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# THE SPECIES OF *ENDERLEINELLUS* (ANOPLURA, HOPLOPLEURIDAE) PARASITIC ON THE SCIURINI AND TAMIASCIURINI\*

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**ABSTRACT:** Twenty species of the *Enderleinellus* parasitic upon squirrels of the Sciurini and Tamiasciurini are described and illustrated, including seven new species: *E. deppei*, *E. kaibabensis*, *E. nayaritensis*, *E. oculatus*, *E. paralongiceps*, *E. pratti*, and *E. tamiasciuri* spp. n. These species are placed into two species-groups, *longiceps*-group and *nitzschi*-group, mainly based on the details of abdominal and genital structures of both sexes. The nymphal stages of *E. extremus* Ferris, *E. paralongiceps* sp. n., and *E. tamiasciuri* sp. n. are also described and illustrated. A key to adult stages of the known species of the *Enderleinellus* from the Sciurini and Tamiasciurini is presented. The characters of taxonomic importance for both nymphal and adult stages in the genus *Enderleinellus* are also discussed.

The genus *Enderleinellus* Fahrenholz, 1912, is known to occur exclusively on hosts of the rodent family Sciuridae. Ellerman (1940), in his review of living rodents, recognizes 44 genera and approximately 389 species in the Sciuridae, these containing approximately 1,361 named forms. At the time of Ferris' monograph (1951) only 26 species of the *Enderleinellus* were known from hosts of only about 50 species (18 genera) of the Sciuridae; 12 species from the Sciurini, 3 species from the Funambülini, 6 species from the Callosciurini, 1 species from the Xerini, and 4 species from the Marmotini. Since 1951 little information has been added to the taxonomy of the *Enderleinellus*, despite the fact that a great deal of study is needed and many new additional taxa remain to be discovered in the genus. Johnson (1959, 1960, 1964) reviewed the regional fauna of the *Enderleinellus* of Thailand, Africa, and the Indo-Malaysian areas, respectively, and described a new species, *E. corrugatus*, from *Callosciurus (Tamiops) maclellandi*, Thailand. Kaneko (1954) described a new species, *E. kumadi*, from *Callosciurus erythraeus thawanensis*, Japan. Blagoveschtchensky (1965) reported four additional new species of *Enderleinellus*: *E. krochiniae* from *Sciurus anomalus syriacus* in Turkey, *E. dolichocephalus* from *Marmota camtschatica* in Siberia, *E. disparilis* from *Citellus rufescens rufescens* (= *C. undulatus*)

in Siberia, and *E. propinquus* from *Citellus fulvus* in Kazakhstan, USSR. Kim, Brown, and Cook (1963) studied the population differences of the *Enderleinellus suturalis* complex on three host species of *Citellus* quantitatively, and showed some subspecific differences among the louse populations on *C. franklini*, *C. tridecemlineatus*, and *C. harrisi*. Kim (1966) described the nymphal stages of the three North American species of the *Enderleinellus*: *E. longiceps*, *E. marmotae*, and *E. suturalis*.

While studying the "longiceps-group" of Ferris (1951), I have discovered several new species. This led me to initiate a revisional study of the genus *Enderleinellus*. All of the species, except for the *nitzschi*-group, will key to the "longiceps-group" in Ferris' monograph (1951); these are *E. arizonensis* Werneck, *E. brasiliensis* Werneck, *E. extremus* Ferris, *E. hondurensis* Werneck, *E. insularis* Werneck, *E. kelloggi* Ferris, *E. longiceps* Kellogg and Ferris, *E. mexicanus* Werneck, *E. microsciuri* Werneck, *E. urosciuri* Werneck, and *E. venezuelae* Ferris.

The scientific names and the classification of generic and subgeneric levels of the host species are those of Ellerman (1940) and Hall and Kelson (1959), and the classification of the Sciuridae is that of Simpson (1945). Other species-groups of *Enderleinellus* will be treated in relation to the host groupings of the Sciuridae in subsequent papers, since the species grouping of the lice seems to parallel closely the host classification.

For the measurements, the standardized mensuration system adopted for the study of the *Enderleinellus suturalis* complex is fol-

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lowed in this paper (Kim, Brown, and Cook, 1963).

The bulk of the material on which most of this study is based came from three principal sources: the insect collection of the University of California, Berkeley, California (UCB); United States National Museum collection (USNM); and the University of Minnesota Entomology Collection, St. Paul, Minnesota (UM). Type specimens are deposited in these institutions unless otherwise noted.

In this paper 20 species of the genus *Enderleinellus* parasitic upon the Sciurini and Tamiasciurini of the rodent family Sciuridae, including seven new species, are described and illustrated. These species are placed into two species-groups (the *longiceps*-group and the *nitzschi*-group) based mainly on details of abdominal and genital structures of both sexes. The nymphal stages of *Enderleinellus extremus* Ferris, *E. paralongiceps* sp. n., and *E. tamiasciuri* sp. n. are also described and illustrated. The characters of taxonomic importance in the genus *Enderleinellus* are discussed with reference to adult morphology by Kim (1965) and to nymphal morphology by Kim (1966).

#### NOTE ON MORPHOLOGY OF *ENDERLEINELLUS*

In the systematics of *Enderleinellus* a limited number of adult characters, such as the thoracic sternal plate, abdominal setae, paratergites, and a few genital features, have been mostly commonly used. On the other hand, the comparative morphology of *Enderleinellus* has not been studied and is still poorly known. For this reason, I have studied the morphology of the *Enderleinellus* species, particularly of *E. longiceps* Kellogg and Ferris, in greater detail. This has yielded additional characters of importance for recognizing species. I have also attempted to standardize a terminology applicable to all groups of Hoplopleuridae. The morphological terminology of Kim (1965) for adult stages, and of Cook and Beer (1959), and Kim (1966) for nymphal stages are followed in this paper, unless otherwise noted.

The head and thorax of both sexes provide a few significant taxonomic characters, i.e., the length and arrangement of head setae, the presence or absence of ACHS, number and

size of ADTS, and shape of the thoracic sternal plate. The thoracic sternal plate is variously shaped, with or without an anterior process (Fig. 7). The abdomen provides the majority of characters used in the systematics of *Enderleinellus* and shows striking sexual dimorphism within each species, especially in the terminalia.

The abdomen consists of nine rather distinct segments with the tenth segment obscure. It usually bears from three to five paratergites on abdominal segments 2 to 6. Spiracles are commonly present on segments 3 to 5 or even 3 to 7 (Fig. 1). The number and size of the paratergal setae and the size of spiracle provide good taxonomic characters for some species (e.g., *E. longiceps* Kellogg and Ferris and *E. malaysianus* Ferris). Abdominal segments 7 and 8 are each usually provided with a pair of marginal setae (MAS) on each side, but in some species MAS are missing on the abdominal segments. The number and size of MAS in segments 7 and 8 are also of taxonomic importance.

The tergal and sternal plates of the abdomen are poorly sclerotized, and sometimes completely lacking, except for the genital areas. The number of the sclerotized tergites and sternites, and the number and shape of setae on these sclerites, are sometimes taxonomically important. In many species the number of lateral abdominal setae (LAS), which are on the membrane between the median tergites or sternites and the paratergites is of taxonomic importance. The central tergal or sternal setae (CAS) with lateral abdominal setae in each segmental row are expressed as "lateral setae (LAS)-central setae (CAS)-lateral setae (LAS)" (e.g., 0-4-0) (Fig. 1). The most striking characters for separating closely related species (e.g., *longiceps*-group) are found in the genitalia, particularly in the male.

The male genitalia consist of five major parts: the basal apodeme, endomere, paramere, aedeagus, and pseudopenis (Figs. 2, 3). The basal apodeme (= basal plate (bp), Ferris (1919), and Ewing (1932)) is composed of paired, long, rodlike sclerites which may be fused anteriorly to form a Y- or U-shaped structure (e.g., *E. longiceps* K. and F. and *E. nitzschi* Fahr.). The basal apodeme is sometimes fused completely to form a single rodlike structure (e.g., *E. zonatus* Ferris). The shape

and length of the basal apodeme is distinct for each species.

The *aedeagus* or *penis* (= penis (p), Ferris (1919) and Ewing (1932)) is usually a membranous or a weakly sclerotized tube located within the genital sac or the frame of the endomere. The structure of the *endomere* varies greatly between the species-groups. The endomere is very large and complex in the *longiceps*-group, while it is almost completely lacking in the *nitzschi*-group. In the *longiceps*-group, the most important specific taxonomic characters are generally found in the structure of the endomere.

In the *nitzschi*-group the *internal sac* (= "preputial sack," Mjöberg (1910); mesosome, Cummings (1916); vesica penis, Nuttall (1916); internal sac, Ewing (1932); vesicula penis, Ferris (1919)) is quite evident since it bears numerous conspicuous teeth (Figs. 139, 144, 149). The function and origin of the internal sac is not clear, although there are speculations by several workers.

The *parameres* (= paramere (par), Ferris (1919) and Ewing (1932)) are paired, generally sword-shaped sclerites which articulate anteriorly to the posterior end of the basal apodeme. The *pseudopenis* (= pseudopenis (pp), Ferris (1919); ventral apodeme, Ewing (1923)) is a Y-shaped sclerite between the parameres.

The genitalia of *Enderleinellus longiceps* K. and F. is typical of the *longiceps*-group. I have, therefore, studied the genitalia of this species in greater detail with special reference to the organization of the endomere. As shown in Figures 2 and 3, the *basal apodemes* are located ventrally and are articulated posteriorly to parameres. Dorsal to the basal apodeme there are components of the endomere. The *endomere* consists of four major parts: the *dorsal endomere*, *anterior endomere*, *posterior endomere*, and *middle endomere*. The *dorsal endomere* (= U-shaped pieces (e), Ferris (1919); dorsal endomere, Ewing (1932)) is a U-shaped dorsal sclerite which is more or less completely detached from the major part of the endomere. The *middle endomere*, *anterior endomere*, and *posterior endomere* are attached on the surface of a ball-like, membranous genital sac located between the dorsal endomere and the ventral basal apodeme. Within the

genital sac there is a tubelike *aedeagus* or *penis* connected to the *ejaculatory duct*. The *middle endomere* is a more or less ringlike sclerite covering the dorsal surface of the genital sac. The *anterior endomere* (= in part, weakly chitinized structure (sp), Ferris (1919); Statum penis (?), Nuttall (1916)), is poorly sclerotized and covers the anterior to ventral surface of the genital sac. On the posterior surface there is the *posterior endomere*. The *posterior endomere* consists of two large, lateral sclerites which are connected by a narrow sclerite. Posterior to the endomere there is a Y-shaped *pseudopenis*. The apical part of the pseudopenis reaches the end of the body. In the vicinity of the apical part of the pseudopenis there is an inverted U-shaped structure, called here the *radula*, which is placed vertically over the apical part of the pseudopenis. The morphological origin and the function of this structure is uncertain. The shape and size of the basal apodeme, paramere, endomere, aedeagus, and radula are of great taxonomic importance.

The *female genitalia* consist of five major parts: the genital plate, gonopods, genital lobes, valvula, and the spermatheca (Fig. 44). The *genital plate* is variously shaped and bears a definite number of middle and posterior setae. The *gonopods* are paired, sclerotized, flattened plates variously shaped, which bear two or three setae on the inner margin of each plate. The *genital lobes* are paired lobes borne on each side of the sternum of abdominal segment 9, each having a strong, spiniform, genital seta and a tuft of setae. At the middle part of the female genitalia there is an elongated, weakly sclerotized structure, called here the *valvula*. The valvula is variously shaped; it may be tapered, serrated, or even blunt at the apex. Between the gonopods there is dorsally a short, wide, sclerotized plate. This may be referred to as the *intervalvula* (= intervalvula Snodgrass (1935)). The *spermatheca* is weakly sclerotized in certain species, while lacking in others. The shape and size of the genital plate, gonopods, genital lobes, intervalvula, and spermatheca provide useful taxonomic characters for distinguishing cryptic species. In some species there is a series of *vulvar fimbriae* posterior to the genital plate and gonopods (Fig. 6, 153). The size and shape of the genital



- genital plate with 1 or 2 posterior setae on each side (*longiceps*-group) ..... 4
- Abdomen with 5 paratergites on segments 2 to 6; male: head with ACHS, even if minute; genitalia with 3 major parts, with an inverted Y- or V-shaped basal apodeme and with internal sac bearing many teeth; female: spermatheca lacking; vulvar fimbriae short; genital plate with 3 posterior setae on each side (*nitzschi*-group) ..... 2
2. Abdomen without sclerotized sternite and with segment 3 bearing 2 long, strong paratergal setae as long as paratergite; male: 4 sclerotized tergites present on segments 2 to 5; anterior part of internal sac with numerous large teeth; female: abdomen with 1 very small tergite on segment 5; paratergites of segment 2 with a single dorsal paratergal seta; gonopods elongated, each with 3 setae on mesal margin; base of genital lobes with 5 or more stiff, long setae; (Figs. 144-148); ex *Sciurus anomalus syriacus*, Syria, Iran, Turkey, and Caucasus Crimea ..... 19. *E. krochinae* Blagoveschtchensky
- Abdomen with sclerotized sternites; without above combination of characters ..... 3
3. Abdomen with 6 sclerotized sternites on segments 1 to 6 and with paratergites of segment 2 bearing 2 dorsal paratergal setae; male: abdomen with 6 distinct tergites on segments 1 to 6, even if 1st tergite very small; internal sac with more than 10 large teeth on anterior part and numerous small teeth on posterior part and apex of terminalia with numerous marginal setae; female: gonopods with posterior seta stronger than anterior two setae; genital plate with 2 rows of 3 setae more or less horizontally arranged and without valvula; genital seta apical; (Figs. 139-143); ex *Sciurus vulgaris*, Europe ..... 18. *E. nitzschi* Fahrenholz
- Abdomen with 4 sclerotized sternites on segments 3 to 6 and with paratergites of segment 2 bearing 1 dorsal paratergal seta; male: abdomen with 7 distinct sclerotized tergites on segments 1 to 7, even if 1st tergite small; internal sac with numerous small teeth, occasional large teeth and 1 or 2 setiferous tubercles on anterior part and a continuous series of large teeth on posterior part and apex of terminalia without numerous marginal setae; female: gonopods each with 3 similar setae; genital plate with 2 rows of 3 setae more or less vertically arranged; distinct valvula present; genital seta subapical; (Figs. 149-153); ex *Tamiasciurus* spp., North America ..... 20. *E. tamiasciuri* sp. n.
- 4(1). Males; genitalia with basal apodemes, endomeres, parameres, pseudopenis, and radula ..... 5
- Females; genitalia with spermatheca (or if lacking, sclerotized tubular valvula), genital plate, gonopods, genital lobes, and valvula ..... 21
5. Arms of basal apodeme subapically bilobed (Figs. 34-42) (*extremus*-subgroup) ..... 13
- Arms of basal apodeme not subapically bilobed but bent laterally (Figs. 26-33) (*longiceps*-subgroup) ..... 6
6. Arms of basal apodeme apically bilobed to receive paramere; posterior endomere with anteromesal, hooklike process; paramere more or less uniformly thickened with abruptly tapering end; (Figs. 16, 33); ex *Sciurus igniventris*, Brazil ..... 8. *E. urosciuri* Wernick
- Arms of basal apodeme gradually tapering at apex without lobe; lice without above combination of characters ..... 7
7. Abdominal segment 2 with 2 dorsal paratergal setae; abdomen with 7 sclerotized tergites on segments 1 to 8, even if 1st two tergites very small; middle endomere poorly developed and not ring-shaped ..... 5
- Abdominal segment 2 with 1 dorsal paratergal seta; abdomen with 5 tergites on segments 3 to 7, even if 1st tergite small; middle endomere well developed and more or less ring-shaped (Figs. 26-30) ..... 9
8. Abdomen with less than 9 DLAS on each side and with 7 sclerotized tergites on segments 1 to 7 but 1st two tergites small, poorly sclerotized dots; 1st rows of sternal and tergal setae 0-4-0; dorsal endomere with short lateral arms; arms of basal apodeme with small subapical protuberance or small acute spur toward meson (Fig. 32); posterior endomere well developed; (Figs. 72-79); ex *Sciurus variegatoides* and *S. yucatanensis*, Central America ..... 7. *E. hondurensis* Wernick
- Abdomen with more than 10 DLAS on each side and with 7 sclerotized tergites on segments 2 to 8 but only one on segment 2 small or lacking; 1st rows of sternal setae 1-2-1 and of tergal setae 1-4-1; dorsal endomere with long, slender lateral arms; arms of basal apodeme subapically without protuberance; posterior endomere poorly developed; (Figs. 66-69); ex *Sciurus griseus*, California, USA ..... 6. *E. kelloggi* Fenn
9. Abdomen with 1st row of tergal setae 1-2-1; abdominal segment 3 with sclerotized tergite very small ..... 10
- Abdomen with 1st row of tergal setae 1-4-1; abdominal segment 3 with sclerotized tergite very distinct ..... 11
10. Thorax with inner ADTS 2 to 3 times

- longer than outer seta; antennae placed more or less laterally; dorsal endomere more or less V-shaped; anterior endomere with 2 well-sclerotized lateral pieces, between them present one median piece; basal apodeme thickened in middle; (Figs. 54-57); ex *Sciurus kaibabensis*, Arizona, USA
- ..... 4. *E. kaibabensis* sp. n.
- Thorax with inner ADTS 5 to 6 times longer than outer seta; antennae placed ventrally; dorsal endomere U-shaped; anterior endomere with 2 sclerotized pieces placed medially on thinly sclerotized membrane; basal apodeme slender; (Figs. 60-62); ex *Sciurus aberti*, USA
- ..... 5. *E. paralongiceps* sp. n.
11. Middle endomere with sclerotized inner loop encasing aedeagus; posterior endomere in dorsal view elongated or with lateral protuberance; paramere basally thickened ..... 12
- Middle endomere without inner loop; aedeagus tubular; posterior endomere more or less triangular; paramere slender; anterior part of middle endomere posteriorly produced in middle; thorax with inner ADTS twice as long as outer seta; abdominal membrane scaly; (Figs. 1-5); ex *Sciurus carolinensis*, *S. niger*, North America
- ..... 1. *E. longiceps* Kellogg and Ferris
12. Anterior endomere well developed, with 4 sclerotized parts in dorsal view, 1 median, 2 lateral, and 1 anterior pieces; middle endomere with more or less elongated inner loop; dorsal endomere thin, with long lateral arms; posterior endomere not produced laterally; (Figs. 45-48); ex *Sciurus nayaritensis*, Mexico
- ..... 2. *E. nayaritensis* sp. n.
- Anterior endomere with 2 sclerotized parts, 2 lateral pieces placed medially on thinly sclerotized membrane; middle endomere with more or less round inner loop; dorsal endomere not thin, with short lateral arms; posterior endomere laterally and anteriorly produced; (Figs. 49-51); ex *Sciurus oculus*, *S. alleni*, Mexico
- ..... 3. *E. oculus* sp. n.
13. Arms of basal apodeme with a quite shallow posterior emargination ..... 14
- Arms of basal apodeme with a deeply V- or U-shaped emargination ..... 15
14. Arms of basal apodeme with mesal lobe larger than outer lobe and rounded at apex (Fig. 41); dorsal endomere with its posterior part strongly notched on each side; posterior endomere posteriorly smooth; anterior endomere membranous; (Figs. 24, 41); ex *Sciurus aestuans*, Brazil
- ..... 16. *E. brasiliensis* Wernick
- Arms of basal apodeme with outer lobe larger than mesal lobe, with both lobes apically acute and with outer lobe notched apically; dorsal endomere posteriorly not notched; posterior endomere with short, acute posterior process; anterior endomere sclerotized (Fig. 23); abdomen with 7 sclerotized tergites on segments 1 to 7; paratergites of abdominal segment 2 with a single dorsal paratergal seta; (Figs. 129, 130); ex *Sciurus nesaeus*, Venezuela
- ..... 15. *E. insularis* Wernick
15. Abdominal segment 2 with 2 dorsal paratergal setae; abdomen with 9 or 10 DLAS on each side; 6th row of tergal setae 3-6-3 or 16 setae continuous; abdomen with 5 to 7 sclerotized tergites on segments 1 to 7, 1st tergite minute ..... 18
- Abdominal segment 2 with 1 dorsal paratergal seta; abdomen with 10 or more DLAS; 6th row of tergal setae 4-6-4 to 4-8-4; abdomen with 6 tergites on abdominal segments 1 to 6 or 2 to 7, even if 1st tergite is minute ..... 16
16. Abdomen with 1st row of tergal setae 0-2-0, with 6 sclerotized tergites on segments 2 to 7, and with 12 DLAS; arms of basal apodeme with mesal lobe shorter than outer lobe (Fig. 38); dorsal endomere posteriorly notched on each side; aedeagus tubular; pseudopenis with its apical part long, at least half as long as its lateral arms; (Figs. 119-122); ex *Sciurus arizonensis*, *S. apache*, *S. nayaritensis*, *S. alleni*, Southwestern USA and Mexico
- ..... 13. *E. arizonensis* Wernick
- Abdomen with 1st row of tergal setae 0-4-0; lice without above combination of characters ..... 17
17. Arms of basal apodeme with posterior lobes short and narrow, not expanded basally, with outer lobe subapically tuberculated; dorsal endomere narrow, with long lateral arms; anterior side of radula rounded; posterior endomere anteriorly prolonged; abdomen with bulbous anal lobe bearing numerous setae, with 10 DLAS and with 2nd row of tergal setae 0-6-0; (Figs. 134-136); ex *Microsciurus palmeri*, Colombia
- ..... 17. *E. microsciuri* Wernick
- Arms of basal apodeme with posterior lobes long, and thick, basally expanded, mesal lobe shorter than outer lobe, without small tubercle; dorsal endomere wide, with shorter lateral arms; anterior side of radula truncate; posterior endomere more or less triangular; abdomen without bulbous anal lobe, with 11 DLAS and with 2nd row of tergal setae 0-4-0; (Figs. 125, 126); ex *Sciurus griseogena*, *S. gerrardi*, Venezuela
- ..... 14. *E. venezuelae* Ferris
18. Arms of basal apodeme with mesal lobe

