenting hot sandy areas is given by long dense silvery hair on the face (fig. 59) and elsewhere. The silvery mat is particularly thick on the lower frons and clypeus of the male. The thorax is black with a few white spots. In contrast the gaster is a rather bright red ornamented with white spots and bands. From *Clypeadon* such as *utahensis*, with which it might be confused, the long-haired face and somewhat clubbed antenna of *bechteli* male separates it readily. In the female the knobbed pygidium is quite distinctive (fig. 49).

L. bechteli is restricted in distribution (map 18 B) and is localized even within its range. We have found both sexes in some abundance around flowers of *Tamarix* in Thousand Palms, along a sandy wash near Palo Verde, and in low sand dunes east of Borrego Springs (see records above). Males also visit flowers of *Croton*, *Sphaeralcea*, and *Baccharis*. We have seen 68 males and 80 females of this species. It has been collected only in the spring and almost exclusively in April.

Prey has been reported as workers of *Pogonomyrmex* californicus Buck (Evans, 1962).

Tribe Cercerini Genus *Eucerceris* Cresson

There are 38 known species of *Eucerceris*, all from the North American continent and the majority from the southwest. One of the United States species is central and eastern, five extend a few degrees east of the 100th meridian, and the remainder occur west of this line. We are treating 10 species as Californian.

The principal early workers on *Eucerceris* were Cresson (1865), Viereck (1902), Viereck and Cockerell (1904*a*, *b*), and Mickel (1916). All of these added new species, distributional data, and discussions of relationships. However, the principal work on the genus has been contributed by Scullen in a series of papers (1939-1968), the last of

which was a comprehensive revision. This contained keys, synonymy, maps, some descriptions, many illustrations, and a bibliography. A flaw in this fine paper was the failure to recognize the validity of the new names proposed by Schletterer (1887) and Dalla Torre (1890). Since these authors did not accord generic status to *Eucerceris*, they proposed new names for those which had previously been occupied in *Cerceris* and were thus secondary homonyms. Although the international rules of nomenclature on this point were changed in 1961, they were not retroactive and the names of Schletterer and Dalla Torre must be used. Unfortunately, this requires the supplanting of *Eucerceris* fubipes Cresson with *E. cressoni* (Schletterer), *E. elegans* Cresson with *E. nevadensis* (Dalla Torre).

In males of *Eucerceris* the development and distribution of apical hair brushes or fimbriae on the sterna offer convenient separational characters. Details of the pygidial plate and the ocellocular distance are useful, also. In one species, *vittatifrons*, the second submarginal cell is petiolate in front. All of the other males of the California species have the second cell sessile. In females the structure of the clypeus and dentition of the mandibles characterize each of the Californian species. Secondary features are found in punctation, sculpture of the propodeal enclosure, and shape of the pygidial plate. The second submarginal cell is petiolate in females of all of the Californian species, although not throughout the genus.

The strong secondary sexual differences in clypeal morphology, sternal pubescence, and extent of red markings have made association of the sexes difficult and have occasioned considerable synonymy. As in xerophilic species of other philanthine genera, *Philanthus*, *Cerceris*, and *Clypeadon*, there is a strong tendency toward erythrism, particularly in females. This is carried to an extreme in some specimens of *Eucerceris nevadensis*, which are nearly all red.

In contrast to *Cerceris*, its companion genus in the tribe, *Eucerceris* has more definite species characters in the male but somewhat more obscure ones in the female, at least in most pinned specimens. Satisfactory study of essential mandibular and clypeal details of the female can be made only after the mandibles are spread.

There do not appear to be any obvious species groups among Californian *Eucerceris*. Separation on the basis of sternal hair brushes of the male seems to be rather artificial. The same can be said for groups founded on the number of teeth on the clypeus or the mandibles of females.

The two most obvious characters of *Eucerceris* which differentiate it from *Cerceris* are (1) the somewhat inflated third submarginal cell whose distal vein reaches the marginal cell well beyond the middle, and (2) the transversely grooved terga. More minor differences are the less distinct clypeal brushes in the male and the ordinarily prolonged apicolateral corners of the male pygidial plate (compare figs. 79, 90).

The nesting habits of three species of *Eucerceris* have been reported by Scullen (1939, 1968), Linsley and MacSwain (1954), R. Bohart and Powell (1956), Krombein (1960), and Evans (1970). In addition, prey records have been summarized by Scullen and Wold (1969).

The incompletely known biology of *Eucerceris* closely parallels that of *Cerceris* differing only in such details as number of cells (up to 5) and depth of burrow (up to 57 cm). The prey is restricted to adult Curculionidae. The reader is referred to the discussion of *Cerceris* biology as well as to a discussion of nesting habits under the individual species of *Eucerceris* (flavocincta and ruficeps).

KEY TO THE GENUS EUCERCERIS IN CALIFORNIA

| 1. | Antennal flagellum with 11 articles; abdomen with seven |
|----|---|
| | visible segments (males) |
| | Antennal flagellum with 10 articles; abdomen with six |
| | visible segments (females) |
| 2. | Sternum V with a posterior row of prominent although |
| | sometimes short fimbriate hairs which are not divided |
| | into two distinct tufts 3 |
| | Sternum V without a prominent row of fimbriae but often |
| | with a small median pair of flattened tufts |
| 3. | Fimbriae on sterna III-V 4 |
| | Fimbriae on sternum V only 5 |
| 4. | Ocellar triangle considerably more than its breadth from |
| | compound eye canaliculata (Say) |
| | Ocellar triangle about its breadth or less from compound |
| | eye |
| 5. | Second submarginal cell petiolate in front . vittatifrons Cresson |
| | Second submarginal cell not petiolate in front 7 |
| 6. | Pygidial carina unusually raised toward middle, somewhat |
| | angulate in side view; middle tooth of clypeal apex |
| | protruding well beyond lateral teeth arenaria Scullen |
| | Pygidial carina relatively low and of even height, rounded |
| | rather than angled in side view; teeth of clypeal apex |
| | about equal in length cressoni (Schletterer) |
| 7. | Inner eye margins moderately to strongly converging above; |
| | apicolateral projections of pygidial plate long and rather |
| | fingerlike in dorsoposterior view (fig. 78); ocellocular |
| | distance at most only a little more than length of |
| | flagellomere II 8 |
| | Inner eye margins only slightly converging above; apicolat- |
| | eral projections of pygidial plate rather short or blunt; |
| | ocellocular distance considerably more than length of |
| | flagellomere II |
| 8. | Sterna III-IV without fimbriae; ocellocular distance less than |
| | length of flagellomere II flavocincta Cresson |
| | Sterna III-IV with strong fimbriae; ocellocular distance a |
| | little more than length of flagellomere II |
| | similis Cresson |

- 12. Free margin of clypeus with four distinct teeth, all on the same level, median pair of teeth acute and well separated (fig. 60) cressoni (Schletterer) Free margin of clypeus with outer teeth distinct, inner teeth forming angles on a depressed median lobe (figs. 62, 66) 13
- 13. Frons rather evenly punctate across area just below midocellus, punctures mostly less than a diameter apart; pygidial plate plainly narrowing toward base (fig. 67).
 - Frons with punctures irregularly spaced across area just below midocellus, many punctures more than a diameter apart, pygidial plate only slightly narrowing toward base (as in fig. 70) arenaria Scullen

- 19. Lateral section of clypeus with a large conical projection; median section of clypeus discally flat (fig. 71) canaliculata (Say)

Lateral section of clypeus without a projection; median section of clypeus moderately convex discally (fig. 65)

Eucerceris arenaria Scullen (Fig. 62; map 21)

Eucerceris arenaria Scullen, 1948:156. Female holotype, Helendale, California; Univ. California, Riverside.

Geographic range. – Western Texas and Colorado to California (map 21).

California records. – INYO CO.: Deep Springs, Lone Pine Creek, Mazourka Canyon. KERN CO.: Johannesburg, Mohave (and 6 mi. ne.), Red Rock Canyon, Walker Pass. LOS ANGELES CO.: Mint Canyon, Palmdale, Pearblossom, Valyermo. MONO CO.: 7 mi. s. Benton Station. RIVERSIDE CO.: Coachella, Cotton wood Canyon, Desert Hot Springs, Magnesia Canyon, Palm Springs, Tahquitz Canyon, Thousand Palms. SAN BERNARDINO CO.: Cajon, 25 mi. s. Ivanpah, Kramer Junction, Mentone, Morongo Valley, Parker Dam. SAN DIEGO CO.: Borrego Valley, Scissors Crossing.

The male is distinguished by having fimbriae on sternum V only and the middle tooth of the clypeal apex acute



Map 21. California distribution of *Eucerceris arenaria* Scullen. Inset: overall distribution.

and protruding well beyond the lateral ones. The black and ivory markings are similar to those of *vittatifrons* which in addition to a blunt middle clypeal tooth has the second submarginal cell petiolate in front. The female of *arenaria* has a conical projection on the disc of the middle clypeal lobe, and the teeth on the apical margin of the clypeus are irregularly spaced (fig. 62). In addition the pygidial plate is hardly narrowed toward the base (about as in fig. 76).

We have seen one female from Los Angeles County, California in which the thorax is partially red. Altogether, 152 males and 50 females have been studied. Californian collecting dates are in each of the warm months from June 1 to October 15. Localities are all in Upper and Lower Sonoran Life Zones.

Eucerceris canaliculata (Say) (Fig. 71; map 22)

Philanthus canaliculatus Say, 1823:80. Male holotype, Arkansas, destroyed; male neotype, Kansas; Acad. Nat. Sci., Philadelphia. Cerceris bidentata Say, 1823:1823:80. Female holotype, Arkansas; destroyed.



Map 22. California distribution of *Eucerceris canaliculata* (Say). Inset: overall distribution.

- Eucerceris canaliculata atronitida Scullen, 1939:50. Male holotype, Beaver Canyon, Utah; U.S. Natl. Mus., Washington. New synonym.
- Eucerceris biconica Scullen, 1948:157. Female holotype, 15 mi. n. El Paso, Texas; Culif. Acad. Sci., San Francisco.

Geographic range. - U. S. west of the Mississippi River, central and western Mexico (map 22).

California records. - Known from various inland localities of southern California and a more northern collection at Hallelujah Junction, Lassen County.

We have seen 613 males and 98 females of this relatively abundant species. Collecting dates range from June 28 to October 10, indicating more than one brood. Localities are all in Upper and Lower Sonoran Life Zones.

E. canaliculata is a yellow and red wasp which is recognized in the male by the presence of prominent fimbriae on sterna III-V of which that on V is shortened but stretches across the middle third of the sternum. Also, the ocellocular distance is unusually great. The female is a rather large wasp in which the lateral section of the clypeus bears a conical discal projection (fig. 71).

In our opinion *atronitida* and its synonym *biconica* represent a slightly darker Mexican form which is not worthy of recognition as a subspecies.

Eucerceris cressoni (Schletterer) (Figs. 60, 61; map 23)

- Eucerceris fulvipes Cresson, 1865:111, nec Cerceris fulvipes Eversmann, 1849. Female lectotype, Rocky Mountains, Colorado; Acad. Nat. Sci., Philadelphia.
- Cerceris cressoni Schletterer, 1887:489, n. name for fulvipes Cresson.

Eucerceris simulatrix Viereck and Cockerell, 1904a:84. Male holotype, Las Vegas, New Mexico; Acad. Nat. Sci., Philadelphia.

Geographic range. – Great Plains and Rocky Mountains, west to southern California (map 23).

California records. - RIVERSIDE CO.: (Recorded by Scullen, 1968).

This medium-sized, black and yellow *Eucerceris* is the type species of the genus. The male has fimbriae on sternum V only, the second submarginal cell not petiolate, and the three apical teeth of the clypeus about equal in length. The female has the midlobe of the clypeus raised discally and has four rather equal teeth apically. In addition there is only a single inner mandibular tooth (fig. 60). We have seen only 16 males and 6 females of this species, all out-of-state. Scullen (1968) recorded two California localities: Riverside Co. and Los Angeles Co. The latter record was apparently based on a male of *arenaria*, however.



Map 23. California distribution of *Eucerceris cressoni* (Schletterer), *E. ruficeps* Cresson (enclosed in broken line), and *E. pimarum* Rohwer (enclosed in solid line). Inset: overall distribution of *E. cressoni*.

Eucerceris flavocincta Cresson (Figs. 63, 64; map 24)

- Eucerceris flavocinctus Cresson, 1865:109. Female holotype, Rocky Mountains, Colorado; Acad. Nat. Sci., Philadelphia.
- Eucerceris cingulatus Cresson, 1865:110. Male holotype, Colorado; A cad. Nat. Sci., Philadelphia.
- Eucerceris chapmanae Viereck and Cockerell, 1904a:84. Female holotype, White Oaks, New Mexico; Acad. Nat. Sci., Philadelphia.
- Eucerceris striareata Viereck and Cockerell, 1904a:84. Female holotype, White Oaks, New Mexico; Acad. Nat. Sci., Philadelphia.

Geographic range. - Southern Canada and United States west of the 100th meridian (map 24).

California records. – Sierran localities from Tulare County north, and from Mendocino, Trinity, and Siskiyou counties.

We have seen 177 males and 126 females of this relatively common western species. Collection dates range from June 19 to August 14 with the largest numbers in July. Localities are in the Canadian Life Zone.



Map 24. California distribution of *Eucerceris flavocincta* Cresson. Inset: overall distribution.

The male of *flavocincta* is the only *Eucerceris* in California without sternal fimbriae. Also, the ocellocular distance is unusually narrow so that the inner eye margins converge rather strongly toward the vertex. The female has the clypeus nearly flat as in the other two black and yellow species, *provancheri* and *similis*. From these *flavocincta* differs in having the propodeal enclosure finely carinate and all dark. From *provancheri* it differs also in its more sharply tapering pygidial plate. From *similis* it differs additionally in having the four apical teeth of the clypeus (above the depressed lobe) grouped in two pairs (compare figs. 63 and 65).

Scullen (1968) recorded a male from "Sierra Madre Mts., 9,700 feet." He speculated that it was from Mexico. It seems to us that the Sierra Madre range in southern Wyoming is more likely and furthermore it is within the known range of the species.

E. flavocincta has been studied in California by Bohart and Powell (1956), in Oregon by Scullen (1939), and in Wyoming by Evans (1970). Bohart and Powell reported flavocincta nesting in berms of clay, silt, and gravel along the edge of an old excavation. Most burrows were found to enter the ground at right angles, proceed for about 4 cm, and then angle into the hill. Total nest depth was about 13 cm. Up to four cells were found per nest located from 7 to 13 cm below the surface, and each cell contained from six to nine weevils. Evans (1970) illustrated a comparable nest for *flavocincta*. Prey has been recorded as weevils of the genera *Panscopus*, *Peritaxia*, and *Dyslobus* (Scullen and Wold, 1969; Evans, 1970). Bohart and Powell (1956) recorded the chrysidid, *Hedychrum nigropilosum* Mocsáry, as a presumptive parasite.

