

A REVISION OF THE  
NORTH AMERICAN  
FLIES BELONGING TO THE  
GENUS *RHAPHIOMIDAS*  
(DIPTERA, APIOCERIDAE)

MONT A. CAZIER

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## ABSTRACT

The present revision covers all known species of flies belonging to the genus *Rhaphiomidas* from the United States and Mexico. Keys to identify both males and females (when known) are presented as are formal descriptions of nine new species, *Rhaphiomidas auratus*, *forficatus*, *hasbroucki*, *hirsuticaudus*, *nigricaudis*, *socorroae*, *spinicaudus*, *tarsalis*, *undulatus*, two new subspe-

cies, *xanthos vittatus*, *episcopus michelbacheri* and 12 previously described species for a total of 23 taxa. Included are seven distributional maps of all the species and subspecies, three figures showing typical habitats, one figure showing labeled structures and 10 figures of abdominal maculation patterns.

## INTRODUCTION

I published the last revision of the flies belonging to the genus *Rhaphiomidas* in 1941 and added one new species in 1954, bringing the total known fauna at that time to 12 species. While I was working on the latter paper it became obvious that more specimens would be necessary for the proper interpretation of several of the species, and that the internal structures of the male terminalia should be studied and used for the first time. Accordingly the study was set aside for more than 20 years during which time many hundreds of specimens from critical areas were collected. Coincidentally, many specimens were accumulated by the museums, universities, and private individuals, primarily in the western states, which greatly augmented my collection.

By 1982 I had available more than 5000 specimens of these rare flies, representing all previously known species, nine new species, two new subspecies, and a considerable amount of new ecological, behavioral, and distributional data. I assumed that such an accumulation of specimens and data was worthy of synthesis for the benefit of science and anyone interested in these rather unusual insects. Thus the following revision is presented.

Historical account: The genus *Rhaphiomidas* was established by Osten Sacken in 1877 with the description of *R. episcopus*, an endemic species occurring only on the southern end of Baja California Sur, Mexico. The type species is therefore *R. episcopus* by original designation. In 1892 Coquillett described *Apomidas* for his central California species, *A. trochilus*, but this genus is a synonym (Cazier, 1941) of *Rhaphiomidas* with

the type species being *A. trochilus* by original designation. The known *Rhaphiomidas* fauna of North America began with the description of *episcopus* by Osten Sacken in 1877, his only contribution in this genus. Coquillett added *acton* Coquillett in 1891 and *trochilus* (Coquillett) in 1892. In 1895 Townsend described *xanthos* and *mellifex*, the former represented only by males and the latter only by females. *R. mellifex* was synonymized under *xanthos* by Cazier (1941). For the next 46 years the genus was represented by the five names, as given above, and in 1941 this was reduced to four with the placement of *mellifex* as a synonym of *xanthos*. In 1941 Cazier added seven new species and in 1954 one additional one. The new additions were *terminatus*, *painteri*, *aitkeni*, *abdominalis*, *parkeri*, *maehleri*, *maculatus*, and *brevirostris*. Prior to the present paper there were 12 known species in North America. In the present paper nine new species and two new subspecies bring the total to 23 taxa for the genus *Rhaphiomidas*. The new species and subspecies herein proposed are *forficatus*, *socorroae*, *spinicaudus*, *auratus*, *undulatus*, *nigricaudis*, *hirsuticaudus*, *hasbroucki*, *tarsalis*, *xanthos vittatus*, *episcopus michelbacheri*.

In 1936, Painter reviewed the genus *Rhaphiomidas* in his paper on the family Apioceridae in North America and gave keys to the then known four species. In 1941 Cazier presented a review of the genus and included keys to both males and females of the then known 11 species. In 1954 Cazier revised the 1941 keys, including the new species *brevirostris* Cazier for a total of 12 species. In the present work a key to the males of all 23 species and subspecies are included. The key

to the females covers 20 species and subspecies as *xanthos vittatus* new subspecies; *spinicaudus*, new species, and *socorroae* new species are as yet unknown.

Distribution: At the present time the family Apioceridae is composed of five genera distributed as follows: *Magascelis* Philippi (1865), endemic in Chile; *Tongamyia* Stuckenberg (1966), endemic in southern Africa; *Apiocera* Westwood (1835), discontinuous north and south temperate areas of the world generally; *Neorhaphiomidas* Norris (1936), endemic in southwestern Australia; and *Rhaphiomidas* Osten Sacken (1877), endemic in western United States and northwestern Mexico.

The northernmost records for *Rhaphiomidas* in North America are for *trochilus* Coquillett from Antioch, Contra Costa County, California and for intergrades between *acton* Coquillett and *maehleri* Cazier from the vicinity of Mono Lake, Mono County, California (map 7). Both locations are on or near 38° north latitude. The westernmost record appears to be the *trochilus* Antioch location which is on or near longitude 122° (map 5). The easternmost extent appears to be in the United States for *painteri* Cazier from locations near the Rio Grande River in New Mexico and Texas at about longitude 107° (map 6). The records for *episcopus episcopus* Osten Sacken from near Cabo San Lucas on the tip of Baja California Sur, Mexico are the southernmost records at present (map 4). This locality is near the junction between the Tropic of Cancer and longitude 110°.

The species are not evenly distributed among the states comprising the total area. California has six endemic species, shares an additional five species with Arizona, one subspecies with Baja California Norte, and an additional two species with southern Nevada for a total of 14 species and subspecies. Mexico is second to California with five endemic species and subspecies in Baja California Sur, two endemic species in Baja California Norte and one endemic species in northern Sonora for a total of 8 species and subspecies. New Mexico shares one species with Texas and Arizona and Nevada have no endemic species or subspecies. I would expect that additional species will be found in the Mexican states of Sonora, Sinaloa, Nayarit, Jalisco, and per-

haps Colima when these states are more thoroughly collected, also, from the area between the Colorado River in Arizona and the Rio Grande River in New Mexico and possibly Texas. The very rapid flight and other difficulties in capturing these flies is probably responsible for these distributional gaps.

The species have been found near sea level on Coronado Island, San Diego County; Manhattan Beach, Los Angeles County; Antioch, Contra Costa County all in California; and 5 miles south of Riito, Sonora, Mexico, in dune deposits back of ocean or river beaches. Near Indio at the northern end of Salton Sea, Riverside County, California, *acton* intergrades with *maehleri* have been taken at and a few feet below sea level. The highest record appears to be for *acton* intermediates with *maehleri* from the vicinity of Mono Lake, Mono County, California at about 6500 feet. The locations near Las Cruces, Dona Ana County, New Mexico for *painteri* are around 3800 feet in altitude and the record for *parkeri* Cazier in Molino Basin, Santa Catalina Mountains, Pima County, Arizona is at about 4200 feet.

Ecology: Most of the available information has been gathered by collectors and consists of brief notes on specimen labels as to types of habitats, behavior patterns, resting sites, or flying and feeding observations. However, Cazier (1941) recorded some biological information on *parkeri* as transmitted by F. H. Parker who observed the females of this species inserting their abdomens into soft sand in sheep tracks and other depressions. If undisturbed the females spent one to two minutes, presumably laying eggs, then removed the abdomen from the sand and flew to other depressions and repeated the performance. Although no eggs were found because of the loose sand, this was almost certainly oviposition behavior similar to that observed by me for *Apiocera painteri* (Cazier, 1963). Furthermore, this observation in addition to the structural similarities between *Rhaphiomidas* and *Apiocera* females supports their affinity for sandy habitats. The females of both genera have retrorse hairs on the apical abdominal segments, usually segments five, six and seven, their genital opening is surrounded by movable acanthophorites and the abdomen is extensible, all of these structural

modifications enable them to insert the eggs into soft sandy substrate. In addition, Hogue (1967) reported the emergence of a male *terminatus terminatus* Cazier from a pupal case in a sandy flat area on the landward edge of a coastal sand dune which separated the area from the ocean. Furthermore, most information on labels indicates this preference for sandy types of habitats and observations on 16 of the 23 species and subspecies confirms such a preference. Since this involves both oviposition and evidently larval and pupal situations, I consider this the primary ecological requisite for the genus *Rhaphiomidas*. Secondarily, they evidently require at least sparse plant cover on which to rest, mate, seek protection, and nectar. This plant cover may also be involved in the selection of the exact oviposition site, as it is in *Apiocera* (Cazier, 1963, 1982).

Sand dunes, whether unconsolidated or partially or almost completely consolidated, are favored by many species, and the flies are especially abundant around the sparsely vegetated edges. In extensive low lying, sandy, partially consolidated dune areas the flies occur throughout the sparsely vegetated portions. In dunes bordering the ocean they are almost entirely confined to the landward sides or to the secondary dunes back of the beaches. In sand deposits along the shores of rivers and lakes they are usually widely scattered and evidently have little or no preference to areas close to the water. Thus far, none has been recorded drinking either free or bound water and their moisture requirements are evidently satisfied by the nectar they imbibe. In some situations the flies have been collected outside their preferred areas but never very far from sandy situations. One specimen of *tarsalis*, new species, was taken in a black light trap and a female of *acton acton* was found in a Malaise trap. Specimens of *auratus*, new species, were collected on plants growing on an alkaline flat. Specimens of *acton maehleri* have been collected along a dusty, sandy road, in sand blowouts and several specimens have been found dead on the ground or impaled in the radiators of cars and flying in refuse areas. These records are unusual and the exception rather than the rule.

The majority of species about which in-

formation is available prefer the semiconsolidated dune deposits irrespective of the location (fig. 1). Such species include; *hasbroucki*, new species, *brevirostris*, *parkeri*, *tarsalis*, *socorroae*, *terminatus terminatus*, and *acton maehleri*. Those found along the edges of unconsolidated dunes include *trichilus* and *hirsuticaudus*, new species. In sandy areas without dunes one can find *parkeri*, *undulatus*, new species, *acton acton*, and *acton maehleri*. Specimens of *nigricaudis*, new species, and *forficatus*, new species, have been collected along dry, rocky washes but sandy areas were nearby.

Information on the relationship between *Rhaphiomidas* species and their plant associations is sketchy and often confusing due to incomplete data as to what the flies were doing. The long proboscis makes it possible for them to gather or feed on the nectar without contacting the pollen so the only authentic feeding records would depend on the observer seeing the proboscis inserted into the flower. The presence of pollen on the fly could mean either its sitting on the flower or feeding on deeply imbedded nectaries. Definite feeding has been recorded for *nigricaudis* on sage, *Salvia* species, for *undulatus* on sage, *Salvia apiana* Jepson, for *parkeri* on sand verbena, *Abronia* species, and for *acton maehleri* on wild buckwheat, *Eriogonum fasciculatum* Benth. Flower sitting records are known for *nigricaudis* on rosemary mint, *Poleomintha incana* (Torrey) Gray, for *xanthos vittatus* on *Antigonon leptopus* Hook and Arnott, for *acton maculatus* Cazier on *Eriastrum densifolium* (Benth.) Mason and for *acton maehleri* on hairy-headed sunflower, *Geraea canescens* T. & G., *Gilia erimica* (Jepson) H. L. Mason and sage, *Salvia victosa* = *riparia* H.B.K.

Similarly, plant records without flower indications could mean that the flies were either mating or sitting in the shade to escape the heat, hiding from the males, or getting ready to "sleep" there for the night. Specimens found just sitting on plants for reasons other than mating include *nigricaudis* on desert ironwood, *Olneya tesota* Gray; for *terminatus terminatus* on *Eriastrum filifolium* (Nuttall) Wootton and Standley; for *auratus*, new species on greasewood, *Sarcobatus* species, on salt bush *Atriplex* species and on indigo





FIG. 1. *Rhaphiomidas parkeri* and *R. acton maehleri*. Habitat 6 miles southeast of Parker, Yuma County, Arizona. Photograph by J. M. Davidson.

bush, *Dalea* species; for *tarsalis* on sandpaper plant, *Petalonyx thurberi* Gray; for *parkeri* on various small shrubs in an area of creosote bush, *Larrea tridentata* (De Candolle) Coville and on mesquite, *Prosopis juliflora* (Swartz) DC.; for *brevirostris* on dead wolfberry, *Lycium* species (fig. 2), mesquite, *Prosopis juliflora*, creosote bush, *Larrea tridentata*, bursage, *Franseria* species and joint fir, *Ephedra* species; for *hirsuticaudus* on creosote bush, *Larrea tridentata* and desert ironwood, *Olneya tesota*. Sitting on plants for mating purposes has been observed in *hambroucki* on creosote bush, *Larrea tridentata*, joint fir, *Ephedra* species, big galleta, *Hilaria rigida* (Thurber) Bentham, rosemary mint, *Poliomintha incana* (Torrey) Gray, mesquite, *Prosopis juliflora*, desert ironwood, *Olneya tesota*; and for *brevirostris* on dead wolfberry, *Lycium* species.

Seasonal occurrence as indicated by data on specimens (inclusive dates) indicates a rough division into three time periods that are only loosely correlated with geographical distribution. The early spring species (March–May) would include *forficatus*, April 14–15, from the northern portion of Baja California Sur; *nigricaudis*, April 9–May 23, from southern California and southwestern Arizona; and *spinicaudus*, March 30, from middle Baja California Norte. The midsummer group of species, by far the largest number (May–September), also the most widely distributed and of the longest duration includes *acton acton*, May 2–September 6, from southern California; *acton maculatus*, May 17–July 11, from southern California and northern Baja California Norte; *acton maehleri*, April 1–October 27, from southern California and southwestern Arizona; *aitkeni*,

May 28–July 15 and *auratus*, May 13–July, both from the southern third of California and southwestern Nevada; *brevirostris*, June 4–13, from northwestern Sonora, Mexico; *hasbroucki*, May 7–June 29, from southeastern California and southwestern Arizona; *parkeri*, April 8–June 28, from southeastern California, southcentral and southwestern Arizona and northwestern Sonora, Mexico; *socorroae*, May 17–18, from middle Baja California Norte; *tarsalis*, May 24–July 15, from the southern quarter of California; *terminatus terminatus*, July 15–August 6, from southwestern California; *trochilus*, July 3–September 9, from middle western California; and *undulatus*, May 10–June 17, from southern California. Those species and subspecies that appear primarily in late fall include *episcopus episcopus*, September 4–30, *episcopus michelbacheri*, August 27–October 17, *xanthos xanthos*, August 11–September 30, *xanthos vittatus*, October 8–9, all four being from extreme southern Baja California Sur; *terminatus abdominalis*, August 3–September 24, from southwestern California; *painteri*, September 8–23, from southwestern New Mexico; *hirsuticaudus*, September 3–February 23, from southeastern California and southwestern Arizona. The above seasons are of course limited and not natural as they are based on the activities of collectors and not on natural phenomenon. Also, some species have only one or a few collection records to draw upon, e.g., *socorroae*, *forcicatus* and *spinicaudus*, for which only one collection each has been made.

**General behavior:** Most of the species of *Rhaphiomidas* occur in arid and semiarid areas where they are exposed at times to high temperatures and to extreme fluctuations in temperatures that necessitate some sort of protection. Limited protection is undoubtedly afforded by their hairiness which traps an insulating layer of air on the body surface, e.g., *parkeri* and *brevirostris*. They lack the waxy pruinosity that aids in preventing water loss in *Apiocera*. Most of their protection appears to be in their strong, very rapid flight and in their use of plants for shade and perching. Before the sand heats up to an intolerable degree, the flies can usually be found sitting out in the open sand with their wings folded over their back or sometimes extending at

right angles to the body, the tips nearly touching the sand, e.g., *trochilus*. When the substrate becomes intolerably hot, about 12:00 noon, the flies move into the shade of plants or up into them where they can be found from a few inches to several feet above ground on exposed roots, e.g., *hasbroucki* or on sturdy vertical twigs or branches, e.g., *brevirostris* (fig. 2). During the period of maximum heat, between 12:30 PM and 4:00 PM the females prefer to sit on shaded branches or to make occasional short flights between plants or into the flight paths of the males, e.g., *hasbroucki* and *brevirostris*. The males can be found in the same situations with the females or more commonly, especially during breeding season, cruising about looking for the females. During these cruising flights the speed of flight is moderate and the males are most easily captured. When disturbed or pursued their flight is so rapid as to make them nearly invisible. Oviposition behavior has been recorded only once and the observations were made in late afternoon, 3:30–7:00 PM, after the substrate began to cool, e.g., *parkeri*. Where they spend the night is unknown.

Feeding has been observed a number of times for a few species and consists of the fly hovering over the flower while inserting its long proboscis presumably into the nectaries. Several insertions are usually made into each composite flower and the fly is especially vulnerable while in this hovering high-pitched buzzing flight.

For additional details on behavior the reader is referred to the ecology and behavior sections under *parkeri*, *brevirostris*, *trochilus*, and more especially *hasbroucki*.

**Natural enemies:** Aside from bug collectors, mainly humans, the only natural enemy known for *Rhaphiomidas* species is a robber fly *Proctacanthus nearo* Martin (determined by Eric Fisher) a large male of which was found feeding on a male of *Rhaphiomidas hasbroucki*.

#### ACKNOWLEDGMENTS

The present paper, as in *Apiocera*, is based largely on my first, modest apiocerid collection, which is housed in the American Museum of Natural History, New York, on the numerous specimens borrowed from many



FIG. 2. *Rhaphiomidas brevirostris*. Female perched on dead *Lycium* twig, 39 miles north of Puerto Penasco, Sonora, Mexico. Photograph by J. M. Davidson.

individuals and institutions, and on the recent collections I made and deposited in the Arizona State University Collection. I especially thank Dr. Frank F. Hasbrouck, Curator in charge of the Arizona State University Collection, for allowing me unrestricted use of this material, for permission to place the primary types described from specimens in this collection in the American Museum of Natural History, and for permitting me to exchange material and distribute secondary types in various university, museum, and private collections. My thanks and appreciation are also extended to Drs. Lee H. Herman, Curator, and R. T. Schuh, Chairman and Curator of the Department of Entomology, American Museum of Natural History, for their assistance and their enduring patience with the loan of specimens which has been long overdue; my apology.

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#### ABBREVIATIONS

- AMNH, American Museum of Natural History, New York.
- ASU, Arizona State University, Tempe.
- CAS, California Academy of Sciences, San Francisco.
- EME, Essig Museum of Entomology, University of California, Berkeley.
- LACM, Los Angeles County Museum, Los Angeles.
- MAC, Mont A. Cazier
- MCZ, Museum of Comparative Zoology, Cambridge.
- NSDA, Nevada State Department of Agriculture, Reno.
- SDMNH, San Diego Museum of Natural History, San Diego.
- UCB, University of California, Berkeley.
- UCD, University of California, Davis.
- UCIS, University of California Insect Survey.
- UCR, University of California, Riverside.
- UK, University of Kansas, Snow Collection, Lawrence.
- USNM, National Museum of Natural History, Smithsonian Institution, Washington, D.C.
- USU, Utah State University, Logan.

#### MATERIALS AND METHODS

In 1954 when I made a preliminary exploratory examination of the male terminalia structures enclosed in the large external terminalia of *Apiocera* and *Rhaphiomidas* I found few usable characteristics in the latter genus among the 12 species then known. In

contrast, many definitive differences at both group and specific levels were found in the terminalia structures of *Apiocera* (Cazier, 1982). Part of this difference was due to the greatly reduced and simplified terminalia in *Rhaphiomidas*, and another part to the fact

that at that time only two of the species (*parakeri* and *brevirostris*) exhibited differences, and both of these were so abundantly distinct in easily seen characters that the internal differences were largely ignored or deemed unnecessary. This position has been made untenable by the discovery of several new species that exhibit unique and rather startling differences in the inner structures, the aedeagus, and in the inner surface of external structures such as the hemitergites, and to a lesser extent the gonostyles and their lateral inner lobes. It has, therefore, become necessary to open the large hemitergites to expose the inner surfaces and structures even though some of these can be viewed more or less satisfactorily through the dorsal and ventral openings. The only really satisfactory method of doing this, as with *Apiocera*, is to spread the hemitergites apart while the specimen is still fresh and relaxed. This, of course, has obvious limitations in a study of this kind and a method of doing this with old dry specimens had to be devised. The method described below is difficult, complicated, and damages the color, maculation, and pilosity of the specimens. However, it opens the hemitergites and is applicable when a series of males is available.

In fresh material opening the terminalia poses no problem. The specimen is mounted and pinned into a thick (1 inch) styrofoam block so that the venter is on the styrofoam surface. Brace pins are placed on each side of the abdomen just anterior to the base of the terminalia. The hemitergites can then be teased apart and braced outward at about a 90° angle from the body for drying. The membranous anal tube overlaying the aedeagus can then be braced to one side or basally out of the way.

Unfortunately, dried specimens pose quite a difficult problem, especially since the abdomen cannot be broken between segments four and five without destroying some characteristics. Relaxing the entire specimen has proved unsatisfactory in softening the large basal muscles holding the hemitergites in position, and when moistened for a long period other parts of the specimen will begin to disintegrate. A number of different techniques have been tried over the years but the one described below, although far from perfect, has worked well for me.

To begin with you should have a supply of styrofoam strips, some  $\frac{3}{4}$  to 1 inch thick by 2 to 3 inches wide, by 6 to 8 inches long and some others  $\frac{1}{2}$  inch thick by 1 inch wide by the same length as the thicker strips. The narrow thinner strips should be glued to the top of the wider strips with the edges of both strips flush on one side so that the other side of the top forms a step. The exposed portion of the bottom strip will be about 1 inch wide, the step up will be about  $\frac{1}{2}$  inch higher and 1 inch wide. A second piece of  $\frac{1}{2}$ -inch-thick styrofoam by  $1\frac{1}{2}$  inches wide by 5 or 6 inches long has a small piece of  $\frac{1}{2}$ -inch styrofoam by  $1\frac{1}{2}$  inches long by  $\frac{1}{2}$ -inch wide glued to the top of the 5- or 6-inch piece so that the edges of the two pieces are flush on one side. The larger stepped piece is to be used for spreading the hemitergites and drying the specimens, and its length can be determined by the number of specimens you intend to relax at a sitting and the convenience in handling. I found a 1-foot length to be most convenient. The smaller piece has to be fairly exact as it is going to be used upside down on top of a beaker of heated water but can be adjusted to the size of the beaker. I found it best to do one or two specimens at a time and that a 250-milliliter beaker with a top diameter of about  $2\frac{3}{4}$  inches worked best. This piece is going to be used to hold the mounted specimen in the warm to hot water so that only the terminalia is submerged. An electric hot plate with a  $4\frac{1}{2}$ -inch-diameter top and a regulator of temperatures up to 500°F worked very well. Although not necessary you might want some crystals of chlorocresol to put in the water to speed the relaxing process. A teaspoonful per beaker was found to be adequate but was seldom used.

A few minutes before you are ready to begin, put the beaker of water on the hot plate and turn the thermostat up to 500°F. In about 10 minutes bubbles will begin to rise to the top, indicating the start of boiling which you do not want. Turn the thermostat down to 100°F and wait about 5 minutes for the excessive heat to dissipate. The amount of water necessary is determined before you heat it and is dependent on the size of the specimen and where you pin it in the block. Pin the specimen into the flush face of the small block, held with small piece downward, so that the

abdomen is hanging downward and put the block upside down toward one side of the beaker top so the specimen does not touch the beaker. Then fill the beaker with water until the terminalia is covered and mark the level on the outside of the beaker for future reference. Heat the water, insert the specimen and leave it for from 15 to 45 minutes depending on the size and the species. Not all species or specimens relax in the same amount of time so testing from time to time is necessary after the first 15 minutes. The height of the water level on the specimen can also be regulated by moving the specimen upward or downward on the block.

If you have a choice of specimens to be dissected, select individuals in which the wings and legs are away from the apical abdominal segments and as high up as possible. For testing the state of relaxation or for final spreading remove the specimen from the water and pin it on the lower step of the large block so that the terminalia and apical two abdominal segments overhang the surface of the upper step. Push the pin downward so the terminalia rests on the surface of the upper step and cross two insect pins, one from each side, over the top of the abdomen just anterior to the base of the terminalia, pressing them down on the segment to prevent lateral movement. With the specimen so anchored take an insect pin in each hand and coming in from each side put outward pressure on the hemitergites. If they fail to move, put the specimen back in the warm water and test again later. If the hemitergites are movable anchor them outward at a 90° or greater angle from the long axis of the body. If the hemitergites move apart with reluctance brace them slightly apart and break the basal muscle by picking it apart with an insect pin. Let the specimen dry for 24 hours or less depending on the temperature.

A relatively small number of specimens will become greasy no matter how much care is exercised in collecting, killing, and preparing the specimens for study. Most of these can be degreased with solvents, such as white gas or acetone which have high solvency but which are dangerous because of their flammability. Neither should be used in the vicinity of heat, sparks, or flame. In order to avoid blurring the print or distortion of the

labels beneath the specimens, use a wide-mouth relatively shallow (6 cm), black-topped jar that has a cardboard or rubber lining in the top. Pin the specimens in the top and put just enough solvent in the jar so that when the top is screwed onto the jar the liquid will cover the specimens but not the labels. Most specimens will be degreased if left in the solvent for 24 hours and the liquid can be used over and over again until saturated and yellowish with grease.

### TERMINALIA NOMENCLATURE AND MORPHOLOGY

The male terminalia of both genera of the North American Apioceridae, *Rhaphiomidas* and *Apiocera*, have the genital and excretory organs housed in a greatly enlarged boxlike (Cole, 1927) structure at the terminus of the abdomen, the ninth or genital segment (fig. 33). In *Apiocera* the structures therein contained are complicated, numerous, and have become greatly diverse, modified and of primary importance taxonomically (Cazier, 1982). The same cannot be said of the inner structures of the terminalia in *Rhaphiomidas* which are simplified, reduced, and have been considered to be of little taxonomic value in the past. In the present treatment they assume considerable importance especially in several of the new species. The female terminalia have not been studied critically but do not appear to have the taxonomic value of the males.

As in *Apiocera*, before Cazier (1982) only the external features of their terminalia had been used in taxonomic studies and, as would be expected, individual parts were often referred to by different names. There is great variability in the terminalia and its enclosed structures in male Diptera and one has but to examine a few of the morphological and phylogenetical studies to ascertain the degree of nomenclatural confusion in these structures (e.g., Cole, 1927, 1969; Crampton, 1923, 1942; Freeborn, 1924; Tuxen, 1970 and many others). Therefore, in the present context I am not concerned with the attempts by morphologists to homologize the various parts of the terminalia between various orders, families, and genera of Diptera. Rather, I am attempting to standardize the terminology



from a taxonomic viewpoint within the family Apioceridae and its two North American genera, *Rhaphiomidas* and *Apiocera*. Names of homologous structures will be used when they apply, appropriate terms already in use in both genera will be recognized, and some terminology not in previous use will be proposed. Most of the terms are, however, already in use.

**Hemitergites:** The dorsolateral covering of the terminalia arising as lateral posterior projections of the ninth abdominal tergite are recognized as hemitergites following Freeborn (1924), Cole (1927, 1969) and Cazier (1982). These structures have in the past been referred to as "lateral lobes of the ninth tergite" (Cazier 1941, 1954), and since the latter expression is merely a description of a hemitergite, this term is herein adopted for these large, conspicuous, paired structures that form the bulk of the visible terminalia in *Rhaphiomidas* (figs. 7, 10, 13, 16). This term is applied to the same structures in *Apiocera* (Cazier, 1982). Taxonomically the small size of these structures is of value in identification as in *xanthos xanthos* and *episcopus episcopus*. Their shape is specifically important in *undulatus* (fig. 18), *forficatus* (figs. 12, 13), *parkeri* (figs. 9, 10), and *hirsuticaudus* (fig. 7). The external pilosity is important in *hirsuticaudus* and their color in *nigricaudis* (fig. 33), *trochilus* (fig. 32) and *parkeri*. The setarious spines on the inner surface are definitive for *spinicaudus* (figs. 15, 16) and the longitudinal carinae on this surface characterize *hasbroucki* (figs. 20, 21), *tarsalis* (fig. 22), *undulatus* (fig. 18) and *socorroae* (fig. 26).

The dististyles, claspettes, proctiger, and locking folds so characteristic and taxonomically important in *Apiocera* are all missing from the *Rhaphiomidas* species known at present. Gross dissections in the basal region of the terminalia in *hasbroucki* failed to disclose even the rudimentary vestiges of these structures. The membranous anal tube lies directly over the aedeagus in *Rhaphiomidas* instead of over the proctiger which is directly over the aedeagus in *Apiocera*.

**Aedeagus:** This tubular, open-ended, distally upturned structure with a greatly enlarged base, issues from a membrane and muscle beneath the anal tube and above and between the interbasal folds of the gonostyles

(fig. 25). Although I have not used this structure extensively in the classification there are some definitive modifications. The rounded dorsal projection from the enlarged base overlapping the tubular base is characteristic of *socorroae* (fig. 25). The degree of upturn and recurve in the distal end of the tube is of importance in *parkeri* and *spinicaudus*.

**Gonostyles:** These are the two lateral posterior projections on the ninth abdominal sternite which partially enclose, ventrally, the genital cavity formed by the hemitergites (figs. 9, 18). They are not articulated and have at their inner base near the junction with the ninth sternite the interbasal lobes. Nomenclature for the structures in this area is especially confused (Cole, 1969) and I have adopted gonostyles because of its previous usage in *Rhaphiomidas* (Cazier, 1941, 1954). In *Apiocera* these are missing but the median posterior projection of the ninth abdominal sternite in that genus has abundant characteristics. In *Apiocera* the interbasal folds are associated with the dististyles (Cazier, 1982). In *Rhaphiomidas* the length of the gonostyles in relation to the extent of the hemitergites posteriorly is of value in *parkeri* (fig. 9), *undulatus* (fig. 18), and *brevirostris*. The inward curvature of the finger-like gonostyles and their vestiture is of some importance in *brevirostris*, *episcopus episcopus*, and *trochilus*. The dorsoventral flattening of the usually rounded arms is characteristic of *spinicaudus*. However, in *brevirostris* and *parkeri* the inner surface is flattened. In most species, other than those given above, the gonostyles do not extend posteriorly to the apex of the hemitergites, they are rounded and straight or only slightly bent inward and are usually sparsely clothed with golden, white or yellow pile.

**Interbasal folds:** These folds at the inner basal surface of the gonostyles are two-segmented with the basal segment attached to the ninth sternite and the unarticulated apical segment to the gonostyle base. The apical segment is usually rounded, extending posteriorly subparallel with the gonostyle and with its apical half unattached to the gonostyle. Even though I have not used this structure in the classification, it does exhibit some bold and some subtle differences between a few of the species. For example, in *brevirostris* the

apical segment extends inward at a 45° angle from the gonostyle, its median surface is flattened and concave and its apex is acutely pointed downward. In *parkeri* these folds are more distantly associated with the gonostyles and their apices are strongly clavate instead of evenly rounded. In *spinicaudus* the lobes are reduced and indistinct. In *trochilus* only the extreme tip of the second segment is free from the gonostyles. There are other more subtle differences among the species.

Ninth abdominal sternite: I have used this structure only in connection with the color and pilosity of the associated terminalia. Its basal lateral angles are interlocked with the lower basal angles of the hemitergites, the surface is convex, the posterior margin is emarginate between the base of the gonostyles and there are rather subtle differences in shape which would be difficult to define.

In most species it appears to be almost square as in *episcopus michelbacheri* and *socorroae*. In the former subspecies the lateral margins are shallowly emarginate. In the larger more robust species and subspecies, such as *acton acton*, *acton maeherli*, and *nigricaudis*, the segment is much wider than long.

Anal tube: As mentioned previously, the membranous tube is directly over the aedeagus. It protrudes through the gigantic muscle that connects the bases of the hemitergites and articulates these structures. It is long and extends posteriorly to about the apical third of the hemitergites, is shallowly divided apically and sparsely long pilose in about its apical quarter. It has not been used in this work but may have usable characteristics. However, it will require special preparation to make them available.

# KEYS

Unlike the keys to *Apiocera* males (Cazier, 1982), those to *Rhaphiomidas* do not require the extensive use of the internal structures of the terminalia. In all but five species only externally visible characters are used and in one of these, *spinicaudus*, the unique erect setarious spines on the inner hemitergite surface can be seen through either the dorsal narrow sutural opening between the hemitergites or through the wider opening between them on the undersurface (fig. 16). Even then a second character is made available. The other four species *hasbroucki*, *undulatus*, *tarsalis*, and *socorroae* have subdorsal longitudinal carinae on the inner hemitergite surface which can be seen through the dorsal opening between the hemitergites (figs. 18, 20, 22, 26). However, the angle of the carinal crest and its extent are difficult to determine through the sutural opening. Here again, however, secondary external differences are given. Thus, the need for dissection and mutilation of specimens is minimized.

In the key to the females only externally visible characters are used and usually only single species or subspecies are found in the dichotomies. The females of three species and one subspecies are unknown as follows: *tar-*

*salis*, *socorroae*, *spinicaudus*, and *xanthos vittatus*. In the text the species are arranged in the order in which they appear in the key to the males.

