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Notes on the Biology of *Nomadopsis*, with Descriptions of Four New Species (Apoidea, Andrenidae)

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The present paper, which gives recent additions to the knowledge of the bee genus *Nomadopsis*, serves as a sequel to my revisional study of the group (1958). The permanency of the nesting sites of a number of species is discussed, the comparative biologies of two species are presented, and four new species are described.

I wish to thank Dr. Paul D. Hurd, Jr., California Insect Survey, University of California, Berkeley; Dr. Charles D. Michener, Department of Entomology, University of Kansas, Lawrence; and Mr. Roy R. Snelling, Davis, California, for the loan of certain specimens used in this study. The research for this paper, an outgrowth of an investigation of the parasitic bee genus *Oreopasites*, was supported partly by the National Science Foundation (Grant G-14854).

PERMANENCY OF NESTING SITES

There is little information in the literature as to how long ground-nesting, solitary bees occupy their nesting sites. Nothing is known of this matter for *Nomadopsis* except for my observations made in 1953. At that time I learned that some nesting sites in Tuolumne County, California, had been used the previous year. In 1961 I revisited the nesting

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areas in order to determine whether they were still active. These sites are treated here in the same sequence in which they were originally discussed (Rozen, 1958, pp. 6–13). Both the nesting sites of *edwardsii* (Cresson) at Strawberry were still active and infested with *Oreopasites*, the anthophorid bee parasitic on *Nomadopsis*. Because the sparsely inhabited nesting site of *linsleyi* Rozen 4 miles east of Sonora was built over, it was no longer available to the species.

Although it was too late in the season for *anthidia anthidia* (Fowler) to be flying at Tuolumne City in July, 1961, I exhumed numerous hibernating larvae and cells from previous years at the "telephone pole site." A great many hibernating *Panurginus* larvae, one of *Oreopasites*, and two probably of *Nomadopsis boharti* Rozen were also uncovered. Because of the paucity of nests eight years before, the site of *anthidia anthidia* closest to the pollen source was not excavated. The third site of this species, on a hard-packed dirt road, is now inaccessible for study, being enclosed by a fence. However, since the tire tracks have deeply eroded, it probably no longer serves as a nesting site.

The clover-visiting *Nomadopsis* (*anthidia anthidia*, *micheneri* Rozen, and *trifolii* Timberlake) at Strawberry and Pinecrest were sparse in 1961, probably as a result of the low rainfall and consequently reduced clover supply. The nesting site of *micheneri*, a bridle path, at Strawberry was no longer used, though the path was still in essentially the same condition as in 1953. The nests of *micheneri* at Pinecrest could not be located, perhaps because of rerouted roads. The nesting area of *trifolii*, of low density in 1953, was totally inactive in 1961, and *Trifolium* was not blooming in the general area. However, *trifolii* was active and abundant a half mile away, where it was collecting pollen from *Mimulus*.

In summary, of the nine nesting sites of *Nomadopsis* studied in Tuolumne County in 1953, three were inhabited, three were not checked (though one was presumed to be inactive), one was obliterated by man, and two were no longer active.

BIOLOGY OF *NOMADOPSIS ZONALIS SIERRAE* ROZEN AND *FILIORUM*, NEW SPECIES

HABITAT: I discovered *Nomadopsis* (*Nomadopsis*) *zonalis sierrae* flying at Tuolumne, Tuolumne County, California, on July 3, 1961. The pollen-collecting site and nesting area were located several hundred yards from the locality where the biologies of *anthidia anthidia*, *trifolii*, and *boharti* had been investigated in 1953 (Rozen, 1958). Although these observations were made too late in the season for these bees (including *fracta* Rozen, which had been common on *Eriodictyon* in 1953) to be flying, a few hiber-

nating larvae of *anthidia anthidia* and presumably of either *fracta* or *trifolii* were excavated from the nesting site of *zonalis sierrae*.

The nesting area occupied more than 20 feet of a gently sloping dirt road in a lumber yard. Infrequently used, the roadway at this point was unshaded, with little or no herbage present on the nesting area. The pollen plant, *Monardella*, grew profusely 100 yards away. The soil at the nesting site consisted of an upper loose layer, which was probably dust during dry weather, and a lower hard-packed stratum in which the larvae of *zonalis sierra* and the other two *Nomadopsis* were found. The soil at this level was rather even-grained, containing few pebbles, and the upper cells occurred where there was no visible moisture.

Nomadopsis (*Macronomadopsis*) *filiorum*, new species, was flying near Bridgeport, Mono County, California (elevation approximately 6500 feet), on June 30, 1961. Although presumably the bees had not yet started their nesting activities, several nests were located on July 10. Sagebrush dominated the country adjacent to the nesting area. The burrows were situated on an unused, nearly horizontal road, where the asphalt surface had partly crumbled. Because of the low density of the population, I could not determine the dimensions of the nesting site. The entire road was unshaded during the day, and the pollen source, *Trifolium*, grew 1 mile away, though undiscovered patches may have existed closer to the nesting site. Near the surface, the soil contained numerous pebbles, but at the cell level these were fewer, and the earth was moist and easily excavated. No other bee was seen nesting in the area.

