

Table 2.—Relative abundance of brown soft scale predators (Coccinellidae) in Rio Grande Valley citrus groves in 1966.

Species	% of total collected
<i>Chilocorus cacti</i> (L.)	64.0
<i>Cycloneda sanguinea</i> (L.)	19.0
<i>Olla abdominalis</i> (Say)	9.0
<i>Thalassa montezumae</i> Mulsant	8.0

C. rufilabris Burmeister, were much more abundant in the groves than coccinellids. Although lacewings have been observed feeding on brown soft scale, they are not considered effective predators.

DISCUSSION

The general trend of the population of brown soft scale in Rio Grande Valley citrus groves continued downward through 1966. The peak levels occurred in September, characteristic of the tendency in recent years for the highest populations to occur in fall. Before 1965, the highest levels occurred in summer, or about the time applications of insecticides for control of cotton insects ended. The tendency for higher levels to occur later in the season appears to have begun at about the time use of LV aerial applications of methyl parathion became widespread. Researchers have suspected in the past that drift into citrus groves of methyl parathion from applications to cotton plantings at least contributed to the extraordinary buildup of the scale (Hart et al. 1966b). Recently, studies of drift conducted at our laboratory (Hart et al., unpublished data) indicated that under some conditions reduced drift occurs with ULV (i.e., undiluted technical) applications; thus the correlation between ULV sprays and the downward trend in scale population is worthy of continued study. The area where the greatest scale populations occur continues to be the mid-

valley area where cotton and citrus plantings are widely interspersed. Insecticide applications are generally applied to cotton at 5-7 day intervals from April through August in the lower Rio Grande Valley.

Population levels of parasites continued to demonstrate some relationship to population levels of scale. However, this relationship becomes obscure during the summer months (June-August), when drift in cotton spray programs may deplete parasite populations. Whenever brown soft scales are found in significant numbers in the Rio Grande Valley citrus groves, parasites also occur. Parasites were found in the midvalley area throughout the cotton-spray season during 1966.

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Morphology and Biology of a Nest-Producing Mite, *Bakericheyla chanayi* (Acarina: Cheyletidae)¹

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ABSTRACT

Bakericheyla chanayi (Berlese & Trouessart) is recorded from the following fringillid birds in California: *Zonotrichia leucophrys nuttalli* Ridgway, *Z. l. gambeli* (Nuttall), *Z. l. pugetensis* (Grinnell), *Z. atricapilla* (Gmelin), and *Pipilo erythrophthalmus* (L.) subspecies. The female is redescribed. The male, nymph, and larva are described for the 1st time. The mites are blood-

sucking parasites which construct "nests" of silk on the skin of the host. In the nests occur all stages of the mite. Incidence of infestation is higher in migratory subspecies of white-crowned sparrows than in resident species in California. The health of infested birds is impaired by the mites.

It is well known that certain mites such as the tetranychids produce silk which they spin into protective webs. Less commonly recognized today is the

occurrence of this phenomenon among certain members of the Cheyletidae symbiotic with avian hosts.

Mégnin (1883) in discussing *Cheyletus* [sic] *ropalpus* Mégnin, 1878, noted the presence of silk plaques serving as protective nests for the mite.

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of immatures on the skin of the avian host, "*Cardinalis fulgens* [Fringillidae]." In the description of the "nest" or nest, of the mite he noted that the nest resembled a small spot of mold about 2 mm diam composed of a felting of very fine fibers attached at their proximalities to the skin of the bird. Under the webbing were eggs in all stages of development, and immature mites. Berlese (1889) made a similar observation concerning *Cheyletiella chanayi* Berlese & Trouessart, 1889. He noted the mites were widely disseminated in white silken nests on the skin of *Fringilla coelebs* L.