Eucerceris nevadensis (Dalla Torre) (Fig. 72; map 25)

- Eucerceris elegans Cresson, 1879:xxiii. Male holotype, Nevada; Acad. Nat. Sci., Philadelphia, nec Cerceris elegans Eversmann, 1849.
- Cerceris nevadensis Dalla Torre, 1890:200, n. name for Eucerceris elegans Cresson.
- Eucerceris ferruginosa Scullen, 1939:45. Female holotype, Angeles Bay, Baja California Norte, Mexico. Calif. Acad. Sci., San Francisco. New synonymy.
- Eucerceris mojavensis Scullen, 1968:44. Male holotype, 7 mi.e. Mojave, California; Univ. California, Davis. New synonymy.
- Eucerceris elegans monoensis Scullen, 1968:28. Female holotype, Grant Lake, Mono County, California; Calif. Acad. Sci., San Francisco. New synonymy.

Geographic range. – Nevada, eastern and southern California, and Baja California, and Baja California Norte, Mexico (map 25).

California records. -- INYO CO.: 5 mi. e. Big Pine, Lone Pine, KERN CO.: Brown, Red Rock Canyon, 7 mi. e. Mohave, LOS ANGELES CO.: Llano, 2 mi. s. and 21 mi. ne. Pearblossom. MONO CO.: Benton Station, Grant Lake, Hammil, Lee Vining, 10 mi. n. Lee Vining. SAN BERNARDINO CO.: Adelanto, Oro Grande, Yermo, Yucca Valley. SAN DIEGO CO.: Borrego.

We have studied 108 males and 34 females of this colorful species. Scattered collection dates in California range from June 4 to October 20. Localities are in the Upper and Lower Sonoran Life Zone.

Recognition characters in the male are the presence of prominent fimbriae on sterna III-IV and a pair of flattened rectangular tufts close together near the middle of sternum V. These tufts are well formed and longer than a midocellus. The female has two prominent but not large teeth near the middle of the inner edge of the mandible (fig. 72). The more distal tooth is the larger and is curved. The clypeus is nearly flat and its depressed apex is rather broad. The scutum has well-spaced punctures.

The color range in female *nevadensis* is extreme. This has led to the naming of several subspecies. Various intermediates have been found and we prefer not to use formal



Map 25. California distribution of *Eucerceris nevadensis* (Dalla Torre). Inset: overall distribution, dots for typical form and lines for variety with a red female (*ferruginosa* Scullen).

subspecies names. However, a reasonable case could be made for E. nevadensis ferruginosa with mojavensis as a synonym. This form generally has extensive pale marks on the scutum of the male and the female terga (as well as the rest of the body) mostly red. If this subspecies were recognized, elegans and monoensis would fall under typical nevadensis, in which males generally have the scutum with a pair of small ivory dashes anteriorly (rarely all dark). The corresponding female has the thorax mainly black and the abdomen black with ivory-yellow bands. We have seen three females which are striking intermediates. One from Fernley, Nevada has the thorax half red and the abdominal ground color red on the first two and last two segments. Another from Dayton, Nevada has a little more black on the abdomen. A third from two miles east of Lone Pine, California, and associated with typical ferruginosa females has yellow bands across terga I to IV which are otherwise red. If ferruginosa should be recognized as a subspecies, the first two specimens above would have to be considered nevadensis s.s. and the third would be an unusual ferruginosa. Approximate ranges of the two forms are shown on map 25.
Eucerceris pimarum Rohwer (Figs. 73, 74, 80; map 23)

Eucerceris pimarum Rohwer, 1908:326. Female holotype, Phoenix, Arizona, November, 1897; U. S. Natl. Mus., Washington.

Eucerceris apicata Banks, 1915:404. Male holotype, Yuma, Arizona; Mus. Comp. Zool., Cambridge. Tentative new synonymy.

Geographic range. -- Arizona and southern California.

California records. - RIVERSIDE CO.: 18 mi. w. Blythe, 466, 299, X-16-65 (R. M. Bohart, F. D. Parker, UCD). IMPERIAL CO.: Palo Verde, 19, VIII-20-46 (P. D. Hurd, CIS), 466, 19, X-10-71 (R. M. Bohart, E. E. Grissell, C. Goodpasture, UCD).

The synonymy of *pimarum* and related species is somewhat complicated. Scullen (1965a) misassociated the sexes and confused *pimarum* with conata Scullen and bitruncata Scullen. Males which he identified as pimarum belong to bitruncata, a species occurring from eastern Arizona to Texas. These males have a well-developed row of fimbria on sternum V in contrast to *pimarum*. Females of the two species differ in the clypeal apex, that of bitruncata with the median pair of teeth much depressed (fig. 68). Also, the entire median section of the clypeus is more nearly flat in pimarum. E. apicata based on a male from Yuma, Arizona, is apparently a synonym of *pimarum*, based on a male from Phoenix, Arizona. Females identified by Scullen as *apicata* are apparently referable to *conata* Scullen, a western species not yet reported from California. From this mix-up three species emerge, pimarum, bitruncata, and conata, but only the first is definitely Californian.

E. pimarum is the only extensively red species with weakly differentiated posteromedian hair tufts on sternum V in the male. The distinctive female characters are given in the key.

We have seen 10 males and 8 females of this Lower Sonoran form including the holotype from Phoenix and several females from Tucson and Littlefield, Arizona. All of these were collected in the fall, September 10 to October 16.

Eucerceris provancheri (Dalla Torre) (Figs. 69, 70, 79; map 26)

- Eucerceris insignis Provancher, 1889:418, nec Cerceris insignis Klug, 1845. Malc lectotype, Los Angeles, California; U.S. Natl. Mus., Washington.
- Cerceris provancheri Dalla Torre, 1890:204, n. name for insignis Provancher.

Geographic range. – Western Nevada, California, and Baja California Norte, Mexico (map 26).

California records. – Rather widely distributed in the state except in the far north and in the southeast.



Map 26. California distribution of *Eucerceris provancheri* (Dalla Torre). Inset: overall distribution.

We have seen 195 males and 98 females. There is probably only a single summer brood peaking in July, but collection dates range from June 5 to August 27. Localities are in Transition and Upper Sonoran Life Zones.

E. provancheri is the only species of Californian *Eucerceris* in which the male has well-developed fimbriae on sterna III-V in combination with a densely punctate scutum. A further peculiarity is that the fimbriate row of sternum III occupies less than a third of the sternal breadth. The female is similar to *flavocincta*, which is also black and yellow, but in *provancheri* the propodeal enclosure is bimaculate as well as coarsely striate. Furthermore, the pygidial plate is ovate rather than subtriangular (fig. 70).

Eucerceris ruficeps Scullen (Figs. 75, 76; map 23)

Eucerceris ruficeps Scullen, 1948;159. Female holotype, Antioch, California; Calif. Acad. Sci., San Francisco.

Geographic range. - Central California (map 23).

California records. - CONTRA COSTA CO.: Antioch, 2168, 1699 numerous dates from V-18 to IX-26 (W. F. Barr, R. C.

Bechtel, R. M. and G. E. Bohart, A. A. Grigarick, P. D. Hurd, E. G. Linsley, J. W. MacSwain, S. Miyagawaa, J. Powell, J. R. Powers, W. J. Turner, E. C. Van Dyke, UCD, CIS, CAS, WSU); Bethel Island, 1d, VII-31-59 (J. Powell, CIS). STANISLAUS CO.: Del Puerto Canyon, 19, V-30-59 (F. D. Parker, UCD).

The male of *ruficeps* has well-developed fimbriae on sterna III-IV only. In addition the scutum is closely punctate. The female is the only species with a flat median clypeal section which also has the scutal punctures essentially contiguous. The head of the female is largely red.

E. ruficeps was found nesting in hard-packed sand in the Antioch sand dune region by Linsley and MacSwain (1954). These authors found *ruficeps* using abandoned burrows of halictine bees. Each modified burrow was vertical for about 20 cm at which point lateral tunnels branched off for an additional length of 29 and 42 cms. Soil plugs were found near the burrow entrance, at the branching point of the burrow, and near the terminus of the lateral tunnels. Weevils were stored, apparently still alive, in the last plug near the terminus. Each nest contained from four to five cells and each cell had 15 to 20 weevils of the genera *Sitona* and/or *Dysticheus*.

Eucerceris similis Cresson (Figs. 65, 78; map 27)

- Eucerceris similis Cresson, 1879:xxii. Female lectotype, Nevada; Acad. Nat. Sci., Philadelphia.
- Eucerceris barri Scullen, 1968:19. Female holotype, Jacob's Cabin, Heart Mt., Lake County, Oregon; U. S. Natl. Mus., Washington. New synonymy.

Geographic range. - Northern California, western Nevada, and southern Oregon (map 27).

California records. - Fairly abundant in Sierran localities from Mono County north. It is known also from the mountains of Glenn and Siskiyou counties.

Of this western species we have seen 397 males and 118 females. There is probably only a single summer brood, peaking in July. Extreme collection dates are June 22 and August 22. Localities are in the Transition and Canadian Life Zones.

The presence of well-developed sternal fimbriae on III-IV only, and slender apicolateral corners on the pygidial plate (fig. 78) will distinguish the male. The female is similar to those of *provancheri* and *flavocincta*, both of which also have the clypeus nearly flat and only a single mandibular tooth. However, in *similis* the four main teeth of the clypeal apex are rather evenly spaced instead of forming two groups of two as in the other species. Furthermore, the propodeal enclosure of *similis* is nearly smooth rather than carinulate.



Map 27. California distribution of *Eucerceris similis* Cresson. Inset: overall distribution.

Eucerceris vittatifrons Cresson (Figs. 66, 67, 77; map 28)

Eucerceris vittatifrons Cresson, 1879:xxii. Male lectotype, Nevada; Acad. Nat. Sci., Philadelphia.

Geographic range. - United States west of the 100th meridian (map 28); also central Mexico (States of Aguascalientes and San Luis Potosi).

California records. - INYO CO.: Antelope Springs, Big Pine, 9 mi. e. Bishop, 9 mi. w. Lone Pine, Mazourka Canyon, 7 mi. n. Parchers Camp. LASSEN CO.: Hallelujah Junction, Litchfield. LOS ANGELES CO.: Acton, Lovejoy Lake, Palmdale. MONO CO.: II mi. n. Bridgeport, Topaz Lake. RIVERSIDE CO.: 9 mi. w. Beaumont, 7 mi. s. Desert Hot Springs, Idyllwild, Magnesia Canyon, Palm Canyon, Pinon Flat. SAN BERNARDINO CO.: Cajon Junction, Clark Mountain, Cushenberry Spring, 10 mi. n. Lake Arrowhead, 12 mi. e. Mentone, Miller Canyon, Summit Valley. SAN DIEGO CO.: 5 mi. sw. Boulevard, "Descanso to Alpine," Warner Springs (and 9 mi. s.).

The male of *vittatifrons* is the only one in California with the second submarginal cell petiolate in front. Furthermore, it has fimbriae on sternum V but not on III-IV, and the median apical tooth of the clypeus is blunt. The two complete black vittae of the face (fig. 77) are characteristic



Map 28. California distribution of *Eucerceris vittatifrons* Cresson. Inset: overall distribution.

but not entirely unique. The female also has these black stripes. In addition the midsection of the female clypeus is subconical (fig. 66) and the pygidial plate is plainly narrowed toward the base (fig. 67). The abdomen in both sexes is black with narrow ivory bands on the terga. The legs are marked with red, especially in females.

This species is locally abundant and we have seen a total of 72 males and 28 females. Collection dates extend from May 21 to October 5. Localities are in Upper Sonoran and Transition Life Zones.

Genus Cerceris Latreille

Cerceris, with over 800 species worldwide, is the largest genus of the Sphecidae. Furthermore, it is well represented on every continent and on many large islands. About 75 species can be considered Nearctic and 26 of these are known to occur in California. Species of Cerceris are colorful, relatively abundant, and of some importance through their habits as predators and plant pollinators. It is not unusual, then, that they have attracted the attention of several taxonomists of Hymenoptera. Chief among these have been Say (1823, 1824), F. Smith (1856, 1873), Cresson (1865, 1879), Provancher (1888), Banks (1912, 1917, 1947), Viereck (1902), Viereck and Cockerell (1940*a*, *b*), Mickel (1916, 1918), and Scullen (1965*b*, etc.).

A recent review of the genus by Scullen (1965b) is the most complete treatment of the North American species. It includes keys, synonymy, new descriptions, distributional maps, notes on biology, illustrations, and a comprehensive bibliography. This important contribution will be used for a long time by students of Cerceris. However, in some respects Scullen's keys are difficult to use because there has been a great reliance on coloration, and what appears to us to be an excessive use of the subspecies concept, often without a clear geographical basis. This last situation obscures the picture of natural color variation within a population and clinal effects throughout the distribution of the species. Consequently we have submerged subspecies names, while pointing out the color pattern on which they were based so that others can accord them subspecific status if they wish.

We have been fortunate in having a large number of *Cerceris* available for study. In all we have seen 6,100 males and 2,650 females, about two-thirds of which were determined by Dr. Herman Scullen.

Cerceris are unusually variable in color, particularly with respect to red markings. With some trepidation we have used markings as separational points where there seemed to be some proof of specific distinctness (for example, in combination with structural features in the opposite sex). In females most species of Cerceris are readily distinguished by peculiarities of the clypeus. Morphology of the fifth sternum, mesopleuron, shape of the pygidial plate and tegula, and details of punctation are useful, also. Males are much less distinctive and consequently the somewhat unreliable nature of the color pattern assumes a larger role in species differentiation. However, a convenient major separation point is the presence of a more or less definite swelling toward the base of the sternum in many of the smaller species. This platform-like swelling has been used as a basis for the subgenus Apiraptrix Shestakov, but we prefer to give group status to the species concerned. Clypeal, mesopleural, and sternal structure are relatively similar in males, but details of punctation and tegular shape are helpful as in females. The pygidial plate offers some taxonomic characters but to a lesser degree than in the female. The shape, nature, and breadth of the clypeal brush, formed by the group of hairs appended to the lower lateral edge of the clypeus, are some of the most important characters in male Cerceris. Basically, there are two types of brushes and only a few which might be considered intermediate. The commonest type is that illustrated by C. acanthophila (fig. 95) in which the hairs tend to adhere as if

waxed, and form a subrectangular lamina. In the other type, as exemplified by C. nigrescens (fig. 88), the hairs are more loosely grouped to make a subtriangular brush.

Secondary sex differences have caused difficulties in association of the sexes. Scullen (1965b) reported an inability to distinguish males of *C. nigrescens, aequalis* and *varians*. Also, he lumped males of *acanthophila* with *minax* and *vanduzeei, echo* with *rufinoda*, and *convergens* with *chilopsidis*. We have been able to separate all of these on antennal, clypeal, and sculptural details.

California *Cerceris* divide rather readily into six species groups as follows:

I, C. finitima group. A basal platform-like swelling on sternum II (especially developed in males); most females with a well-defined mesopleural tooth; size generally small; male flagellomere XI not hairy beneath (fig. 99). Included species: acanthophila Cockerell, bridwelli Scullen, chilopsidis Viereck and Cockerell, conifrons Mickel, convergens Viereck and Cockerell, echo Mickel, finitima Cresson, kennicottii Cresson, minax Mickel, rufinoda Cresson, and vanduzeei Banks.