DEVELOPMENT: The eggs of both *zonalis sierrae* and *filiorum* are similar in appearance and orientation to those of other *Nomadopsis*; their dimensions are listed in table 1. During the first several larval instars, the dorsolateral tubercles on the body are poorly developed, being scarcely visible, and the larva is sedentary on top of the pollen ball. However, in the case of *zonalis sierrae* and probably also in the case of other *Nomadopsis*, an instar with very pronounced dorsolateral tubercles develops next and reorients so that it rests on its back, with the pollen ball cradled on its venter, as described by Rozen (1958). Now facing the posterior end of the cell, the larva remains in that position until through eating. Before defecating, it again reorients, so that the head is directed toward the future exit. Although the complete details regarding the method of moving are still unknown, waves of body contractions progressing posteriorly permit the larva to move forward when the dorsolateral tubercles touch the cell wall.

Both *zonalis sierrae* and *filiorum* have a single generation a year, so that, after defecating, the larva enters a quiescent hibernating stage. In this

regard, they are similar to the other species in the respective subgenera. The larvae (fig. 1) are typical of other *Nomadopsis* and differ only slightly from each other. The mandibles of both *zonalis sierrae* and *filiorum* bear numerous teeth along the upper and lower edges.

TABLE 1
DIMENSIONS (IN MILLIMETERS) OF POLLEN BALLS AND EGGS
OF *Nomadopsis zonalis sierrae* ROZEN AND
Nomadopsis filiorum, NEW SPECIES

	<i>zonalis sierrae</i>	<i>filiorum</i>
Ball diameter		
Number	13	10
Average	3.4	3.7
Range	3.1–3.8	3.5–3.9
Egg length		
Number	5	3
Average	2.1	2.2
Range	2.0–2.3	2.2–2.3
Egg width		
Number	2	4
Average	0.5	0.4
Range	—	0.4–0.5

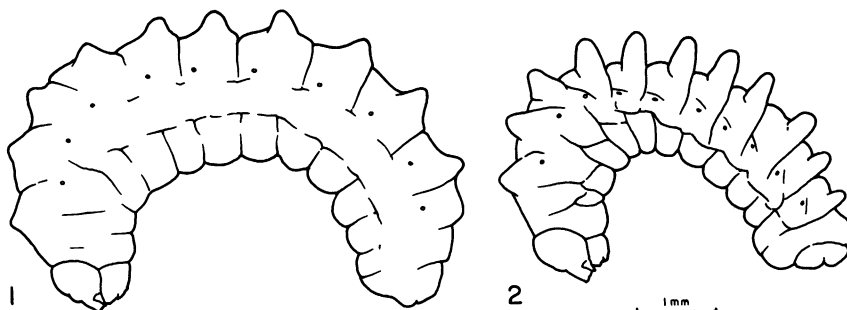
As stated previously (Rozen, 1958), larvae of *Nomadopsis* may have distinctive colors. For example, the body color of the hibernating *anthidia anthidia* is conspicuously yellow. *Nomadopsis edwardsii* is distinctly less yellow, but is slightly more vivid than *euphorbiae* (Cockerell). *Nomadopsis barbata* Timberlake and *puellae* (Cockerell) are cream color, just slightly more vivid than *zonalis sierrae*. Although the larva of *scutellaris* (Fowler) tends to be concolorous with larvae of *barbata* and *puellae*, it shows considerable variation, perhaps an indication of the polylectic habits of the adults.

The following experiment suggests that the color of the larva may be determined by the kind of pollen consumed. If this is true, then the hue of the larva is an expression of its pollen preference, and consequently its taxonomic use is only as reliable as the constancy of its pollen preference. The half-consumed pollen balls of two growing larvae of *zonalis sierrae* were replaced with two half-balls of *edwardsii*. The pollen balls of *zonalis sierrae* normally consist of *Monardella* pollen; those of *edwardsii*, *Potentilla* pollen. The *zonalis sierrae* larvae, consuming the new pollen, quickly developed a yellow hue that in the hibernating form was concolorous with that of normal *edwardsii*. Their color was not intermediate between

that of normal *zonalis sierrae* and that of *edwardsii*, in spite of the fact that their total diet was derived from the pollen balls of both.

Another interesting facet of the experiment was that the larva of a bee considered to be monolectic on *Monardella* pollen would accept and develop on a diet of *Potentilla* pollen. Neither larva pupated successfully, a fate of many *Nomadopsis* larvae reared in the laboratory.

The dorsolateral tubercles of *zonalis sierrae* and presumably of other *Nomadopsis* are most pronounced at the time the feeding larva reorients in the cell so that it rests on its back. Subsequent feeding tends to decrease



FIGS. 1, 2. Hibernating larvae of *Nomadopsis zonalis sierrae* Rozen. 1. Normal larva. 2. Larvae that consumed only part of pollen ball.

the size of the tubercles. As a consequence, larvae (fig. 2) that do not consume the normal amount of food but develop into hibernating forms have an unusual appearance due to the exaggerated tubercles.