Except for the publication by Volgin and Nikolaeva (1965), recent authors working with these and closely related mites have made no mention of nest formation or silk production, hence it was of considerable interest to us when we encountered birds in California so heavily infested with cheyletids that the skin appeared almost covered with their white cottonlike nests. Examination of the mites showed that they belong to the genus *Bakericheyla* Volgin (1966), and except for a somewhat smaller overall size they differ only slightly from the description and figures published for the female of *Neocheyletiella chanayi* (Berlese & Trouessart) by Baker (1949). Through the courtesy of Dr. E. W. Baker, 2 specimens of this species from the Berlese collection deposited in the U.S. National Museum were lent for comparative study. Except for somewhat greater size these specimens agree in every detail with the species collected in California. Some of the dorsal setae are missing in the Berlese collection specimens, but the setal alveoli remain visible.

A redescription of the female of *B. chanayi* is given here, based on specimens collected in California. The male, which was mentioned but not described by Berlese (1889), is described for the 1st time as well as the nymph and larva.

Bakericheyla chanayi (Berlese & Trouessart)
1889

FEMALE.—Fig. 1, 2.—Idiosoma 470–513 μ long by 314–356 μ wide.

Gnathosoma.—86–104 μ long to tip of palpi; 86–87 μ wide. Pair of gnathosomal setae ca. 55 μ long and very fine. Palpal femur with long, pectinate, dorsal seta, sparsely pectinate ventrolateral seta and a simple ventral seta; genu with long, pectinate, dorsal seta, shorter pectinate, lateral seta; tibia with several short, nude setae and 2 longer, sparsely pectinate dorsal setae; claw well developed, curved (6 μ from base to apex of curve), and without teeth. Peritreme forming a broad M pattern composed of long, slender segments.

Dorsum.—Propodosomal shield small, 110–116 μ long by 156–165 μ wide, as figured, with some invasion of posterolateral margins by cuticular striations; anterolateral margin with pair of long, pectinate outer setae and pair of very short, simple, inner setae; lateral margins with pair of long, pectinate setae; posterior margin with pair of long, pectinate setae just off posterolateral margins and pair of short, simple, inner setae either on or just off the shield

margin. Pair of long, pectinate, scapular setae, somewhat shorter than longest setae of propodosomal shield. Hysterosoma separated from propodosoma by pattern of cuticular striations, without shield; 2 pairs of short, simple anterior setae, 12 μ long, arise from slight sclerotizations of the cuticula as figured; 2 pairs of slightly longer submedian setae, 17 and 33 μ long, respectively, arise near middle and posterior $\frac{1}{4}$ of hysterosoma; pair of long, simple, dorsal setae arise near posterior margin and a similar pair may appear dorsal, terminal, or ventral depending on distortion in mounting. Genito-anal opening flanked dorsoterminally by 2 pairs of short, simple setae.

Venter.—Pair of delicate propodosomal setae over 90 μ long arise between coxae II. Hysterosoma with 2 pairs of submedian setae about 95 μ long at levels of coxae III and IV; similar pair between coxae IV and genito-anal opening. Genito-anal opening bordered by broad lips in an inverted V shape; 2 pairs of rather short, simple setae flanking lips; 2 longer pairs of setae more anterolateral in position and extending past posterior margin of body.

Legs.—Leg I 200 μ long to tip of tarsus, extending slightly beyond palpi; tarsus I 27–31 μ long exclusive of ambulacrum; leg IV not extending past posterior margin of body. All legs with 2 claws and comblike pulvillus. Coxal setal formula 2, 1, 2, 2; setae simple, weak, and relatively long; coxal apodemes only partially discrete posteriorly on coxae II, III, and IV. Longer setae of legs lightly pectinate. Femur of leg I with 2 long, pectinate dorsal setae and a similar posteroventral seta; genu with anterior marginal, short, deeply serrate seta (also on genu II) and a short, mushroom-shaped solenidion distal to base of long, pectinate dorsal seta as in Fig. 6; tibia with short, rodlike, dorsal, subterminal solenidion, 2 simple, short to medium, ventral setae, and 2 long, pectinate, dorsal setae; tarsus with moderate dorsal, subterminal projection (more prominent than figure by Baker (1949)) extending over basal part of ambulacrum; a rather short seta and a somewhat longer solenidion arising near apex of dorsal prominence, and 2 rather long nude setae on its distal face; 4 simple setae near base of ambulacrum, extending almost to or slightly beyond tips of claws; 1 simple seta on midventral part of tarsus.

