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Descriptions of Three New Species of the Bee Genus *Calliopsis* (Hymenoptera, Andrenidae)

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The species below are described at the present time to make their names available for use in connection with biological studies recently completed on them. The species are closely related and belong in a group with *Calliopsis coloradensis* Cresson, *C. chlorops* Cockerell, and *C. coloratipes* Cockerell. Evidence for interspecific mating in the group is given.

The presence of all three new species, as well as others in their group, at the Southwestern Research Station of the American Museum of Natural History offers an unparalleled opportunity for the study of ecological differentiation in these closely related *Calliopsis* bees.

I wish to thank the following collectors and museum curators who have lent so generously of their own specimens or of specimens in their care which have been used in this study: Dr. G. E. Bohart, United States Department of Agriculture, Wild Bee Pollination Investigations, Utah State University, Logan; Drs. G. D. Butler, Jr., and F. G. Werner, University of Arizona, Tucson; Dr. P. D. Hurd, Jr., California Insect Survey, University of California, Berkeley; Dr. W. E. LaBerge, University of Nebraska, Lincoln; Dr. C. D. Michener, the University of Kansas, Lawrence; Dr. E. S. Ross, the California Academy of Sciences, San Francisco; Dr. J. G. Rozen, Jr., the American Museum of Natural History, New York City; Mr. Roy R. Snelling, Los Angeles County

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Museum, Los Angeles, California; and Prof. P. H. Timberlake, Citrus Experiment Station, Riverside, California.

In the descriptions actual measurements of the type specimens are given in millimeters (mm.), or in ocular micrometer units (m.u.), with each unit equal to 0.017 mm. Where the unit of measurement is not specified it is ocular micrometer units. Differences from the type specimen found in some paratypes are noted within parentheses. Observations and measurements were made at 30 times magnification with a Bausch and Lomb StereoZoom® Microscope and Daylight Fluorescent Illuminator giving 500 foot-candles illumination at specimen level.

DESCRIPTION OF NEW SPECIES

Calliopsis rozeni, new species

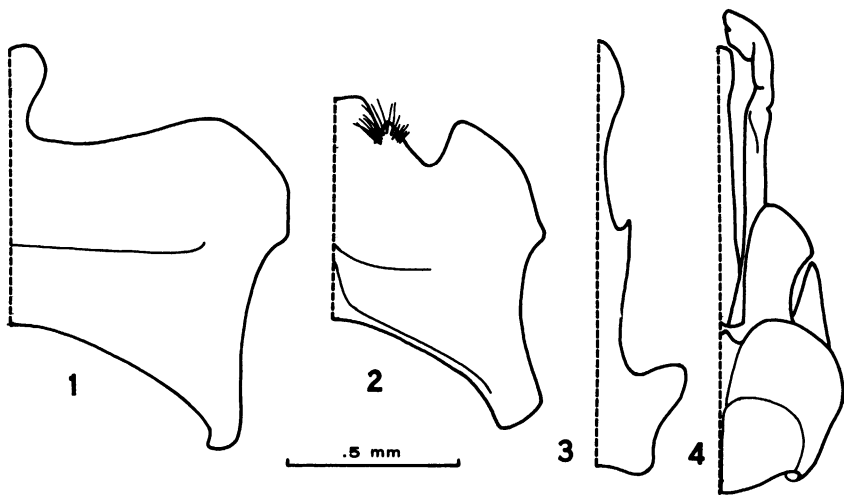
Figures 1-4

This species is named for Dr. Jerome G. Rozen, Jr., who has contributed numerous specimens for my study of the genus. The species is closest to *C. coloradensis* Cresson and an undescribed species from Mexico. Superficially, it bears a striking resemblance to *C. crypta*. The males of *rozeni* have the tips of the projections beside the apical portion of metasomal sternum 6 flat, whereas in *coloradensis* and *crypta* they are bent distinctly ventrad. The females of *rozeni* are distinguished from those of *crypta* by the fine head punctures described in item 10 below and by the possession of fulvous long hairs on the mesoscutum and mesoscutellum, whereas in *crypta* the head punctures are coarse, and the long hairs on the mesoscutum and mesoscutellum are brown. The females of *coloradensis* have fine, dense punctures, regularly spaced about two puncture widths apart on the disk of metasomal tergum 1, whereas those of *rozeni* have larger, sparse punctures, irregularly spaced from one-half to three puncture widths apart.

FEMALE: Length, 8.0 mm.; forewing length, including tegula, 5.5 mm.; hind wing length, 3.8 mm., 228 m.u.; clypeal length, 0.60 mm., 36 m.u.; mesoscutal length, 1.43 mm., 86 m.u. Integumental background color of head and mesosoma black.

Head: Cream-colored areas: (1) Paraocular area below sinuous line drawn from halfway up outer subantennal suture to lower inner margin of facial fovea, thence bordering fovea ventrally and ending at orbit slightly ventral to middle of fovea; (2) clypeus, except for thin brown apical border and two vertical bars of brown originating at dorsolateral corners of clypeal emargination and extending dorsally about five-sevenths of median length of clypeus; (3) absent on labrum; (4) supra-

clypeal area almost to upper rim of antennal socket, dorsal margin rounded; (5) irregularly shaped area on each subantennal plate (to all black); (6) absent on mandible, middle portion testaceous, base and tip brown. (7) Scape, pedicel, and dorsal surface of flagellum dark brown. Ventral surface of flagellomeres 1 to 4 dark brown, with successively greater amounts of tan, remaining ones tan. (8) Hairs of vertex fulvous, of frons, clypeus, and gena whitish. (9) Punctures of head smaller and sparser than in male or in *crypta*. (10) Punctures along shortest line from



FIGS. 1-4. Male terminalia of *Calliopsis rozeni*, new species. 1. Fifth metasomal sternum, ventral view. 2. Sixth metasomal sternum, ventral view. 3. Eighth metasomal sternum, ventral view. 4. Genitalia, ventral view.

posterior ocellus to compound eye uniformly very fine, much finer than on vertex, mostly three puncture widths apart. (11) Ventral portion of frontal line a slightly elevated, narrow, shallow, interrupted (to uninterrupted) sulcus. (12) Clypeus with punctures of median portion mostly two puncture widths apart. (13) Inner orbits slightly convergent below, interocular distance at ventral rim of median ocellus to minimum interocular distance, 99/91. (14) Galeae finely shagreened, shiny, distance from tips in repose to base of prementum subequal to interantennal distance, 21. (15) Head width to head length, 155/107. (16) Median apical border of clypeus below orbit by breadth of median ocellus. (17) Ratios of eye length, minimum interocular distance, and flagellar length, 82/91/81. (18) Ratios of interocellar, ocellocular, antennocular,

and interantennal distances, 28/28/24/21. (19) Ocellolabral distance (from ventral rim median ocellus to median apical margin of clypeus) equal (to subequal) to clypeal width, 90/90. (20) Ratio of clypeocellar distance (ventral rim median ocellus to frontoclypeal suture) to outer subantennal sutural distance (maximum distance between outer subantennal sutures), 54/48. (21) Basal labial palpomere about 2.8 times combined length of other palpomeres, 47/17. (22) Ratios of lengths of scape, first, second, penultimate, and last flagellomeres, 40/9/5/9/14. Maximum flagellar width less than (to subequal to) breadth of median ocellus, 10/11. Flagellar length about 2.0 times scape length, 81/40.