- definitely broader at base than outer lobe; anterior part of middle endomere medially produced or strongly notched (Figs. 17, 18); abdomen with 5 to 6 sclerotized tergites on segments 2 to 7 or 3 to 7, 1st tergite minute if abdomen with 6 sclerotized tergites ..... 19
- Arms of basal apodeme with posterior lobes of same width at base; anterior part of middle endomere medially neither produced nor notched; abdomen with 7 sclerotized tergites on segments 1 to 7, even if 1st tergite minute ..... 20
19. Anterior part of middle endomere medially produced in both anterior and posterior sides; abdomen with radula anteriorly truncate (Fig. 88); aedeagus short; (Figs. 86-88); ex *Sciurus socialis*, Guatemala; *S. deppoi negligens* (= *S. negligens*), *S. aureogaster*, *S. griseoflavus*, *S. poliopus*, Mexico ..... 9. *E. extremus* Ferris
- Anterior part of middle endomere medially notched very deeply in posterior side and more or less flattened in anterior side; abdomen with radula anteriorly rounded (Fig. 101); aedeagus long; (Figs. 100, 101); ex *Sciurus deppoi*, Mexico; *S. granatensis hoffmanni*, Costa Rica ..... 10. *E. deppoi* sp. n.
20. Abdomen with 1st row of tergal setae 0-4-0 and with 10 DLAS on each side; arms of basal apodeme with mesal lobe slightly curved outward, with posterior emargination narrow but deep, and with outer lobe subapically tuberculated (Fig. 36); dorsal endomere with long lateral arms; aedeagus with paired, short, recurved hooklike apodeme at the midline; posterior endomere touched medially but not fused by middle pieces (Fig. 19); paramere thick; (Figs. 107-109); ex *Sciurus truei*, *S. nelsoni* (highland forms), Mexico ..... 11. *E. mexicanus* Werneck
- Abdomen with 1st row of tergal setae 0-2-0 and with 9 DLAS on each side; arms of basal apodeme with mesal lobe directed posteriorly, with posterior emargination wider, and without tuberculated outer lobe; dorsal endomere with short lateral arms; aedeagus with narrow, long apodeme; posterior endomeres fused by middle pieces (Fig. 20); paramere slender; (Figs. 115, 116); ex *Sciurus colliaci* (lowland form), Mexico ..... 12. *E. pratti* sp. n.
- 21(4). Female lice parasitic upon *Sciurus igniventris* Wagner or *Sciurus aestuans* Linn. in Brazil ..... 22
- Female lice parasitic upon other host species ..... 23
22. Female lice found on *Sciurus igniventris* Wagner; total body length about 0.82 mm (*longiceps*-subgroup) ..... 8. *E. urosciuri* Werneck
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- Females without apparent spermatheca but with valvula strongly sclerotized, tubular, pointed at apex, this sclerotization extending forward to genital plate (Fig. 70), with abdominal segment 2 bearing a single dorsal paratergal seta; abdomen with about 11 DLAS on each side, without sclerotized tergite and sternite (Figs. 70, 71); ex *Sciurus griseus*, California, USA (*longiceps*-subgroup) ..... 6. *E. kelloggi* Ferris
24. Spermatheca strongly bent, with deeply V-shaped anterior emargination, its end expanded, the expansion of the anterior end being larger than that of the posterior end (Fig. 124); abdomen without either sclerotized tergite or sternite, with about 11 DLAS on each side; genital plate with 2 groups of 2 setae on posterior margin (Figs. 123, 124); ex *Sciurus arizonensis*, Southwestern U. S., *S. apache*, *S. nayaritensis*, *S. alleni*, Mexico (*extremus*-subgroup) ..... 13. *E. arizonensis* Werneck
- Spermatheca not bent; lice without above combination of characters ..... 25
25. Abdomen with 2 or more small sclerotized tergites (*extremus*-subgroup) ..... 26
- Abdomen without tergites (*longiceps*-subgroup) ..... 32
26. Abdominal segment 2 with 2 dorsal paratergal setae; abdomen with 9 or 10 DLAS on each side; genital plate with 2 posterior setae on each side ..... 27
- Abdominal segment 2 with a single dorsal paratergal seta; abdomen with 8 or less DLAS on each side; genital plate with 1 posterior seta on each side ..... 30
27. Spermatheca elongated, this being anteriorly swollen, then abruptly constricted, again expanding gradually toward posterior end and then becoming terminally truncate with a small, strongly sclerotized terminal appendix (Fig. 92); abdomen with 2 or 3 small tergites on segments 2 and 3 or 2 to 4 and with 10 DLAS on each side (Figs. 90-97); ex *Sciurus socialis*, Guatemala; *S. deppoi negligens*, *S. aureogaster*, *S. griseoflavus*, and *S. poliopus*, Mexico ..... 9. *E. extremus* Ferris
- Not so ..... 28
28. Abdomen with 2nd row of tergal setae 0-2-0; spermatheca constricted or desclerotized at posterior third; valvula short, narrow and pointed at apex; gonopods each with 3 setae on mesal

- margin; (Figs. 102-106); ex *Sciurus deppei*, Mexico; *S. granatensis hoffmanni*, Costa Rica ..... 10. *E. deppei* sp. n.  
 Abdomen with 2nd row of tergal setae 0-4-0; lice without above combination of characters ..... 29
29. Gonopods each with 3 similar setae in the middle; valvula broad, serrated and pointed at apex; base of genital lobe with 3 very long, strong setae, one being as long as genital seta; (Figs. 110-114); ex *Sciurus truei* and *S. nelsoni* (highland forms), Mexico ..... 11. *E. mexicanus* Werneck  
 Gonopods each with 3 setae, the middle one being much longer than others; valvula narrow, not serrate and split at apex; base of genital lobe with 3 long setae but none so long as genital seta; (Figs. 117, 118); ex *Sciurus colliaci* (lowland forms), Mexico ..... 12. *E. pratti* sp. n.
- 20(26). Spermatheca very large, oval, with deeply U-shaped anterior emargination (Fig. 128); abdomen with about 8 DLAS and with 2 small sclerotized tergites on segments 2 and 3; valvula serrated and pointed at apex; (Figs. 127, 128); ex *Sciurus gerrardi*, *S. griseogena*, Venezuela ..... 14. *E. venezuelae* Ferris  
 Not so ..... 31
11. Spermatheca extremely minute, short, anteriorly swollen, and then abruptly constricted; (Fig. 138); ex *Microsciurus palmeri*, Colombia ..... 17. *E. microsciuri* Werneck  
 Spermatheca larger, long, tubular (Fig. 132); setae at base of genital lobe long but not so stiff; abdomen with 2 small sclerotized tergites on segments 1 and 2 and with 6 DLAS; (Figs. 131-133); ex *Sciurus nesaeus*, Venezuela ..... 15. *E. insularis* Werneck
- 23(25). Abdominal segment 2 with a single dorsal paratergal seta; abdomen with 10 or more DLAS on each side; spermatheca variously shaped ..... 33  
 Abdominal segment 2 with 2 dorsal paratergal setae; abdomen with about 7 DLAS on each side and DLAS usually continuous to CAS in each row of segments 6 and 7; spermatheca large, swollen in middle and then tapering posteriorly, sometimes anterior part desclerotized (Figs. 81-85); valvula short, branched at apex; (Figs. 80-85); ex *Sciurus variegatoides*, *S. yucatanensis*, Central America ..... 7. *E. hondurensis* Werneck
31. Spermatheca slender, tubular (Fig. 8); valvula branched at apex; abdomen with about 10 DLAS and with segment 2 bearing a single dorsal paratergal seta; (Figs. 6-8); ex *Sciurus carolinensis*, *S. niger*, North America .....  
 ..... 1. *E. longiceps* Kellogg and Ferris  
 Not so ..... 34
34. Spermatheca very small, short, trapezoid (Fig. 43); valvula broad at base and pointed at apex; abdomen with about 13 DLAS; (Figs. 43, 44); ex *Sciurus nayaritensis*, Mexico ..... 2. *E. nayaritensis* sp. n.  
 Lice without above combination of characters ..... 35
35. Spermatheca large, with 2 strongly sclerotized lateral arms at anterior end (Fig. 52); abdomen with about 13 DLAS; valvula pointed at apex; (Figs. 52, 53); ex *Sciurus oculusatus*, *S. alleni*, Mexico ..... 3. *E. oculusatus* sp. n.  
 Not so ..... 36
36. Spermatheca short, wide, and posteriorly abruptly constricted, its constriction being very short (Fig. 59); valvula broad at base and serrated at apex; (Figs. 58, 59); ex *Sciurus kaibabensis*, Arizona, USA ..... 4. *E. kaibabensis* sp. n.  
 Spermatheca forming anterior part large, oval ring, posteriorly overlapped by small, less sclerotized posterior ring (Fig. 64); valvula narrow and pointed at apex; (Figs. 63, 64); ex *Sciurus aberti*, USA ..... 5. *E. paralongiceps* sp. n.

DESCRIPTIONS AND DISCUSSIONS

The species of *Enderleinellus* parasitic upon the Sciurini and Tamiasciurini are placed into two species-groups based on the details of the abdominal and genital structures of both sexes, particularly of the male, and further substantiated by other details of male morphology. The characters shared by all species within this group have been described above and, for brevity, will not be repeated in the species description. Diagnostic characters are not enumerated under each individual species, since the key to the species provides a comprehensive diagnosis for each species in relation to other closely related species. All authorities and sources of the complete citations in each species descriptions will be found under "Literature Cited."

*longiceps*-group

This group may be characterized by the following characters:

1. Abdomen with 4 paratergites on segments 2 to 5.
2. Male: head without ACHS; genitalia with 5 major parts, with a more or less



inverted U-shaped basal apodeme and without visible internal sac.

3. Female: spermatheca present, except for *E. kelloggi* with strongly sclerotized tubular valvula; a series of long vulvar fimbriae present posterior to genital plate and gonopods; genital plate with a group of 1 or 2 posterior setae on each side.

The 17 species of *Enderleinellus* parasitic upon the Sciurini are placed in this group. The species of *longiceps*-group may be grouped further into two subgroups mainly by the details of male genitalia: A. *longiceps*-subgroup (8 species); B. *extremus*-subgroup (9 species).

#### A. *longiceps*-subgroup

1. Male with arms of basal apodeme not subapically bilobed but bent laterally and expanded mesally.
2. Female without sclerotized tergites on abdomen, except for *E. kelloggi*.

#### 1. *Enderleinellus longiceps* Kellogg and Ferris

(Figs. 1-9, 26)

*Enderleinellus longiceps* Kellogg and Ferris, 1915, Anoplura and Mallophaga of North American Mammals, Stanford Univ. Publ., Univ. Ser. (no vol. no.), p. 44-46; pl. 2, fig. 5; pl. 4, fig. 12; pl. 6, fig. 2; Ignoffo, 1959, p. 476 (key; Minnesota); Stojanovich and Pratt, 1965, p. 9 (illust. key); Kim, 1966, p. 328 (nymphs).

*Enderleinellus longiceps* K. and F. (*partim*), Ferris, 1916a, p. 148 (not the record from *S. arizonensis*); Ferris, 1916b, p. 105 (not the record from *S. arizonensis*); Ferris, 1919, p. 19-22, figs. 9, 10 (not the records from *S. kaibabensis*, *S. aberti*, *S. apache*, *S. oculatus*, and *S. nayariensis*); Werneck, 1948, p. 284-285, figs. 1-3; Hopkins, 1949, p. 455-456 (not the records from the host listed in Ferris, 1919); Ferris, 1951, p. 109-110 (not the records from *S. kaibabensis*, *S. aberti*, *S. allent*, and *S. oculatus*); Race, 1956, p. 174; Beer, Cook, and Schwab, 1959, p. 608

(ex *Dipodomys merriami*, Arizona, stagglers?). *Enderleinellus nitzschi* Fahrenholz; Mathewson and Hyland, 1962, p. 168 (*lapsus calami*).

*Type data*: This species was originally described from specimens collected from "gray squirrels" in Lincoln, Nebraska (Osborn's collection), which might refer to either *Sciurus carolinensis* (gray squirrel) or *S. niger* (fox squirrel). Accordingly, I here designate *Sciurus carolinensis* Gmelin (gray squirrel) as the type host of *E. longiceps* K. and F.

*Type specimens*: Holotype male, allotype female, and 2 male paratypes are deposited in UCB.

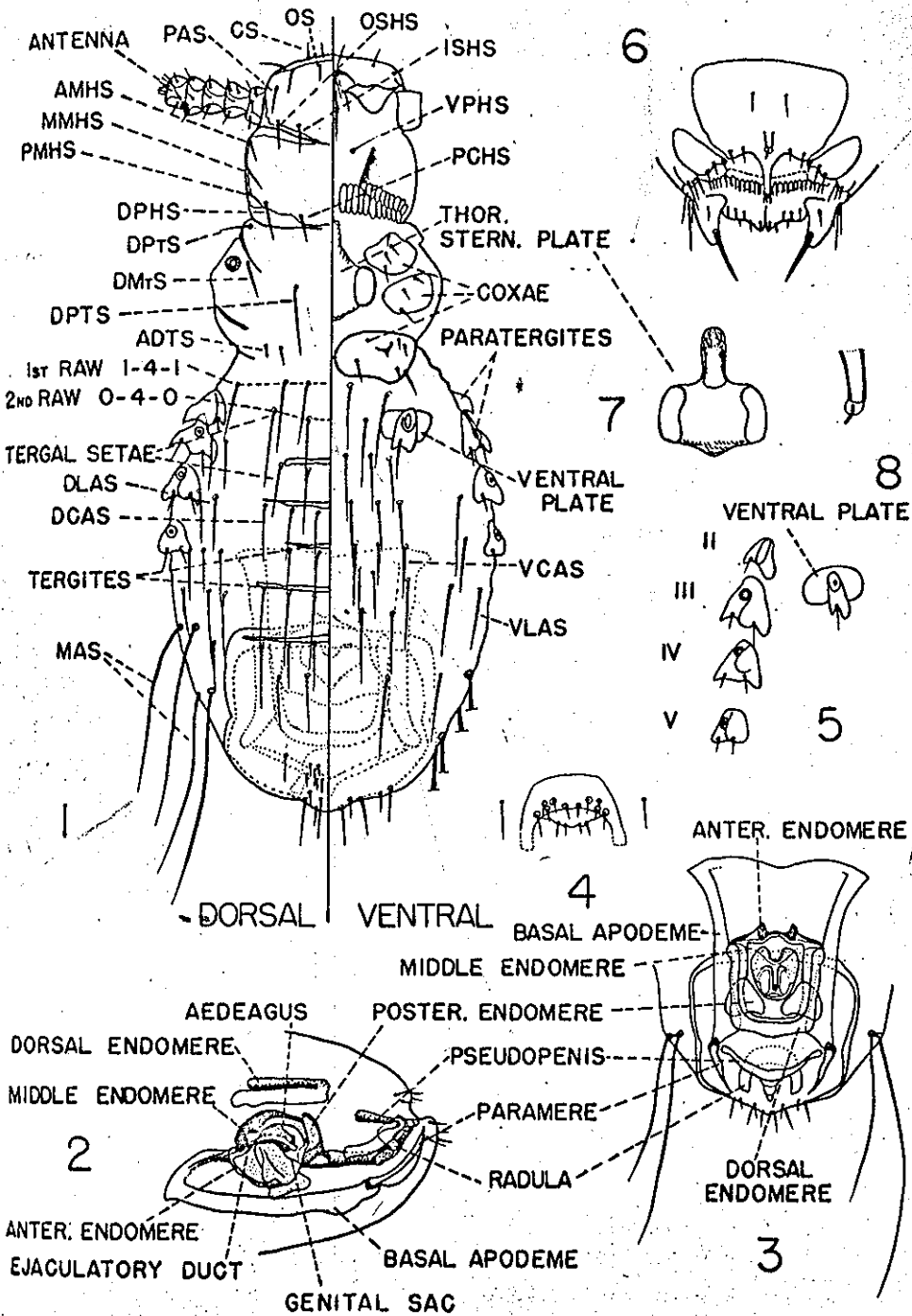
#### Description

*Male* (Fig. 1): Total body length about 0.70 mm. Head length 0.0115 to 0.0140 mm, width 0.0114 to 0.0122 mm; AS, ACHS, and ADHS lacking; PCHS present. Thorax DPTS long; inner ADTS twice as long as outer seta. Legs as in other members of the genus. Abdomen: 5 narrow sclerotized tergites present, occupying the median third of each of the segments 3 to 7; 1st row of tergal setae 1-4-1, 2nd row 0-4-0, 5th and 6th rows 3-6-3; no sclerotized sternite, except for segment 2 with 2 ventral plates completely detached from paratergites; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; about 13 DLAS present on each side; 4 paratergites present on segments 2 to 5; paratergites of segment 2 with 1 dorsal and no ventral paratergital setae, and of segments 3 to 5 each with 1 dorsal and 1 ventral paratergital setae on each side; 3 spiracles present on paratergites of segments 3 to 5; segments 7 and 8 each with a pair of long MAS on each side; cuticle of abdomen appearing scaly. Genitalia (Figs. 2, 3): dorsal endomere U-shaped; middle endomere ring-shaped, without inner loop; anterior part of middle endomere posteriorly produced in middle; tubular aedeagus; anterior endomere with a pair of middle pieces and thinly sclerotized lateral pieces; posterior endomere paired, more or less triangular; paramere slender, gradually tapering and pointed at apex; basal apodeme U-shaped, not subapically bilobed but slightly bent laterally and expanded mesally; pseudopenis Y-shaped, with posterior part bearing 2 or 3 annuli; radula inverted U-shaped, rounded anteriorly.

*Female*: Total body length about 0.71 mm.

FIGURES 1-8. *Enderleinellus longiceps* Kellogg and Ferris. 1. Dorsal and ventral views of body (holotype). CS, clypeal setae; OS, oral setae; PAS, preantennal setae; ISHS, inner sutural head setae; OSHS, outer sutural head setae; DPHS, dorsal principal head setae (= PDHS, Kim, 1965); PCHS, posterior central head setae; VPHS, ventral principal head setae; AMHS, anterior marginal head setae; MMHS, middle marginal head setae; PMHS, posterior marginal head setae; DPts, dorsal prothoracic seta; DMts, dorsal mesothoracic seta; DPTS, dorsal principal thoracic setae; DLA, dorsal lateral abdominal setae; DCAS, dorsal central abdominal setae; VCAS, ventral central abdominal setae; VLAS, ventral lateral abdominal setae; MAS, marginal abdominal setae; thor. stern. plate, thoracic sternal plate; 1st row 1-4-1, 1st row 1 DLAS-4 DCAS-1 DLAS. 2. Three-dimensional view of male genitalia (semidiagrammatic). 3. Dorsal view of male genitalia (holotype). 4. Male, radula (holotype). 5. Male, paratergites and ventral plate (holotype). 6. Female genitalia (allotype). 7. Female, thoracic sternal plate (allotype). 8. Female, spermatheca (allotype).

I. ENDERLEINELLUS LONGICEPS KELLOGG & FERRIS



*Head, thorax, and legs* as in male except for, head length 0.0136 to 0.0150 mm, width 0.0115 to 0.0128 mm. *Abdomen* without any sclerotized tergites and sternites except for segment 2 bearing a pair of ventral plates as in male; dorsum with about 10 DLAS on each side; paratergites, spiracles, and paratergal setae as in male. *Genitalia* (Fig. 6): spermatheca slender and tubular; valvula branched at apex; genital plate with a group of 2 setae on posterior margin of each side and with a pair of setae in middle; gonopods each with 3 setae on mesal margin; genital lobe with a long spiniform subapical genital seta and a dorsal seta, its base with 3 or more long slender setae.

*Nymphs*: Descriptions, see Kim (1966).