MALE.—Fig. 3–6.—Very similar in general facies to female. Idiosoma 345 μ long by 243 μ wide.

Gnathosoma (Fig. 5) as described for female, but relatively more slender; 84 μ long to tip of palpi and 73 μ wide. Propodosoma dorsally as in female but shield 98 μ long and 122 μ wide. Dorsal hysterosoma (Fig. 4) resembling that of female in location of 2 anterior pairs of short setae, but sclerotized cuticular origins of the setae less distinct; 2 pairs of more posteriorly situated submedian setae similar to those of female but smaller; genito-anal opening a narrow lipped slit dorsally at level of posterior $\frac{1}{4}$ of hysterosoma; 2 pairs of short, simple setae flanking lips, anterior pair shortest; slightly anterolaterally arises a pair of short setae and directly posterior to them a pair of long, simple setae extending beyond margin of

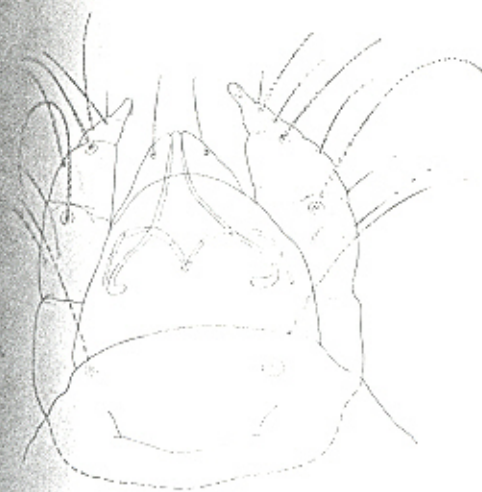


FIG. 1-4.—*B. chanayi*. 1, Female, ventral view; 2, same, dorsal view; 3, male, ventral view; 4, same, dorsal view.

body. Prominent sclerotized internal penis leading to genito-anal orifice (Fig. 4). Venter similar to that of female but lacking genito-anal opening and associated setae; in their place is a 5th pair of long, sparsely pectinate, submedian setae arising subterminally (Fig. 3).

Legs similar to those of female but legs IV extending beyond posterior margin of relatively small gnathosoma. Chaetotaxy of legs as in female (Fig. 6).

NYMPH.—Very similar in general appearance to female but smaller. Idiosoma of moulting nymph 330μ long by 254μ wide. Gnathosoma 80μ long to tip



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FIG. 5.—*B. chanayi*, dorsal view of male gnathosoma.

by 72μ wide; as in female but femur with only one seta and genu with single seta. Setation and appearance of venter as in male except for presence of terminal, papillalike anal pore flanked by 2 pairs of long, short setae arising from raised alveoli. Dorsal shield as in female; propodosomal shield 92μ long by 17μ wide. Legs as in adults.



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FIG. 6.—*B. chanayi*, dorsal view of genu-tarsus I of male.

LARVA.—Idiosoma 330μ long by 173μ wide. Greatest width at level between coxae II and III. Setal pattern of dorsal idiosoma as on female. Propodosomal plate indistinct but ca. 73μ long by 73μ wide. Ventral podosoma with 2 pairs of long, simple, submedian setae; pair of long, simple, posteromarginal setae on either side of terminal anal pore; 2 pairs of short, simple setae flanking anal pore. Basal gnathosomal setae arise more anteriorly than in adult. Palpal femur and genu each with a single seta, dorsal, pectinate, and long; tibia as in adult. Legs I–III with dorsal chaetotaxy as in adult but lacking some of ventral setae of adult. Coxa I with 1 filiform, long, simple seta; coxae II and III with no setae.