Mesosoma: (23) Cream-colored areas: Medially interrupted stripe along posterior border of pronotum; dot on right pronotal lobe (a dot on each pronotal lobe, or none); posterior border of scutellar crest. (24) Mesoscutal and mesoscutellar hairs fulvous, long hairs concolorous with short hairs. Hair of metanotum fulvous (to whitish), of propodeum, pleura, hind tibiae, and anterior face of hind basitarsi white. (25) Punctures of disk of mesoscutum one-half or less puncture width apart, about same diameter as on mid vertex, interspaces shiny; of disk of mesoscutellum about as on mesoscutum. (26) Dorsal enclosure of propodeum declivous, with low, carinate posterior border, enclosure bearing longitudinal, vermiform ridges medially, and straighter, longitudinal ridges laterally, interspaces shiny. (27) Legs with light color same as on face. Foreleg with cream color on apex of femur and base of tibia covering area of knee and an adjacent area about equal to it. (28) Middle leg color similar to foreleg; spur with many short hairs but teeth indistinct; spur length slightly less than one-half of length of middle basitarsus, 26/55. (29) Hind leg brown. (30) Tegulae transparent, testaceous, with anterior patch of cream color. Humeral plate with cream-colored apex. (31) Wings iridescent, faintly fumeous beyond cells. Costal vein cream-colored basally, darkening to tan at pterostigma; subcostal vein, the darkest vein, dark brown, vannal vein straw color, other veins brown. Pterostigma no wider than to inner border of prestigma. (32) Length of marginal cell greater than, and length of marginal cell along costal margin of wing shorter than (or subequal to), distance from tip of marginal cell to wing tip, 69/58/60.

Metasoma: (33) Terga black, with posterior depressed margins pale testaceous. (34) Tergal hair bands entire, depressed, white, sparse, denser laterally. Suberect hairs of disk of tergum 4 fulvous, of disk of tergum 5 white. Prepygidial and pygidial fimbria white, with a trace of fulvous. (35) Punctures of medial area of tergum 1 sparse, irregularly spaced, one-half to three puncture widths apart, interspaces shiny; of

lateral area crowded, fairly regularly spaced, less than one puncture width apart, interspaces shiny. (36) Punctures of tergum 2 smaller than those of tergum 1, regularly distributed, one to two puncture widths apart, interspaces shiny. Pygidial plate covered with microscopic, appressed, fulvous hair, except on narrow, flat, brown margin; apex narrowly rounded. (37) Sterna 1 to 5 dark brown. Sternum 6 testaceous, with a clear, median, subcircular area.

MALE: Length, 6.5 mm.; forewing length, including tegula, 4.7 mm.; hind wing length, 3.2 mm., 182 m.u.; clypeal length, 0.55 mm., 33 m.u.; mesoscutal length, 1.27 mm., 77 m.u. Integumental background color of head and mesosoma black to brownish black.

Head: Yellow areas: (1) Paraocular area below diagonal line from slightly lateral to upper rim of antennal socket to ventral margin of facial fovea ending at orbit about one-third of eye length below summit of eye; (2) clypeus, except for thin testaceous apical border and two small brown cuneiform marks; (3) labrum; (4) supraclypeal area to above upper rim of antennal socket; (5) subantennal plates; (6) outer basal half (to two-thirds) of mandible, tip dark reddish brown; (7) a broad lateroventral stripe on dark scape, and a mere dot on lateroventral surface of dark brown flagellomere 1. Pedicel and dorsal flagellar surface dark brown. Flagellomeres 2 to 11 tan ventrally, except mesial half of flagellomeres 2 and 3 dark brown. (8) As in female. (9) Punctures of head larger and denser than in female but finer than in *crypta*. (10) As in female. (11) Ventral portion of frontal line an elevated carina. (12) Clypeus with punctures of median portion one and one-half to three puncture widths apart. (13) Inner orbits convergent below, interocular distance at ventral rim of median ocellus to minimum interocular distance, 90/67. (14) As in female, but interantennal distance, 19. (15) Head width to head length, 138/100. (16) Median apical border of clypeus below orbit by about two-thirds of breadth of median ocellus. (17) Ratios of eye length, minimum interocular distance, and flagellar length, 77/67/90. (18) Ratios of interocellar, ocellocular, antennocular, and interantennal distances, 25/24/17/19. (19) Ocellolabral distance greater than clypeal width, 83/74. (20) Ratio of clypeocellar distance to outer subantennal sutural distance similar to that of female, 48/42. (21) Basal labial palpomere similar to that of female, 42/16. (22) Ratios of lengths of scape, first, second, penultimate, and last flagellomeres, 30/8/5/9/11. Maximum flagellar width as in female. Flagellum about 3.0 times length of scape.

Mesosoma: (23) Yellow areas: Medially interrupted stripe along posterior border of pronotum; scutellar crest as in female. (24) Hair color

as in female, except mesoscutal and mesoscutellar hair pale gray (to pale fulvous). (25) Punctures of disk of mesoscutum one-half to one puncture width apart, slightly larger than on mid vertex, interspaces shiny; of disk of mesoscutellum contiguous, slightly larger and deeper than on mesoscutum. (26) As in female, except median portion longer and ridges farther apart. (27) Legs with light color same as on face. Foreleg with femur yellow on dorsal apical one-third, tibia yellow on anterior and dorsal surfaces, basitarsus and second tarsomere yellow; third to fifth tarsomeres successively darker, testaceous to light brown. (28) Middle leg with femur yellow on dorsal apical one-fifth, tibia and basitarsus yellow on anterior surfaces, apicotarsus (second to fifth tarsomeres) progressively darker, testaceous to light brown; posterior aspect of tibia dark brown; ratio of lengths of tibia, basitarsus, and apicotarsus, 64/51/59 (62/48/64). (29) Hind leg with yellow on dorsal apical fifth of femur, anterior aspect of tibia, and basitarsus, and on basitibial plate entirely; basitarsus in some cases bordered anteriorly with thin brown margin; apicotarsus brown. (30, 31) As in female. (32) Ratios similar to those of female, 58/49/54.