## KEY TO RHAPHIOMIDAS MALES

1. Mouthparts with proboscis short (5.3 mm to 6.4 mm), extending anteriorly beyond the antennae by about the length or little more than the length of the antennae; antennae with third segment pear-shaped, strongly swollen in apical half (fig. 5) ..... 2
- Mouthparts with proboscis long (7.2 mm to 14.4 mm), extending anteriorly beyond the antennae by from 2½ to 5 times the length of the antennae; antennae with third segment elongate, widest medially (fig. 11) ..... 3
2. Posterior tarsal segments two through five more than half the length of segment one; tarsal pulvilli broad, about two-thirds the length of the tarsal claws (fig. 4); compound eyes separated from the lateral ocelli on the vertex by more than the width of a lateral ocellus (see fig. 27); pleural margins of abdominal terga two through seven pruinose; hemiter-

- gites of terminalia not triangular . . . . . *brevirostris*  
 Posterior tarsal segments two through five less than half the length of segment one (fig. 8); tarsal pulvilli narrow, less than half the length of the tarsal claws (fig. 8); compound eyes separated from the lateral ocelli on the vertex by less than the width of a lateral ocellus (see fig. 28); pleural margins of abdominal terga two through seven not pruinose, nitid (shiny); hemitergites of terminalia triangular (fig. 7) . . . . . *hirsuticaudus*
- 3(1). Terminalia rounded, hemitergites overlapping along suture in apical half, not elongated or heart-shaped (dorsal view) (fig. 10); gonostyles extending posteriorly to or almost to the apex of the hemitergites (fig. 9) . . . . . *parkeri*  
 Terminalia elongate or short, heart-shaped, hemitergites not or narrowly overlapping distally; gonostyles not extending posteriorly to or near the apex of the hemitergites (fig. 18) . . . . . 4
4. Hemitergites narrow, gradually attenuated from base to apex (lateral view) (fig. 13), apices narrow, bluntly pointed and prominently crossing over each other (dorsal view) (figs. 12, 13) . . . *forficatus*  
 Hemitergites not gradually attenuated from base to apex, apices broadly rounded (fig. 15) or truncate (lateral view), not or barely overlapping apically (fig. 16) . . . . . 5
5. Inner hemitergite surface clothed with short, erect setarous spines in apical half (visible dorsally or ventrally through sutural openings) (figs. 15, 16); anterior tarsal segments two through five with large ventral arolia (fig. 17) . . . . . *spinicaudus*  
 Inner hemitergite surface without spines of any kind (figs. 18, 20, 22); anterior tarsal segments two through five without ventral arolia . . . . . 6
6. Hemitergites with subdorsal longitudinal carina on inner surface below the sutural margin (usually visible dorsally through the sutural opening in closed terminalia, barely in *undulatus*) (figs. 18, 20, 22, 26) . . . . . 7  
 Hemitergites without subdorsal longitudinal carina on the inner surface below the sutural margin (figs. 12, 15) (only the sutural margin is visible dorsally and the membranous anal tube internally in closed terminalia) . . . . . 10
7. Hemitergites large, elongate, sutural margins strongly undulated from base to apex; gonostyles extending posteriorly to or almost to middle of the hemitergites; size large (fig. 18) . . . *undulatus*  
 Hemitergites small to medium, narrow, sutural margins gradually curved from base to apex (fig. 20); gonostyles extending posteriorly to apical third or apical quarter of hemitergites; size small to medium . . . . . 8
8. Carinal crest on the inner hemitergite surface rounded (fig. 20); first tarsal segment on the posterior legs clothed throughout only with short white hair . . . . . *hasbroucki*  
 Carinal crest on the inner hemitergite surface with a sharp edge (fig. 22); the first tarsal segment on the posterior legs has the short white pile but the ventral surface is sparsely clothed with long white erect hairs that are gradually curved toward the base (fig. 24) . . . . . 9
9. Subdorsal carina on inner hemitergite surface extending posteriorly to apical quarter of hemitergites (fig. 22); aedeagus without median modification at apex of enlarged base; abdominal tergites four through six without dark transverse maculations . . . . . *tarsalis*  
 Subdorsal carina on inner hemitergite surface extending posteriorly to middle of hemitergites (fig. 26); aedeagus with rounded projection at apex of enlarged basal portion overlapping narrow tube-like posterior projection at its base, not reaching angle of the upward bend in the tube (fig. 25); abdominal tergites four through six with black transverse vittae covering at least the basal half of each tergite . . . . . *socorroae*
- 10(6). Compound eyes separated from the lateral ocelli on the vertex by less than the width of a lateral ocellus (fig. 28) . . . . . 11  
 Compound eyes separated from the lateral ocelli on the vertex by the width or more than the width of a lateral ocellus (fig. 27) . . . . . 12
11. Abdominal tergites two through four with apical margins golden or pale in color (figs. 29, 30).  
 A. Body pile white; abdominal tergites with broad black vittae covering most of basal half (fig. 29); anterior and middle femora dark . . . . . *xanthos vittatus*  
 Body pile yellowish or golden; ab-



- dominal tergites two through five with at most middorsal black spots; anterior and middle femora golden or testaceous ..... *xanthos xanthos*
- Abdominal tergites two through four with apical margins bordered with glabrous, narrow dark transverse vittae, each vitta about one-fourth the width of the tergite ..... *painteri*
- 12(10). Hemitergites entirely black or black with narrow yellow or orange dorsal, apical and ventral margins (figs. 32, 33) ... 13
- Hemitergites not primarily black ... 15
13. Hemitergites entirely black.
- A. Abdominal tergites orange and black maculated (fig. 30) ..... *episcopus michelbacheri*
- Abdominal tergites black ..... *episcopus episcopus*
- Hemitergites black with narrow yellow or dark orange margins (figs. 32, 33) ... 14
14. Abdominal tergites black or dark brown in basal three-quarters to two-thirds, narrowly bordered along apical margin of each segment with pale yellow or cream color; terminalia elongate, narrow (fig. 31) ..... *trochilus*
- Abdominal tergites orange with at most small median dark isolated spots on segments three and four (fig. 33); terminalia robust, wide (fig. 33) ..... *nigricaudis*
- 15(12). Posterior tibiae and first tarsal segments without short black spines on the inner margin ..... 16
- Posterior first tarsal segment and usually the tibia with short, stout, usually black spines on the inner margin (fig. 39) ... 18
16. Posterior legs white or golden macrochaetose; costal wing vein white or golden pilose from the base to near the apex ..... 17
- Posterior legs primarily black or dark macrochaetose; costal wing vein black pilose except at extreme base.
- A. Abdominal tergite three broadly black at least in the basal half (fig. 34), posterior edge of dark marking straight from side to side or slightly evenly bowed medially (fig. 34) . *terminatus terminatus*
- Abdominal tergite three with large isolated median dark marking extending from basal margin to apical two-thirds (fig. 35) ..... *terminatus abdominalis*
17. Posterior and middle femora primarily or entirely testaceous ..... *auratus*
- Posterior and middle femora black or piceous except at apex ..... *aitkeni*
- 18(15). Abdominal tergite one usually black at least medially; abdominal middorsal dark markings usually large (fig. 41); pile usually deep golden and long ..... *acton maculatus*
- Abdominal tergite one entirely orange or with apical border orange or yellow (fig. 38); middorsal dark markings absent or usually with small narrow longitudinal line or spot on segment two, increasing in size to large or medium-sized spot on segment five (fig. 38) ..... 19
19. Sexes dichromatic and dimaculate (figs. 38, 40). See key to females ..... *acton maehleri*
- Sexes similar in both color and abdominal maculations ..... *acton acton*

#### KEY TO RHAPHIOMIDAS FEMALES

1. Proboscis of mouthparts short, extending anteriorly beyond the antennae by little more than the length of the antennae; third antennal segment, short, pear-shaped, strongly swollen in apical half ..... 2
- Proboscis of mouthparts long (when unbroken), extending anteriorly beyond the antennae by from 1½ to 4 times the length of the antennae; third antennal segment elongate or robust, not pear-shaped ..... 3
2. Fourth abdominal segment with white discal pile partially retrorse, facing anteriorly; metapleura with supraepimeron and infraepimeron (fig. 3) pilose; tarsal pulvilli more than half as long as the tarsal claws ..... *brevirostris*
- Fourth abdominal segment with white-discal pile not retrorse, facing posteriorly; metapleura with posterior half of supraepimeron and all of infraepimeron glabrous (fig. 3); tarsal pulvilli less than half as long as the tarsal claws ..... *hirsuticaudus*
- 3(1). Macrochaetae of posterior tibiae primarily or entirely black or piceous .... 4
- Macrochaetae of posterior tibiae primarily or entirely light colored, not black or piceous ..... 6
4. Costal wing vein black pilose throughout

- or with a few golden hairs at tip; middle and posterior femora dark brown or black, entirely black pilose.
- A. Abdominal tergites one through four entirely black, sternites entirely black ..... *episcopus episcopus*  
Abdominal tergites orange and black maculated; sternites entirely orange .. *episcopus michelbacheri*
- Costal wing vein white, golden or black and white pilose basally; middle and posterior legs uniformly orange, brown, testaceous, white or yellowish pilose . . . . . 5
5. Metapleura with posterior half of supraepimeron sparsely clothed with long white hairs medially; tarsal pulvilli broadly expanded apically ..... *xanthos xanthos*  
Metapleura without pile on posterior half of supraepimeron; tarsal pulvilli usually narrow, not or but little expanded apically. . . . .
- A. Middle and posterior legs brownish, dark in color ..... *terminatus terminatus*  
Middle and posterior legs yellow, golden, or testaceous, light in color .... *terminatus abdominalis*
- 6(3). Tarsal pulvilli short and narrow, half or less than half the length of the tarsal claws ..... 7  
Tarsal pulvilli long, two-thirds to three-quarters the length of the tarsal claws, narrow or broadly expanded apically . . . . . 8
7. Abdominal tergites two through four with broad, basal, transverse, dark vittae covering half or more than half of surface ..... *hasbroucki*  
Abdominal tergites two through four without broad, basal, transverse dark vittae ..... *tarsalis*
- 8(6). Posterior femora, tibiae and basal tarsal segment black or piceous; femora and tibiae densely clothed with long white pile ..... *forcatus*  
Posterior femora, tibiae and basal tarsal segment not all black or piceous; femora and tibiae not densely clothed with long white pile ..... 9
9. Tarsal pulvilli narrow, not or barely expanded apically, lateral margins usually subparallel ..... 10  
Tarsal pulvilli wide, broadly expanded apically, lateral margins not subparallel ..... 11
10. Ventral macrochaetae on first tarsal segment of the posterior legs entirely or primarily black or dark brown; size large, 24.7–34 mm long .... *trochilus*  
Ventral macrochaetae on first tarsal segment of the posterior legs entirely or primarily yellow or golden; size small, 17–22 mm long ..... *auratus*
- 11(9). Fourth abdominal tergite with white discal pile retrorse, facing anteriorly .... *parkeri*  
Fourth abdominal tergite with white discal pile not retrorse, facing posteriorly ..... 12
12. Abdominal tergites two through four with posterior margins narrowly bordered with brown or black ..... *painteri*  
Abdominal tergites two through four with posterior margins pale yellow or orange ..... 13
13. Abdominal tergites two through four pale yellow or cream colored apically, with broad or narrow black transverse vittae basally, vittae usually widest medially; if markings are reduced to middorsal spots, these are largest basally (fig. 40) ..... *nigricaudis*  
..... *aitkeni*  
..... *acton maehleri*  
Abdominal tergites two through four orange, without dorsal dark markings or with middorsal dark narrow longitudinal spots, increasing in size from segments three through four (fig. 37) .. 14
14. Front of head (frons) with pile dark orange ..... *acton maculatus*  
Front of head (frons) with pile white or pale yellow ..... *undulatus*  
..... *acton acton*

## SYSTEMATICS

### GENUS *RHAPHIOMIDAS* OSTEN SACKEN

*Rhaphiomidas* Osten Sacken, 1877, p. 281; 1878, p. 85; 1883, p. 293. Coquillett, 1891, pp. 84–86. Williston, 1893, pp. 101–118. Townsend,

1895, pp. 601–607; 1901, pp. 163–164. Williston, 1908, pp. 188–189. Hermann, 1909, pp. 104–122. Coquillett, 1910, p. 600. Norris, 1936, p. 64. Painter, 1936, p. 188. Cazier, 1941, pp.

616–629; 1954, pp. 1–7; 1965, pp. 356–357; 1982, pp. 291–299. Bernardi, 1975, p. 3. Arnaud, 1979, p. 151.

*Apomidas* Coquillett, 1892, pp. 314–315. Norris, 1936, p. 50. Painter, 1936, p. 188. Cazier, 1941, pp. 616–617.

**DIAGNOSIS:** Adults large robust, setigerous, thinly to densely pilose flies. The thorax is well developed and the postnotum of the metathorax has a large conical swelling on the lateral lobe. Veins R4, R5, M1 and M2 terminate on the anterior wing margin and the discal cell is always present.

**DESCRIPTION:** Male: **Head** large, posterior surface flattened, densely pilose, sparsely macrochaetose; compound eyes large, bare, narrowly or widely separated on the vertex from the lateral ocelli; ocelli three in number; antennae three-segmented, third segment varying in size and shape; mouthparts with one-segmented prominent palpi, proboscis tubelike, elongate (labium and terminal paired labella), medium to long in extent, sucking in function, not fleshy. **Thorax** large, mostly mesonotum dorsally, macrochaetose, pilose and pruinose to varying extents; scutellum prominent, macrochaetose, pilose and pruinose; supraepimera and infraepimera of mesopleura with varying degrees of pilosity (fig. 3); postnotal conical swellings large, acutely or bluntly pointed. **Abdomen** large, robust, gradually tapering from base to apical, prominent, terminalia, strongly articulate, varying in color, maculation, pilosity, and pruinosity. **Legs** long, usually slender varying in color, pilosity, macrochaetosity and pruinosity, tarsi with first segment usually subequal to segments two through five combined, tarsal pulvilli present, varying in size and shape, empodium absent. **Terminalia** external, prominent, simplified, varying in size, shape, color, pilosity and pruinosity between the species. See special section for details and terminology of parts.

**FEMALE:** Similar to male but they may be monochromatic or dichromatic with them. The secondary sexual characteristics consist of: compound eyes usually more broadly separated from the lateral ocelli and not or with little variation between species; abdominal segment seven truncate apically, segments five through seven with retrorse pile, in *parkeri* segments four through seven being the only

exception; genital opening surrounded with from 10 to 15 stout, dark acanthophorites on each side, usually withdrawn into distal opening in segment seven.

**TYPE SPECIES:** *Rhaphiomidas episcopus* Osten Sacken by original designation. Type locality Baja California Sur, Mexico.

**RELATIONSHIP:** *Rhaphiomidas* can be distinguished from *Apiocera*, the only other genus of North American Apioceridae, by its larger size, more robust form, sucking tube-like proboscis, one-segmented palpi, wing with vein, M2 connected above the wing apex on the costal margin instead of on the posterior margin as in *Apiocera*, presence of conical swellings on the lateral lobes of the postnotum and by its greatly simplified male terminalia. From the Australian *Neorhaphiomidas*, with which it is only distantly related, *Rhaphiomidas* can be distinguished by its much larger size, more robust form, lack of fusion of wing veins R2, R3, M1, M2 before the apex of the costal margin, much larger head, subequal ocelli instead of a much larger anterior ocellus, the much larger and entirely different male terminalia and the more prominent conical postnotal swellings. Because of the increased importance and use of the terminalia structures in the present classification, especially the enclosed parts, and the lack of nomenclatural stability of the structures, a special section on terminalia is included (see p. 191). In so far as possible the terms of parts evidently homologous with those in *Apiocera* (Cazier, 1982) will be used in *Rhaphiomidas*.

*Rhaphiomidas brevirostris* Cazier

Figures 4–6; Map 1

*Rhaphiomidas brevirostris* Cazier, 1954, pp. 5–6.

**DIAGNOSIS:** Medium-sized, relatively narrow, abdominal tergites primarily black, each tergite narrowly bordered apically with a yellow transverse vitta; compound eyes separated from lateral ocelli on vertex by more than the width of a lateral ocellus; third antennal segment bulbous and pear-shaped apically, widest anterior to middle (fig. 5); proboscis of mouthparts short, ranging in length from 5.3 mm to 6.4 mm, averaging 6.0 mm (fig. 5); posterior tarsal segments two through five more than half the length of segment one;

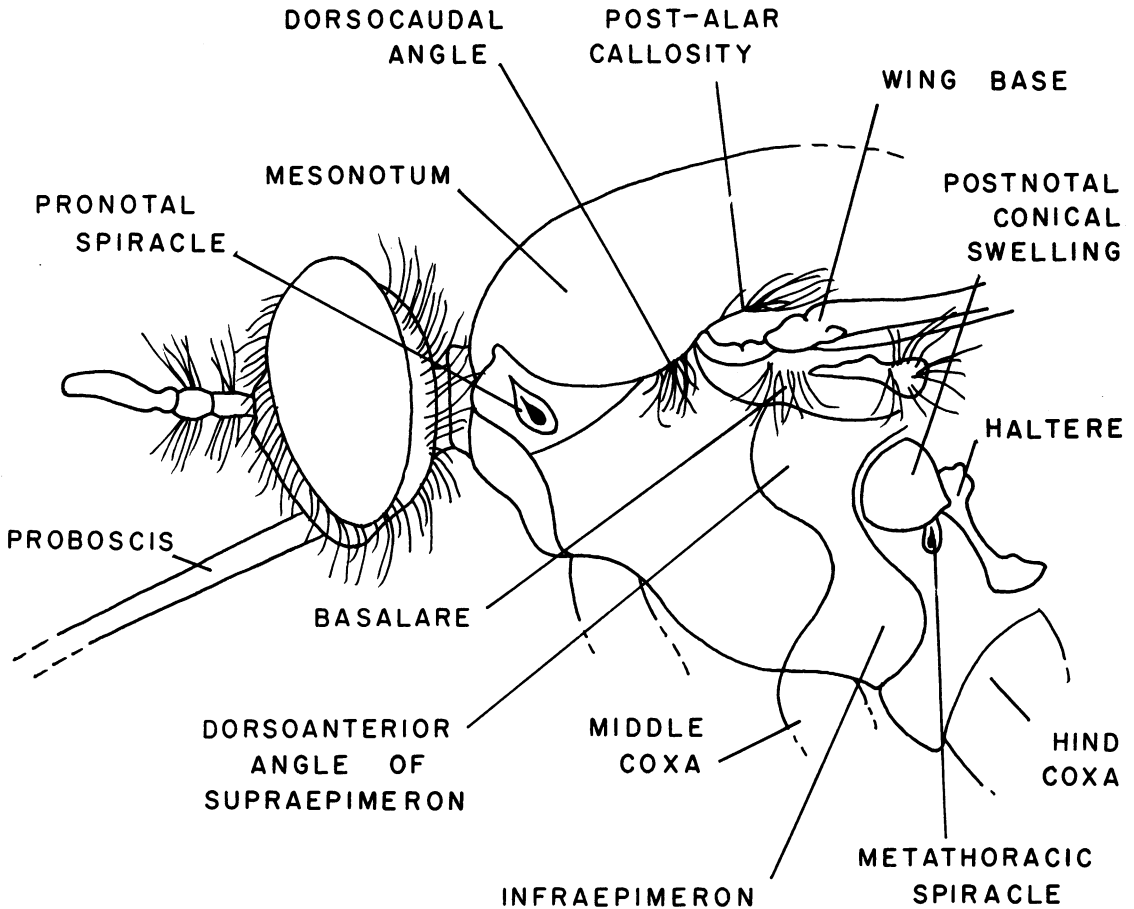
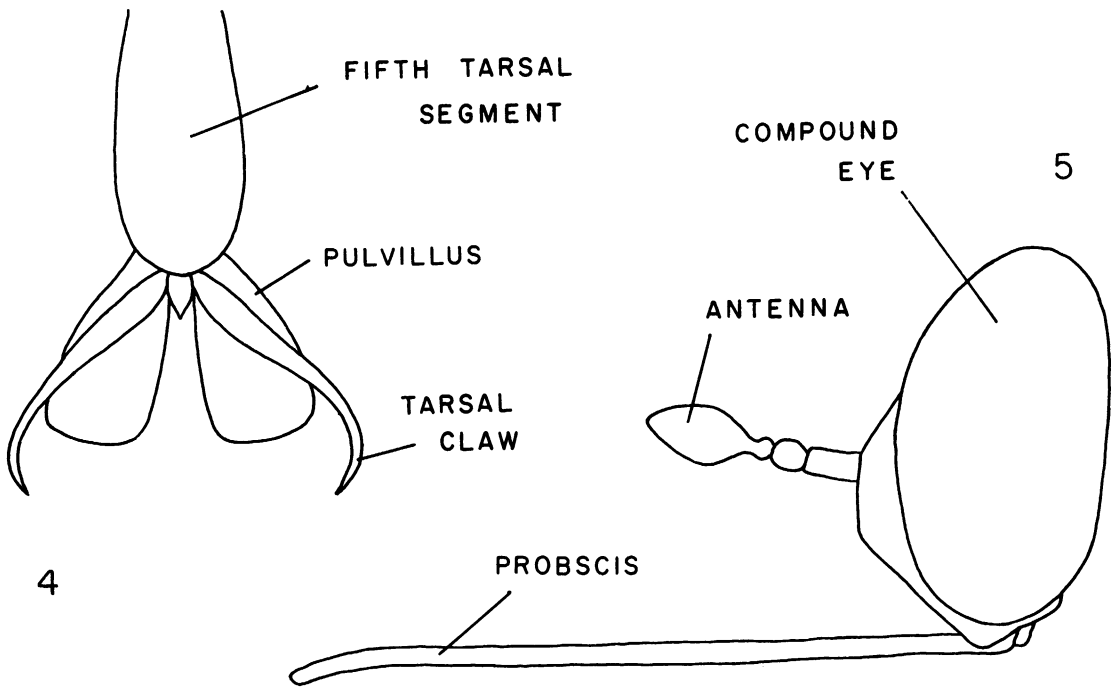


FIG. 3. *Rhaphiomidas acton maehleri*. Pleural view of head and thorax.

tarsal pulvilli broad, about two-thirds the length of the tarsal claws (fig. 4); pleural margins of abdominal terga two through seven pruinose.

**REDESCRIPTION OF TYPE: Male: Head** with frons moderately densely clothed with long white pile, hairs yellowish from median ocellus to vertex, surface white pruinose; vertex between lateral ocelli yellowish pilose, surface between lateral ocelli and compound eyes deeply impressed, compound eyes separated from lateral ocelli by about  $1\frac{1}{2}$  times the width of a lateral ocellus; posterior surface with bare, white pruinose, narrow band bordering posterior margin of compound eyes, median portion densely clothed with long erect white pile, macrochaetae long, white, mixed in with dense white pile; antennae with segments one

and two dark, sparsely white pruinose, sparsely clothed with long, stiff, white hairs, resembling macrochaetae, third segment (right one missing) dark, bare, bulbous apically, pear-shaped, widest anterior to middle (fig. 5), with swollen ring at junction with second segment, surface sericeous, little longer than segments one and two combined; mouthparts with palpi short, dark, sparsely long white pilose, proboscis short 6.1 mm, protruding anteriorly beyond antennae by about  $1\frac{1}{2}$  times an antennal length. **Thorax** with humeral callosities deeply acutely incised posteriorly, surface gray pruinose, sparsely clothed with long white hair, sparsely white macrochaetose; mesonotum with single median dark longitudinal vitta, two lateral vittae, one on each side, dark, inter-

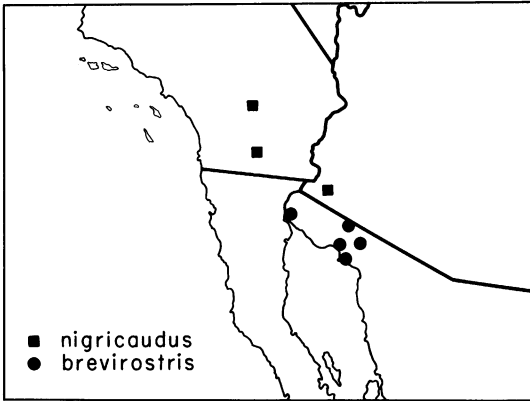


FIGS. 4–5. *Rhaphiomidas breviostris*. 4. Dorsal view of fifth tarsal segment on posterior tarsus in male. 5. Lateral view of male head.

rupted diagonally in posterior quarter, surface gray pruinose except for dark areas, disc sparsely light brown pilose, lateral margins more densely longer white pilose, lateral macrochaetae white, posterior angles (post-alar callosities) gray pruinose, sparsely white pilose and macrochaetose; wings with costal vein white pilose from base to near apex; scutellum deeply, acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins obliquely grooved, posterior margin shallowly rounded laterally, truncate medially, surface and margins sparsely long white pilose, posterior submarginal macrochaetae long, white and numerous; mesopleural sclerites gray pruinose, dorsocaudal angle and basare densely long white pilose, not macrochaetose, supraepimeron and infraepimeron densely long white pilose medially; postnotal conical swellings with sides gradually constricting from base to near apex, apex more narrowly constricted and extending to narrow point. **Legs** not greatly enlarged; coxae densely gray pruinose, densely long white pi-

lose, sparsely white macrochaetose; femora piceous, white pilose and macrochaetose; anterior and middle tibiae testaceous on outer and lateral surfaces, inner surface facing femora dark brown, pile and macrochaetae white, posterior tibiae piceous, brown and white pilose, white macrochaetose; anterior and middle tarsi testaceous, white pilose and macrochaetose, posterior tarsi with segment one piceous, brown pilose, white macrochaetose, segments two through five light brown, brown pilose, white macrochaetose; tarsal pulvilli long, broadly expanded apically, about two-thirds as long as claws (fig. 4). **Abdomen** with segments primarily black, each segment narrowly bordered apically with a pale yellow transverse vitta; tergite one gray pruinose, densely clothed with long white pile, pile longer and more dense laterally; tergites two through seven gray pruinose, discal pile white, straight, recumbent posteriorly, moderately dense, about half the length of hairs on tergite one, pleural areas more densely clothed with long white hair similar to those on tergite one, not straight; sternites marked and colored





MAP 1. Distributions of *Rhaphiomidas* sp.: *R. nigricaudus*, *breviostris*.

same as tergites, moderately densely clothed with long white pile, becoming less dense toward sternite seven. **Terminalia** rounded, piceous medially, margins narrowly bordered with pale yellow, yellow border widened at hemitergite apex, dorsally and discally moderately densely clothed with long, irregular, erect white pile, pile longer and more dense along ventral edge of hemitergites (terminalia in holotype not open. Remainder of terminalia description based on a specimen collected 39 miles north of Puerto Penasco, Sonora, Mexico, in which the hemitergites have been separated); hemitergites strongly convex externally, left (looking from terminalia toward head) hemitergite overlapping right hemitergite from near base to apex, upper and lower margins of left hemitergite gradually converging apically into an acute point, upper and lower margins of right hemitergite converging apically into an obtuse point, inner surface concave, smooth, shiny, sparsely irregularly clothed with long golden hairs, upper margin of large muscle attachment with short, diagonal, faint carina near base; ninth sternite shallowly convex, piceous, posterior margin broadly, obtusely emarginate between bases of gonostyles, surface moderately densely clothed with long erect white hairs; gonostyles extending posteriorly slightly beyond hemitergite apices, testaceous in color, moderately densely clothed with long white pile, shallowly bowed laterally at middle, slightly turned upward and inward apically, posterior extensions rounded, narrow, finger-like; interbasal folds wide at base, extending

diagonally inward and posteriorly from gonostyle base, posterior extension wide to truncate, elongate, flattened apex, surface sparsely golden pilose, ventral surface slightly impressed, dorsal surface smooth, shiny, shallowly convex; aedeagus projecting medially through basal membrane connecting the gonostyles, ventral to membranous anal tube which extends through membrane and muscles connecting the hemitergites, base greatly enlarged, smooth and shallowly convex dorsally, abruptly constricted apically into dorsally curved, rounded tube, not recurved anteriorly, apex cut off obliquely, open. Length 24.0 mm; mesonotal width 5.9 mm (redescription of holotype and internal terminalia of plesiotype).

**FEMALE:** Similar to the male except for her much larger size and the usual secondary sexual differences. In the female the third antennal segments are orange, the tarsal pulvilli are narrow and not greatly expanded apically, the posterior tibiae is lighter in color than the femora and the sparse, short, white, straight, hairs on the disc of the fourth abdominal segment are retrorse, laterally they are oriented in all directions. Length 31.0 mm; mesonotal width 6.8 mm.

**HOLOTYPE:** Male, Mexico, Sonora, La Choya, June 12, 1952, R. Schrammel, W. Gertsch, M. Cazier, deposited in the American Museum of Natural History.

**ALLOTYPE:** Female, Mexico, Sonora, 20 miles southwest of Sonoita, June 13, 1952, R. Schrammel, W. Gertsch, M. Cazier, deposited in the American Museum of Natural History.

**PARATOPOTYPES:** Same data as holotype (1 male, 1 female AMNH).

**PARATYPE:** Same data as allotype (1 male AMNH).

**DISTRIBUTION:** MEXICO: **Sonora:** La Choya, June 12, 1952, W. Gertsch, R. Schrammel, M. Cazier (2 males, 1 female); 20 miles southwest of Sonoita, June 13, 1952, W. Gertsch, R. Schrammel, M. Cazier (1 male, 1 female); 39 miles north Puerto Penasco, June 4, 1968, N. Leppla, J. Bigelow, J. Davidson, M. Cazier (14 males, 11 females); 46 miles west of Sonoita, June 4, 1968, same collectors (2 males, 2 females); 5 miles south Riito, June 5, 1968, same collectors (5 males, 10 females). **ARIZONA:** **Yuma Coun-**



FIG. 6. *Rhaphiomidas brevirostris*. Habitat 39 miles north of Puerto Penasco, Sonora, Mexico. Photograph by J. M. Davidson.

ty: 15 miles east Yuma, May 1, 1972, P. Torchio, F. D. Parker, G. E. Bohart (1 female). See map 1.

**ECOLOGY AND BEHAVIOR:** The type series was collected in dry sandy areas which were sparsely covered with low vegetation. The females were usually found resting in the shade on the stems of shrubs, whereas the males were taken either in flight or after they had found the females. The normal flight was rather rapid but when disturbed the flies were barely visible. At 39 miles north of Puerto Penasco the flies were found on semiconsolidated dry dunes that were sparsely vegetated with the grass, *Hilaria rigida* (Thurber) Benth and dead or dying wolfberry or squawberry, *Lycium* species (fig. 6). Their behavior was much the same as noted at the type locality but different collecting difficulties were experienced at this locality due to the rigidity of the dead *Lycium* on which the females preferred to sit. Most of the 14 males were netted in flight as they cruised near the shrubs

looking for the females. Several nets were severely damaged in collecting the 11 females which were sitting upright on vertical dead *Lycium* trunks (fig. 2). The type of habitat and the behavior of the flies at 46 miles west of Sonoita and 5 miles south of Riito were nearly identical with those at 39 miles north of Puerto Penasco except that the flies were less numerous and the vegetative cover on the semiconsolidated dunes consisted of scattered mesquite, *Prosopis juliflora*, creosote bush, *Larrea tridentata*, bur sage, *Franseria* species, and joint fir, *Ephedra* species. All these plants were being used for sitting by the females (fig. 6). At 5 miles south of Riito there were pools of standing water among the dunes but no *Rhaphiomidas* were observed visiting them.

**VARIABILITY:** The most notable variation in the series of 49 specimens is in the size. The males vary from the minimum of 24.0 mm, as in the holotype, to about 29.7 mm. In females the length range is from 23.5 mm

to 34.2 mm. The abdominal tergite color ranges from being almost black to being heavily gray pruinose giving the specimen a much lighter appearance. Teneral specimens vary from testaceous to brown depending upon the amount of time spent from emergence to fully dried adults. In the males the left-hand hemitergite is always crossed over the right one, at least in the 24 specimens on hand, and the terminalia is bilaterally asymmetrical due to the differences in the shape of the apex of the hemitergites. This condition appears to be unique among the North American *Rhaphiomidas* species. Other than the minor variations noted above, there is little variability in the 49 specimens.

**RELATIONSHIPS:** Superficially *brevirostris* most closely resembles *parkeri* but can be readily separated from it as discussed under the latter species. The only other species with which *brevirostris* might be confused and which comes out with it in the same key dichotomy is the remotely related new species, *hirsuticaudus*. The general overall dark color, the pilosity, the proboscis length and the bulbous third antennal segment are similar in the two species but beyond these characters they are entirely different. In *hirsuticaudus* the compound eyes are separated from the lateral ocelli on the vertex by less than the width of a lateral ocellus; abdominal tergites one through seven are not bordered apically by transverse pale yellow vittae; the supraepimeron, except for the dorsal anterior corner, and the infraepimeron are bare; the pleural region of abdominal segments two through five are black, shiny (nitid) and nonpruinose; the posterior legs are greatly enlarged; segments two through five of the posterior tarsi are less than half the length of segment one (fig. 8); the tarsal pulvilli are less than half the length of the tarsal claws (fig. 8); the inside surface of both the tibiae and the first tarsal segment are armed with short, stout, black spines in addition to hair and macrochaetae; the hemitergites are subtriangular (fig. 7) and the pile arrangement on them is unique. There are many other distinguishing features. In *brevirostris* the compound eyes are separated from the lateral ocelli on the vertex by about  $1\frac{1}{2}$  times the width of a lateral ocellus; abdominal tergites one through seven are bordered apically by transverse pale yellow vit-

tae; the supraepimeron and infraepimeron are pilose; the pleural region of abdominal segments two through five are gray pruinose; the posterior legs are not greatly enlarged; segments two through five of the posterior tarsi are more than half the length of segment one; the tarsal pulvilli are greatly expanded apically and are three-quarters the length of the tarsal claws (fig. 4); the inside surface of both the tibiae and the first tarsal segment are not spinous; the hemitergites are elongate and constricted apically and the pile on them is not arranged in a unique fashion.

***Rhaphiomidas hirsuticaudus*, new species**

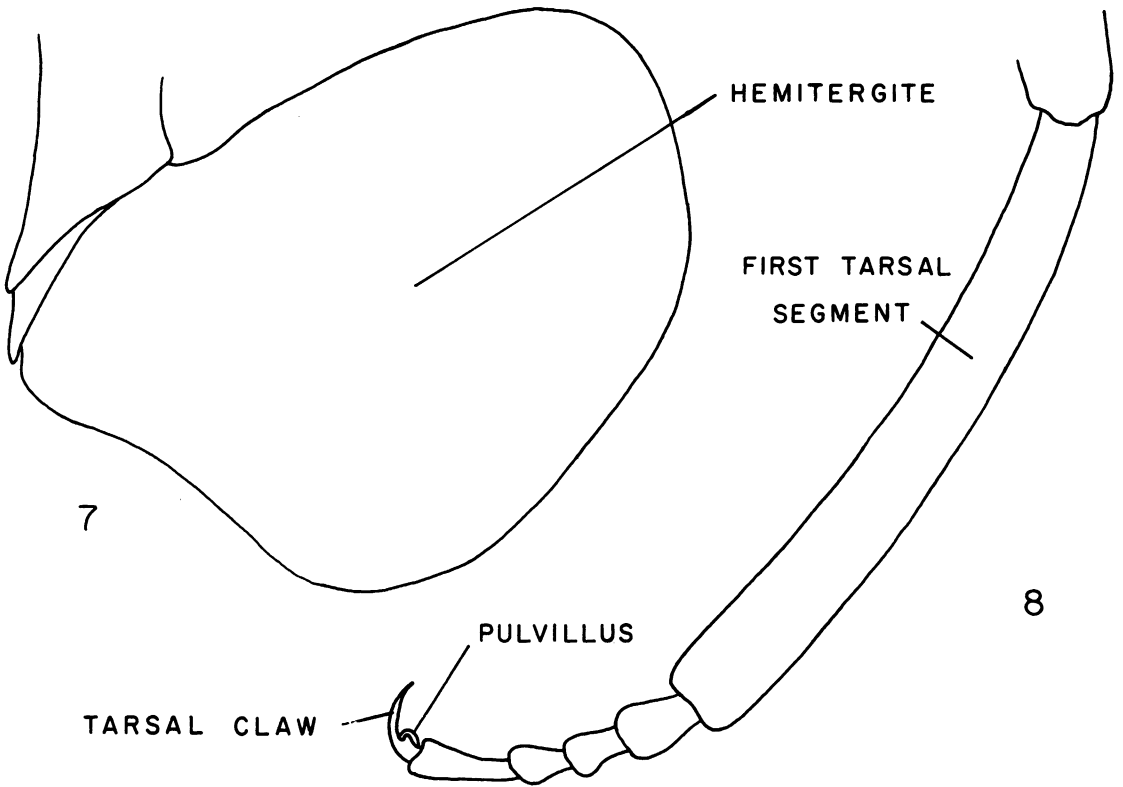
Figures 7–8; Map 2

**DIAGNOSIS:** Large-sized, robust, abdominal tergites entirely dark; compound eyes separated from lateral ocelli on vertex by less than the diameter of a lateral ocellus; third antennal segment bulbous and pear-shaped apically, widest anterior to middle; proboscis of mouthparts short (5.1 mm), extending anteriorly beyond the antennae by little more than the length of the antennae; posterior tarsal segments two through five less than half the length of segment one (fig. 8); tarsal pulvilli narrow, less than half the length of the tarsal claws (fig. 8); pleural margins of abdominal terga two through five not pruinose, segments six and seven without pruinose covering; posterior legs greatly enlarged; hemitergites of terminalia subtriangular (fig. 7), densely golden pilose.

**DESCRIPTION OF TYPE:** Male: **Head** with lower frons long white pilose, pile around ocellar triangle yellowish, surface white pruinose; vertex between lateral ocelli white pilose, surface between lateral ocelli and compound eyes shallowly impressed, compound eyes separated from lateral ocelli on vertex by about three-fourths the width of a lateral ocellus; posterior surface with bare, gray pruinose, narrow band bordering posterior margin of compound eyes, median portion moderately densely clothed with long white pile, subdorsal row of long white macrochaetae evident; antennae with segments one and two black, faintly pruinose, sparsely white pilose and long white macrochaetose, first segment about twice the length of second, third segment brown, sericeous, bare, bulbous api-

cally, pear-shaped, widest anterior to middle, base with swollen ring at junction with second segment, about same length as one and two combined; mouthparts with palpi short and black, sparsely white pilose, proboscis short (5.1 mm), protruding beyond antennae by slightly less than the antennal length. **Thorax** with humeral callosities deeply incised posteriorly, surface gray pruinose, densely white pilose anteriorly, sparsely white pilose posteriorly, sparsely long white macrochaetose; mesonotum with double median dark longitudinal vittae, two dark lateral vittae, one on each side, interrupted diagonally in posterior quarter, surface gray pruinose except for dark areas, disc sparsely, short, pale brown pilose, lateral margins densely long white pilose, lateral and posterior macrochaetae white, posterior angles (post-alar callosities) gray pruinose, sparsely white pilose medially, median macrochaetae long and white; wings with costal vein white pilose from base to near apex; scutellum deeply acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins obliquely grooved, posterior margin shallowly, evenly rounded, margins densely long white pilose, surface gray pruinose, sparsely long white pilose, posterior submarginal macrochaetae long, white, sparse; mesopleural sclerites sparsely gray pruinose, dorsocaudal angle with small patch of medium length erect white hair, basalare densely clothed with long white hair, supraepimeron bare except for dorsal anterior angle, infraepimeron bare; postnotal conical swellings with sides gradually constricted to acute apex. **Legs** with posterior pair enlarged and longer than anterior or middle pair; coxae black faintly gray pruinose, moderately densely white pilose, sparse macrochaetae primarily white; femora black, shiny, not pruinose, ventral surface glabrous, moderately densely white pilose dorsally and laterally, ventral macrochaetae black, longest medially, dorsal apical macrochaetae white; anterior tibiae black, shallowly bowed from base to apex along glabrous side of femora, sparsely irregularly white pilose, outside edge white macrochaetose, inside surface sparsely short macrochaetose, middle tibiae black, less bowed than anterior pair, otherwise the same, posterior tibiae black, straight, sparsely short,

primarily white pilose laterally and along outside surface, inside surface facing femora densely long white pilose, hairs decumbent facing base, dorsal and lateral macrochaetae primarily white, ventrolateral interior surface sparsely short black spinose, anterior tibiae shorter than anterior femora, middle tibiae equal to femoral length, posterior tibiae longer than posterior femora; tarsi reddish brown sparsely brown pilose, anterior tarsi with segments two through five slightly longer than segment one, segment one sparsely black spinose ventrally, spines decreasing in size from base to apex, middle tarsi with segments two through five equal in length to segment one, dorsal macrochaetae white, all segments with black or brown ventral spines decreasing in size from base to apex, posterior tarsi with segments two through five less than half the length of segment one (fig. 8), segment one with erect dense golden decumbent hairs, sparsely black spinose and white macrochaetose, segments two through five with short brown recumbent hair and short sparse spines brown or black, dorsal short macrochaetae white; tarsal pulvilli short, narrow, less than half the length of the tarsal claws, not expanded apically (fig. 8) (right, looking from terminalia toward head, posterior leg broken off near base of tibiae). **Abdomen** primarily black, segments six and seven shiny (nitid) not pruinose, apical narrow membranous border pale brown, sparsely long white pilose, terga one gray pruinose except for shiny (nitid) lateral apical angles, densely long white pilose, terga two through five pruinose sparsely short white pilose dorsally, pleural areas shiny (nitid), moderately densely long white pilose; sternum one gray pruinose, glabrous, sterna two through five gray pruinose, sparsely long white pilose, sterna six and seven piceous, nitid, sparsely long white pilose. **Terminalia** (unopened) reddish brown, subtriangular, one angle forming junction with abdomen, one side ventral, one side apical, third side dorsal at a sharp angle upward (fig. 7); hemitergites with recumbent pile, sparsely white pilose basally, pile increasing in length, density, and turning golden toward apical and ventral sides, long golden apical hairs on each hemitergite crossing over or united apically along middle line, forming densely pilose line where hemitergites would come together when

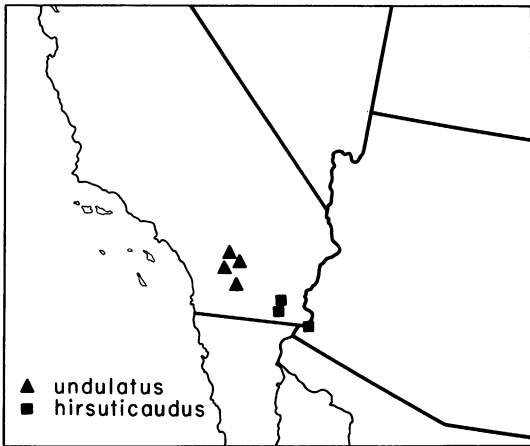


FIGS. 7-8. *Rhaphiomidas hirsuticaudus*. 7. Lateral view of male terminalia. 8. Posterior male tarsus.

closed, hemitergites appear (through dense pile) to be together at dorsal apical corner, spreading apart down apical or posterior border, ventral angle obscured by dense long

golden hair; ninth sternite shallowly convex, piceous, moderately densely clothed with long yellowish hair, posterior border acutely emarginate between bases of gonostyles; gonostyles piceous, long, curved, finger-like, slightly enlarged apically, extending posteriorly to near hemitergite ventral angle, sparsely long golden pilose; interbasal folds short, extending inward along gonostyle base, shallowly concave ventrally; aedeagus appears to be enlarged basally, narrowing into smooth dorsally curved tube. Length 29.2 mm; mesonotal width 6.2 mm.