The plesiotype female, male, nymph, and numerous additional specimens were taken from an immature white-crowned sparrow, *Zonotrichia leucophrys* (Forster) subspecies, collected 26 Jan. 1967 at Kensington, Contra Costa County, Calif., by D. P. Furman. The plesiotype larva and several additional specimens were taken from *Z. l. nuttalli* (Ridgway) collected at Berkeley, Alameda County, Calif., in February 1952 by O. E. Sousa. Additional specimens have been taken from the rufous sided towhee, *Pipilo erythrophthalmus* (L.) subspecies, collected 23 Mar. 1966 at the Hopland Experimental Range, Mendocino County, Calif., by B. Nelson and from *Z. atricapilla* (Gmelin) taken at Berkeley, Calif. As discussed below, numerous other white-crowned sparrows in California have been observed with apparent signs of infestation with this mite. Representative specimens of the mite have been deposited with the U. S. National Museum.

In Baker's (1949) redescription of *B. chanayi* the idiosoma is given as 493μ long and 333μ wide. These measurements are within the range of those found on the presently reported collections. However, the 2 specimens examined of this species from the Berlese collection are somewhat larger, with an idiosoma 594μ long by 405μ wide; other measurements, as of legs and dorsal shield, also are proportionately larger. In all other morphological respects the Berlese specimens agree with the adult female mites described here.

The species *B. faini* (Lawrence), 1959, is very close to *B. chanayi*. In view of the demonstrated wide geographic distribution of the latter species in Europe and North America, a comparative study should be made to clarify any distinction between *B. faini* and *B. chanayi*. Of the 8 species now known in the genus *Bakericheyla*, 7 have been taken only from birds; the host of the remaining species, *B. microrhyncha* (Berlese & Trouessart), 1889, is unknown. Similarly birds are the only known hosts for species of the 2 closely related genera, *Neocheyletiella* Baker, 1949, and *Ornithocheyletia* Volgin, 1964.

INCIDENCE AND INTENSITY OF INFESTATION

The presence of *Bakericheyla* in the white-crowned sparrows of Berkeley, Calif., was first observed by Sousa in 1952 while he was studying the blood parasites of the fringillid birds of that area. In a total of 1024 fringillid birds captured in the Berkeley area, 340 corresponded to the species complex of *Z. leuco-*

Table 1.—Incidence of *B. chanayi* in the white-crowned sparrows of Berkeley, Calif.

Host	Status	No. examined	Positive	% positive
<i>Zonotrichia leucophrys</i>				
<i>Z. l. nuttalli</i>	Resident	196	6	3.0
<i>Z. l. pugetensis</i>	Migratory	132	21	15.9
<i>Z. l. gambeli</i>	Migratory	12	2	16.6
Totals		340	29 ^a	8.5

^a An additional infestation was observed in an undetermined subspecies of *Z. leucophrys*.

phrys. Three subspecies are recorded for the area, *Z. l. nuttalli* (Ridgway), *Z. l. gambeli* (Nuttall), and *Z. l. pugetensis* (Grimell). Both the Gambel white-crowned sparrow and the Puget Sound white-crowned sparrow are migratory subspecies visiting the Berkeley area during the wintering period. The Nuttall white-crowned sparrow is the resident subspecies.

A total of 30 white-crowned sparrows have been found infested by *B. chanayi*. Twenty-six were found positive at the time of capture, and 4 were detected positive some time after capture, while in captivity in the laboratory. The incidence of *B. chanayi* in the migratory subspecies (*pugetensis* and *gambeli*) was found to be considerably higher than in the resident counterpart (*nuttalli*). Table 1 shows the relative frequency of *B. chanayi* in the white-crowned sparrows we examined in the Berkeley area.