Metasoma: (33) As in female. (34) As in female except suberect hairs of disk of terga 4 and 5 fulvous. (35) Punctures of medial area of tergum 1 fairly regularly spaced, slightly less than one puncture width apart, about same spacing laterally, interspaces shiny. (36) Punctures of tergum 2 as described for female, except less than one-half puncture width apart, interspaces shiny. Pygidial plate brown, with upturned margin, coarsely punctured medially, bearing few hairs; apex narrowly rounded. (37) Sterna successively lighter posteriorly, light brown to straw color. Sterna and genitalia as illustrated (figs. 1-4), sternum 6 without ventrally projecting prongs.

TYPE MATERIAL: Holotype, male, Rodeo, Hidalgo County, New Mexico, August 22, 1962, on *Heterotheca subaxillaris* (J. G. Rozen, M. Statham, S. J. Hessel). Allotype, female, Southwestern Research Station of the American Museum of Natural History, 5 miles west of Portal, 5400 feet in altitude, Cochise County, Arizona, August 10, 1956, on *Melilotus alba* (Ellen Ordway). The holotype and allotype are deposited in the American Museum of Natural History. In addition 154 male and 120 female paratypes are from the following localities: *Arizona*: Apache (5 miles southeast), Cochise County, one male, August 11, 1958, on *Baccharis* (P. D. Hurd); Apache (3 miles east), three males, April 19, 1961 (Rozen and Schrammel); Apache (6 miles southeast), Skeleton Canyon, two males, one female (P. D. Hurd), one female, September 4, 1958 (E. G. Linsley); Benson (7 miles west), Cochise County, one male,

September 3, 1961, on *Heterotheca subaxillaris* (P. D. Hurd); Bisbee (10 miles northwest), 5500 feet in altitude, Mule Mountains, Cochise County, one male, September 7, 1950 (T. Cohn, P. Boone, M. Cazier); Coconino County, one female, August 18, 1927 (L. D. Anderson); Douglas, one male, August 16, 1936 (W. W. Jones); Flagstaff, one female, September 12, 1951, J. G. Rozen; Mt. View, one female, August 27, 1954, on *Psilostrophe cooperi* (P. H. Timberlake); Phoenix, one male, April 21, 1933 (R. H. Crandall). Portal and vicinity, Cochise County, Chiricahua Mountains, by years: 1956: Southwestern Research Station, one female, August 8, on *Melilotus alba* (C. and M. Cazier). 1958: One female, August 7 (P. Opler); four males, on *Baccharis*, two males, two females, August 15, two males, one female, August 16 (P. D. Hurd); two females, August 16, on *Baileya pleniradiata*, two males, one female, August 19, on *Heterotheca subaxillaris* (E. G. Linsley); Southwestern Research Station, one female, August 13, no flower, one male, August 19, on *Heterotheca subaxillaris* (P. D. Hurd); Southwestern Research Station, one male, August 17, on *Helianthus*, one male, August 17, on *Heterotheca subaxillaris*, one male, August 24, on *Sphaeralcea emoryi*?, three males, one female, August 26, on *Heterotheca subaxillaris* (all E. G. Linsley). 1959: Southwestern Research Station, one male, September 3 (G. I. Stage); (3 miles east), three males, two females, September 2 (J. R. Powers); (1 mile northeast), one female, September 9, on *Helianthus* (J. R. Powers); (2.5 miles northeast), one male, August 29 (Cazier and Statham). 1961: (Two miles northeast), one male, September 18 (M. Statham); (5 miles northeast), one male, September 12, on *Pectis papposa* (J. G. Rozen, M. Statham), one female, September 28 (M. Statham, M. A. Cazier, M. Mortenson). 1962: Southwestern Research Station, two males, August 21, one female, September 3, one male (taken *in copulo* with female paratype number 9 of *crypta*, both on same pin) September 14, two females, September 17, all on *Heterotheca subaxillaris*, one female, September 17, no flower (all J. G. Rozen); Southwestern Research Station, one female, August 26 (M. Statham), two females, August 29, one female, September 3 (J. G. Rozen, M. Statham, S. J. Hessel). Santa Rita Mountains, four males and four females, May 9, 1937 (W. Benedict); San Xavier Mission, one male, one female, October 15, 1936, E. P. Van Duzee; Skeleton Canyon (near Apache), Cochise County, one male, August 22, 1962, on *Gaillardia* (J. G. Rozen, M. Statham, S. J. Hessel). Superior, Pinal County, Boyce Thompson Arboretum, four females and four males, May 3, 1953, on aster, seven females and seven males, May 3, 1953, on desert marigold, one female, May 15, 1953, on aster (all G. D. Butler); Tucson, one male, September 30, 1938, (R. H. Crandall); Tucson (10 miles south), one