FEMALE: Similar to the male except for her slightly larger size and the usual sexual differences. However, the female lacks the nitid (shiny) pleural areas on abdominal tergites one through four, the pile on the pleural areas of terga of segments two through four is not much longer or more dense than on the dorsum, the macrochaetae on the legs are all white, the tarsi lack the short ventral spines, the anterior tibiae is only slightly bowed, the



MAP 2. Distributions of *Rhaphiomidas* sp.: *R. undulatus*, *hirsuticaudus*.



middle and posterior tibiae are straight, segments two through five of the posterior tarsi are more than half the length of segment one, the posterior tarsi are not as enlarged as in the male and the posterior tibiae lacks the decumbent hairs on the inside surface, facing femora. Length 33.2 mm; mesonotal width 7.5 mm.

**HOLOTYPE:** Male, California, Imperial County, 4 miles northwest Glamis, October 9, 1977, N. Rulien, from the collection of E. M. Fisher, in the collection of the California Academy of Sciences.

**ALLOTYPE:** Female, California, Imperial County, 2 miles west Glamis, September 3, 1975, F. Hovors, in the collection of the Los Angeles County Museum.

**PARATYPES:** CALIFORNIA: **Imperial County:** 1.3 miles southwest Glamis, September 22, 1984, Art Evans (1 male); 5 miles southwest Glamis, Highway 78, September 28, 1981, R. A. Cunningham (1 male). ARIZONA: **Yuma County:** Yuma, February 23, 1977, S. Anderson (1 male R. A. Cunningham collection; 1 male author's collection ASU; 1 female AMNH). See map 2.

**ETYMOLOGY:** The species name is from the Latin *hirsuta* meaning hairy and *cauda* meaning tail, in reference to the unusual structure and pilosity of the male terminalia.

**ECOLOGY AND BEHAVIOR:** The locations near Glamis are in the Algodones dune belt which is about 40 miles long, three to four miles wide, and has individual unconsolidated dunes 200 to 300 feet high. This dune belt extends from a few miles into northeastern Baja California, Norte, northwest along the southeastern border of the Cahuilla Basin. The dunes were probably produced by wind transport of sand inshore from the beaches of Lake Cahuilla, a much larger forerunner of the Salton Sea, and do not appear to be very active nor are they increasing in size (Norris and Norris, 1961, p. 605).

These features of the dunes would appear to be supported by the presence of considerable areas in the central portion that support both perennial and annual plants. One such area is along the branch road going south of state route 78 down the middle of the loose sand field. This would be about 2 miles west of Glamis and the plants would offer shade for the flies during the heat of the day which

is a requisite in the habitats of other species. Also, this branch road has turn-outs for camping where a black light could be operated. It was at a black light that the single female was collected.

Glamis is on state highway number 78 at the eastern edge of the dunes where the highway crosses the dunes on the way to Brawley. It is also at the junction of a dirt road that parallels the edge of the dunes, eventually arriving at Mecca to the northwest and federal highway number 80 to the southeast. Glamis is about 15 miles from the northwest end of the dune belt, so the type locality at 4 miles northwest of Glamis is probably along the dune edge where shade would be provided primarily by creosote bush, *Larrea tridentata* or by the scattered ironwood trees, *Olneya tesota* and blue palo verde, *Cercidium floridum* Benthham that occur along the dune margin.

**VARIABILITY:** One male paratype is teneral and therefore pale brown in basic color but the white covering pile gives it a tan appearance. The second male paratype is black and dark brown basically. The third antennal segment may lack the basal ring but flares outward at the junction with the second segment; the supraepimeron has in addition to the sparse pile on its dorsal anterior angle a few white hairs anterior to the postnotal conical swellings in both male paratypes. The posterior coxal macrochaetae in both males are long and black instead of being primarily white and the ventral spines on the first segment of the posterior tarsi increase in size from base to apex. Abdominal sterna six and seven are pale brown instead of piceous. The gonostyles of the terminalia are pale brown rather than piceous and are densely long white pilose and extend only to about the middle of the ventral hemitergite margin. The color variability as noted above may be due to the teneral and partially teneral condition of both male paratypes. In basic characteristics there is little variability between the three male specimens.

**RELATIONSHIPS:** Superficially *hirsuticaudus* most closely resembles *brevirostris* but is abundantly distinct as discussed under the latter species. Of all known *Rhaphiomidas* species, *hirsuticaudus* shares with *spinicaudus* the position of being the most divergent,

having many characteristics that are unique for the genus. The following characteristics will separate *hirsuticaudus* from all other species: as the name indicates, the terminalia pilosity is unique as is the triangular shape of the hemitergites (fig. 7); the enlarged posterior legs in the males is a character not shared with any others; the nitid nonpruinose femora, tibiae and tarsi, and the arcuate anterior male tibiae are characteristic as are the nitid pleural areas on abdominal segments one through five, and segments six and seven in their entirety.

*Rhaphiomidas parkeri* Cazier

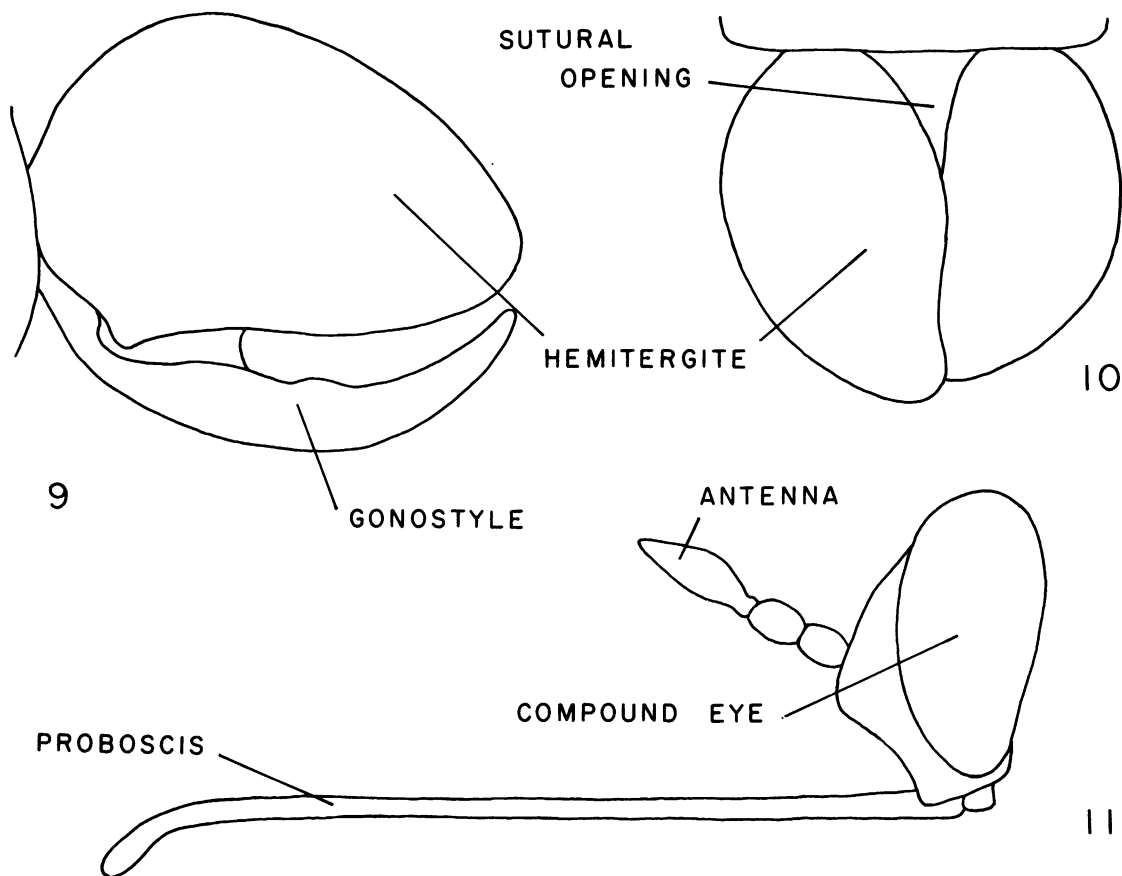
Figures 9–11; Map 6

*Rhaphiomidas parkeri* Cazier, 1941, pp. 625–626.

**DIAGNOSIS:** Medium-sized, elongate, narrow, moderately densely clothed with long gray and white pile, abdominal tergites dark brown or black bordered apically with narrow, pale yellow transverse vittae; mouthparts with the proboscis ranging from 8.5 mm to 10.8 mm in length, averaging 9.8 mm (fig. 11); third antennal segment elongate, widest medially, primarily orange (fig. 11); terminalia rounded, hemitergites with sutural margins overlapping from basal third to apex (fig. 10), hemitergites piceous, narrowly bordered with yellow, gonostyles extending posteriorly almost to or slightly beyond apex of hemitergites (fig. 9). Female with pile on fourth abdominal segment retrorse.

**REDESCRIPTION OF PARATYPE: Male: Head** with frons moderately densely clothed with long white pile, hairs white to and including vertex, surface white pruinose; posterior surface bare and densely white pruinose in narrow band bordering posterior margin of compound eyes, median portion densely clothed with long white pile, long erect white macrochaetae indistinct and mixed in with dense white pile; compound eyes separated from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the width of a lateral ocellus; antennae with segments one and two piceous, sparsely irregularly white pruinose, sparsely clothed with long erect white macrochaetae, third segment bare, orange, elongate, widest medially (fig. 11), with dark widened basal ring at junction with segment two, longer than segments one and two combined (fig. 11); mouthparts with

palpi short, brown, sparsely long white pilose, not macrochaetose, proboscis long, 9.2 mm in length (fig. 11). **Thorax** with humeral callosities deeply incised posteriorly, surface gray pruinose, sparsely long white pilose and macrochaetose; mesonotum with two median longitudinal dark vittae and two lateral vittae one on each side, discal surface and lateral margins exclusive of vittae gray pruinose, pile moderately dense, slightly yellowish or off-white, lateral marginal macrochaetae white, posterior lateral angles (post-alar callosities) tumid, prominent, sparsely white pilose and macrochaetose; wings with costal vein white pilose throughout; scutellum deeply acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins shallowly emarginate, posterior margin evenly rounded, surface and margins sparsely long white pilose, submarginal macrochaetae white; mesopleural sclerites gray pruinose, dorsocaudal angle and basallare densely long white pilose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gradually constricted to acute apical point. **Legs** not enlarged, coxae piceous, moderately densely long white pilose, all femora, tibiae and tarsi white pilose and macrochaetose, anterior and middle femora piceous except for yellow distal tip, tibiae and tarsi uniformly testaceous, posterior femora and tibiae piceous, tarsi reddish brown, tarsal pulvilli large, greatly expanded apically, three-quarters the length of tarsal claws, lateral margins divergent apically. **Abdomen** with all tergites primarily black, each narrowly bordered apically with a pale yellow transverse band, moderately densely clothed throughout with long semierect white pile, sternites as in tergites in color and pilosity. **Terminalia** rounded, sutural margins overlapping from basal third to apex (fig. 10), hemitergites piceous medially, narrowly bordered with yellow along dorsal margin to and including apex, ventral margin yellow in basal two-thirds, margins converging posteriorly from apical third to bluntly pointed apex (lateral view) (fig. 9), surface moderately clothed with long erect white hair, inner surface wrinkled irregularly, shining, concave medially, convex along dorsal margin, glabrous; ninth sternite shallowly convex, basal angles ex-



FIGS. 9-11. *Rhaphiomidas parkeri*. 9. Lateral view of male terminalia. 10. Dorsal view of male terminalia *in situ*. 11. Lateral view of head in male.

panded laterally, color piceous, moderately clothed with white pile, posterior margin obtusely notched medially between bases of gonostyles; gonostyles extending posteriorly almost to apex of hemitergites (fig. 9), testaceous, moderately clothed with long white hair, lateral posterior extensions finger-like, rounded, strongly bowed medially, curved inward apically, gradually narrowing from base to bluntly rounded apex (fig. 9); interbasal folds short, two-segmented, enlarged and bluntly rounded apically, protruding from base into bowed area of gonostyles, ventral surface deeply concave, dorsal surface convex; aedeagus projecting medially through membrane connecting gonostyles, lying ventral to membranous anal tube, base greatly enlarged, dorsal surface shallowly concave

medially, apex abruptly narrowed into narrow rounded tube, tube curved sharply upward and recurved anteriorly, apex obliquely open. Length 22 mm; mesonotal width 5 mm (redescribed from two paratypes from the type locality, one with the hemitergites separated).

**FEMALE:** Similar to the male except for the usual secondary sexual differences. However, the white pile on the fourth abdominal tergite is uniformly retrorse, a condition unique to this species, the yellow apical transverse abdominal bands are wider than in males, the dark areas on the legs are less well defined, the tarsal pulvilli are shorter and much less robust than in males and the hind tibiae are yellow rather than piceous. Length 22 mm; mesonotal width 5 mm.

**HOLOTYPE:** Male, California, Riverside

County, Blythe, April 18, 1939, F. H. Parker, in the California Academy of Sciences, no. 4722.

**ALLOTYPE:** Female, same data as holotype, in the California Academy of Sciences, no. 4723.

In the original description the types were recorded as being in the author's collection. They were later presented to the California Academy of Sciences as indicated by Arnaud (1979, p. 151).

**DISTRIBUTION:** **ARIZONA:** **Yuma County:** 6 miles southeast Parker, May 7, 1966, J. A. and J. M. Davidson, M. Cazier (1 male, 1 female); same location, April 23, 1966, same collectors (10 males, 9 females). **Pima County:** Molino Basin, Santa Catalina Mountains, 4200 feet, May 16, 1962, Killian Roever (1 female); Continental, Santa Rita Mountains, June 28, 1939, C. B. Philip (1 female). **CALIFORNIA:** **Riverside County:** Blythe, April 18, 1939, F. H. Parker (6 males, 4 females); same location, April 27, 1949, C. D. MacNeill (1 female); Hopkins Well, April 29, 1952, G. A. Marsh, P. D. Hurd (3 females). **Imperial County:** 3 miles south Palo Verde, April 8, 1949, P. D. Hurd (5 males, 1 female); Palo Verde, April 9, 1963, P. D. Hurd (1 female); 8 miles south Glamis, April 14, 1973, Don Emlay (1 female); 5 miles west Glamis, April 22, 1968, F. G. Andrews (1 male); 12 miles west Glamis, April 9, 1972, P. H. Sullivan (1 male); 10 miles west Glamis, April 28, 1973, J. M. Cicero (2 females); Glamis, April 30, 1973, T. Stemwedel (1 male); 2 miles west Glamis, April 22, 1978, Brown and Faulkner (1 female); 14 miles east Brawley, April 28, 1973, Joe Schuh (4 males); Algodones Dunes, April 13, 1962, M. Hain (1 female); Gordons Well, April 17, 1960, Eric Fisher (1 male). **San Bernardino County:** 12 miles south Cadiz, April 29–30, 1978, J. O'Grady (5 females). See map 6.

**ECOLOGY:** The following notes on the ecology, biology, and behavior were supplied by F. H. Parker at the time the species was described and named after him.

On April 18, 1940, at a golf course on the mesa near Blythe, California, specimens of *parkeri* were observed on the ground and in small shrubs where creosote bush, *Larrea tridentata* was

dense. The females would alight in sheep tracks or other depressions in the soft sand, work their abdomens into the sand, extending it about twice its normal length until the wings were flat on the ground and the abdomen assumed a vertical position. If undisturbed the female presumably laid an egg or several eggs, then removed the abdomen from the sand and flew to another depression a few inches to several feet away and repeated the behavior. Each "oviposition" required from one to two minutes to complete. When the females removed their abdomens, the loose fine sand filled the hole and no eggs could be found. These observations were made in the afternoon between 3:30 and 7:00 PM, after the temperature started to drop but these activities may have started earlier. However, during the hotter portions of the day, the flies were to be found mostly sitting in the shrubs. Males were abundant but because of their rapid and prolonged flight were more difficult to obtain. Copulation took place at every opportunity when the females flew into the flight path of the males or were seen by them on the sand or shrubs. Only one specimen was observed to fly to a sand verbena, *Abronia* species, and extend its proboscis into the flower, hovering meanwhile as do sphingid moths. Subsequent attempts to obtain eggs and larvae from this locality have proved fruitless. Several species of *Apiocera* were abundant in this area but were apparently confined to open areas and were not taken on shrubs.

The only other possible feeding plant association with *parkeri* is recorded on the labels on the three female specimens collected at Hopkins Well. The generic name *Abronia* is on each specimen but there is no indication as to whether they were taking nectar from these sand verbena flowers or just sitting on the plants.

The series of 11 males and 10 females collected 6 miles south of Parker were in an area of relatively unconsolidated dunes, adjacent to a large canal, in which there were occasional large thickets of mesquite, *Prosopis juliflora*, and a few smaller perennial plants which supplied shade for the flies (fig. 1). The males were flying around the vegetation, occasionally landing on the sand either in the sun or shade, or pursuing females as they flew out of the vegetation. During the hottest part of the day, about 12:30–4:00 PM, the males were engaged primarily in flying from shade to shade beneath the overhanging mesquite branches, evidently looking for females. It

was during this period that they were most easily netted.

**VARIABILITY:** In comparison with some of the other species, *parkeri* exhibits little individual or geographical variability in morphology. In length the males range from 26.4 mm to 21.0 mm and the females from 28.1 mm to 20.0 mm. In some males the gonostyles extend posteriorly slightly beyond the apices of the hemitergites (fig. 9) and the mesonotal pile varies from white to golden in both sexes. In one female from 12 miles south of Cadiz the proboscis is more than 5 times the length of the antennae (13.3 mm to 2.5 mm). In the other four females the proboscis varies from 3.5 to 4.0 times the antennal length.

**RELATIONSHIPS:** Superficially *parkeri* resembles only *brevirostris* of the presently known species. Both of these have similar abdominal maculations and pilosity as well as rounded terminalia in the males. In the females of both species the abdominal maculations are similar and these are the only ones in which the pilosity of the fourth abdominal segment is wholly or in part retrorse. The major differences are that in *parkeri* the third antennal segment is elongate and widest medially (fig. 11), whereas in *brevirostris* it is bulbous and pear-shaped apically with the widest portion anterior to the middle (fig. 5). In *parkeri* the posterior portion of the supraepimeron and all of the infraepimeron are bare, whereas in *brevirostris* both structures are pilose. In *parkeri* the proboscis of the mouthparts is from 3.5 to 5.0 times longer than the antennal length (fig. 11), whereas in *brevirostris* it is only 1 to 1.5 times the antennal length (fig. 5). In *parkeri* the abdominal pile is long, moderately dense and semi-erect, whereas in *brevirostris* it is shorter and less dense. In *parkeri* the apex of the aedeagus is recurved anteriorly, whereas in *brevirostris* the apex is bent upward but not recurved. In *parkeri* the postnotal conical swellings are gradually constricted to the apex, whereas in *brevirostris* the gradual constriction from the base stops before the apex which then extends as a narrow projection to the apex.

The females of *parkeri* and *brevirostris* can be separated from the females of all other known species by their retrorse pile on the fourth abdominal segment. In *parkeri* the re-

trorse pile is short, dense, and regularly oriented toward the base of the abdomen. In *brevirostris* the retrorse pile is shorter, sparse and irregular in its orientation toward the base, especially laterally and in some areas toward the apex.

In several locations *parkeri* occurs sympatrically with *acton maehleri*, the females of which strongly resemble those of *parkeri*. However, once again the retrorse pile on the fourth abdominal segment will readily separate *parkeri* as the females of *acton maehleri* have this pile oriented only apically. The males are abundantly distinct as indicated in the key, those of *acton maehleri* having heart-shaped orange terminalia and orange abdominal tergites with middorsal black maculations. In *parkeri* the terminalia are round, black medially, and the abdominal tergites are largely black with narrow yellow apical margins.

#### *Rhaphiomidas forficatus*, new species

Figures 12-14; Map 3

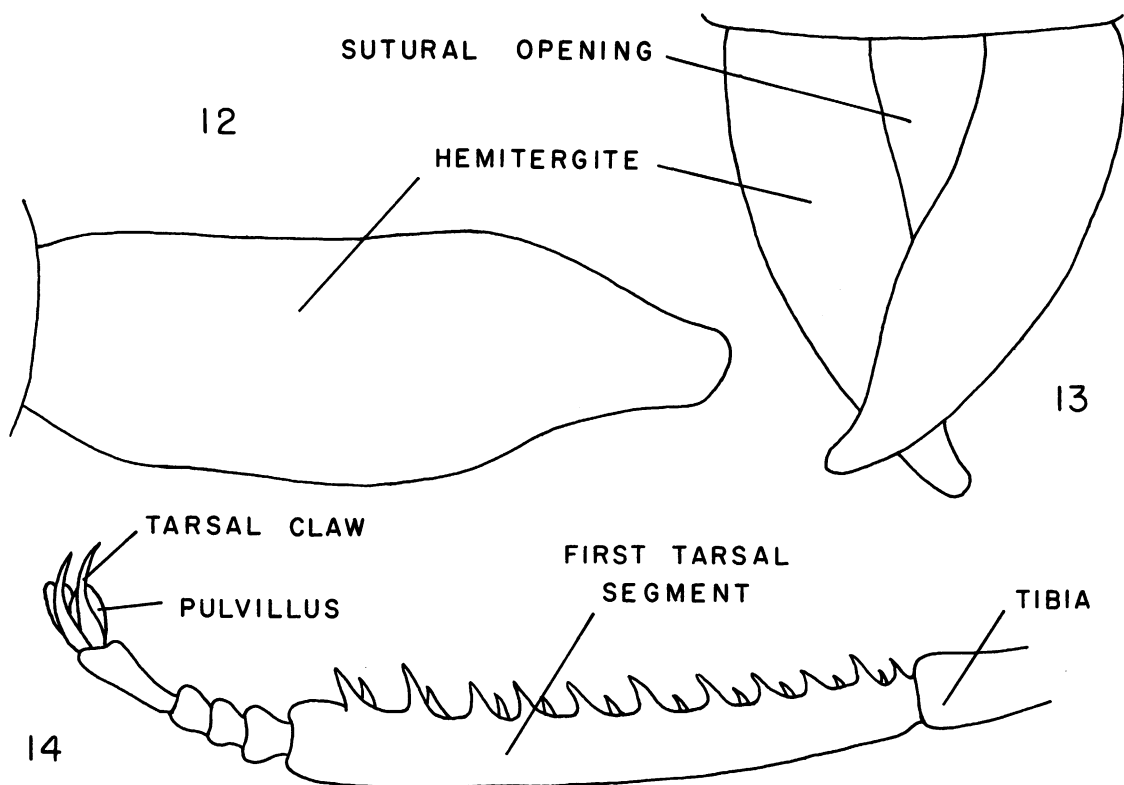
**DIAGNOSIS:** Medium-sized, moderately robust, each abdominal tergite bordered apically by a narrow, transverse yellow vitta; proboscis of mouthparts long, ranging in length from 8.7 mm to 10.2 mm, averaging 9.4 mm; third antennal segment elongate, widest medially; terminalia elongate, heart-shaped, hemitergites elongate, narrow, apices bluntly pointed, strongly overlapping each other (figs. 12, 13), gonostyles extending posteriorly to about apical third of hemitergites; compound eyes separated from lateral ocelli on vertex by about the width of a lateral ocellus; posterior tarsal segments two through five less than half the length of segment one in the male (fig. 14).

**DESCRIPTION OF TYPE:** Male: **Head** with lower frons long white pilose, upper frons and ocellar triangle yellowish pilose, surface white pruinose; vertex between lateral ocelli long brown pilose, surface between lateral ocelli and compound eyes deeply impressed, compound eyes separated from lateral ocelli on vertex by about the width of the lateral ocellus; posterior surface with bare white pruinose narrow band bordering posterior margin of compound eyes, median portion densely clothed with long white pile, sub-



dorsal row of long white macrochaetae evident; antennae with segments one and two piceous, faintly pruinose, sparsely white pilose and long white macrochaetose, first segment about  $1\frac{1}{2}$  times longer than second, third segment orange with faint irregular dark areas, widest medially, base with swollen ring at junction with second segment, longer than segments one and two combined; mouthparts with palpi short, black, sparsely white pilose, proboscis long, about 9.6 mm. **Thorax** with humeral callosities deeply incised posteriorly, surface gray pruinose, moderately densely long white pilose, sparsely white macrochaetose; mesonotum with single median, wide, dark longitudinal vitta, wide lateral vittae, one on each side, not interrupted, surface gray pruinose except for dark vittae, disc sparsely clothed with moderately long brown pile, lateral margins densely long brown and white pilose mixed, lateral and posterior macrochaetae, white, posterior angles (post-alar callosities) gray pruinose, sparsely brown pilose apically, submarginal macrochaetae long and white; wings with costal vein primarily golden pilose in basal third, short black pilose in apical two-thirds; scutellum deeply acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins obliquely grooved, posterior margin evenly shallowly rounded, surface with anterior two-thirds nitid (shiny) sparsely long white pilose, basal third gray pruinose, sparsely long white pilose, sparse submarginal macrochaetae white; mesopleural sclerites gray pruinose, dorsocaudal angle and basallare densely long white pilose, supraepimeron bare except for dorsal anterior angle, infraepimeron bare; postnotal conical swellings with sides gradually constricted to acute apex. **Legs** with coxae black, sparsely gray pruinose, densely long white pilose, sparsely white macrochaetose; femora black, not pruinose, surface dull, wrinkled and sericeous, sparsely long white pilose ventrally, densely long white pilose dorsally, white macrochaetose; tibiae with anterior and middle pair testaceous, white macrochaetose, clothed beneath with long curved silky white hair, middle tibiae with ventral irregular double rows of short stout black spines, posterior tibiae black, white macrochaetose, dorsal inner surface in basal half densely clothed with long white

curved hairs, apically short black pilose, ventral surface sparsely long white pilose from base to apex, inner surface with two irregular rows of short stout black spines; tarsi of anterior and middle legs testaceous, white macrochaetose, short white pilose, middle tarsi with first and second segments short black spinose ventrally, first segment with ventral irregular double row of spines, anterior tarsi without spines, posterior tarsi with first segment black, sparsely clothed beneath with long brownish hair, upper surface densely clothed with recumbent short black pile, ventral surface with irregular double row of short stout black spines, longest distally (fig. 14), macrochaetae white, segments two through five of posterior tarsi brownish in color, white pilose and macrochaetose, short, less than half the length of the first segment (fig. 14); tarsal pulvilli long, about two-thirds the length of the tarsal claws, wide, strongly expanded apically (fig. 14). **Abdominal tergites** not pruinose, primarily black in color, moderately densely long white pilose, tergite one black with narrow dark yellow apical border, tergites two through five with posterior margins of black discal areas shallowly lunate, widest medially, not reaching apical margins, yellow apical areas narrow medially, laterally broadly expanded toward base, narrowly connected to pleural dark areas; sternites one through four testaceous throughout, sternites five and six with dark discal areas, sternites one through six moderately densely long white pilose. **Terminalia** (unopened), heart-shaped, black with narrow brownish border along apical half of sutural margin, light brown apex, narrow yellow ventral border, pile white, erect, medium in length dorsally longer laterally; hemitergites strongly convex medially, lateral margins gradually converging posteriorly into bluntly pointed apices, apex of right hemitergite strongly overlapping apex of left hemitergite (appearing forked) (fig. 13); ninth sternite black, shallowly convex, sparsely long white pilose, posterior border shallowly evenly emarginate medially between bases of gonostyles; gonostyles finger-like, rounded, brown, sparsely long white pilose, only slightly bowed medially, extending posteriorly to about apical third of hemitergites; interbasal folds short, concave ventrally; aedeagus enlarged basally, narrowing apically into smooth



FIGS. 12-14. *Rhaphiomidas forcatus*. 12. General shape of hemitergite. 13. Hemitergites *in situ*, dorsal view. 14. Lateral view of posterior male tarsus.

dorsally curved tube, recurved anteriorly at tip. Length 24.6 mm; mesonotal width 7.1 mm. The holotype specimen has been dermestid infested but aside from several holes at the base of the abdomen and one in the left infraepimeron it is in better condition than any of the others.

**FEMALE:** Similar to the male except in the usual secondary sexual differences. However, in the female the golden pile on the costal wing vein consists of a few hairs at the extreme base; none of the legs have short stout black spines; and the posterior tarsal segments two through five are slightly more than half the length of segment one. Length 22.1 mm; mesonotal width 6.4 mm.

**HOLOTYPE:** Male, Mexico, Baja California Sur, San Ignacio, April 14, 1968, 560 feet, M. E. Irwin, deposited in the University of California, Riverside.

**ALLOTYPE:** Female, 25 miles south of Santa Rosalia, April 15, 1968, 560 feet, M. E. Irwin,

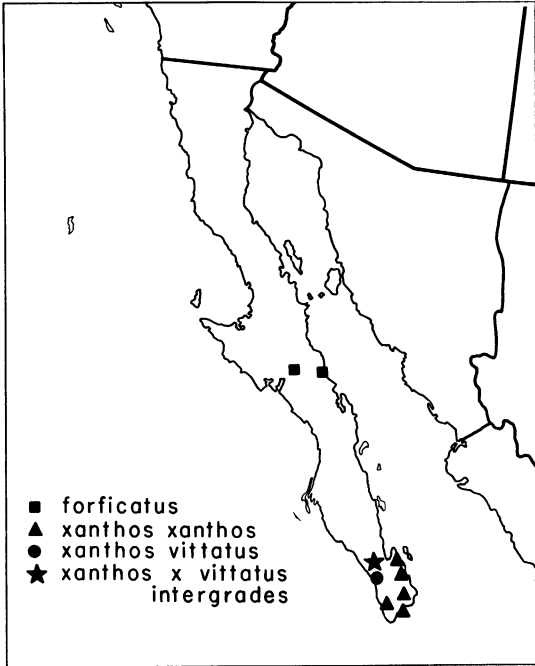
deposited in the University of California, Riverside.

**PARATOPOTYPES:** Mexico, Baja California Sur, San Ignacio, April 14, 1968, 560 feet, M. E. Irwin (5 males, 2 females UCR, AMNH and author's collection at ASU). See map 3.

**ETYMOLOGY:** The species name is from the Latin *forcatus* meaning forked, in reference to the overlapping hemitergite apices which give the species the appearance of having a forked tail.

**ECOLOGY:** The only information available is on the label of the allotype which gives "drywash" as the collecting situation.

**MALE TERMINALIA:** The terminalia of the type specimen was not opened because of possible damage to the rest of the specimen, such as hair matting and discoloration. However, three male paratopotypes were more or less satisfactorily opened so that the internal characters could be described. On the inside surface of the hemitergites, posterior to the



MAP 3. Distributions of *Rhaphiomidas* sp.: *R. forficatus*, *xanthos xanthos*, *xanthos vittatus*, *xanthos* × *vittatus* intergrades.

tip of the muscle attachment, there is a raised convex area the surface of which is diagonally striate. The remainder of the surface is smooth. Below the dorsal margin, in the basal two-thirds, there is a raised obtuse ridge that brings the upper surface up to the inner level. Behind the apex the surface is shallowly concave. The surface has a few scattered long erect brownish hairs.

The ventral characteristics of the aedeagus are given in the description but the most characteristic feature is the deeply, evenly, concave, dorsal surface of the enlarged basal portion and the strongly recurved narrow apical tube. The interbasal folds are short, rounded dorsally and bulbous apically. The finger-like lateral gonostyles are slightly clavate apically.

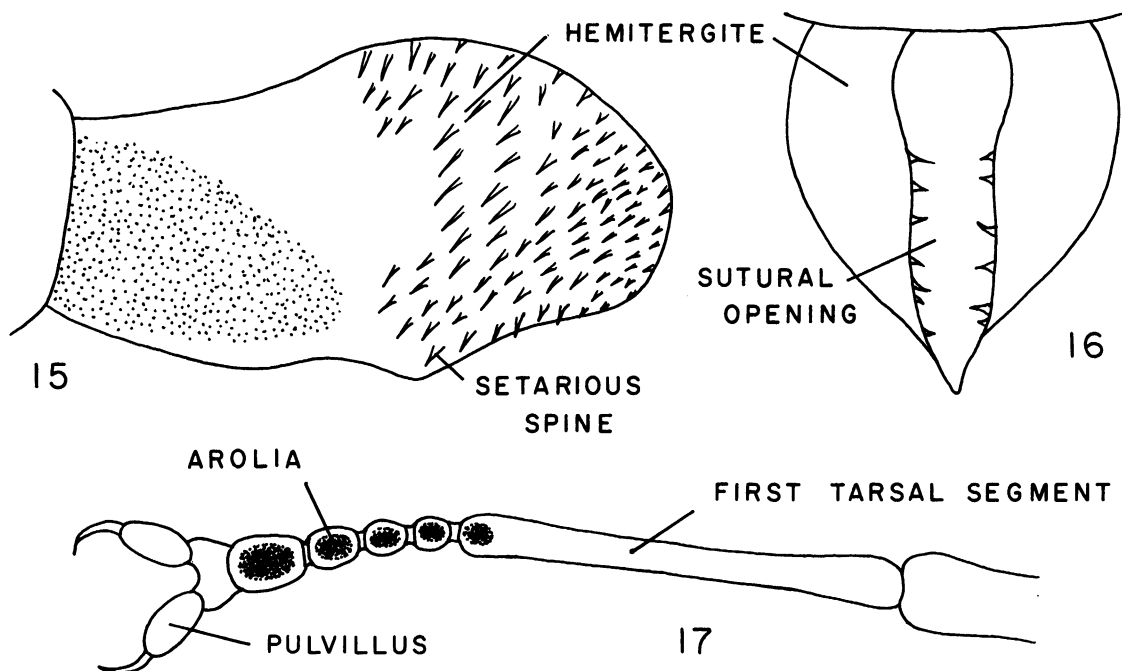
**VARIABILITY:** The males range in size from the type length of 24.6 mm to 24.7 mm, whereas the females vary from 22.1 mm to 23.5 mm. Aside from a little variability in pile color, maculation extent, number of spines on the middle and posterior legs, the series of five male and two female paratopo-

types is remarkably uniform in all major features. In the scissor-like apical overlap of the male hemitergites, the frequency of right overlapping left is three and left overlapping right is also three.

**RELATIONSHIPS:** Even superficially, *forficatus* does not appear to be closely related to any of the described species. However, it does have affinities with others in a few characters but is abundantly distinct. It could be mistaken for *brevirostris* because both have the hemitergites strongly overlapping apically (fig. 13) and both have yellow apical transverse vittae on abdominal tergites two through six. However, *forficatus* has a longer proboscis, the third antennal segment is elongate rather than pear-shaped, the compound eyes are separated from the lateral ocelli on the vertex by about the width of a lateral ocellus instead of 1½ times the width, the gonostyles extend posteriorly to about the apical third of the hemitergites instead of to or near the apex of the hemitergites, the middle and posterior tibiae and first tarsal segments are spinose ventrally (fig. 14), whereas in *brevirostris* there are no spines on these structures.

*Rhaphiomidas forficatus* resembles *hirsuticaudus* by having the posterior tarsal segments two through five in the male less than half the length of the first segment (fig. 14) and the compound eyes are closer to the lateral ocelli on the vertex than in most other species. However, *forficatus* has a long rather than short proboscis, its hemitergites are elongate and overlapping (figs. 12, 13) instead of subtriangular and not overlapping (fig. 7), its abdominal tergites are banded apically with yellow rather than being unicolorous dark, and in *forficatus* there are no nitid pleural areas on the abdominal segments. There are many other differences.

In proboscis length, recurved aedeagal apices, overlapping hemitergite apices and yellow-banded abdominal tergites, *forficatus* bears a vague resemblance to *parkeri*. However, in *forficatus* the terminalia are elongate and heart-shaped (fig. 13) instead of being round, the second through the fifth posterior tarsal segments in the male are less than half the length of the first segment (fig. 14) instead of being more than half the length, the middle and posterior tibiae and first tarsal segments in the male are ventrally spinose (fig. 14) rath-



FIGS. 15–17. *Rhaphiomidas spinicaudus*. 15. Inside hemitergite surface. 16. Dorsal view of hemitergites *in situ*. 17. Ventral view of anterior male tarsus.

er than nonspinose, the gonostyles are short rather than extending to or almost to the apex of the hemitergites as in *parkeri*.

***Rhaphiomidas spinicaudus*, new species**

Figures 15–17; Map 4

**DIAGNOSIS:** Small-sized, moderately robust, hairy, clothed with long irregularly curved (sinuous) hair, black in color; compound eyes separated from lateral ocelli on vertex by about twice the width of a lateral ocellus; proboscis of mouthparts long, ranging from 8.1 mm to 10.2 mm, averaging 9.4 mm; third antennal segment elongate, black, widest medially; anterior tarsi with basal segment thickened at both ends, narrow medially (fig. 17), sericeous, basal segment on right leg with three ventrolateral macrochaetae only, on left tarsus four ventrolateral macrochaetae only, about  $1\frac{1}{2}$  times longer than segments two through five combined, ventral apex with small arolium-like pad of short dense golden hairs, segments two through five with similar arolia increasing in size through

segment five (fig. 17); terminalia small, narrow, heart-shaped, primarily black in color, inner hemitergite surface with regularly spaced short erect setarious spines covering apical half (figs. 15, 16), surface without carinae, gonostyles short extending posteriorly to about apical third of hemitergites.