The marked difference in the infestation rate among local and migratory subspecies may be the result of higher susceptibility in the nonresident birds. It could also suggest a higher rate of infestation in their corresponding breeding grounds. The suggestion that transmission may also occur locally is further strengthened by the fact that *B. chanayi* has been

detected also in other resident birds, such as *Pipilo erythrophthalmus* (L.).

The number of "nests" found on an animal's body surface varied from 2, in very light infestations, to several hundreds (300-400) in very heavy infestations. The degree of infestation was observed to increase under conditions of prolonged captivity in the laboratory. The heaviest infestations were seen in the Puget Sound white-crowned sparrows (Fig. 7). Infestations in these sparrows became more acute during captivity. Infestations in the Nuttall white-crowned sparrows were of less intensity, usually less than 10 nests, even after extended periods of captivity. Table 2 presents information on the frequency of infestation in 76 captive birds following different periods of captivity in outdoor cages. It is interesting to note that some of the birds remained negative even after 386-410 days in captivity. The mites did not seem to be easily transferred from one animal to another in the same or adjacent cages. Of 36 white-crowned sparrows held in captivity, 11 were negative for mites at the time of capture. Only 4 of these initially clean birds became infested during captivity. Such avian species as *Carpodacus mexicanus* (Müller) and *Junco oreganus* (Townsend) kept in close proximity of cages with infested *Zonotrichia* remained negative after periods of captivity ranging from 30 to 122 days. No evidence of infestation, natural or acquired, was demonstrated in these 2 fringillid species.

Effect on the Host.—Biologically, *B. chanayi* in the white-crowned sparrows exhibited peculiarities not encountered in other members of the family Cheyletidae. These mites were found to be true blood-sucking parasites of their avian hosts. This fact was demonstrated by collecting the mites from their nests at different stages of engorgement and subjecting them to study either as whole mounts, or following section-

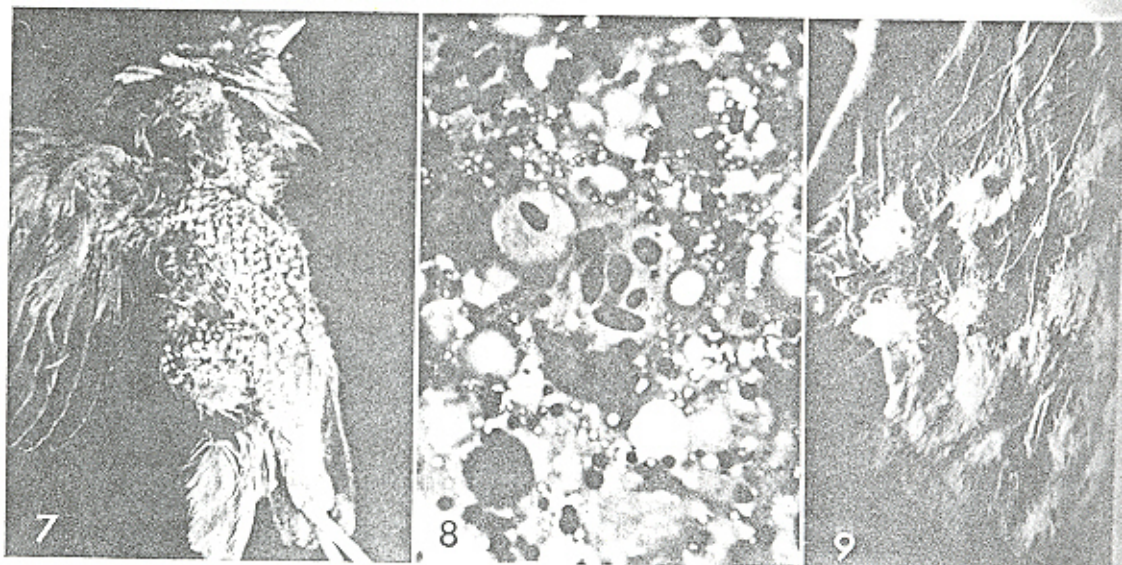


FIG. 7.—Nests of *B. chanayi* on heavily infested *Z. l. pugetensis*.