male, August 7, 1940, on *Verbesina exauria* (P. H. Timberlake); Warren, one male, April 21, 1927 (J. O. Multin); Yuma, one male, May 6, 1939 (R. M. Bohart); Yuma Test Station, Yuma County, one male, April 28, 1956, on *Euphorbia* (R. R. Snelling, M. D. Stage). *New Mexico*: Granite Pass, Peloncillo Mountains (15 miles northeast of Rodeo), Hidalgo County, one female, August 25, 1958, on *Eriogonum* (P. D. Hurd), one female, August 26, 1963 (A. Raske); High Rolls, Otero County, one female, June 2, 1902; Lordsburg (5 miles east), one male, April 19, 1961, on *Hymenoxys odorata* (W. E. LaBerge); Organ Mountains, Filmore Canyon, about 5700 feet in altitude, one male, September 1, on *Eriocarpum gracile* (Townsend); Road Forks, Hidalgo County, seven males, two females, August 15, 1958 (E. G. Linsley). Rodeo and vicinity, Hidalgo County, by years: 1958: Two females, August 3, 22 (C. G. Moore); four females, on *Helianthus* (W. R. Bowen), two males, one female (R. H. James), one male (P. M. Marsh), one female (J. M. Marston), all August 19; three males (R. M. Bohart), two females (J. M. Marston), one female (G. B. Pitman), all August 22; eight males, five females, August 23, on *Baileya pleniradiata* (P. D. Hurd); two females, August 23 (M. A. Cazier); (7 miles southeast), one male (no collector), one female (J. M. Marston), one male, one female (C. G. Moore), one male, one female (P. A. Opler), two males, one female (G. B. Pitman), two females (R. E. Rice), all August 21; (2.5 miles north), seven males, 17 females, August 23, on *Baileya pleniradiata* (E. G. Linsley); (18 miles north), one male (R. H. James), one female (D. D. Linsdale), three males, one female (G. B. Pitman), one male, four females (R. E. Rice), all August 25. 1959: (One mile south), one female, September 4; (2.5 miles north), one male, September 4, on *Heterotheca subaxillaris*, three males, same date, on *Baileya pleniradiata*, two males, September 6, one male, September 7, one male, three females, September 6, on *Heterotheca subaxillaris*, two males, one female, September 7, same flower, one male, one female (*in copulo* on same pin), September 7, on *Baileya pleniradiata* (all G. I. Stage), one male, September 7 (D. D. Linsdale), three males, September 7, on *Heterotheca subaxillaris* (J. R. Powers). 1962: Four males, one female, August 22, on *Heterotheca subaxillaris* (J. G. Rozen, M. Statham, S. J. Hessel); (4.5 miles north), one female, August 21 (same collectors). Roswell, one male, September 12, 1937 (R. H. Crandall); Socorro, one male, one female, August 26, 1931, on *Baileya multiradiata* (P. H. Timberlake). Soledad, Organ Mountains, one male, August 15 (T. D. A. Cockerell), "*C. chlorops*." *Texas*: Big Bend National Park, Coopers Store, Brewster County, 19 males, nine females, April 11, 1949, on *Baileya multiradiata* (C. D. Michener, R. H. Beamer); same locality except not Coopers

Store, one male, July 16, 1950 (Ray F. Smith); Davis Mountains, Jeff Davis County, one male, April 17, 1954, on *Chamaesaracha conloides* (R. H. Beamer), one female, same date, on *Gaillardia* (L. D. Beamer); Marathon (20 miles south), one male, one female, April 12, 1949, on *Baileya multiradiata* (C. D. Michener, R. H. Beamer); Stonewall, one male, April 16, 1953 (R. H. Beamer); Uvalde, five males, April 14, 1952 (Michener, Beamer, Wille, LaBerge), three females, same data, on *Parkinsonia*. *Chihuahua*: Salaices, 5200 feet in altitude, two males, August 20, 1947 (G. M. Bradt). *Coahuila*: La Gloria, south of Monclova, 3300 feet in altitude, three males, one female, August 24, 1947 (C. D. Michener); Paila, 3900 feet in altitude, one female, August 21, 1947 (C. D. Michener); Piedras Negras (192 kilometers south), 1300 feet in altitude, one male, August 25, 1949 (G. M. Bradt).

DISCUSSION AND DISTRIBUTION: It is unusual for two solitary bees of different species to be taken *in copulo*. Such cases, when they have been so captured, have in almost all instances been interpreted to signify that the two specimens are not, in fact, of different species. One male of *rozeni* was collected *in copulo* with a female of *crypta* by J. G. Rozen, Portal, Southwestern Research Station, Arizona, September 14, 1962, on *Heterotheca subaxillaris*, and one pair of *rozeni* was taken *in copulo* by G. I. Stage, 2.5 miles north of Rodeo, New Mexico, September 7, 1959, on *Baileya pleniradiata*. Both collectors had observed the specimens carefully prior to collection. Inasmuch as I have an interspecific mating pair of *Calliopsis chlorops* Cockerell with *C. coloradensis* Cresson, I believe the phenomenon may be more common than preserved specimens indicate. Nevertheless, I have not yet seen a specimen of either sex of any of these species which can be considered an intermediate, or hybrid, form. It is possible that the males can be deceived by some of the females of these extremely closely related and superficially indistinguishable pairs of species. I conclude that no viable offspring are produced.

The species has a wide distribution in the southwestern United States and north central Mexico, and the range is expected to be but little extended beyond present limits.

FLOWER RECORDS: *Baccharis*, *Baileya pleniradiata*, *Chamaesaracha conloides*, desert marigold, *Eriocarpum gracile*, *Eriogonum*, *Gaillardia*, *Helianthus*, *Heterotheca subaxillaris*, *Hymenoxys odorata*, *Melilotus alba*, *Parkinsonia*, *Pectis papposa*, *Psilostrophe cooperi*, *Sphaeralcea emoryi*?, and *Verbesina exauria*. The species is taken primarily on *Heterotheca subaxillaris* which is a favorite flower among its relatives also.

Calliopsis pectidis, new species

Figures 5-8

This species is named for one of the genera of plants, *Pectis*, used as its food source. The name is adopted from the one proposed for it in manuscript by P. H. Timberlake who recognized the species as a new form more than a decade ago. Its closest relative is an undescribed species, but both species have close affinities with *rozeni*.

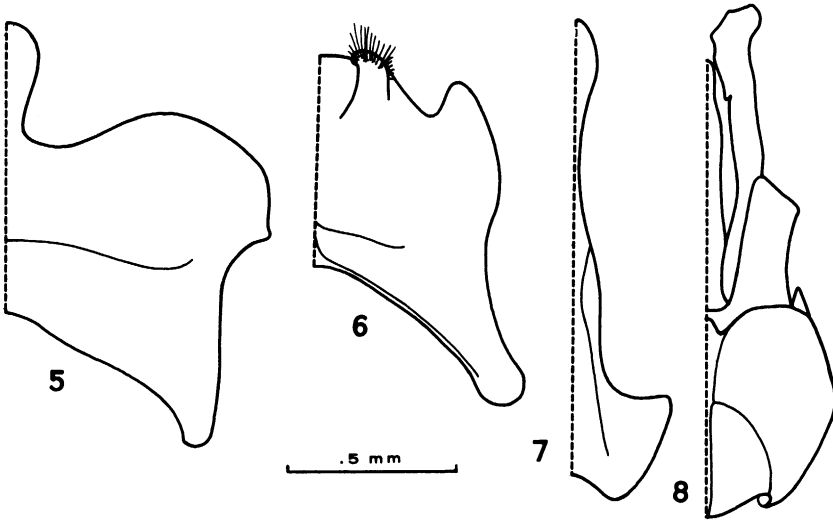
The male is separated from other described *Calliopsis* of its group by the presence of yellow markings on the coxae and trochanters. The female is distinguished by the presence of large amounts of cream coloration on the tibiae and basitarsi as described in 27, 28, and 29 below, and by the characteristic nap-like vestiture of the mesoscutum as described in 24 below.