*Specimens examined*: Four type specimens, as in "Type data." Ex *Sciurus carolinensis* Gmelin: GEORGIA: Thomasville, collected by E. V. Komarek, 1 male and 4 females; MINNESOTA: Princeton, by L. Abrahamson, 9 males, 13 females, 3 nymph 3, 8 nymph 2, and 1 nymph 1; 2 miles E. S. of Onamia, by P. J. Clausen, 27 males, 60 females, 4 nymph 3, and 2 nymph 2; MISSISSIPPI: Bayou St. Louis, Ferris Coll. 905 (USNM 23691), 6 males and 5 females. Ex *S. niger* Linn.: KANSAS: Leavenworth, collected by K. C. Emerson, 2 females; MINNESOTA: Carlos Avery, Game Farm, 3 males and 1 female; NEBRASKA: Valentine, Ferris Coll. 901 (USNM 70023), G.F.F., 6 males and 6 females; ex *S. n. niger* Linn.: FLORIDA: nr. Ocala, by J. C. Moore (Lot 47-6066), 1 male and 1 female; ex *S. n. rufiventris* E. Geoffroy St-Hilaire: INDIANA: Waterloo, G. F. Ferris, 5 males and 7 females; NEBRASKA: Valentine, Ferris Coll. 901 (USNM 70023), G.F.F., 2 males and 3 females. Ex gray squirrel: GEORGIA: collected by H. Hixson, 1 female; MARYLAND: Laurel, by E. B. Marshall, 1 male and 2 females. Ex red squirrel: KANSAS: Ft. Leavenworth, collected by K. C. Emerson, 2 females (host misidentified).

#### Comments

Very closely related to *E. nayaritensis*, *E. kaibabensis*, *E. paralongiceps*, and *E. oculatus*.

#### 2. *Enderleinellus nayaritensis* sp. n.

(Figs. 10, 27, 43-48)

*Enderleinellus longiceps* Kellogg and Ferris (*partim*), Ferris, 1919, p. 20 (*err. det.*, the record from *Sciurus nayaritensis*).

*Enderleinellus arizonensis* Werneck (*partim*), 1948,

p. 288 (*err. det.*, the part of the record from *Sciurus nayaritensis*); Hopkins, 1949, p. 456 (the part of the record from *Sciurus nayaritensis*); Ferris, 1951 (the record from *S. nayaritensis*).

*Type data*: Holotype male and allotype female from *Sciurus nayaritensis* J. A. Allen, Sierra Madre, Zacatecas, Mexico (Ferris Coll. 899: USNM 90947). Paratypes: 6 males and 3 females, data same as in holotype; 2 males and 2 females from *Sciurus nayaritensis* (= *S. nayaritensis apache*), Santa Lucia, Sinaloa, Mexico, 7 Aug. 1963, JDS-434. Holotype, allotype, and 7 paratypes (on 3 slides) are deposited in UCB. One male and 1 female paratype (on 1 slide) are deposited in USNM, 1 male and 1 female paratype deposited in UM, and 1 male and 1 female paratype in the private collection of Dr. K. C. Emerson.

#### Description

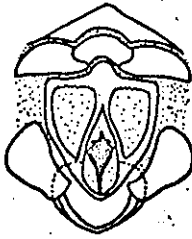
*Male*: Total body length about 0.60 mm. *Head* (Fig. 48), *thorax*, and *legs* as in *E. longiceps* except for the following characters: Head length 0.0135 to 0.0142 mm, width 0.0096 to 0.0111 mm; antennae ventrally placed; inner ADTS  $2\frac{1}{2}$  to 3 times longer than outer seta; sternal plate longer than wide. *Abdomen* with 5 narrow, sclerotized tergites occupying the median third of each of segments 3 to 7; 1st row of tergal setae 1-4-1, 2nd row 0-4-0, 5th row 3-6-3, 6th row 4-6-4; about 14 DLAS present on each side; no sclerotized sternites, except for segment 2 with 2 ventral sternal plates completely detached from paratergites; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; paratergites, paratergal setae spiracles, and MAS as in *E. longiceps*. *Genitalia* (Figs. 10, 27, 45, 46): dorsal endomere thin, with long lateral arms; anterior endomere well developed and consisting of 4 sclerotized parts in dorsal view, 1 median, 2 lateral, and 1 triangular anterior pieces; middle endomere with more or less elongated inner loop encasing aedeagus and its anterior part anteriorly produced in middle; posterior endomere longer than wide; basal apodeme mesally expanded at subapex and bent laterally; paramere thickened at basal third, then gradually tapering, and pointed at apex; pseudopenis anteriorly concave in middle, its posterior part with 2 or 3 annuli; radula inverted U-shaped and anteriorly rounded.

*Female*: Total body length about 0.61 mm. *Head, thorax, and legs* as in male; head length 0.0142 to 0.0156 mm, width 0.0092 to 0.0114 mm. *Abdomen* without any sclerotized tergites and

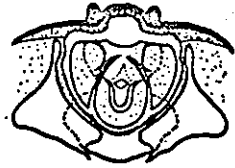
FIGURES 9-25. Males: Endomeres (excluding dorsal endomere). 9. *E. longiceps* K. and F. (holotype). 10. *E. nayaritensis* sp. n. (holotype). 11. *E. oculatus* sp. n. (holotype). 12. *E. kaibabensis* sp. n. (holotype). 13. *E. paralongiceps* sp. n. (holotype). 14. *E. kelloggi* Ferris (holotype). 15. *E. hondurensis* Werneck (holotype). 16. *E. urosiuri* Werneck (after Werneck, 1937). 17. *E. extremus* Ferris (holotype). 18. *E. deppiei* sp. n. (holotype). 19. *E. mexicanus* Werneck (holotype). 20. *E. pratti* sp. n. (holotype). 21. *E. arizonensis* Werneck (holotype). 22. *E. venezuelae* Ferris (holotype). 23. *E. insularis* Werneck (holotype). 24. *E. brasiliensis* Werneck (after Werneck, 1937). 25. *E. microsciuri* Werneck (holotype).



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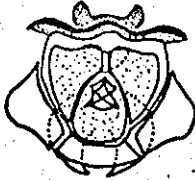
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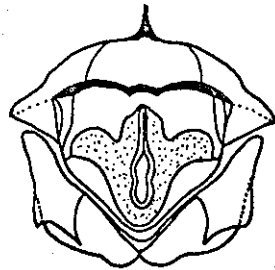
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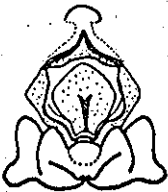
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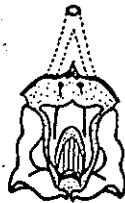
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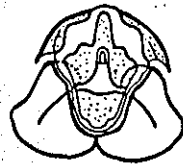
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sternites except for segment 2 as in male; 1st and 2nd rows of tergal and sternal setae, paratergites, spiracles, paratergal setae, and MAS as in male. *Genitalia* (Figs. 43, 44): spermatheca very small, short, trapezoid; valvula broad at base and pointed at apex; genital plate with a group of 2 setae on posterior part of each side and with a pair of setae in middle; gonopods with 3 setae on posteromesal margin, outermost seta longer than other setae; genital lobe with a long, subapical, spiniform seta and no dorsal seta, and its base with 3 or 4 long setae.

*Nymphs*: Unknown.

*Specimens examined*: All type specimens.

#### Comments

This species is closely allied to *E. longiceps* Kellogg and Ferris, *E. oculatus* sp. n., and *E. kaibabensis* sp. n.

#### 3. *Enderleinellus oculatus* sp. n.

(Figs. 11, 28, 49-53)

*Enderleinellus longiceps* Kellogg and Ferris (*partim*), Ferris, 1919, p. 20 (*err. det.*, the record from *Sciurus oculatus*); Werneck, 1948, p. 284 (*err. det.*, the record from *S. alleni*); Hopkins, 1949, p. 456 (the record from *S. oculatus* and *S. alleni*); Ferris, 1951, p. 109 (the records from *S. oculatus* and *S. alleni*).

*Type data*: Holotype male, allotype female, and 21 paratypes (8 males and 13 females) from *Sciurus oculatus* Peters, State of Vera Cruz, Mexico, Ferris Coll. 896 (USNM 54235). All type specimens except for 3 paratypes are deposited in UCB; 1 male and 2 female paratypes (on 1 slide) are deposited in UM.

#### Description

*Male*: Total body length about 0.64 mm. *Head*, *thorax*, and *legs* as in *E. longiceps* Kellogg and Ferris except for the following characters: head length 0.0134 to 0.0144 mm, width 0.0111 to 0.0116 mm; antennae ventrally placed; head setae stiff; thoracic sternal plate with anterior process slightly enlarged at anterior end. *Abdomen* with 5 narrow tergites occupying the median third of each of segments 3 to 7; 1st row of tergal setae 1-4-1, 2nd row 0-4-0, 5th row 3-6-3 or 2-6-2, 6th row 3-6-3; about 12 DLAS present on each side; no sclerotized sternites except for segment 2 as other species; 1st row of sternal setae 0-4-0, 2nd

row 0-2-0; paratergites, paratergal setae, spiracles, and MAS of segments 7 and 8 as in *E. longiceps*. *Genitalia* (Figs. 11, 28, 49): dorsal endomere thicker, with shorter lateral arms; anterior endomere consists of 2 sclerotized parts, 2 lateral pieces placed medially on thinly sclerotized wide anterior membrane in dorsal view; middle endomere with more or less round inner loop encasing aedeagus; posterior endomere anteriorly prolonged and laterally produced; basal apodeme, paramere, and pseudopenis (with 2 or 3 annuli) similar to those of *E. nayaritensis* sp. n.; radula with anterior side more or less flattened.

*Female*: Total body length about 0.67 mm. *Head*, *thorax*, and *legs* as in male; head length 0.0142 to 0.0160 mm, width 0.0119 to 0.0120 mm. *Abdomen* with no sclerotized tergites and sternites except for segment 2 as in male; 1st and 2nd rows of tergal setae, paratergites, spiracles, paratergal setae, and MAS same as in male; about 12 DLAS present on each side; 1st row of sternal setae 0-4-0, 2nd row 1-2-1. *Genitalia* (Figs. 52, 53): spermatheca large, with 2 strongly sclerotized lateral arms at anterior; half; valvula pointed at apex; genital plate with a group of 2 setae on posterior part and 1 pair of setae in middle; gonopods each with 3 similar setae on posterior part; genital lobe with a long spiniform subapical seta and a single dorsal seta, its base with 3 stiff setae on small lobe.

*Nymphs*: Unknown.

*Specimens examined*: Type specimens, data as in "Type Data"; 1 male from *Sciurus alleni* Nelson, Sierra de Guadalupe, Mexico, Ferris Coll. 897 (USNM 116931).

#### Comments

This species is closely related to *E. longiceps* K. and F., *E. nayaritensis* sp. n., and *E. kaibabensis* sp. n. One male specimen from *S. alleni* may possibly be a straggler or contaminant.

#### 4. *Enderleinellus kaibabensis* sp. n.

(Figs. 12, 29, 54-59)

*Enderleinellus longiceps* Kellogg and Ferris (*partim*), Ferris, 1919, p. 19 (*err. det.*, the record from *Sciurus kaibabensis*); Hopkins, 1949, p. 456 (the record from *S. kaibabensis*); Ferris, 1951, p. 109 (*err. det.*, not the records

FIGURES 23-42. Males: Basal apodeme, dorsal endomere, paramere, and pseudopenis. 26. *E. longiceps* K. and F. (holotype). 27. *E. nayaritensis* sp. n. (holotype). 28. *E. oculatus* sp. n. (holotype). 29. *E. kaibabensis* sp. n. (holotype). 30. *E. paralongiceps* sp. n. (holotype). 31. *E. kelloggi* Ferris (holotype). 32. *E. hondurensis* Werneck (holotype). 33. *E. urosiuri* Werneck (after Werneck, 1937). 34. *E. extremus* Ferris (holotype). 35. *E. deppei* sp. n. (holotype). 36. *E. mexicanus* Werneck (holotype). 37. *E. pratti* sp. n. (holotype). 38. *E. arizonensis* Werneck (holotype). 39. *E. venezuelae* Ferris (holotype). 40. *E. insularis* Werneck (holotype). 41. *E. brasiliensis* Werneck (after Werneck, 1937). 42. *E. microsiuri* Werneck (holotype), A and B.

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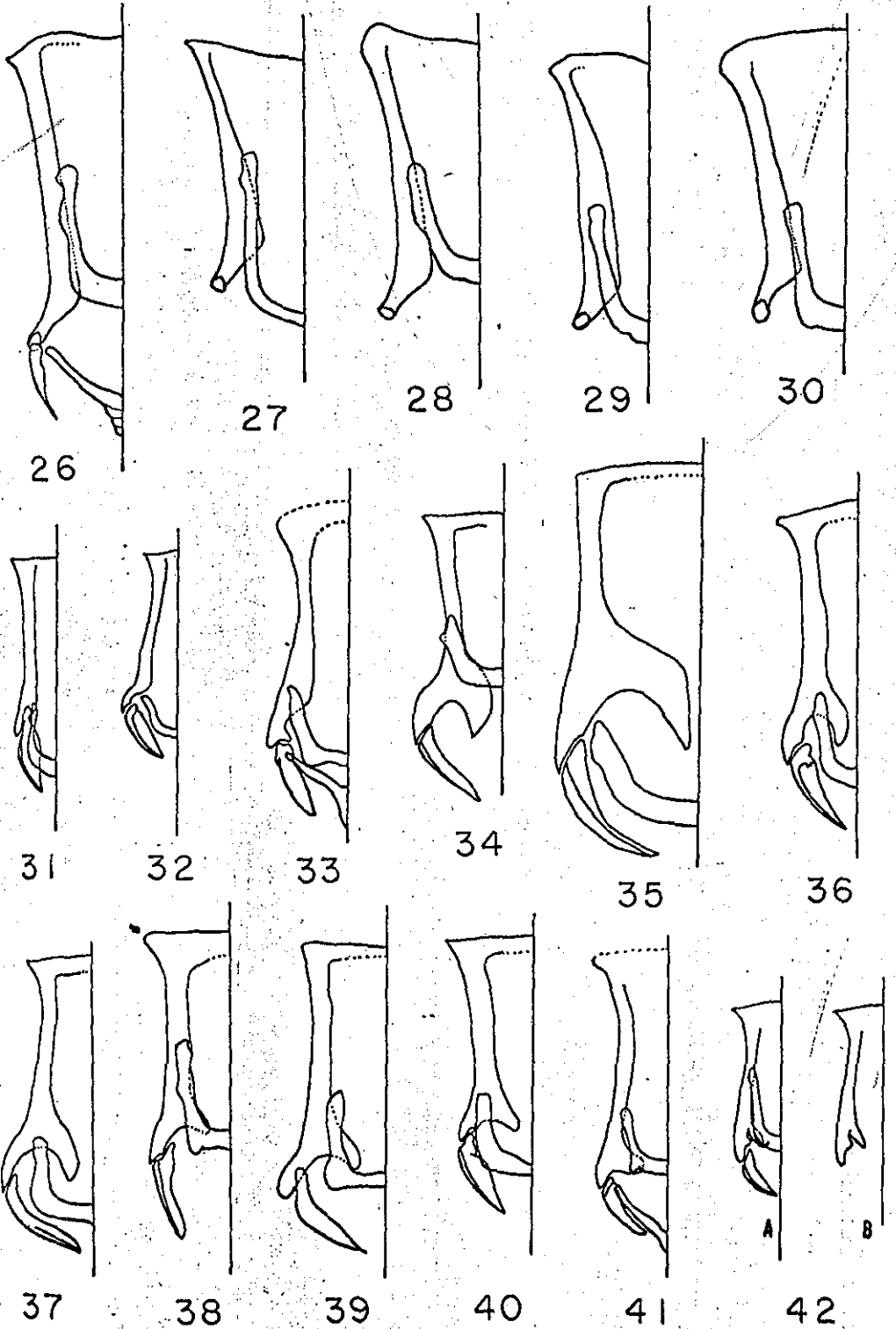
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from *S. carolinensis*, *S. niger*, *S. aberti*, *S. alleni*, and *S. oculus*).

**Type data:** Holotype male, allotype female, and 6 paratypes (3 males and 3 females), ex *Sciurus kaibabensis* Merriam, Kaibab National Forest, Arizona, USA, Ferris Coll. 906 (USNM 168301), G.F.F. All type specimens except for 2 paratypes are deposited in UCB; 1 male and 1 female paratype (on 1 slide) are deposited in UM.

#### Description

**Male:** Total body length about 0.68 mm. *Head* (Fig. 55), *thorax*, and *legs* as in *E. longiceps* K. and F. except for head length 0.0127 to 0.0134 mm, width 0.0110 to 0.0111 mm. *Abdomen* with 5 narrow tergites occupying the median third of each of segments 3 to 7, of these one on segment 3 very small; 1st row of tergal setae 1-2-1, 2nd row 0-4-0 or occasionally 0-5-0; 5th row 2-6-2, 6th row 4-6-4; about 12 DLAS present on each side; no sclerotized sternites except for segment 2 with 2 ventral plates completely detached from paratergites; 1st row of sternal setae 0-4-0 or occasionally 0-6-0, 2nd row 0-2-0; paratergites, paratergal setae, spiracles, and MAS of segments 7 and 8 as in *E. longiceps*. *Genitalia* (Figs. 12, 29, 54, 56): dorsal endomere more or less V-shaped and posteriorly expanded in middle; anterior endomere consisted of 4 parts, 2 more or less oval lateral pieces which are connected by a middle piece and anterior part with poorly sclerotized membrane; middle endomere with inner loop fused to its anterior part, encasing aedeagus; posterior endomere longer than wide and mesally becoming narrow; basal apodeme thickened at anterior fourth and gradually expanding to subapex mesally; paramere narrow, thin and sharply pointed at apex; pseudopenis Y-shaped, its posterior part with 4 or 5 annuli; radula with anterior side slightly rounded.

**Female:** Total body length about 0.7 mm. *Head*, *thorax*, and *legs* as in male; head length 0.0127 to 0.0135 mm, width 0.0111 to 0.0116 mm. *Abdomen* without sclerotized tergites and sternites except for segment 2 as in male; 1st and 2nd rows of tergal setae as in male; about 11 DLAS present on each side; 1st row of sternal setae 0-4-0, 2nd row 1-2-1; paratergites, paratergal setae, spiracles, and MAS same as in male. *Genitalia* (Figs. 58, 59): spermatheca short, wide, and posteriorly abruptly constricted, its constriction very short; valvula broad at base and serrated at apex; genital plate with a group of 2 setae on posterior margin of each side; gonopods each laterally produced, with 3 setae on posterior margin, its outer seta

longer than others; genital lobe with a long spiniform genital seta at subapex, with a dorsal seta next to genital seta, and its base with 3 long setae; anal margin between genital lobes strongly fimbriated.

**Nymphs:** Unknown.

**Specimens examined:** Type specimens.

#### Comments

This species is closely allied to *E. longiceps* K. and F., *E. nayaritensis* sp. n., *E. oculus* sp. n., and *E. paralongiceps* sp. n.

#### 5. *Enderleinellus paralongiceps* sp. n.

(Figs. 13, 30, 60-65)

*Enderleinellus longiceps* Kellogg and Ferris (*partim*), Ferris, 1919, p. 19 (*err. det.*, the record from *Sciurus aberti ferreus*); Hopkins, 1949, p. 456 (the record from *Sciurus aberti*); Ferris, 1951, p. 109 (*err. det.*, the record from *S. aberti*; not the records from *S. carolinensis*, *S. niger*, *S. kaibabensis*, *S. alleni*, and *S. oculus*).

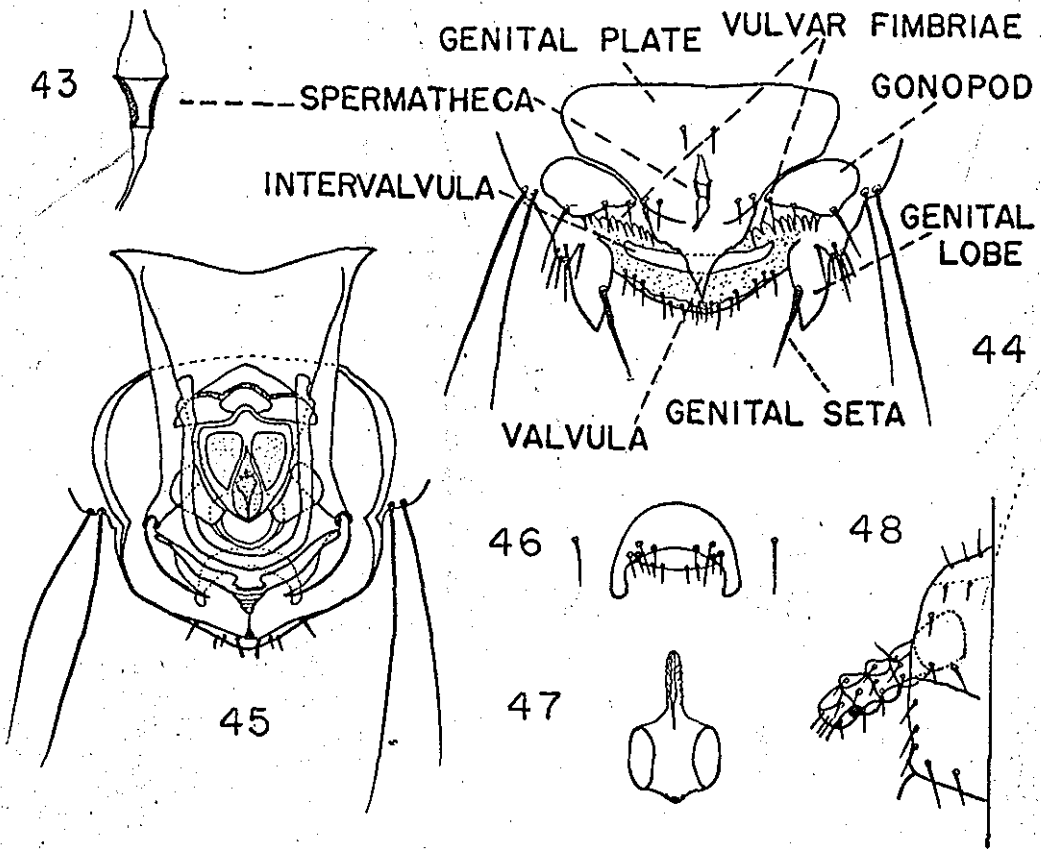
**Type data:** Holotype male, allotype female, and 6 paratypes, ex *Sciurus aberti ferreus* True, Estes Park, Colorado, Ferris Coll. 493 (USNM 19023 and 25819). Paratypes: 2 males, 2 females, 2 nymph 2, ex *Sciurus aberti* Woodhouse, Flagstaff, Arizona, 20 June 1958, collected by J. R. Beer. Holotype, allotype, and 4 paratypes are deposited in UCB; 1 male and 1 female paratype are in USNM; 6 paratypes, 2 male, 2 female, and 2 nymph 2 in UM.