II, C. nigrescens group. No basal platform on sternum II; no definite mesopleural tooth; male flagellmere XI hairy beneath, especially toward apex (fig. 87); female pygidial plate not narrowed basally (figs. 104, 105); discal clypeal projection of female strong and (except in *aequalis*) double (figs. 101, 106, 108, 142). Included species: *aequalis* Provancher, *macswaini* Scullen, *nigrescens* F. Smith, *sextoides* Banks, and *varians* Mickel.

III, C. californica group. No basal platform on sternum II, no definite mesopleural tooth; male flagellomere XI not hairy beneath; female with a concavity on sternum V; female clypeus with no discal projection but a pair of minute subapical teeth (fig. 141); male clypeal brush narrow (fig. 97). Included species: californica Cresson, completa Banks, and grandis Banks.

IV, C. compacta group. No basal platform on sternum II, at most a small mesopleural tooth; male flagellomere XI not hairy beneath; discal clypeal projection of female with an attached deflected membrane (fig. 138), mandible on inner surface with a large subapical tooth in female and a large medial tooth in male; sterna IV-V in male with dense preapical subfimbriae; male clypeal brush narrow (fig. 81). Included species: cochisi Scullen, compacta Cresson, and sandiegensis Scullen.

V, C. frontata group. No basal platform on sternum II; no well-defined mesopleural tooth; male flagellomere XI not hairy beneath (fig. 96); female clypeus with a strong, double, discal projection (figs. 133, 139); female pygidial plate more narrowed basally than apically (figs. 140, 144); male pygidial plate unusually long (figs. 90, 93). Included species: *bicornuta* Guérin and *frontata* Say.

VI, C. graphica group. No basal platform on sternum II; no well-defined mesopleural tooth; male flagellomere XI not hairy beneath (fig. 82); female clypeus with a single, nasiform, discal projection which is flanked by a strong tooth or lobe (figs. 135, 136); female pygidial plate narrowed about equally toward base and apex (fig. 137); female mandible deeply incised subapically; male clypeus with a median double point (instead of a single one) and clypeal brush unusually broad (fig. 94). Included species: femurrubrum Viereck and Cockerell, and graphica F. Smith.

Some two dozen references to the biology of *Cerceris* in America north of Mexico have been summarized by Scullen (1965b). Evans (1971) updated Scullen's work and added a number of original observations. Generalized habits for *Cerceris* are given below, and the more pertinent references to biology are discussed under individual species of the genus. No attempt has been made to cite every paper treating prey records as these have been recently reviewed by Scullen and Wold (1969). We have summarized their results with respect to Californian species.

While Cerceris are normally considered to be groundnesting wasps, a single record exists of a twig nester (see discussion under finitima). Most Cerceris, however, nest in aggregations in bare, often sandy, level ground. The burrow is ordinarily a vertical tube which becomes oblique soon after entering the ground and ultimately becomes nearly horizontal. In excavating, the female wasp uses her pygidial plate to push most of the soil to the surface, where it forms a circular tumulus. As the work progresses, some soil is retained in the burrow to form an inner plug. After the main burrow is dug, prey are gathered and stored, mid-burrow, in the inner plug. The burrow entrance is not closed during flights, but the female may effect closure from within as soon as she begins cell provisioning. The prey are carried well forward under the wasp's body during flight, and the wasp uses both its mandibles and legs to grip the beetle. After sufficient prey are collected, the wasp breaches the plug and constructs one to several cells. Then the prey gathering and storage process is repeated. Brood cells usually number less than 10, and up to 40 prey may be stored per cell. According to Evans (1971), the cells are of two sizes. The larger ones contain more prey and produce females, the smaller ones with fewer prey produce males. A single female ordinarily constructs only one nest in her lifetime.

Prey of North American *Cerceris* consist exclusively of adult Coleoptera of the families Curculionidae, Buprestidae, Tenebrionidae, Bruchidae, Chrysomelidae, Nitidulidae, and Phalacridae. Each species of Cerceris is rather prey specific, collecting a single species or a variety of closely related beetles within a single family. Evidence suggests that prey selection may be influenced by habitat preference and relative size of wasp and prey. In Europe several species of Cerceris prey upon bees, but this habit has not yet been reported in the New World.

Cerceris are parasitized by Chrysididae, Mutillidae, and Sarcophagidae.

KEY TO THE GENUS CERCERIS IN CALIFORNIA

| 1. Abdomen with seven visible terga, flagellum with 11 articles | |
|--|-----|
| (males) | 2 |
| Abdomen with six visible terga, flagellum with 10 articles | |
| (females) | 27 |
| 2. Sternum II with a bulging, basal, sometimes platform-like | |
| swelling which is usually delimited by a curving or | |
| angular transverse declivity | 3 |
| Sternum II essentially flat or concave | 13 |
| 3. Tergum I distinctly red | 4 |
| Tergum I not distinctly red | 7 |
| 4. Propodeal enclosure lightly sculptured, often largely smooth. | |
| clypeus with punctures at middle of midsection mostly | |
| more than a diameter apart bridwelli Scull | len |
| Propodeal enclosure coarsely and completely ridged; clypeus | |
| with punctures at middle of midsection mostly less than | |
| a diameter apart | 5 |
| 5. Scutal punctures essentially contiguous; clypeal brush occu- | |
| pying about 1/3 of clypeal rim; clypeal punctures rather | |
| coarse and evenly distributed rufinoda Cress | on |
| Scutal punctures somewhat separated; clypeal brush occu- | |
| pying about 1/4 of clypeal rim | 6 |
| 6. Clypeal punctures of midsection rather evenly distributed | - |
| conifrons Micl | kel |
| Clypeal punctures of midsection unevenly distributed, leav- | |
| ing irregular smooth areas toward apex | |
| echo Mici | cel |
| 7. Clypeus usually with lateral sections black or mostly so; | |
| subantennal scierite black or mostly so | 8 |
| Clypeus with lateral sections not mostly or all black; | |
| subantennal sclerite mostly or all pale | 9 |
| 8. Least interocular distance about 1.8 times eye breadth in | |
| front view; cly peal pubescence rather bristly | |
| | ell |
| Least interocular distance about 1.5 times eye breadth in | |
| front view; clypeal pubescence fine | |
| | on |
| 9. Tegulae unusually convex, Appearing distorted; propodeal | |
| enclosure nearly always coarsely cross carinate | |
| The second | on |
| Tegulae not unusually convex | 10 |
| 10. Distance between antennal socket and compound eye less | |
| than length of hagehomere 1 | |
| Distance between entered and the series of t | ell |
| to or greater than length of floodlamora I | |
| 11 Church with measure station dominating surface of with | 11 |
| 11. Cryptus with macropunctation dominating surface of mid- | |
| section which is longer and narrower than usual (fig. 98): | |

| Clypeus with micropunctation of midsection extensive and prominent between macropunctures (fig. 100); propodeal enclosure usually with considerable smooth areas 12 12. Clypeal brush subrectangular and with a relatively firm apical margin (fig. 95) | propodeal enclosure generally coarsely cross carinate |
|---|--|
| 12. Clypeal brush subrectangular and with a relatively firm apical margin (fig. 95) | Clypeus with micropunctation of midsection extensive and prominent between macropunctures (fig. 100); pro- podeal enclosure usually with considerable smooth areas 12 |
| margin (fig. 95) | 12. Clypeal brush subrectangular and with a relatively firm apical |
| 13. Last flagellar article with obvious erect hair toward apex of incurved surface | margin (fig. 95) <i>acanthophila</i> Cockerell Clypeal brush tapering, without a firm apical margin (fig. 100) |
| Last flagellar article without obvious hair | 13. Last flagellar article with obvious erect hair toward apex of incurved surface |
| 14. Flagellum beyond scape pale within for its entire length | Last flagellar article without obvious hair |
| 15. Clypeal brush somewhat tapering, off-white, a single brush occupying no more than one-fourth of a clypeal breadth | 14. Flagellum beyond scape pale within for its entire length 15 Flagellum beyond scape darkened within for part of its length |
| Clypeal brush with apex broad and nearly straight, golden, a single brush occupying two-sevenths to nearly one-third of clypeal breadth | 15. Clypeal brush somewhat tapering, off-white, a single brush occupying no more than one-fourth of a clypeal breadth |
| single brush vitu apex bioad and nearly straight, gotten, a single brush occupying two-sevenths to nearly one-third of clypeal breadth | Chuped bush with any bread and nearly straight golden a |
| 16. Clypeal brush tapering to a rounded apex | single brush occupying two-sevenths to nearly one-third of clypeal breadth |
| nigrescens F. Smith Clypeal brush with a broad, straight or concave apex | 16. Clypeal brush tapering to a rounded apex |
| 17. Propodeum below enclosure with large punctures, mostly separated by rather smooth areas; flagellomere II about 2.0 times as long as broad; body length usually about 10 mm | Chreat brush with a broad straight or concave apex 17 |
| separated by rather smooth areas; flagellomere II about 2.0 times as long as broad; body length usually about 10 mm | 17. Propodeum below enclosure with large punctures, mostly |
| 2.0 times as long as broad; body length usually about 10 mm | separated by rather smooth areas; flagellomere II about |
| Propodeum below enclosure with close fine sculpture of small punctures and microstriation; flagellomere II about 1.5 times as long as broad; body length usually about 8 mm | 2.0 times as long as broad; body length usually about 10 mm |
| small punctures and microstriation; flagellomere II about 1.5 times as long as broad; body length usually about 8 mm | Propodeum below enclosure with close fine sculpture of |
| 8 mm | small punctures and microstriation; flagellomere II about |
| 18. Pygidium with a tuft of outstanding hair apicolaterally as seen from above; clypeus with median tooth distinct, sharp or angled forward; pygidial plate much longer than wide | 8 mm |
| wide | 18. Pygidium with a tuft of outstanding hair apicolaterally as seen from above; clypeus with median tooth distinct, sharp or angled forward; pygidial plate much longer than |
| other characters are different; clypeus with a rounded median tooth or a double one | Pyzidium without a distinct tuft apicolaterally, or if so. |
| 19. Pygidium laterally with a prominent outwardly directed hair tuft (fig. 90); flagellomere I about as long as scape; midtooth of clypeal apex angled but not projecting much beyond lateral ones (fig. 91) bicornuta Guérin Pygidium laterally with a small tuft (fig. 93); flagellomere I shorter than scape; midtooth of clypeal apex projecting well beyond lateral ones (fig. 92) frontata Say 20. Clypeal apex with a double rather than a single median projection; one clypeal brush occupying two-fifths of clypeal breadth (fig. 94) | other characters are different; clypeus with a rounded median tooth or a double one |
| tuit (iig. 50), higher labout as tong as scape, midtooth of clypeal apex angled but not projecting much beyond lateral ones (fig. 91) bicornuta Guérin Pygidium laterally with a small tuft (fig. 93); flagellomere I shorter than scape; midtooth of clypeal apex projecting well beyond lateral ones (fig. 92) frontata Say 20. Clypeal apex with a double rather than a single median projection; one clypeal brush occupying two-fifths of clypeal breadth (fig. 94) | 19. Pygidium laterally with a prominent outwardly directed hair tuft (fig 90): flagellomere L shout as how as scape: |
| beyond lateral ones (fig. 91) bicornuta Guérin Pygidium laterally with a small tuft (fig. 93); flagellomere I shorter than scape; midtooth of clypeal apex projecting well beyond lateral ones (fig. 92) frontata Say 20. Clypeal apex with a double rather than a single median projection; one clypeal brush occupying two-fifths of clypeal breadth (fig. 94) | midtooth of clypeal apex angled but not projecting much |
| shorter than scape; midtooth of clypeal apex projecting well beyond lateral ones (fig. 92) | beyond lateral ones (fig. 91) bicornuta Guérin Projein laterally with a small tuft (fig. 93): flagellomere l |
| well beyond lateral ones (fig. 92) | shorter than scape; midtooth of clypeal apex projecting |
| 20. Clypeal apex with a double rather than a single median projection; one clypeal brush occupying two-fifths of clypeal breadth (fig. 94) | well beyond lateral ones (fig. 92) frontata Say |
| clypeal breadth (fig. 94) | 20. Clypeal apex with a double rather than a single median projection; one clypeal brush occupying two-fifths of |
| clypeal brush occupying much less than two-fifths of clypeal breadth (figs. 81, 97) | clypeal breadth (fig. 94) |
| clypeal breadth (figs. 81, 97) | clypeal brush occupying much less than two-fifths of |
| bi-emarginate | 21. Flagellomere IV broader than long: sternum VII with apex |
| simply concave <i>femurrubrum</i> Viereck and Cockerell 22. Mandible with a strong tooth near middle of inner edge; row of hairs toward apex on sterna IV-VI somewhat matted and subfimbriate (view from in front) | bi-emarginate graphica F. Smith Flagellomere IV longer than broad; sternum VII with apex |
| 22. Mandible with a strong tooth near middle of inner edge; row of hairs toward apex on sterna IV-VI somewhat matted and subfimbriate (view from in front) | simply concave femurrubrum Viereck and Cockerell |
| | 22. Mandible with a strong tooth near middle of inner edge; row of hairs toward apex on sterna IV-VI somewhat matted and subfimbriate (view from in front) |