FEMALE: Length, 7.7 mm.; forewing length, including tegula, 5.0 mm.; hind wing length, 3.4 mm., 204 m.u.; clypeal length, 0.56 mm., 34 m.u.; mesoscutal length, 1.49 mm., 90 m.u. Integumental background color of head, mesosoma, and metasomal dorsum black.

Head: Cream-colored areas: (1) As in *rozeni*, except sinuous line beginning about two-thirds up outer subantennal suture and ending at orbit about at middle of fovea; (2) as in *rozeni*, except brown clypeal bars narrower and extending dorsally about five-eighths (or less) of the median length of the clypeus; (3) labrum, except for testaceous rim of labral plate and median area of clypeus apical to it; (4) supraclypeal area to above upper rim of antennal socket, dorsal margin coming to a point; (5) subantennal plate; (6) about basal fourth, middle portion testaceous, tip brown; (7) small apicoventral dot on scape. Pedicel and flagellum as in *rozeni*, except lighter brown. (8) As in *rozeni*, but all areas with shorter, more plumose hair. (9) Punctures of head mostly slightly larger than in *rozeni*. (10, 11, 12) As in *rozeni*. (13) Similar to *rozeni*, except slightly less convergent below, ratio, 94/89. (14) Galeae shiny, more finely shagreened than in *rozeni*, distance from tips in repose to base of prementum about two-thirds of interantennal distance, 14/22. (15) Head width to head length, 152/105. (16) As in *rozeni*. (17) Ratios of eye length, minimum interocular distance, and flagellar length, 80/89/85. (18) Ratios of interocellar, ocellocular, antennocular, and interantennal distances, 31/25/24/22. (19) Ocellolabral distance subequal to clypeal width, 87/85. (20) Similar to *rozeni*, ratio, 53/44. (21) Measurement not available for type, taken on paratype of equivalent size: basal labial palpomere about 2.3 times length of other palpomeres, 37/16. (22) Ratios of lengths of scape, first, second, penultimate, and last flagellomeres, 39/10/5/9/13.

Maximum flagellar width less than breadth of median ocellus. Flagellar length slightly more than 2.0 times scape length, 85/40.

Mesosoma: (23) Cream-colored areas: Pronotal stripe as in *rozeni*, except wider and less medial interruption; entire apex of pronotal lobe; posterior border of scutellar crest. (24) Hair only about half of length of that of *rozeni* and *crypta*, more plumose. Mesoscutal and mesoscutellar hair color as in *crypta*, except long dark hairs of lighter brown hue; short hairs so dense as to conceal mesoscutal punctures, giving appearance of



FIGS. 5-8. Male terminalia of *Calliopsis pectidis*, new species. 5. Fifth metasomal sternum, ventral view. 6. Sixth metasomal sternum, ventral view. 7. Eighth metasomal sternum, ventral view. 8. Genitalia, ventral view.

closely applied nap at 10 times magnification, a highly distinctive, unique appearance in its group. Lateral and posterior hairs of metanotum white, medial hairs fulvous; hair of propodeum, pleura, hind tibiae, and hind basitarsi white. (25) As in *rozeni*, except punctures of disk of mesoscutum contiguous, smaller than in *rozeni*, slightly smaller than on mid vertex, interspaces smooth. (26) Dorsal enclosure of propodeum with less distinct, low, carinate, posterior border than in *rozeni*, the posterolateral portions with adjacent narrow, shiny, almost impunctate areas; ridges of enclosure as in *rozeni*, except much finer and more numerous, with a few punctures laterally, interspaces shiny. (27) Legs with light color same as on face. Foreleg with cream color on apex of femur, dorsal and

most of anterior and posterior aspects of tibia, basal half of basitarsus. (28) Middle leg color similar to that of foreleg; spur similar to that of *rozeni*, except teeth more distinct. Spur length one-half of length of middle basitarsus, 24/48. (29) Hind leg similar to foreleg, except anterior aspect of basitarsus entirely light, with brown rim. (30) Tegulae hyaline laterally, straw color posteriorly, with anterior patch of cream color. Humeral plate as in *rozeni*. (31) As in *rozeni*. (32) Length of marginal cell less than (to subequal to), and length of marginal cell along costal margin of wing shorter than, distance from tip of marginal cell to wing tip, 54/48/56.

Metasoma: (33) As in *rozeni*. (34) Tergal hair bands as in *rozeni*, except denser, more plumose, hence much more distinct. Suberect hairs of disk of terga 4 and 5 brownish. Prepygidial and pygidial fimbria as in *rozeni*. (35) As in *rozeni*, except much finer, regularly spaced, less than one puncture width apart, interspaces shiny. (36) Punctures of tergum 2 as in *rozeni*, except much finer, mostly one-half of puncture width apart, interspaces shiny. Pygidial plate as in *rozeni*, except margin slightly upturned. (37) As in *rozeni*, except clear, median, subcircular area larger in proportion to size of bee.

MALE: Length, 7.2 mm.; forewing length, including tegula, 4.3 mm.; hind wing length, 2.9 mm., 174 m.u.; clypeal length, 0.56 mm., 34 m.u.; mesoscutal length, 1.37 mm., 83 m.u. Integumental background color of head and mesosoma black.

Head: Yellow areas: (1) Paraocular area below dorsally convex curve from slightly lateral to upper rim of antennal socket to inner ventral margin of facial fovea ending at orbit about three-tenths of eye length below summit of eye; (2) as in *rozeni* except cuneiform marks broader, shorter, pale testaceous; (3, 4, 5, 6) as in *rozeni*; (7) scape entirely (to a mere longitudinal streak of brown on dorsal surface); pedicel and flagellomere 1 on dorsolateral surfaces. Flagellomeres 2 to 11 as in *rozeni* except of brighter hue. (8) As in female. (9) Punctures of head as in female. (10, 11, 12) Similar to *rozeni*. (13) Inner orbits less convergent below than in *rozeni*, ratio 86/67. (14) Galeae shiny, more finely shagreened than in *rozeni*, distance from tips in repose to base of prementum slightly less than interantennal distance, 17/19. (15) Head width to head length as in *rozeni*, 138/100. (16) As in *rozeni*. (17) Ratios of eye length, minimum interocular distance, and flagellar length, 72/67/95. (18) Ratios of interocular, ocellocular, antennocular, and interantennal distances, 24/25/16½/19. (19) Ocellolabral distance greater than clypeal width, 81/67. (20) Ratio of clypeocellar distance to outer subantennal sutural distance, 47/40. (21) Measurement not available for type, taken on paratype of equivalent size: basal labial palpomere similar to that of female, shorter

than in *rozeni*, about 2.1 times length of other palpomeres, 34/16. (22) Ratios of lengths of scape, first, second, penultimate, and last flagellomeres, 29/9/5/9/13. Maximum flagellar width less than breadth of median ocellus, 11/12. Flagellar length about 3.3 times scape length, 95/29.