MATING: Males and females of *zonalis sierrae*, like those of other *Nomadopsis*, *sensu stricto*, fly together in copula from flower to flower. The male, maintaining a position during copulation exactly like that described for *edwardsii*, is transported to the nesting site after the female has gathered a full supply of pollen. Copulation was never observed to initiate at the nesting site.

Although *filiorum* was not observed mating, males were seen flying over clover and over the nesting site, as do the males of *anthidia anthidia* and *micheneri*. As a consequence these flights are probably search flights for females, and it seems safe to assume that copulation takes place at both places. The flight is extremely rapid, perhaps swifter than that of other species of *Macronomadopsis*.

NEST PATTERN: The burrow entrances of both *zonalis sierrae* and *filiorum* are plugged and surrounded with a low dry tumuli, as are those of all other species of *Nomadopsis*. The dimensions of the tunnels and cells are

given in table 2. The shape and orientation of the cells of both species are the same as for other *Nomadopsis*, and the cell lining is only faintly visible in *zonalis sierrae* and even less apparent in *filiorum*. Both species nest shallowly, as typical for other *Nomadopsis*, and the cells are provisioned with a spherical, wax-coated ball (table 1) on which the egg is deposited.

Sufficient burrows of *zonalis sierrae* were excavated to suggest strongly that there is usually only a single cell to a burrow, though a few branched burrows were uncovered. When the nest pattern of *edwardsii* was checked in the light of this discovery, I found that the same pattern seemed to

TABLE 2
DIMENSIONS (IN MILLIMETERS) OF BURROWS AND CELLS OF
Nomadopsis zonalis sierrae ROZEN AND *Nomadopsis filiorum*, NEW SPECIES

Species	Cell Width	Cell Length	Diameter of Main Burrow
<i>zonalis sierrae</i>	6-7	10-12	5-6
<i>filiorum</i>	6-7	11-13	6

prevail. If so then the figure (Rozen, 1958, fig. 64) of the branching tunnel of *edwardsii* represents an atypical situation. The 1-cm. dip in the tunnel immediately before the cell is characteristic of *zonalis sierrae* as well as *edwardsii*.

The nest of *filiorum* is clearly branching, with a grape-like cluster of cells, as diagrammed for *anthidia anthidia* (Rozen, 1958, fig. 63).

PARASITISM: The nesting site of *zonalis sierrae* was infested with a parasitic bee belonging to the *vanduzeei* complex of *Oreopasites*, and their larvae were recovered from the cells. No *Oreopasites* was seen about the nesting site of *filiorum*.

DESCRIPTION OF NEW SPECIES

Nomadopsis (Macronomadopsis) filiorum, new species

Figures 3-6

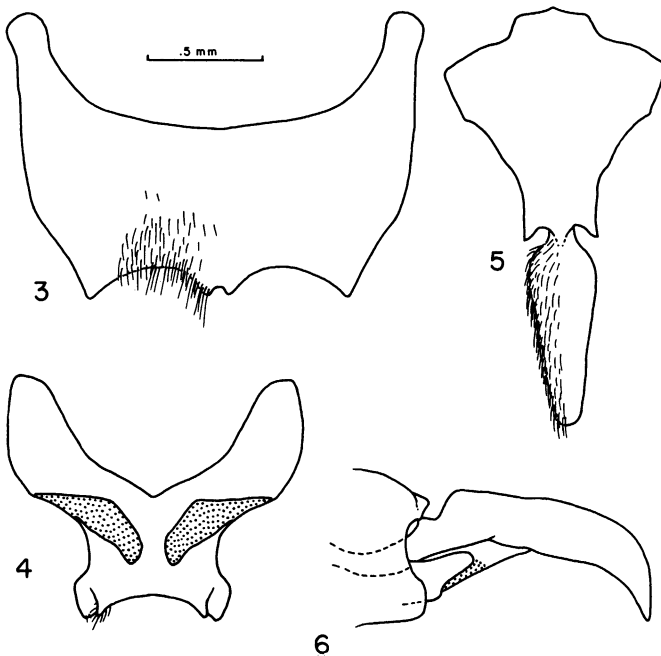
Nomadopsis (Macronomadopsis) micheneri ROZEN, in part, 1958, p. 95.

The males of this apparently typical *Macronomadopsis* readily key to *micheneri* in Rozen (1958). Larger in body size and with a distribution apparently allopatric with that of *micheneri*, they can be recognized by the more attenuated shape of the median process on the eighth metasomal sternum. Further, the tegulae are opaque dark brown, as opposed to those

of *micheneri*, which are a semitransparent lighter brown and usually possess anteriorly an opaque yellow maculation. The females of *filiorum* key to *micheneri*, but the larger body size and dark anterior surface of the middle basitarsus contrast with the smaller body size and light basitarsus of *micheneri*.

MALE: Length, approximately 10 mm.