**DESCRIPTION OF TYPE:** Male: **Head** with tumid mesofacial plate, below antennal bases, shallowly tuberculate, upper surface not pruinose, clothed moderately densely with long erect white pile, lower surface densely white pilose, forming a beard (mystax) that obscures the subcranial cavity into which the proboscis originates; frons black, not pruinose, moderately densely clothed with long white and brownish sinuous hair; ocellar triangle and vertex not pruinose, moderately densely long brown pilose, vertex with surface between lateral ocelli and compound eyes shallowly impressed, compound eyes separated from lateral ocelli by about twice the width of a lateral ocellus; posterior surface with bare, not pruinose, narrow band bordering posterior margin of compound eyes,

median portion moderately densely clothed with long sinuous brownish pile, subdorsal row of white macrochaetae not evident; antennae black, segments one and two sparsely white macrochaetose, third segment bare, elongate, widest medially, base with swollen ring at junction with second segment, longer than segments one and two combined; mouthparts with palpi short, sparsely long white pilose, proboscis long, 10.2 mm. [The apparent lack of pruinosity may be due to greasy conditions of the type, but degreased paratopotypes also lack pruinosity.] **Thorax** with humeral callosities deeply incised posteriorly, surface not pruinose, moderately densely clothed with long erect sinuous brownish pile, sparsely indistinctly macrochaetose; mesonotum with disc covered with lumps of grease, surface sparsely clothed with long sinuous brownish pile, lateral margins in apical half densely long sinuous white pilose, macrochaetae white, posterior angles (post-alar callosities) densely long sinuous white pilose, submarginal macrochaetae long and white; wings with costal vein golden pilose in basal third, apical two-thirds white pilose; scutellum deeply acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins obliquely grooved, posterior margin evenly shallowly rounded, surface moderately densely clothed with long sinuous brownish pile, submarginal macrochaetae long white and indistinct; mesopleural sclerites irregularly sparsely dark gray pruinose, dorsocaudal angle and basale densely long pilose, hairs sinuous and white, supraepimeron bare except for dorsal anterior angle, infraepimeron bare; postnotal conical swellings dark gray pruinose, sides gradually constricted to blunt obtuse apex. **Legs** with coxa black, not pruinose, moderately densely clothed with long sinuous white pile, posterior coxa with single long white macrochaeta; femora black except for apex which is testaceous, surface sericeous, shiny, moderately densely clothed with long sinuous white pile, not pruinose, sparsely long white macrochaetose especially laterally and ventrally; tibiae with anterior and middle pair testaceous on inner surface, piceous on outer surface, moderately densely short golden distally recumbently pilose throughout, sparsely long white macrochae-

tose, surface dull sericeous, not pruinose, posterior tibiae black sericeous, outer and lateral surfaces moderately clothed with short golden distally recumbent hair and sparsely long white macrochaetose, inner surface in proximal two-thirds densely clothed with long decumbent light golden hairs, distal third with hairs shorter with tips of hairs less strongly bent over; tarsi with basal segment of anterior pair thickened at both ends, narrowed medially, testaceous, about  $1\frac{1}{2}$  times longer than segments two through five combined (fig. 17), surface sericeous, sparsely short distally recumbent pilose, basal segment on right leg with three long ventrolateral macrochaetae only, on left tarsus four long ventrolateral macrochaetae, ventral apex with small arolium-like pad of short dense golden hairs, segments two through five testaceous, upper surfaces sparsely short golden pilose, ventral surfaces with arolium-like pads increasing in size to fifth segment (fig. 17), middle tarsi testaceous, basal segment little longer than segments two through five combined, all segments sparsely short distally recumbent golden pilose, ventrally long white macrochaetose, small remnants of arolium-like pads on apices of segments two through five, posterior tarsi with segment one black, segment two piceous, segments three through five brown, segment one sparsely clothed with short distally recumbent golden hairs on dorsal and lateral surfaces, ventral surface densely clothed with long erect decumbent golden pile, bent tips oriented basally, surface granulated, shiny, segments two through five sparsely short recumbently golden pilose dorsally, ventrally and laterally with long white macrochaetae, without arolium-like pads ventrally; tarsal pulvilli narrow (fig. 17), parallel-sided, about two-thirds the length of tarsal claws, not strongly expanded apically. **Abdominal** tergites, pleurites, and sternites uniformly black, tergites two through five greasy, discs rubbed, pleurites one through five densely clothed with long sinuous white pile, sternites one through five sparsely clothed with long sinuous white pile. **Terminalia** (not opened in type), primarily black, apical half of dorsal margin and apical truncate margins narrowly brown in color, small, narrow, heart-shaped, moderately densely long erect sinuous white pilose, hair longer and more dense ventrally;



hemitergites with dorsal margins widely separated basally, gradually converging to apex (fig. 16), margins strongly internally sharply toothed in apical two-thirds (fig. 16), dorsal apical margin gradually rounded downward (lateral view) to posterior dorsal angle, posterior margin truncate, ventral margin shallowly emarginate anterior to ventral angle, broadly rounded medially, straight to base (fig. 15), inner surface (internal description from male paratype) smooth, shiny, apical half moderately densely covered with short erect setarious spines, each spine with an arista-like terminal fine short hair, spines slightly oriented toward venter (fig. 15); ninth sternite black, shallowly convex, sparsely long white pilose, posterior margin deeply obtusely emarginate medially between bases of gonostyles; gonostyles dorsoventrally flattened, thin, slightly wider apically, sparsely long white pilose especially along outer edges, flattened arms straight, only slightly pointing inward toward apex, not bowed or finger-like; interbasal folds indistinct, apex barely protruding inward from inner gonostyle margin, not concave ventrally; aedeagus (description from male paratype) enlarged basally, narrowing apically into a smooth elongate sinuous tube projecting at about a 45° angle upward and posteriorly, apex not recurved, dorsal surface of enlarged base deeply excavated medially, lateral margins almost vertical. Length 21.3 mm; mesonotal width 4.7 mm.

FEMALE: Unknown.

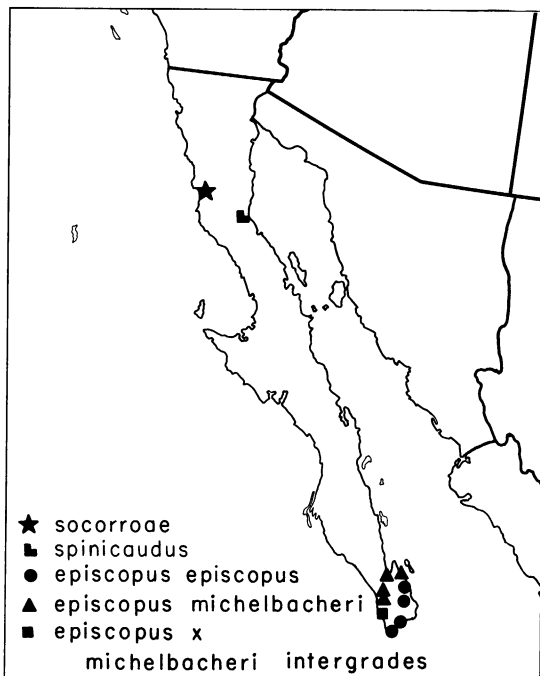
HOLOTYPE: Male, Mexico, Baja California Norte, Millers Landing, March 30, 1973, J. A. Powell, deposited in the California Academy of Sciences on indefinite loan from the Essig Museum of Entomology, University of California, Berkeley.

PARATOPOTYPES: Same data as holotype (1 male AMNH, 1 male Essig Museum). See map 4.

ETYMOLOGY: The species name is from the Latin *spina* meaning spine and *cauda* meaning tail in reference to the setarious spines on the inner hemitergite surface.

ECOLOGY: No information.

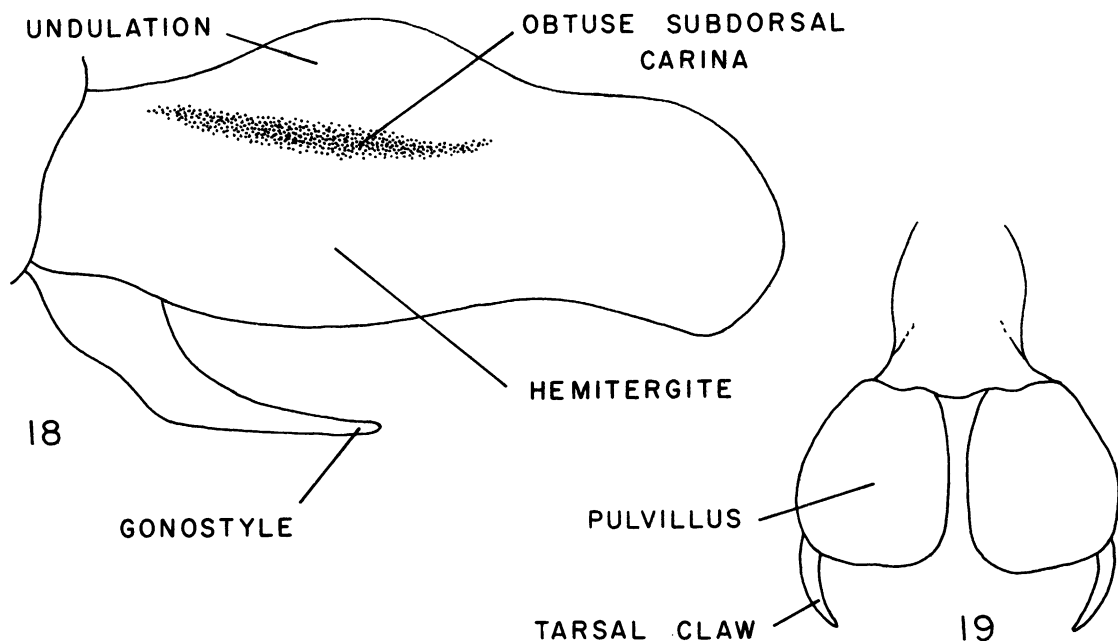
VARIABILITY: The two male paratopotypes exhibit little or no variability in any characteristics except for changes that resulted in degreasing and opening their terminalia. The



MAP 4. Distributions of *Rhaphiomidas* sp.: *R. socorroae*, *spinicaudus*, *episcopus episcopus*, *episcopus michelbacheri*, *episcopus* × *michelbacheri* intergrades.

long sinuous white and brownish pile is badly matted but the lumps of grease, especially on the mesonotum, are gone, revealing a dull black impunctate surface. In the type, the presence of the setarious spines on the inside hemitergite can be seen looking down through the dorsal opening between the hemitergite margins (fig. 16). However, the open terminalia reveal the extent of this spination as given in the description (fig. 15).

RELATIONSHIPS: As in *hirsuticaudus*, *spinicaudus* shares the distinction of not being closely related to any of the other described species in the genus. Its unique features include the following: the setarious spines on the inner hemitergite surface (fig. 15) which must give the males a sensory and physical clasping advantage during copulation, the long sinuous pile, the widely separated compound eyes, the presence of arolii-like pads on the ventral surface of the anterior tarsal segments (fig. 17), the dense patches of decumbent pile on the posterior tibiae and basal tarsal segments, the shape of the apex of the hemiter-



FIGS. 18–19. *Rhaphiomidas undulatus*. 18. Lateral view of male terminalia. 19. Ventral view of fifth tarsal segment in male.

gites (fig. 15), the sinuous shape of the aedeagal tube and the dorsoventrally flattened paper thin gonostyles.

Geographically *spinicaudus* is allopatric and, so far as presently known, the most proximate species is *forficatus* from San Ignacio, Baja California Sur, about 100 miles south of Millers Landing. Still farther south are *episcopis* and *xanthos* and in the extreme north of Baja California we find *acton maculatus*, all three of which can be separated from *spinicaudus* by all of its unique features as given above.

***Rhaphiomidas undulatus*, new species**

Figures 18–19; Map 2

**DIAGNOSIS:** Large-sized, robust, moderately clothed with white and yellowish pile, abdominal segments three through five orange, without dark maculations; mouthparts with proboscis long, ranging from 10.0 mm to 13.4 mm in length, averaging 11.8 mm; third antennal segment elongate, widest medially, primarily orange with faint dark irregular dorsal mottling; terminalia elongate, heart-shaped, dark orange, hemitergites not grad-

ually attenuated apically, apices broadly rounded, narrowly overlapping, sutural margins strongly undulating from base to apex, inner surface without spines, with shallow obtuse subdorsal longitudinal carina (fig. 18), gonostyles extending posteriorly to about middle of hemitergites (fig. 18); anterior tarsal segments two through five without ventral arolia, tarsal pulvilli large, broadly expanded apically (fig. 19).

**DESCRIPTION OF TYPE:** Male: **Head** with frons and vertex moderately densely clothed with white pile, surface gray pruinose; posterior surface bare and densely gray pruinose in narrow band bordering posterior margin of compound eyes, median portion densely long white pilose, sparsely long white macrochaetose in dorsal portion; compound eyes separated from lateral ocelli on vertex by about the width of a lateral ocellus; antennae with segments one and two brownish, sparsely white pruinose, sparsely clothed with long erect white pile, segment one with pile hair-like, segment two with stiff macrochaetae in a median horizontal row, segment three bare, primarily orange, dorsal surface with dark irregular mottling, basal ring white pruinose,

length about  $1\frac{1}{2}$  times the length of segments one and two combined; mouthparts with palpi short, dark and white pilose, proboscis long 13.4 mm. **Thorax** with humeral callosities prominent, deeply incised posteriorly deeply grooved between mesonotum, surface gray pruinose, sparsely long white pilose, sparsely white macrochaetose; mesonotum with two narrowly separated dark median longitudinal vittae, extending from anterior margin not reaching basal margin, two lateral longitudinal dark vittae, one on each side, extending from near humeral callosity to post-alar callosity, surface between vittae and lateral margins gray pruinose, pile moderately dense and short discally, longer and more dense laterally, lateral marginal macrochaetae white or yellowish, post-alar callosities dark, sparsely white pruinose, pilose and macrochaetose; wings with costal vein white pilose throughout; scutellum deeply, acutely delimited from posterior mesonotal margin, transverse groove acute, sharply defined, lateral margins shallowly emarginate, posterior margin evenly rounded, surface with basal half black, apical half densely gray pruinose, sparsely irregularly white and yellowish pilose, submarginal macrochaetae white; mesopleural sclerites sparsely gray pruinose, dorsocaudal angle and basare densely long white pilose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gradually constricted to acute apical point. **Legs** not enlarged, coxae black, densely long white pilose, anterior and middle femora piceous and orange, posterior femora orange, all femora sparsely white pilose and white macrochaetose, tibiae pale orange, white pilose and macrochaetose, middle and posterior tibiae with irregular double row of short stout black spines on inner surface facing femora, tarsi orange, white pilose and macrochaetose, first tarsal segment of middle and posterior legs with irregular double row of ventral short black or white spines; tarsal pulvilli large, paddle-shaped, greatly enlarged from base to evenly rounded apex, about three-quarters as long as tarsal claws (fig. 19). **Abdomen** primarily orange, tergite one black in basal half, apical half with orange transverse vitta widened laterally, tergite two with median black basal mark in basal one-third, apical two-

thirds orange, tergites three through seven orange, without black maculations, surface clothed with short white pile, longer and more dense laterally, sternites all orange, moderately densely clothed with long white pile. **Terminalia** elongate, uniformly dark-orange, moderately clothed with short erect white pile, sutural margins of hemitergites strongly undulated from base to about apical quarter (fig. 18), narrowly overlapping in apical quarter, apical margin evenly rounded, protruding strongly below ventral margin, ventral margin nearly straight to base, inner hemitergite surface shiny, with few scattered hairs, obtuse subdorsal carina extending from near base to beyond middle of hemitergite (fig. 18), convex, apical third evenly, deeply, concave; ninth sternite shallowly convex, basal angles not expanded laterally, surface moderately densely clothed with long golden pile, posterior margin obtusely notched medially between bases of gonostyles; gonostyles extending posteriorly to about middle of hemitergites (fig. 18), inner margins flattened, outer margins of finger-like extensions rounded, moderately clothed with golden pile, lateral arms shallowly bowed, slightly enlarged at tip; interbasal folds short, two-segmented, enlarged, bluntly rounded dorsally and apically, concave ventrally; aedeagus projecting medially through membrane connecting gonostyles, lying ventrally to membranous anal tube, base greatly enlarged, dorsal surface slightly concave medially, ventral surface convex, apex abruptly narrowed into narrow rounded tube, tube bent sharply upward at a right angle to tube base, apex truncate, open. Length 29.0 mm; mesonotal width 7.7 mm.

**FEMALE:** Similar to the male except for the usual secondary sexual characteristics, her larger more robust size and a few minor differences. The anterior half of the scutellum is sparsely gray pruinose, the dark basal maculations on abdominal tergite two are wider, separated transversely and extend posteriorly in the middle beyond the center of the tergite, legs unicolorous, the middle and posterior tibiae and first tarsal segments lack the short stout black spines and the proboscis of the mouthparts is 17.0 mm in length. Length 35.0 mm; mesonotal width 8.5 mm.

**HOLOTYPE:** Male, California, San Diego County, Borrego Valley, May 21, 1941, Dr.

E. C. Van Dyke, deposited in the California Academy of Sciences.

ALLOTYPE: Female, same data as holotype, deposited in the California Academy of Sciences.

PARATOPOTYPES: Same data as holotype (1 male, 6 females); California, Borego (Borrego), May 21, 1941, R. C. Dickson (1 male, 1 female). Paratopotypes deposited in CAS, AMNH, UCR, collection of E. M. Fisher and the author's collection at ASU.

PARATYPES: CALIFORNIA: **Riverside County:** Palm Springs, May 10, 1941, E. C. Van Dyke (1 male); 1000 Palms Canyon, May 16, 1970, D. Smith (1 male, 2 females); Palm Canyon, May 10, 1954, P. H. Timberlake (1 male); Sec. 19, T6S, R6E, elevation about 2800 feet, NE of Black Hill, May 22, 1973, on *Salvia apiana*, white sage, G. R. Ballmer (1 male UCIS specimen no. 318776); Pinyon Flat, San Jacinto Mountains, June 17, 1952, W. Gertsch, R. Schrammel, M. Cazier (1 male). Paratypes deposited in CAS, AMNH, UCR, collection of E. M. Fisher and the author's collection at ASU (map 2).

ETYMOLOGY: From the Latin *undulatus* meaning waved or wavy in reference to the sutural hemitergite margins which are characteristic of this species.

ECOLOGY: The only information available is that one specimen from near Black Hill was taken on *Salvia apiana* and, since the legs and ventral body surface were covered with small, pale yellow pollen grains, it can be assumed that the specimen was taken on the flower of this plant and was, perhaps, nectar feeding. A second specimen from Palm Canyon also bears the label on *Salvia apiana* but the specimen is devoid of pollen and may have either been resting on the plant or feeding on nectar without contacting the flower with its legs or body. Their long proboscis and hovering flight ability would make such feeding behavior possible.

VARIABILITY: There is little variability in any of the eight males and four females available for study. The inner structures of the terminalia are also constant in the four males in which the hemitergites were separated.

RELATIONSHIPS: *Rhaphiomidas undulatus*, in size, color, and general appearance resembles *acton acton* but is easily separated from this subspecies by the smooth carinate inner

hemitergite surface (fig. 18), its elongate hemitergites, the undulating sutural hemitergite margins and shorter gonostyles (fig. 18). Both of these species are sexually monochromatic. The same characters given above will also separate *undulatus* from *acton maehleri*, and in addition the latter subspecies is dichromatic sexually (figs. 38, 40). *Rhaphiomidas undulatus* occurs geographically, ecologically and chronologically together with *nigricaudis* at Borrego and Borrego Valley but can be readily distinguished by its hemitergite carina, undulating sutural hemitergite margins, shorter gonostyles (fig. 18), orange terminalia and monochromatic sexes. In *nigricaudis* the sexes are dichromatic, the hemitergites are black narrowly bordered with dark orange (fig. 33), the inner hemitergite surface is opaque, not carinate, and the terminalia are shorter and more robust. At Pinyon Flat one male of *undulatus* was taken with four males and three females of *acton acton* as they visited the flowers of an unidentified plant species.

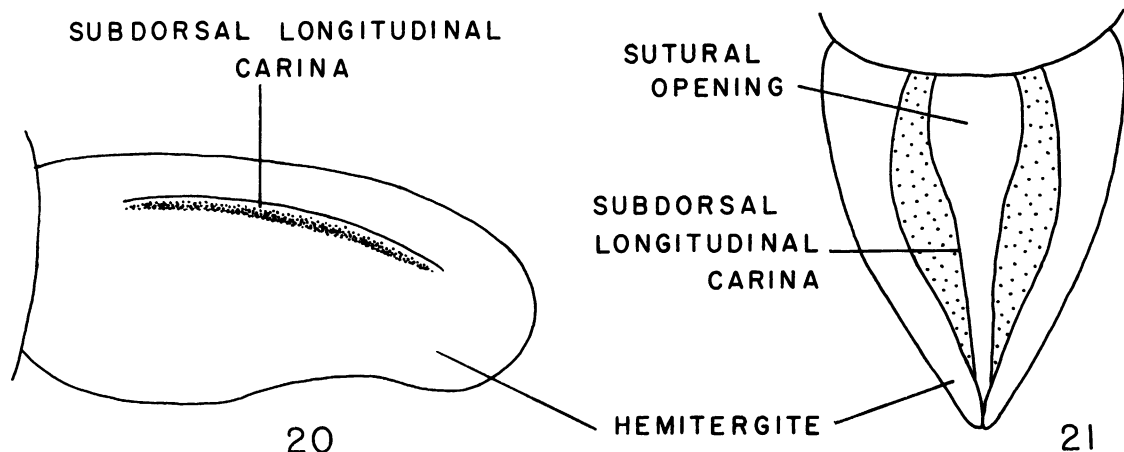
As of this date there are only four species in the genus *Rhaphiomidas* that have the subdorsal longitudinal carina on the inner hemitergite surface. These are *hasbroucki*, *tarsalis*, *socorroae*, and *undulatus* which can be separated as given in key dichotomies seven, eight, and nine, and as can be seen, are abundantly distinct from each other.

### *Rhaphiomidas hasbroucki*, new species

Figures 20–21; Map 5

DIAGNOSIS: Small- to medium-sized, narrow, each abdominal tergite with varying amounts of yellow and black maculations; compound eyes separated from lateral ocelli on vertex by about  $1\frac{3}{4}$  times the width of a lateral ocellus; proboscis of mouthparts ranging in length from 8.8 mm to 10.6 mm, averaging 9.6 mm; third antennal segment elongate, widest medially; male terminalia small, elongate, heart-shaped; hemitergites short and narrow, not overlapping apically, apices broadly rounded, not attenuated, inner surface with prominent subdorsal longitudinal carina (visible through sutural opening) (figs. 20, 21); gonostyles extending posteriorly to apical third or apical quarter of hemitergites.

DESCRIPTION OF TYPE: Male: **Head** with



FIGS. 20–21. *Rhaphiomidas hasbroucki*. 20. Lateral view of inside hemitergite surface. 21. Dorsal view of male terminalia *in situ*.

tumid mesofacial plate below antennal bases, white pruinose, moderately densely clothed with long white pile, not obscuring subcranial cavity; frons white pruinose, long white pilose laterally, long hairs on lower frons directed laterally by antennal bases, ocellar triangle moderately densely pilose; vertex between ocelli densely long white pilose, hairs thickened, oriented anteriorly, surface white pruinose, surface between lateral ocelli and compound eyes shallowly impressed, compound eyes separated from lateral ocelli on vertex by about  $1\frac{3}{4}$  the width of a lateral ocellus; posterior surface with bare white pruinose band bordering posterior margin of compound eyes, median portion densely clothed with medium length white hair, subdorsal row of long white macrochaetae evident; antennal segments one and two piceous, faintly pruinose, sparsely white pilose, long white macrochaetose, third segment bare, sericeous, with faint irregular dark areas, elongate, widest medially, base with swollen ring at junction with second segment, longer than segments one and two combined; mouthparts with palpi short, pale yellowish, white pruinose, sparsely long white pilose, some hairs thickened, proboscis long, 10.6 mm. **Thorax** with humeral callosities deeply incised posteriorly, surface white pruinose, moderately densely long white pilose, sparsely long white macrochaetose; mesonotum with double median longitudinal dark gray vittae, narrowly

separated medially, single wide longitudinal dark gray vitta on each side, diagonally interrupted toward base, surface other than dark gray pruinose vittae primarily white pruinose, disc sparsely clothed with long light brown hairs, lateral margins densely clothed with white and brownish long pile, sparsely long white macrochaetose, posterior angles (post-alar callosities) light gray pruinose, sparsely long white pilose, submarginal macrochaetae long and white; wings with costal margin white pilose from base to near apex; scutellum deeply acutely delimited from posterior mesonotal margin, transverse groove sharply defined, especially laterally, lateral margins obliquely grooved, posterior margin shallowly evenly rounded, surface light gray pruinose, posterior two-thirds sparsely long white pilose, sparse submarginal macrochaetae white; mesopleural sclerites light gray pruinose, dorsocaudal angle and basalar densely long white pilose, not macrochaetose, supraepimeron bare except for dorsal anterior angle, infraepimeron bare; postnotal conical swellings with sides gradually constricted to acute apex, not prolonged, surface densely clothed with minute white hairs. **Legs** with coxae densely gray pruinose, long white pilose, sparsely long white macrochaetose; anterior and middle femora piceous except for distal testaceous tip, surface not pruinose, clothed with medium length white hair on upper, anterior and lower surfaces, posterior

surface with white hairs longer, sparsely long white macrochaetose, posterior femora entirely piceous, not pruinose, moderately densely clothed with medium length white pile, ventral surface sparsely long white macrochaetose; tibiae testaceous, moderately densely short white pilose, long white macrochaetose; tarsi with first segment on anterior legs shorter than segments two through five combined, middle tarsi with first segment subequal to segments two through five combined, posterior tarsi with first segment about one-third longer than two through five combined, all tarsi testaceous, short white pilose, medium to long white macrochaetose, basal segment on all tarsi irregularly short black spinose; tarsal pulvilli short, narrow, parallel-sided, about half the length of the tarsal claws, not expanded apically. **Abdominal** tergite one black basally, apical margin broadly yellow, yellow vitta widest laterally, densely clothed with long white hair overlapping base of segment two, tergites, pleurites, and sternites two through five moderately densely clothed with short fine silky hairs, slightly longer and more dense laterally on tergites, all terga primarily orange in color, terga two narrowly black basally with small median triangular black spot reaching middle of terga, terga three with longitudinal narrow median dark line in basal half, terga four broadly dark in basal half, median dark extension not reaching apical margin, terga five with median halfmoon-shaped dark marking not reaching apical margin, terga six unicolorous orange, pleura and sterna uniformly orange. **Terminalia** (opened) small, narrow, heart-shaped (fig. 21), bicolored orange, moderately densely clothed with erect, medium length white pile, hemitergites shallowly convex medially, apical half of dorsal margin, posterior and ventral margins narrowly bordered with a paler orange color, surface shiny, margins not strongly attenuated apically, dorsal margin shallowly sinuate, posterior margin evenly rounded, ventral angle bending slightly downward, ventral margin shallowly rounded to base, inner surface pale orange, nearly glabrous, shiny basally, sericeous apically, median dorsal area, below margin, with an acute carina, crest rounded, extending longitudinally from about basal third to apical third (evident even with terminalia closed, appearing as an in-

ternally protruding ledge paralleling the dorsal margin) (fig. 21), apices contiguous, not overlapping; ninth sternite pale orange, strongly convex, moderately densely clothed with erect, medium length white pile, posterior margin broadly evenly shallowly emarginate between bases of gonostyles, gonostyles evenly shallowly bowed outward medially, outer margins evenly rounded, inner surface shallowly concave, extending posteriorly to about apical quarter of hemitergites, sparsely short white pilose, not enlarged apically; interbasal folds short, extending posteriorly paralleling gonostyles for a short distance, ventral surface strongly concave, dorsal surface evenly shallowly rounded; aedeagus enlarged basally, narrowing abruptly into smooth, evenly shallowly, dorsally curved tube, not recurved apically, dorsal surface of enlarged base shallowly concave, surface wrinkled. Length 23.9 mm; mesonotal width 6.4 mm.

**FEMALE:** In addition to the usual secondary sexual differences, the female is more sparsely clothed with shorter pile, the abdominal tergites are dark on the basal two-thirds, the apical third is pale yellow, and the tarsal pulvilli are shorter and not as wide as in the male. Length 22.6 mm; mesonotal width 5.8 mm.

**HOLOTYPE:** Male, California, Riverside County, 3 miles south Rice, May 10, 1968, N. Foster, J. Bigelow, M. Cazier, deposited in the American Museum of Natural History.

**ALLOTYPE:** Female, same location as holotype, May 19, 1968, deposited in the American Museum of Natural History.

**PARATOPOTYPES:** Same location as holotype, May 10, 17, and 19, same collectors (108 males, 23 females).

**PARATYPES: ARIZONA: Yuma County:** 14 miles north Quartzsite, May 14, 1966, J. H. and J. M. Davidson, M. Cazier (5 males, 1 female); 18 miles southeast Parker, May 14, 1966, J. H. and J. M. Davidson, M. Cazier (1 male, 5 females); 8 miles southeast Parker, May 7, 1966, J. H. and J. M. Davidson, M. Cazier (19 males, 2 females); 6 miles southeast Parker, May 7, 1966, S. A. Gorodenski, J. M. Davidson, M. Cazier (31 males, 3 females); same location, May 14, 1966, J. H. and J. M. Davidson, M. Cazier (100 males, 10 females); same location May 29, 1966, S.

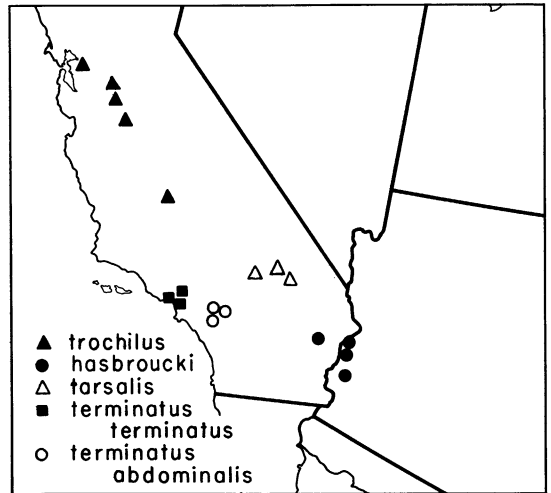
A. Gorodenski, J. M. Davidson (23 males, 2 females); 3 miles southeast Parker (incorrectly labeled Mojave County), June 11–29, 1978, J. Powell (1 male). CALIFORNIA: **Riverside County:** 2 miles south Rice, June 2, 1979, J. O. O’Grady (1 female). See map 5.

Paratopotypes and paratypes in many collections.

**ETYMOLOGY:** The species is named for Dr. F. F. Hasbrouck as a small token of my appreciation for the encouragement and extensive cooperation he has extended to me for many years and especially during the present study.

**ECOLOGY AND BEHAVIOR:** The type series of 133 specimens was collected in a semi-consolidated dune field in the bottom of Rice Valley 3 miles south of Rice. The primary vegetative cover in the valley was the creosote bush, *Larrea tridentata*, however in the dune area joint fir, *Ephedra* species and the perennial grass, *Hilaria rigida* were also in evidence and figured prominently in the behavior of the flies. The fourth plant species, *Poliomintha incana*, was in bloom and its small pale blue flowers may have been serving as the food (nectar) supply but no flies were observed visiting the flowers. All four plant species were serving the flies for shade, as resting perches for the females and as points of orientation for the males during their search flights for the females. The *Larrea*, *Ephedra*, and *Poliomintha* shrubs were the foundation for the hummocks they formed by holding the sand, forming high hummocks with the upper part of the plant on top and some of its roots exposed on the side of the hummock. Wind was undoubtedly the primary erosive agent, cutting away and piling up the sand into small dunes and forming the hummocks.

The females were found resting in the shade of exposed, dead, or live roots of the above plant species or on the shaded vertical stems and branches on top of the hummocks. The males, on the other hand, were seldom found in these situations preferring to sit in the shade on the sand or more commonly being in flight. Although no specimens were marked, it soon became evident that the males were following regular flight paths around and through the hummocks using them as pylons, coming in close to each plant as if looking for the females. Landings took place only when a fe-



MAP 5. Distributions of *Rhaphiomidas* sp.: *R. trochilus*, *hasbroucki*, *tarsalis*, *terminatus terminatus*, *terminatus abdominalis*.

male was seen but no copulations were observed. By stationing ourselves near a plant, after determining from which direction the flies were coming, it was possible to collect the long series of males by rapidly swinging the net into them head on. Unfortunately, this technique caused considerable leg damage as the flies were brittle and seemed to lack all internal moisture or gut content.

Although the unbalanced sex ratio in the type series may be, in part, a function of our collecting techniques and the difficulties in getting the females off their stiff perches, I believe the May dates in 1968 do not reflect peak season activity for both sexes. On May 10 the ratio of males to females was five to one, respectively, but only six specimens were taken. On May 17 the ratio was almost 10 males (109) to one female (12), whereas on May 19 the disparity had dropped to a little more than two males (55) to one female (24). Furthermore, on May 19 three newly emerged females were found on the stems of *Hilaria*, just above ground level, where they were drying and unable to fly. Also, on this date four females were found just above ground level on the exposed roots of *Ephedra* and *Larrea* and, although dry, they were reluctant to take flight. The peak of reproductive activity in the 1968 season seems to have been shortly after May 19, all other factors remaining constant.



The series of 154 males and 15 females collected 6 miles south of Parker were in an area of relatively unconsolidated dunes, adjacent to a large canal, where there were scattered large thickets of mesquite, *Prosopis juliflora*, and a few smaller perennial plants which supplied shade for the flies. Although numerous annual plants were in bloom, as was the *Larrea*, no *hasbroucki* were observed visiting them. At this location, *hasbroucki* was sympatric, syntopic, and synchronic with *parkeri* and males of both species were flying around the dune vegetation, occasionally landing on the sand either in the sun or shade, or pursuing females as they flew out of the vegetation. As was the case with *parkeri*, during the hottest part of the day, between 12:30 PM and 4:00 PM, the males of *hasbroucki* were engaged primarily in flying from shade to shade beneath the overhanging mesquite branches, evidently looking for females. While in this position and resting they were fairly easy to capture.

This same exact location was collected on three occasions in 1966, each time both the captured and visual records indicated that the sex ratio was not balanced. On May 7 the ratio was about 10 males (31) to every female (3), on May 14 it was exactly 10 males (100) to every female (10) and on May 29 it was about 10 males (23) to every female (2). Unless our sampling technique was at fault, a distinct possibility in view of the females secretiveness and the difficulties in working in and under mesquite, the peak of reproductive activity was probably in June, at least in 1966.

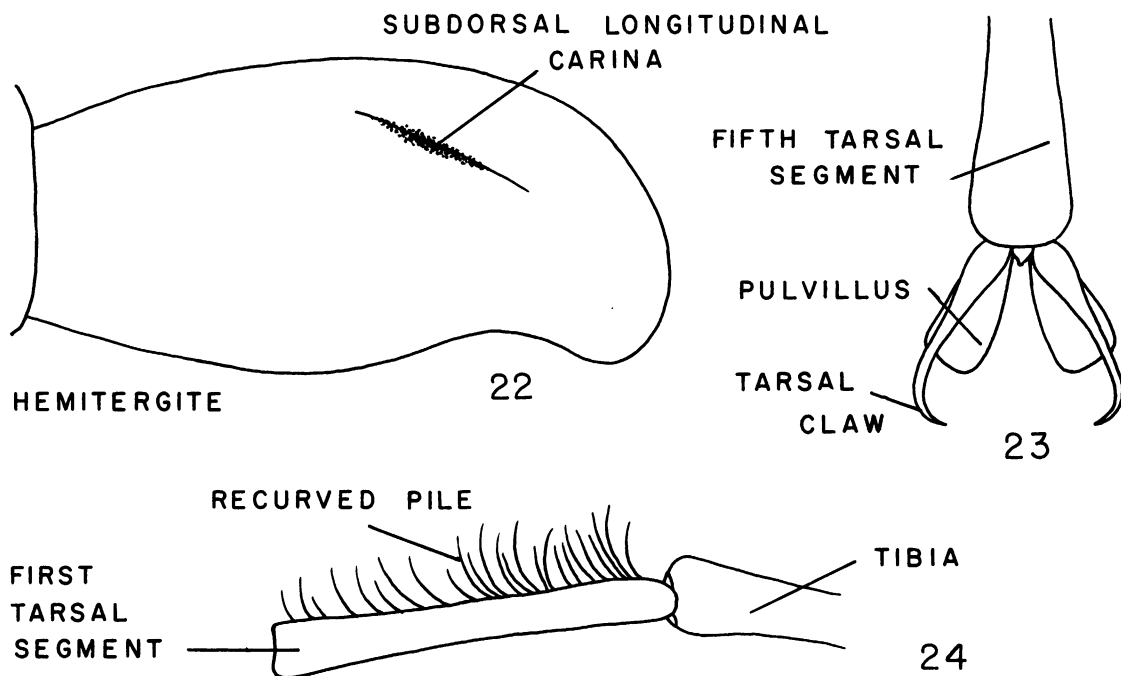
At 18 and 8 miles southeast of Parker and 14 miles north of Quartsite, the flies were captured in dry, sandy desert washes that were shaded by *Larrea*, *Prosopis*, and occasional ironwood, *Olneya tesota*, trees. There was no water in the vicinity of any of these locations but there was a profusion of annual flowers in bloom, to which no flies were seen visiting.

**VARIABILITY:** In length the males vary from 19.4 mm to 24.0 mm, the females from 20.4 mm to 24.7 mm; the abdominal maculations in the male vary from having only the bases of tergites one and two dark, to having all tergites broadly black, each with a narrow transverse apical yellow vitta, strongly resembling the female. The females are much

less variable than the males in color pattern ranging from having a narrow apical transverse vitta on each tergite to having the yellow vittae slightly wider, never having the tergites almost entirely yellow as in the male; in the heavily maculated males, pleurites one and two and the base of the hemitergites may be darkened. Otherwise, in the major characters the large series is remarkably uniform.

**RELATIONSHIPS:** The presence of a subdorsal carina on the inside surface of the hemitergites relates *hasbroucki* with *socorroae*, *undulatus* and *tarsalis*, the only other species having this characteristic. Of these three other species *hasbroucki* appears more closely related to *tarsalis* both morphologically and in its distribution (map 5). In distribution *undulatus* is known only from the area around Palm Springs and 1000 Palms in western Riverside County and Borrego Valley in San Diego County (map 2) and *socorroae* only from Baja California (map 4). Both *hasbroucki* and *tarsalis* are found only in central and eastern San Bernardino and Riverside Counties in California and Yuma County, Arizona (map 5). Morphologically *undulatus* is a large species with elongate hemitergites in which the dorsal margins are undulating (fig. 18) and its gonostyles extend posteriorly only to about the middle of the hemitergites (fig. 18). *Rhaphiomidas hasbroucki*, *socorroae* and *tarsalis* are small-sized, the terminalia are small, the hemitergites are short, without an undulating dorsal margin (figs. 20, 22) and their gonostyles extend posteriorly to the apical third or apical quarter of the hemitergites. The aedeagal structures will separate *socorroae* from all other species (fig. 25).