Mandible without a strong tooth near middle of inner edge; hairs toward apex on sterna IV-VI not matted nor 23. Pale bands on terga III-V narrowed medially by anterior emarginations; clypeal midsection with strong macropunctures over most of its surface; specialized hairs on sterna IV-VI long and close-set as seen from in front; enclosure coarsely pitted laterally ... compacta Cresson Pale bands on terga III-V broad and not emarginate anteriorly; clypeal midsection primarily micropunctate, at least on upper half; specialized hairs on sterna IV-VI rather sparse; enclosure smooth laterally 24 24. Markings extensively yellow and dark red; clypeal apex about half as broad as length of flagellomere I (fig. 81) . Markings mostly yellow and black; clypeal apex about two-thirds as broad as length of flagellomere I sandiegensis Scullen 25. Tergum II with a black median spot surrounded by yellow or nearly so completa Banks Tergum II with yellow not tending to enclose a black median 26. Propodeal enclosure becoming punctate anterolaterally Propodeal enclosure becoming weakly cross striate anterolaterally; body nearly all yellow grandis Banks Mesopleuron with at most a slight angle as seen from above . 37 28. Center of clypeal midsection raised into a sharp or blunt cone (figs. 110, 116) 29 Center of chypeal midsection at most convex, often with a 29. Punctures on anterior third of scutum with polished interspaces; tergum 1 red conifrons Mickel Punctures on anterior third of scutum mostly contiguous; tergum I not red vanduzeei Banks 30. Pygidial plate with uneven texture, much smoother toward 31. Clypeal projection ending in two rounded lobes (fig. 122) convergens Viereck and Cockerell Clypeal projection ending in rather sharp corners (fig. 32. Pygidial plate oval, not unusually narrow (about as in fig. 132); clypeal projection with a small median lobe between apical corners (fig. 126) kennicottii Cresson Pygidial plate not oval, narrowed toward apex (figs. 125, 130); clypeal projection without a median apical 33. Pygidial plate moderately broad basally and tapering rather evenly to a narrow apex (fig. 130) . . acanthophila Cockerell Pygidial plate unusually narrow but not tapering evenly toward apex (fig. 125) minax Mickel 34. Clypeal projection bicornered or bilobed and overhanging apical rim; (figs. 111, 112) tegula not unusually convex; Clypeal projection more of a raised carina, not overhanging apical rim, at least medially (figs. 114, 119); tegula unusually convex, appearing distorted; propodeal enclo35. Apex of clypeal projection about half as broad as least interocular distance (fig. 112); tergum I not red chilopsidis Viereck and Cockerell Apex of clypeal projection about a fourth as broad as least interocular distance (fig. 111); tergum I mostly red bridwelli Scullen 36. Clypeal projection with apex removed from apical rim of clypeus a distance equal to about half length of flagellomere II; tergum I black and yellow, not red finitima Cresson Clypeal projection with apex removed from apical rim of clypeus a distance equal to or longer than flagellomere II; tergum I extensively red echo Mickel 37. Clypeus without a discal projection, or with a projection which bears an attached and deflected membrane (figs. Clypeus with a conical or two-pointed discal projection (figs. 38. Clypeus with a discal projection which bears an attached and 39. Yellow band of tergum III greatly narrowed by a deep anterior emargination; mesopleuron without a projecting angle as seen from above compacta Cresson Yellow band of tergum III broad, not narrowed by an anterior emargination; mesopleuron with a projecting 40. Markings of head and thorax rather extensively reddish cochisi Scullen Markings of head and thorax mostly black and yellow sandiegensis Scullen 41. Sternum V without a median concavity; clypeus without a pair of tiny outwardly directed teeth near apical middle (fig. 118); tegula unusually convex, appearing distorted . Sternum V with a median concavity; clypeus with a pair of tiny outwardly directed teeth near apical middle 42. Concavity of sternum V with posterior edge raised medially into an angle of about 135° as seen in posterior view californica Cresson Concavity of sternum V with posterior edge only a little raised, angle, if any, about 170° as seen in posterior view 43 43. Tergum II with yellow tending to enclose a black spot; translucent area of concavity of sternum V extending most or all of the length of sternum V . . . completa Banks Tergum II extensively yellow but without a central black spot; translucent area of concavity of sternum V much shorter and forming a broad oval grandis Banks 44. Clypeus with discal projection conical or nasiform (figs. 106, Clypeus with discal projection broad toward apex and at 45. Pygidial plate narrowed toward apex, subtriangular (fig. 104); propodeal enclosure finely and longitudinally striate aequalis Provancher Pygidial plate nearly as broad apically as basally, rectangular but with convex sides (fig. 137); propodeal enclosure 46. Clypeal apex with most lateral teeth flattened anteroposteriorly (fig. 136); postocellar area of head in dorsal

| iew | longer | than | breadth of | oceilar | triang | e | • | • | • | ٠ | • | • | • | |
|-----|--------|------|------------|---------|--------|---|---|---|---|---|---|---|---|--|
|-----|--------|------|------------|---------|--------|---|---|---|---|---|---|---|---|--|

| graphica F. Smith |
|--|
| Clypeal apex with most lateral teeth a little flattened from |
| the sides (fig. 135); postocellar area of head not longer |
| than breadth of ocellar triangle |
| |
| 47. Pygidial plate with lateral carinae strongly converging toward |
| base (figs. 140, 144), pygidium laterally near apex with |
| an outwardly directed tooth |
| Pygidial plate with lateral carinae parallel or diverging toward |
| base (figs. 105, 143), pygidium laterally without an |
| outwardly directed tooth |
| 48. Clypeal discal projection with a strong and thick fringe of |
| hairs along its concave apex (fig. 139) frontata Say |
| Clypeal discal projection without hairs concentrated into a |
| fringe (fig. 133) bicornuta Guérin |
| 49. Pygidial plate with carinae nearly parallel (fig. 143) |
| sextoides Banks |
| Pygidial plate with carinae converging posteriorly to a |
| moderately narrow, rounded apex (fig. 105) |
| 50. Apical truncation of clypeus narrower than length of |
| flagellomere I and flanked by a strong tooth (fig. 108) . |
| nigrescens F. Smith |
| Apical truncation of clypeus broader than length of flagello- |
| mere I, lateral corner of truncation formed by a blunt |
| tooth (fig. 101) |
| 51. Median apex of clypeal projection about same distance from |
| clypeal apex as from base macswaini Scullen |
| Median apex of clypeal projection much closer to clypeal |
| apex than to base varians Mickel |

Cerceris acanthophila Cockerell (Figs. 95, 130; map 29)

Cerceris acanthophila Cockerell, 1897: 135. Male lectotype, Deming, New Mexico; Acad. Nat. Sci., Philadelphia.

Cerceris cockerelli Viereck, 1902:731. Male lectotype, La Jolla, California; Acad. Nat. Sci., Philadelphia. New synonymy.

Cerceris huachuca Banks, 1947:29. Male holotype, Patagonia, Arizona; Mus. Comp. Zool., Cambridge.

Geographic range. – British Columbia and the United States west of the Continental Divide except for a record in southeastern Colorado (map 29).

California records. - Widespread in the state except in the southeast.

We have seen 254 males and 118 females of this common and widespread western species. It is found mostly in the Upper Sonoran and Transition Life Zones where it occurs from May to October.

This somewhat misunderstood species is one of our most common in the genus. The synonymy of *huachuca* is based on Scullen (1965b). We have added C. cockerelli, the lectotype of which we have examined. Scullen did not identify the males of cockerelli, and both acanthophila and vanduzeei, as well as specimens now assigned to minax, he placed under acanthophila.



Map 29. California distribution of *Cerceris acanthophila* Cockerell. Inset: overall distribution.

We distinguish *acanthophila* in the male by a combination of the extensively micropunctate midsection of the clypeus and the subrectangular clypeal brush (fig. 95). The male of *chilopsidis* is somewhat similar but it has the clypeal brush narrower and the antennocular distance shorter than flagellomere I.

Based on the smooth apical third of the pygidial plate (as in fig. 125) in females of *acanthophila*, *minax*, *conver*gens and kennicottii, these four species constitute a subgroup. The last two are easily separated by the conformation of the apex of the clypeal projection (figs. 122, 126). Also, they usually have the subantennal area mostly or all black. Females of *minax* and *acanthophila* are much alike but can be distinguished by the broader and more evenly tapering pygidial plate in *acanthophila* (compare figs. 125 and 130).

Cerceris aequalis Provancher (Figs. 86, 87, 103, 104, 106; map 30)

- Cerceris aequalis Provancher, 1889:417. Female lectotype, Los Angeles California; U. S. Natl. Mus., Washington.
- Cerceris vicinoides Viereck and Cockerell, 1904b:140. Female holotype, Pecos, New Mexico; Acad. Nat. Sci., Philadelphia.



Map 30. California distribution of *Cerceris aequalis* Provancher. Inset: overall distribution.

Cerceris psamathe Banks, 1912:21. Female holotype, Lee county, Texas; Mus. Comp. Zool., Cambridge.

Geographic range. – United States west of the Continental Divide (map 30).

California records. – Widespread in the state except in the Great Valley and in the southeast.

We have seen 281 males and 257 females of this relatively abundant species in habitats of the Upper Sonoran, Transition, and Canadian Life Zones, collected from April to July.

Within the nigrescens group, this is the only Californian species in which the clypeal projection of the female is single and nasiform (figs. 103, 106). The male closely resembles those of varians and nigrescens, and the three were not distinguished in this sex by Scullen (1965b). Although they may occur together, as shown by collections of females, only a single species has been found in a number of localities. Sex associations made on this basis and a study of the indicated males has turned up some useful species characters. Thus, nigrescens male has a loose, subtriangular clypeal brush (fig. 88) together with a mostly dark flagellum. C. aequalis male has a compact, subrectangular clypeal brush (fig. 88) and a flagellum which is at least partly darkened on the inner surface. *C. varians* male has a compact, subrectangular clypeal brush but the flagellum is broadly pale orange along its entire inner surface.

We have examined a series of specimens collected on Santa Cruz Island and the males seem indistinguishable from *aequalis*. The females are quite similar, also, except that the clypeal process is considerably depressed. We have decided to call attention to this form but not to identify it by name. The subspecies *bolingeri* Scullen from Oregon and Nevada, and subspecies *idahoensis* Scullen from the Rocky Mountains may be distinct species. In any case we have omitted them from consideration here.

Cerceris bicornuta Guérin (Figs. 84, 90, 91, 133, 140; map 31)

- Cerceris bicornuta Guérin, 1844:443. Female holotype, New Orleans, Louisiana; Museo Civico di Storia Naturale, Genoa.
- Cerceris dufourii Guérin, 1844:443. Male holotype, New Orleans, Louisiana; Museo Civico di Storia Naturale, Genoa.
- Cerceris venator Cresson, 1865:116. Male lectotype, Illinois; Acad. Nat. Sci., Philadelphia.
- Cerceris curvicornis Cameron, 1890:124. Male holotype, Mazatlan, Jalisco, Mexico; British Mus. Nat. Hist., London.
- Cerceris fidelis Viereck and Cockerell, 1904b:132. Female holotype, Santa Fe, New Mexico; Acad. Nat. Sci. Philadelphia. New synonymy.

Geographic range. – Transcontinental below latitude 45° in the United States and northern Mexico (map 31).

California records. – COLUSA CO.: Colusa. CONTRA COSTA CO.: Antioch. FRESNO CO.: Firebaugh, GLENN CO.: Artois. IMPERIAL CO.: Bard, Brawley, Calexico, Palo Verde, Westmorland. INYO CO.: Bishop (and 15 mi. n.), Carroll Creek, Cartago, Independence, Lone Pine, Round Valley. KERN CO.: Bakersfield, Buttonwillow. MERCED CO.: Dos Palos. MODOC CO.: Lake City. MONO CO.: Hammil, Topaz Lake. RIVERSIDE CO.: Blythe, Corona, Hemet, Indio, Magnesia Canyon, Ripley, Riverside, Thermal. SACRAMENTO CO.: Bryte, Sacramento. SAN BERNARDINO CO.: Colton, Victorville. SAN DIEGO CO.: Borrego Valley, San Felipe Creek, Scissors Crossing, Warner Springs. SAN JOAQUIN CO.: Tracy. STANISLAUS CO.: 5 mi. ne. Crows Landing, Turlock (and 10 mi. sw.). SUTTER CO.: Live Oak. TULARE CO.: Angola, Visalia, Woodlake. YOLO CO.: Davis, Woodland.

We have seen 299 males and 89 females of this easily recognized species. It is especially to be looked for in the Lower and Upper Sonoran Life Zones during the months of June to August.

The two members of the C. frontata group, frontata, and bicornuta have much in common. Both are large, the markings are similar, the pygidial plate is similar in shape (figs. 140, 144), the female discal clypeal projection is double and thrust strongly forward (figs. 133, 139), the last



Map 31. California distribution of *Cerceris bicornuta* Guérin. Inset: overall distribution.

male antennal article is strongly incurved beneath (fig. 96), and female sternum VI has an apicolateral tooth. The male of *bicornuta* is easily separated by its more prominent tuft of hair arising laterally on the pygidium (fig. 90). It also differs from *frontata* in having the more basal flagellomeres longer, the midtooth of the clypeal apex less prominent (compare figs. 91, 92), the midbasitarsis more contorted in side view (compare figs. 84, 85). The female of *bicornuta* has the clypeal projection unfringed and shorter, the two large teeth on the inner edge of the mandible close together (fig. 133), and sternum V not spinose laterally.

Scullen (1965b) recognized *fidelis* as a subspecies with lighter and more reddish markings. Since its distribution in the southwest is wholly contained within that of more typical *bicornuta*, and considering the variability in markings, we have synonymized *fidelis*.

C. bicornuta biology has been studied in other states by several workers, but few data other than host records exist. Strandtmann (1945) found one nest of bicornuta (reported as serripes) in a deturfed golf green. The burrow extended 10 cm beneath the soil surface where 15 weevils were found in the enlarged burrow. Krombein excavated one nest which also terminated at 10 cm (1953) and another which ended at 75 cm (1960) beneath the soil surface. Rau (1928), in his highly readable account of this species, reported *bicornuta* using vacated *Bembix* burrows and even holes caused by pegs inserted in the ground and then removed. Prey for *bicornuta* includes curculionids of the genera *Sphenophorus* and *Ophryastes* as summarized by Scullen and Wold (1969).

Cerceris bridwelli Scullen (Fig. III; map 32)

Cerceris bridwelli Scullen, 1965b:361. Female holotype, Imperial County, California; U. S. Natl. Mus., Washington.

Geographic range. – Southern California, Nevada, Utah, Arizona, and Baja California Norte (map 32).

California records. - IMPERIAL CO.: 29 mi. e. Calexico, 1d, VII-12-61 (V. D. Roth, CIS); Glamis, 19, IX-26-64 (M. E. Irwin, UCR); Salton Sea, 1d, *Tamarix* (CIS); Westmorland, 3dd, V-32 (H. S. Gentry, CIS). RIVERSIDE CO.: 18 mi. w. Blythe, 19, IV-24-63 (F. D. Parker, L. A. Stange, UCD), 1d, VI-7-65 (J. T. Doyen, CIS); 5 mi. e. Desert Center, 1d, 19, V-22-39 (E. P. Van Duzee, CAS); 4 mi. e. Mecca, 27dd, 599, Croton californica, VII-21-56 and VII-16-58 (M. Wasbauer, CIS). SAN BERNARDINO



Map 32. California distribution of *Cerceris bridwelli* Scullen and *C. rufinoda* Cresson (enclosed in solid line). Inset: overall distribution of *C. bridwelli*.

CO.: 14 mi. w. Rice, 1d, Asclepias, V-5-55 (C. D. MacNeill). SAN DIEGO CO.: Borrego, 12dd, 699, IV-25 to V-26-54 (E. P. Van Duzee, P. D. Hurd, M. Wasbauer, CAS, CIS).

Among Californian species of the *finitima* group, and especially those with the first tergum contrastingly red, *bridwelli* is readily recognized by the broad whitish-yellow bands on terga II-IV or II-V. The male has a subrectangular clypeal brush which occupies about two-sevenths of the apical clypeal rim. In the female the discal clypeal projection is rather sharply cornered and concave apically (fig. III). This differentiates it from the closely related southwestern species, *crotonella* Banks, in which the clypeal projection is more of a truncate cone.

At times *bridwelli* is moderately abundant in the Colorado Desert of California and in southern Arizona. We have taken it also in sandy areas of Nevada, east of Pyramid Lake and north of Winnemucca.

Material available for study has been 112 males and 34 females. In California it primarily inhabits the Lower Sonoran Life Zone but in Nevada and Utah it encroaches on the Upper Sonoran.