Head: As described for *micheneri*, except for the following: Clypeal



FIGS. 3-6. Male terminalia of *Nomadopsis filiorum*, new species. 3. Sixth metasomal sternum, ventral view. 4. Seventh metasomal sternum, ventral view. 5. Eighth metasomal sternum, ventral view. 6. Apex of genitalia, lateral view.

length and protuberance intermediate between that of *micheneri* and that of *anthidia*, i.e., similar to that of *zebrata* (Cresson); supraclypeal area half as long as broad. Pedicle with very small, light maculation on ventral surface or dark. Labial palpus with basal segment slightly more than one and one-half times length of other segments together and at broadest point narrower than length of last segment.

Mesosoma: As described for *micheneri*, except for the following: Hair on dorsum grayish white. Mesoscutum with posteromedial part punctate,

punctures being approximately two puncture widths apart. Tegulae nearly opaque dark brown, without light maculation anteriorly. Middle legs with tibia possessing median dark maculation larger than that in *micheneri*; tarsus with segments 2 to 5 dark. Hind legs with basitibial plate light and with light maculation extending short way down anterior surface of segment; two specimens with light maculation on dorsal surface at apex; basitarsus with anterior surface partly light; other segments dark.

Metasoma: As described for *micheneri*. Pygidial plate apically pointed as in *micheneri*; eighth sternum (fig. 5) with posterior process more attenuate than in other *Macronomadopsis*; genitalia in ventral view as figured for *zebrata* (Rozen, 1958, fig. 177); other sterna and lateral view of genitalia as illustrated (figs. 3–6).

FEMALE: Length, 10–11 mm.

Head: As described for female of *micheneri*, except for the following: Clypeal length intermediate between that of *micheneri* and that of *anthidia*. Mouth parts like those of male.

Mesosoma: As described for *micheneri*, except for the following: Pronotum with lateral angles having very small light dashes. Mesoscutum with punctation slightly denser than that in *micheneri*. Tegulae like those of male. Legs completely dark, except fore and middle tibiae with light basitibial area. Wings with costal sclerite completely dark.

Metasoma: Like that of *micheneri*, except for the following: Light bands generally broader than those of *micheneri*. First tergum with band either complete or but very briefly interrupted medially; band very shallowly excavated from behind by sublateral dark spots; second tergum narrowing medially but not interrupted medially and very shallowly excavated from behind by sublateral dark spots; third and fourth terga each with band more uniform in width, not interrupted medially and not interrupted by sublateral dark spots; fifth tergum with band either broad and briefly interrupted medially or very small, being represented as two indistinct light marks.

TYPE MATERIAL: Holotype male, allotype, and six male paratypes and one female paratype: Bridgeport, Mono County, California, June 30, 1961 (J. G. Rozen); four male paratypes and one female paratype, same, except July 10, 1961. The holotype is deposited in the American Museum of Natural History.

DISCUSSION AND DISTRIBUTION: At the time of revising the genus, I had six specimens of *filiolum*, all from Mono County (Walker Lake, Mono Lake, and Bridgeport; Rozen, 1958, map 5). Because these specimens were few in number and poorly preserved, I tentatively assigned them to *micheneri*, though their atypical appearance was discussed. An examination

of well-preserved material upon which this description is based has resulted in the discovery of additional characteristics distinguishing *micheneri* from *filiorum*. Because of the distinctness of the two populations, *filiorum* is regarded as a distinct species.

Though most similar to *micheneri*, *filiorum* shows strong resemblances to the other *Macronomadopsis*—*anthidia*, *zebrata*, and *barri* Rozen.

This species has been collected from June 30 to July 23.

FLOWER DATA: Males were found patrolling *Trifolium* patches, just as do males of *micheneri*, in search of mates. Consequently this species, like *micheneri*, probably collects pollen from clover.