#### Description

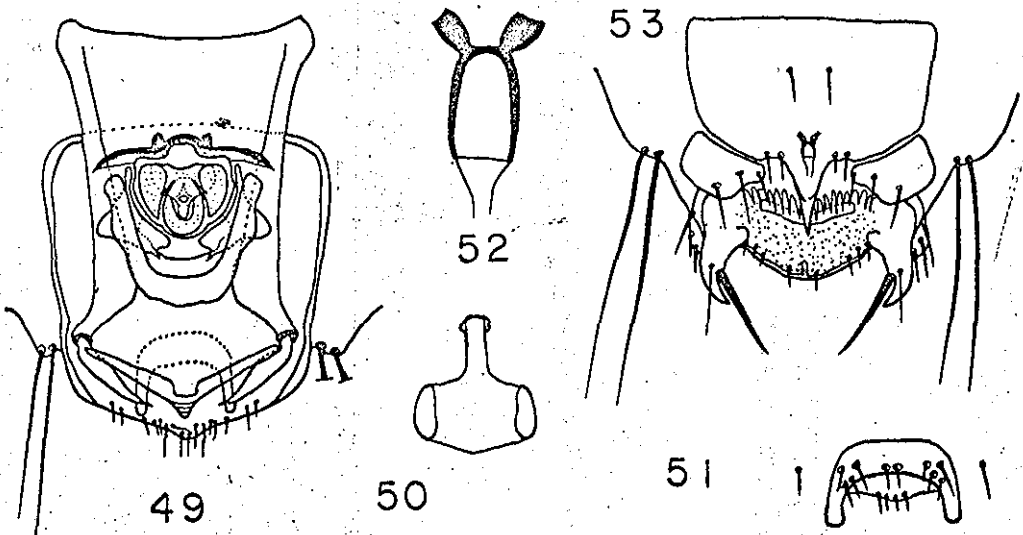
**Male:** Total body length about 0.68 mm. *Head*, *thorax*, and *legs* as in *E. longiceps* K. and F. except for head length 0.0122 to 0.0127 mm, width 0.0094 to 0.0113 mm; antennae ventrally placed; PCHS as long as MHS; outer ADTS minute, inner ADTS 5 to 6 times longer than outer seta. *Abdomen* with 5 narrow tergites occupying the median third of each of segments 3 to 7, of these one on segment 3 usually very small; 1st row of tergal setae 1-2-1, 2nd row 0-4-0, 5th row 3-5-3 or 2-6-2, 6th row 2-6-2; about 10 DLAS present on each side; no sclerotized sternites, except for segment 2 with 2 ventral plates as in *E. longiceps*; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; paratergites, paratergal setae, spiracles, and MAS of segments 7 and 8 as in *E. longiceps*. *Genitalia* (Figs. 13, 30, 60, 62): dorsal endomere more or less U-shaped; anterior endomere with 2 sclerotized pieces placed medially on thinly sclerotized membrane;

FIGURES 43-48. *Enderleinellus nayaritensis* sp. n. 43. Female, spermatheca (allotype). 44. Female genitalia (allotype). 45. Male genitalia (holotype). 46. Male, radula (holotype). 47. Male, thoracic sternal plate (holotype). 48. Male, dorsal view of head (holotype).

FIGURES 49-53. *Enderleinellus oculus* sp. n. 49. Male genitalia (holotype). 50. Male, thoracic sternal plate (holotype). 51. Male, radula (holotype). 52. Female, spermatheca (allotype). 53. Female genitalia (allotype).



2. *E. NAYARITENSIS* SP. N.



3. *E. OCULATUS* SP. N.



anterior part of middle endomere posteriorly produced and fused with inner loop encasing a star-shaped aedeagus; posterior endomere slightly expanded in lateral side; basal apodeme slender; paramere slender; pseudopenis Y-shaped, with very short posterior part bearing 4 or 5 annuli; radula anteriorly rounded.

*Female*: Total body length about 0.74 mm. *Head, thorax, and legs* as in male; head length 0.0112 to 0.0130 mm, width 0.0099 to 0.0109 mm. *Abdomen* without sclerotized tergites and sternites except for segment 2 as in male; 1st row of tergal setae 0-2-0 or occasionally 0-3-0, 2nd row variable 1-6-1 or 1-4-1; 11 to 13 DLAS on each side; 1st row of sternal setae 0-4-0, 2nd row 1-2-1 or sometimes 0-2-0; paratergites, paratergal setae, spiracles, and MAS same as in male. *Genitalia* (Figs. 63, 64): spermatheca with anterior part long, oval ring and posteriorly overlapped by small, less sclerotized ring; valvula narrow and pointed at apex; genital plate with a group of 2 setae on posterior part and a pair of middle setae; gonopods triangular, each with 3 setae on mesal margin and also with 2 long setae at posterior corner; genital lobes each with a long spiniform genital seta at subapex, with a weak but long dorsal seta, and its base with 2 or 3 long setae; vulvar fimbriae long.

*Nymph 1*: Unknown.

*Nymph 2* (Fig. 65): Total body length 0.46 to 0.55 mm. *Head*: ADPHS represented by inner seta of a pair of small setae located anterior to clypeofrontal suture; 3 MHS irregularly arranged; PDPHS longer than MHS; PCHS distinct; VPHS long. *Thorax*: sternal plate distinctly present, with 2 oval, lateral sclerites which are connected by membranous median area and without anterior process; DPTS and DMts present; DPTS long and strong, reaching 1st CAS; ADTS minute. *Abdomen* with 2 pairs of MAS on each side; 8 DCAS and VCAS arranged in more or less straight line; 3 pairs of spiracles located anterior to AMAS; 2 paratergites, 2nd one bearing a spiracle, on each side; ventral ACS present next to base of PMAS; a pair of AnS; abdomen with slight indication of segmentation; 1 VLAS occasionally present lateral to 6th CAS, this probably a sexual difference.

*Nymph 3*: Unknown.

*Specimens examined*: Type specimens from *Sciurus aberti* data as in "Type data."

#### Comments

This species is closely related to *E. longiceps* K. and F., *E. nayaritensis* sp. n., *E. oculus*

sp. n., and *E. kaibabensis* sp. n. The nymph 2 of this species is separable from that of *E. longiceps* by having 2 paratergites, 8 DCAS, and 7 VCAS, and ACS present next to PMAS.

#### 6. *Enderleinellus kelloggi* Ferris

(Figs. 14, 31, 66-71)

*Enderleinellus kelloggi* Ferris, 1916a, "Catalogue," Proc. Calif. Acad. Sci. 4(6): 148 (without description); Ferris, 1916b, p. 105; Hopkins, 1949, p. 456; Ferris, 1951, p. 109; Stojanovich and Pratt, 1965, p. 8' (key).

*Enderleinellus kelloggi* Ferris (*partim*), 1919, p. 22 (the records from *Sciurus griseus* only); Werneck, 1937, p. 401-402; Werneck, 1948, p. 285-286 (the records from *S. griseus* and not from *Sciurus variegatoides* and *Microsciurus palmeri*).

*Type data*: Holotype male, allotype female, and 6 paratypes, ex *Sciurus griseus nigripes* Bryant, Stanford University, California (skin in Stanford Zool. Dept. Coll.). Paratypes: 6 males and 3 females, ex *Sciurus griseus griseus* Ord, Pleasant Valley, Mariposa Co., California, collected by G. F. Ferris, 1915. All type specimens except for 2 paratypes are deposited in UCB; 1 male and 1 female paratypes (on 1 slide) are deposited in UM.

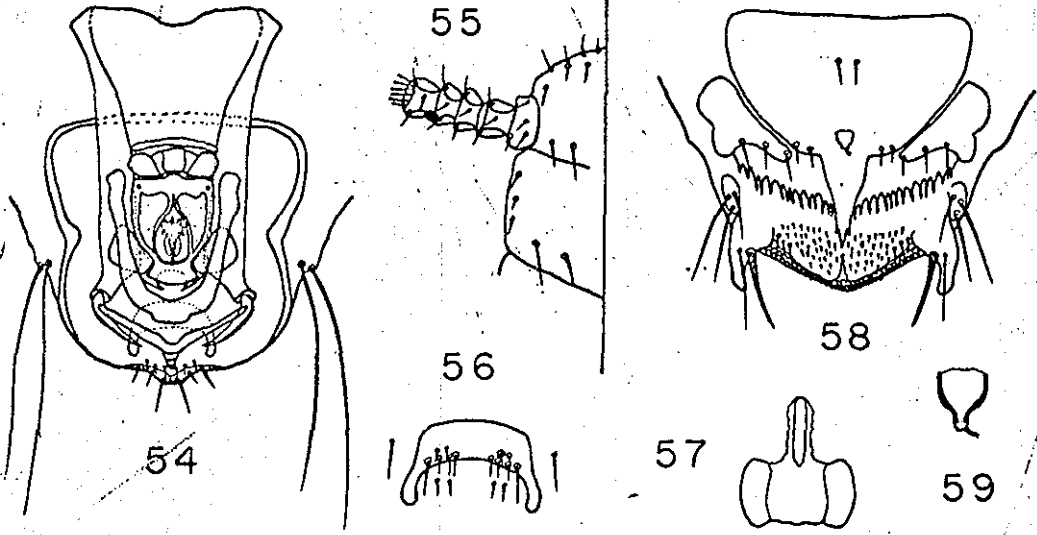
#### Description

*Male*: Total body length 0.63 to 0.64 mm. *Head*: length 0.0117 mm, width 0.0112 mm; antennae ventrally placed; AS, ACHS, and ADHS lacking; PCHS distinct, about as long as MHS. *Thorax*: sternal plate more or less flattened posteriorly; DPTS long; inner ADTS about 3 times longer than outer seta. *Legs* as in other member of the genus. *Abdomen* with 7 narrow, sclerotized tergites on segments 2 to 8, of these one on segment 2 very small or lacking; 1st row of tergal setae 1-4-1, 2nd row 0-4-0 or occasionally 1-2-1; 10 to 14 DLAS present on each side; no sclerotized sternites, except for segment 2 with 2 ventral plates completely detached from paratergites; 1st row of sternal setae 1-2-1 or occasionally 0-3-0, 2nd row 0-2-0, 4th, 5th, and 6th rows 3-6-3; 4 paratergites present on segments 2 to 5; paratergites of segment 2 each with 2 dorsal and no ventral paratergal setae; paratergites of segments 3 to 5 each with a single dorsal and 1 ventral paratergal seta; 3 spiracles borne on paratergites of segments 3 to 5; segments 7 and 8 each with a pair of long MAS on each side; cuticle of abdominal membrane appearing scaly. *Genitalia* (Figs. 14, 31, 66, 69): dorsal

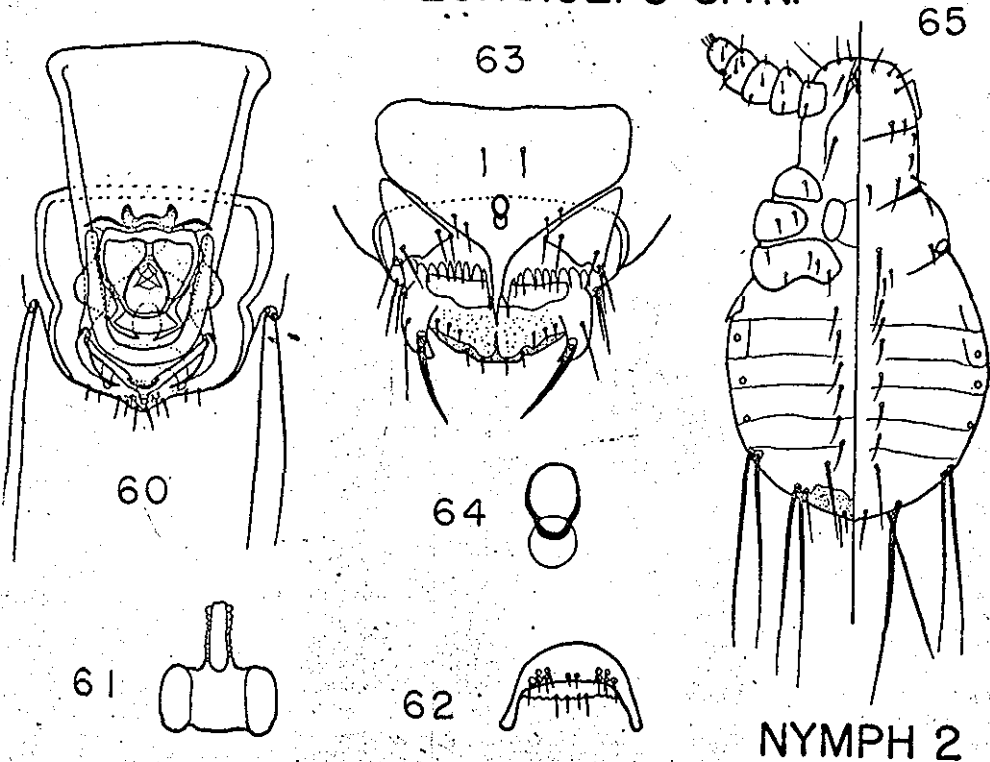
FIGURES 54-59. *Enderleinellus kaibabensis* sp. n. 54. Male genitalia (holotype). 55. Male, dorsal view of head (holotype). 56. Male, radula (holotype). 57. Male, thoracic sternal plate (holotype). 58. Female genitalia (allotype). 59. Female, spermatheca (allotype).

FIGURES 60-65. *Enderleinellus paralongiceps* sp. n. 60. Male genitalia (holotype). 61. Male, thoracic sternal plate (holotype). 62. Male, radula (holotype). 63. Female genitalia (allotype). 64. Female, spermatheca (allotype). 65. Nymph 2 (paratype).

4. E. KAIBABENSIS SP.N.



5. E. PARALONGICEPS SP.N.



endomere strongly U-shaped; with long, slender lateral arms, anterior endomere with an oval lateral sclerite on each side of thinly sclerotized membrane; a weakly sclerotized, narrowly trapezoidal or triangular structure present anterior to anterior endomere; middle endomere poorly developed encasing aedeagus; aedeagus well developed; paramere large, scalpel-like, enlarged in middle, and not pointed toward each other; basal apodemes slender, of same thickness and much closer together; pseudopenis relatively large and its posterior part large with 4 or more annuli; radula anteriorly flattened; posterior end of abdomen with a small bulbous median lobe bearing 2 long setae.

**Female:** Total body length 0.73 to 0.78 mm. **Head, thorax, and legs** as in male; head length 0.0112 to 0.0120 mm, width 0.0108 to 0.0110 mm. **Abdomen** without sclerotized tergites and sternites except for segment 2 as in male; 1st row of tergal setae 1-4-1 or 2-4-2, 2nd row 0-4-0; DLAS continuous to CAS in each tergal row of segments 6 to 8; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; paratergites of segments 2 to 5 each with a single dorsal and 1 ventral paratergal setae; paratergites, spiracles, and MAS as in male. **Genitalia** (Fig. 70) without an apparent spermatheca; valvula strongly sclerotized, tubular and serrated at apex, this sclerotization extending forward to genital plate; genital plate with a group of 2 posterior setae on each side; gonopods posteriorly fimbriated, with 3 similar setae at its middle part; genital lobe with a spiniform genital seta at apex, with 1 short dorsal seta, and its base with 1 long and 3 or 4 short setae; vulvar fimbriae long and few in number; anal area with microtrichiae.

**Nymphs:** Unknown.

**Specimens examined:** Type specimens, data as in "Type data."

#### Comments

This species is allied to *E. hondurensis* Werneck.

#### 7. *Enderleinellus hondurensis* Werneck (Figs. 15, 32, 72-85)

*Enderleinellus hondurensis* Werneck, 1948, Mem. Inst. Oswaldo Cruz, Rio de Janeiro 45(2): 286, figs. 7-9; Hopkins, 1949, p. 455; Ferris, 1951, p. 108-109.

*Enderleinellus kelloggi* Ferris (*partim*) 1919, p. 22 (*err. det.*, the records from *Sciurus variegatoides* (= *S. boothiae*, *S. melania*, and *S. goldmani*)); Werneck, 1937, p. 401-402 (the records from *Sciurus variegatoides*).

**Type data:** Holotype male, allotype female, and 2 paratypes, ex *Sciurus variegatoides boothiae* Gray (= *Sciurus boothiae*), San Pedro, Sula Prairie, Honduras, Ferris Coll. 892 (USNM 90168). All type specimens are deposited in UCB.

#### Description

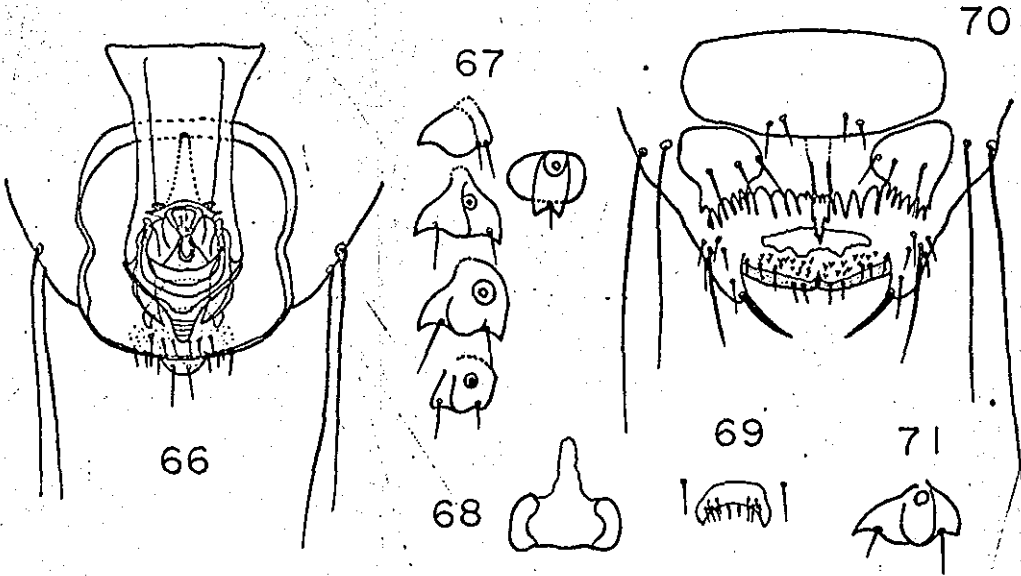
**Male:** Total body length 0.55 to 0.66 mm. **Head, thorax, and legs** as in *E. kelloggi* Ferris except for head length 0.0132 to 0.0134 mm, width 0.0102 to 0.0109 mm; inner ADTS 2 to 3 times longer than outer seta. **Abdomen** with 7 sclerotized tergites on segments 1 to 7, of these ones on segments 1 and 2 very small dot or almost lacking; 1st and 2nd rows of tergal setae 0-4-0; about 6 DLAS on each side; no sclerotized sternites except for segment 2 with a pair of ventral plates completely detached from paratergites; 1st row of sternal setae 0-4-0, 2nd row 0-2-0, 5th row 2-7-2, 6th 13 setae continuous; paratergites, paratergal setae, spiracles, MAS of segments 7 and 8 as in *E. kelloggi*; cuticle of abdominal membrane appearing more or less scaly. **Genitalia** (Figs. 15, 32, 72, 75): dorsal endomere wide, with short lateral arms; anterior endomere poorly developed, membranous; middle endomere small, crown-shaped, bearing aedeagus posteriorly; posterior endomere well developed and its posteromesal angle pointed; arms of basal apodeme with small subapical protuberance or small acute spur toward meson; paramere thickened and mesally notched at base; pseudopenis Y-shaped, with large posterior part bearing 5 or 6 annuli; anterior margin of radula more or less flattened; posterior end of abdomen not bulbous, but with about 8 setae.