Mesosoma: (23) Yellow areas: As in female, except almost all pronotal lobe yellow. (24) As in female, except mesoscutal hairs somewhat less dense but still concealing punctures. (25) As in *rozeni*, except punctures of disk of mesoscutum smaller, less than one-half of puncture width apart, smaller than on mid vertex, interspaces smooth. (26) As described for female, except narrow, shiny, impunctate area bordering dorsal enclosure absent, ridges straighter, fewer. (27) Legs with light color same as on face. Foreleg with coxa yellow on apical one-half of ventral surface, trochanter with yellow patch apicoventrally, femur with yellow on apical three-fourths of anterodorsal surface and apical one-third of posterior surface, tibia and tarsomeres 1 to 4 yellow, tarsomere 5 testaceous. (28) Middle leg with coxal yellow reduced to apical one-fourth of ventral surface, trochanter with apicoventral yellow patch smaller than on foreleg, femur and tibia with yellow pattern similar to that of foreleg, tarsomeres 1 to 3 yellow, tarsomeres 4 and 5 successively darker testaceous; ratios of lengths of tibia, basitarsus, and apicotarsus, 56/53/56. (29) Hind leg with yellow color pattern of trochanter, femur, and tibia similar to that on middle leg; coxa with yellow as on front trochanter; tarsomeres 1 and 2 yellow, tarsomeres 3 to 5 successively darker testaceous. (30, 31) As in female. (32) Length of marginal cell equal to (to subequal to), and length of marginal cell along costal margin of wing shorter than, distance from tip of marginal cell to wing tip, 51/46/51.

Metasoma: (33) As in *rozeni*. (34) As in female, except very few erect, brownish hairs. (35) Punctures of medial area of tergum 1 smaller than in *rozeni*, regularly spaced, contiguous, interspaces smooth. (36) Punctures of tergum 2 as on tergum 1 except smaller. Pygidial plate similar to that of *rozeni*, except coarsely punctured subperipherally. (37) Sterna successively lighter, light brown to straw color. Sterna and genitalia as illustrated (figs. 5-8).

TYPE MATERIAL: Holotype, male, and allotype, female, 2 miles north-east of Portal, Cochise County, Arizona, August 21, 1962 (J. G. Rozen, M. Statham, S. J. Hessel). The holotype and allotype are deposited in the American Museum of Natural History. In addition 65 male and 47 female paratypes are from the following localities: *Arizona*: Ajo, one male, July 23, 1938 (R. I. Sailer); Aguila, one male, two females, September 20, 1953, on *Pectis papposa* (P. H. Timberlake); Brenda (2 miles

west), Yuma County, two males, September 2, 1961, on *Pectis angustifolia* (P. D. Hurd); Carrizozo, Lincoln County, one male, one female, September 10, 1961, on *Gutierrezia microcephala* (P. D. Hurd), one female, same, except on *Haplopappus spinulosus*; Congress (4 miles southwest), one male, September 15, 1961, on *Hymenothrix wislizeni* (P. D. Hurd); Florence Junction (3.1 miles south), Pinal County, two females, September 3, 1961, on *Pectis papposa* (P. D. Hurd); Gila Bend, one female, August 12, 1954, on *Pectis papposa* (Bohart and Butler), (28 miles east), Maricopa County, one male, September 1, 1959 (J. R. Powers). Portal: (Five miles west), Southwestern Research Station, 5400 feet in altitude, one male, one female, August 9, 1956, on *Melilotus alba* (C. and M. Cazier), one female, August 15, 1956 (E. Ordway); three males, August 15, 17, 26, 1958, on *Heterotheca subaxillaris* (E. G. Linsley); (5 miles east), one female, September 14, 1955, on *Verbesina encelioides* (G. E. Bohart), same date (C. and M. Cazier); (2.5 miles northeast), one male, August 16, 1959 (M. Statham); (2 miles northeast), one male, July 30, 1959, one female, August 1, 1959, on *Baccharis* (M. Statham), one female, host of *Holcopasites arizonicus*, September 24, 1961 (M. Cazier), 11 males, five females, August 21, 1962 (J. G. Rozen, M. Statham, S. J. Hessel); (5 miles northeast), five males, one female, September 12, 1961, on *Pectis papposa* (J. G. Rozen, M. Statham), two females, September 28, 1961 (M. Statham, M. Cazier, M. Mortenson). Salome (2.3 miles north), one female, September 14, 1953, on *Pectis papposa* (P. H. Timberlake). California: Blythe (10 miles north), one male, one female, October 2, 1954 (J. C. Hall); Julian (12 miles east), San Diego County, one male, September 4, 1955 (J. C. Downey); Twentynine Palms, two females, September 5, 1946, on *Pectis papposa* (P. H. Timberlake). New Mexico: Lordsburg (11 miles northwest), one female, September 9, 1959, on *Haplopappus* (G. I. Stage); Road Forks, one male, August 15, 1958 (E. G. Linsley). Rodeo: one female, August 19, 1958, on *Helianthus* (W. R. Bowen); one female, August 21, 1958, one female, August 22, 1958, on *Baileya* (both R. M. Bohart); one male, one female, August 22, 1958 (G. B. Pitman), one female (C. G. Moore), one male (D. D. Linsdale), one female (J. M. Marston), all August 22, 1958; one male, August 23, 1958, on *Baileya pleniradiata* (P. D. Hurd); (2.5 miles north), one male, five females, August 23, 1958, on *B. pleniradiata* (E. G. Linsley); (4.8 miles north), one male, on *Tidestromia langinosa*, eight males, two females, on *Pectis papposa*, all September 4, 1961 (P. D. Hurd); (18 miles north), one female, August 25, 1958 (G. B. Pitman); (7 miles southeast), one male, August 21, 1958 (no collector). Baja California Sur: San Pedro, seven females, on Compositae, 19 males, October 7, 1941 (E. S. Ross,

R. M. Bohart); Sierra de la Laguna Mountains, Big Canyon (about latitude 23° 34' N., longitude 110° 00' W.), one female, September 13, 1941, same collectors.