***Nomadopsis* (*Micronomadopsis*) *snellingi*, new species**

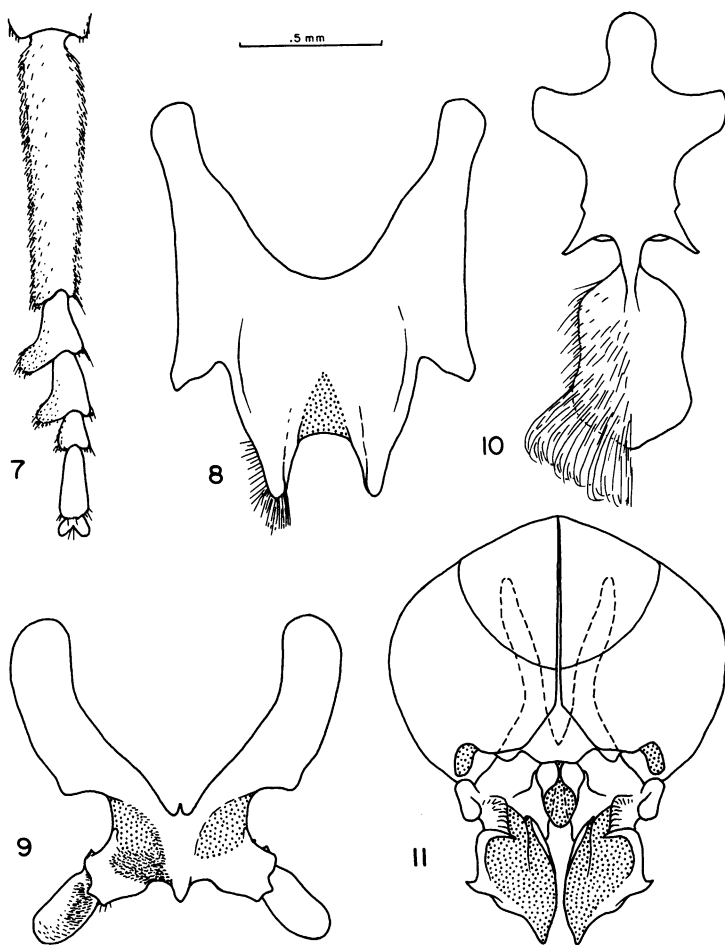
Figures 7–11

The males of *snellingi* can be recognized immediately because of their many peculiar features. They are the only *Nomadopsis* to possess distinct black tips to the wings, as found in males of *Hypomacrotera*, and the bright yellowish flagella are found only in *trifolii* Timberlake and *snellingi*. Further, the middle tarsi are longer than those of other *Nomadopsis*, and the shape of the hind tarsi (fig. 7) is unique. In both males and females, the length of the mouth parts is diagnostic. Although they are nearly as long as those of *zonalis* (Cresson), the relative lengths of the component parts differ, so that the basal segment of the labial palpus is only one and a half times the length of the other segments, as compared with seven to eight times in *zonalis*. Also, the first segment is shorter than the head length in *snellingi*. The tips of the mouth parts, when in repose, extend to between the front coxae, as in *zonalis*.

Because of the odd assortment of characters, neither the males nor the females can be keyed out in my previous work on the genus.

MALE: Length, approximately 8 mm.

Head: Integumental background color black; color of light markings yellow. Hair somewhat yellowish, normal in length and in density, being about as dense as that of *trifolii*. Inner orbits converging very slightly toward clypeus. Labrum light. Clypeus protuberant and elongate, so that median part extending below lower margins of eyes; color light; punctuation moderately light; each paraocular area light below and laterad of line drawn from point one-third of way down inner orbit to point just below antennal socket; subantennal areas light; supraclypeal area light and long, being about as long as wide; distance between antennal sockets slightly more than one and one-half times diameter of one socket; vertex not extending greatly above level of upper margins of eyes; vertex with shiny glabrous area laterad of each lateral ocellus. Antennal scape and pedicel



FIGS. 7-11. Male tarsus and terminalia of *Nomadopsis snellingi*, new species. 7. Left hind tarsus, dorsal view. 8. Sixth metasomal sternum, ventral view. 9. Seventh metasomal sternum, ventral view. 10. Eighth metasomal sternum, ventral view. 11. Genitalia, ventral view. The scale refers to figures 8 to 11.

with ventral surface light; first and second flagellar segments subequal in length; other segments, except terminal one, broader than long; flagellar color orange-yellow throughout; hairs in row along dorsolateral part of flagellum absent. Mandibles light at base; galeae slightly shiny, though with distinct minute papillae on upper surface; labial palpus with basal segment approximately 1.5 times length of other segments combined.

Mesosoma: Integumental background color black; hair amberish,

moderately long and moderately dense and plumose. Pronotum with each lateral angle having transverse light dash; lateral lobes dark or with small light maculation. Mesoscutum with anterior part having punctures fine and dense, being almost contiguous; punctures sparse posteromedially. Tegulae transparent, very light brown except for yellow opaque maculation anteriorly. Mesoscutellum with disk moderately and irregularly punctured; color dark, except for narrow light band along posterior margin. Metanotum light or with dark area along anterior margin. Propodeal triangle microscopically sculptured. Legs with color of light maculation same as light maculations on face. Forelegs with coxae dark or with small apical light maculation; trochanter with small apical light maculation on ventral surface; femur with apical three-fourths of antero-dorsal surface light and with apical one-third of posterior surface light; tibia and tarsus light. Middle legs with color pattern of femur, tibia, and tarsus as described for forelegs; tarsus extremely long, being almost twice length of fore tarsus and having first segment longer than femur. Hind legs with femur having at most apical one-fourth light; tibia light, except for large, oblong, dark maculation on anterior and posterior surfaces; tarsus light and with configuration as figured (fig. 7). Wings hyaline except for pronounced dark spot extending from tip of marginal cell to apex on forewing; humeral plate light, veins brown.

Metasoma: Integumental background color of dorsum dark brown; hair color toward apex of metasoma brown. Terga with color of light bands same as color of light maculations on face; bands moderate in width; marginal area almost opaque dark brown. Terga 1 to 5 with bands nearly uniform in width and moderately shallowly excavated from behind by sublateral dark spots; sixth tergum with band not extending laterad of sublateral dark spots. Sterna 2 and 3 each with indistinct sublateral brushes of fine hairs along posterior margin. Pygidial plate rounded and with well-developed marginal carina and rather smooth interior; sterna and genitalia as figured (figs. 8-11).