In *hasbroucki* the carinal crest on the inside hemitergite surface is rounded (fig. 20), the short white erect pile on the first posterior tarsal segment is uniform, the abdominal tergite maculations are dark brown or black, the color is yellowish in the male and the sexes are dichromatic. In *tarsalis* the carinal crest has a sharp edge (fig. 22), the undersurface of the first tarsal segment of the posterior legs is sparsely clothed with long white hairs that are gradually curved basally (fig. 24), the segment is also densely clothed with short recumbent white hair, the abdominal tergite maculations when present on tergites two



FIGS. 22–24. *Rhapsiomidas tarsalis*. 22. Lateral view of inside hemitergite surface. 23. Dorsal view of fifth tarsal segment on posterior leg in male. 24. Lateral view of first tarsal segment of posterior tarsus in male.

through five are deep orange, a shade darker than the rest of the surface, and the sexes are monochromatic.

***Rhapsiomidas tarsalis*, new species**

Figures 22–24; Map 5

**DIAGNOSIS:** Small- to medium-sized, abdominal tergites one and two black basally, tergite two with faint light brown median basal halfmoon-shaped marking on otherwise silky orange surface, tergites three to six entirely silky orange, sexes monochromatic; compound eyes separated from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the width of a lateral ocellus; third antennal segment elongate, widest medially; proboscis of mouthparts long, ranging in length from 10.8 mm to 11.8 mm, averaging 11.5 mm; anterior tarsal segments two through five without ventral arolia; posterior tarsal pulvilli narrow, parallel-sided, extending to apical third of tarsal claws (fig. 23); first tarsal segment on posterior legs sparsely clothed with long white

erect hairs, gradually curved toward base (fig. 24); terminalia small, narrow, heart-shaped, elongate not rounded; gonostyles extending posteriorly to about apical third or quarter of hemitergites; hemitergites not attenuated, apices broadly rounded, sutural margins gradually curved from base to apex, inner surface without spines, with subdorsal longitudinal carina in apical half, carinal crest with sharp edge (fig. 22).

**DESCRIPTION OF TYPE: Male: Head** with tumid mesofacial plate below antennal bases white pruinose, sparsely long white pilose, pile not obscuring subcranial cavity; frons white pruinose, moderately densely long white pilose laterally, long hairs on lower frons directed laterally by antennal bases, ocellar triangle sparsely long white pilose, white pruinose; vertex between ocelli moderately clothed with long white hairs oriented anteriorly, surface sparsely white pruinose, surface between lateral ocelli and compound eyes moderately deeply impressed, sparsely white pruinose, glabrous, compound eyes separated

from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the width of a lateral ocellus; posterior surface with bare white pruinose band bordering posterior margin of compound eyes, median portion densely clothed with medium length sinuous white hair, subdorsal irregular double row of long cream-colored macrochaetae evident, abundant; antennal segments one and two orange, sparsely white pruinose and long white macrochaetose, third segment bare sericeous, orange, elongate, widest medially, base with swollen ring at junction with second segment, slightly longer than segments one and two combined; mouthparts with palpi short, yellowish, sparsely long white pilose and macrochaetose, proboscis long, 10.8 mm. **Thorax** with humeral callosities deeply incised posteriorly, surface densely white pruinose, moderately densely long white pilose, sparsely long white macrochaetose; mesonotum with double median longitudinal dark vittae, narrowly separated medially, single wide longitudinal dark vittae on each side, diagonally interrupted toward base, surface other than dark vittae with disc light brown pruinose, moderately densely clothed with medium length brownish hair, lateral margins white pruinose, densely white and brownish pilose, sparsely long white macrochaetose, posterior angles (post-alar callosities) light gray pruinose, medium transverse row of macrochaetae white, sparsely irregularly white pilose; wings with costal margin white pilose from base to near apex; scutellum deeply acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins obliquely grooved, posterior margin shallowly evenly rounded, surface light gray pruinose, irregularly and sparsely clothed with long sinuous brownish hair, sparse submarginal macrochaetae white; mesopleural sclerites light gray pruinose, dorsocaudal angle and basare densely long white pilose, not macrochaetose, supraepimeron bare except for anterior third, infraepimeron bare; postnotal conical swellings with side margins gradually constricted to acute point, apex not prolonged, surface bare, densely gray pruinose. **Legs** with coxae sparsely gray pruinose, densely white pilose, sparsely white macrochaetose; all femora piceous except for distal light orange tips, surface not pruinose, moderately densely long white pilose, ventral

surface sparsely long white macrochaetose, more dense and longer on venter of posterior femora; tibiae orange, densely clothed with short recumbent white hairs, inner margins moderately densely clothed with long erect, basally curved white hairs (fig. 24), white macrochaetose; tarsi orange, densely clothed with short recumbent white hairs, ventral margin sparsely clothed with long, erect, basally curved white hair, anterior tarsi with first segment shorter than two through five combined, middle tarsi with first segment about equal to segments two through five combined, posterior tarsi with first segment longer than segments two through five combined, all tarsi without short black ventral spines; tarsal pulvilli narrow, subparallel-sided, not greatly expanded apically, extending to about apical third of tarsal claws (fig. 23). **Abdominal** tergite one black basally, apical orange uninterrupted transverse vitta narrow medially, widened laterally, densely long white pilose especially laterally and apically, apical long white hairs strongly overlapping base of tergite two, tergite two with narrow basal transverse vitta, irregular median light brown basal spot and light brown basal spot on pleura, remainder orange, surface sparsely short silky golden pilose medially, longer and more densely pilose laterally, tergites three through six with median longitudinal narrow dark line extending from base to about middle of each tergite, remainder of each tergite and pleurite orange, pilosity as on tergite two; sternites two through seven pale orange, sparsely white and golden pilose, hairs medium in length. **Terminalia** (closed) small, narrow, heart-shaped, brownish orange, slightly lighter around apical border, densely clothed with medium length, erect white pile, pile longer and more dense along ventral margin of hemitergites; hemitergites with outer surface shallowly convex, sutural area between hemitergites open, margins evenly rounded from base to contiguous apices, not overlapping, apices evenly rounded downward, ventral apical angle evenly rounded, protruding ventrally slightly below ventral margin (fig. 22), subdorsal inner carina visible through sutural opening, appearing as an internally protruding ledge or shelf beginning near middle of hemitergite, extending to near apex, paralleling dorsal margin (in a male

paratype in which the hemitergites have been separated the inner surface is smooth, sericeous, sparsely pilose, convex in basal third, shallowly concave in apical two-thirds excluding carina, carina extends from near middle to apical quarter, sloping slightly downward apically, crest with knifelike edge) (fig. 22); ninth sternite orange, shallowly convex, moderately densely clothed with erect, white and golden pile of medium length, posterior margin broadly evenly shallowly emarginate between bases of gonostyles, gonostyles evenly shallowly bowed outward medially, outer margins convex, evenly rounded, inner margins deeply concave, extending posteriorly to about apical quarter of hemitergites, sparsely long white pilose basally, more densely and shorter pilose apically, apex not enlarged; interbasal folds short, extending inward and parallel to gonostyles a short distance, deeply concave ventrally, evenly rounded and convex dorsally; aedeagus (taken from dissected paratype) enlarged basally, narrowing abruptly into smooth, evenly rounded, dorsally irregularly curved tube, curve shallow, not recurved apically, dorsal surface of enlarged base shallowly concave, surface diagonally wrinkled. Length 24.2 mm; mesonotal width 6.6 mm.

**FEMALE:** In addition to the usual secondary sexual differences, the female is more sparsely clothed with shorter pile in all areas, abdominal pleurites three and four have dark basal spots, smaller than on pleurite two, the tarsal pulvilli are narrower and shorter, extending to middle of claws, and the tarsal segments lack the long basally curved ventral hairs. Length 22.4 mm, mesonotal width 6.4 mm.

**HOLOTYPE:** Male, California, San Bernardino County, 9 air miles southwest Kelso, Kelso Dunes, June 29 and 30, 1978, J. Powell, P. Rude, deposited in the California Academy of Sciences on indefinite loan from the Essig Museum of Entomology, University of California, Berkeley.

**ALLOTYPE:** Female, California, San Bernardino County, 2 miles south Kelso, Kelso Dunes, June 30, 1978, J. Powell, J. Doyen, deposited in the California Academy of Sciences on indefinite loan from the Essig Museum of Entomology, University of California, Berkeley.

**PARATOPOTYPES:** Same data as holotype (1

male, 1 female Essig Museum of Entomology, UCB; 1 male, 1 female author's collection at ASU).

**PARATYPES:** CALIFORNIA: **San Bernardino County:** 8 miles southwest Kelso, Kelso Dunes, July 14–15, 1974, J. Doyen (2 females); Cronise Lake, May 24, 1958, E. L. Sleeper (3 males); Baker, June 7, 1937, Pohl (1 female); Cottonwood Wash, 2520 feet elevation, Section 3, T9N, R12E, June 16, 1980, T. Griswold (2 males, 7 females) on *Petalonyx thurberi*. The last location is about 6 miles south of Flynn on the edge of the Devils Playground dunes (2 females Essig Museum; 2 females AMNH; 2 males collection Arthur V. Evans; 1 male, 6 females USU). See map 5.

**ETYMOLOGY:** The species name is from the Greek *tarso*, meaning instep, in reference to the characteristic long curved hairs on the ventral surface of the first segment of the posterior tarsi.

**ECOLOGY:** The only information available is on the specimen labels which indicates that this is a dune species. One specimen from 8 miles southwest of Kelso was taken at a "black light trap" and the other bears the name of one of the species of sandpaper plants, *Petalonyx thurberi*. I would assume that it was taken at the flowers of this plant but it might also have just been sitting on it.

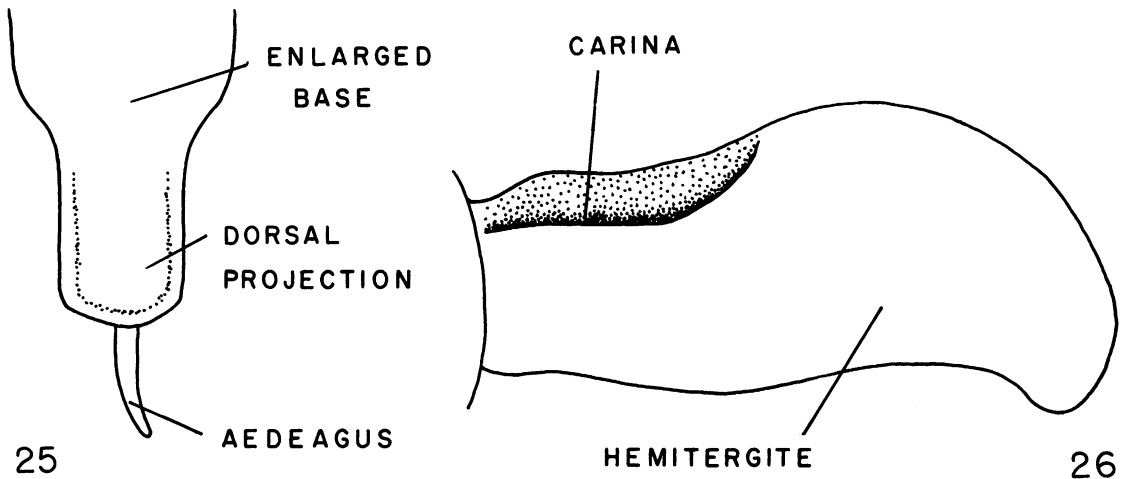
**VARIABILITY:** The three males and seven females show little variability other than in size. The males range from 21.7 mm to 25.4 mm in length, whereas the females range from 17.3 to 24.6 mm.

**RELATIONSHIPS:** *Rhaphiomidas tarsalis* can be separated from all other species except *socorroae*, *undulatus*, and *hasbroucki* by having the subdorsal carinae on the inner hemitergite surface (fig. 22). It appears to be most closely related to *hasbroucki* but can be readily separated from *socorroae*, *undulatus*, and *hasbroucki* as discussed in the relationship section of the latter species.

### *Rhaphiomidas socorroae*, new species

Figures 25–26; Map 4

**DIAGNOSIS:** Medium-sized, narrow, moderately densely clothed with long white or golden pile, abdominal tergites pale orange with broad black maculations; mouthparts with proboscis long, 9.4 mm in length; third



FIGS. 25-26. *Rhaphiomidas socorroae*. 25. Dorsal view of aedeagus. 26. Lateral view of inside hemitergite surface.

antennal segment elongate, widest medially, longer than segments one and two combined; terminalia elongate, narrowly heart-shaped, gonostyles extending posteriorly to about apical third of hemitergites, hemitergites not attenuated from base to apex, apices broadly rounded, not overlapping apically (fig. 26), inner surface without spines but with acutely crested, subdorsal, longitudinal carina extending from base to about middle of hemitergite (fig. 26); anterior tarsal segments two through five without ventral arolia, first tarsal segment of posterior legs with short pile and long, white, erect hairs that are gradually curved toward base; aedeagus with median, rounded, dorsal projection from enlarged base, extending posteriorly and overlapping basal portion of narrow, rounded, upturned tube (fig. 25).

**DESCRIPTION OF TYPE: Male:** Head with frons moderately densely clothed with long golden pile extending over vertex, facies long white pilose; posterior surface with narrow bare band bordering posterior margin of compound eyes, median surface (obscured) moderately densely clothed with golden pile, subdorsal macrochaetae pale brownish; compound eyes separated from lateral ocelli on vertex by about twice the width of a lateral ocellus; antennae with segments one and two black, white pilose and macrochaetose, mac-

rochaetae on segment two arranged in median transverse row, third segment (glued to edge of locality label) bare, dark, elongate, widest at about middle, bluntly rounded apically, basal ring prominent, slightly longer than segments one and two combined; mouthparts with palpi short, dark, long white pilose, proboscis long, 9.4 mm in length. **Thorax** (greasy) with humeral callosities prominent, deeply incised posteriorly, densely clothed with long brownish pile, sparse macrochaetae light brownish; mesonotum moderately densely clothed with long brownish pile, more dense laterally, lateral marginal macrochaetae light in color, off-white, postalar callosities not prominent, sparsely whitish pilose and macrochaetose; wings with costal vein deep golden pilose in basal sixth, black pilose apically; scutellum deeply, acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins shallowly emarginate, surface long white pilose especially laterally, submarginal macrochaetae off-white in color; mesopleural sclerites sparsely gray pruinose, dorsocaudal angle and basalare densely long white pilose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gray pruinose, gradually constricted from base to bluntly rounded apex. **Legs** not enlarged,

coxae black, moderately clothed with long whitish pile, femora piceous, long golden pilose, anterior and middle tibiae testaceous, posterior tibiae piceous, all tibiae clothed with long yellowish pile and pale macrochaetae, tarsi testaceous, golden pilose, posterior tarsal segment one short golden pilose, spinulose beneath, sparsely clothed beneath with long pale hairs that curve basally at apex; tarsal pulvilli large, spatulate, extending apically to apical third of claws. **Abdomen** bicolored pale orange with black maculations, moderately densely clothed with long pale pile, more dense laterally, tergite one black throughout, tergite two with basal half black, broadly expanded posteriorly at middle extending to apical quarter of tergite, apical pale orange transverse vitta narrowed medially, broadly expanded laterally toward but not reaching base, narrowed again at posterior pleural angle, tergite three with pale orange vitta broadly expanded on each side of median black expansion, narrowly interrupting black transverse basal vitta, narrowing again at posterior pleural angle, broad median black projection reaching to about apical quarter of tergite, not extending to posterior margin, tergites four through seven with transverse, black, basal, vittae covering basal half to two-thirds of each terga, apical half to two-thirds pale orange; sternites primarily pale orange, sternum two through four with small median dark areas, sternum five and six with large median dark maculations. **Terminalia** elongate, narrow, heart-shaped, black with narrow brownish margins, sparsely light golden pilose, more densely long white pilose along ventral margin; hemitergites with sutural margins slightly expanded medially, evenly rounded apically, ventral apical angle protruding slightly below ventral margin which is shallowly emarginate to base (fig. 26), inner surface shallowly convex, submarginal carina in basal half arcuate medially, deeply concave between acute ridge and sutural margin, prominent (fig. 26), inner surface opaque; ninth sternite shallowly convex, moderately densely long white pilose, lateral margins not expanded, posterior margin obtusely notched medially between bases of gonostyles, surface shiny, piceous narrowly orange along apical border; gonostyles orange moderately clothed

with long white pile, lateral arms rounded, only slightly bowed medially, extending posteriorly to apical third of hemitergites; interbasal folds two-segmented, narrowly divergent from gonostyles apically, dorsal surface convex, ventral surface shallowly concave; aedeagus projecting medially through membrane connecting gonostyles, lying ventrally to membranous anal tube, base greatly enlarged, shallowly concave medially, margins around concavity slightly expanded laterally but roundly produced apically over base of narrow rounded tube (fig. 25), tube bent sharply upward at right angles posterior to overhanging median projection, apex of tube obliquely open. Length 23.5 mm; mesonotal width 5.9 mm.

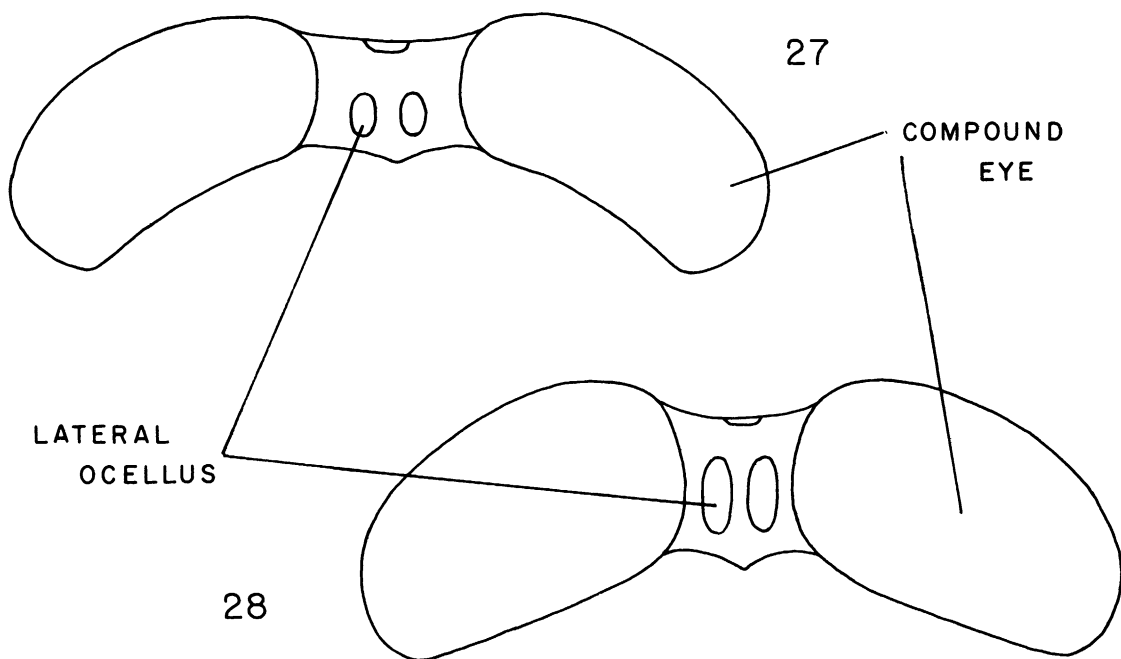
**FEMALE:** Unknown.

**HOLOTYPE:** Male, Mexico, Baja California Norte, Arroyo Socorro [sic] dunes south of San Quintin, May 17–18, 1975, C. E. Griswold, deposited in the California Academy of Sciences on indefinite loan from the Essig Museum of Entomology, University of California, Berkeley. See map 4.

**ETYMOLOGY:** The species is named for the type locality Socorro. The locality on the type label is spelled Socorro which is evidently a mistake, according to all available maps.

**ECOLOGY:** The only available information is that on the type specimen, which indicates that *socorroae* is a dune-inhabiting species.

**RELATIONSHIPS:** *Rhaphiomidas socorroae* can be separated from all other known species in the genus by the unique structure of the aedeagus as described. All other species have the narrow rounded tube gradually narrowing from the enlarged base with no overhanging posterior projection from the enlarged base (fig. 25). It would appear to be most closely related, based on the carinate inner hemitergite surface, to *undulatus*, *hasbroucki*, and *tarsalis* but is easily distinguished as given in the key. Superficially *socorroae* looks very much like the southern California *terminatus abdominalis*, especially in size, shape, and abdominal maculations. However, *terminatus abdominalis* lacks the carinae on the inside hemitergite surface and the overhanging aedeagal structure. Also, its terminalia are uniformly brown, the third antennal segment



FIGS. 27–28. Dorsal view of head and vertex showing positioning of compound eyes and ocelli in male. 27. *Rhaphiomidas episcopus episcopus*. 28. *R. xanthos xanthos*.

is orange and the tarsal pulvilli are not spatulate.

*Rhaphiomidas xanthos xanthos* Townsend,  
new combination  
Figure 28; Map 3

*Rhaphiomidas xanthos* Townsend, 1895, p. 606 (male). *R. mellifex* Townsend, 1895, p. 604 (female). Cazier, 1941, p. 619 (synonymy).

**DIAGNOSIS:** Medium-sized, moderately robust abdominal tergites primarily orange or yellowish, maculations middorsal in male, transverse vittae in female; mouthparts with proboscis long, ranging from 9.1 mm to 12.2 mm, averaging 10.2 mm in length; third antennal segment short, robust, widest medially, subequal in length to segments one and two combined; terminalia short, heart-shaped, gonostyles extending posteriorly to apical quarter of hemitergites, hemitergites not attenuated from base to apex, apices broadly rounded dorsally, shallowly emarginate ventrally, not or barely overlapping apically, inner surface without spines, surface

shallowly convex dorsally, almost carinate; legs with anterior tarsal segments two through five without ventral arolia, posterior legs unicolorous; compound eyes separated from lateral ocelli on vertex by less than the width of a lateral ocellus (fig. 28); abdominal tergites two through four entirely or broadly golden or pale yellow in apical half.

**REDESCRIPTION:** Male: **Head** with frons with pruinose, moderately densely clothed with long yellowish pile from antennal bases to over the vertex, facies long white pilose; posterior surface white pruinose, narrow bare pruinose band bordering posterior margins of compound eyes, median surface densely clothed with long white pile, subdorsal row of macrochaetae white; compound eyes separated from lateral ocelli on vertex by about half the width of a lateral ocellus (fig. 28); antennae with segments one and two orange, sparsely white pruinose and pilose, white macrochaetae on second segment in median transverse row, third segment bare, orange, abruptly enlarged at basal quarter, widest medially, gradually narrowed to bluntly rounded



apex, slightly longer than segments one and two combined, basal ring white pruinose; mouthparts with palpi short brown, sparsely white pilose, proboscis long, 9.1 mm in length. **Thorax** with humeral callosities deeply incised posteriorly, surface gray pruinose, sparsely yellowish pilose and macrochaetose; mesonotum with single median longitudinal black vitta, narrowly divided anteriorly, two lateral vittae one on each side, irregular in shape, surface gray pruinose except for black vittae, disc sparsely golden pilose, margins more densely longer golden pilose, marginal macrochaetae pale yellowish, post-alar callosities not prominent, gray pruinose, sparsely golden pilose and off-white macrochaetose; wings with costal vein golden pilose basally, black pilose from near base to apex; scutellum deeply, acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins shallowly emarginate, posterior margin evenly rounded, surface and margins long golden pilose, submarginal macrochaetae off-white in color; mesopleural sclerites gray pruinose, dorsocaudal angle and basalare densely long white pilose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gray pruinose, gradually constricted from base to bluntly rounded apex. **Legs** not enlarged, coxae black, gray pruinose, moderately densely long golden pilose, femora, tibiae and tarsi testaceous, white pilose except for outer edge of posterior tibiae and all of first tarsal segment which are black or brown short pilose, macrochaetae black and off-white mixed; tarsal pulvilli large, spatulate, extending to curved apex of claws. **Abdomen** primarily orange, sparsely clothed with short golden pile on tergites two through six, segment one long white pilose, black basally with narrow apical orange transverse vitta, narrowing medially, widest laterally, tergite two with narrow black basal transverse vitta and isolated median dark spot, tergites three through five orange without dark maculation, each tergite including second orange with narrow apical bare yellowish border, sternites without maculations, moderately densely long golden pilose. **Terminalia** small, heart-shaped, uniformly orange, moderately densely long golden pilose; hemiter-

gites with sutural margins not overlapping, apices with dorsal angles evenly rounded, ventral angles shallowly emarginate, ventral margin straight, inner surface rugose, obtuse convex elevation in dorsal third curved downward in apical two-thirds, subsutural and lower areas shallowly concave; ninth sternite shallowly convex, not expanded laterally, moderately clothed with golden pile, posterior margin obtusely notched medially between bases of gonostyles; gonostyles extending posteriorly to about apical quarter of hemitergites, shallowly bowed from base to apex, apex pointed, surface of flattened lateral arms shiny, sparsely pilose; interbasal folds short, two-segmented, moderately divergent apically from gonostyles, enlarged apically, surface rugose, dorsal surface convex, ventral surface shallowly concave; aedeagus projecting medially through membrane connecting gonostyles, lying ventrally to membranous anal tube, base greatly enlarged, dorsal surface shallowly concave along median line, gradually narrowed into a narrow rounded tube, tube curved sharply upward at right angles, apex obliquely open. Length 24.1 mm; mesonotal width 6.5 mm. Redescribed from a male collected 4 km north of Los Barriles, Baja California Sur, Mexico September 4–5, 1977 by Fisher and Westcott.

**FEMALE:** Similar to the male except for the usual secondary sexual characteristics, the bicolored transverse abdominal maculations and a few minor differences. The first abdominal tergite is like the male except that the orange apical margin is lighter in color and the pile is white, tergite two is black in basal half laterally to basal three-quarters medially, tergites three and four are black except for light-colored, narrow, apical border, tergites two through four are sparsely clothed with short recumbent white pile. The supraepimeron has a sparse median group of long white hairs in addition to those on the dorsoanterior angle and the infraepimeron has two or three scattered white hairs. Length 26.4 mm; mesonotal width 8.2 mm. The female was collected at the same locality as given above for the male.

**LECTOTYPE:** Male, Mexico, Baja California Sur, El Taste, September, Eisen. Selected from two male specimens labeled "type" by Town-

send, deposited in the University of Kansas, Snow Collection.

LECTOTYPE: Female, same data as lectotype male, designated as lectotype of *R. mellifex* Townsend which is a synonym of *xanthos*. Designations by Cazier, 1941.

DISTRIBUTION: MEXICO: **Baja California Sur**: 4 km north Los Barriles, September 4–5, 1977, Fisher and Wescott (9 males, 4 females); San Jose del Cabo, William M. Wheeler collection (1 male); same location September 11–16, 1967, J. Chemsak, A. and M. Michelbacher (1 male); 5 miles north San Jose del Cabo, September 14, 1967, J. Chemsak, A. and M. Michelbacher (1 male); 3 miles north San Jose del Cabo, September 10–13, 1967, J. Chemsak, A. and M. Michelbacher (1 male); 1 mile northeast San Pedro, September 8, 1967, J. Chemsak, A. and M. Michelbacher (1 male); Canon San Lazaro, 13 miles northwest San Jose del Cabo, September 16, 1967, J. Chemsak, A. and M. Michelbacher (1 male); Todos Santos, August 11, 1966, Ray Bandar (1 male); 4 km north Los Barriles, 10 m elevation, September 4, 1977, R. R. Snelling (2 males); 1.5 miles southwest San Jose del Cabo, September 30, 1981, D. Faulkner and F. Andrews (3 males); 7 km south Cuduan, August 26, 1982, Faulkner and Brown (1 male); Playa Los Cerritos, 11.2 miles south Todos Santos, September 28, 1981, F. Andrews and D. Faulkner (1 male); 11 miles northeast Todos Santos, September 16, 1983, R. R. Snelling on flowers of *Antigonon leptopus* (1 male). See map 3.

ECOLOGY: Specimens from the above localities collected by David Faulkner were taken as they reposed on the ground. The male from 11 miles northeast of Todos Santos was on the flowers of *Antigonon leptopus*.

VARIABILITY: There is little variation exhibited in specimens from the vicinity of San Jose del Cabo in the south and Los Barriles about 53 miles to the north, both locations being east of the cape region mountains. However, the single males, one missing its terminalia, from the vicinity of the northern San Pedro (located at the junction of the west branch of the road going to San Jose del Cabo by way of Todos Santos and the east branch going by way of Santiago) situated to the west of the Trinchera Mountains and Todos Santos located to the west of the cape region

mountains, are more heavily maculated. Abdominal tergites three and four have large middorsal black spots instead of no maculations or reduced markings on these segments. A single male from 27 km northeast of Todos Santos has the abdominal tergites transversely vittate and is herein recognized as a subspecies of *xanthos xanthos*.

RELATIONSHIPS: Dichotomy six separates a number of species based on the presence or absence of the subdorsal, longitudinal carina on the inner hemitergite surface. I have included *xanthos xanthos* with those species not having this carina because the shallow convexity cannot be seen through the space between the sutural margins. If interpreted in this way, *xanthos xanthos* will key out in the same dichotomy with *painteri* but in my opinion they are only distantly related both morphologically and distributionally. In distribution *painteri* is known only from New Mexico (map 6), whereas *xanthos xanthos* is known only from the southernmost portion of Baja California Sur, Mexico (map 3). In *painteri* the posterior legs are bicolorous and the apical margins of the abdominal tergites are dark in color. In *xanthos xanthos* the posterior legs are unicolorous and the apical margins of the abdominal tergites are golden or light in color.

If, on the other hand, the longitudinal convexity on the inner hemitergite surface is interpreted as being a carina, *xanthos xanthos* will key to three other species, one of which, *hasbroucki*, appears to be most closely related. As given in the key *xanthos xanthos* is easily distinguished from *undulatus* by its sutural terminalia margins, gonostyles, tarsal pulvilli and smaller size. From *tarsalis* it differs by having the convexity obtusely rounded and below the submargin and by being sexually dichromatic. Although it is sexually dichromatic, as is *hasbroucki*, it can again be distinguished by the obtusely rounded convexity, its more robust form and narrowly separated compound eyes (fig. 28).

***Rhaphiomidas xanthos vittatus*,**  
new subspecies  
Figure 29; Map 3

DIAGNOSIS: Small-sized, relatively narrow, abdominal tergites primarily black, bordered

apically with narrow, pale transverse vittae (fig. 29); mouthparts with proboscis long, 8.2 mm in length; third antennal segment short, robust, widest medially, slightly longer than segments one and two combined; terminalia short, narrow, heart-shaped, gonostyles extending posteriorly to apical quarter of hemitergites, hemitergites not attenuated from base to apex, apices broadly rounded dorsally, more sharply angulate ventrally, ventral angle not emarginate, apices not overlapping, inner surface without spines, surface shallowly convex in dorsal third; legs with anterior tarsal segments two through five without ventral arolia, posterior legs unicolorous; compound eyes separated from lateral ocelli on vertex by about half the width of a lateral ocellus (see fig. 28).

**DESCRIPTION:** Male: Similar to the males of *xanthos xanthos* in major characteristics, differing primarily by having the body pile white instead of yellowish or golden, the ventral hemitergite angles sharply rounded instead of shallowly emarginate, the abdominal tergites primarily black and transversely black and off-white vittate (fig. 29) instead of being primarily orange with at most middorsal dark spots and by having the anterior and middle femora largely piceous instead of orange or testaceous as in *xanthos xanthos*. Length 20.2 mm; mesonotal width 5.5 mm.

**FEMALE:** Unknown.

**HOLOTYPE:** Male, Mexico, Baja California Sur, 27 km northeast Todos Santos, elevation 900 feet, October 8–9, 1975, on the flowers of *Antigonon leptopus*, R. R. Snelling, deposited in the Los Angeles County Museum (map 3).

**ETYMOLOGY:** The name is modified from the Latin *vitta* meaning striped or banded to indicate the abdominal maculations characteristic of this subspecies.

**ECOLOGY:** The holotype was collected on the flowers of *Antigonon leptopus* but no pollen grains were found adhering to any part of the body or mouthparts. As noted for other species, the specimen was probably hovering while inserting the long proboscis into the nectaries of the flower.

**DISCUSSION:** When additional material is available from the western portion of the cape region, it may be found that the two heavily maculated specimens discussed under *xan-*

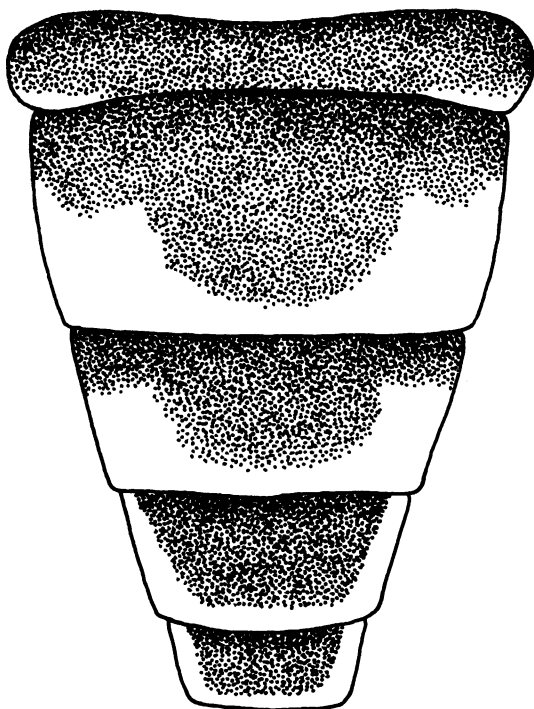


FIG. 29. *Rhaphiomidas xanthos vittatus*. Dorsal view of abdominal tergites one through five in male.

*thos xanthos* are intermediates between that subspecies and *xanthos vittatus*.

*Rhaphiomidas painteri* Cazier  
Map 6

*Rhaphiomidas painteri* Cazier, 1941, pp. 622–623.

**DIAGNOSIS:** Small-sized, head and thorax predominantly black, abdomen with first segment and middle of second black, segments two through four orange except for dark, glabrous, narrow apical border; mouthparts with proboscis long; third antennal segment short, robust, widest medially; terminalia small, heart-shaped, gonostyles not extending posteriorly to apex of hemitergites, hemitergites not gradually attenuated from base to apex, apices broadly rounded, narrowly overlapping apically, inner surface without spines, or carinae; legs with anterior tarsal segments two through five without ventral arolia, posterior femora entirely or in part dark, tibiae and tarsi golden; compound eyes separated from

the lateral ocelli on the vertex by less than the width of a lateral ocellus.

**REDESCRIPTION:** Male: **Head** (greasy) with frons white pilose, vertex between ocelli sparsely yellowish pilose, posterior surface sparsely white pilose and macrochaetose; compound eyes separated from lateral ocelli on vertex by slightly less than the width of a lateral ocellus; antennae with segments one and two brown, sparsely long white pilose and macrochaetose, third segment short, robust, bare, brown, equal in length to segments one and two combined, widest medially basal ring moderate, apex bluntly rounded; mouthparts with palpi short, brownish, sparsely long white pilose, proboscis long, 9.0 mm. **Thorax** with humeral callosities moderately prominent, deeply incised basally, surface greasy black, white pilose and macrochaetose; mesonotum mottled irregularly brown and black, disc bare (rubbed), lateral margins white pilose and macrochaetose, post-alar callosities prominent, white pilose and macrochaetose; wings with costal margin golden pilose basally, bare apically; scutellum shallowly obtusely delimited from posterior mesonotal margin, surface sparsely white pilose, submarginal macrochaetae white, lateral and apical margins evenly rounded; mesopleura (greasy) gray pruinose, sparsely white pilose, dorsocaudal angle and basalare densely white pilose and macrochaetose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gray pruinose, gradually constricted from base to acute apex. **Legs** not enlarged, coxae black, gray pruinose, white pilose and macrochaetose, femora piceous ventrally, light brown dorsally, white pilose and macrochaetose, tibiae testaceous, white pilose and macrochaetose, tarsi white pilose and macrochaetose; tarsal pulvilli large, spatulate, extending well into apical curve of claws. **Abdomen** primarily pale orange, segment one primarily black, segment two with median, irregular darkened area, segments two through four with black, narrow apical border, segments five and six entirely pale orange, all segments sparsely long white pilose, more dense along pleural margins, sternite one black, sternites two and three with dark apical borders, sternites four and five pale orange, all sternites sparsely long white

pilose. **Terminalia** (unopened) small, heart-shaped, uniformly pale orange, sparsely clothed with golden pile, sutural hemitergite margins narrowly overlapping in apical half, apices evenly, broadly rounded, ventral margin nearly straight; ninth sternite shallowly convex, shiny, not expanded laterally, sparsely clothed with long golden pile, posterior margin obtusely, shallowly notched medially between gonostyles; gonostyles extending posteriorly to about apical quarter of hemitergites, lateral arms evenly rounded, strongly evenly arcuate, sparsely golden pilose; interbasal folds short, rounded, tips divergent internally from gonostyle bases, sparsely golden pilose; aedeagus projecting medially through membrane connecting gonostyles basally, lying ventrally to membranous anal tube, base greatly enlarged, strongly narrowed posteriorly into a rounded tube, tube strongly evenly curved upward, apex obliquely open. Length 20.9 mm; mesonotal width 5.9 mm.

**FEMALE:** Same as male but with the pile more intact, that of the thorax uniformly yellowish, dense, of first abdominal segment semi-erect, white, second, third, and fourth segments with yellow recumbent, dense pile. Length 20 mm, width 5.6 mm.

**HOLOTYPE:** Male in the collection of R. H. Painter, now in the National Museum of Natural History, Smithsonian Institution, collected at State College, New Mexico, September 23 (W. J. Baerg).

**ALLOTYPE:** Female in the National Museum of Natural History, collected at Las Cruces, New Mexico, September 10 (Townsend).