DISCUSSION AND DISTRIBUTION: Paul D. Hurd, Jr., has informed me (*in litt.*) that two females of *Holcopasites arizonicus* (Linsley) were taken in association with a female *C. pectidis* by Mont A. Cazier, 2 miles northeast of Portal, Arizona, on September 24, 1961. This is the second species record of a *Calliopsis-Holcopasites* association, the other being of *H. calliopsidis* (Linsley) with *C. andreniformis* Smith. The species is apparently widespread from southern New Mexico to the Mohave and California deserts in California and south to near the tip of Baja California Sur. I anticipate its discovery in the Sonoran Desert of northern Mexico.

FLOWER RECORDS: *Baccharis*, *Baileya pleniradiata*, *Haplopappus*, *Heli-anthus*, *Heterotheca subaxillaris*, *Hymenothrix wislizeni*, *Melilotus alba*, *Pectis angustifolia*, *P. papposa*, *Tidestromia lanigosa*, and *Verbesina encelioides*. Seven of the same genera and four of the same species are visited by *pectidis* and *rozeni*.

***Calliopsis crypta*, new species**

Figures 9-12

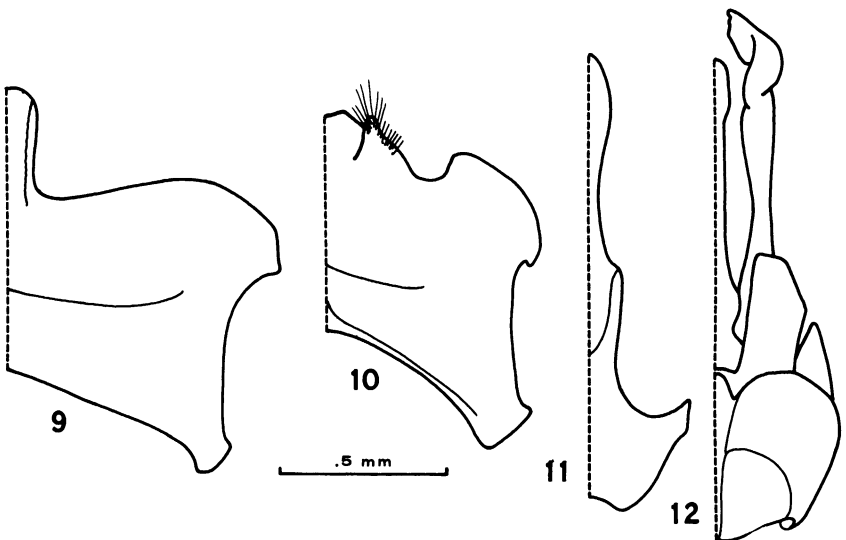
The specific name from the Greek meaning "hidden" is applied because this species remained mixed in a series of specimens of *C. chlorops* and *C. rozeni* for a long time prior to its recognition.

The differentiation of *crypta* from *rozeni* is discussed under the latter. The species is closest to *C. chlorops* Cockerell and an undescribed species from Mexico. The males of *crypta* have the expanded middle section of sternum 8 with smoothly rounded posterior corners, whereas *chlorops* bears a tiny, posteriorly directed, sharply pointed process at each corner. The females of *crypta* have the mandibular base black or brownish black, whereas *chlorops* has the base cream colored.

FEMALE: Length, 8.6 mm.; forewing length, including tegula, 5.5 mm.; hind wing length, 3.8 mm., 228 m.u.; clypeal length, 0.60 mm., 35 m.u.; mesoscutal length, 1.53 mm., 90 m.u. Integumental background color of head and mesosoma black.

Head: Cream-colored areas: (1, 2) As in *rozeni*; (3) dot (in some cases) dorsally near apex of labral plate; (4) as in *rozeni*; (5) absent from sub-antennal plate; (6) absent from mandible, base and tip brownish black. (7) As in *rozeni*, except tan areas of flagellomeres 1 to 4 smaller. (8) As in *rozeni*, except nearly all hair of vertex brown (view with integument as background). (9) Punctures of head larger and denser than in *rozeni*.

(10) Punctures along shortest line from posterior ocellus to compound eye of various sizes, some not much finer than on vertex, mostly one or less puncture width apart. (11) As in *rozeni*, except reaching more abruptly to a greater elevation, ending in a point. (12) Clypeus with punctures of median portion larger than in *rozeni*, one to two puncture widths apart. (13) Similar to those in *rozeni*, ratio, 99/89. (14) As in *rozeni*. (15) Similar to ratio in *rozeni*, 153/107. (16) As in *rozeni*. (17) Ratios of eye length, minimum interocular distance, and flagellar length, 82/89/88.



FIGS. 9-12. Male terminalia of *Calliopsis crypta*, new species. 9. Fifth metasomal sternum, ventral view. 10. Sixth metasomal sternum, ventral view. 11. Eighth metasomal sternum, ventral view. 12. Genitalia, ventral view.

Flagellum slightly longer than in *rozeni*. (18) Similar to ratios in *rozeni*, 27/29/25/21. (19) Ocellolabral distance slightly greater than clypeal width, 90/85. (20) Ratio of clypeocellar distance to outer subantennal sutural distance, 55/50. (21) As in *rozeni*. (22) Similar to ratios in *rozeni*, 40/10/5/9/14. Maximum flagellar width equal to breadth of median ocellus, 11/11. Flagellar length about 2.2 times scape length.

Mesosoma: (23) Cream-colored areas as in *rozeni*, except dot on each pronotal lobe. (24) As in *rozeni*, except short hairs of mesoscutum fulvous, long hairs brown; short hairs and lateral long hairs of mesoscutellum fulvous, other long hairs brown. (25) Punctures of disk of mesoscutum contiguous, larger than in *rozeni*, and larger than on mid vertex, inter-

spaces smooth; of disk of mesoscutellum about as on mesoscutum. (26) As in *rozeni*, except more ridges, and enclosure appearing somewhat duller although with interspaces shiny. (27) As in *rozeni*. (28) As in *rozeni*, except spur length to length middle basitarsus, 27/55. (29, 30, 31) As in *rozeni*. (32) As in *rozeni*, except ratio 67/57/65 (some specimens with ratio almost identical to that in *rozeni*).

Metasoma: (33) As in *rozeni*. (34) As in *rozeni*, except disk of tergum 4 with at least 10 brown hairs. (35) Punctures of tergum 1 larger than in *rozeni*, only slightly smaller than on mesoscutum and on mesepisternum below scrobe. Punctures of medial area dense, fairly regularly spaced, one or less puncture width apart, interspaces shiny. (36) As in *rozeni*, except less than one puncture width apart. (37) As in *rozeni*, except clear, median, subcircular area larger.