FEMALE: Length, 8.5 mm.

Head: Integumental background color and color of light markings like those of male. Hair like that of male, except not so yellowish, sparser, and therefore not so conspicuous. Inner orbits subparallel. Labrum dark. Clypeus protuberant and with median portion extending below lower margin of eyes; color dark, except for median longitudinal light dash and for irregular light maculations laterally; each paraocular area dark, except for irregularly shaped, narrow, light area along margin of eye and along epistomal suture; in one specimen light area reduced and interrupted so that one area occurs along margin of eye and other along

epistomal suture; subantennal areas light; supraclypeal area light; vertex like that of male, except projecting considerably above upper margins of eyes. Antennal scape and pedicle entirely dark; flagellum darker than that of male, being brown at base and becoming somewhat paler toward apex. Mouth parts like those of male.

Mesosoma: Integumental background color like that of male; hair grayish white, with only tinge of amberish on dorsum, otherwise like that of male. Pronotum with each lateral angle with transverse light dash; lateral lobes dark. Mesoscutum with punctuation like that of male, except posteromedial portion glabrous. Tegulae transparent light brown. Mesoscutellum like that of male, except light band nearly or completely absent. Metanotum dark, except for narrow light band along posterior margin. Propodeal triangle like that of male. Legs brown, except for basitibial areas of forelegs and middle legs; all legs normal in size, not as in male. Wings hyaline and without apical dark spot found on males; humeral plate partly light; veins brown.

Metasoma: Integumental background color like that of male. Terga with color of light markings same as color of light maculations on face; bands moderately narrow; marginal area opaque brown. Terga 1 to 4 with bands rather uniform in width, uninterrupted medially, and moderately excavated from behind by sublateral dark spots; fifth tergum with band somewhat broader than others but briefly interrupted medially on one specimen.

TYPE MATERIAL: Holotype male, allotype, and three male (one teratoid) and two female paratypes: Squaw Valley, Fresno County, California, June 18, 1957, on *Salvia* (R. R. Snelling). The holotype is deposited in the California Academy of Sciences, San Francisco. The species is named for Mr. Roy R. Snelling.

DISCUSSION AND DISTRIBUTION: Although markedly distinct, *snellingi* is in many ways very similar to *trifolii*, which belongs to the *fracta* group of *Micronomadopsis*. Males of the two species not only possess similar genitalia, but share the following characteristics: bright yellow antennae, yellow color of maculations on head and body, similar patterns of yellow maculations, and hair brushes on the second metasomal sternum, though these brushes are not very pronounced in *snellingi*. Further, though not previously noticed, the wings of *trifolii* exhibit faint apical infuscations. The females of the two species resemble one another to some extent, but, since females of *Nomadopsis* are not so distinctive as the males, such similarities are less significant.

FLOWER DATA: *Nomadopsis snellingi* is known only from the type series, collected on *Salvia*.

***Nomadopsis (Micronomadopsis) beamerorum*, new species**

Figures 12–15

This small species, known only from two male specimens, can be distinguished from all other *Nomadopsis* on the basis of the flattened, slightly clubbed antennae (fig. 12). Although *beamerorum* keys out to *phaceliae* Timberlake in my monograph on *Nomadopsis*, the two species are not phylogenetically similar and can be distinguished easily on the basis of the antennal club and on the basis of the longer antennal segments of *beamerorum*.

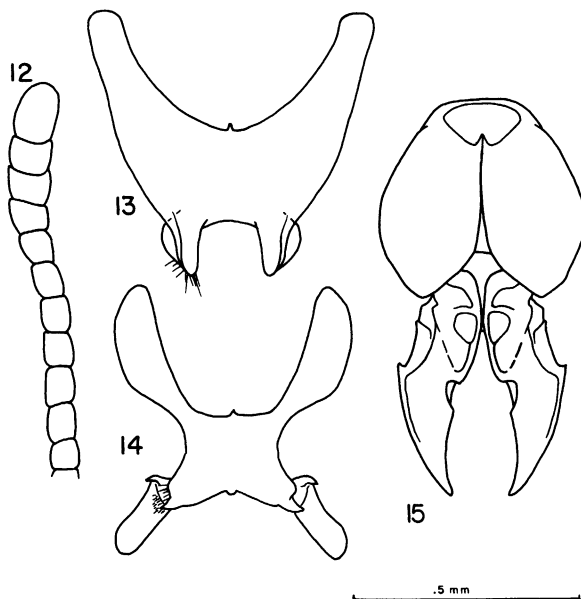
MALE: Length, approximately 4.5 mm.

