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IN ENTOMOLOGY

NEW SPECIES, RELATIONSHIPS,
AND NOTES ON THE BIOLOGY OF THE
ENDOGEAN TENTYRIINE GENUS TYPHLUSECHUS
(TENEBRIONIDE: STENOSINI)

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NEW SPECIES, RELATIONSHIPS, AND NOTES ON THE
BIOLOGY OF THE ENDOGEAN TENTYRIINE GENUS
TYPHLUSECHUS (TENNEBRIONIDAE: STENOSINI)

ROLF L. AALBU and FRED G. ANDREWS¹

ABSTRACT

Four new species of *Typhlusechus* are described from the Southwest United States and Mexico, including two from caves. The summarized phylogenetic history is presented, and a key is provided for the species in the genus. The distribution and endogean biology of the genus is discussed. The phylogenetic relationships and systematic position of the tribe and the genus are discussed. The genus *Discopleurus* is discussed in relation to *Typhlusechus*. The tribe Typhlusechini is reduced to a subtribe of the Stenosini as Typhlusechina.

INTRODUCTION

In 1897 Linell described *Typhlusechus singularis* from two specimens collected in Los Angeles County, California. Few specimens of this minute beetle have subsequently been collected. In 1966, Andrews collected specimens of *T. singularis* in Berlese samples taken from nests of packrats (*Neotoma fuscipes*) near Gilman Hot Springs, Riverside County, California. In 1978, Aalbu conducted a seasonal analysis of the Coleoptera of Mitchell Caverns, San Bernardino County, California, for Park System. During the course of this survey eight examples of new species of *Typhlusechus* were trapped in ethylene glycol pitfall traps in the interior and exterior areas of the caverns (Aalbu, 1979). Additional specimens and new species of *Typhlusechus* were located in museum collections, and provided by collectors.

Subtribe Typhlusechina Casey.

Genus *Typhlusechus* Linell.

Typhlusechus Linell, 1897:154: Fall, 1901:163: Casey, 1907:496:
Doyen and Lawrence 1979:368.

Diagnostic description of the genus *Typhlusechus*.

Length 1.6—3.0 mm. Width 0.4—0.8 mm. Body elongate, flat-

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tened, parallel, laterally margined, reddish brown to yellowish brown, cuticular surface appearing glabrous, actually finely punctate, each puncture bearing a short seta. HEAD relatively large, horizontal, quadrate to slightly octagonal, surface slightly to moderately convex, finely to coarsely punctate; eyes composed of two pairs of ommatidia, upper pair located in basal portion of antennae in fossae, each pair separated by connecting furrow a little longer than diameter of ommatidia; antennae slightly longer than head, 11-segmented, set in fossae in genae, last 3 segments forming loosely joined, clavate club, segments 9, 10 with small notch on apical borders; genae acutely produced anteriorly around mentum. THORAX quadrate to subquadrate, surface slightly to moderately punctate, apex truncate in center, sides explanate, margins subparallel to sinuate, wider at apex, anterior angles slightly to strongly produced, basal margin broadly lobed to depressed in center with lateral acute elevations. ELYTRA approximately as long as head, thorax combined; surface slightly to moderately convex, finely to deeply punctate, lateral margins explanate, subparallel, base of scutellar region depressed; disc slightly to moderately convex, epipleura broad at base, gradually narrowed behind; first four abdominal segments decreasing in length; suture between mesosternum, mesepisternum, mesepimeron present, faint externally; metacoxae more widely separated than procoxae; legs short, femora gradually enlarged to middle, slightly less at apex; tibiae slender, gradually broader at apex, tarsi moderately short, apical segment elongate.

The small size of individuals in this genus makes close observation of characters difficult without a cleared specimen or a scanning electron microscope. In his original description of the genus, Linell had difficulty in observing the ommatidia and antennae; he noticed only 10 antennal segments and described the eyes as "apparently of a single ocellus situated on an impressed puncture a little nearer to the lateral than to the posterior margin of the head." Casey (1907) found the eyes to be "extremely minute, on the upper surface near the base at some distance from the obtuse sides of the head, consisting of a slender oblique slit, closed at the middle by the intrusion of its sides, the anterior part very small, rounded and enclosing a very few extremely minute crystalline facets, the posterior part elongate, lenticular and extremely minute with the facets not distinct." He was correct in the number of antennal segments.

Key to the Known Species of *Typhlusechus*.

1. Posterior margin of pronotum unmodified; antennal fossae in genae shallow, not sharply defined; ommatidial pairs not widely separated; head margins broadened anteriorly; tarsi equal in length to tibiae; Michoacan, Mexico (Figs. 3, 13, 14 and 17) *T. balsasensis* n. sp.

- Posterior margin of pronotum modified with median depression bounded by raised protuberances: antennal fossae in genae deep, sharply defined; ommatidial pairs widely separated; head margins parallel to broadened posteriorly (Fig. 15) 2
2. Elytra with humeral angles notched (Fig. 8): Chihuahuan desert: Texas and Northern Mexico (Figs. 5 and 17)
..... *T. spilmani* n. sp.
Elytra with humeral angles entire (Fig. 7) 3
3. Pronotum with base strongly produced posteriorly to form two acute, oblique elevations, each $\frac{1}{3}$ distance from sides; base of elytra with two corresponding gibbose prominences; California (Figs. 1, 6, and 17) *T. chemehuevii* n. sp.
Pronotum with base with only slightly produced acute elevations at about $\frac{1}{4}$ distance from sides; elytra with elevations corresponding or lateral to pronotal elevations very slight or obsolete (Fig. 7) 4
4. Pronotum with anterior lateral margins widely explanate; head with lateral margins subparallel, wider at base; abdomen with epipleura clearly extended forward past humeral angles, widening at apex forming a tooth-like lateral prominence; Mexico, Baja California, Sur (Figs. 4, 9, and 17) *T. peninsularis* n. sp.
Pronotum with anterior margins only slightly explanate; head with lateral margins parallel; abdomen with epipleurae not extended laterally and forming tooth-like prominence; California (Figs. 2, 7, and 17) *T. singularis* Linell.