**Female:** Total body length 0.66 to 0.70 mm. **Head, thorax, and legs** as in male; head length 0.0107 to 0.0149 mm, width 0.0089 to 0.0104 mm. **Abdomen** without sclerotized tergites and sternites, except for segment 2 as in male; 1st and 2nd rows of tergal setae 0-4-0 or occasionally 1st row 0-2-0; DLAS usually continuous to CAS in each tergal row of segments 6 and 7; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; paratergites, paratergal setae,

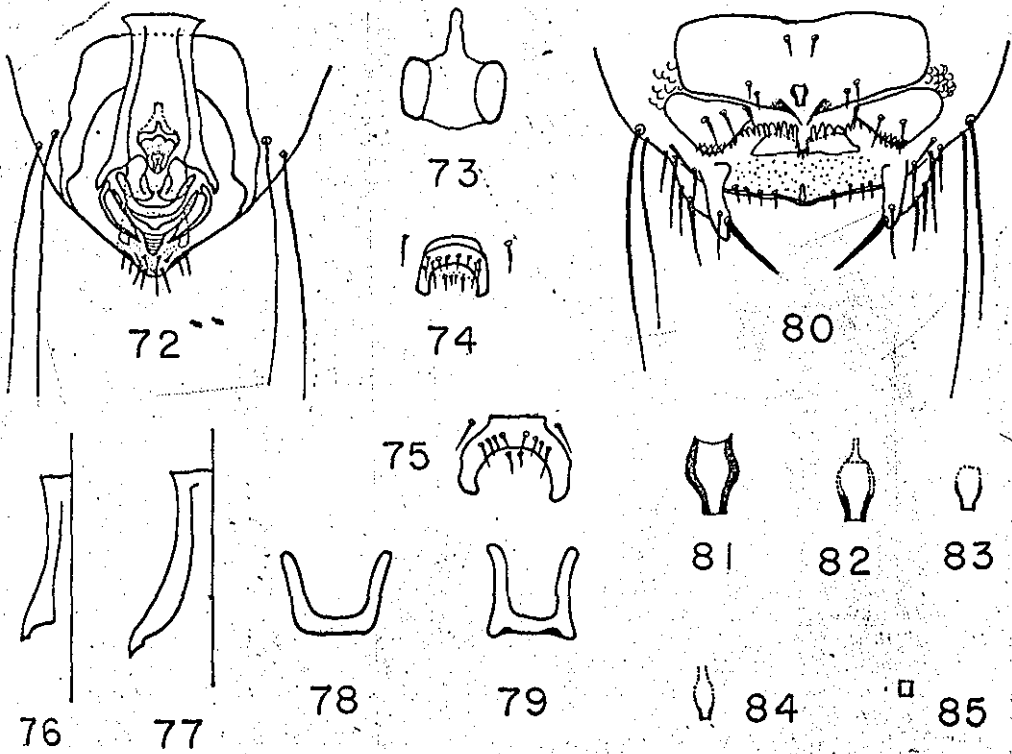
FIGURES 66-71. *Enderleinellus kelloggi* Ferris. 66. Male genitalia (holotype). 67. Male, paratergites and ventral plate (holotype). 68. Male, thoracic sternal plate (holotype). 69. Male, radula (holotype). 70. Female genitalia (allotype). 71. Female, paratergite of abdominal segment 2 (allotype).

FIGURES 72-85. *Enderleinellus hondurensis* Werneck. 72. Male genitalia (holotype; ex *Sciurus variegatoides boothiae*). 73. Male, thoracic sternal plate (holotype). 74. Male, radula (holotype). 75. Radula (ex *S. variegatoides goldmani*). 76. Male, basal apodeme (paratype; ex *S. v. boothiae*). 77. Basal apodeme (ex *S. v. goldmani*, *S. v. melania*, and *S. yucatanensis yucatanensis*). 78. Male, dorsal endomere (paratype; ex *S. v. boothiae*). 79. Dorsal endomere (ex *S. v. goldmani*, *S. v. melania*, and *S. y. yucatanensis*). 80. Female genitalia (allotype; ex *S. v. boothiae*). 81-85. Female, spermatheca: 81. allotype; 82. paratype, ex *S. v. boothiae*; 83. paratype and ex *S. v. melania*; 84. ex *S. v. goldmani* and *S. v. melania*; 85. ex *S. y. yucatanensis*.

### 6. E. KELLOGI FERRIS



### 7. E. HONDURENSIS WERNECK



spiracles, and MAS as in male. *Genitalia* (Figs. 80, 81-85): spermatheca large, swollen in middle and then tapering posteriorly, sometimes its anterior part desclerotized; genital plate with a group of 2 setae on its posterior part; gonopods each with 3 similar setae on its anterior part; genital lobe with a long spiniform subapical seta, with a weak dorsal seta, and its base with more than 4 long, strong setae; valvula short, branched at apex; vulvar fimbriae short.

*Nymphs*: Unknown.

*Specimens examined*: Type specimens, data as in "Type data." Ex *Sciurus variegatoides goldmani* Nelson (= *Sciurus goldmani*), Huehuetan, Chiapas, Mexico, Ferris Coll. 895 (USNM 77906), 8 males and 9 females; ex *S. v. melania* (Gray) (= *Sciurus melania*), Boqueron, Colombia (there is no such place in Colombia at present; if specimens were collected before 1903, this locality would be equivalent to Boqueron, southwestern part of Panama), F.C.M. 14253, Ferris Coll. 1011, 2 males and 19 females. Ex *Sciurus yucatanensis yucatanensis* J. A. Allen, Gruta de Balankranche, Yucatan, Mexico, 29 July 1962, JGM 239, 2 males and 2 females (K. C. Emerson).

**Comments**

This species is closely related to *E. kelloggi* Ferris and *E. urosciuri* Werneck. The specimens from *S. variegatoides melania*, *S. v. goldmani*, and *S. yucatanensis* differ from typical specimens of *E. hondurensis* parasitic upon *S. v. boothiae* in few details of the genitalia, although all other characters in both male and female seem to agree: the arms of the basal apodeme slightly thickened at subapex, but without small subapical protuberance or acute spur toward meson (Fig. 77); the lateral arms of the dorsal endomere parallel and its posterior part notched on each side (Figs. 78-79); radula differently shaped, with its anterior margin distinctly truncate (Figs. 74, 75) and with 8 setae arranged in more or less straight line; spermatheca with its anterior part strongly desclerotized (Figs. 81-85). There are also some specimens from the type

host having spermatheca with its anterior half strongly desclerotized.

**8. *Enderleinellus urosciuri* Werneck**  
(Figs. 16, 33)

*Enderleinellus urosciuri* Werneck, 1937, Mem. Inst. Oswaldo Cruz, Rio de Janeiro 32(3): 400-401, fig. 12; Hopkins, 1949, p. 457; Ferris, 1951, p. 114.

*Type data*: Holotype male, allotype female, and 4 paratypes, ex *Sciurus igniventris* Wagner (= *Urosciurus igniventris*), de Acajutuba, Rio Negro, Est. do Amazonas, Brazil. Type specimens are probably deposited in the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil.

*Diagnosis*: Total body length: male 0.77 mm, female 0.82 mm. *Genitalia*: dorsal endomere wide, with short lateral arms; anterior endomere with thinly sclerotized membrane; a triangular, poorly sclerotized structure present anterior to anterior endomere; middle endomere with its anterior part posteriorly produced in middle; posterior endomere with anteromesal, hooklike process; arms of basal apodeme laterally bent, mesally thickened at subapex and apically bilobed to receive basal end of paramere; paramere more or less uniformly thickened with abruptly tapering apex; pseudopenis with long posterior part.

**Comments**

This species is definitely a member of *longiceps*-subgroup and closely related to *E. hondurensis* Werneck. The specimen of this species was not available for this study. However, this species is easily recognized by the details of male genitalia based on Werneck's illustration (1937).

**B. *extremus*-subgroup**

1. Male with arms of basal apodeme subapically bilobed.
2. Female with 2 or more sclerotized tergites on abdomen, except for *E. arizonensis* Werneck, spermatheca of which is strongly bent and its ends expanded.

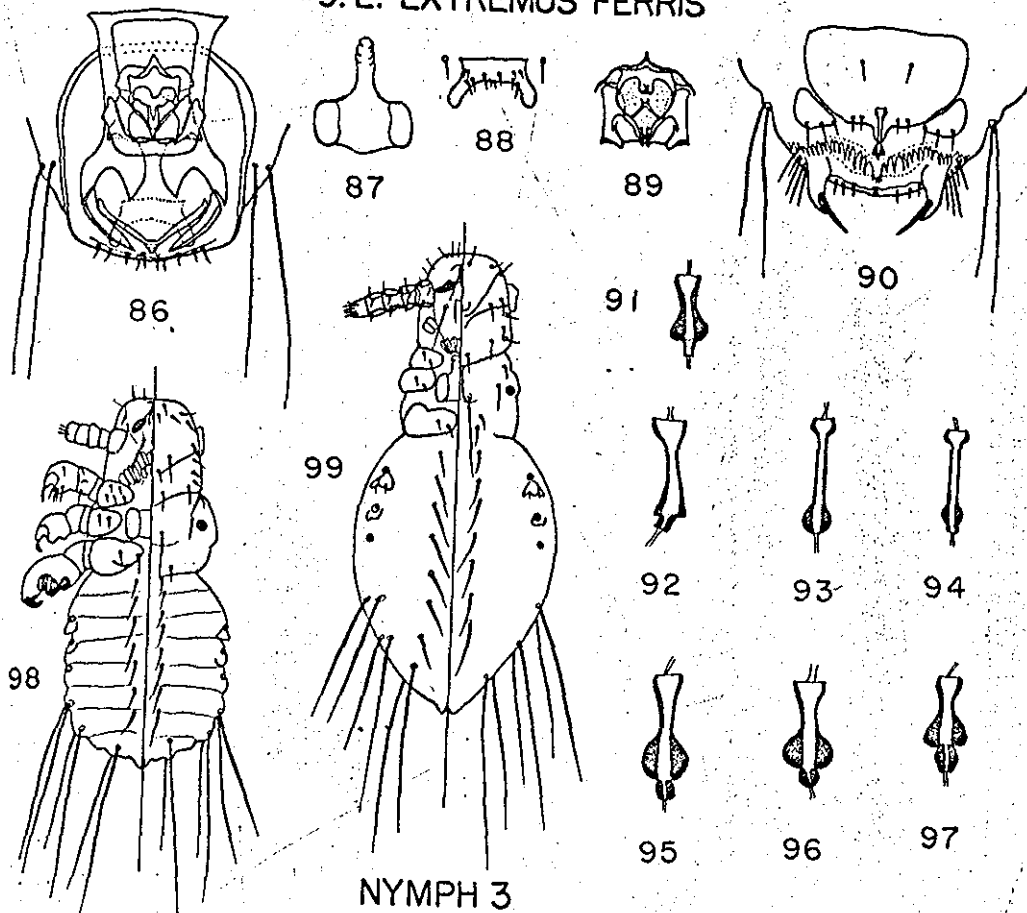
**9. *Enderleinellus extremus* Ferris**  
(Figs. 17, 34, 86-99)

*Enderleinellus extremus* Ferris (*partim*), 1919,

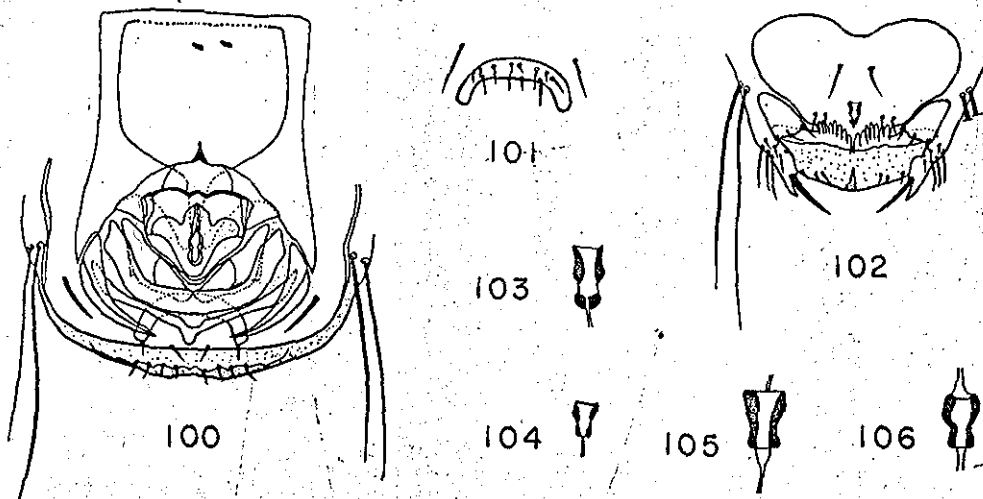
FIGURES 86-99. *Enderleinellus extremus* Ferris. 86. Male genitalia (holotype). 87. Male, thoracic sternal plate (holotype). 88. Male, radula (holotype). 89. Male, endomeres excluding dorsal endomere (ex *Sciurus polioopus*). 90. Female genitalia (paratype; ex *S. socialis*). 91-97. Female, spermathecae; 91. ex *S. polioopus*; 92. allotype, ex *S. deppoi negligens*; 93. paratype; 94. ex *S. aureogaster*; 95. ex *S. aureogaster*; 96. ex *S. aureogaster hypopyrrhus*; 97. ex *S. griseoflavus chiapensis*. 98. Nymph 2. 99. Nymph 3.

FIGURES 100-106. *Enderleinellus deppoi* sp. n. 100. Male genitalia (holotype). 101. Male, radula (holotype). 102. Female genitalia (allotype). 103-106. Female, spermathecae; 103. allotype; 104. paratype; 105. ex *Sciurus aureogaster hypopyrrhus*; 106. ex *S. granatensis hoffmanni*.

9. E. EXTREMUS FERRIS



10. E. DEPPEI SP.N.



Contributions Toward a Monograph of the Sucking Lice, Part 1, Leland Stanford Junior Univ. Publ., Univ. Ser. (no vol. no.), p. 24-25, fig. 12 (not the records from *Sciurus deppiei*, *S. nelsoni*, *S. colliacii*, *S. granatensis hoffmanni*, *S. nesaeus*, and *S. arizonensis huachucae*); Werneck, 1948, p. 291 (not the record from *Sciurus deppiei*); Hopkins, 1949, p. 456 (not the record from *Sciurus deppiei*); Ferris, 1951, p. 108 (not the record from *S. deppiei*).

**Type data:** Holotype male, allotype female, and 8 paratypes (4 males and 4 females), ex *Sciurus socialis* Wagner, Nenton, Guatemala, USNM 76746, Ferris Coll. 887. All type specimens, except for 1 male and 1 female paratype which are in possession of USNM are deposited in UCB.

### Description

**Male:** Total body length 0.57 to 0.62 mm. **Head** length 0.0126 to 0.0130 mm, width 0.011 to 0.012 mm; AS, ACHS, and ADHS lacking; PCHS long. **Thorax** with sternal plate of *longiceps*-group; DPTS, DPtS, and DMtS present; inner ADTS about 2 or 3 times longer than outer seta. **Legs** as in other member of the genus. **Abdomen** with 6 small sclerotized tergites on segments 2 to 7, of these, one on segment 2 minute; 1st and 2nd rows of tergal setae 0-4-0, 4th and 5th rows 2-6-2, 6th row 3-6-3; about 9 DLAS present on each side; no sclerotized sternites except for segment 2 with a pair of ventral plates completely detached from paratergites; 1st and 2nd rows of sternal setae either 0-2-0 or 0-4-0; 4 paratergites present on each side of segments 2 to 5; paratergites of segment 2 with 2 dorsal and no ventral paratergital setae and of segments 3 to 5 with 1 dorsal and 1 ventral paratergital setae; 3 spiracles borne on paratergites of segments 3 to 5 on each side; abdominal membrane not scaly. **Genitalia** (Figs. 17, 34, 86, 88): dorsal endomere wide, with short lateral arms; anterior part of middle endomere medially produced in both anterior and posterior sides; aedeagus short; anterior endomere with its middle piece triangular and its lateral parts large; posterior endomere well developed; arms of basal apodeme subapically bilobed and with its mesal lobe definitely broader at base than outer lobe; paramere thickened at base; pseudopenis with short posterior part bearing 3 or 4 annuli; anterior margin of radula truncate.

**Female:** Total body length 0.62 to 0.64 mm.

**Head, thorax, and legs** as in male; head length 0.012 to 0.0135 mm, width 0.0117 to 0.0122 mm. **Abdomen** with 2 or 3 very small sclerotized tergites on segments 2 and 3 or 2 to 4 or sometimes almost completely lacking; 1st and 2nd rows of tergal setae 0-4-0 or occasionally 1st row 0-3-0; 9 to 10 DLAS present on each side; 1st row of sternal setae 0-4-0 or occasionally 0-5-0, 2nd row 0-2-0; paratergites, paratergal setae, spiracles, and MAS as in male. **Genitalia** (Figs. 90, 91): Spermatheca elongated, this being anteriorly swollen, then abruptly constricted, again expanding gradually toward posterior end then becoming terminally truncate, with a small, strongly sclerotized terminal appendix; genital plate with a group of 2 setae on each side of its posterior margin and 1 pair of middle setae; gonopods each with 3 similar setae on posterior margin; genital lobes each with a long spiniform subapical genital seta and its base with about 5 long setae; valvula branched at apex.

**Nymph 1:** Unknown.

**Nymph 2** (Fig. 98): Total body length 0.45 mm. **Head** with long ADPHS placed in middle anterior to clypeofrontal suture; 3 MHS distinct, arranged in straight line; PCHS, VPHS, and PDPHS long; ACHS minute; antennae 5-segmented. **Thorax:** sternal plate well developed, without anterior process; DPTS long; DPtS minute; DMtS long; ADTS minute; legs 1 and 2 similar in size and shape, much smaller than leg 3. **Abdomen:** distinctly segmented; 2 paratergites present on segments 4 and 5; 3 spiracles present, of these, first 2 borne on paratergites; 8 DCAS and 7 VCAS present on each side; 3 pairs of long and slender MAS present on each side.

**Nymph 3** (Fig. 99): Total body length 0.56 to 0.61 mm. **Head, thorax, legs, and abdomen** similar to nymph 2, except for the following characters: ACHS missing; DPtS as long as DMtS; thoracic sternal plate with distinctive anterior process; 2 paratergites larger than those in nymph 2; abdomen without distinct segmentation.

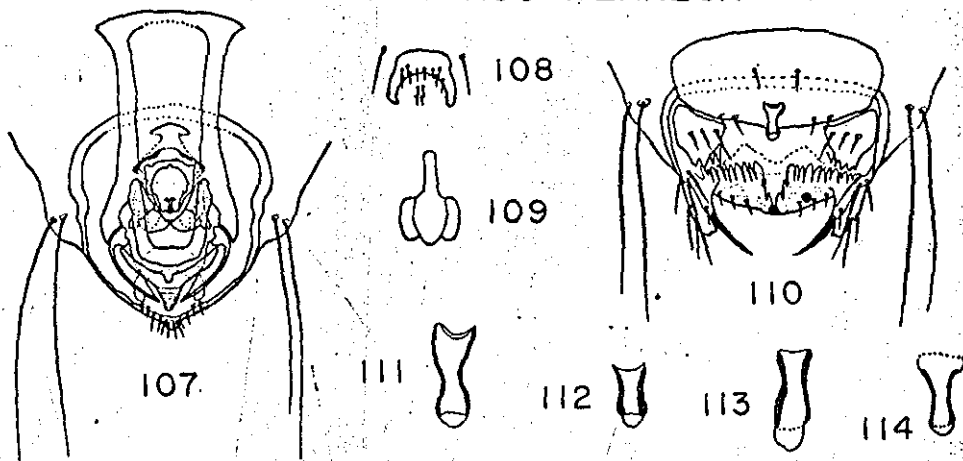
**Specimens examined:** Ex *Sciurus socialis*, all type specimens. Ex *Sciurus deppiei negligens* Nelson (= *Sciurus negligens*), Alta Mira, Tamaulipas, Mexico, USNM 62070, Ferris Coll. 495, 5 males and 4 females. Ex *Sciurus griseoflavus chiapensis* Nelson, San Cristobal, Chiapas, Mexico, USNM 75960, 2 males, 5 females, 2 nymph 3, and 1 nymph 2. Ex *Sciurus aureogaster* Cuvier (including *S. a. hypopyrrhus*), Puebla, Mexico, December

FIGURES 107-114. *Enderleinellus mexicanus* Werneck. 107. Male genitalia (holotype). 108. Male, radula (holotype). 109. Male, thoracic sternal plate (holotype). 110. Female genitalia (allotype). 111-114. Female, spermathecae; 111. allotype, ex *Sciurus truei*; 112. ex *S. nelsoni*; 113. ex *S. nelsoni*; 114. paratype, ex *S. truei*.

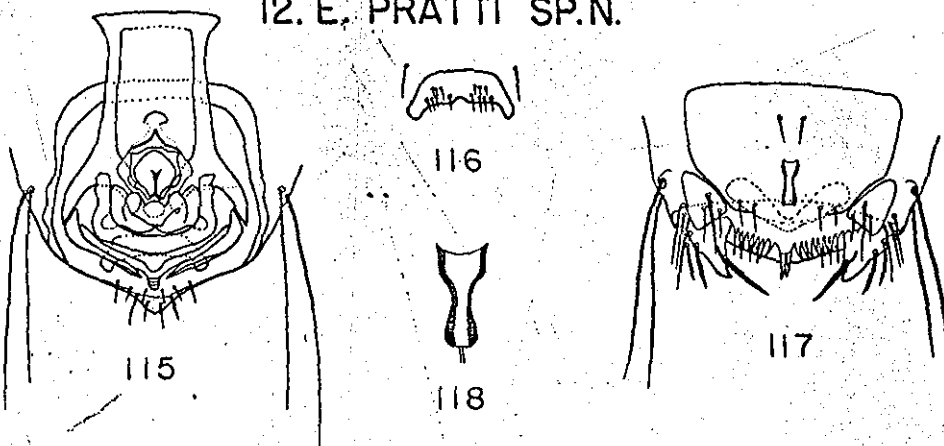
FIGURES 115-118. *Enderleinellus pratti* sp. n. 115. Male genitalia (holotype). 116. Male, radula (holotype). 117. Female genitalia (allotype). 118. Female, spermatheca (allotype).