Head: Integumental background color black; light markings very pale cream color to white. Hair white, of moderate length and rather sparse. Inner orbits converging somewhat toward clypeus, but not so strongly as do those of *callosa* Timberlake. Labrum light. Clypeus with median part extending below level of lower margins of eyes, distinctly more so than that of *callosa*; clypeus moderately protuberant; color light; punctuation and plumosity about like those of *callosa*; each paraocular area light below and laterad of line drawn from point halfway down inner orbit to just below antennal socket; subantennal areas light; supraclypeal area light; area very long, being one and one-third times as long as wide and having width equal to diameter of antennal socket; antennal sockets separated by distance slightly less than diameter of antennal socket; vertex like that of *callosa*. Antennal scape and pedicle dark; flagellum elongate, with segments 2 through 7 longer than wide and cylindrical; segments 8 through 11 flattened on one surface and expanded, forming a club (fig. 12); in *callosa* apical flagellar segments flattened on one surface but not expanded to form club; flagellar coloration like that of *callosa*. Mandibles light at base; galeae papillate; mouth parts normally long, somewhat longer than in *callosa*; stipes and galea subequal in length; labial palpus with basal segment twice as long as following segments together.

Mesosoma: Integumental background color black. Hair as described for *callosa*, except apparently sparser and perhaps not quite so plumose. Pronotum with light dashes of lateral angles confluent, forming a light band on posterior edge of pronotum; lateral lobes light. Mesoscutum with punctuation like that of *callosa*, except punctures sparser posteromedially than anteriorly. Tegulae like those of *callosa*. Axillae normal, not forming callosities; mesoscutellum mostly dark, but with irregular light flecks along posterior margin. Metanotum normal, without callosities, and completely light. Propodeal triangle sculptured but only slightly dulled. Legs with color of light markings same as color of facial markings. Forelegs

with light maculations as in *callosa*. Middle legs with light maculations as in *callosa*, except coxa and trochanter in some individuals completely dark; tarsus equal in length to fore tarsus. Hind legs like those of *callosa*, except dark area on anterior surface of tibia of some specimens larger; tarsus slightly shorter and more robust than that of *callosa* and tending to be darker. Wings like those of *callosa*.

Metasoma: Integumental background color of dorsum black. Terga as



FIGS. 12-15 Male antenna and terminalia of *Nomadopsis beamerorum*, new species. 12. Ventral surface of antenna. 13. Sixth metasomal sternum, ventral view. 14. Seventh metasomal sternum, ventral view. 15. Genitalia, dorsal view. The scale refers to figures 13 to 15.

described for *callosa*. Terga 1 to 5 with bands moderately narrow, similar in width, and shallowly excavated from behind by sublateral dark spots; sixth tergum with band slightly wider and not expressed laterad of sublateral dark spots; seventh tergum normal in shape. Genitalia and terminal sterna as illustrated (figs. 13-15).

TYPE MATERIAL: Holotype male, Balmorhea, Reeves County, Texas, May 1, 1954, on *Prosopis* (R. H. Beamer); one male paratype, Imperial, Pecos County, Texas, April 10, 1954 (L. D. Beamer). The holotype is deposited in the Snow Entomological Museum, University of Kansas,

Lawrence. This species is named for Mrs. L. D. Beamer and the late Professor R. H. Beamer.

DISCUSSION AND DISTRIBUTION: This species is similar to *callosa* as judged by the strong similarity in size, color pattern, flattening of the antennae, shape of the sixth and seventh metasomal sterna, and narrowed penis valves. However, because of the absence of callosities and the presence of clubbed antennae, *beamerorum* cannot be confused with *callosa*.

It does not show distinct affinities with any of the species groups of *Micronomadopsis* and consequently does not support the insertion of *callosa* in the *euphorbiae* group. These two species should probably be regarded as a fourth group in the subgenus.

FLOWER DATA: The holotype was collected from *Prosopis*.

***Nomadopsis solitaria*, new species**

Figures 16–20

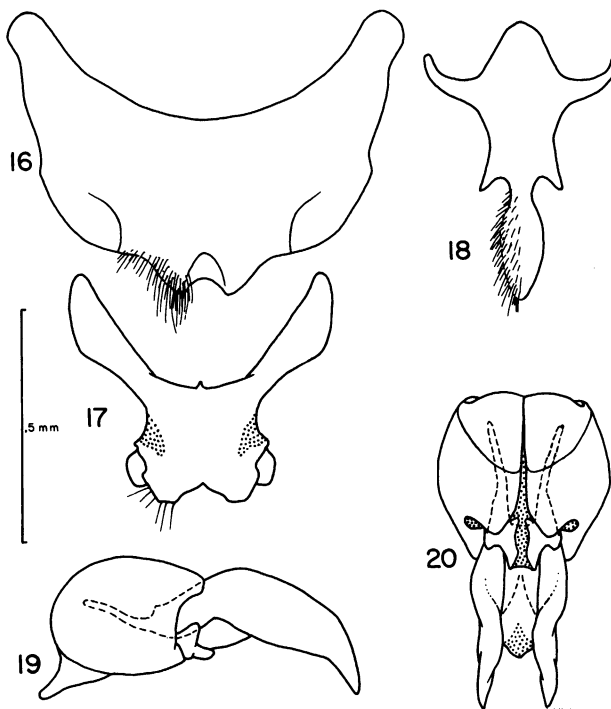
This species, known from a single male specimen, is similar to *smithi* Rozen and *xenus* Rozen and runs to them in the key to males (Rozen, 1958). However, its completely dark clypeus, darker legs, and distinctive genitalia and terminal metasomal sterna serve adequately to distinguish it from the other two species.