Cerceris californica Cresson (Figs. 97, 141, 145; map 33)

- Cerceris californica Cresson, 1865:128. Male holotype, California; Acad. Nat. Sci., Philadelphia.
- Cerceris ferruginior Viereck and Cockerell, 1904b:134. Male holotype, Deming, New Mexico; Acad. Nat. Sci., Philadelphia.
- Cerceris garciana Viereck and Cockerell, 1904b:135. Male holotype, Las Cruces, New Mexico; Acad. Nat. Sci., Philadelphia.
- Cerceris populorum Viereck and Cockerell, 1904b:135. Male holotype, Albuquerque, New Mexico; Acad. Nat. Sci., Philadelphia.
- Cerceris argyrotricha Rohwer, 1908:324. Female holotype, Las Cruces, New Mexico; U. S. Natl. Mus., Washington.
- Cerceris cognata Mickel, 1916:408. Female holotype, Worland, Wyoming: University of Nebraska, Lincoln.
- Cerceris denticularis Banks, 1917:113. Female lectotype. Umatilla, Oregon: Mus. Comp. Zool., Cambridge.
- Cerceris arno Banks, 1947:19. Female syntypes, Colton and Mountains near Claremont, California; Mus. Comp. Zool., Cambridge. New synonymy.
- Cerceris calodera Banks, 1947:22. Male holotype, Jacumba, California; Mus. Comp. Zool., Cambridge.
- Cerceris illota Banks, 1947:23. Male syntypes, Tucson, Patagonia, Palmerlee, Arizona and Colton, California; Mus. Comp. Zool., Cambridge.
- Cerceris isolde Banks, 1947:24. Male holotype, Palmerlee, Arizona; Mus. Comp. Zool., Cambridge.

Geographic range. – British Columbia and the United States west of the Continental Divide except in Texas where it extends about to the 97th meridian; also in northern Mexico (map 33).

California records. - Widespread in the state.

Map 33. California distribution of *Cerceris californica* Cresson. Inset: overall distribution.

We have seen 1,122 males and 216 females of this species. It is largely restricted to Lower and Upper Sonoran Life Zones during the months of May to August.

This is perhaps the commonest Cerceris in California and it is rather variable in markings. This accounts in part for the 11 synonyms. As might be expected, the more red and vellow forms are concentrated in the more arid regions, but basing subspecies on coloration seems futile when there is extensive overlapping as in this case. The female clypeal character of no discal projection but a pair of minute subapical teeth places the species in the californica group along with completa and grandis. These three species share the additional features in the female of a concavity on sternum V and no definite mesopleural tooth. Both sexes have a simple sternum II. The male has a narrow clypeal brush and no appreciable hair beneath flagellomere XI. From the other two species, *californica* differs in the male by having the combination of no enclosed black median spot on tergum II and punctures anterolaterally on the propodeal enclosure rather than striae. The female has the concavity of sternum V deeper and more definitely margined posteriorly than in the other two. Reddish forms of the species have been called subspecies arno by Scullen



(1965b) but this seems untenable. In any case the name representing the reddish desert forms should be *ferruginior* which has a priority of 43 years.

The biology of *C. californica* is the most thoroughly documented of any North America *Cerceris*. Linsley and MacSwain (1956) studied the habits of 25 females, nesting in bare, packed sand at Tanbark Flat, San Gabriel Mountains, California. In general, each nest was dug vertically from 5 to 9 cm at which point a 5 cm earth plug was formed. Beneath this plug each cell was constructed at an increasing depth from the soil surface. Cells were apparently "constructed and provisioned in one afternoon following several days of accumulating prey in the plug." Up to four cells were found per nest with five to 11 buprestids (*Acmaeodera*, *Agrilus*, *Anthaxia*, *Chrysobothris*) in each cell. Parasites of the genera *Dasymutilla* (mutillidae) and *Metopia* (sarcophagidae) were reared from cells of *californica*.

Cerceris chilopsidis Viereck and Cockerell (Figs. 112, 127; map 34)

Cerceris chilopsidis Viereck and Cockerell, 1904b:136. Female holotype, Rincon, New Mexico; Acad. Nat. Sci., Philadelphia.

Geographic range. – Southern California to Texas west of the 100th meridian; also north to central Utah and south into Baja California (map 34).

California records. -- IMPERIAL CO.: Bard, 1d, 299, VIII-14 to IX-27-65 (H. Ray, CSDA); Brawley, 1d, VI-18-60 (G. E. Bohart, UCD); 3.3 mi. nw. Glamis. 19, IV-13-68 (R. Hobza, UCR); 2 mi. s. Palo Verde, 19, Euphorbia, X-18-59 (J. W. MacSwain, CIS), 19 X-10-71 (E. E. Grissell, UCD); Seeley, 19, VI-9-45 (J. W. MacSwain, CIS). INYO CO.: Furnace Creek, 599, Prosopis, IV-7 to 8-39 (E. G. Linsley, E. C. Van Dyke, CIS, CAS), 14dd, 599, IV-27-56 (R. M. Bohart, UCD). RIVERSIDE CO.: Blythe, 299, VI-9 to 24-45 (E. G. Linsley, J. W. MacSwain, CIS), 2dd, VI-28-59 (L: A. Stange, UCD), 19, VIII-9-62 (R. M. Hardman, CSDA); Hemet, 19, on beets, V-26-35 (H. L. McKenzie, UCD); Indio, 1d, VII-29-66 (D. R. Miller, UCD); 7 mi. s. Ripley, 1d, X-19-51 (P. D. Hurd, CIS). SAN DIEGO CO.: Borrego, 299, VIII-31-56 (F. X. Williams, CAS); Palm Canyon, San Ysidro Mts., 19, VI-14-58 (L. A. Stange, LACM); Warner Springs, 19, V-8-57 (H. R. Moffitt, UCD).

The male of *chilopsidis* has not previously been identified. It is most similar to that of *vanduzeei* since both have the middle section of the clypeus coarsely punctate and the clypeal brush is rectangular. However, in *chilopsidis* the clypeal brush is more restricted, extending along the outer one-fifth of the clypeal rim instead of one-fourth as in *vanduzeei*. Also, *chilopsidis* males have the facial markings whitish instead of yellow, and have the propodeal enclosure nearly smooth to lightly sculptured, rather than coarsely striate. The most positive separation point between



Map 34. California distribution of *Cerceris chilopsidis* Vieteck and Cockerell. Inset: overall distribution.

this species and its close relatives is the narrowed frons, with the antennocular distance less than the length of flagellomere I.

The female of *chilopsidis* has the pygidial plate broad and evenly textured, which differentiates it from *acanthophila* and related species. The wide and rather sharply cornered clypeal projection defines it still further (fig. 112).

We have seen 20 males and 64 females of *chilopsidis*. In southern California it is primarily Lower Sonoran but in the rest of its range it extends into the Upper Sonoran Life Zone.

Cerceris cochisi Scullen (Figs. 81, 138; map 35)

Cerceris cochisi Scullen, 1965:416. Female holotype, Lordsburg to Silver City, New Mexico; U. S. Natl. Mus., Washington.

Geographic range. — southern California to southern Texas as far east as the 95th meridian; also Baja California to San Ignacio, and northern Sonora, Mexico (map 35).

California records. -- IMPERIAL CO.: Devils Canyon, Coachella Valley, 13, V-7-32 (from Scullen, 1965b; Palo Verde, 19 X-10-71



Map 35. California distribution of *Cerceris cochisi* Scullen and *C. completa* Banks (enclosed in a solid line). Inset: overall distribution of *C. cochisi*.

(E. E. Grissell, UCD); U.S.D.A. Experimental Farm, 13, VI-1912 (J. C. Bridwell, from Scullen, 1965b; Winterhaven, 13, VI-16-56 (G. R. Ferguson, from Scullen 1965b). RIVERSIDE CO.: 2 mi. e. Anza, 299, VII-15-63 (J. Powell, CIS, UCD); Blythe, 13, Tamarix, VII-30-47 (J. W. MacSwain, CIS). SAN BERNARDINO CO.: Morongo Valley, 13, VIII-29-34 (C. D. Michener, from Scullen, 1965b).

The compacta group, to which cochisi belongs, is especially distinctive in the female where the discal clypeal projection bears a deflected membrane. The male has a narrow clypeal brush, a large medial tooth on the inner edge of the mandible, and dense preapical subfimbriae on sterna IV-V. The other two species in California, compacta and sandiegensis, are very similar to cochisi and further collection and study may serve to strengthen or break down the idea that three species are involved as we now believe. Differences are particularly a matter of markings (see key to species) but the clypeal apex is unusually narrow in cochisi males. There is a perceptible subtooth on the mesopleuron of females of cochisi and sandiegensis, but at most a faint angle on compacta. We have seen 7 males and 12 females of cochisi which in California is restricted to Lower Sonoran areas of the far south.

Cerceris compacta Cresson (Map 36)

Cerceris compacta Cresson, 1865:127. Female lectotype, Illinois; Acad. Nat. Sci., Philadelphia.

Cerceris solidaginis Rohwer, 1908:323. Male holotype, Las Cruces, New Mexico; U. S. Natl. Mus., Washington.

Cerceris belfragei Banks, 1917:114. Female and male syntypes, Texas; Mus. Comp. Zool., Cambridge.

Geographic range. – Eastern and central United States below 45° latitude, becoming more southerly to the west, and extending into southern California and northern Mexico (map 36).

California records. - IMPERIAL CO.: Bard, 13dd, 499, VI-6 to IX-3-65 (W. Akins, R. Haygood, H. Ray, CSDA); Calexico, 2dd, Melilotus alba, VI-28-58 (R. Snelling, CIS), 1d, IX-11-58 (E. I. Schlinger, UCR); Gordons Well, 1d, VIII-27-57 (E. I. Schlinger, UCD); Westmorland, 19, III-9-64 (H. T. Reynolds, UCR). RIVER-SIDE CO.: Thermal, 5dd, VI-29-57 (E. I. Schlinger, UCD).

C. compacta is the most widespread species of its group since it extends almost from coast to coast. From the closely related *cochisi* and *sandiegensis* it seems to differ in the female by the absence of a mesopleural subtooth. Further, in both sexes the yellow band of tergum III is nearly divided by an anterior emargination. The species is



Map 36. California distribution of *Cerceris compacta* Cresson (enclosed in solid line) and *C. minax* Mickel. Inset: overall distribution of *C. compacta*.

not common in California and the above features will probably distinguish it. See also the discussions under the other two species. We have seen a total of 133 males and 60 females, mostly from outside California. In this state it has invaded Lower Sonoran areas of the far south.

A single prey record exists for *compacta*, namely the chrysomelid *Colospis brunnea* (F.) reported by Scullen (1965b).

Cerceris completa Banks (Map 35)

- Cerceris completa Banks, 1919:83. Male holotype, Claremont, California; Mus. Comp. Zool., Cambridge.
- Cerceris grandis percna, Scullen, 1965b:415. Female holotype, Mokelumne Hill, California; U. S. Natl. Mus., Washington. New synonymy.

Geographic range - California and southern Oregon.

California records. – ALAMEDA CO.: 20 mi. s. Livermore. FRESNO CO.: Coalinga. INYO CO.: Deep Springs, 3 mi. n. Lone Pine. KERN CO.: Buttonwillow, nr. Orchard Peak. KINGS CO.: Avenal Creek. LOS ANGELES CO.: Acton, Gorman. SAN DIEGO CO.: Scissors Crossing. SANTA CLARA CO.: San Antonio Valley. SANTA CRUZ CO.: Santa Cruz. SHASTA CO.: Cassel. SISKIYOU CO.: Happy Camp. TUOLUMNE CO.: Jacksonville. YOLO CO.: Davis.

We have seen 26 males and 6 females of this west coast species. It is found in widely scattered and mostly Upper Sonoran localities in California but is never common. It has been collected during July and August.

In both sexes tergum II has a more or less well-defined black central spot. This feature differentiates it from *californica* and *grandis*. In addition the female of *completa* has the translucent area of the concavity on sternum V extending most or all of the length of the sternum.

Scullen (1965b) described *percna* as a black and yellow subspecies of *grandis*. The type female was from Mokelumne Hill in Calaveras County, and two paratypes were from southern California. We have seen a female from near Coalinga determined as *percna* by Scullen. Except for its larger size it agrees with females of *completa*. In our opinion the female pygidial differences mentioned in Scullen's key are not sufficient to distinguish *completa* and *percna*. Scullen did not include *percna* males in his key.

Cerceris conifrons Mickel (Figs. 109, 110, 128; map 37)

Cerceris conifrons Mickel, 1916:410. Female holotype, Harrison, Nebraska; Univ. Nebraska, Lincoln. Geographic range. – United States west of 97° longitude, except the northern tier of states; also records from northern Mexico and Alberta, Canada (map 37).

California records. - INYO CO.: Antelope Springs, 13, 19 VI-29 and VII-10-61 (R. M. Bohart, J. Powell, UCD, CIS); 3 mi. e. Big Pine, 633, Eriogonum inflatum, VI-24-71 (R. M. Bohart, E. E. Grissell, UCD); Bishop, 13, VIII-20-60 (E. I. Schlinger, UCD), 22.4 mi. n., 13, 19, VII-8-66 (H. K. Court, UCD; Deep Springs, 1633, 299, VI-25 to IX-10 (R. M. Bohart, E. E. Grissell, P. D. Hurd, M. Wasbauer, UCD, CIS, CSDA); 3 mi. n. Lone Pine, 19, VII-3-53 (J. W. MacSwain, CIS).

Cerceris conifrons is one of the red-noded species of the finitima group. However, none of these three, conifrons, bridwelli, and echo, can be called common in California. The female of conifrons is easily distinguished from others of its subgroup by the cone-shaped elevation near the center of the clypeus. Also, the scutal punctures are well separated. Males have the scutal feature, and the punctures of the clypeal midsection are rather evenly distributed. This last character seems to form a distinction from echo which is certainly very similar in the male. We have seen 59 males and 29 females of conifrons. In California it seems to be established only in the Owens Valley area where it occupies the Upper Sonoran Zone.



Map 37. California distribution of *Cerceris conifrons* Mickel and *C. macswaini* Scullen (enclosed in solid line). Inset: overall distribution of *C. conifrons*.

Cerceris convergens Viereck and Cockerell (Figs. 89, 122, 132; map 38)

Cerceris convergens Viereck and Cockerell, 1904b:136. Female holotype, Alamogordo, New Mexico; Acad. Nat. Sci., Philadelphia.

Cerceris rinconis Viereck and Cockerell, 1904b:137. Female holotype, Rincon, New Mexico; Acad. Nat. Sci., Philadelphia.

- Cerceris hesperina Banks, 1917:115. Female and male syntypes, Yakima, Washington; Mus. Comp. Zool., Cambridge.
- Cerceris pudorosa Mickel, 1918:338. Female holotype, Auburn, California; Univ. Nebraska, Lincoln.
- Cerceris snowi Banks, 1919:84. Male lectotype, Tucson, Arizona; Mus. Comp. Zool., Cambridge.

Geographic range. – Southern Canada and the United States west of the 100th meridian except more easterly in Texas; also records from northern Mexico (map 38).

California records. - Common at lower elevations throughout the State.

Altogether, we have seen 684 males and 278 females of this widespread species of the Upper and Lower Sonoran Life Zones. It occurs from June to September.

C. convergens is one of the commoner members of the finitima group. The male customarily has the clypeus extensively black, agreeing in this respect with the much less abundant and more restricted (in California) kennicottii. In convergens male the clypeus is usually entirely black, it is more coarsely punctate, and the apical teeth are more prominent. In kennicottii male the clypeus is usually black on the apical third of the middle section and with a large pale spot above. Also, the clypeus has the punctation and pubescence more fine, and the apical teeth are less prominent. The breadth of the frons is a more positive character. It is broader in convergens and the antennocular distance is more than the length of flagellomere II rather than less.