FIGURES 119-124. *Enderleinellus arizonensis* Werneck. 119. Male genitalia (holotype). 120. Male, paratergites and ventral plate (holotype). 121. Male, radula (holotype). 122. Male, thoracic sternal plate (holotype). 123. Female genitalia (allotype). 124. Female, spermatheca (allotype).

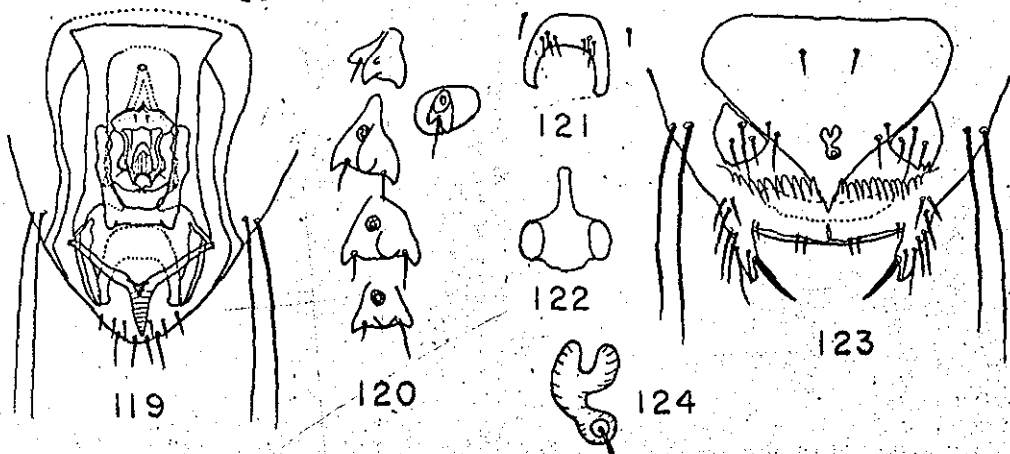
11. E. MEXICANUS WERNECK



12. E. PRATTI SP.N.



13. E. ARIZONENSIS WERNECK





1951, 3 males and 3 females; Papanita, Vera Cruz, Mexico, USNM 93016, Ferris Coll. 902, 2 males and 3 females; Juchitan, Oaxaca, Mexico, USNM 73297, Ferris Coll. 903, 4 males and 3 females. Ex *Sciurus polioopus* Fitzinger, Cerro San Felipe (?), Oaxaca, Mexico, USNM 68182, Ferris Coll. 900, 1 male and 1 female.

#### Comments

This species is closely related to *E. deppiei* sp. n. and *E. mexicanus* Werneck. The female specimens from various host species show a range of variations in some details of spermatheca, particularly in size from the typical specimen as shown in Figures 91-97. The occurrence of *E. extremus* on *Sciurus deppiei negligens* requires further investigation for the host-parasite relationship of *E. extremus* Ferris and *E. deppiei* sp. n. The specimens from *Sciurus polioopus* Fitzinger differ from typical *E. extremus* in some details of the genitalia. The middle endomere, aedeagus, and spermatheca of those specimens are definitely different from typical *E. extremus* as shown in Figures 89 and 91. However, for the present I tentatively refer this form to *E. extremus* until further study is carried out on additional material. Before making a final decision it will require examining a long series of specimens, both adults and nymphs, collected from *S. polioopus*.

#### 10. *Enderleinellus deppiei* sp. n.

(Figs. 18, 35, 100-106)

*Enderleinellus extremus* Ferris (*partim*), 1919, p. 24 (*err. det.*, the records from *Sciurus deppiei*, and *S. granatensis hoffmanni*); Werneck, 1948, p. 291 (the record from *S. deppiei*); Hopkins, 1949, p. 456 (the record from *S. deppiei*); Ferris, 1951, p. 108 (*err. det.*, the record from *S. deppiei*).

*Type data*: Holotype male, allotype female, and 1 paratype (all on 1 slide), ex *Sciurus deppiei* Peters, Teapa, Tabasco, Mexico, USNM 100048, Ferris Coll. 886. Paratypes: 1 male and 5 females, ex *Sciurus granatensis hoffmanni* Peters (= *S.*

*aequans hoffmanni*), Santa Clara, Costa Rica (= Santa Clara, Nicaragua), USNM 15755 and 37341.

#### Description

*Male*: Total body length about 0.565 mm. *Head, thorax, and legs* same as in *E. extremus* Ferris, except for head length about 0.0099 mm, width about 0.0102 mm. *Abdomen* with 5 small sclerotized tergites on segments 3 to 7; 1st and 2nd rows of tergal setae 0-4-0 or occasionally 1st row 0-2-0, 4th and 5th rows 2-6-2, 6th row 3-6-3; about 9 DLAS present on each side; no sclerotized sternites except for segment 2 with a pair of ventral plates completely detached from paratergites; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; paratergites, paratergal setae, spiracles, and MAS as in *E. extremus*. *Genitalia* (Figs. 18, 35, 100, 101): dorsal endomere very wide, with short lateral arms; anterior endomere well developed, but poorly sclerotized, with mesal part anteriorly pointed; middle endomere with anterior part thick, medially notched very deeply in posterior side and more or less flattened in anterior side; aedeagus long; posterior endomere more or less triangular, with posterolateral angle acute; arms of basal apodeme subapically bilobed, with mesal lobe definitely broader at base than is outer lobe; paramere basally thickened and gradually tapering; pseudopenis with short posterior part bearing 2 or 3 annuli; abdominal membrane lateral to parameres with a long spiniform seta on each side; radula wide, with anterior margin rounded.

*Female*: Total body length about 0.65 mm. *Head, thorax, and legs* as in male; head length 0.0119 to 0.0124 mm, width 0.0099 to 0.0113 mm. *Abdomen* with 2 to 3 small sclerotized tergites on segments 2 and 3 or 2 to 4 which are sometimes almost completely lacking; 1st and 2nd rows of tergal setae, 2nd row of sternal setae, DLAS, paratergites, paratergal setae, spiracles and MAS as in male; 1st row of sternal setae occasionally 0-5-0. *Genitalia* (Figs. 102, 103): spermatheca constricted or desclerotized at posterior third (Figs. 104-106); valvula short, narrow and pointed at apex; genital plate with a group of 2 setae on posterior part and 1 pair of setae in the middle; gonopods each with 3 similar setae on its posterior margin; genital lobes each with a long, spiniform, subapical genital seta and with its base bearing 3 long and 3 or more small setae.

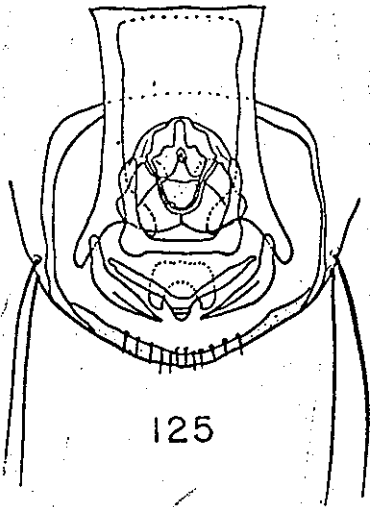
*Specimens examined*: All type specimens, as in "Type data." Ex *Sciurus aureogaster aureogaster*

FIGURES 125-128. *Enderleinellus venezuelae* Ferris. 125. Male genitalia (holotype). 126. Male radula (holotype). 127. Female genitalia (allotype). 128. Female spermatheca (allotype).

FIGURES 129-133. *Enderleinellus insularis* Werneck. 129. Male genitalia (holotype). 130. Male radula (holotype). 131. Female genitalia (paratype). 132-133. Female spermathecae; 132. paratype 1; 133. paratype 2.

FIGURES 134-138. *Enderleinellus microsciuri* Werneck. 134. Male genitalia (holotype). 135. Male radula (holotype). 136. Male, thoracic sternal plate (holotype). 137. Female genitalia (allotype). 138. Female spermatheca (allotype).

14. *E. VENEZUELAE* FERRIS



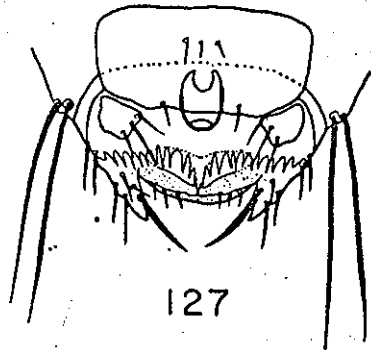
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126

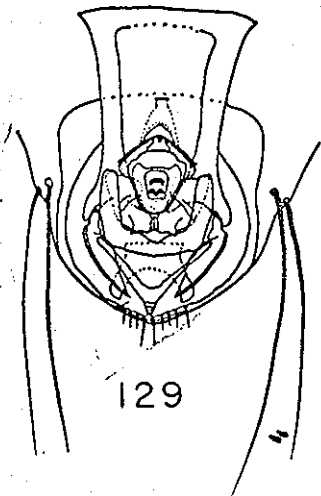


128



127

15. *E. INSULARIS* WERNECK



129



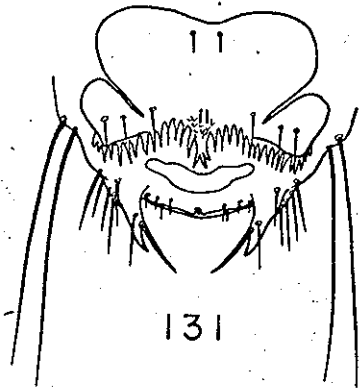
130



132

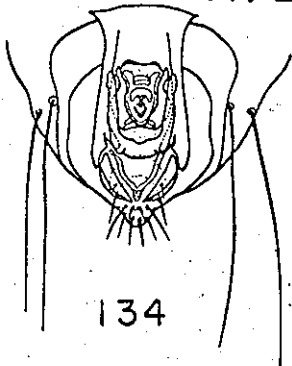


133



131

17. *E. MICROSCIURI* WERNECK



134



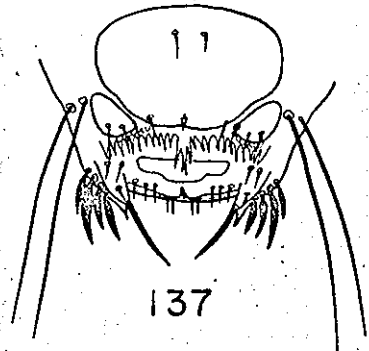
135



136



138



137

Cuvier (= *S. a. hypopyrrhus*), Juchitan, Oaxaca, Mexico, USNM 73297, 1 female.

#### Comments

This species is closely allied to *E. extremus* Ferris and *E. mexicanus* Werneck. The primary species of *Enderleinellus* parasitic on *Sciurus aureogaster* is *E. extremus* Ferris. A female specimen of *E. deppei* sp. n. collected from *S. aureogaster* is probably a contaminant.

#### 11. *Enderleinellus mexicanus* Werneck (Figs. 19, 36, 107-114)

*Enderleinellus mexicanus* Werneck (*partim*), 1948, Mem. Inst. Oswaldo Cruz, Rio de Janeiro 45: 289; figs. 16-18 (not the records from *Sciurus colliaceti*); Hopkins, 1940, p. 455 (the records from *Sciurus truei* and *S. nelsoni* only); Ferris, 1951, p. 110 (not the record from *S. colliaceti*). *Enderleinellus extremus* Ferris (*partim*), 1919, p. 24 (*err. det.*, the record from *Sciurus nelsoni*).

*Type data*: Holotype male, allotype female, and 5 paratypes (3 males and 2 females), ex *Sciurus truei* Nelson, Chacala, Mexico, USNM 96795, Ferris Coll. 890. All type specimens are deposited in UCB.

#### Description

*Male*: Total body length 0.62 to 0.63 mm. *Head* length 0.0137 to 0.0143 mm, width 0.0099 to 0.0101 mm; AS, ACHS, and ADHS lacking; PCHS usually longer than MHS; antennae more or less ventrally placed. *Thorax*: sternal plate of typical *longiceps*-group; DPTS, DPTS, and DMtS distinct; inner ADTS as long as or 1.5 longer than outer seta. *Abdomen* with 7 sclerotized tergites on segments 1 to 7 occupying the median half to third, of these one on segment 1 very small or occasionally completely lacking; 1st and 2nd rows of tergal setae 0-4-0, 4th and 5th rows 2-4-2, 6th row 3-6-3; about 10 DLAS present on each side; no sclerotized sternites, except for segment 2 as in other species; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; abdomen with 4 paratergites on seg-

ments 2 to 5 on each side; paratergites of segment 2 with 2 dorsal and no ventral paratergal setae; paratergites of segments 3 to 5 each with 1 dorsal and 1 ventral paratergal setae, ventral paratergal seta being longer than dorsal one; 3 spiracles borne on paratergites of segments 3 to 5; segments 7 and 8 with a pair of long, slender MAS; end of abdomen with bulbous lobe bearing 4 setae. *Genitalia* (Figs. 19, 36, 107, 108): dorsal endomere U-shaped, with long lateral arms; anterior endomere with sclerotized lateral pieces and membranous middle part; middle endomere ringlike, with its anterior part medially notched slightly on posterior side; aedeagus with paired, short, recurved hooklike apodeme at the midline; posterior endomere well developed, touching medially, but not fused by middle piece; arms of basal apodeme with mesal lobe slightly shorter than outer lobe, its outer lobe with small subapical tubercle; paramere thickened at base and gradually tapering toward apex; pseudopenis with long posterior part bearing 5 or more annuli; radula with its anterior margin more or less flattened.

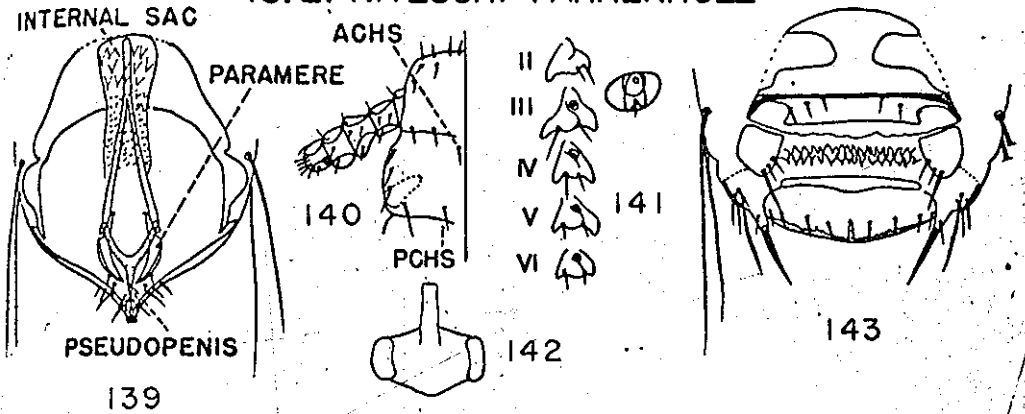
*Female*: Total body length 0.65 to 0.67 mm. *Head, thorax, and legs* as in male except for head length 0.0128 to 0.0140 mm, width 0.0104 mm and inner ADTS as long as outer seta. *Abdomen* with 4 very small tergites on segments 2 to 6, these occasionally lacking; 1st row of tergal setae 0-4-0 or occasionally 0-2-0, 2nd row 0-4-0; about 10 DLAS present on each side; no sclerotized sternites except for segment 2 as in male; paratergites, paratergal setae, spiracles, and MAS as in male; ventral paratergal setae of segments 4 and 5 as long as or slightly shorter than paratergites. *Genitalia* (Figs. 110, 111): spermatheca forming an elongate body which is more or less constricted at about the middle; genital plate with a group of 2 posterior setae on each side and with a pair of middle setae; gonopods each with 3 similar setae in the middle and its posterior margin slightly fimbriated; valvula broad, serrated and pointed at apex; genital lobes each with a spiniform subapical genital seta, 2 lateral setae, and 1 dorsal seta, and with its base bearing 3 very long setae, one of these about as long as genital seta.

FIGURES 139-143. *Enderleinellus nitzschi* Fahrenholz. 139. Male genitalia (ex *Sciurus vulgaris*). 140. Male, dorsal view of head; ACHS, anterior central head setae; PCHS, posterior central head setae. 141. Male, paratergites and ventral plate. 142. Male, thoracic sternal plate. 143. Female genitalia (ex *Sciurus vulgaris*).

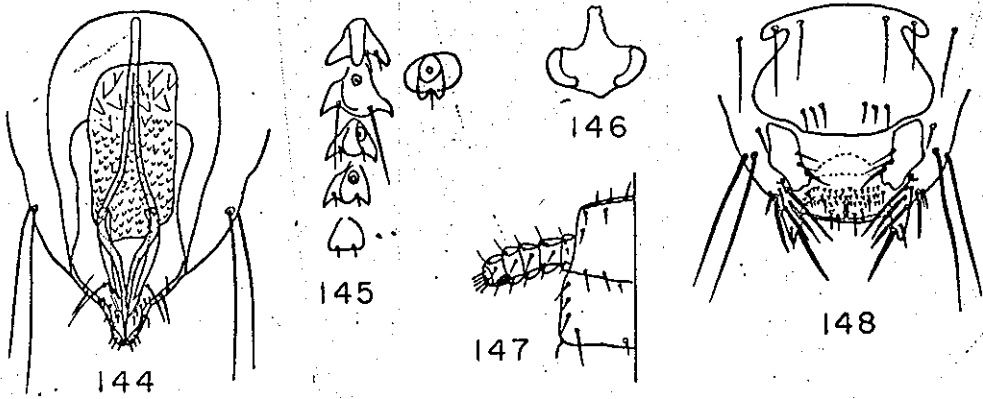
FIGURES 144-148. *Enderleinellus krochiae* Blagoveschtchensky. 144. Male genitalia (ex *Sciurus anomalus syriacus*). 145. Male, paratergites and ventral plate. 146. Male, thoracic sternal plate. 147. Male, dorsal view of head. 148. Female genitalia (ex *S. anomalus syriacus*).

FIGURES 149-155. *Enderleinellus tamiasciuri* sp. n. 149. Male genitalia (allotype). 150. Male, dorsal view of head (allotype). 151. Male, paratergites and ventral plate (allotype). 152. Male, thoracic sternal plate (allotype). 153. Female genitalia (holotype). 154. Nymph 2. DPTS, dorsal principal thoracic setae; ADTS, accessory dorsal thoracic setae; VCAS, ventral central abdominal setae; MAS, marginal abdominal setae; AMAS, anterior marginal abdominal setae; PMAS, posterior marginal abdominal setae; AcS, accessory setae. 155. Nymph 3. VPHS, ventral principal head setae; MHS, marginal head setae; DPTS, dorsal prothoracic seta; DMtS, dorsal mesothoracic seta; AnS, anal seta.

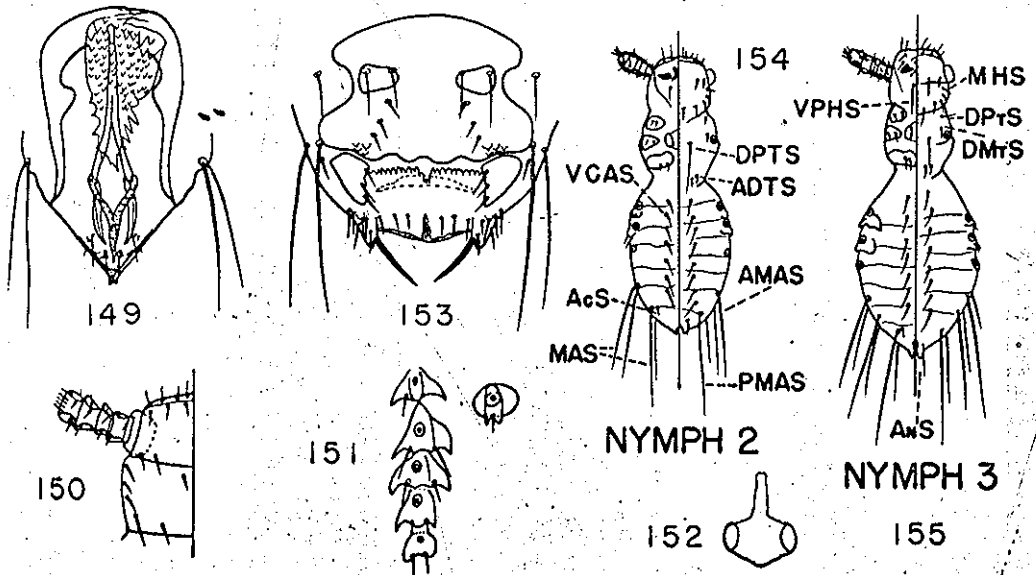
18. E. NITZSCHI FAHRENHOLZ



19. E. KROCHINAE BLAGOVESCHTCH.



20. E. TAMIASCIURI SP. N.



*Nymphs:* Unknown.