MALE: Length, 5.0 mm.

Head: Integumental background color black, light markings pale yellow. Hair grayish white, moderate in length and density. Shortest interocular distance about equal to length of eye. Inner orbits converging slightly toward clypeus. Labrum dark. Clypeus short, so that median part extending but slightly below level of lower margins of eyes, and not protuberant; color dark; each paraocular area with a thin light stripe adjacent to the inner orbit from halfway down inner orbit nearly to anterior mandibular articulation; subantennal areas dark; supraclypeal area dark; vertex dulled owing to microscopic sculpturing, but not so dulled as that of *smithi* though more so than that of *xenus*; vertex extending but slightly above upper margins of eyes. Antennal scape and pedicle dark; flagellum with under surface dark tawny. Mandibles light at base; galeae with upper surface distinctly papillate, though perhaps somewhat shinier than those of *smithi*; labial palpus with basal segment slightly less than twice as long as others combined.

Mesosoma: Integumental background color black. Hair grayish white. Pronotum completely dark. Mesoscutum with punctuation similar to that of *xenus*; integumental sculpturing absent. Tegulae with anterior part dark opaque brown; posterior part transparent light brown; striations inconspicuous, about like those of *xenus*. Mesoscutellum with punctuation simi-

lar to that of *xenus*. Propodeal triangle with basal part rugosely sculptured as in *xenus* and *smithi*. Legs with color of light maculations tawny yellow. Forelegs with femur dark, except for small, apical, light maculation; tibia light on anterior and dorsal surfaces; tarsus light to tawny and broad, like that of *smithi*, *xenus*, *boharti*, and *Macronomadopsis*. Middle legs with femur



FIGS. 16–20. Male terminalia of *Nomadopsis solitaria*, new species. 16. Sixth metasomal sternum, ventral view. 17. Seventh metasomal sternum, ventral view. 18. Eighth metasomal sternum, ventral view. 19. Genitalia, lateral view. 20. Genitalia, ventral view.

dark; tibia dark, except for basitibial area; tarsus dark. Hind legs with femur dark; tibia dark, except for basitibial plate; tarsus dark. Wings hyaline, veins and humeral plate brown.

Metasoma: Integumental background color dark brown. Terga with color of bands tawny yellow, same as light maculations on fore tibiae; bands narrow; terga finely pitted, duller than that of *xenus* but shinier than that of *smithi*; marginal areas transparent light brown. First tergum with band narrowing slightly medially and moderately interrupted from

behind by sublateral dark spots; terga 2, 3, and 4 with bands narrow, nearly uniform in width, and without sublateral dark spots; fifth tergum with band slightly narrower than preceding ones and indistinctly interrupted by sublateral dark spots; sixth tergum with band distinct but narrow and not represented laterad of sublateral dark spots. Pygidial plate short and sharp-pointed as in *xenus* and *smithi*; sterna and genitalia as figured (figs. 16–20).

TYPE MATERIAL: Holotype male, Termo, Lassen County, California, June 9, 1960 (G. I. Stage). This specimen, the property of the California Insect Survey, is being retained at the American Museum of Natural History for an indefinite period.

DISCUSSION AND DISTRIBUTION: Both *xenus* and *smithi*, together with *boharti*, were not assigned to a subgenus because of their unusual characteristics. Further, because of the difference in their genitalia, *xenus* and *smithi* were considered probably only superficially similar. Now, with the discovery of *solitaria*, the characters of the males that bind these three forms together seem stronger and probably denote a close relationship in spite of the rather dissimilar genitalia. Males of *xenus*, *smithi*, and *solitaria* are about the same size and have similar narrow, metasomal, light bands. Their faces are non-protuberant, the fore tarsi are laterally expanded (as are those of *Macronomadopsis*), and the propodeal triangles are rugously sculptured basally. The fifth metasomal sternum of each (and also of *Macronomadopsis*) bears a short median process. The other terminal sterna are rather similar and in some respects those of *solitaria* are intermediate between those of the other two species.

The phylogenetic relationship of *smithi*, *xenus*, and now *solitaria* with *Macronomadopsis* continues to be in question, although the genitalia of *solitaria*, especially in lateral view (fig. 19), are surprisingly similar to those of *Macronomadopsis*. Also, the relationship of *boharti* to these three species and to *Macronomadopsis* is obscure. It shares with all of them the broad fore tarsi and the short median process of the fifth metasomal sternum.

FLOWER DATA: None.

BIBLIOGRAPHY

ROZEN, JEROME G., JR.

1958. Monographic study of the genus *Nomadopsis* Ashmead (Hymenoptera: Andrenidae). Univ. California Publ. Ent., vol. 15, pp. 1–202, 218 text figs., 17 maps.