The female of *convergens* is the only one of the California fauna to have the discal projection of the clypeus terminate in a pair of evenly rounded lobes (fig. 122). The pygidial plate is similar in texture to those of *kennicottii*, *acanthophila* and *minax* (compare figs. 125, 130, 132).

Cerceris echo Mickel (Figs. 119, 120, 121)

Cerceris echo Mickel, 1916:412. Female holotype, Monroe Canyon, Sioux County, Nebraska; Univ. Nebraska, Lincoln.

Geographic range. – United States west of 95° longitude; also Alberta, Canada.

California records. - SIERRA CO.: Independence Lake, 19, VII-20-54 (R. C. Blaylock, U.C.D.).



Map 38. California distribution of *Cerceris convergens* Viereck and Cockerell. Inset: overall distribution.

The single locality in California is in the Canadian Life Zone on the eastern side of the Sierra. We have seen 14 males and 15 females from out-of-state.

This widespread species reaches its western limit in the California Sierra where it is rare. It is close to *rufinoda* and *conifrons* which also have the first tergum contrastingly red. The male has the scutal punctures well separated and the clypeal punctures unevenly distributed. The former character separates it from *rufinoda*, the latter from *conifrons*. However, the differences are not great and misidentifications could easily be made. The female has the clypeal projection hardly more than a raised carina and the tegulae are strongly humped. These characters differentiate from *rufinoda* and *conifrons* but not from *finitima*. The red first tergum of *echo* and the higher position of its clypeal projection can be used to separate the female from that of *finitima*.

Two nests of *echo* (eastern variety) were studied by Evans (1971) in Massachusetts. He found the females nesting in flat, fine-grained sand. One burrow ended 6 cm below the soil surface with three detached cells at depths from 9 to 13 cm. The other burrow ended at 15 cm and one cell was found. Up to 39 beetles of the family Phalacridae were found in one cell. *C. echo* is the only species known to use this family of beetles as prey.

Cerceris femurrubrum Viereck and Cockerell (Figs. 94, 135; map 39)

- Cerceris femur-rubrum Viereck and Cockerell, 1904b:135. Male holotype, Albuquerque, New Mexico; Acad. Nat. Sci., Philadelphia.
- Cerceris thione Banks, 1947:18. Male syntypes, Colton and Claremont, California; Mus. Comp. Zool., Cambridge.
- Cerceris athene Banks, 1947:20. Female holotype, Claremont, California; Mus. Comp. Zool., Cambridge. New synonymy.

Geographic range. – Southern California to Colorado and Texas as far east as 97° longitude (map 39). It has also been recorded from Mexico as far south as Nayarit and Morelos.

California records. - IMPERIAL CO.: Bard, Brawley, 29 mi. e. Calexico, Coachella, Gordons Well, Palo Verde. KERN CO.: Shafter (and 13 mi. s.). LOS ANGELES CO.: Claremont. RIVERSIDE CO.: Anza, Arlington, Banning, Blythe (and 18 mi. w.), Corona, Deep Canyon, Indio, Mecca, Mira Loma, Palm Springs, Ripley, Salton Sea (n. end), Temecula, Thermal. SAN BERNARDINO CO.: East Highlands, 25 mi. s. Ivanpah, Mentone, Morongo Valley, Twentynine Palms. SAN DIEGO CO.: Borrego, Warner Springs (and 9 mi. s.). TULARE CO.: Visalia.

The species is moderately abundant south of the Tehachapis. We have seen a total of 678 males and 120 females, mostly from California. It is primarily a creature of the Lower Sonoran Zone and appears from June to October.

C. femurrubrum is a smaller species than graphica but seems rather closely related on the basis of the broad male clypeal brush, a two-lobed apex of the male clypeus (rather than the usual 3 lobes) (fig. 94), a somewhat conical rather than two-pointed discal clypeal projection in the female (figs. 135, 136), pronounced lateral lobes on the female clypeal rim, the female pygidium subrectangular and nearly as broad apically as basally (fig. 137), the antennal sockets far removed from the clypeus, and the propodeal enclosure with a patch of lateral punctures rather than longitudinally striate. In spite of all the similarities the two species are easy to distinguish. The male femurrubrum has the flagellum more slender, and sternum VIII with the apex simply concave rather than bi-emarginate. In the female the lateral teeth of the clypeal apex are somewhat flattened from the sides, the discal clypeal projection is more pointed and slender (compare figs. 135 136) and the more median apical teeth of the clypeal rim are independent rather than part of a snout-like projection. Also, the postocellar area of the head is much less developed in *femurrubrum*.

There is a considerable range in markings, with some Californian females being primarily black and yellow with



Map 39. California distribution of *Cerceris femurrubrum* Viereck and Cockerell. Inset: overall distribution.

only a little red in contrast to the more reddish typical form. The black and yellow sort was originally named as *athene* but we are treating it simply as a color form.

We know of only a single prey record of the tenebrionid *Eurymetopon rufipes* Eschscholtz recorded by Wasbauer (1957) for this species.

Cerceris finitima Cresson (Figs. 113, 114; map 40)

Cerceris finitima Cresson, 1865:122. Female holotype, Illinois; Acad. Nat. Sci., Philadelphia.

Cerceris finitima nigroris Banks, 1912:27. Male holotype, Falls Church, Virginia; Mus. Comp. Zool., Cambridge.

Cerceris vierecki Banks, 1947:30. Female holotype, Tempe, Arizona; Mus. Comp. Zool., Cambridge. New synonymy.

Cerceris finitima citrina Scullen, 1965b:380. Female holotype, Riverside, California; Calif. Acad. Sci., San Francisco. New synonymy.

Geographic range. – Southern Alberta and widespread in the United States except in the northwest; recorded also from Central America as far south as El Salvador (map 40).

California records. - COLUSA CO.: Colusa. CONTRA COSTA CO.: Antioch, GLENN CO.: Glenn. KINGS CO.: Stratford. LOS ANGELES CO.; Whittier. ORANGE CO.: Fullerton. RIVERSIDE

46



Map 40. California distribution of *Cerceris finitima* Cresson. Inset: overall distribution.

CO.: 15 mi. sw. Corona, Riverside, Winchester. SACRAMENTO CO.: Carmichael. SAN BERNARDINO CO.: 8 mi. s. Colton, Needles. SAN DIEGO CO.: Warner Springs. SANTA BARBARA CO.: Santa Cruz Island, Santa Ynez Mts. STANISLAUS CO.: 5 mi. n. Crows Landing, Newman, Patterson, Turlock. TEHAMA CO.: Dales. YOLO CO.: Davis.

Among the black and yellow species of the *finitima* group in California, *finitima* appears distinct by its bulging tegulae. Also, in the female the clypeal projection is simply a raised carina located not far above the apical rim. The male clypeus is about as shown for *acanthophila* (fig. 95). C. f. vierecki and citrina, recognized as subspecies by Scullen (1965b) seem to us as minor color forms which are unworthy of formal designation.

C. finitima is one of the more abundant species in the lowlands of California where it occurs in both Upper and Lower Sonoran Zones. We have seen a total of 330 males and 138 females taken from July to October.

Strandtmann (1945) dug one nest of *finitima* from sandy-clay soil in Ohio. One cell was found at 5 cm beneath the soil surface. Prey was the chrysomelid *Chaetocnema pulicaria* Melsheimer, the only record known for *finitima*. An unusual record was given by the Raus (1918) who found a female of *finitima* nesting in a twig. A single cell was also found in the same twig from which another *finitima* emerged several weeks later.

Cerceris frontata Say (Figs. 85, 92, 96, 139, 144; map 41)

- Cerceris frontata Say, 1823:80. Female syntypes, Arkansas, destroyed; female neotype, Lordsburg, New Mexico, U.S. Natl. Mus., Washington.
- Cerceris texensis Saussure, 1867:89. Female holotype (headless), Texas; (?) Mus. Hist. Nat., Geneva.
- Cerceris occidentalis Saussure, 1867:100. Female lectotype, Texas; Mus. Hist. Nat., Geneva.
- Cerceris nui Rohwer, 1920:230. Female holotype, St. Louis, Missouri; U. S. Natl. Mus., Washington. New synonymy.

Geographic range. – Southern half of United States from the Mississippi Valley to California; also recorded from northern Mexico as far south as La Paz and Durango (map 41).

California records. – CONTRA COSTA CO.: Antioch. RIVER-SIDE CO.: Banning, 18 mi. w. Blythe. SACRAMENTO CO.: Twitchell Island. SAN JOAQUIN CO.: Vernalis. STANISLAUS CO.: Turlock. SOLANO CO.: Rio Vista. YOLO CO.: Davis.

We have seen 242 males and 131 females of this widespread species which occurs in both Upper and Lower



Map 41. California distribution of *Cerceris frontata* Say. Open circles are from Scullen (1965b). Inset: overall distribution.

Sonoran Life Zones south of the lower Sacramento Valley where it occurs from June to October.

Among the larger species of California Cerceris, frontata, and bicornuta are recognized in the male by the long pygidial plate (fig. 93) and strongly incurved last antennal segment (fig. 96); and the porrect, double, discal clypeal projection in the female (fig. 139) together with the long pygidial plate (fig. 140). Differences between the two species are discussed under bicornuta.

Scullen (1965b) recognized a darker eastern United States subspecies as *frontata raui*. The ranges overlap broadly and we think that a formal designation of subspecies is unneeded.

The biology of C. frontata has not been studied in California. Rau (1928) gave an animated, but rather cursory account of this species (reported as raui) nesting in the middle of a dirt road near St. Louis. The nest was 60 cm in length with cells at 42 cm beneath the soil level. Rau reported 15 to 20 small weevils per cell. Krombein (1960) found a nest of *frontata* which terminated at 64 cm beneath the soil surface. Three cells were found at various depths, the deepest containing 6 adult weevils and an egg of *frontata*. Rau suggested (1928:328) that this species may re-use old burrows rather than construct new ones. Four genera of curculionids (Cleonus, Lixus, Ophryastes, Thecesternus) have been discussed as prey by Scullen and Wold (1969).

Cerceris grandis Banks

Cerceris grandis Banks, 1913:423. Female holotype, Yuma, Arizona: Am. Mus. Nat. Hist., New York.

Geographic range. - Coachella Valley of southern California, extending into southwestern Arizona.

California records. - IMPERIAL CO.: Bard, 16, VI-22-63 (R. L. Westcott, UCD). RIVERSIDE CO.: Blythe, 16, VI-23-46 (W. F. Barr, CIS): Indio, 19, VI-27-36 (E. S. Ross, CAS); Thermal, 16, Melilotus alba, VIII-2-54 (M. Wasbauer, CIS). C. grandis appears to be strictly a Lower Sonoran form occurring in Riverside and Imperial Counties.

The californica group of three species, californica, completa, and grandis are closely related but appear to be distinct. Unfortunately, californica is the only one of which we have been able to study a long series. The color range of californica is great and the most xanthic specimens closely resemble those we have identified as grandis. Hopefully, the different sculpture of the propodeal enclosure will be a constant separating character. In grandis males the enclosure is largely polished but with some indications of oblique carinulae. Females have the carinulae more extensive. In californica the enclosure may be smooth or somewhat roughened but there are always some large punctures toward the sides. The sculpture of the enclosure in *completa* is much like that in *grandis*. Both sexes of *grandis* have the punctures of tergum I well separated by polished interspaces. This is not the case in *californica*. Another distinguishing feature which will be useful, if constant, is the extent and shape of the translucent area of the concavity of sternum V in females. As detailed in the key, this area differs in our material of the three species.

Cerceris graphica F. Smith (Figs. 82, 83, 136, 137)

- Cerceris graphica F. Smith, 1873:410. Female holotype, Mexico; Brit. Mus. Nat. Hist., London.
- Cerceris hebes Cameron, 1890:124. Male holotype, Mexico; Brit. Mus. Nat. Hist., London.
- Cerceris macrosticta Viereck and Cockerell, 1904b:133. Female holotype, New Mexico; Acad. Nat. Sci., Philadelphia. New synonymy.
- Cerceris ampla Banks, 1912:16. Female and male syntypes, Fedor, Texas; Mus. Comp. Zool., Cambridge.

Geographic range. - Central America, Mexico and the United States as far north as 41° latitude; more southerly in the west.

California records. - SAN DIEGO CO.: The Narrows, 19, 1V-15-34 (no collector, CIS).

The relationship of graphica with femurrubrum has been discussed under the latter species. Scullen (1965b) treated the species as macrosticta, with ampla as a synonym. Later (1965c) he considered macrosticta, graphica, simplex F. Smith, and larvata Taschenberg as subspecies of simplex. Fritz (1970) has shown that simplex is distinct from graphica on characters of the antennae and clypeal brush in the males. He synonymized simplex and larvata under intricata F. Smith, which is shown to range from Mexico to Argentina. C. graphica is a more northerly species of which the lighter red forms are represented by the name macrosticta. We do not think that a useful purpose is served by recognition of macrosticta as a subspecies in view of the color gradations we have observed.

The only California record of which we are aware is that of Scullen (1965b) apparently based on a specimen he identified from "The Narrows." San Diego County. Scullen unfortunately placed his distributional spot too far west and in the vicinity of San Diego. We have studied 40 males and 20 females from out-of-state.

The tenebrionid genera *Eleodes* and *Metopoloba* are the only reported prey for *graphica* (Scullen and Wold, 1969). An unpublished observation on nesting habits was made by R. Bohart at Lake Texoma, Oklahoma, in 1965. Females constructed nests in sand dunes to depths of nearly two

meters. Prey were all tenebrionids which were identified by T. J. Spilman as *Bothrotes canaliculatus* (Say).

Cerceris kennicottii Cresson (Fig. 126)

Cerceris kennicottii Cresson, 1865:128. Male holotype, Louisiana; Acad. Nat. Sci., Philadelphia.

- Cerceris eriogoni Viereck and Cockerell, 1904b:139. Male holotype, Organ Mountains near Las Cruces, New Mexico; Acad. Nat. Sci., Philadelphia.
- Cerceris kennicottii beali Scullen, 1965b:387. Female holotype, Scottsdale. Arizona; U. S. Natl. Mus., Washington.

Geographic range. – Southeastern Canada and widespread in eastern and central United States, extending in the southwest from Texas to southeastern California.

California records. – IMPERIAL CO.: Calexico, 2dd, VII-11 to IX-23-57 (E. I. Schlinger, UCD); Bard, 22dd, 699, VI-16 to IX-3-65 (R. Haygood, H. Ray, CSDA). RIVERSIDE CO.: Blythe, 1d, VII-8-56 (L. A. Stange, LACM), 4dd, 199, V-20 to VI-15-66 (W. C. Kilgore, CSDA); Ripley, 1d, Helianthus, VIII-16-46 (P. D. Hurd, CIS).

The relationship of this species with convergens has been discussed under the latter. It should be added that the female of kennicottii has the clypeal projection rather sharply cornered and with a median tubercle or tooth on its forward edge (fig. 126). From acanthophila and minax females it can be separated further by the somewhat broader oval of the pygidial plate.

In California the records are strictly Lower Sonoran. We have seen a total of 73 males and 26 females.

Cerceris macswaini Scullen (Map 37)

Cerceris macswaini Scullen, 1965b:485. Female holotype, Imperial County, California; U. S. Natl. Mus., Washington.

Geographic range. - Southern California and western Arizona.