*Specimens examined:* All type specimens. Ex *Sciurus nelsoni* Merriam, Huitzalac, Morelos, Mexico, USNM 51156, Ferris Coll. 888, 4 males and 5 females.

#### Comments

This species is closely related to *E. pratti* sp. n., *E. extremus* Ferris, and *E. deppei* sp. n., and is found on the highland forms of Mexican *Sciurus*. Female specimens show that there are considerable variations in spermathecae, particularly in total length, among different populations (Figs. 111-114).

#### 12. *Enderleinellus pratti* sp. n.

(Figs. 20, 37, 115-118)

*Enderleinellus mexicanus* Werneck (*partim*), 1948, p. 289, 303 (*err. det.*, the record from *Sciurus colliaei*); Hopkins, 1949, p. 455 (not the records from *Sciurus truei* and *S. nelsoni*); Ferris, 1951, p. 110 (*err. det.*, the record from *S. colliaei*).

*Enderleinellus extremus* Ferris (*partim*), 1919, p. 24 (*err. det.*, the record from *Sciurus colliaei*).

*Type data:* Holotype male, allotype female, and 7 paratypes, ex *Sciurus colliaei* Richardson, Santiago, Tepic, Mexico, USNM 91245, Ferris Coll. 891. Holotype, allotype, and 5 paratypes are deposited in the collection of UCB. One male and 2 female paratypes (on 1 slide) are deposited in UM.

#### Description

*Male:* Total body length 0.66 to 0.68 mm. *Head* length 0.0113 to 0.0116 mm, width 0.0110 mm; AS, ACHS, and ADHS lacking; PCHS usually longer than MHS; DPHS long. *Thorax:* sternal plate of typical *longiceps*-group; DPTS, DPts, and DMtS distinct; inner ADTS slightly longer than outer seta. *Legs* as in other member of the genus. *Abdomen* with 7 sclerotized tergites, on segments 1 to 7 of these one on segment 1 very poorly sclerotized or sometimes completely missing; 1st row of tergal setae 0-2-0, 2nd row 0-4-0, 5th row 4-7-4 or 4-6-4, 6th row 4-8-4 or 16 setae continuous; 9 or 10 DLAS present on each side; DLAS of segment 7 much longer than other setae; no sclerotized sternites, except for segment 2 with a pair of ventral plates completely detached from paratergites; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; 4 paratergites present on segments 2 to 5 on each side; paratergites of segment 2 with 2 dorsal and no ventral paratergal setae; paratergites of segments 3 to 5 with 1 dorsal and 1 ventral setae; ventral paratergal seta being longer than dorsal seta; 3 spiracles borne on paratergites of segments 3 to 5 on each side; end of abdomen slightly prolonged, bearing 4 or more setae. *Genitalia* (Figs. 20, 37, 115, 116): dorsal endomere wide, with short lateral arms; anterior endomere circling middle endomere and anteriorly pointed;

middle endomere ringlike, encasing narrow, long, sclerotized aedeagus; posterior endomere fused by middle piece; arms of basal apodeme with posterior emargination wider and without subapical tubercle on outer lobe; paramere slender; pseudopenis with short posterior part bearing 3 or 4 annuli; radula wide, with anterior margin definitely truncate.

*Female:* Total body length 0.62 to 0.72 mm. *Head, thorax, and legs* as in male; head length 0.0117 to 0.0123 mm, width 0.0108 to 0.0104 mm. *Abdomen* with 3 very small tergites on segments 2 to 4; 1st and 2nd rows of tergal and 2nd row of sternal setae as in male; 1st row of sternal setae occasionally 0-2-0; no sclerotized sternites; paratergites, paratergal setae, spiracles, and MAS as in male. *Genitalia* (Figs. 117, 118): spermatheca long, anterior third swollen, then abruptly constricted, and gradually swollen posteriorly, without terminal appendix; genital plate with a group of 2 posterior setae on each side and a pair of middle setae; gonopods each with 3 long setae, the middle one being much longer than others; valvula narrow, not serrated and slightly branched at apex; genital lobes each with a spiniform subapical genital seta, and with its base bearing 2 spiniform setae and 3 long, slender setae.

*Nymphs:* Unknown.

*Specimens examined:* All type specimens.

#### Comments

This species is closely allied to *E. mexicanus* Werneck, *E. deppei* sp. n., and *E. extremus* Ferris, and is found on the lowland forms of Mexican squirrels. This species is named in honor of Dr. Harry D. Pratt, CDC, Atlanta, Georgia.

#### 13. *Enderleinellus arizonensis* Werneck

(Figs. 21, 38, 119-124)

*Enderleinellus arizonensis* Werneck, 1948, Mem. Inst. Oswaldo Cruz, Rio de Janeiro 45(2): 288, 301; fig. 12; Hopkins, 1949, p. 456-457; Ferris, 1951, p. 108; Stojanovich and Pratt, 1965, p. 9 (key).

*Enderleinellus extremus* Ferris (*partim*), 1919, p. 24 (*err. det.*, the record from *Sciurus arizonensis huachuca*).

*Enderleinellus longiceps* Kellogg and Ferris (*partim*), Ferris, 1916a, p. 148; Ferris, 1916b, p. 105 (*err. det.*, both records from *Sciurus arizonensis huachuca*).

*Type data:* Holotype male, allotype female, and 2 paratypes (1 male and 1 female), ex *Sciurus arizonensis huachuca* J. A. Allen, Huachuca Mts., Arizona, USA (skin in Stanford Univ.). All type specimens are deposited in UCB.

#### Description

*Male:* Total body length 0.76 to 0.79 mm. *Head, thorax, and legs* as in other species of *longiceps*-group except for head length 0.0125 to 0.0130

mm, width 0.0124 to 0.0129 mm; thorax with inner ADTS 2 to 2.5 times longer than outer seta. *Abdomen* with 6 small sclerotized tergites on segments 2 to 7; 1st row of tergal setae 0-2-0, 2nd row 0-4-0, 5th row 3-8-3, 6th row 4-8-4; about 12 DLAS present on each side; no sclerotized sternites except for segment 2 with 2 ventral plates completely detached from paratergites; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; 4 paratergites present on segments 2 to 5; paratergites of segment 2 with 1 dorsal and no ventral paratergal seta; paratergites of segments 3 to 5 with 1 dorsal and 1 ventral paratergal setae and each with a spiracle; segments 7 and 8 each with a pair of long, slender MAS; end of abdomen with 4 long setae. *Genitalia* (Figs. 21, 38, 119, 121): dorsal endomere with its posterior part posteriorly notched on each side, with long lateral arms; anterior endomere encasing middle endomere with a pair of minute setae and anteriorly pointed; posterior endomere almost as long as middle endomere; arms of basal apodeme parallel and with mesal lobe shorter than outer lobe; paramere with its basal end more or less tapering and its apex blunt; pseudopenis with apical part long, at least half as long as its lateral arms, bearing more than 7 annuli; radula with long lateral arms.

*Female*: Total body length 0.78 to 0.83 mm. *Head, thorax, legs, and abdomen* as in male except for the following characters: no sclerotized tergites and sternites; 1st row of tergal setae 0-2-0, occasionally 0-3-0; 1st row of sternal setae 0-4-0, but sometimes 0-5-0. *Genitalia* (Figs. 123, 124): spermatheca strongly bent, with deeply U-shaped anterior emargination, with its ends expanded, the expansion of anterior end being larger than that of posterior end; genital plate with 2 groups of 2 posterior setae and a pair of middle setae; gonopods each with 3 setae in the middle, the middle seta being longer than others; genital lobes each with a spiniform subapical genital seta, 1 dorsal, 3 long lateral setae and with its base bearing 3 long setae; valvula wide at base and serrated.

*Nymphs*: Unknown.

*Specimens examined*: Ex *Sciurus arizonensis huachuca* J. A. Allen, Huachuca Mts., Arizona, USA (skin in Stanford Univ.), all type specimens and 4 females. Ex *Sciurus alleni* Nelson, Sierra de Guadalupe, Mexico, USNM 116931, Ferris Coll. 897, 1 male and 1 female. Ex *Sciurus apache* J. A. Allen, Colonia Garcia, Chihuahua, Mexico, USNM 13234, Ferris Coll. 898, 2 males and 2 females. Ex *Sciurus nayaritensis* J. A. Allen, Sierra Madre, Zacatecas, Mexico, USNM 90947, 1 male and 1 female.

#### Comments

This species is closely related to *E. venezuelae* Ferris. Two specimens of *E. arizonensis* collected from *Sciurus nayaritensis* are possibly contaminants, based on the hypothesis that the primary species of *Enderleinellus* parasitic

on *Sciurus nayaritensis* is *Enderleinellus nayaritensis* sp. n. described earlier.

#### 14. *Enderleinellus venezuelae* Ferris (Figs. 22, 39, 125-128)

*Enderleinellus venezuelae* Ferris, 1919, Contributions Toward a Monograph of the Sucking Lice, Part 1, Leland Stanford Junior Univ. Publ., Univ. Scr. (no vol. no.), p. 25-26, fig. 13; Werneck, 1948, p. 292, figs. 22-24; Hopkins, 1949, p. 457; Ferris, 1951, p. 114.

*Type data*: Holotype male, allotype female, and 10 paratypes (5 males and 5 females), ex *Sciurus griseogenus* Gray, Macuto, Venezuela, F. e. m. 17621, Ferris Coll. 1015. Paratypes: 3 males and 3 females, ex *Sciurus griseogenus meridensis* Thomas (= *S. meridensis*), Montes del Escorial, Merida, Venezuela, F. e. m. 18159, Ferris Coll. 1013; 2 males and 3 females, ex *Sciurus gerrardi inconstans* Osgood (= *S. versicolor zuliae*), Rio Zurare, Venezuela, F. e. m. 18732, Ferris Coll. 1066. All type specimens except for 7 paratypes are deposited in UCB; 2 males and 2 female paratypes in UM and 1 male and 2 females in USNM.

#### Description

*Male*: Total body length about 0.61 mm. *Head, thorax, and legs* as in *E. arizonensis* Werneck except for head length 0.0116 to 0.0124 mm, width 0.0095 to 0.0097 mm, and ISHS much shorter than OSHS. *Abdomen* with 6 sclerotized tergites on segments 1 to 6, of these one on segment 1 very small; 1st and 2nd rows of tergal setae 0-4-0, 5th row 3-6-3, 6th row 4-6-4 or 3-8-3; about 11 DLAS present on each side; no sclerotized sternites except for segment 2 as in other species; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; end of abdomen without bulbous lobe; paratergites, paratergal setae, spiracles, and MAS as in *E. arizonensis*. *Genitalia* (Figs. 22, 39, 125, 126): dorsal endomere with its posterior angle more or less thickened (Fig. 39); anterior endomere poorly developed; middle endomere elongated, its anterior part thick and deeply concave on its posterior side; aedeagus borne on internal apodeme; posterior endomere large and more or less triangular; arms of basal apodeme with posterior lobes expanded, mesal lobe being shorter than outer lobe; without any tubercle; paramere scalpel-shaped; pseudopenis with long lateral arms and with short apical part bearing about 2 annuli; radula with its anterior margin flattened.

*Female*: Total body length about 0.63 mm. *Head, thorax, legs, and abdomen* as in male except for the following characters: head length 0.0125 mm, width 0.0092 to 0.0098 mm; abdomen with 2 small sclerotized tergites or sometimes completely missing, and with about 8 DLAS on each side. *Genitalia* (Figs. 127, 128): spermatheca very large, oval, with deeply U-shaped anterior emargination; genital plate with 1 posterior seta on each side and 3 middle setae; gonopods each with 3 similar setae on mesal margin; genital lobes each

with a spiniform subapical genital seta, 2 small dorsal and 2 long lateral setae, and its base with 2 long setae; valvula wide at base, serrated and pointed at apex.

*Nymphs:* Unknown.

#### Comments

This species is closely related to *E. arizonensis* Werneck.

#### 15. *Enderleinellus insularis* Werneck

(Figs. 23, 40, 129-133)

*Enderleinellus insularis* Werneck, 1948, Mem. Inst. Oswaldo Cruz, Rio de Janeiro 45(2): 293-294, figs. 25, 26; Hopkins, 1949, p. 457; Ferris, 1951, p. 109.

*Enderleinellus extremus* Ferris (*partim*), 1919, p. 24 (*err. det.*, the record from *Sciurus nesaeus*).

*Type data:* Holotype male and 6 paratypes, ex *Sciurus nesaeus* G. Allen, Margarita Island, Venezuela, F. e. m. 16608, Ferris Coll. 1014. All type specimens are deposited in UCB.

#### Description

*Male:* Total body length 0.57 to 0.64 mm. *Head, thorax, and legs* as in other species of *longiceps*-group except for the following characters: head length 0.0122 to 0.0125 mm, width 0.0099 to 0.0109 mm; antennae more or less ventrally placed; thorax with inner ADTS about 3 times longer than outer seta. *Abdomen* with 7 small sclerotized tergites on segments 1 to 7; 1st and 2nd rows of tergal setae 0-4-0, 5th and 6th rows 3-6-3; about 10 DLAS present on each side; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; end of abdomen without anal lobe; paratergites, paratergal setae, spiracles, and MAS as in *E. arizonensis*. *Genitalia* (Figs. 23, 40, 129, 130): dorsal endomere thick, not notched posteriorly, and with its posterior part thinner in middle; anterior endomere sclerotized, consisting of 3 parts, middle piece heavily sclerotized and placed on lateral pieces; a thinly sclerotized trapezoidal structure present in front of anterior endomere; anterior part of middle endomere thick and flat in both sides; posterior endomere with short, acute process; arms of basal apodeme with outer lobe larger than mesal lobe, with both lobes relatively acute at apex, and with outer lobe notched apically; paramere scalpel-shaped and thickened; paramere Y-shaped, with long lateral arms and short apical part bearing about 4 annuli; radula with its anterior margin truncate.

*Female:* Total body length 0.60 to 0.65 mm. *Head, thorax, legs, and abdomen* as in male except for the following characters: head length 0.0122 mm, width 0.0104 to 0.0109 mm; thorax with inner ADTS about twice as long as outer seta; abdomen with 2 very small sclerotized tergites on segments 1 and 2 or sometimes completely missing; abdominal segments 6 and 7 usually with DLAS continuous to DCAL. *Genitalia* (Figs. 131, 132):

spermatheca large, long, tubular; genital plate with 1 posterior seta on each side and 1 pair of middle setae; gonopods usually connected to genital plate, each with 2 setae in middle; genital lobes each with a spiniform subapical genital seta and 1 long dorsal seta, and its base with about 5 long setae; valvula 3-branched at apex; vulvar fimbriae numerous.

*Nymphs:* Unknown.

*Specimens examined:* Ex *Sciurus nesaeus* G. Allen, Margarita Island, Venezuela, F. e. m. 16608, Ferris Coll. 1014, type specimens, 1 male and 1 female.

#### Comments

This species is closely related to *E. brasiliensis* Werneck and *E. microsciuri* Werneck.

#### 16. *Enderleinellus brasiliensis* Werneck

(Figs. 24, 41)

*Enderleinellus brasiliensis* Werneck, 1937, Mem. Inst. Oswaldo Cruz, Rio de Janeiro 32: 399, fig. 11; Hopkins, 1949, p. 47; Ferris, 1951, p. 108.

*Type data:* Holotype male, allotype female, and 2 female paratypes, ex *Sciurus aestuans* Linn., de Abaeté, Est. do Pará, Brazil. Type specimens are probably deposited in the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil.

*Diagnosis:* Total body length: male 0.48 mm, female 0.50 mm. *Genitalia:* dorsal endomere with its posterior part strongly notched on each side; anterior endomere poorly developed and membranous; middle endomere ring-shaped, posteriorly encasing a cross-shaped aedeagus; posterior endomere more or less triangular; arms of basal apodeme with its mesal lobe rounded at apex and longer than outer lobe; paramere thickened at base and tapering gradually; pseudopenis with short apical part.

#### Comments

This species is closely related to *E. insularis* Werneck and *E. venezuelae* Ferris, but is easily recognized by the details of male genitalia based on Werneck's illustration. No specimens of this were available for this study.

#### 17. *Enderleinellus microsciuri* Werneck

(Figs. 25, 42, 134-138)

*Enderleinellus microsciuri* Werneck, 1948, Mem. Inst. Oswaldo Cruz, Rio de Janeiro 45(2): 287-288, figs. 10-12; Hopkins, 1949, p. 458; Ferris, 1951, p. 110.

*Enderleinellus kelloggi* Ferris (*partim*), 1919, p. 22 (*err. det.*, the record from *Microsciurus palmeri*).

*Type data:* Holotype male, allotype female, and 3 paratypes (2 males and 1 female), ex *Microsciurus palmeri* Thomas (= *Microsciurus mimulus palmeri*), Novita, Choco, Colombia, USNM 17894, Ferris Coll. 471.

**Description**

**Male:** Total body length 0.54 to 0.60 mm. *Head, thorax, and legs* as in other species of *longiceps*-group except for the following characters: head length 0.0109 mm, width 0.0106 mm; antennae more or less ventrally placed; thorax with outer ADTS half as long as inner seta. *Abdomen* with 6 sclerotized tergites on segments 2 to 7; 1st row of tergal setae 0-4-0, 2nd row 0-6-0, 5th row 3-8-3, 6th row 4-7-4; about 10 DLAS on each side; no sclerotized sternites except for segment 2 as in other species of *longiceps*-group; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; end of abdomen with a bulbous lobe bearing 4 long and 2 or more short setae; paratergites, paratergal setae, spiracles, and MAS as in *E. insularis* Werneck. *Genitalia* (Figs. 25, 42, 134, 135): dorsal endomere with very long lateral arms; anterior endomere poorly developed; lateral parts of middle endomere anteriorly prolonged; aedeagus placed in posterior part of middle endomere; posterior endomere anteriorly prolonged; arms of basal apodeme with its posterior lobes short, narrow, not expanded basally, and with its outer lobe subapically tuberculated; paramere thick and pointed at apex; pseudopenis with short apical part bearing 3 or 4 annuli; radula with its anterior side rounded.

**Female:** Total body length 0.55 to 0.56 mm. *Head, thorax, legs, and abdomen* as in male except for head length 0.0130 mm, width 0.0109 mm; abdomen with 3 small sclerotized tergites on segments 1 to 3; 2nd row of tergal setae 0-4-0. *Genitalia* (Figs. 137, 138): spermatheca extremely minute, short, anteriorly swollen and then abruptly constricted; genital plate with 1 posterior seta on each side and 1 pair of middle setae; gonopods each with a spiniform subapical genital seta, 1 small dorsal and 2 large thick setae, and with its base bearing 2 long, stiff lateral setae and 2 small dorsal setae; valvula 3 or 4 branched at apex.

*Nymphs:* Unknown.

*Specimens examined:* Ex *Microsciurus palmerti* Thomas (= *Microsciurus mimulus palmerti*), Novita, Choco, Colombia, USNM 178947, Ferris Coll. 471, all type specimens, 5 males and 3 females.

**Comments**

This species is closely allied to *E. insularis* Werneck.

**nitzschi-group**

1. Abdomen with 5 paratergites on segments 2 to 6 (Fig. 141).
2. Male: head with ACHS, even if minute; genitalia with 3 major parts, with an inverted Y-shaped basal apodeme, and with internal sac bearing many teeth.
3. Female: spermatheca completely lacking; vulvar fimbriae short or vestigial; genital plate with a group of 3 setae on each side.

Three species in *nitzschi*-group have been identified or recognized as *Enderleinellus nitzschi* Fahrenholz by most workers until Blagoveschtchensky (1965). This species-group has been known from squirrels of *Tamiasciurus* and subgenera *Sciurus* and *Tenes* of *Sciurus* (Family Sciuridae).

**18. *Enderleinellus nitzschi* Fahrenholz**  
(Figs. 139-143)

*Enderleinellus nitzschi* Fahrenholz, 1916, Archiv für Naturgeschichte, 1915, Abteil. A, 11. Heft, p. 29 (nom. nov.); O'Mahoney, 1944, p. 60; Conci, 1946, p. 8-9; Eichler, 1946, p. 105; Werneck, 1948, p. 282; Brink, 1948, p. 132; Stojanovich and Pratt, 1965, p. 7 (key).

*Enderleinellus nitzschi* Fahrenholz (*partim*), Ferris, 1919, p. 8-11 (not the records from *Tamiasciurus hudsonicus* (= *Sciurus hudsonicus*) and *T. douglasii* (= *S. douglasii*)); Jancke, 1938, p. 66 (the record from *S. vulgaris* only); Hopkins, 1949, p. 454 (the records from *S. vulgaris* only); Ferris, 1951, p. 110-111, fig. 48 (the records from *S. vulgaris* only).

*Pediculus sphaerocephalus* Nitzsch, 1818, Germer and Zincken's Magazin der Entomologie 3: 305 (ex *Sciurus vulgaris*) (nec *Pediculus sphaerocephalus* von Olfers, 1816); Burmeister, 1838-46, Ordo 1, Trib. 1, Fam. prima, *Pediculus* 4 (no pagination); Nitzsch, 1864, p. 27.

*Haematopinus sphaerocephalus* (Nitzsch), Stephens, 1829, p. 329; Denny, 1842, p. 36; Giebel, 1874, p. 35-36, pl. 1, fig. 4; Piaget, 1880, p. 635 (key), 640-641.