**DISTRIBUTION:** MEXICO: **Dona Ana County:** New Mexico State University Campus, Las Cruces, 1190 m elevation, September 7, 1979, G. S. Forbes and Mike Hayes (3 females), September 8, 1979, G. S. Forbes (2 males, 11 females), September 13, 1979, G. S. Forbes (1 female); September 9, 1982, Mick Brown (1 female), dead on sidewalk and in alfalfa field; stock tank 0.4 miles east Tortugas Mountain, 1280 m elevation, September 13, 1979, G. S. Forbes (1 female) on flowers of *Funastrum heterophyllum* (= *Sarcostemma heterophyllum*) climbing milkweed; Mesilla Dam, Rio Grande River, 1195 m elevation, September 2, 1982, G. S. Forbes,

sight record; Jornada Experimental Range, 2 km south of College Ranch, 1350 m elevation, September 18, 1983, G. S. Forbes sight record in ravine in creosote scrub plant association; Dune 2.3 miles north Mesquite exit on highway I-10, September 18, 1981, G. S. Forbes (1 male), August 29, 1982, G. S. Forbes (2 males, 1 female); September 16, 1982, G. S. Forbes (18 males, 3 females), September 23, 1982, G. S. Forbes (2 females), September 24, 1982, Dave Lightfoot (1 female), October 2, 1982, Dave Lightfoot (1 female); dune 2.9 miles north Mesquite exit on highway I-10, August 28, 1982, G. S. Forbes (1 male), September 15, 1982, G. S. Forbes (3 males, 2 females); north base Bishop's Cap, 6.2 miles southeast I-10, 1370 m elevation, September 4, 1982, G. S. Forbes (1 female); 300 m east Memorial General Hospital, Las Cruces, September 11, 1982 (2 males); 8 miles north Texas line in New Mexico, 1984, G. S. Forbes. TEXAS: El Paso County: Anthony sand dunes, 0.2–0.3 m south of New Mexico State line, September 3, 1983, G. S. Forbes (5 males) same data, Dave Peterson (1 pair in copulation); El Paso, 1935, Texas A&M College. The above records were submitted by G. S. Forbes (personal commun.).

ECOLOGY: According to G. S. Forbes (personal commun.), *painteri* is reasonably abundant throughout much of the scrub association in Dona Ana County of New Mexico and south into the area of El Paso in Texas. The specimens from the campus of the State University of New Mexico were found visiting the flowers of alfalfa, *Medicago sativa* Linnaeus. Two females have been seen visiting the flowers of *Lepidium montanum* Nuttall (peppergrass) and one individual on *Dithyrea wislizeni* Engelman (spectacle pod). One specimen from 8 miles north of the Texas border, in New Mexico, was taken on *Ipomopsis longiflora* (Torrey) Verne Grant (= *Gilia longiflora*) white-flowered *gilia* but Forbes was not sure as to whether it was feeding on nectar or just perching. At the Tortugas mountain location one female was taken by Forbes on the flowers of *Funastrum heterophyllum*, climbing milkweed.

According to data supplied by Forbes, the breeding habitats of *painteri* are similar to those known for other species of *Rhaphiomidas*. In the El Paso, Texas region, and the

Las Cruces, Anthony and Mesquite areas of New Mexico they have been found commonly in isolated dunes in the vicinity of highway I-10.

VARIABILITY: In 33 males from seven different locations in New Mexico and Texas in the Rio Grande River basin the following variability has been found. The ground color of the head, pronotum, mesonotum, mesopleura, scutellum, palpi, antennal segments one and two, the first abdominal segment and the base of the second are black. There is no indication of mesonotal orange spots near the wing bases. The head is white pilose, pruinose and macrochaetose. The mesonotum is gray pruinose, white macrochaetose, pale golden or yellowish pilose with two median and a lateral longitudinal dark vitta. The tibiae and tarsi may be either golden or testaceous in color. Abdominal tergite two may be black or orange basally, black discally or entirely orange except for the narrow apical black margin; tergites three and four may be orange with a narrow black apical margin or orange with a narrow longitudinal median discal dark vitta; tergite five may be entirely orange or with a narrow longitudinal median discal dark vitta and is usually without the dark apical margin; the apical borders on tergites two through four are black in hardened specimens and orange in teneral examples. In the terminalia the hemitergites may overlap each other to varying degrees or not at all, they do not give the terminalia a rounded appearance but are heart-shaped. The inner hemitergite surface is rough, there is a rounded elevation along the basal subdorsal margin which is not carinate and there are no erect spines. The gonostyles are evenly shallowly curved inward from base to apex and do not extend to the apex of the hemitergites. The aedeagus is sharply curved upward at a 90° angle posterior to the basal enlarged section which has a shallow, median, longitudinal dorsal groove.

In the female allotype the third antennal segment is orange, short and robust medially; the mesonotal orange spots near the wing bases are very faint and the lateral macrochaetae are pale; the scutellum is densely clothed with long recurved yellowish pile and the apical border is not orange; the costal wing vein is yellowish pilose throughout; the mesopleural sclerites are sparsely gray pruinose, dorso-

caudal angle and basare densely, long white pilose, supraepimeron bare except for dorsoanterior angle, infraepimeron bare; abdomen with recumbent pile more dense than in other species, glabrous apical margins on segments two through four dark brown; legs with both pile and macrochaetose pale, tarsal pulvilli broadened apically, extending to apical quarter of claws; the proboscis has the tip broken off.

In 20 female specimens from eight different localities in New Mexico and Texas in the Rio Grande River basin the variability is the same as noted above for the males except for the secondary sexual characters and three female specimens. In these females the black abdominal markings are more extensive than in any other specimens examined. Tergite one is entirely black, two is black except for narrow orange transverse vitta in the basal third and lateral apical orange area, three has large median irregular dark area, four is black except for two small lateral orange spots on the basal margin. In a number of specimens the black apical border on tergite three is missing and in several the apical border on tergite two is only partially darkened. The abdominal dark maculations are variable and intermediate in other specimens of the series. Three females that were collected in an alfalfa field on the New Mexico State University Campus, September 8, 1979, by G. S. Forbes are now in the collection of the San Diego Museum of Natural History. In these specimens one has no evidence of the mesonotal orange spots near the wing base, the second has them faintly indicated, and in the third they are larger and more evident and the scutellum has a prominent, narrow orange apical border. In most specimens there is no indication of orange coloration on either the mesothorax or the scutellum and its presence in these three specimens may be due to imperfect hardening of the integument. In other respects the specimens do not appear to be teneral. This variability renders this character useless for separating *painteri* from other species, at least in the females.

**RELATIONSHIPS:** *Rhaphiomidas painteri* can be separated from all known species that have the abdominal tergites primarily orange or yellow by its black or dark brown, glabrous, narrow apical borders on abdominal tergites

two, three and usually four. Even though *painteri* appears in the same key dichotomy with *xanthos xanthos* they are probably only distantly related as their greatly disjunct distributions would seem to indicate. *Rhaphiomidas xanthos xanthos* occurs only in the area south of La Paz near the tip of Baja California Sur. Furthermore in *xanthos xanthos* the compound eyes almost touch the lateral ocelli on the vertex of the head, the third antennal segment is longer and less robust than in *painteri*, the femora are uniformly yellow or pale orange and the macrochaetae on the femora and tibiae are primarily black in *xanthos xanthos*. There are other differences.

Three other relatively small species with disjunct distributions might possibly be confused with *painteri*. These are *hasbroucki* and *tarsalis* from California and *socorroae* from Baja California Norte. In these three species the hemitergites of the terminalia are longer and each species has a characteristic carina on the inner surface of the hemitergites. Also, the compound eyes are widely separated from the lateral ocelli, the third antennal segments are long and narrow, and the tarsal pulvilli are not spatulate as they are in *painteri*. Geographically *parkeri* from south central Arizona is the most proximate species to *painteri* but is abundantly distinct in its rounded terminalia, strongly overlapping hemitergites, elongate and narrow third antennal segments, elongate gonostyles and its primarily black abdominal tergites and terminalia hemitergites.

*Rhaphiomidas episcopus episcopus*

Osten Sacken, new combination

Figure 27; Map 4

*Rhaphiomidas episcopus* Osten Sacken, 1877, p. 281 (female). Townsend, 1895, p. 603 (male).

**DIAGNOSIS:** Medium-sized, usually robust; abdomen, terminalia, and legs black, tergites without maculations; mouthparts with proboscis long, ranging from 9.0 mm to 10.2 mm, averaging 9.6 mm in length; third antennal segment elongate widest medially; terminalia short, heart-shaped; gonostyles extending posteriorly to about apical third of hemitergites; hemitergites not gradually attenuated from base to apex, apices evenly,

broadly rounded, inner surface without spines or carinae, surface entirely black in color; anterior tarsal segments two through five without ventral arolia; compound eyes separated from the lateral ocelli on the vertex by more than the width of a lateral ocellus (fig. 27).

**REDESCRIPTION: Male: Head** (greasy) with frons white pilose, vertex between ocelli black pilose, pile sparse to moderate, facies long white pilose; posterior surface gray pruinose, narrow bare pruinose band bordering posterior margins of compound eyes, median surface long, golden pilose dorsally, disc long, white pilose, subdorsal macrochaetae golden or brownish; compound eyes separated from lateral ocelli on vertex by about twice the width of a lateral ocellus (fig. 27); antennae with segments one and two black, sparsely dark pruinose and white pilose, macrochaetae dark, those on second segment arranged in a median transverse row, third segment bare, black above, dark orange beneath, longer than segments one and two combined, basal ring prominent, margins widest medially, gradually narrowed to bluntly rounded apex; mouthparts with palpi short, black, sparsely long, white pilose, proboscis long, 9.0 mm. **Thorax** with humeral callosities not prominent, shallowly incised basally, surface greasy black, faintly gray pruinose, densely brownish pilose, sparsely black macrochaetose; mesonotum with median longitudinal black vittae, narrowly separated, lateral wide vittae narrowly interrupted subapically, surface gray pruinose except for black vittae, disc sparsely brown pilose, lateral margins more densely clothed with longer brown pile, lateral marginal macrochaetae black, post-alar callosities not prominent, gray pruinose densely long yellowish pilose, sparsely black macrochaetose; wings with costal vein black pilose throughout; scutellum deeply, acutely delimited from posterior mesonotal margin, transverse groove sharply defined, obscured by long curly light brown pile, lateral margins shallowly emarginate, apical margin evenly rounded, submarginal macrochaetae black; mesopleura sparsely dark gray pruinose, dorsocaudal angle and basallare densely long yellowish pilose, supraepimeron bare except for sparse yellowish pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings dark gray pruinose, gradually constricted

from base to acute apex. **Legs** not enlarged, coxae black, gray pruinose, moderately densely clothed with long black pile, femora black, pile and macrochaetae black, tibiae black, anterior tibiae golden and black pilose, black macrochaetose, middle and posterior tibiae black pilose and macrochaetose, middle and anterior tarsi golden and black pilose, ventral surface of anterior tarsi with long recurved posterior marginal hairs, posterior tarsal segment one heavily spinose beneath; tarsal pulvilli large spatulate, extending to apical curve in claws. **Abdomen** with all segments black, tergite one with pile black medially, more dense and yellowish laterally, remaining segments moderately densely black pilose, sternites black in color, moderately densely black pilose. **Terminalia** small, broad, heart-shaped, black in color and pilosity, hemitergites with sutural margins gradually curved apically, apical angles evenly rounded, ventral margin nearly straight, surface shiny in basal half, opaque in apical half, inner surface shallowly concave, shiny, shallowly wrinkled; ninth sternite shallowly convex, not expanded laterally, moderately densely clothed with long black pile, posterior margin obtusely notched medially between bases of gonostyles; gonostyles extending posteriorly to about one-third of hemitergites, lateral arms rounded, shallowly bowed medially, outer margins with long, moderately dense black pile, surface shiny; interbasal folds short, bluntly rounded, tips divergent from base of lateral arms, dorsal surface rounded, ventral surface shallowly concave; aedeagus projecting medially through membrane connecting gonostyles basally, lying ventrally to membranous anal tube, base greatly enlarged, dorsal surface shallowly concave along median line, gradually narrowed posteriorly into a rounded tube, tube curved sharply upward at right angle, apex obliquely open. Length 21.5 mm; mesonotal width 6.4 mm. Redescribed from a male collected 4 km west of Santiago, Baja California Sur, Mexico, September 5, 1977, 215 m in elevation by Fisher and Westcott.

**FEMALE:** Similar to the male except for the usual secondary sexual characteristics and its more robust form. In the males, the abdominal segments gradually decrease in width from segment one through seven or to the



base of the terminalia. In the females, abdominal segments one through three are wide and about equal in width. Segment four is wide at the base but its lateral margins are sharply angulate and constricted apically to their junction with segment five which also has its lateral margins constricted apically although less so than segment four. The lateral margins of segments six and seven are usually straight and without apical reduction in width. The light-colored pile on the thorax, especially on the mesonotum, instead of being yellowish as in the male is white. The same is also true for the pile on abdominal segment one. Length 24.8 mm; mesonotal width 7.6 mm. Redescribed from a female with the same data as given above for the male.

The type locality was given in the original description as "California." However, subsequent collecting indicates that the species is from Baja California Sur, Mexico.

**DISTRIBUTION: MEXICO: Baja California Sur:** 4 km west Santiago, September 5, 1977, 215 m, Fisher and Westcott (8 males, 6 females); 4 km north Los Barriles, September 4 and 5, 1977, Fisher and Westcott (5 males, 9 females); same location, 10 m elevation, R. R. Snelling (3 males, 16 females); Cabo San Lucas, September 12, 1967, J. Chemsak, A. and M. Michelbacher (4 males, 1 female); San Jose del Cabo, September 11–16, 1967, J. Chemsak, A. and M. Michelbacher (4 males, 4 females); 5 miles north San Jose del Cabo, September 14, 1967, J. Chemsak, A. and M. Michelbacher (1 male, 1 female); 3 miles north San Jose del Cabo, September 10–13, 1967, J. Chemsak, A. and M. Michelbacher (10 males, 2 females); 1.5 miles southwest San Jose del Cabo, September 30, 1981, D. Faulkner and F. Andrews (6 females); El Taste, September 1893, Eisen (1 female); 1 mile southwest Agua Caliente, September 17, 1983, R. R. Snelling on flowers of *Antigonon leptopus* (4 males); vicinity of Miraflores, September 17, 1983, on flowers of *Antigonon leptopus* (1 female). See map 4.

**ECOLOGY:** Specimens from localities collected by David Faulkner et al. and R. R. Snelling were found nectaring in blossoms of *Antigonon leptopus*.

**VARIABILITY:** The series, 34 males and 37 females, of this subspecies that were available

for study exhibit little variability in any of the major characters. There are slight differences in the shades of the lighter colored pile in both sexes, and in a few specimens the pile on the pleural areas of the abdominal segments is pale in color. In most of the males the basal half of the hemitergites has the surface smooth and shiny, whereas the apical half is opaque due to fine surface sculpturing. However, the extent of these differences varies. Variability in abdominal maculation attributed to this species in the past is now understood to represent color and maculation characteristics that are correlated with geographical distribution differences. Thus, the division of this monotypical species into two subspecies as described herein.

**RELATIONSHIPS:** *Rhaphiomidas episcopus episcopus* is singularly distinct from all other species and subspecies in the genus by its uniformly black-colored, pilose and macrochaetose abdominal segments two through seven, coupled with its gray pruinose, light-colored pilose thorax. As noted above, the distribution of this form is on the east side of the cape regions central mountainous area with the exception of the Cabo San Lucas location which is on the extreme southwestern tip of the peninsula. Since *episcopus michelbacheri* is confined to the western side of the central mountains, one might assume that intermediates, if they exist, might be found in or near Cabo San Lucas. Such is not the case, however, at least in the four males and one female available from there, as all five are black without even the faintest indication of orange on the abdomen. See discussion under *episcopus michelbacheri*.

*Rhaphiomidas episcopus episcopus* occurs geographically, chronologically and evidently ecologically together with *xanthos xanthos* at or in the vicinity of Los Barriles and San Jose del Cabo (maps 3, 4). However, they are only distantly related and are easily separated since *xanthos xanthos* has the abdominal segments and terminalia primarily orange or yellowish and the compound eyes are separated from the lateral ocelli on the vertex by less than the width of a lateral ocellus (fig. 28). In *episcopus episcopus* the abdominal segments and terminalia are black and the compound eyes are separated from the lateral ocelli on

the vertex by more than the width of a lateral ocellus (fig. 27). From all other species and subspecies *episcopus episcopus* can be distinguished as given in the key.

Parallel geographical subspeciation in the cape region is taking place in *episcopus episcopus* and *xanthos xanthos* in almost identical locations. In both species the divergence has been from the solid-colored or least maculated type occurring east of the central cape mountains to the most maculated types, *episcopus michelbacheri* and *xanthos vittatus* west of these mountains. These are the only species known from the cape region.

***Rhaphiomidas episcopus michelbacheri*,  
new subspecies**

Figure 30; Map 4

**DIAGNOSIS:** Medium-sized, relatively narrow, abdominal tergites primarily orange, middorsal black maculations large (fig. 30); mouthparts with proboscis long, 8.0 mm in length; third antennal segment elongate, widest medially, about one-third longer than segments one and two combined; terminalia short, moderately robust, heart-shaped, gonostyles extending posteriorly to about apical quarter of hemitergites, hemitergites not attenuated from base to apex, apices broadly rounded, not overlapping, inner surface without spines, surface shallowly concave; legs with anterior tarsal segments two through five without ventral arolia, posterior legs unicolorous piceous, compound eyes separated from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the width of a lateral ocellus (fig. 27).

**DESCRIPTION:** Male: Similar to the males of *episcopus episcopus* in basic characteristics, differing primarily in color and maculation characters. In *episcopus michelbacheri* the mesonotal and scutellar macrochaetae are brownish instead of black, the pile on the base and venter of the hemitergites is golden rather than black, the gonostyles are golden pilose throughout instead of black, the entire ventral body surface including the coxae is golden or light brownish pilose rather than black, the middle and posterior femora and tibiae are piceous, whereas the anterior femora is piceous but the tibiae are testaceous. The most

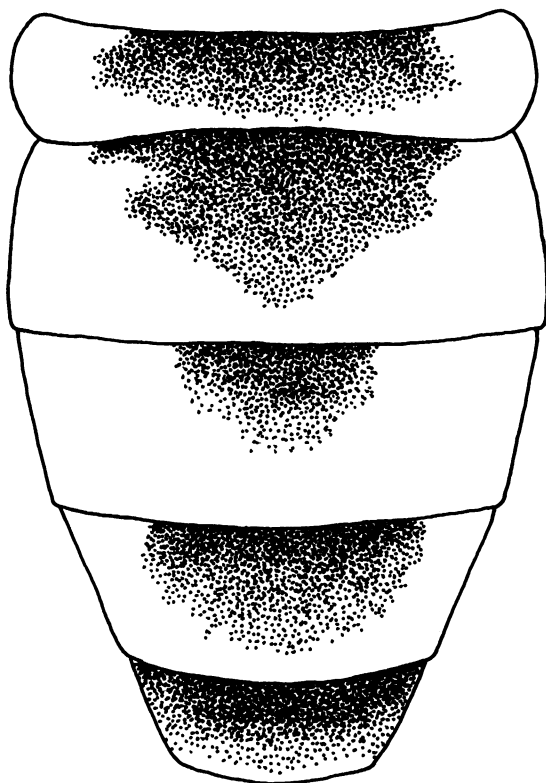


FIG. 30. *Rhaphiomidas episcopus michelbacheri*. Dorsal view of abdominal segments one through five in male.

obvious differences, however, are in the abdominal tergites orange color with black maculations (fig. 30) in contrast with the immaculate all black coloration of these tergites in *episcopus episcopus*. In *episcopus michelbacheri* the first abdominal tergite is black basally with a transverse apical orange vitta that is narrow medially, broadly widening laterally, tergites two and three are black transversely vittate in the basal third, with a median dorsal rounded posterior extension to the apical third, not reaching apical margin, tergites four and five are more broadly black medially with an orange transverse vitta that is narrow along apical margin medially, broadly expanding laterally to full length of tergite, black maculations not reaching pleural margin, tergites six and seven although not completely visible appear to be similar to four and five (fig. 30). Length 21.3 mm; mesonotal width 6.4 mm.

**FEMALE:** Similar to the male except for the usual secondary sexual characteristics and its more robust abdominal form. The first abdominal tergite has both the basal and apical margins orange with a narrow black vitta in between, medially the black spot extends from the basal margin to about the apical quarter of the tergite, tergite two has the median expansion of the black basal vitta sharply pointed medially and almost reaching the apical margin, tergites three and four are similar to the male. Length 21.5 mm; mesonotal width 6.0 mm.

**HOLOTYPE:** Male, Mexico, Baja California Sur, San Pedro, October 7, 1941, Ross and Bohart, deposited in the California Academy of Sciences on indefinite loan from the Essig Museum of Entomology, University of California, Berkeley.

**ALLOTYPE:** Female, Mexico, Baja California Sur, 2 miles northeast of San Pedro, September 19, 1967, J. Chemsak, and A. and M. Michelbacher, deposited in the California Academy of Sciences, on indefinite loan from the Essig Museum.

**PARATOPOTYPES:** Same data as holotype (2 males, 5 females).

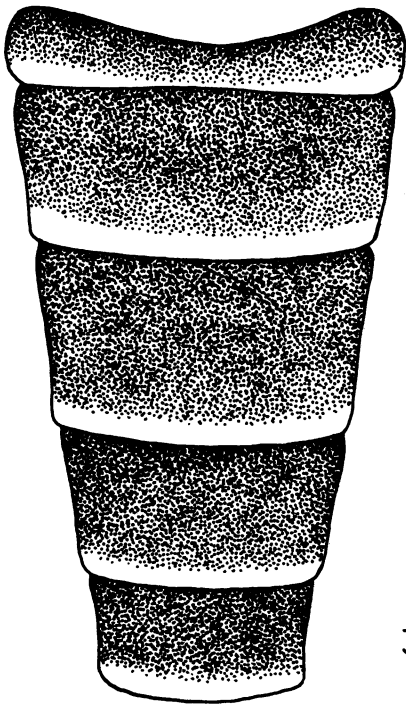
**PARATYPES: MEXICO: Baja California Sur:** Todos Santos, October 10, 1941, Ross and Bohart (4 females); 18 miles east Todos Santos, October 17, 1941, Ross and Bohart (4 males); 29 km north Todos Santos, September 3, 1977, Fisher and Westcott (1 male); Los Animas, Sierra Laguna, October 12, 1941, Ross and Bohart (1 male, 3 females); La Paz, October 7, 1955, F. X. Williams (1 male); 2 to 5 km south of highway one junction with highway 19, August 29, 1982, Faulkner and Brown (9 males, 3 females); 2 km south of junction of highways one and 19, August 29, 1982, Faulkner and Brown (1 male); 33 miles north Todos Santos, October 4, 1981, D. Faulkner and F. Andrews (6 males, 10 females); 21 miles northeast Todos Santos, September 16, 1983, R. R. Snelling, on flowers of *Melochia tomentosa* (1 male, 4 females); 11 miles northeast Todos Santos, September 16, 1983, R. R. Snelling, on flowers of *Antigonon leptopus* (1 female); 3 miles north San Pedro, September 15, 1983, R. R. Snelling, on flowers *Antigonon leptopus* (1 male, 8 females).

Paratypes deposited in AMNH, CAS, SDMNH, UCB, UCD, UCR, collection of Eric Fisher, Sacramento, LACM, and the author's collection at ASU. See map 4.

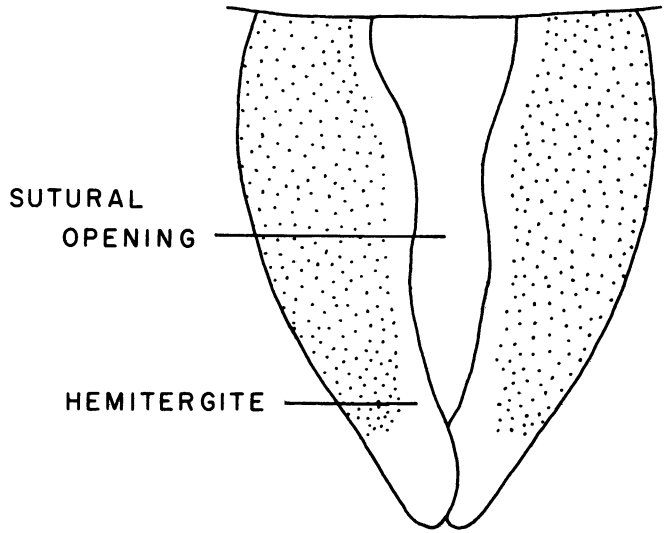
**ETYMOLOGY:** The subspecies is named in honor of Dr. A. E. Michelbacher (Mickly), Professor Emeritus, University of California, Berkeley as a small token of my deep appreciation for his sage advice, counseling and field training during my formative years in entomology. Also, as a dedication with respect to his many contributions to entomology resulting from his field research expertise and tireless collecting proficiency. Thanks are extended to his wife, Martha, in recognition of her infinite patience and understanding.

**ECOLOGY:** Specimens from localities collected by David Faulkner et al. were nectaring in flowers of *Antigonon leptopus* and *Melochia tomentosa* Linnaeus.

**DISCUSSION:** As was indicated under *episcopus episcopus*, the specimens from Cabo San Lucas properly belong to this subspecies and none exhibit the characteristics of *episcopus michelbacheri*. The latter subspecies varies in the extent of the orange abdominal maculations but in none of the locations listed above do they approach the immaculate black characteristics of *episcopus episcopus*. However, a single small male specimen from Pescadero, about 6 miles south of Todos Santos, appears to be an intermediate between the two subspecies both geographically and in color and maculation. Even though the specimen was evidently killed while still teneral, it clearly displays only a small amount of orange on abdominal tergite one, and tergite two has only three small orange spots on the lateral edges of the disc. Otherwise, the abdominal segments are a dark brown, the pile on segments two through seven is black as are the macrochaetae on the legs and mesonotum. The legs are colored as in *episcopus michelbacheri* with the anterior tibiae testaceous. One male and two females from Playa Los Cerritos, 11.2 miles south of Todos Santos, September 28, 1981, F. Andrews and D. Faulkner, also exhibit characteristics intermediate between *episcopus* and *michelbacheri*. Additional material from the region between Cabo San Lucas and Todos Santos will, no doubt, aid in the interpretation within this



31



32

FIGS. 31–32. *Rhaphiomidas trochilus*. 31. Dorsal view of abdominal tergites one through five in the male. 32. Dorsal view of male terminalia *in situ*.

species and will probably also shed light on a similar problem between *xanthos xanthos* and *xanthos vittatus*.

*Rhaphiomidas trochilus* (Coquillett)  
Figures 31–32; Map 5

*Apomidas trochilus* Coquillett, 1892, pp. 314–315.  
Cazier, 1941, pp. 616–617 (*Rhaphiomidas*).

**DIAGNOSIS:** Large-sized, elongate, narrow, sparsely clothed with gray and white pile, abdominal segments black in basal two-thirds, narrowly bordered apically with yellow or cream-colored transverse vittae (fig. 31); mouthparts with the proboscis ranging from 8.0 mm to 9.9 mm in length, averaging 9.1 mm; third antennal segment elongate, widest medially, primarily orange with dark infuscations dorsally; terminalia elongate, narrowly heart-shaped (dorsal view) (fig. 32), gonostyles extending posteriorly to apical third of hemitergites, hemitergites black, narrowly bordered with yellow orange, not attenuated apically, apices broadly rounded (lateral

view), not or barely overlapping (fig. 32), inner hemitergite surface without spines or carinae; anterior tarsal segments without ventral arolia; compound eyes separated from lateral ocelli on vertex by more than the width of a lateral ocellus.

**REDESCRIPTION:** Male: **Head** with frons moderately densely clothed with long white pile throughout, surface white pruinose; posterior surface bare and densely white pruinose in narrow band bordering posterior margin of compound eyes, median portion densely long white pilose, subdorsal margin sparsely long white macrochaetose mixed with dense white pile; compound eyes separated from lateral ocelli on vertex by about 1¼ times the width of a lateral ocellus; antennae with segments one and two reddish brown, sparsely white pruinose, sparsely clothed with long erect white macrochaetae, third segment bare, orange with dark dorsal infuscations, elongate, widest medially, wide basal ring white pruinose, longer than segments one and two combined; mouthparts with palpi short, tes-

taceous, long white pilose, not macrochaetose, proboscis long, 8.2 mm in length. **Thorax** with humeral callosities deeply incised posteriorly, sparsely gray pruinose, long white pilose and long white macrochaetose; mesonotum with two narrowly separated median longitudinal dark vittae not extending to base and a single wide lateral vitta on each side, interrupted posteriorly, not extending to posterior margin, discal surface and lateral margins exclusive of vittae gray pruinose, pile moderately dense, brownish in color, lateral marginal macrochaetae white, posterior lateral angles (post-alar callosities) tumid, prominent, densely gray pruinose, sparsely white pilose and macrochaetose; wings with costal vein yellowish to brownish pilose throughout; scutellum deeply, acutely delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins shallowly emarginate, posterior margin evenly rounded, surface and margins gray pruinose, sparsely long white pilose, submarginal macrochaetae white; mesopleural sclerites gray pruinose, dorsocaudal angle and basalare densely long white pilose, supraepimeron bare except for sparse long white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gradually constricted to acute apical point, surface gray pruinose, disc short gray pilose. **Legs** not enlarged, coxae piceous, moderately densely long white pilose, sparsely white macrochaetose, femora, tibiae and tarsi white pilose, black and brown macrochaetose, anterior and posterior femora dark in basal half to two-thirds, middle femora, tibiae and tarsi uniformly testaceous, tarsal pulvilli large narrow, about three-fourths the length of tarsal claws, sides subparallel only slightly divergent apically. **Abdominal** tergites primarily black, narrowly bordered apically with narrow yellow or orange transverse band, apical band on tergite one narrowed medially (fig. 31), surface moderately clothed with long white pile, longer and more dense laterally on each segment, discal pile semi-erect, sternites with pale lateral and apical borders, pile long white and sparse. **Terminalia** elongate, narrowly heart-shaped, sutural margins narrowly overlapping only at apex (fig. 32); hemitergites black with narrow orange or yellowish border along suture and ventral margin, border wider at apex (fig. 32), surface sparsely clothed with

long semi-erect white pile, sutural margin shallowly sinuous to bluntly evenly rounded apex, apex extending ventrally slightly below ventral margin, ventral margin nearly straight to base, inner surface shallowly irregularly wrinkled, without carinae, uniformly shallowly concave, glabrous; ninth sternite shallowly convex, piceous, basal angles expanded laterally, moderately clothed with long white pile, posterior margin obtusely notched medially between bases of gonostyles; gonostyles rounded, shallowly curved, extending posteriorly to apical third of hemitergites, reddish brown in color, moderately clothed with long white pile, lateral posterior extensions finger-like, rounded, sides parallel in apical two-thirds, apices bluntly rounded; interbasal folds short, two-segmented, evenly rounded to bluntly rounded apex, apex slightly produced apically beyond base, ventral surface shallowly concave, dorsal surface convex; aedeagus projecting medially through membrane connecting gonostyles at base, lying ventral to membranous anal tube, base greatly enlarged, dorsal surface shallowly concave medially, apical third abruptly narrowed into slender rounded tube, tube gradually curved upward, apex obliquely truncate, open. Length 28.1 mm, mesonotal width 7.0 mm; length 30.1 mm, width 7.7 mm (redescribed from two specimens collected at Antioch, Contra Costa County, California, the largest male with the hemitergites separated).

**FEMALE:** Similar to the male except for the secondary sexual characteristics and its larger more robust size and shape. The pile on the fourth abdominal tergite is not retrorse, the pale areas on the dorsal abdominal segments are wide, those on segments three and four covering about half the surface, the dark areas on the femora are not well defined, the tarsal pulvilli are small and narrow, little more than half the length of the tarsal claws. Length 33.0 mm, mesonotal width 8.3 mm (redescribed from a female collected at Antioch, Contra Costa County, California).

**HOLOTYPE:** Female, California, Merced County, in the National Museum of Natural History, Smithsonian Institution.

**DISTRIBUTION:** CALIFORNIA: **Contra Costa County:** Antioch, August 24, 1938, M. Cazier (3 males); same location, September 1, 1937, M. Cazier (2 males); same location, August 19–26, 1933, M. Cazier (1 male); same

location, August 11, 1950, P. D. Hurd (1 male); same location, September 8, 1948, P. D. Hurd, J. W. MacSwain (2 males); same location, August 15, 1933, M. Cazier (1 female); same location, August 27, 1938, Carl T. Sierra (1 male); same location, August 25, 1955, C. D. MacNeill (1 male, 1 female); same location, September 9, 1935, G. E. Bohart (2 males); same location, August 24, 1935, F. R. Platt (3 males); same location, August 1937 and 1938 (3 males), August 26, 1933 (1 male), August 19, 1933, T. G. Aitken (1 male); same location, August 16, 1942 (1 male), August 2, 1938 (1 male), July 15, 1937 (1 male), August 10, 1941 (1 female), E. C. Van Dyke; same location, August 1937, E. S. Ross (1 male); 2 miles east Antioch, August 18, 1974, J. Doyen, P. Opler (1 female). **Stanislaus County:** Oakdale, August 24, 1961, W. Graham (1 male). **Tulare County:** Lindsay, August 20, 1920, R. A. Milhaus (1 male). **San Joaquin County:** Near Ripon, September 2, 1968, John Strohbeen (1 male, 1 female). **County?:** Rawson Creek, Sierra Nevada Mountains, 5500 feet, July 8, 1927 (1 female), July 3, 1927, V. Duran (1 female). See map 5.

**ECOLOGY AND BEHAVIOR:** The following information was recorded by the author (1941) and appears to be the only data available on this species:

The Antioch specimens were collected three or four miles east of Antioch in the barren sand hills along the south side of the San Joaquin-Sacramento River. The adults are exceedingly fast in flight and, unlike many asilids, do not habitually return to the same resting point after being disturbed. During flight the wings make a humming noise that is distinctly audible for a distance of twenty to thirty yards. None of the numerous specimens collected at this locality has been taken on or in association with flowers. Most of the specimens are found resting on the sand with the wings folded over the back or often extending at right angles to the body, the tips nearly touching the sand.

The Antioch location was localized and of limited extent and it is my understanding that the dune area no longer exists.

**VARIABILITY:** As compared with several other species, e.g., *hasbroucki* and *acton*, *trochilus* exhibits little individual variability in most major characteristic morphological features. The dark areas on the legs vary slightly

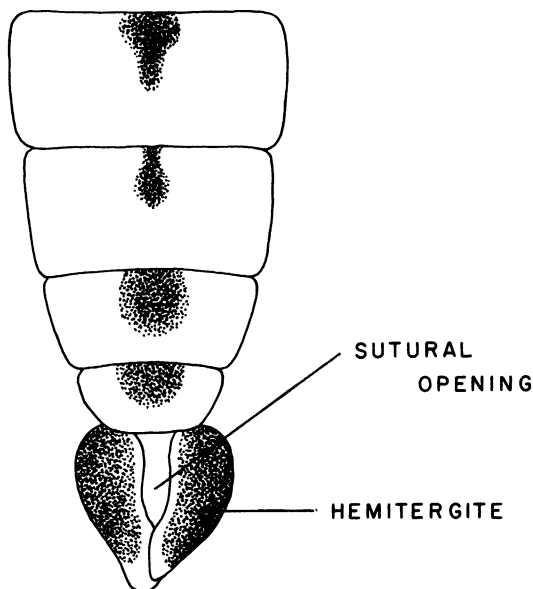


FIG. 33. *Rhaphiomidas nigricaudis*. Dorsal view of abdominal tergites two through five and male terminalia *in situ*.

in extent as do the widths of the transverse light-colored abdominal vittae. The pile on the costal wing vein may be primarily dark in color and the legs will have an occasional light-colored macrochaeta.

**RELATIONSHIPS:** *Rhaphiomidas trochilus* does not appear to be closely related to any other known species. Superficially it resembles *parkeri* but only in the abdominal markings. The latter is distinct in its rounded, broadly overlapping hemitergites (fig. 10), its long gonostyles (fig. 9), white macrochaetae on the legs which are also more heavily pigmented. In general shape and the elongate narrow terminalia *trochilus* resembles *terminatus terminatus* and *terminatus abdominalis*. However, its pale-bordered hemitergites (fig. 32), more regularly marked abdomen (fig. 31), white pilosity and larger size distinguish *trochilus* from either of the two subspecies.

***Rhaphiomidas nigricaudis*, new species**  
Figure 33; Map 1

**DIAGNOSIS:** Medium- to large-sized, narrow to robust, moderately densely clothed with golden pile, abdominal tergites primarily orange, maculations dark (fig. 33); mouth-

parts with proboscis ranging from 8.0 mm to 10.8 mm in length, averaging 9.5 mm; third antennal segment elongate, widest medially, orange; terminalia rounded, heart-shaped, hemitergites not attenuated nor overlapping distally, disc black, margins narrowly dark orange, apices broadly rounded, gonostyles extending posteriorly to apical third of hemitergites, inner hemitergite surface without spines or carinae; anterior tarsal segments two through five without ventral arolia; compound eyes separated from the lateral ocelli on the vertex by little more than the width of a lateral ocellus.