California records. – IMPERIAL CO.: Palo Verde, 1033, 699, X-10-71 (R. M. Bohart, C. Goodpasture, E. E. Grissell, UCD). RIVERSIDE CO.: Blythe, 433, 299, VI-24-45 (E. G. Linsley, CIS), 233, VI-23-46 (W. F. Barr, R. F. Smith, UCD), 13, 299, Tamarix gallica, VII-30-47 (J. W. MacSwain, CIS, UCD), 233, VII-5-51 (J. W. MacSwain, R. F. Smith, CIS); Hemet, 233, VII-27-46 (J. W. MacSwain, CIS); Mecca, 13, VII-1918 (CIS); Palm Springs, 13, 299, VI-22-45 (CIS).

On the basis of its small size and general appearance, macswaini would seem to fit into the finitima group. However, the absence of a basal platform on sternum I and the rather hairy last flagellomere of the male place it in the nigrescens group. Here it is distinguished in the male by the tapering clypeal brush in combination with the all pale inner surface of the flagellum. In the female the broad clypeal apex and the projection set rather high on the face but not strongly thrust forward will separate it from its close relatives.

The species occupies much the same Lower Sonoran areas in southern California and Arizona as grandis. We have seen a total of 25 males and 13 females.

Cerceris minax Mickel (Figs. 99, 100, 124, 125; map 36)

Cerceris minax Mickel 1918:339. Female holotype, Sacramento, California; Univ. Nebraska, Lincoln.

Geographic range. – California as far north as 39° latitude (map 36).

California records. – ALAMEDA CO.: Corral Hollow, 20 mi. s. Livermore. LOS ANGELES CO.: Tanbark Flat. MONTEREY CO.: 17 mi. n. Parkfield. PLACER CO.: Auburn. RIVERSIDE CO.: Temecula. SACRAMENTO CO.: Sacramento. SAN BERNARDINO CO.: Cajon Pass, Mentone, Oak Glen Lodge, Sheep Creek Canyon. SANTA BARBARA CO.: Los Prietos, Nojoqui Falls County Park, Santa Cruz Island, Santa Ynez Mountains. SANTA CLARA CO.: San Antonio Ranger Station. STANISLAUS CO.: Del Puerto Canyon. TULARE CO.: Ash Mountain. VENTURA CO.: Foster Park, Santa Paula, Sespe Canyon. YOLO CO.: Rumsey.

This species was synonymized under acanthophila by Scullen (1965b) but was subsequently distinguished by him in determinations. Males are readily separated by the loosely subtriangular clypeal brush in minax. Females have the pygidial plate smooth on the apical third as in acanthophila, kennicottii, and convergens, but the outline of the plate is more slender and less tapering (compare figs. 125, 130, 132). On the whole, minax is less common than acanthophila but it is the predominant form in the San Gabriel Mountains (Tanbark Flat) and on the island of Santa Cruz.

We have seen 80 males and 147 females of *minax*. For the most part it inhabits Upper Sonoran areas during the months of May to July.

Cerceris nigrescens F. Smith (Figs. 88, 105, 107, 108; map 42)

- Cerceris nigrescens F. Smith, 1856:466. Female holotype, Nova Scotia; Brit. Mus. Nat. Hist., London.
- Cerceris arelate Banks, 1912:18. Female holotype, Great Falls, Virginia; Mus. Comp. Zool., Cambridge. New synonymy.
- Cerceris nigritulus Banks, 1915:402. Male holotype, Colden, New York; Mus. Comp. Zool., Cambridge.
- Cerceris munda Mickel, 1918:337. Female holotype, Sacramento, California. Univ. Nebraska, Lincoln. New synonymy.

Cerceris abbreviata Banks, 1919:84. Male lectotype, Yakima River, Washington; Mus. Comp. ZooL, Cambridge.

Cerceris crawfordi Brimley, 1928:199. Male holotype, Raleigh, North Carolina; North Carolina State Dep. Agric., Raleigh.

Geographic range. – Transcontinental in southern Canada and the United States except in south central and southeastern areas (map 42).

California records. - Widespread in the State except in the southeast.

C. nigrescens is a relatively common species and occurs in various Life Zones from Lower Sonoran to Canadian. We have seen a total of 771 males and 435 females collected from May to September.

Males of *nigrescens* were not distinguished by Scullen (1965b) from those of *aequalis* and *varians*. The resolution of this problem has been discussed under *aequalis*. The female of *nigrescens* is similar to that of *varians* but the apical truncation of the clypeus is narrower and the clypeal projection is broader and more prominent (compare figs. 101, 108 and 102, 107). Scullen (1965b) recognized the subspecies *arelate* and *munda* based on markings. Typical *nigrescens* from the northeast (Nova Scotia) have the female markings rather whitish. In *arelate* and *munda* the pale color is yellow and often quite extensive in the latter form. We see no clear distinctions among these forms and the distribution given for *nigrescens* by Scullen (1965b) completely overlaps those of *munda* and *arelate*.

The nest architecture of *nigrescens* was noted briefly by Krombein (1938) in New York and by Evans (1971) in Massachusetts. A total of six nests were excavated and cells were found up to 10 cm beneath the soil surface. The number of prey per cell varied from 13 to 25 weevil adults. Included were the curculionids *Gymnaetron*, *Hyperodes*, and *Sitona* as summarized by Scullen and Wold (1969), and *Calomycterus* as noted by Evans (1971).

Cerceris rufinoda Cresson (Figs. 118, 129; map 32)

- Cerceris rufinoda Cresson, 1865:121. Male holotype, Rocky Mountains, Colorado; Acad. Nat. Sci., Philadelphia.
- Cerceris rufinoda var. crucis Viereck and Cockerell, 1904b:139. Female holotype, Las Cruces, New Mexico; Acad. Nat. Sci., Philadelphia.
- Cerceris rufinoda crucis Viereck and Cockerell, of Scullen, 1965b: 395. New synonymy.

Geographic range. – Transcontinental in the United States except in the southeast; also known from southern Alberta. California records are all in western Great Basin areas.



Map 42. California distribution of *Cerceris nigrescens* F. Smith. Inset: overall distribution.

California records. - LASSEN CO.: Hallelujah Junction, 19, VII-7-49 (P. D. Hurd, CIS). MONO CO.: 11 mi. n. Bridgeport, 1d, VII-7-61 (P. M. Marsh, UCD); Topaz Lake, 2dd, VIII-17-51 (R. C. Bechtel, E. I. Schlinger, UCD).

C. rufinoda is one of the four species of the finitima group in California which have the first tergum red, the others being bridwelli, conifrons, and echo. Males of these are separated mostly by rather subtle punctation characters on the clypeus and scutum, as given in the key. As a rule, the tegulae are more strongly humped than those of bridwelli and conifrons, but this feature is subject to considerable variation. Females of the four are rather easily distinguished by the clypeal conformation. In rufinoda the midsection is convex and bears four nearly equal tooth-like lobes at its apex (fig. 118). The other three all have a definite discal projection on the clypeus (compare figs. 109, 110, 111, 118, 119, 120).

Scullen (1965b) raised the more reddish forms of rufinoda from variety *crucis* to the subspecies rank. Since the form seems to be merely a color variant and the distribution is nearly identical with that of typical *rufinoda*, we have downgraded it.

50

C. rufinoda is one of several species with broad ranges which barely extend into California. The three eastern California localities are all Upper Sonoran. We have seen a total of 29 males and 8 females of this pretty species.

Strandtmann (1945) found a nest of *rufinoda* in the gravel-clay soil of a country road in Ohio. The burrow was approximately 9 cm long and 6 cm deep. One cell which contained 36 weevil adults was found at the terminus of the burrow. Two genera of curculionids (*Miccotrogus, Smicronyx*) were discussed as prey for *rufinoda* by Scullen and Wold (1969).

Cerceris sandiegensis Scullen (Map 43)

Cerceris sandiegensis Scullen, 1965b:432. Female holotype, 2mi.e. Anza, California; Calif. Acad. Sci., San Francisco.

Geographic range. – Southern California to New Mexico (map 43).

California records. - KERN CO.: Frazier Park, 19, VII-20-63 (J. Powell, CIS). LOS ANGELES CO.: Tanbark Flat, 19, VII-3-50 (H. F. Robinson, UCD). RIVERSIDE CO.: 2mi. e. Anza, 13, 399, Eriogonum fasciculatum, 13, VII-11-64 (G. E. Wallace, UCR); Hurkey Creek, 13, VI-20-40 (F. H. Rindge, CIS); Idyllwild, 333,



Map 43. California distribution of *Cerceris sandiegensis* Scullen. Inset: overall distribution.

VI-17 to 27 (G. C. Bechtel, E. C. Van Dyke, M. Wasbauer, UCD, CAS, CIS); Riverside, 2dd, V-27 to VI-54 (J. C. Hall, UCD). SAN BERNARDINO CO.: Cajon, 1d, 19, VII-19-58 (L. A. Stange, H. R. Moffitt, LACM, UCD); Cajon Pass, 3d, VI-24 to VII-4 (H. E. Cott, E. I. Schlinger, UCD); 5 mi. e. Calimesa, 19, VII-28-65 (M. Irwin, UCR); Devore, 1d, VI-14-70 (J. C. Hall, UCD); Mill Creek, 1d, X-6-46 (A. L. Melander, UCR); Oak Glen Lodge, 1d, 19 VII (F. C. Clark, CAS); Wrightwood, 1d, VII-156 (L. A. Stange, LACM); Yucaipa, 1d, VI-158 (H. R. Moffitt, UCD). SAN DIEGO CO.: 5 mi. ne. Jamul, 1d, VI-24-65 (R. L. Langston, CIS); Oak Grove, 3dd, 19, VI-6-40 (C. D. Michener, CIS); Warner Springs, 2dd, VI-12-58 (J. C. Hall, H. R. Moffitt, UCD); 2 mi. n., 1d, *Eriogonum* fasciculatum, VII-8-56 (P. D. Hurd, CIS), 9 mi. s., 1d VII-4-66 (R. M. Bohart, UCD). SANTA BARBARA CO.: Los Prietos, 3dd, VI-25-65 (J. Powell, CIS).

Relationships of the three members of the compacta group, compacta, cochisi and sandiegensis, have been discussed under the first two species. Color characters as given in the key will apparently distinguish them. Breadth of the clypeal apex in the male (broadest in sandiegensis), punctation details of the male clypeus (finest in compacta), and the mesopleural tooth of the female (absent in compacta) indicate that three species are involved.

C. sandiegensis inhabits the Upper Sonoran Zone in southwestern California. We have indicated a questionable record from Groveland, Tuolumne County on map 43 (inset). We have seen 33 males and 16 females.

Cerceris sextoides Banks (Figs. 142, 143, map 44)

Cerceris sextoides Banks, 1947:10. Female holotype, Lone Tree, Yakima River, Washington; Mus. Comp. Zool., Cambridge.

Cerceris eurymele Banks, 1947:11 Female holotype, Davis, California; Mus. Comp. Zool., Cambridge.

Geographic range. – Pacific Coast states from British Columbia to Baja California Norte and east into Nevada, Utah and Idaho (map 44).

California records. - Widespread in the state except in the southeast.

C. sextoides is one of the commonest and most widespread species in California where it inhabits Life Zones from Lower Sonoran to Canadian. We have seen a total of 518 males and 208 females collected from May to October.

This is the largest species of the *nigrescens* group but occasional large males of *aequalis* are about the same size and are superficially similar. The longer flagellomere II (twice as long as broad) and the less dense propodeal sculpture of *sextoides* are separational characters. The female has a strong two-pointed projection (fig. 142) and



Map 44. California distribution of *Cerceris sextoides* Banks. Inset: overall distribution.

the pygidial plate is nearly parallel sided (fig. 143). Other females of the *nigrescens* group in California have the sides of the pygidial plate plainly converging toward the rounded apex.

Scullen (1965b) placed sextoides as a synonym of tepaneca Saussure but later (in a letter dated June 2, 1969) wrote that tepaneca was a Mexican representative of clypeata Dahlbom and that sextoides was distinct.

The curculionid genera Sitona and Trigonoscuta were reported by Scullen (1965b) as prey of C. sextoides (as tepaneca).

Cerceris vanduzeei Banks (Figs. 98, 115, 116, 117; map 45)

- Cerceris vanduzeei Banks, 1917:114. Female holotype, San Diego, California; Mus. Comp. Zool., Cambridge.
- Cerceris complanata Mickel, 1918:340. Female holotype, Auburn, California; Univ. Nebraska, Lincoln.
- Cerceris vanduzeei eburnea Scullen, 1965b:399. Female holotype, North Powder, Union County, Oregon; U.S. Natl. Mus., Washington. New synonymy.



Map 45. California distribution of *Cerceris vanduzeei* Banks. Inset: overall distribution.

Geographic range. – Pacific Coast states from British Columbia to California and east into Montana (map 45).

California records. - Widespread in the state except in the southeast.

We have studied 177 males and 144 females of vanduzeei. The California material was largely collected in the Lower Sonoran, Upper Sonoran, and Transition Life Zones during the months of June to October.

The male of vanduzeei has not previously been recognized. It is similar to minax and acanthophila but the clypeus has a narrower midsection on which macropunctures predominate (compare figs. 95, 98). The clypeal brush is broadly rectangular as in acanthophila but not minax (compare figs. 98, 100). Most males of vanduzeei can be further distinguished from the other two species by the coarsely carinate propodeal enclosure. The female of vanduzeei has the midsection of the clypeus raised into a low cone. The customary clypeal projection found in many Cerceris females is represented in vanduzeei by a pair of protruding tooth-like lobes just above the clypeal apex. A similar situation occurs in conifrons which is readily separated by its red first tergum. Scullen (1965b) described whitish forms of vanduzeei as subspecies eburnea. The latter is more northerly but with broad zones of overlap. We prefer not to recognize subspecies in this case.

Cerceris varians Mickel (Figs. 101, 102; map 46)

Cerceris varians Mickel, 1918:336. Female holotype, Donner Lake, Placer Co., California; Univ. Nebraska, Lincoln.

Geographic range. – California and southern Oregon to southwestern Wyoming (map 46). Records east of California are 7 mi. w. Ely, Nevada, 15 mi. s. Green River, Wyoming and 2 mi. e. Leslie, Idaho (map 46).

California records. - This is a Sierran species which occurs also in the coastal mountains west of the Great Valley.

We have seen 103 males and 83 females of *varians* which inhabit Upper Sonoran, Transition, and Canadian Life Zones in California during the months of June to August.

The relationships to *aequalis* and *nigrescens* have been discussed under those species. The male of *varians* has a rather broad and rectangular clypeal brush and the flagellum is broadly pale reddish for its whole length. The female has a wide apical truncation on the clypeus and a projection that narrows apically and is not strongly projecting (figs. 101, 102).



Map 46. California distribution of *Cerceris varians* Mickel. Inset: overall distribution.

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56

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FIGURES

Bulletin of the California Insect Survey

PLATE I

Figs. 1, 3, 4, 6, 7, 9. Facial patterns of male *Philanthus*. Figs. 2, 5, 8. Inner views of antennae of male *Philanthus*.

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1. ventilabris



2. ventilabris



3. pacificus



4. crotoniphilus



5. crotoniphilus



6. multimaculatus







7. zebratus

8. zebratus

9. gibbosus

Bulletin of the California Insect Survey

PLATE II

Figs. 10-13. Facial patterns of female *Philanthus*. Figs. 14-16. Side view of head of male *Philanthus*.