*Polyplax sphaerocephala* (Burm.), Enderlein, 1904, p. 143; von Dalla Torre, 1908, p. 14; Mjöberg, 1910, p. 159-160.

*Enderleinellus sphaerocephalus* (Burm.), Fahrenholz, 1912a, p. 56; Fahrenholz, 1912b, p. 52-53, figs. 22-23; pl. 2, figs. 5-7.

*Enderleinellus sphaerocephalus* (Nitzsch) (*partim*), Ferris, 1916a, p. 148-149 (not the records from *Tamiasciurus*); Séguy, 1944, p. 428 (the record from *Sciurus vulgaris* only).

*Type data:* This species was originally described from *Sciurus vulgaris* Linn. in Europe. The location of the Nitzsch's type of *Enderleinellus nitzschi* Fahrenholz is not certain; Nitzsch's insect collection is known to be deposited in Zool. Univ. Mus., Halle, Germany, according to Horn and Kahle (1937-39).

**Description**

**Male:** Total body length 0.72 to 0.76 mm. *Head* (Fig. 140) relatively short and with its anterior margin more or less truncate; head length 0.0125 to 0.0140 mm, width 0.0122 to 0.0124 mm; AS and ADHS lacking; ACHS and PCHS distinctly present; antennae 5-segmented, and more or less ventrally placed. *Thorax:* sternal plate with 2 oval, strongly sclerotized lateral pieces which are connected by a membranous median area and with



a more or less membranous anterior process; DPTS, DPIS, and DMIS present; inner ADTS as long as outer seta. *Legs*: anterior and middle legs similar in size and shape; posterior femora with a pair of toothlike processes on the anterior margin; posterior tibiae with a similar process at outer anterior angle and posterior tarsus with a very large claw. *Abdomen* with 6 or 7 sclerotized tergites on segments 1 to 6 or 1 to 7, of these one on segment 1 sometimes very small; 1st and 2nd rows of tergal setae 0-4-0; about 4 DLAS present on each side; 6 sclerotized sternites present on segments 1 to 6; sternum of segment 2 with 2 ventral plates completely detached from paratergites; 1st row of sternal setae 0-5-0, 2nd row 0-2-0; 5 or 6 tergites present on segments 2 to 6 or 2 to 7, of these one on segment 7 usually very small or lacking; paratergites of segment 2 with 2 dorsal and no ventral paratergal setae, its outer dorsal paratergal seta being much longer than inner dorsal paratergal seta; paratergites of segments 3 to 6 each with 1 long dorsal, 1 long ventral paratergal setae and with a spiracle; segments 7 and 8 each with a pair of long, slender MAS; end of abdomen sharply pointed, with numerous setae. *Genitalia* (Fig. 139): with 3 major parts; basal apodeme inverted V- or Y-shaped, thin, long, with its lateral arms much longer than basal part, and its posterior end articulated on paramere; paramere with its anterior part thin and abruptly thickened at basal third; pseudopenis Y-shaped, striated, and its apical part as long as or longer than lateral arms; internal sac distinct, with large teeth on anterior part and small teeth on its posterior two-thirds; endomeres, aedeagus, and other genitalic structures membranous.

*Female*: Total body length 0.79 to 0.89 mm. *Head, thorax, and legs* as in male except for the following characters: head length 0.0116 to 0.0125 mm, width 0.0104 to 0.0122 mm; ACHS lacking. *Abdomen* with 5 sclerotized tergites on segments 2 to 6; segment 9 with sclerotized tergite extending entirely across the segment; about 8 DLAS present on each side; 1st and 2nd rows of tergal setae 0-4-0; 6 sclerotized sternites present on segment 1 to 6; segment 2 with 2 ventral plates as in male; 1st row of sternal setae 0-4-0, 2nd row 0-2-0; paratergites, paratergal setae, spiracles, and MAS as in male. *Genitalia* (Fig. 143): no spermatheca; posterior part of genital plate with 3 similar setae on each side; gonopods each with 3 setae on mesal margin, posterior seta being longer and stronger than others; genital lobes each with a long spiniform apical genital seta, a small dorsal seta and its base with 1 very long and 2 or 3 median to short setae; vulvar fimbriae in 2 rows and very short; no valvula.

*Nymphs*: Unknown.

*Specimens examined*: Ex *Sciurus vulgaris fuscoater* Altum, Switzerland, USNM 15218, 5 males and 8 females.

#### Comments

This species is closely related to *E. krochinae* Blag. and *E. tamiasciuri* sp. n., and possibly

restricted to Palearctic region. *Enderleinellus nitzschi* Fahr., found on Palearctic squirrels of *Sciurus vulgaris*, for which 41 forms are known (Ellerman, 1940), is a polytypic species or a species complex.

#### 19. *Enderleinellus krochinae* Blagoveschtchensky (Figs. 144-148)

*Enderleinellus krochinae* Blagoveschtchensky, 1965, Ent. Rev. (Ent. Obozr. (USSR)) 44(1): 85, figs. 1-6.

*Enderleinellus nitzschi* Fahrenholz (partim), Ferris, 1919, p. 9 (err. det., the record from *Sciurus anomalus syriacus* (= *Sciurus syriacus*)); Hopkins, 1949, p. 454 (the record from *S. anomalus*); Ferris, 1951, p. 110-111, fig. 48 (err. det., the record from *Sciurus anomalus* only); Stojanovich and Pratt, 1965, p. 7 (key).

*Type data*: Holotype female, allotype male, and 62 paratypes (19 males and 43 females), ex *Sciurus anomalus syriacus* Ehrenberg (= *Sciurus persicus* Erzl.), Azerbaydzhan, Zakataly, USSR (Zoological Institute of the USSR Academy of Sciences).

#### Description

*Male*: Total body length 0.69 to 0.72 mm. *Head* (Fig. 147): head length 0.0143 mm, width 0.0122; anterior margin more or less truncate; AS and ADHS lacking; ACHS and PCHS present but ACHS very minute; DPHS long. *Thorax and legs* as in *E. nitzschi* Fahr. except for inner ADTS 1.5 longer than outer seta. *Abdomen* with 4 sclerotized tergites on segments 2 to 5; 1st and 2nd rows of tergal setae 0-4-0; about 3 DLAS present on each side; no sclerotized sternites except for segment 2 as in other species; paratergites, paratergal setae, spiracles, and MAS as in *E. nitzschi*, except for paratergal setae of segment 3 long and as long as or longer than paratergites, and paratergites of segment 6 minute; end of abdomen prolonged, blunt and with 12 or more short but stiff marginal setae. *Genitalia* (Fig. 144): basal apodeme inverted Y-shaped and its basal part shorter than lateral arms; parameres thickened at base and gradually tapering; pseudopenis with its apical part thin, long, and striated; internal sac with numerous large teeth on anterior part and with numerous small teeth scattered on posterior part without a series of posterior serrations.

*Female*: Total body length 0.64 to 0.74 mm. *Head, thorax, and legs* as in male except for the following characters: head length 0.014 mm, width 0.0120 mm; ACHS lacking; inner ADTS twice as long as outer seta. *Abdomen* without sclerotized tergites and sternites except for segment 2 with 2 ventral plates as in male, segment 5 with very small sclerotized tergite, 9th tergite, and genital plate; 1st row of tergal setae 0-4-0, 2nd row 1-4-1; about 9 DLAS present on each side; paratergites, spiracles, and MAS as in male; paratergites of segment 2 with 1 dorsal and no ventral paratergal seta; paratergites of segments

3 to 6 with 1 dorsal and 1 ventral paratergal setae. *Genitalia* (Fig. 148): genital plate with 2 groups of 3 setae arranged more or less horizontally on posterior side; gonopods elongated, each with 3 setae on mesal margin; genital lobes each with a long, spiniform subapical genital seta and a dorsal seta and its base with 3 very long spiniform setae, 1 tuberculated and 4 or more setae; no distinct valvula.

*Nymphs*: Unknown.

*Specimens examined*: Ex *Sciurus anomalus syriacus* Ehrenberg (= *Sciurus syriacus*), North Syria, USNM 13511, Ferris Coll. 446, 2 males and 4 females.

#### Comments

This species is closely related to *E. nitzschi* Fahr. and *E. tamiasciuri* sp. n.

#### 20. *Enderleinellus tamiasciuri* sp. n. (Figs. 149–155)

*Enderleinellus nitzschi* Fahrenholz (*partim*), Ferris, 1919, p. 8–11 (*err. det.*, the records from *Tamiasciurus*); Hopkins, 1949, p. 458 (the records from *Tamiasciurus*); Ferris, 1951, p. 110–111 (*err. det.*, the records from *Tamiasciurus*); Ignoffo, 1959, p. 476 (the record from northern red squirrels) (*key*); Mathewson and Hyland, 1962, p. 169.

*Enderleinellus sphaerocephalus* (Nitzsch) (*partim*), Ferris, 1916a, p. 148–149 (*err. det.*, the records from *Tamiasciurus*); Ferris, 1916b, p. 107–108; Séguy, 1944, p. 428 (the record from *Tamiasciurus*).

*Type data*: Holotype female, allotype male, and 3 paratypes (1 female, 1 nymph 2, and 1 nymph 3), ex *Tamiasciurus hudsonicus* (Erxleben) (= *Sciurus hudsonicus*), Wayne Co., Pennsylvania, 17 July 1945, collected by F. Harper (Lot 46-4505). *Paratypes*: Ex *Tamiasciurus hudsonicus vancouverensis* Allen (= *Sciurus hudsonicus vancouverensis*), Kuiu Island, Alaska (skin in UCMVZ), 5 females; ex *T. h. fremonti* (Audubon and Bachman) (= *Sciurus fremonti*), El Paso Co., Colorado (skin in UCMVZ), 3 females. Ex *Tamiasciurus douglasii albolimbatus* (J. A. Allen) (= *Sciurus douglasii albolimbatus*) Tuolumne Meadows, Yosemite National Park, California, Ferris Coll. 318, 2 males and 1 female. Holotype, allotype, and 3 paratypes (1 female and 2 nymphs) are deposited in USNM; 2 male and 6 female paratypes are in UCB; and 3 female paratypes in UM.

#### Description

*Male*: Total body length about 0.63 mm. *Head* (Fig. 150), *thorax*, and *legs* as in *E. nitzschi* Fahr., except for head length 0.0109 mm, width 0.0114 mm. *Abdomen* with 7 sclerotized tergites on segments 1 to 7, of these one on segment 1 very small; 1st and 2nd rows of tergal setae 0.4–0; about 4 DLAS present on each side; 4 sclerotized sternites present on segments 3 to 6; sternum of segment 2 with a pair of ventral plates as in *E.*

*nitzschi* Fahr.; 5 paratergites present on segments 2 to 6; paratergites of segment 2 with 1 dorsal and no ventral paratergal seta; paratergites of segments 3 to 6 each with 1 dorsal and 1 ventral paratergal setae; 3 spiracles borne on paratergites of segments 3 to 5; segments 7 and 8 each with a pair of MAS; end of abdomen sharply pointed but devoid of numerous marginal setae. *Genitalia* (Fig. 149) with 3 major parts; basal apodeme inverted Y-shaped, with its basal part as long as or longer than lateral arms; parameres slender and of similar thickness; pseudopenis typically Y-shaped, not striated but covered with minute hair-like microprojections, with its apical part longer than lateral arms; internal sac with numerous small teeth, occasionally with few large teeth, and usually with 1 or 2 setiferous tubercles in its anterior part and with its posterior part continuously serrated (a series of large teeth) on each side.

*Female*: Total body length 0.61 to 0.68 mm. *Head, thorax*, and *legs* as in male except for the following characters: head length 0.0114 to 0.0117 mm, width 0.0110 to 0.0111 mm; ACHS lacking. *Abdomen* with 5 sclerotized tergites on segments 2 to 6; 1st and 2nd rows of tergal setae and sternal setae, paratergites, spiracles, paratergal setae, and MAS as in male; dorsal membrane of posterior part of abdomen appearing scaly. *Genitalia* (Fig. 153): no spermatheca; genital plate with 2 rows of 3 setae more or less vertically arranged; gonopods each with 3 similar setae on its mesal margin; genital lobes each with a long, spiniform subapical genital seta and 1 small dorsal seta, and its base with 1 tuberculated, 3 lateral, and 1 dorsal setae; a single row of vulvar fimbriae very short; valvula present.

*Nymph 1*: Unknown.

*Nymph 2* (Fig. 154): Total body length about 0.45 mm. *Head*: antennae 5-segmented; 3 distinct MHS on each side; PCHS placed mesal to and as long as PDPHS; ADPHS represented by the inner one of a pair of small setae located anterior to clypeofrontal suture; VPHS distinct. *Thorax*: sternal plate well developed, with 2 oval, sclerotized lateral pieces connected by membranous median area; DPTS very long; DPtS and DMtS distinct; 2 ADTS, inner seta much longer than outer ADTS. *Legs*: anterior and middle legs similar in size and shape; posterior legs large and stronger, with 2 tubercles on tibia. *Abdomen* 8 DCAS, 7 VCAS, 3 spiracles, and 2 paratergites each bearing 2 paratergal setae present on each side; AnS present; 2 pairs of MAS present; AcS present mesad to VPMAS; segmentation evident.

*Nymph 3* (Fig. 155): Total body length about 0.56 mm. *Head, thorax, legs*, and *abdomen* as in nymph 2 except for the following characters: abdomen with 3 pairs of MAS on each side; end of abdomen prolonged.

*Specimens examined*: All type specimens. Ex *Tamiasciurus hudsonicus petulans* (Osgood) (= *Sciurus hudsonicus petulans*), Glacier Bay, Alaska (skin in UCMVZ), 1 female.

**Comments**

This species is closely related to *E. nitzschi* Fahr. and *E. krochinae* Blag., and restricted to the New World. In a female specimen collected from *T. h. petulans* the paratergites of abdominal segment 6 are completely lacking; this specimen may be a mutant.

**LIST OF SPECIES OF ENDERLEINELLUS PARASITIC ON THE SCIURINI AND TAMIASCIURINI**

*longiceps*-group

*longiceps*-subgroup

1. *E. longiceps* Kellogg and Ferris .....  
..... Ex *Sciurus carolinensis* Gmelin (TYPE HOST), *S. niger* Linnaeus, North America.
2. *E. nayaritensis* sp. n. ....  
..... Ex *Sciurus nayaritensis* J. A. Allen (TYPE HOST), Mexico.
3. *E. oculatus* sp. n. ....  
..... Ex *Sciurus oculatus* Peters (TYPE HOST), Mexico; *S. alleni* Nelson, Mexico.
4. *E. kaibabensis* sp. n. ....  
..... Ex *Sciurus kaibabensis* Merriam (TYPE HOST), Arizona, USA.
5. *E. paralongiceps* sp. n. ....  
..... Ex *Sciurus aberti ferreus* True (TYPE HOST), Colorado, USA.
6. *E. kelloggi* Ferris .....  
..... Ex *Sciurus griseus nigripes* Bryant (TYPE HOST), *S. g. griseus* Ord, California, USA.
7. *E. hondurensis* Werneck .....  
..... Ex *Sciurus variegatoides boothiae* (TYPE HOST), Honduras; *S. variegatoides* ssp., Central America; *S. yucatanensis yucatanensis* J. A. Allen, Mexico.
8. *E. urosciuri* Werneck .....  
..... Ex *Sciurus igniventris* Wagner (= *Urosciurus igniventris*), (TYPE HOST), Brazil.

*extremus*-subgroup

9. *E. extremus* Ferris .....  
..... Ex *Sciurus socialis* Wagner (TYPE HOST), Guatemala; *S. aureogaster* Cuvier, *S. depei negligens* Nelson (= *S. negligens*), *S. griseoflavus chiapensis* Nelson, *S. polioptus* Fitzinger, Mexico.
10. *E. depei* sp. n. ....  
..... Ex *Sciurus depei* Peters (TYPE HOST), Mexico; *S. granatensis hoffmanni* Peters (= *S. aestuans hoffmanni*), Costa Rica.
11. *E. mexicanus* Werneck .....  
..... Ex *Sciurus truei* Nelson (TYPE HOST), *S. nelsoni* Merriam, Mexico.
12. *E. pratti* sp. n. ....  
..... Ex *Sciurus collaet* Richardson (TYPE HOST), Mexico.
13. *E. arizonensis* Werneck .....  
..... Ex *Sciurus arizonensis huachucá* J. A.

- Allen (TYPE HOST), Arizona, USA; *S. alleni* Nelson, Mexico; *S. apache*, J. A. Allen, Mexico; (?) *S. nayaritensis* J. A. Allen, Mexico.
14. *E. venezuelae* Ferris .....  
..... Ex *Sciurus griseogena* Gray (TYPE HOST), *S. gerrardi inconstans* Osgood (= *S. versicolor zuliae*), Venezuela.
15. *E. insularis* Werneck .....  
..... Ex *Sciurus nesaeus* G. Allen (TYPE HOST), Venezuela.
16. *E. brasiliensis* Werneck .....  
..... Ex *Sciurus aestuans* Linnaeus (TYPE HOST), Brazil.
17. *E. microsciuri* Werneck .....  
..... Ex *Microsciurus palmeri* Thomas (= *M. mimulus palmeri*) (TYPE HOST), Colombia.

*nitzschi*-group

18. *E. nitzschi* Fahrenholz .....  
..... Ex *Sciurus vulgaris* Linnaeus (TYPE HOST), Europe.
19. *E. krochinae* Blagoveschtchensky .....  
..... Ex *Sciurus anomalus syriacus* Ehrenberg (= *S. syriacus*; *S. persicus*) (TYPE HOST), Syria, Iran, Turkey, and Caucasus Crimea.
20. *E. tamiasciuri* sp. n. ....  
..... Ex *Tamiasciurus hudsonicus* (Erxleben) (TYPE HOST), North America; *T. douglasii* (Bachman), Western North America.

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## Suggestions to Authors, VII. Preparation of Halftone Plates

When a number of small photographs, either photomicrographs or electron micrographs, form the illustrations for an article, they must be mounted by the author to form a plate, or plates. The author himself must give some thought to the final design of the printed page. For electron micrographs, which already approach the limit of resolution, it is usually best to plan the plate the exact size that it is to appear in the Journal. For photomicrographs, or macrophotographs, where detail is not as fine or critical, the original plate may, depending upon the nature of the material, be laid out on a somewhat larger scale, and reduced in the copying process. The finished plate, as it appears in print, may occupy the full width of the two columns (5½ inches), and if necessary the entire height of the column (8¾ inches). It is usually preferable, however, to use less than the full height of the page, so as to allow room for the legend underneath. When the plate occupies the full page, the legend must go on a facing page. This compels us to start the article on either a right or left hand page, depending upon the printer's makeup in setting the article, and may cause delay in publication if the article will not fit conveniently into the current dummy. The author himself can judge the amount of space required for his legends, by counting the number of words in similar legends published in the Journal.

All work must be of professional caliber. Such instant do-it-yourself devices as polaroid prints (particularly for photomicrographs) are not acceptable.

Large, page-sized photographs, such as pages 696-699 in this volume, may be submitted loose, but in general it is better to mount them, leaving at least an inch margin of illustrator's board to protect corners and edges. The professional photographers' Dry Mounting Tissue is preferred to such makeshifts as rubber cement. For composite plates, the individual prints must be squared and mounted with edges touching (butted), no white showing between. The engraver will then cut a fine line of separation between the figures. It is extremely important that the work be done accurately, since otherwise the engraver must cut wide channels in the plate to correct irregularities in the author's trimming and mounting (see page 1032, this issue). Wide lines of separation are not only unnecessary and unsightly, as well as a waste of copper, but they create so much visual "noise" that the pattern

of the plate dominates the information conveyed.

Typewritten labels cannot be accepted. Numbers and letter labels, including arrows or guidelines, should be one of the several kinds of professional overlay or appliqué materials available in drafting supply stores. The kind in which the letter is protected by the supporting film is preferred to the kind in which the letter is applied and the tissue removed. The latter type of label is vulnerable and frequently has already smudged by the time it reaches the editor's office. The finished plate should be protected by a flap of strong, smooth paper.

Both black and white labels should be available (or black edged with white), as necessity demands, so that the letter stands out, regardless of the value of the background. See volume 52: 417-427 and 538-555 for examples of good treatment, also pages 951 and 975-985 in this number.

All photographs intended for reproduction should have a "glossy" finish and suitable contrast. It is also desirable, though not always feasible, to use photographs of approximately the same quality in assembling a plate. The engraver can adjust his technique somewhat to accommodate to the nature of the original, but he cannot work at cross purposes on the same copper plate.

An occasional small photograph can be handled as a text figure, column width. These usually require no number, since this is provided by the legend (see p. 905, this issue). But the use of many text figures to save the author the trouble of mounting a plate cannot be permitted.

It is always desirable to send duplicate plates for review purposes. These can be either unmounted photocopies of the finished plate, scaled down, if necessary, to the size they will appear in the Journal, or duplicate prints of electron micrographs, crudely labelled with pen and ink, to give the referee an idea of what it's all about. In any case, these prints should be thin enough, and of the proper size, to fit into a 9- by 12-inch envelope, along with the manuscript. We cannot undertake to repeatedly wrap, unwrap, and ship the bulky original plates to referees, not only because of the labor and postage involved, but because this invariably results in severe deterioration before the plates come to the hands of the engraver.

Color plates can also be accepted, at the author's expense, but for these the author must make advance arrangements with the editor.