**DESCRIPTION OF TYPE:** Male: **Head** with frons and vertex moderately densely clothed with pale golden pile, surface greasy (gray pruinose in paratypes); posterior surface greasy (gray pruinose in paratypes), bare in narrow band bordering posterior margin of compound eyes, median portion densely pale golden pilose, macrochaetae sparse, white, indistinct; compound eyes separated from lateral ocelli on vertex by little more than width of a lateral ocellus; antennae with segment one black, segment two piceous, sparsely clothed with long erect whitish macrochaetae, those on segment two arranged in horizontal line around middle, segment three bare, orange, elongate, about  $1\frac{1}{2}$  times longer than segments one and two combined, basal ring orange; mouthparts with palpi dark brown, sparsely long white pilose; proboscis long, 8.0 mm in length. **Thorax** with humeral callosities deeply incised posteriorly, shallowly delimited interiorly, surface greasy (gray pruinose in paratype), sparsely clothed with long pale golden pile, macrochaetae white, sparse; mesonotum greasy (gray pruinose in paratype), moderately densely clothed with long pale golden pile, longest and most dense laterally, lateral macrochaetae pale, post-alar callosities tumid, sparsely pilose and macrochaetose; wings with costal vein golden pilose in basal quarter, dark short pilose in apical three-quarters; scutellum deeply acutely delimited from posterior mesonotal margin, transverse groove sharply defined, surface greasy (gray pruinose in paratype), moderately clothed with long golden pile, posterior margin evenly rounded, lateral margins shallowly emarginate, submarginal macrochaetae pale; mesopleural sclerites greasy (gray pru-

inose in paratype), dorsocaudal angle densely long golden pilose, basalare densely long white pilose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gradually constricted to acute apical point, surface gray pruinose. **Legs** not enlarged, coxae black, densely long white pilose, all femora black except for extreme apex, white pilose and macrochaetose, tibiae pale orange, white pilose and macrochaetose, inner surface of middle and posterior tibiae with irregular row of short stout black spines, surface white pilose and macrochaetose, tarsi pale orange, white pilose and macrochaetose, venter of first segment with double row of short, stout, black spines, tarsal pulvilli large, paddle-shaped, greatly enlarged apically, about two-thirds as long as claws. **Abdomen** primarily deep orange moderately to densely clothed with golden pile, segment one black basally with narrow golden apical border, widest laterally, densely long pale golden pilose, most dense laterally, segment two black in about basal half, widest medially, apical half orange, tergites three through five orange with middorsal black spots in basal half, tergites two through four moderately clothed with short golden pile, tergite five with longer pile, pile more dense and longer laterally on all segments, sternites orange, sparsely long golden pilose. **Terminalia** rounded, heart-shaped hemitergites not overlapping, black narrowly bordered with orange on dorsal, apical, and ventral margins (fig. 33), sutural margin shallowly undulated, apical margins evenly rounded to ventral margins, ventral margins slightly constricted toward base, inner surface smooth, deeply concave, without spines or carinae, with few scattered hairs, outer surface moderately clothed with short erect golden pile; ninth sternite prominently convex, piceous, basal angles expanded laterally, moderately clothed with long golden pile, posterior margin deeply impressed, obtusely notched between gonostyles; gonostyles extending posteriorly to about apical third of hemitergites, orange, apical arms shallowly bowed toward apex, sparsely long golden pilose, outer surface convex, inner surface shallowly concave; interbasal folds short, two-segmented, rounded apically; aedeagus projecting medially through mem-



brane connecting gonostyles at base, lying ventral to membranous anal tube, base greatly enlarged, dorsal surface with median longitudinal concave groove, ventral surface convex, apex abruptly narrowed into narrow rounded tube, tube curved sharply upward and recurved anteriorly at apex, apex obliquely open. Length 23.9 mm; mesonotal width 5.8 mm.

**FEMALE:** In addition to the usual secondary sexual characteristics, the females of *nigricaudis* differ from the males in lacking the orange color and by having the abdominal tergites transversely banded black in basal half and pale yellow or cream colored in about the apical half. In addition, the females have abdominal segment one through four white pilose, sternites one and two have basal black maculations, the ventral pilosity is white, the middle and posterior tibiae and first tarsal segments lack ventral spines. The mesonotal pile is golden as it is in the male. Length 25.6 mm; mesonotal width 6.5 mm.

**HOLOTYPE:** Male, Arizona, Yuma County, Ligturta, April 9, 1966, elevation 1980 feet, J. H. and J. M. Davidson, M. A. Cazier, deposited in the American Museum of Natural History.

**ALLOTYPE:** Female, same data as holotype, deposited in the American Museum of Natural History.

**PARATOPOTYPES:** Same data as holotype (4 females AMNH).

**PARATYPES:** CALIFORNIA: **San Diego County:** Palm Canyon, Borrego Valley, May 1, 1932, H.G. (1 male); May 21, 1941, R. C. Dickson (4 males, 2 females); April 19, 1957, J. C. Hall, H. R. Moffitt, E. I. Schlinger, R. M. Bohart, R. C. Bechtel (11 males, 3 females); Anza Borrego, May 21, 1983, Robert B. Parks (3 males); Coyote Canyon, Anza Borrego, May 21, 1983, Robert B. Parks (1 male); Borrego, April 25, 1955, on *Salvia*, P. H. Timberlake (1 male); Anza Borrego State Park, Tamarisk Grove Camp Ground, May 15, 1976, Paulo Assis de Moraes (2 males); Borrego Valley, May 21, 1941, E. C. Van Dyke (7 males, 1 female); **Imperial County:** Borrego Valley, May 1, 1932, H. Gentry (1 male); April 31, 1932, H. Gentry (2 males, 1 female, teneral); 2 miles W. Ocotillo, May 17, 1978, elevation 1100 feet, C. Bellamy (4 males); **Riverside County:** Morongo, May 23,

1932, C. M. Dammers (1 male); 5 miles south Palm Desert, May 10, 1966, D. Clarke (1 male). Paratypes deposited in AMNH, UCB, UCD, UCR, CAS, collection Eric Fisher, Sacramento, the author's collection at ASU, and LACM. See map 1.

**ETYMOLOGY:** The name is modified from the Latin *nigra* meaning black and *cauda* meaning tail to indicate the black hemitergites of the terminalia of this species.

**ECOLOGY:** The specimens from the type locality, Ligturta, Arizona, were collected along the edge of a dry rocky wash leading into the Gila River. The east side above the wash was covered with semi-consolidated sand but the specimens were found on a purple-flowered shrub intermixed with ironwood, *Olneya tesota*, along the edge below the sand. The male holotype was taken as it inserted its proboscis into a purple flower, presumably to feed on nectar, whereas the four females were found on the shaded stems of this plant from two to three feet above the ground level. All were collected in late morning on a very hot day. Some specimens from Borrego and Palm Canyon have been collected as they visited the flowers of *Salvia* sp.

**VARIABILITY:** In the males, the only variability of any note is in the abdominal maculations which in some specimens lack the middorsal dark areas on both tergites two and three (fig. 33). In a few males the spines on the inner tibial surface are few in number and in some cases are light in color instead of black. The only variability in the main character, the black hemitergite discs (fig. 33), is that in one teneral specimen this area is dark brown. The females are remarkably uniform in structure, abdominal maculations and color. The maculations are not confined to the middorsum of the abdominal tergites and the light-colored apical transverse vittae are not orange as they are in *acton acton* and *undulatus*.

**RELATIONSHIPS:** Although *nigricaudis* is in the same key dichotomy with *trochilus*, based on the hemitergite color, it is only distantly related to that species. It is more closely related and has more features in common with the *acton acton* complex, including *acton maculatus*, and *acton maehleri*. With these three subspecies it shares the abdominal maculations (fig. 33), orange color and the spines

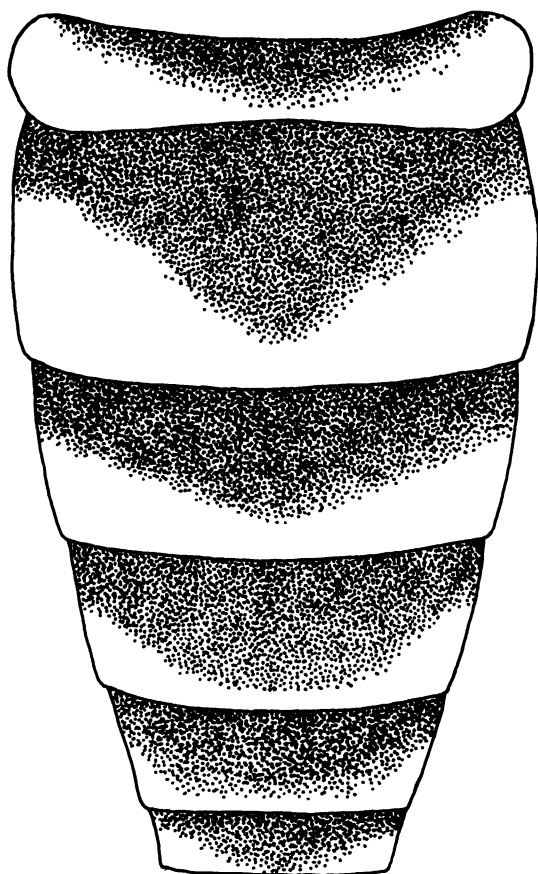


FIG. 34. *Rhaphiomidas terminatus terminatus*. Dorsal view of abdominal tergites one through six in male.

on the middle and posterior tibiae and first tarsal segments (fig. 39). It differs primarily and exclusively from all three by its black with narrow orange bordered hemitergites. The females of *nigricaudis* are like those of *acton maehleri* in having the abdominal tergites with broad, basal, black, transverse vittae and broad apical, pale, transverse vittae (fig. 40). In both *acton acton* and *acton maculatus* the abdominal maculations are confined to isolated middorsal dark spots and the basic color is orange (fig. 37). I have been unable to find a distinguishing character between the females of *nigricaudis* and *acton maehleri*.

*Rhaphiomidas nigricaudis* occurs geographically (maps 1 and 2), ecologically and chronologically together with *undulatus* at

several locations in Borrego Valley and there is some question about the proper association of the females in this area. However, based on the relationship at Ligurta, only those females with broad transverse abdominal vittae and pale coloration are referred to *nigricaudis*, whereas, those with isolated or restricted middorsal dark maculations and orange color from this area are referred to *undulatus*. In a few cases there seems to be some gradation between the two types. However, the males are readily separated by their terminalia. In *nigricaudis* the terminalia are robust, the sutural hemitergite margins are not strongly undulating, the hemitergites are black with narrow orange borders (fig. 33) and the gonostyles extend posteriorly to the apical third of the hemitergites which are not carinate internally. In *undulatus* the terminalia are elongate, the sutural hemitergite margins are strongly undulated from base to apex, the hemitergites are uniformly orange in color and the gonostyles extend posteriorly to about the middle of the hemitergites which are carinate internally (fig. 18).

*Rhaphiomidas terminatus terminatus*  
Cazier, new combination

Figure 34; Map 5

*Rhaphiomidas terminatus* Cazier, 1941, p. 622.  
Hogue, 1967, pp. 49–53 (pupa).

DIAGNOSIS: Medium-sized, elongate, narrow, dark in color; head with compound eyes separated on the vertex from the lateral ocelli by more than the width of a lateral ocellus; mouthparts with the proboscis ranging in length from 7.2 mm to 9.1 mm, averaging 8.6 mm; third antennal segment elongate, widest medially; abdominal tergites two through six black in basal half to more than two-thirds on segment six, apical portion of each segment pale yellow (fig. 34); terminalia narrow, heart-shaped, color uniformly dark reddish brown, gonostyles extending posteriorly slightly beyond the middle of the hemitergites, hemitergites with inner, shallowly concave surface sericeous, without spines or carinae, apices broadly rounded, not attenuated or overlapping each other.

REDESCRIPTION OF TYPE: Male: **Head** with frons moderately densely clothed with long white pile, surface white pruinose; vertex be-

tween and behind ocelli pale yellowish pilose; posterior surface white pruinose, moderately densely long white pilose, irregular median band of long erect pale yellowish macrochaetae; compound eyes separated from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the width of a lateral ocellus; antennal segments one and two dark in color, sparsely irregularly white pruinose, clothed sparsely with long erect white macrochaetae, third segment primarily orange in color, bare, elongate and widest medially, widened basally into swollen ring at junction with segment two, little longer than segments one and two combined; mouthparts with palpi short, light brown in color, sparsely clothed with long white macrochaetae, proboscis long, tubular, straight and rigid, about 9.1 mm in length. **Thorax** with humeral callosities prominent, deeply acutely incised posteriorly, surface sparsely gray pruinose, moderately densely clothed with long white hair, sparsely white macrochaetose posterior lateral angles (post-alar callosity) tumid, prominent black macrochaetose; mesonotum with a median and two lateral, one on each side, longitudinal dark vittae, discal surface brownish pruinose, glabrous, lateral margins gray pruinose, moderately densely long white pilose, sparsely long white macrochaetose; wings with costal margin densely white and golden pilose basally, short black pilose in apical three-quarters; scutellum delimited from basal mesonotal margin by deep sharply defined transverse groove, posterior margin shallowly evenly rounded, lateral margins shallowly emarginate, surface and margins sparsely long white pilose, submarginal macrochaetae white or brown mixed; mesopleural sclerites gray pruinose, dorsocaudal angle with prominent tuft of long white hair, basalare densely long white pilose, supraepimeron and infraepimeron glabrous, postnotal conical swellings shallowly constricted to short apical blunt point. **Legs** reddish brown, not enlarged; anterior femora, tibiae and tarsi white pilose and macrochaetose; middle femora, tibiae and tarsi white pilose, brown macrochaetose; posterior femora white pilose, brown macrochaetose, tibiae white pilose in basal third, black pilose in apical two-thirds, brown or black macrochaetose throughout; tarsi brown pilose and macrochaetose; tarsal pulvilli

broad, expanded apically, about two-thirds the length of the claws; coxae densely white pilose, macrochaetae sparse and white. **Abdomen** with segments primarily black, narrowly bordered along apical margin with pale yellow or white (fig. 34); tergite one with narrow apical white border interrupted medially with extension of black from base, long white pilose especially laterally; tergite two with black basal two-thirds expanded posteriorly at middle, black not reaching apical margin, sparsely long white pilose laterally; tergites three through seven with pale apical margins decreasing in width from three to seven sparsely long white pilose especially laterally; pleural areas primarily dark brown; sternites one through five pale yellow, sparsely clothed with long white pile; sternites six and seven brown basally, pale yellow apically, sparsely long white pilose (fig. 34). **Terminalia** narrow, heart-shaped, uniformly dark reddish brown, moderately densely clothed with pale golden pile; hemitergites broadly rounded apically, not overlapping, inner surface shallowly concave, sericeous, impunctate, glabrous; ninth sternite shallowly convex, shallow median notch in posterior margin between base of gonostyles, surface clothed with long white pile; gonostyles extending posteriorly slightly beyond middle of hemitergites, lateral posterior extensions finger-like, rounded, narrowing from base to bluntly rounded apex, shallowly bowed outward medially, sparsely clothed with long white pile; interbasal folds short, two-segmented, bluntly rounded, extending from base parallel to gonostyle, apical third narrowly separated from gonostyle, ventral surface shallowly concave, sparsely pilose; aedeagus projecting medially through basal membrane connecting gonostyles, ventral to membranous anal tube, base greatly enlarged, narrowing abruptly into dorsally curved rounded tube, apex ending obliquely, open. Length 27 mm; mesonotal width 6.5 mm (redescription of holotype).

**FEMALE:** Similar to male except for the usual sexual differences. Length 25 mm, mesonotal width 7 mm.

**HOLOTYPE:** Male, California, Los Angeles, D. W. Coquillett, in the National Museum of Natural History, Smithsonian Institution no. 54805.

**ALLOTYPE:** Female, same data as holotype

in the National Museum of Natural History, Smithsonian Institution.

**DISTRIBUTION:** CALIFORNIA: **Los Angeles County:** El Segundo Sand Dunes, July 15, 1958, W. W. Harden, Lionel Stange, Arnold Menke (13 males, 2 females); Los Angeles (no further data) (1 female); Huntington Park, July 20–30, 1940, August 6, 1940, Albert Bauman (3 males, 3 females); Manhattan Beach, August 1965 (reared), Carl Hall (1 male). See map 5.

**ECOLOGY:** Hogue (1967) described the location at which Carl Hall observed a male emerging in this backyard at Manhattan Beach as being on sandy flat ground on the landward edge of a sand dune which separated the area from the ocean, which was about three-fifths of a mile to the west. The dune association is also indicated at El Segundo but no further details are available. The six specimens collected at Huntington Park are labeled "on *Hugelia filifolia*" (Nuttall) Jepson, a species of phlox whose current name is *Eriastrum filifolium* (Nuttall) Wootton and Standley. No information is available on whether the flies were just sitting on these small plants or if they were taking nectar from the small purple flowers.

**VARIABILITY:** In the 17 male specimens available for study there is some relatively minor variability in certain characters. The proboscis of the mouthparts vary from being 3 to 3½ times the antennal length; the median mesonotal dark longitudinal stripe may be narrowly divided into two; the macrochaetae on the mesonotum may be all white; the supraepimeron may have a few long white hairs on the dorsal anterior portion; the pale abdominal maculations may be slightly more extensive than on the type; the dorsal and posterior edges of the hemitergites may be narrowly black. The length in the males varies from 21.0 mm to 27.1 mm, in the females the length varies from 22.0 mm to 31.0 mm.

**RELATIONSHIPS:** In size and general appearance *terminatus* appears to most closely resemble *aitkeni*, but there are a number of definitive morphological differences in addition to their widely allopatric distributions. The males of both *terminatus terminatus* and *terminatus abdominalis* can be separated from *aitkeni* by their brown or black macrochaetae on the posterior femora and tibiae, by their

longer proboscis on the mouthparts which are about 3 to 3½ times the length of the antennae, by their uniformly colored femora, and by having the costal wing vein black pilose except at the extreme base. In *aitkeni* the macrochaetae on the posterior femora and tibiae are white, the proboscis on the mouthparts are only about 2 to 2½ times longer than the antennae, the femora are bicolored with the basal portion dark, and the costal wing vein is white or golden pilose from the base to or near to the tip. The females of each species are separable by all the characters given for the males except that in both species the costal wing vein is black pilose from near the base to the tip.

The known distribution of *aitkeni* is confined to two locations in Inyo County, California and one in Nye County, Nevada (map 6), whereas *terminatus terminatus* is known only from southwestern Los Angeles and *terminatus abdominalis* from the area southwest of San Bernardino, California (map 5).

*Rhaphiomidas terminatus abdominalis*  
Cazier, new combination  
Figure 35; Map 5

*Rhaphiomidas abdominalis* Cazier, 1941, pp. 624–625.

**DIAGNOSIS:** The same as given for *terminatus* except for the abdominal maculations. In *abdominalis* the dark maculations on segment two are in the basal third except medially where they expand abruptly to the apical third of the segment, segment three has a large almost square isolated median spot extending from the base to the apical third, segments five through seven have large median isolated halfmoon-shaped dark areas, usually not connected laterally with the dark pleural areas (fig. 35).

**REDESCRIPTION:** Male: With the exception of the abdominal markings, as discussed in the diagnosis, numerous specimens from both subspecies are similar and the ranges of variability closely approximate each other. In *abdominalis* the length of the males varies from 20.0 mm to 25.0 mm and of the females from 21.6 to 26.6 mm, an almost complete overlap between the two subspecies.

**HOLOTYPE:** Male, California, San Bernardino County, Colton, August 16, 1888, F. A.

Eddy, in the Museum of Comparative Zoology.

PARATYPE: California, August 25, C. W. Johnson (1 male AMNH).

DISTRIBUTION: CALIFORNIA: **San Bernardino County:** Bloominton, August 22, 1948, no collector (1 male, 1 female); Rialto, September 24, 1938, P. D. Hurd (1 male), August 17, 1938, P. D. Hurd (2 females), August 15, 1956, P. D. Hurd (1 male), August 15, 1956, E. G. Linsley, P. D. Hurd (10 males, 2 females), August 10, 1955, J. C. Hall (1 male), August 3, 1956, J. C. Hall (1 male, 1 female); **San Bernardino**, August 17, 1977, Sandahl (1 male). **Riverside County:** Mira Loma, August 24, 1941, Guy F. Toland, J. Wilcox (10 males, 3 females). See map 5.

DISCUSSION: In 1941 when both *terminatus* and *abdominalis* were described, only two specimens of each were available and they appeared to be recognizable as distinct species. However, in the present study 34 *abdominalis* and 23 *terminatus* from a number of locations have shown sufficient variability and convergence, especially in the abdominal maculations (figs. 34, 35), to justify the conclusion that they represent the extremes of one polytypic species population. Thus, their change of status to *terminatus terminatus*, by page preference (p. 622), and *terminatus abdominalis*, (p. 624).

***Rhaphiomidas auratus* Cazier, new species**  
Map 6

DIAGNOSIS: Small-sized, narrow, moderately densely clothed with both white and golden pile, abdominal segments primarily orange with small median dorsal dark markings; mouthparts with proboscis ranging from 8.4 mm to 9.9 mm in length, averaging 9.0 mm; third antennal segment orange, elongate, narrow, widest at about middle; terminalia small, elongate, narrow, heart-shaped; gonostyles not extending posteriorly to or near apex of hemitergites, hemitergites entirely golden or brown, broadly rounded apically, not or barely overlapping apically, inner surface without spines or carinae; compound eyes separated from lateral ocelli on vertex by more than the width of a lateral ocellus; abdominal dark maculations confined to middorsal areas of tergites; middle

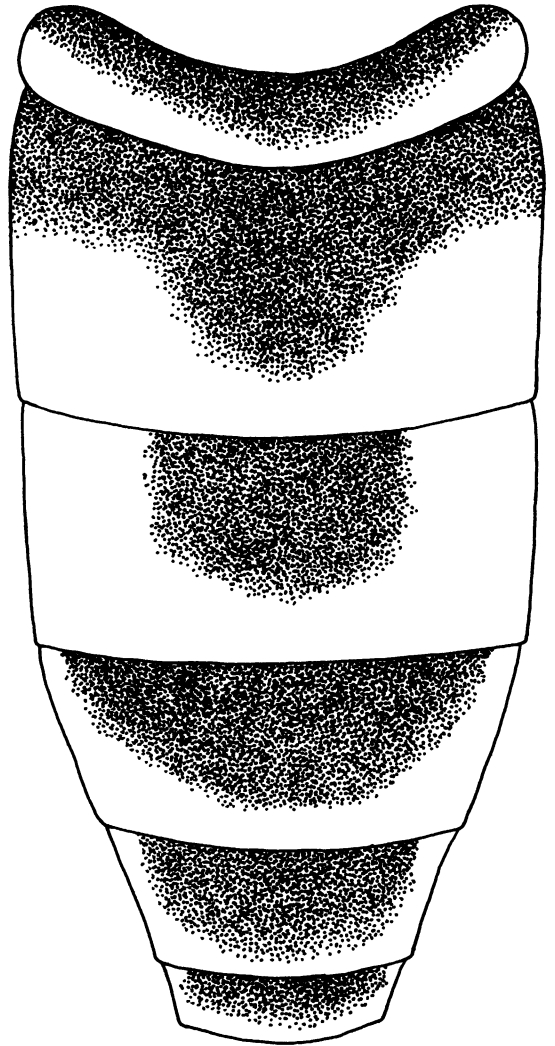


FIG. 35. *Rhaphiomidas terminatus abdominalis*. Dorsal view of abdominal tergites one through six in male.

tibiae and first tarsal segment not spinulose on inner surface, anterior tarsal segments without ventral arolia, posterior femora entirely golden or dark in part, tibiae and tarsi golden or yellow.

DESCRIPTION OF TYPE: Male: **Head** with frons and vertex grayish pruinose, moderately long white pilose; posterior surface bare and gray pruinose in narrow band bordering posterior margin of compound eyes, median portion moderately densely clothed with long white pile, long erect white macrochaetae in-

distinct and mixed in with white pile; compound eyes separated from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the diameter of a lateral ocellus; antennae with segments one and two piceous, sparsely gray pruinose and white macrochaetose, third segment narrow, elongate, bare, orange, bluntly rounded at apex, widest at about middle, about twice as long as segments one and two combined, basal ring dark; mouthparts with palpi short, dark basally testaceous apically, sparsely long white pilose, not macrochaetose, proboscis long, 9.9 mm in length. **Thorax** with humeral callosities not deeply incised posteriorly, surface gray pruinose, sparsely brownish pilose and macrochaetose, mesonotum with two median longitudinal narrowly separated dark vittae not reaching posterior margin, two lateral longitudinal vittae interrupted in basal third, not reaching posterior margin, discal surface and lateral margins exclusive of dark vittae gray pruinose, discal pile white and yellowish, sparse, lateral pile more dense, lateral marginal macrochaetae white, post-alar callosities shallowly tumid, not prominent, sparsely white pilose and macrochaetose; wings with costal vein golden pilose, especially in basal half; scutellum deeply delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins shallowly emarginate, posterior margin evenly rounded, surface sparsely long yellowish pilose, margins more densely pilose, submarginal macrochaetae yellowish; mesopleural sclerites gray pruinose, dorsocaudal angle and basare densely long white pilose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gradually constricted to acute apical point. **Legs** not enlarged, coxae black, sparsely gray pruinose moderately densely long yellowish pilose, femora, tibiae and tarsi light golden except for apex of posterior femora and basal half of anterior femora which are dark, pile mixed golden and white, macrochaetae yellowish, tarsal pulvilli rounded, about two-thirds the length of the tarsal claws. **Abdomen** with all segments primarily orange, moderately clothed with golden pile, more dense and longer laterally, segment one with black rectangular band along apical border of discal portion, segment two with median small bas-

al subtriangular black maculation with acutely pointed posterior angle extending to about middle of segment, not reaching posterior margin, segment three with small oval median basal brownish spot, segment four with larger median basal spot extending to about middle of segment, segment five with still larger median basal dark spot extending posteriorly to about apical two-thirds of segment, segment six about the same as segment five, segment seven without visible dark maculations, sternites immaculate, orange. **Terminalia** small, elongate, narrow, heart-shaped, uniformly orange, moderately densely clothed with short orange pile; hemitergites with sutural margins slightly undulating, apices evenly rounded, protruding slightly below ventral margins, ventral margins nearly straight, inner surface opaque, finely wrinkled, without carinae or pilosity, shallowly concave; ninth sternite shallowly convex, basal angles expanded laterally, color dark orange, moderately clothed with long golden pile, posterior margin obtusely notched medially between bases of gonostyles; gonostyles extending posteriorly about two-thirds the hemitergite length, slightly curved, extensions finger-like, sparsely clothed with long golden pile, inner surface shallowly concave near base, apex bluntly rounded; interbasal folds short, two-segmented, bluntly rounded apices narrowly separated from gonostyles, dorsal surface convex, ventral surface concave; aedeagus projecting medially through membrane connecting gonostyles at base, lying ventral to membranous anal tube, base greatly enlarged, dorsal surface convex medially, apex abruptly constricted into narrow rounded tube, tube sharply turned upward at apex, apex obliquely open. Length 19.0 mm; mesonotal width 5.0 mm.

**FEMALE:** In addition to the usual secondary sexual differences the females have the abdominal tergites more heavily maculated, there are a few dark areas on the abdominal sternites and legs and the unpigmented areas are a dull yellowish color instead of orange. These differences give the females a much darker general appearance than the males. Abdominal tergites one through five are black in the basal third to half, these basal transverse vittae are widest medially on tergites two through five but do not extend poste-

riorly to the margin of the segment, tergite six has a similar basal vitta and also one along the apical margin that is widest medially but does not extend anteriorly to the basal maculation, the visible portion of tergite seven is unmaculated. Sternites two through four have small indistinct irregular midventral dark areas and segment two is dark along the pleural suture as a continuation of the tergal maculation. The legs have the femora piceous from the base to near the apex. The proboscis of the mouthparts is 10.4 mm in length. Length 19.0 mm; mesonotal width 5.2 mm.

**HOLOTYPE:** Male, Nevada, Clarke County, 1.6 miles east Glendale, May 13, 1961, deposited in the California Academy of Sciences, on indefinite loan from the Essig Museum of Entomology, University of California, Berkeley.

**ALLOTYPE:** Female, same data as holotype but J. W. MacSwain, deposited in the California Academy of Sciences, on indefinite loan from the Essig Museum.

**PARATYPES:** Nevada, Clarke County, Riverside, May 11 and 27, 1983, F. D. and J. H. Parker (21 males, 3 females). Deposited in AMNH, UCB, and ASU. Same data (7 males, 4 females); California, Inyo County, approximately 5 miles south Deep Springs College, July 11, 1967, Saul and Suzy Frommer (1 male, 1 female); Arizona, Mohave County at 8 miles east of Mesquite, Nevada, April 26, 1973, F. Parker and P. Torchio (2 males, 1 female). Paratypes deposited in UCR, NSDA, and USU. See map 6.

**ETYMOLOGY:** From the Latin *auratus* meaning golden in reference to the golden abdominal pile.

**ECOLOGY:** The only ecological data on this species is on the labels of the paratype specimens collected by Mr. and Mrs. Frommer south of Deep Springs College, Inyo County, California. These labels indicate that the species was collected on an "alkaline flat" and evidently were on plants belonging to the genera *Sarcobatus*, *Atriplex* and *Dalea*. Neither of the specimens showed any traces of pollen grains.

**VARIABILITY:** In general appearance, size, and shape there is little variability in the paratopotype series. The dark maculations vary somewhat in size but are confined to the middorsum of the tergites in the males. The

holotype and two female paratopotypes are as described, however, in the fourth specimen the maculations and basic orange color are as in the males. The nine males in which the terminalia were opened show little or no variability in this structure.

**RELATIONSHIPS:** As indicated in the key *auratus* is separated from *episcopus* by the color of the hemitergites and legs. However, they would appear to be only distantly related because of their widely disjunct distributions. *Rhaphiomidas episcopus* is known only from the southernmost portions of Baja California Sur, Mexico and exhibits a great deal more variability than does *auratus*. In color, size, and markings *auratus* is more like the Baja California *xanthos* but is easily separated not only by its disjunct distribution but also by its narrower tarsal pulvilli, more widely separated compound eyes and more elongate third antennal segment.

#### *Rhaphiomidas aitkeni* Cazier

Figure 36; Map 6

*Rhaphiomidas aitkeni* Cazier, 1941, pp. 623–624.

**DIAGNOSIS:** Medium-sized, elongate, narrow, dark in appearance; head with compound eyes separated from the lateral ocelli on the vertex by about 1½ times the diameter of a lateral ocellus; mouthparts with the proboscis ranging in length between 8.4 mm and 10.6 mm, averaging 9.0 mm; third antennal segment orange, elongate, widest medially; abdominal segments one and two with black basal bands extending broadly from side to side, segments three through five with median dark maculations not or but narrowly reaching pleural dark areas, apical portion of each segment pale yellow (fig. 36); terminalia narrow, heart-shaped, uniformly pale brown, gonostyles extending posteriorly slightly beyond the middle of the hemitergites, hemitergites with inner, shallowly concave surface sericeous, without spines or carinae, apices broadly rounded, not attenuated or overlapping; posterior legs white macrochaetose; costal wing vein white or golden pilose throughout or except for extreme apex.

**REDESCRIPTION OF TYPE:** Male: **Head** with frons moderately densely clothed with long white pile, slightly darker toward vertex, sur-

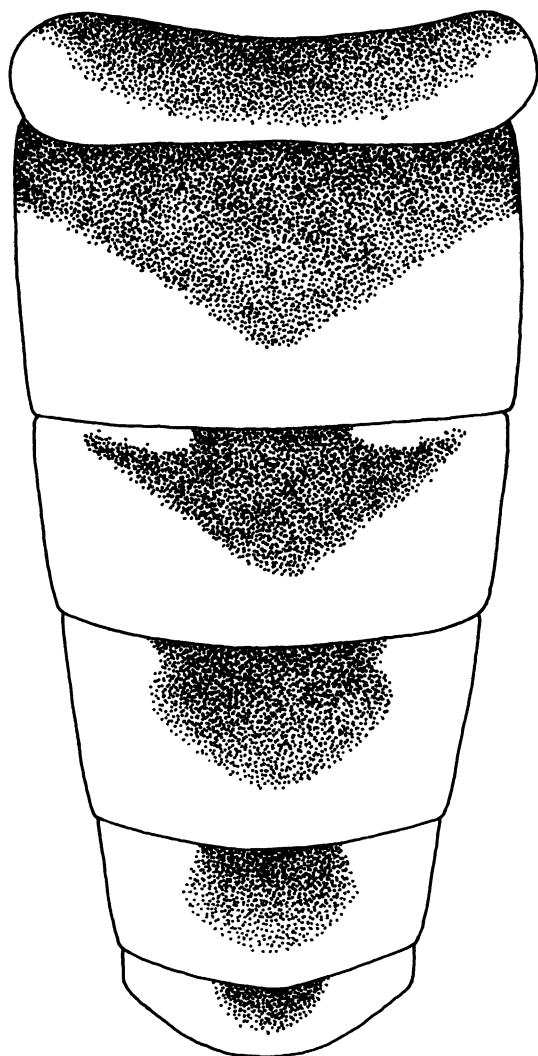


FIG. 36. *Rhaphiomidas aitkeni*. Dorsal view of abdominal tergites one through six in male.

face white pruinose; vertex between and behind ocelli pale yellowish pilose; posterior surface bare and densely white pruinose in narrow band bordering posterior margin of compound eyes, median portion densely clothed with long erect white pile, long erect white macrochaetae mixed in with dense white pile; compound eyes separated from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the width of a lateral ocellus; antennae (broken) with segments one and two dark brown, sparsely irregularly white pruinose, sparsely clothed with long white erect macrochaetae,

third segment bare, orange, elongate, widest medially, with widened basal ring at junction with segment two, little longer than segments one and two combined; mouthparts with palpi short, dark, inconspicuous, sparsely clothed with long white narrow macrochaetae, proboscis about 10.6 mm in length. **Thorax** with humeral callosities deeply acutely incised posteriorly, surface gray pruinose, moderately densely clothed with long white hair, sparsely white macrochaetose; mesonotum with a partially divided median longitudinal dark vitta and two lateral vittae, one on each side, discal surface brownish pruinose, lateral margins gray pruinose, pile pale yellowish white, lateral marginal macrochaetae white, posterior lateral angles (post-alar callosities) tumid, prominent, white pilose and macrochaetose; wings with costal vein white pilose in basal half; scutellum deeply delimited from posterior mesonotal margin, transverse groove sharply defined, lateral margins rounded, posterior margin shallowly evenly rounded, surface and margins sparsely white pilose, posterior submarginal macrochaetae white; mesopleural sclerites gray pruinose, dorsocaudal angle and basallare densely long white pilose, supraepimeron bare except for sparse white pile on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gradually constricted to acute apical point. **Legs** not enlarged, bicolored, coxae and basal two-thirds of femora black or dark brown, apical third of femora, all of tibiae and tarsi pale yellow, macrochaetae and pile on all parts of all legs white; tarsal pulvilli large, subparallel-sided, enlarged apically, extending to apical quarter of claws. **Abdomen** with tergites primarily black, densely clothed with long, erect, white pile giving it a dusty appearance; tergite one black with narrow yellow posterior border; tergite two black in basal half, black expanded gradually at middle toward but not reaching posterior margin, broadly connected laterally to pleural black area, apical half pale yellow; tergite three with median black area narrowly connected to pleural areas (fig. 36); tergites four and five with median halfmoon-shaped marking not reaching pleural areas; sternites two and three primarily pale yellow, slightly darkened medially; sternite four dark basally; sternites five through seven primarily yellow; sternum



sparsely clothed with long erect white pile. **Terminalia** short, narrow, heart-shaped, uniformly light brown except for narrow dark dorsal margins, densely clothed with short erect white and golden pile; hemitergites broadly rounded apically, not overlapping, inner surface shallowly concave, sericeous, impunctate, sparsely pilose along ventral margin; ninth sternite shallowly convex, posterior margin deeply notched medially between bases of gonostyles, surface clothed with long golden pile; gonostyles extending posteriorly to apical quarter of hemitergites, lateral posterior extensions finger-like, rounded, slightly curved inward apically, gradually narrowing from base to bluntly rounded apex, sparsely golden pilose; interbasal folds short, two-segmented, bluntly rounded, extending from base parallel to gonostyles, apical third narrowly separated from gonostyle, ventral surface shallowly concave, dorsal surface convex, sparsely golden pilose; aedeagus projecting medially through basal membrane connecting the gonostyles, ventral to membranous anal tube, base greatly enlarged, narrowing abruptly into dorsally curved rounded tube, apex ending obliquely, open. Length 21 mm; mesonotal width 5.3 mm (redescription of holotype).

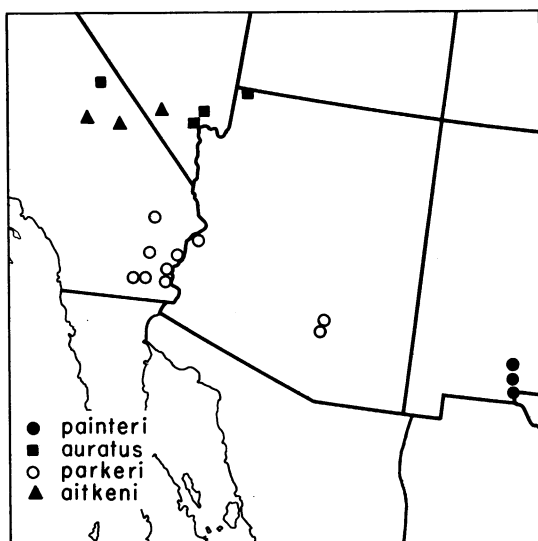
**FEMALE:** Similar to the male except for the usual sexual differences, the costal wing vein is black pilose except for the extreme base, the black areas on tergites two through four are more than half the width of the segments and not or shallowly expanded medially, the dorsum of the anterior and posterior femora are partially black pilose. Length 24 mm; mesonotal width 7.5 mm.

**HOLOTYPE:** Male, California, Inyo County, Panamint Mountains, May 29, 1937, T. G. Aitken, in California Academy of Sciences, no. 4721.

**DISTRIBUTION:** CALIFORNIA: **Inyo County:** 12 miles east Keeler, Highway 190, May 28, 1980, T. W. Schoener, C. A. Toft (2 males, 1 female); Nevada, Nye County, Brigham Young University, AEC-NTS, Mercury, July 15, 1962 (1 male). See map 6.

**ECOLOGY:** No information available.

**VARIABILITY:** The two males from 12 miles east of Keeler are like the holotype in most respects but the abdominal dark markings are reduced in size and on tergites three through



MAP 6. Distributions of *Rhaphiomidas* sp.: *R. painteri*, *auratus*, *parkeri*, *aitkeni*.

seven they do not extend laterally along the base to the pleural areas, there are no dark areas along the pleural suture. In one specimen the median middorsal dark maculations are reduced to small somewhat linear spots. The length in the two specimens ranges from 23.2 mm to about 25.7 mm, or slightly longer than the holotype which is 21.0 mm. The single known female of this species, also from 12 miles east of Keeler, is as given in the description.