10. gibbosus



11. nasalis



12. zebratus



13. inversus



14. pacificus

15. pulcher

16. neomexicanus

PLATE III

Figs. 17, 20, 21, 24. Dorsal view of abdomen in female *Philanthus* to show pattern and punctation.

Figs. 18, 19, 22, 23. Scutum of female Philanthus to show pattern and punctation.



Bulletin of the California Insect Survey

PLATE IV

Figs. 25, 28, 29, 30, 31. Dorsal view of abdomen in female *Philanthus* to show pattern and punctation.

Figs. 26, 27. Scutum of female Philanthus to show pattern and punctation.


PLATE V

Figs. 32-37. Dorsal view of abdomen in female *Philanthus* to show pattern and punctation.



35. crabroniformis

36. multimaculatus

37. bicinctus

Bulletin of the California Insect Survey

PLATE VI

Figs. 38-40. Dorsal view of abdomen in female *Philanthus* to show pattern and punctation.

Figs. 41-46. Vertex and ocellar area of male *Philanthus* to show pattern and punctation.



44. inversus

45. zebratus

46. arizonicus

PLATE VII

Figs. 47, 48. Dorsal view of pygidium in female Clypeadon.

Fig. 49. Dorsal view of pygidium in female Listropygia.

Figs. 50-52. Lateral view of tegula and sclerites below alar fossa in female Aphilanthops.

Fig. 53. Dorsal outline of pygidium in female Aphilanthops.

Figs. 54-57. Facial pattern in female Aphilanthops.

Fig. 58. Facial pattern in female Clypeadon.

Fig. 59. Facial pattern in female Listropygia.

APHILANTHOPSINI ₽



PLATE VIII

Figs. 60, 62, 63, 65, 66, 68, 69, 71. Lower part of face in female Eucerceris (punctation omitted).

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Figs. 61, 64, 67, 70. Outline of pygidial plate in female Eucerceris.

EUCERCERIS ♀



PLATE IX

Figs. 72, 74, 75. Lower part of face in female Eucerceris (punctation omitted).

Figs. 73, 76. Outline of pygidial plate in female Eucerceris.

Fig. 77. Facial pattern in male Eucerceris.

Figs. 78-80. Pygidium of male Eucerceris.

Fig. 81. Clypeus of male Cerceris to show punctation.

Fig. 82. Profile of last two flagellomeres of male Cerceris.

Fig. 83. Pygidium of male Cerceris (punctation omitted).

Figs. 84, 85. Profile of hindbasitarsus in male Cerceris.



PLATE X

Figs. 86, 88, 89, 91, 92, 94, 95, 97, 98, 100. Clypeus of male Cerceris to show punctation and apicolateral brushes.

Figs. 87, 96, 99. Profile of last two male flagellomeres. Figs. 90, 93. Pygidium of male *Cerceris* to show pubescence.



98. vanduzeei

100. minax

PLATE XI

Figs. 101, 106, 108, 109, 111, 112, 114. Lower part of face in female Cerceris (punctation omitted).

Figs. 102, 103, 107, 110, 113. Profile of face of female Cerceris.

Fig. 104. Outline of pygidial plate in female Cerceris.

Fig. 105. Sculpture of pygidial plate in female Cerceris.



PLATE XII

Figs. 115, 118, 119, 122, 123, 126. Lower part of face of female Cerceris. Figs. 116, 120, 124. Lateral view of face of female Cerceris. Figs. 117, 125. Pygidial plate of female Cerceris to show sculpture. Figs. 121, 127-132. Outline of pygidial plate in female Cerceris.



PLATE XIII

•

Figs. 133, 135, 136, 138, 139, 141, 142. Lower part of face of female Cerceris (punctation omitted). Figs. 134, 137, 140, 143-145. Outline of pygidial plate in female Cerceris.



PLATE XIV

Figs. 146-148. Seasonal distribution of three species of *Philanthus* based on collecting data from the specimens examined. Black columns represent males, white columns are females.

2

ł



PLATE XV

Figs. 149-151. Seasonal distribution of three species of *Philanthus* based on collecting data from the specimens examined. Black columns represent males, white columns are females.



INDEX TO SPECIES AND SUBSPECIES NAMES IN PHILANTHINAE

(Synonyms are in italics)

| Pag | e |
|---------------------------------------|---|
| abbreviata Banks (Cerceris)5 | 0 |
| acanthophila Cockerell (Cerceris) 3 | 8 |
| aequalis Provancher (Cerceris) 3 | 8 |
| albopilosus Cresson (Philanthus) | 6 |
| ampla Banks (Cerceris) 4 | 8 |
| anna Dunning (Philanthus)1 | 2 |
| annae Dunning (Philanthus)1 | 2 |
| apicata Banks (Eucerceris) | 2 |
| arelate Banks (Cerceris) 4 | 9 |
| arenaria Scullen (Eucerceris) | 8 |
| argyrotricha Rohwer (Cerceris) 4 | 1 |
| arizonae Dunning (Philanthus) 1 | 5 |
| arizonicus R. Bohart (Philanthus) | 6 |
| arno Banks (Cerceris) | 1 |
| assimilis Banks (Philanthus) | 5 |
| athene Banks (Cerceris) 4 | 6 |
| atronitida Scullen (Eucerceris) 29 | 9 |
| bakeri Dunning (Aphilanthops) 2 | 0 |
| banabacoa Alayo (Philanthus) | 6 |
| barbatus F. Smith (Philanthus) | 6 |
| barbiger Mickel (Philanthus) | 8 |
| barri Scullen (Eucerceris) | 3 |
| basilaris Cresson (Philanthus) 19 | 9 |
| beali Scullen (Cerceris) | 9 |
| bechteli (R. Bohart) (Listropygia) 26 | 5 |
| bechteli R. Bohart (Aphilanthops) 20 | 6 |
| belfragei Banks (Cerceris) 4 | 3 |
| bicinctus Mickel (Philanthus) | 5 |
| biconica Scullen (Eucerceris) 29 | 9 |
| bicornuta Guérin (Cerceris) 39 | 9 |
| bidentata Say (Cerceris) 29 | 9 |
| bilunatus Cresson (Philanthus) | 6 |
| bitruncata Scullen (Eucerceris) 32 | 2 |
| bridwelli Scullen (Cerceris) 40 | 0 |

ţ

| californica Cresson (Cerceris) 41 |
|--|
| californicus Cresson (Philanthus) 8 |
| californicus R. Bohart (Aphilanthops) . 23 |
| californicus (R. Bohart) (Clypeadon) 23 |
| calodera Banks (Cerceris) |
| canaliculata (Say) (Eucerceris) 29 |
| canaliculatus Say (Philanthus) 29 |
| chapmanae Vier. & Ckll. (Eucerceris) 30 |
| chilopsidis Cockerell (Philanthus) 10 |
| chilopsidis Vier. & Ckll. (Cerceris) 42 |
| cingulatus Cresson (Eucerceris) 30 |
| citrina Scullen (Cerceris) 46 |
| clarconis Viereck (Philanthus) 16 |
| cleome Dunning (Philanthus) 12 |
| clypeata Dahlbom (Cerceris) |
| cochisi Scullen (Cerceris) |
| cockerelli Dunning (Philanthus) 10 |
| cockerelli Viereck (Cerceris) |
| cognata Mickel (Cerceris) 41 |
| compacta Cresson (Cerceris) 43 |
| complanataMickel (Cerceris) |
| completa Banks (Cerceris) 44 |
| completus Banks (Philanthus) 18 |
| conata Scullen (Eucerceris) |
| concinnulus Cockerell (Aphilanthops) . 25 |
| conifrons Mickel (Cerceris) 44 |
| convergens Vier. & Ckll. (Cerceris) 45 |
| crabroniformis F. Smith (Philanthus) 8 |
| crawfordi Brimley (Cerceris) 50 |
| cressoni (Schletterer) (Eucerceris) 29 |
| cressoni Schletterer (Cerceris) 29 |
| crotoniphilus Vier. & Ckll. (Philanthus) 9 |
| crucis Vier. & Ckll. (Cerceris) 50 |
| curvicornis Cameron (Cerceris) 39 |
| dawsoni Swenk (Nomada) |

| dreisbachi (R. Bohart) (Clypeadon) 23 |
|---|
| dufourii Guérin (Cerceris) |
| eburnea Scullen (Cerceris) |
| echo Mickel (Cerceris) |
| elegans Cresson (Eucerceris) |
| elsiae Dunning (Aphilanthops) 22 |
| eriogoni Vier. & Ckll. (Cerceris) 49 |
| eurymele Banks (Cerceris) |
| evansi R. Bohart (Clypeadon) 24 |
| femurrubrum Vier. & Ckll. (Cerceris) 46 |
| ferruginior Vier. & Ckll. (Cerceris) 41 |
| ferruginosa Scullen (Eucerceris) 31 |
| fidelis Vier. & Ckll. (Cerceris) 39 |
| finitima Cresson (Cerceris) |
| flavifrons Cresson (Philanthus) 8 |
| flavocincta Cresson (Eucerceris) 30 |
| foxi Dunning (Aphilanthops) 20 |
| frigidus F. Smith (Philanthus) 20 |
| frontalis Cresson (Philanthus) 18 |
| frontata Say (Cerceris) |
| fulvipes Cresson (Eucerceris) 29 |
| garciana Vier. & Ckll. (Cerceris) 41 |
| gibbosa Fabricius (Vespa) 9 |
| gibbosus (Fabricius) (Philanthus) 9 |
| gloriosus Cresson (Philanthus) 11 |
| grandis Banks (Cerceris) |
| graphica F. Smith (Cerceris) 48 |
| haigi R. Bohart (Aphilanthops) 24 |
| haigi (R. Bohart) (Clypeadon) 24 |
| hebes Cameron (Cerceris) |
| hesperina Banks (Cerceris) 45 |

92

Bulletin of the California Insect Survey

| hirticeps Cameron (Philanthus) 15 |
|---|
| hispidus W. Fox (Aphilanthops) 21 |
| huachuca Banks (Cerceris) |
| |
| illota Banks (Cerceris) |
| illustris Mickel (Ococletes) |
| insignatus Banks (Philanthus) 11 |
| insignis Provancher (Eucerceris) 32 |
| inversus Patton (Philanthus) |
| isolde Banks (Cerceris) |
| kennecottii Cresson (Cerceris) 49 |
| arvata Taschenherg (Cerceris) 48 |
| laticinctus Cresson (Philanthus) 25 |
| laticinetus (Cresson) (Clyneadon) 25 |
| lenidus Cresson (Philanthus) |
| levini D Bohart (Dhilanthus) |
| |
| macrosticta Vier. & Ckll. (Cerceris) 48 |
| macswaini Scullen (Cerceris) 49 |
| maculiventris Cameron (Anthophilus) . 10 |
| magnifica Provancher (Liris) |
| melanaspis Cameron (Anthophilus) 10 |
| michelbacheri R. Bohart (Philanthus) . 6 |
| minax Mickel (Cerceris) |
| mojavensis Scullen (Eucerceris) 31 |
| monoensis Scullen (Eucerceris) 31 |
| multiannulatus Dalla Torre (Philanthus) 12 |
| |
| multimaculatus Cameron (Philanthus) . 12 |
| multimaculatus Cameron (Philanthus) . 12 munda Mickel (Cerceris) |
| multimaculatus Cameron (Philanthus) . 12 munda Mickel (Cerceris) |
| multimaculatus Cameron (Philanthus) .12 munda Mickel (Cerceris) |
| multimaculatus Cameron (Philanthus). 12munda Mickel (Cerceris) |
| multimaculatus Cameron (Philanthus). 12munda Mickel (Cerceris) |
| multimaculatus Cameron (Philanthus). 12munda Mickel (Cerceris) |
| multimaculatus Cameron (Philanthus). 12munda Mickel (Cerceris) |

| nigritulus Banks (Cerceris) |
|---|
| nigroris Banks (Cerceris) |
| nitens Banks (Ococletes) |
| nodosus Klug (Anthophilus) 10 |
| |
| occidentalis Saussure (Cerceris) 47 |
| occidentalis Strandtmann (Philanthus) . 14 |
| |
| pacificus Cresson (Philanthus) 15 |
| percna Scullen (Cerceris) |
| pimarum Rohwer (Eucerceris) 32 |
| politus Say (Philanthus) |
| populorum Vier. & Ckll. (Cerceris) 41 |
| provancheri (Dalla Torre) (Eucerceris) . 32 |
| provancheri Dalla Torre (Cerceris) 32 |
| psamathe Banks (Cerceris) |
| psyche Dunning (Philanthus) 6 |
| pudorosa Mickel (Cerceris) |
| pulchellus Cresson (Philanthus) 16 |
| pulcher Dalla Torre (Philanthus) 16 |
| punctatus Say (Philanthus) |
| punctiger Westwood (Cheilopogonus) . 10 |
| |
| quadrinotatus Ashmead (Aphilanthops) 25 |
| |
| raui Rohwer (Cerceris) |
| rinconis Vier. & Ckll. (Cerceris) 45 |
| ruficeps Scullen (Eucerceris) |
| rufinoda Cresson (Cerceris) 50 |
| sanbornii Cresson (Philanthus) 5 |
| sandiegensis Scullen (Cerceris) 51 |
| schusteri R Bohart (Philanthus) 16 |
| sculleni (R. Bohart) (Clypeadon) 23 |
| serrulatae Dunning (Philanthus) |
| sextoides Banks (Cerceris) |
| similis Cresson (Eucerceris) 33 |
| simplex F. Smith (Cerceris) 48 |
| |

| simulatrix Vier. & Ckll. (Eucerceris) 29 |
|--|
| siouxensis Mickel (Philanthus) 6 |
| snowi Banks (Cerceris) |
| solidaginis Rohwer (Cerceris) 43 |
| solivagus Say (Philanthus) 6 |
| strandtmanni Burks (Philanthus) 18 |
| striareata Vier. & Ckll. (Eucerceris) 30 |
| subfrigidus Dunning (Aphilanthops) 22 |
| sublimus Cresson (Philanthus) 8 |
| subversus Banks (Philanthus) |
| |
| tarsatus H. Smith (Philanthus) 6 |
| taurulus (Cockerell) (Clypeadon) 23 |
| tepaneca Saussure (Cerceris) |
| texensis Saussure (Cerceris) |
| thione Banks (Cerceris) |
| |
| utahensis Baker (Anhilanthons) 25 |
| utahensis (Raker) (Clypeadon) 25 |
| |
| vanduzeei Banks (Cerceris) |
| varians Mickel (Cerceris) |
| venator Cresson (Cerceris) |
| ventilabris Fabricius (Philanthus) 17 |
| ventralis Mickel (Ococletes) |
| vertilabris Fabricius (Philanthus) |
| vicinoides Vier & Ckll (Cerceris) 38 |
| wierocki Banks (Cerceris) 46 |
| vittatifrane Crasson (Eucarcarie) |
| Vitalinous Clesson (Eucercens) |
| xanthostigma Cameron (Philanthus) 10 |
| |
| yakima Banks (Philanthus)12 |
| zebratus Cresson (Philanthus) |
| |