FIG. 8.—Undigested avian blood from digestive tract of recently fed mites.

FIG. 9.—Details of nests produced by *B. chanayi* on skin of avian host.

Table 2.—Presence of *B. chauvayi* on captive fringillid birds.

Species	No. birds in captivity	Days captive	Positives		Negatives	
			No. birds	Days captive	No. birds	Days captive
<i>Spizella leucophrys</i>	10	249-410	6	249-292	4	386-410
<i>S. socialis</i>	3	264-290	2	264-290	1	289
<i>S. pygmaea</i>	23	202-300	21	202-300	2	203-227
<i>S. socialis</i>	20	38-159	3	136	17	38-159
<i>S. socialis mexicanus</i>	16	30-90	0	0	16	30-90
<i>S. socialis</i>	4	30-122	0	0	4	30-122
Totals	76	30-410	32	136-300	44	30-410
Positive and negative			42		58	

and staining. The presence of avian blood in the mites was verified also by the squash-and-spread technique. Giemsa stained preparation, observed under oil immersion objectives, revealed the presence of undigested blood in the digestive tract of recently fed mites (Fig. 8). Under laboratory conditions of captivity the infestations in some cases became acute, with great impairment of the health of the animals; the birds became emaciated, less active and alert, with fluffed feathers. The elaboration of nests by the mites simplified detection of the infestation. The nests proper did not seem to cause any local reaction. They were made of interwebbing, fine, silky threads. In appearance the nests were slightly longer than wide, with the entrance generally situated in 1 end of the long axis. Eggs, larvae, nymphs, and adults of both sexes, as well as the remains of past molts were to be found within the chamber of the larger nests. Fig. 9 shows the entrance of 1 nest clearly defined, while the protruding end of an engorged female can be distinguished projecting from an adjoining nest. In extremely heavy infestations the entire skin of the host appeared to be coated with nests of *B. chauvayi*. In 1 animal up to 30 nests/cm² of skin could be counted. In a sample of 50 nests meas-

ured the size varied from 0.5 to 1.9 mm long, and from 0.4 to 1.6 mm wide.

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Culicidae and Tabanidae¹ as Potential Vectors of Anaplasmosis in Mississippi²R. H. ROBERTS,³ W. A. PUND,⁴ H. F. McCORRY,⁵ J. W. SCALES,⁶ AND J. C. COLLINS⁴

ABSTRACT

The role of all hematophagous Diptera or all except Tabanidae as potential vectors of anaplasmosis was assessed for 3 years in Mississippi by exposing groups of anaplasmosis-negative splenectomized steers in the presence of anaplasmosis-carrier steers. However, during the 1st year of the study, another group of Diptera, the eye gnats, *Hippelates* spp. (Chloropidae), also appeared to be potential vectors; the role of this group was therefore

assessed during the 2nd and 3rd years of the study. Populations of insects were surveyed with light traps, animal-baited traps, collections from a bait steer, and eye gnat traps. Of the animals exposed to all Diptera, 32% contracted anaplasmosis. Of those protected from tabanids, none contracted the disease. Also, the animals protected from tabanids were protected from eye gnats.

Anaplasmosis is considered an enzootic disease in

the Mississippi-Yazoo River Delta. However, 1957 and 1958 were epizootic years in this area. The monetary losses in 1958 were estimated at nearly 3 million dollars, and similar losses occurred in neighboring states (Mott et al. 1959). In 1959, 79 herds of cattle containing 14,994 animals distributed throughout 16 counties in the Delta were tested by the complement-fixation (C-F) test for anaplasmosis.

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