MALE: Length, 7.3 mm.; forewing length, including tegula, 4.8 mm.; hind wing length, 3.4 mm., 201 m.u.; clypeal length, 0.51 mm., 31 m.u.; mesoscutal length, 1.27 mm., 77 m.u. Integumental background color of head, mesosoma, and metasomal dorsum black.

Head: Yellow areas: (1) Paraocular area below diagonal line from outer subantennal suture at level of middle of antennal socket (or below) to ventral margin of facial fovea ending at orbit about one-third of eye length below summit of eye; (2) clypeus, as in *rozeni*, except cuneiform marks darker brown; (3) labrum; (4) supraclypeal area as in *rozeni*, except slightly shorter; (5) subantennal plates; (6) mandible as in *rozeni*. (7) Scape entirely black (basal ventral dot or streak of yellow, to a basal, ventral, narrow yellow stripe strongly attenuate apically). Pedicel and flagellum as in *rozeni*, except much darker. (8) Hair color as in *rozeni* (some hairs of vertex brownish). (9) Punctures of head larger, denser than in *rozeni* or *chlorops*. (10) Punctures along shortest line from posterior ocellus to compound eye twice diameter of those in *rozeni*, mostly two puncture widths apart. (11) As in *rozeni*. (12) Clypeus with punctures of median portion mostly two puncture widths apart, larger than in *rozeni*. (13) Inner orbits convergent below about as in *rozeni*, ratio, 89/67. (14) Galeae as in *rozeni*, except distance from tips in repose to base of prementum four-fifths (to subequal to) interantennal distance, 16/20. (15) Head width to head length, 137/96. (16) As in *rozeni*. (17) Ratios of eye length, minimum interocular distance, and flagellar length, 71/67/95. (18) Ratios of interocellar, ocellocular, antennocular, and interantennal distances, 25/25/18/20. (19) Ocellolabral distance greater than clypeal width, 79/67. (20) Ratio of clypeocellar distance to outer subantennal sutural distance identical to that in *rozeni*, 48/42. (21) Basal labial palpomere about 2.6 times combined length of other pal-

pomeres (44/17, measured on paratype). (22) Ratios of lengths of scape, first, second, penultimate, and last flagellomeres, 31/10/6/9/14. Maximum flagellar width as in female. Flagellum about 3.1 (to 3.4) times length of scape.

Mesosoma: (23) Light-colored areas (yellow): As in *rozeni*, except stripe narrower. (24) As in *rozeni*, except mesoscutal and mesoscutellar short hairs fulvous, long hairs whitish (fulvous, or brown as seen from behind). (25) Punctures of disk of mesoscutum larger than in *rozeni* or *chlorops*, mostly one-half (or less) puncture width apart, larger than on mid vertex, interspaces shiny; of disk of mesoscutellum as on mesoscutum. (26) As in *rozeni*, except pattern of ridges more vermiform, less regularly spaced, interspaces duller. (27) As in *rozeni*. (28) Middle leg yellow as in *rozeni*, except tibia with anterior surface splotched with brown; ratio of lengths of tibia, basitarsus, and apicotarsus about as in *rozeni*, 60/50/64. (29) Hind leg yellow as in *rozeni*, except slightly darker, apicotarsus brown. (30) Tegulae with small anterior spot (or streak) of yellow. Humeral plate brown as in *chlorops*. (31) Costal vein tan basally, darkening to brown at pterostigma. Subcostal vein dark brown, vannal vein tan, others brown. Pterostigma as in *rozeni*. (32) Ratios as in *rozeni*, 58/49/53.

Metasoma: (33) As in *rozeni*. (34) As in *rozeni*, except suberect hairs of disk of terga 4 and 5 brownish. (35) Punctures of medial area of tergum 1 larger than in *rozeni*, contiguous, becoming no more than one-half of puncture width apart laterally, interspaces shiny. (36) Punctures of tergum 2 slightly smaller than those on tergum 1, more crowded, interspaces shiny. Pygidial plate similar to that of *rozeni*, except punctures mostly along inner periphery of flat margin. (37) Sternal color as in *rozeni*, except darker. Sterna and genitalia as illustrated (figs. 9-12). Plane of ventral prongs of sternum 6 perpendicular to surface of sternum.

TYPE MATERIAL: Holotype, male, Rustler Park (near Apache), Chiricahua Mountains, Cochise County, Arizona, September 5, 1962 (J. G. Rozen, M. Statham, S. J. Hessel). Allotype, female, Southwestern Research Station of the American Museum of Natural History, 5 miles west of Portal, 5400 feet in altitude, Cochise County, Arizona, September 3, 1962 (J. G. Rozen, M. Statham). The holotype and allotype are deposited in the American Museum of Natural History. In addition 17 male and 28 female paratypes are from the following localities: *Arizona*: Montezuma Pass, Huachuca Mountains, 6500 feet in altitude, Cochise County, one female, September 7, 1950 (T. Cohn, P. Boone, M. Cazier). Portal (5 miles west), Southwestern Research Station, 5400 feet in altitude, by years. 1956: One female, October 5 (E. Ordway). 1958: Two females, August 17, two males, two females, August 26 (all E. G. Linsley),

one male, August 24 (P. D. Hurd), all on *Heterotheca subaxillaris*, one female, August 17, on *Helianthus* (E. G. Linsley). 1959: One male, one female, September 2 (J. R. Powers), one male, four females, September 3 (G. I. Stage), all on *Heterotheca subaxillaris*. 1962: Two females, August 26, one male, two females, August 29, one male, two females, August 30, one female, September 1, one male, September 2 (all J. G. Rozen, M. Statham, S. J. Hessel); one male, September 13, one female (taken *in copulo* with male paratype number 1 of *rozeni*, both on same pin), September 14, five males, one female, September 17, all on *Heterotheca subaxillaris*, one female, September 16, one male, September 20 (all J. G. Rozen). Rustler Park, Chiricahua Mountains, 8500 feet in altitude, Cochise County, two females, August 26, 1959, on *Cirsium* (E. G. Linsley); same locality without altitude, one male, four females, September 5, 1962 (J. G. Rozen, M. Statham, S. J. Hessel). *Chihuahua*: Santa Barbara, 6200 feet in altitude, one male, August 26, 1947 (G. M. Bradt).

DISCUSSION AND DISTRIBUTION: An apparent case of interspecific mating with male *rozeni* is discussed above under that species. The one record from Mexico indicates that *crypta* is a northern Sonoran desert form and not strictly an endemic species of southeastern Arizona.

FLOWER RECORDS: *Cirsium*, *Helianthus*, and *Heterotheca subaxillaris*. *Calliopsis crypta* shares *Helianthus* and *Heterotheca* flowers with both *C. rozeni* and *C. pectidis*.