**RELATIONSHIPS:** *Rhaphiomidas aitkeni* appears to be most closely related to *terminatus terminatus* and *terminatus abdominalis* but can be distinguished as discussed under the former subspecies. From *acton maehleri*, which also is found in Inyo County although not sympatrically, *aitkeni* can be separated by its smaller size, narrow shape, small narrow terminalia, the extensive dark abdominal maculations and the pale yellow abdominal bands (fig. 36). Both *acton acton* and *acton maehleri* are large and robust, the terminalia are large, the dark abdominal maculations are confined to small middorsal spots (males) and the basic color is orange rather than pale yellow. Superficially *aitkeni* resembles the heavily maculated forms of *hasbroucki* but the two are easily separated by the presence of the subdorsal longitudinal carina on the hemitergite inner surface below

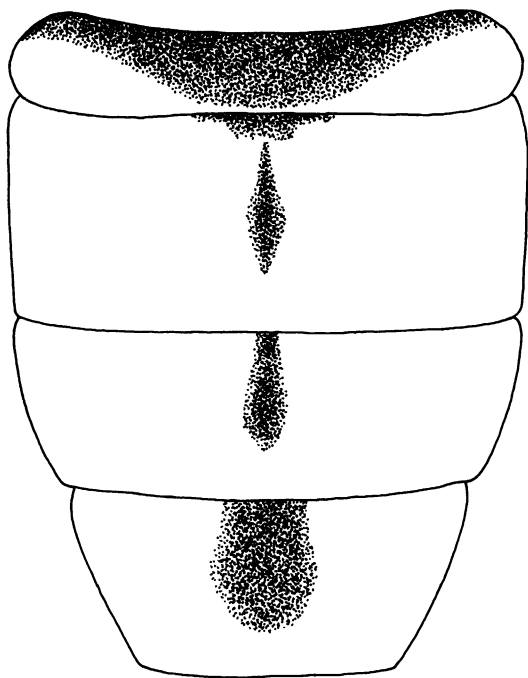


FIG. 37. *Rhaphiomidas acton acton*. Dorsal view of abdominal tergites one through four in female.

the sutural margin (fig. 20) and the small narrow tarsal pulvilli in *hasbroucki*. In *aitkeni* there is no carina on the inner hemitergite surface and the tarsal pulvilli are large and wide.

*Rhaphiomidas acton acton* Coquillett,  
new combination  
Figure 37; Map 7

*Rhaphiomidas acton* Coquillett, 1891, p. 85.

**DIAGNOSIS:** Large-sized, robust, abdomen primarily orange, small black maculations located medially on tergites; mouthparts with proboscis long, ranging from 11.4 mm to 14.4 mm, averaging 13.2 mm in length; third antennal segment elongate, widest about middle; terminalia robust, heart-shaped, hemitergites not attenuated apically, inner surface without spines or carinae, orange in color; compound eyes separated from the lateral ocelli on the vertex by more than the width of a lateral ocellus; anterior tarsal segments without ventral arolia, posterior tibiae and usually the first tarsal segment with short,

black, erect, ventral spines; abdominal segment one with orange apical border, mid-dorsal black maculations small, increasing in size posteriorly to tergite five (fig. 37); both sexes similar in color and maculations, monochromatic.

**REDESCRIPTION:** Male: **Head** with frons white pruinose, long moderately densely white pilose including vertex, facies long white pilose; posterior surface white pruinose, narrow bare pruinose band bordering posterior margin of compound eyes, median surface long, densely white pilose, submarginal macrochaetae white; compound eyes separated from lateral ocelli on vertex by about  $1\frac{1}{2}$  times the diameter of a lateral ocellus; antennae with segments one and two piceous, sparsely white pruinose, pilose and macrochaetose, macrochaetae on second segment arranged in a median transverse row, third segment bare, orange with dark infuscations, elongate, widest medially, about  $1\frac{1}{2}$  times longer than segments one and two combined, apex bluntly rounded, basal ring prominent, white pruinose; mouthparts with palpi piceous, sparsely long white pilose, proboscis long 13.0 mm. **Thorax** with humeral callosities prominent, deeply incised posteriorly, densely off-white pilose and gray pruinose, sparsely off-white macrochaetose; mesonotum with median longitudinal black vitta extending from anterior margin to basal quarter, divided medially in anterior quarter, wide lateral vittae extending from behind humeral callosity, slightly diagonally inward almost to posterior margin, interrupted narrowly in basal quarter, surface gray pruinose except for black vittae, moderately densely brownish pilose, pile longer and more dense along margins, lateral marginal macrochaetae white, postalar callosities not prominent, sparsely white pilose and macrochaetose; wings with costal vein whitish pilose in basal quarter, short black pilose apically; scutellum deeply, acutely delimited from posterior mesonotal margin, transverse groove sharply defined, partly obscured by long light-colored hair from mesonotal margin, lateral margins shallowly emarginate, apical margin shallowly evenly rounded, surface moderately densely clothed with long brownish erect pile, submarginal macrochaetae whitish; mesopleura gray pruinose, dorsocaudal angle and basallare

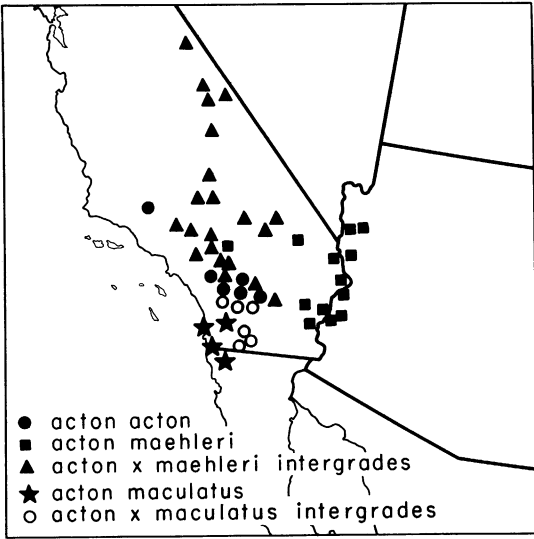
densely off-white pilose, supraepimeron bare except for sparse long hairs on dorsoanterior angle, infraepimeron bare; postnotal conical swellings gray pruinose, gradually constricted from base to acutely pointed apex. **Legs** not enlarged, coxae black, gray pruinose, densely long whitish pilose, femora, tibiae and tarsi unicolorous orange as on abdomen, anterior femora with faint irregular darkish infuscations near base, moderately densely clothed with golden pile, macrochaetae white, inner margins (toward femora) of middle and posterior tibiae and first tarsal segments with rows or scattered short black spines, exclusive of white macrochaetae, tibiae with single irregular row, first tarsal segment with double row of spines; tarsal pulvilli large, spatulate, extending to apical quarter of tarsal claws. **Abdomen** primarily orange with small black middorsal maculations on tergites, tergite one primarily orange, apical orange transverse vitta narrow medially, broadly expanded laterally, surface moderately densely clothed with long whitish pile, more dense and longer laterally, hair prominently extending beyond apical tergite margin, overlapping basal black vitta on tergite two, tergite two with narrow basal black transverse vitta covering about basal quarter of tergite, narrowly expanded medially into rounded posterior projection extending slightly beyond middle of tergite, remainder orange, segments three through five orange except for middorsal small basal rounded black spots, extending posteriorly to about middle of segment, maculation on tergite three smallest, those on tergites four and five larger and subequal, dorsal pile short, recumbent, longer more erect laterally, discal hairs on tergites two and three not reaching apical margin of tergites, those on tergite four barely reaching border, those on tergite five extending prominently beyond apical border, tergites six and seven hidden beneath tergite five, sternites orange, sparsely golden pilose. **Terminalia** orange, robust, wide basally, extending laterally beyond width of tergites five through seven, surface moderately densely short erect golden pilose, hemitergites with sutural margins slightly emarginate before apex, dorsoapical angles broadly evenly rounded, ventral apical angles abrupt right angles, projecting slightly below ventral margins, ventral margins shallowly rounded to

base, apices not overlapping, inner surface shallowly concave in apical half, nearly flat basally, opaque, glabrous, ninth sternite moderately convex basally, lateral margins expanded basally, moderately densely clothed with long golden pile, posterior margin obtusely notched medially between bases of gonostyles; gonostyles extending posteriorly to about apical third of hemitergites, lateral arms rounded, shallowly bowed medially, tips extending slightly inward, sparsely golden pilose; interbasal folds short, two-segmented, narrowly separated from gonostyles at tips, dorsal surface rounded, convex, ventral surface shallowly concave, apices bluntly rounded; aedeagus projecting medially through membrane connecting dististyles basally, lying ventrally to membranous anal tube, base greatly enlarged, dorsal surface shallowly concave along median line, gradually narrowed apically into rounded tube, tube bent gradually upward, apex obliquely open. Length 27.0 mm; mesonotal width 7.0 mm. Redescribed from a specimen collected 1 mile west of Frazer Park, Kern County, California, July 3, 1962 by Eric Fisher. The series of seven males and three females is monochromatic and the location is fairly close to the northern part of Los Angeles County, the type locality of *acton*.

**FEMALE:** Similar to the male except for the usual secondary sexual characters, its more robust form especially of the abdomen (fig. 37), its lighter orange color and its lack of the short black stout spines on the inner surfaces of the middle and posterior tibiae and first tarsal segments. Length 26.8 mm; mesonotal width 7.5 mm. Redescribed from a female in the series from Frazer Park as noted above for the male.

**TYPE MATERIAL:** The type locality was given by Coquillett as the northern part of Los Angeles County, California, July. In this general area there is the town of Acton, after which Coquillett may have named the species since the name *acton* does not appear to be of Latin or Greek origin.

**DISTRIBUTION:** Those locations from which only monochromatic and monomaculate females are known are listed under *acton acton*. Where only males are known from a location its inclusion is based on the classification of females from adjacent samples. Locations in



MAP 7. Distributions of *Rhabdomidas* sp.: *R. acton acton*, *acton maehleri*, *acton x maehleri* intergrades, *acton maculatus*, *acton x maculatus* intergrades.

which intergrades between *acton acton* and *acton maehleri* are exhibited are listed separately. Again, locations from which only males are known are classified according to females from closely adjacent locations. Those locations from which only dichromatic and dimaculate females are known are listed under *acton maehleri*.

*Rhabdomidas acton acton*. CALIFORNIA: **Riverside County**: Banning, June 27, 1952, on *Eriogonum* sp., S. Miyagawa (1 male); Morongo, May 23, 1932, C. M. Dammers (14 males); Colton, June, F. A. Eddy (1 male); Pinyon Flats, San Jacinto Mountains, June 17, 1952, M. Cazier, W. Gertsch, R. Schrammel (4 males, 3 females); Palm Springs, May 31, 1943, J. Wilcox (1 female); Pinyon Flats, 4000 feet, June 13, 1966, W. W. Middlekauff, D. C. Rentz (4 males, 3 females); Palm Canyon, June 11, 1940, on *Eriogonum* sp. (1 male); Palm Springs, May 3, 1952, F. B. Turner (1 female); Banning, July 22, 1957, J. Linsley (1 female); Pinyon Flats, July 2, 1958, M. Charles Cushner (4 males, 2 females); Palm Springs, May 11, 1952, Norma Lewis (1 male); Anza, June 23, 1949, Simonds (3 males, 2 females); Pinyon Flats, June 18, 1941, E. C. Van Dyke (1 male); foot of grade to Idyllwild, San Jacinto Mountains,

June 13, 1941, E. C. Van Dyke (1 male); Caliente, June 18, 1884, W. G. Wright (1 female); Palm Desert, June 18, 1952, R. X. Schick (1 male); Indio, May 17, 1949, L. D. Anderson (1 female); Rim of Deep Canyon, 4500 feet, June 27, 1965, G. R. Ballner (1 female); Anza, June 30, 1957, H. R. Moffitt (2 males, 1 female); 3.5 miles South Palm Desert (Desert Research Center), May 10–12, 1978, Malaise trap, P. L. Boyd (1 female); sec. 19, T6S, R6E, 2800 feet, northeast of Black Hill, on *Salvia apiana*, white sage, G. R. Ballmer (1 female); Banning, July 2, 1952, S. Miyagawa, A. A. Grigarick (2 females); Banning, June 27, 1952, R. L. Anderson, D. S. Thompson (3 females). See map 7.

Locations of intergrading or mixed samples between *acton acton* and *acton maehleri*. CALIFORNIA: **Kern County**: 1 mile west Frazer Park, July 3, 1962, Eric Fisher (7 males, 3 females); West Mojave River, Mojave Desert, July 1, 1937, R. Miller (1 male); Red Rock Canyon, July 4, 1962, W. E. Simonds (1 male, 3 females); 5 miles northwest Garlock, June 12, 1969, D. M. Martin (1 female); Saltdale, July 26, 1947, R. H. Beamer (1 female); **Mono County**: Mono Lake, July 11, 1937, J. A. Comstock (1 female); **Inyo County**: Andrews Camp, Bishop Creek, July 1, 1935, Lloyd Martin (5 males); 7.3 miles west Lone Pine, July 11, 1965, Ballmer and Bath (5 males); Lone Pine Canyon, July 16, 1949, R. A. Flock (1 female); 7 and 10 miles north Parcher's Camp, June 30, 1961, D. R. Miller, J. S. Buckett (13 males, 6 females); 10 miles north Parcher's Camp, June 30, 1961, J. Powell, G. I. Stage (25 males, 13 females); Big Pine Creek, 4500 feet, June 23, 1942, R. Bohart (4 males); Antelope Springs, July 8, 1978, James O'Grady (1 male); Nelson Range, July 9, 1978, James O'Grady (4 males); **Los Angeles County**: Palmdale, September 6, 1952, J. N. Belkin (1 male); 2 miles south Lancaster, July 15, 1974, F. Hojore (1 male, 1 female); Juniper Hills, Mojave Desert, July 1, 1965, C. Henne (2 males, 1 female); 0.5 miles west Lockheed Hanger, Palmdale, August 12, 1974 (7 males, 2 females); Palmdale, August 6, 1962 Sugerman (5 males, 2 females); ranch 2.5 miles south southwest Valyermo, 4800 feet, July 10, 1967, Noel McFarland (10 males, 4 females); Juniper Hills–Pearblossom, July 22, 1962, 3700 feet,

in refuse area (1 male); Devils Punch Bowl County Park, July 16–20, 1963, P. H. Sullivan (2 females); Lancaster, September 6, 1962, W. D. Dyer (1 female); 1 mile northwest Junction 138 and north 4, June 22, 1974, Joseph Cicero (1 male); Palmdale, August 7, 1966, R. L. Westcott (8 males, 7 females); Mojave Desert, July 20, 1930, C. H. Martin (1 male); Big Pine Creek, near Valyermo, June 16, 1966, J. Robertson (2 females); Valyermo, June 1958 (1 female); 2.5 miles southwest and south southwest Valyermo, August 10, 1962, 4800 feet, Noel McFarland, on *Gilia eremica* (1 male, 5 females); 2 miles south of Pearblossom, 3500 feet, August 1979, D. Henne, dead on ground (1 female); Big Rock Creek, 5000 feet, July 10, 1965 (1 male); Palmdale, August 1, 1935 (1 female); Pa-coima, May (1 male): **San Bernardino County:** Top of Cajon Pass, June 30, 1941, E. C. Van Dyke (2 males); 7.7 miles northwest Cajon, Cajon Canyon, July 5, 1964, R. R. Snelling (1 female); 4 miles north Cajon Junction, July 4, 1958, J. C. Hall, E. I. Schlinger (15 males, 4 females); Cajon, August 9, 1944, A. L. Melander (1 female); Yermo, May 23, 1940, W. Reeves, M. Cazier, P. C. Ting (1 male); Cajon Valley, July 14 and 22, 1932, C. M. Dammers (3 males, 2 females); Yermo, May 10, 1937, R. H. Andrews (1 male); Desert Springs, June 22, 1958, Paul H. Arnaud (1 male, 2 females); Yermo, May 28, 1964, on twig, K. R. Swim (1 male); Desert Springs, August 3, 1958, G. H. Nelson, on *Eriogonum fasciculatum*, flying to blossoms, 4000 feet (1 female); Yermo, June 2, 1941, E. C. Van Dyke (1 male); Cajon Valley, July 13, 1938 (1 male); Cajon Pass, July 16, 1949, L. D. Anderson, H. T. Reynolds (3 males, 2 females); East Highland, July 16–17, 1975, J. C. and B. M. Hall (3 males, 3 females); Summit Valley, July 26, 1978, J. C. Hall (1 female); Pinyon Hills, July 11, 1965, D. S. Verity (1 female); 8 miles east San Bernardino, June 19, 1952, A. T. McClay (1 male); 3 miles south Cronise Lake, May 27–28, 1978, James O'Grady (3 males, 3 females); Afton Canyon, May 21, 1978, James O'Grady (2 males); Phelan, June 26, 1937, K. L. Maehler (3 males, 10 females); Victorville, June 24, 1937, K. L. Maehler (1 male); Phelan, June 27, 1952, R. H. and L. D. Beamer, W. LaBerge, A. Wolf, C. Liang, C. Weiner (16 males, 1 female);

Phelan, October 27, 1951, on *Salvia victo-sa* = *riparia* (4 males); Cushinbury Springs, August 19, 1934, C. D. Michener (1 male); **Riverside County:** Mecca, April 25, 1952 (1 female); Palm Springs, May 8, 1927 (2 females); San Jacinto Mountains, July 21, 1929, L. D. Anderson (1 female); 2 miles west Desert Hot Springs, May 17, 1973, Menke and Miller (31 males, 6 females); Palm Springs, May 6, 1946, A. L. Melander (1 male). See map 7.

For the zone of intergradation between *acton acton* and *acton maculatus* see the discussion under the latter subspecies.

The zone of mixed and intergrading samples between *acton* and *maehleri* extends from extreme northern Inyo County south to western Riverside County. The northernmost record for this polytypic species is a female specimen collected at Mono Lake, Mono County, California which, phenotypically, is like *maehleri* (fig. 40). However, the material from Inyo County, to the south and separating Mono Lake from the rest of the *maehleri* samples along the Colorado River, are mixed and more properly belong in the zone of intergradation. These nine northern Inyo County samples contain 57 males and 20 females the latter exhibiting gradations between 13 specimens favoring *maehleri* (fig. 40) and seven specimens tending more toward *acton* (fig. 37). In three samples from northeastern Kern County comprising one male and five females, three of the females resemble *acton* and two are more like typical *maehleri*. In a single sample from southwestern Kern County containing seven males and three females, two females are like *acton*, whereas the third appears dark and broadly vittate as in *maehleri*.

Samples from 18 locations in northern Los Angeles County, the type locality of *acton*, comprise 39 males and 30 females the latter containing 16 specimens referable to *acton*, 14 specimens as in typical *maehleri* including eight specimens that are intermediate between the two extremes. Five collections made at Palmdale, located only about 10 miles northeast of the town of Acton, contain 12 females of which five are typical *acton* and seven are intermediate between *acton* and *maehleri* with no specimens of typical *maehleri* represented. Five collections made at or

near Valyermo contain 21 individuals, 10 males and 11 females, six of the females being assignable to *maehleri* and five to *acton* with no definite intermediates. This location is only about 20 miles west of Phelan, San Bernardino County, the type locality of *maehleri* where the sample of 11 females were all heavily vittate and pale in color, as in *maehleri*. Also, in five additional collections from Phelan containing 23 males and two females the latter were *maehleri*. Three females from nearby Desert Springs were *maehleri*. However, in seven collections from about 20 miles southeast of Phelan, in the vicinity of Cajon, there were 24 males and 10 females, four of which were *acton* and six were intermediates or assignable to *maehleri*. In the extensive area northeast of Phelan, between Victorville and Cronise Lake, four collections containing 10 males and three females are all typical *acton*. Additional collections of females from this area will, in all probability, contain females assignable to *maehleri* or intergrades between *acton* and *maehleri*. South of the Cajon area, near the San Bernardino County border with Riverside County, at or near Colton and Highland, five small collections containing five males and five females represent only *acton* which is consistent with many of the western Riverside County samples.

In the western half of Riverside County, from Mecca northwest to Banning, 33 samples from 16 locations have been studied. These samples were composed of 87 males and 32 females and nine of them contained only females of *acton* and four were mixed with *acton*, intergrades and *maehleri*. In the latter samples one female was intermediate between *maehleri* and *acton*, one was typical *acton* and two were assignable to *maehleri*. From the nearby San Jacinto Mountains one large female represented *maehleri* and from 2 miles west of Desert Hot Springs two of the six females were *acton* and four were intermediates between *acton* and *maehleri*. The single female from Mecca is pale in color and the abdomen is broadly, transversely, vittate as in *maehleri*. The eastern half of Riverside County, beginning at Hopkins Well, is populated only with *maehleri*. Although no specimens from the 58 miles separating Mecca and Hopkins Well have been available I would

suspect that intermediates will eventually be found there (figs. 37, 40).

**ECOLOGY:** The only information available are notes on some specimens as to the collecting situation. Several specimens were collected in a "refuse area" at Juniper Hills, two males were collected on *Eriogonum* species at Banning and Palm Canyon, one female was taken from a Malaise trap at South Palm Desert, another female was taken on *Salvia apiana* northeast of Black Hill, one male was taken on a dead twig at Yermo, at Desert Springs a female was caught as she flew into the blossoms of *Eriogonum fasciculatum* and at 2.5 miles south southwest of Valyermo one male and five females were found on *Gilia eremica*.

**VARIABILITY:** This ubiquitous polymorphic species has the most extensive distributional range and more structural and color variability than any other species in the genus. Also, more material has been available for study from many locations. In this treatment I have recognized three subspecies, *acton acton*, *acton maehleri*, and *acton maculatus* which are geographical variants that I believe merit recognition, especially the first two. In typical *acton acton*, such as represented by the Pinyon Flat series, the males vary from having the abdomen nearly immaculate to having black middorsal markings on all tergites, these markings get progressively larger from tergites two through six in both sexes, the size varies from about 23 mm to 30 mm, the pile varies in color from off-white to light orange, the short dark spines on the inner surface of the first tarsal segment and tibiae of the posterior legs may be numerous and arranged in regular rows (usually two) or they may be few and irregular in arrangement and occasionally light in color instead of black. The posterior femora are usually primarily dark but this pigmentation varies in extent in occasional specimens from scattered locations. There is less extensive variability in most characteristics of this species occurring independently of other features such as ecology, seasonal activity, or geographical distribution. The exceptions to this occur in the subspecies herein recognized.

**RELATIONSHIPS:** Superficially *acton acton*

resembles *undulatus*, with which it was found mixed in several collections. However, males of *undulatus* have longer hemitergites whose sutural margins are undulated from their base to apex and the gonostyles are shorter (fig. 18). In its large size, orange coloration, and abdominal maculation it closely resembles *acton acton* (fig. 37) and the females of the two are inseparable at the moment except by association with the males. Also, *acton*, *nigricaudis*, and *undulatus* all have the short dark spines on the inner margin of the hind tibiae and tarsi in the males (fig. 39). The presence of these spines will separate *acton*, *nigricaudis*, and *undulatus* from the smaller *auratus* and *aitkeni* which they resemble, and the black with orange-bordered hemitergites in *nigricaudis* (fig. 33) will separate it from all four of the other species and subspecies. For further information see the relationship discussion under *nigricaudis*.

*Rhaphiomidas acton maehleri* Cazier,  
new combination  
Figures 38–40; Map 7

*Rhaphiomidas maehleri* Cazier, 1941, pp. 627–628.

**DIAGNOSIS:** The same or similar to *acton acton* except for the difference in distribution (map 7), and the sexual dichromatism and dimaculatism in this subspecies (figs. 37, 40). In the females of *acton maehleri* abdominal segments two through four are pale yellow or cream-colored apically and usually with broad or narrow black transverse basal vittae which are usually widest medially (fig. 40). If the dark maculations are reduced to middorsal spots, these are largest on the basal segments.

**REDESCRIPTION:** Male: See the redescription of the male of *acton acton*. The female is similar to the females of *acton acton* except as noted above in the diagnosis.

**DISCUSSION:** In 1941 when *maehleri* was described only limited material was available for study and phenotypically the type series from Phelan exhibited little individual variability and no tendency for the females to grade into those of *acton*, even though the latter species was known from locations in nearby Los Angeles County. Those specimens listed from additional localities, Cush-

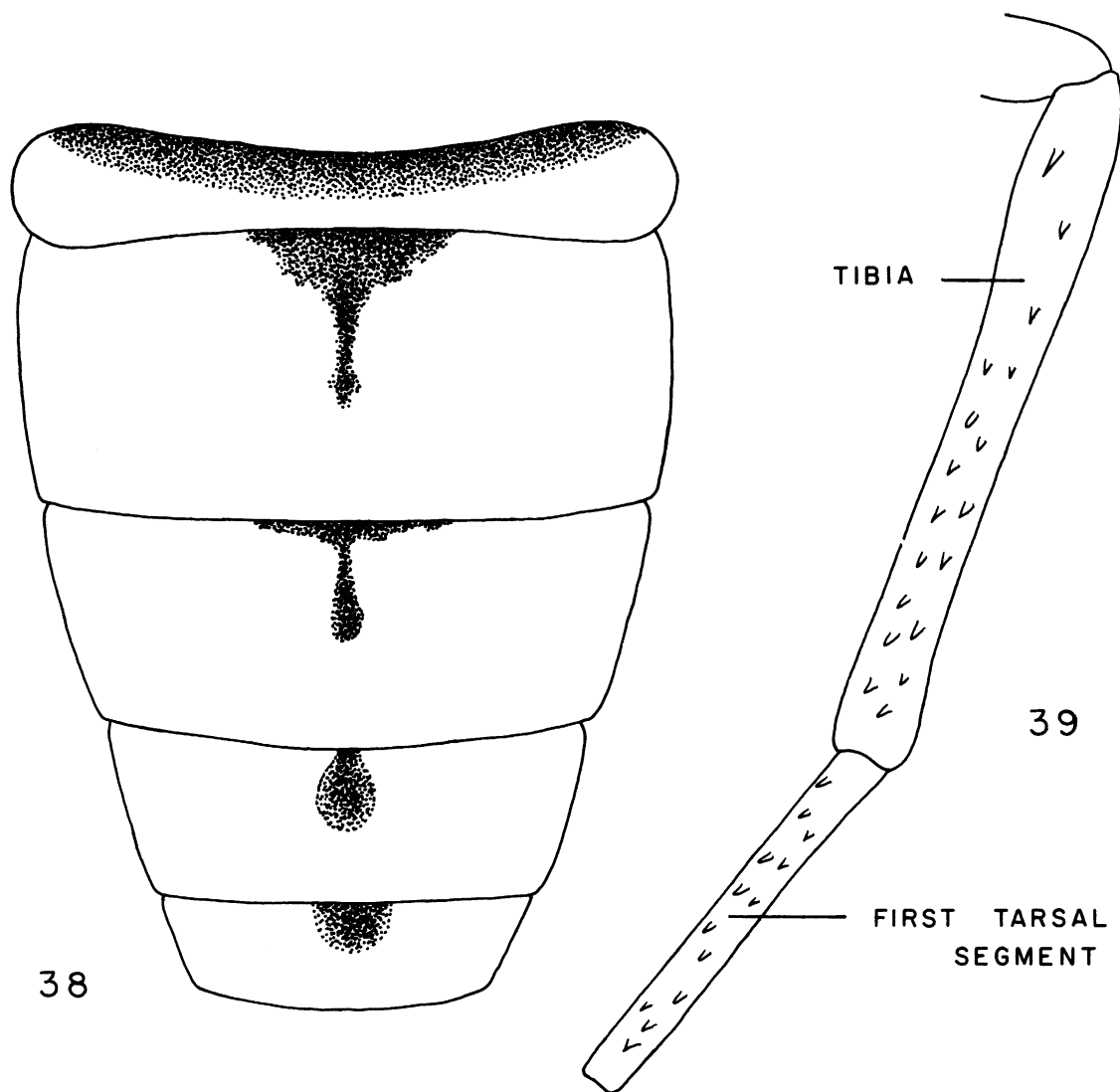
inbury Springs, Cajon Valley and North Fork of Bishop Creek, just happened to agree with the Phelan series in being sexually dichromatic and with the female abdomens broadly, transversely banded with a dark basal vitta on each segment. Additional specimens from numerous locations demonstrate that *maehleri* intergrades with *acton* over a considerable extent of their adjacent distributions (map 7). Also, that within this intergradation range there are local samples that, with our present knowledge, appear to be either *acton* or *maehleri* without known intermediates. The type locations of both *maehleri* and *acton* are in areas which are surrounded by locations where intergrades have been taken. If the type location of *acton* is indeed near the town of Acton, this location is narrowly separated (10 miles) from the zone of intergradation and the available samples from several adjacent locations are sexually dichromatic. See the discussion under *acton acton* for more details.

**HOLOTYPE:** Male, California, San Bernardino County, Phelan, June 26, 1937, K. L. Maehler, J. H. Robinson, no. 4751 in the California Academy of Sciences, San Francisco.

**ALLOTYPE:** Female, same data as holotype, no. 4752 in the California Academy of Sciences.

**PARATOPOTYPES:** Same data as holotype (17 males, 10 females).

**DISTRIBUTION:** Only those locations from sexually dichromatic and dimaculate samples are known are listed here. The localities of intergradation are listed under *acton acton* and are based only on the females. Locations from which only males are known are so indicated and are placed under names appropriate with evidence from adjacent samples. **CALIFORNIA: San Bernardino County:** 12 miles south Cadiz, April 30, 1978, James O'Grady (7 males, 6 females); Clark Valley, Colorado Desert, May 2, 1932, H. Gentry (1 female); Needles, April 25, 1949, C. D. MacNeill (4 males); Parker Dam, April 26, 1949, C. D. MacNeill (1 female). **Imperial County:** 3 miles south Palo Verde, April 8, 1949, P. D. Hurd (1 male, 1 female); Palo Verde, April 1, 1968, R. M. Bohart (1 male). **Riverside County:** Hopkins Well, April 27,



FIGS. 38–39. *Rhaphiomidas acton maehleri*. 38. Dorsal view of abdominal tergites one through five in male. 39. Middle tibia and first tarsal segment in male.

1949, J. E. Gillaspay, L. W. Quate, on *Gaerea canescens* (4 males, 1 female); same location, April 25–27, 1952, J. G. Rozen (1 male, 1 female); same location, April 16, 1958, P. D. Hurd (2 males, 4 females); Blythe, April 18, 1937, F. H. Parker (1 female paratype); same location, April 19, 1979, James O'Grady (1 male); same location April 1979, Phillip Le Feuvre (1 male, 1 female); 18 miles north Blythe, July 1958 (2 males, 1 female); 18 miles west Blythe, April 27, 1958, G. H. Nelson (1 female). ARIZONA: Yuma County: 8 miles

southeast Parker, April 22, 1966, J. H. and J. M. Davidson, M. Cazier (28 males, 8 females); 6 miles southeast Parker, April 23 and May 7, 1966, J. H. and J. M. Davidson, M. Cazier (8 males, 1 female); 20 miles north Quartzsite, April 23, 1966, J. H. and J. M. Davidson, M. Cazier (1 male, 1 female); Ehrenberg, April 26, 1939, F. H. Parker (1 male); Mesa Station, April 18, 1960, D. Mose (1 female). Mohave County: 12.6 miles southeast Yucca, May 29, 1969, J. Bigelow, M. Cazier (5 males); 14 miles south Davis Dam,



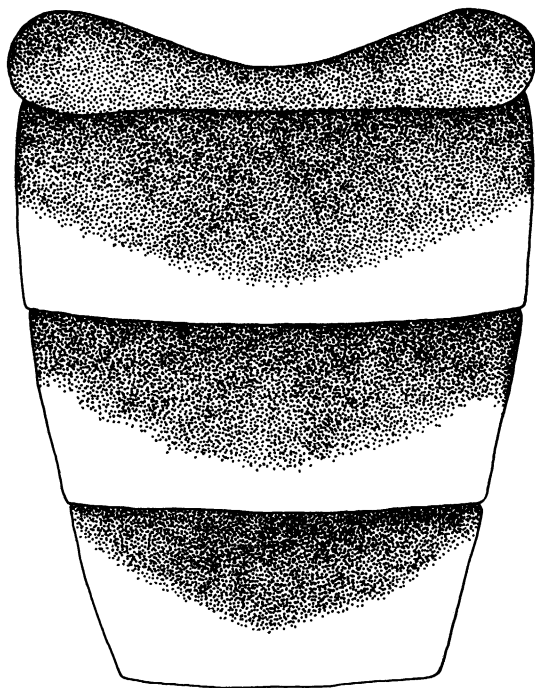


FIG. 40. *Rhaphiomidas acton maehleri*. Dorsal view of abdominal tergites one through four in female.

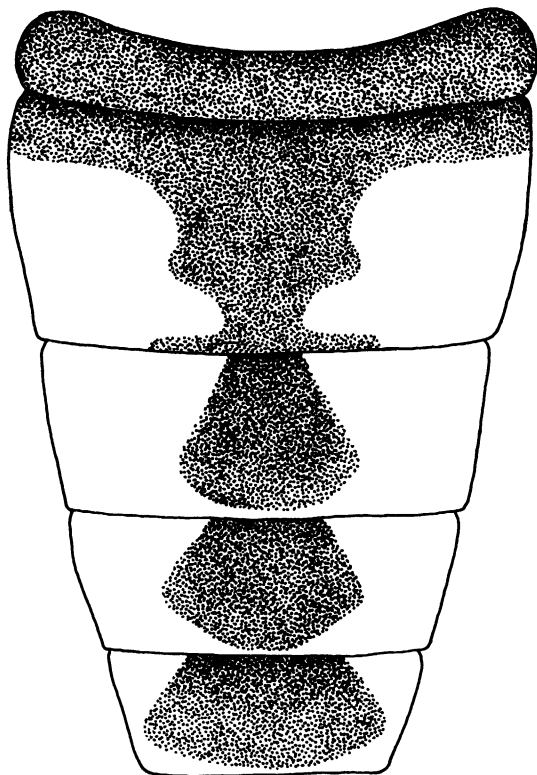


FIG. 41. *Rhaphiomidas acton maculatus*. Dorsal view of abdominal tergites one through five in male.

April 14, 1973, Mark Ebertz (1 male, 1 female); Kingman, June 1, 1979, A. Boehme (1 male). See map 7.

*Rhaphiomidas acton maculatus*, Cazier,  
new combination  
Figure 41; Map 7

*Rhaphiomidas maculatus* Cazier, 1941, pp. 628–629.

**DIAGNOSIS:** The same or similar to *acton* except for the differences in distribution (map 7), the usual coloration of the dorsum of the first abdominal segment, the larger middorsal abdominal dark markings (fig. 41), the longer deep golden or orange pile. In *maculatus* the first abdominal segment is usually black at least medially, whereas in both *acton* and *maehleri* it is primarily orange or yellow (figs. 37, 38, 40). In *maculatus* the abdominal mid-dorsal dark markings are always present and much larger than in fully maculated males of either *acton* or *maehleri* (fig. 41). The females of *acton* and *maculatus* are monochromatic and monomaculated with their males, where-

as in *maehleri* the sexes are dichromatic and dimaculate. In distribution this variation of *acton* is confined primarily to southwestern and central San Diego County, California and adjacent Baja California Norte, Mexico. Populations exhibiting intermediates between *maculatus* and *acton* have been found in northern San Diego County and southern Riverside County. See the section on distribution for more details.

**REDESCRIPTION:** Male and female: See the redescription of *acton* except for the differences noted above in the diagnosis and in the keys.

**HOLOTYPE:** Male, California, San Diego County, Coronado, June 20, 1890, Dr. F. E. Blaisdell, in the California Academy of Sciences, no. 4719.

**ALLOTYPE:** Female, same location as holotype but June 27, 1890, in the California Academy of Sciences, no. 4720.

**PARATYPES: CALIFORNIA: San Diego County:** Kearney Mesa, June 20, 1938, W. P. Medlav (2 males SDMNH, 1 male AMNH, author's collection); Torrey Pines, July 20, no year (1 female USNM).

**DISTRIBUTION:** Additional locations from which only typical *maculatus* are known will be listed initially. Locations from which intergrades with *acton* are known will be listed separately. **CALIFORNIA: San Diego County:** Oak Grove, June 22, 1966 (1 male); San Diego, June 17 and 26, 1938, C. Dammers (2 males); Del Mar, July 11, 1957, J. C. Hall (1 male); Cardiff, June 3, 1962 (1 female); Encinitas, June 30, 1966, D. K. Faulkner (1 female); Vallecito, Anza Borrego State Park, 1.25 miles north northwest Whaie Park, June 7, 1973 (1 male, 1 female); San Felipe Valley, July 6, 1940 and June 4, 1982, E. Haskins (1 male, 2 females). **MEXICO: Baja California Norte:** 12 miles north Meling Ranch, May 17, 1969, C. L. Hogue (7 males, 1 female); 11 miles west Meling Ranch, San Pedro Martir Mountains, May 19, 1969, Jim Robertson (1 male, 1 female); 2 miles southeast Condor, highway three, June 20, 1981, Faulkner and Brown (1 male); 6 miles east Ojos Negros, June 9, 1980, Brown and Faulkner (1 male). See map 7.

Locations from which intermediates between *maculatus* and *acton* are known: **CALIFORNIA: San Diego County:** 6 miles east Campo, July 4, 1965, D. S. Verity (2 males); Jacumba, June 21, 1966, 3180 feet, J. B. Heppner (1 male); 3 miles east Banner, June 12, 1958 (2 males); 4 miles west Jacumba, June 15, 1957 (4 males); 2 miles east Bou-

levard, June 15, 1957, R. L. Westcott (1 male). **Riverside County:** Aguanga, June 29, 1949, June 20, 1955, 2500 feet, on *Gilia* species, Simonds (19 males, 1 female); 1 mile east Aguanga, June 25, 1980, E. M. Fisher, at flowers of *Eriastrum densifolium* (3 males); 1.7 miles north Radec, June 29, 1976, A. J. Mayor, on flowers of *Eriastrum densifolium* (3 males, 1 female); 5.5 miles west Radec, June 28, 1976, A. J. Mayor, on *Eriastrum densifolium* (2 males); 6 miles west Radec, June 29, 1976, A. J. Mayor (1 female).

**ECOLOGY:** No information is available on the edaphic situations in which *maculatus* is found, but as noted above, they have been taken while visiting the flowers of *Gilia* species and *Eriastrum densifolium* both of which occur in sandy situations.

**VARIABILITY:** This subspecies exhibits variation similar to that observed in *acton acton* but in general is of a darker orange color and with longer darker body pile. The abdominal tergite dark markings are usually larger than in any *acton acton* specimens and the first abdominal tergite is more extensively dark (fig. 41) than in *acton acton*. However, in the zone of intergradation all intermediate conditions in all characteristics are to be found and its distributional characteristics as noted above are not as well defined nor as distinct as between *acton acton* and *acton maehleri*. To date, there is no evidence of intergradation or tendency in the females of *acton maculatus* to vary toward the bimaculate and bichromatic condition found in the females of *acton maehleri*.

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