***Typhlusechus chemehuevii*—New Species**
(Figs. 1, 6, 17)

DESCRIPTION: Length 2.4–2.8 mm. Width 0.8 mm. HEAD subquadrate, slightly longer than broad (both anterior, posterior angles obliquely truncate), anterior apical margin obtusely rotundate, surface slightly convex, finely punctate; eyes with 2 ommatidial pairs widely separated; antennal fossae in genae deep, sharp, extending to beneath apical angles of thorax, third antennal segment elongate, approximately equal in length to next two combined. THORAX approximately as long as broad, anterior angles produced acutely toward posterior angles of head, sides strongly explanate, margin slightly wider at apex, anterior angles produced acutely to posterior angles of head, posterior angles obtuse, base strongly produced posteriorly to form two acute oblique projecting elevations, each $\frac{1}{3}$ distance from sides, separated by deep depression which occupies approximately basal $\frac{1}{4}$; truncate at middle, slanting upwards anteriorly. ELYTRA as long as head, thorax combined, surface finely punctate, margins parallel medially, becoming arcuate posteriorly, feebly arcuate, elevated anterior

to humeral edge of depression; humeri prominent, embracing lateral base of thorax; disc laterally, longitudinally convex; two gibbose prominences near anterior edge of elytral basal depression, separated by concavity of about $\frac{1}{3}$ width of elytra; epipleura reaching apex; pleural area with procoxae, mesocoxae each separated by distance of slightly less than diameter of coxae, metacoxae separated by distance of about twice diameter of coxae; third abdominal sternum expanded laterally, embracing elytral margin; tarsi subequal to length of their tibia.

TYPE: California, San Bernardino County, Providence Mountains, Mitchell Caverns State Park, Mitchell Caverns, Elevation 4,400 feet, III-17-79 to IV-16-79, ethylene glycol pitfall trap #13, Rolf L. Aalbu col. Type deposited in California Academy of Sciences Collection.

PARATYPES: Same data (1), same data except VIII-26-78 to XII-31-78 trap #1 (1), VIII-26-78 to XII-31-78 trap #15 (3), VIII-26-78 to XII-31-78 trap #18 (1), III-17-79 to IV-16-79 trap #17 (1), V-8 to VIII-10-81 trap #15 (2), VIII-10-81 to VIII-27-82, ethylene glycol pitfall traps near *Neotoma* nests (9); paratypes to USNM, CDAE, KWBC, RLAC.*

ETYMOLOGY: *Typhlusechus chemehuevii* is named for the Chemehuevi Indians, a Shoshonean tribe which inhabited the Mitchell Caverns area within the last 500 years (a burial site has been found in Mitchell Caverns).

DIAGNOSIS: *Typhlusechus chemehuevii* closely resembles *T. Peninsularis* in the general broad shape with the strongly explanate anterior lateral margins of the thorax, but is distinguished by the larger size of *T. chemehuevii* being again $\frac{1}{3}$ as long, and with a more broad, robust appearance. These characters, along with the strongly explanate anterior lateral margins of the pronotum, are shared with *T. peninsularis*, but are accentuated in *T. chemehuevii* by the posterior pronotal projections and their corresponding elytral prominences (which are practically obsolete in *T. peninsularis* and *T. singularis*). Furthermore, in *T. chemehuevii* the pronotal extensions are more pronounced and massive than in any other species of *Typhlusechus* and about $\frac{1}{3}$ the distance from the pronotal margins (Figs. 1 and 6); in *T. singularis* and *T. peninsularis* the pronotal extensions are about $\frac{1}{4}$ the distance from the pronotal margins (Figs. 2, 7, and 9).

***Typhlusechus balsasensis*—New Species.**
(Figs. 3, 13, 14, 17)

DESCRIPTION: Length 1.7–1.9 mm. Width 0.4 mm. HEAD horizontal, very large (almost equal in size to pronotum), subqua-

*R.L.A.C. = Rolf L. Aalbu Collection.

drate (anterior lateral margins expanded), anterior angles obliquely truncate, posterior, angles truncate, anterior apical margin obtusely rotundate, surface strongly punctate; eyes with ommatidial pairs separated by connecting furrow of little longer than diameter of one ommatidium; top pair near posterior angles, lower pair on lateral-basal portion of shallow antennal groove in genae at approximate position of third antennal segment when antennae in fossae, antennae slightly longer than head, set in relatively shallow sharp fossae in genae (not extending to beneath apical angles of thorax), third segment elongate, slightly longer than next two combined. THORAX slightly longer than broad, surface slightly convex, densely punctate, sides explanate, margins subparallel, slightly wider at apex, not sinuate, anterior angles slightly produced, posterior margin broadly lobed without elevation. ELYTRA with striae deeply punctate, humeri prominent, margins parallel around middle becoming arcuate posteriorly, feebly arcuate, elevated anteriorly to humeri, fifth elytral intervals slightly carinate from humeri to approximately $\frac{1}{3}$ length of elytra; epipleurae reaching apex; procoxae, metacoxae each separated by distance of slightly less than diameter of coxae; metacoxae separated by distance of approximately twice diameter of coxae; tarsi approximately equal in length to tibiae.

TYPE: MEXICO, Michoacan, 5 miles southwest Tiquicheo, 1400 feet elevation, VII-8-70, E. Fisher, P. Sullivan collrs. Type deposited in California Academy of Sciences Collection.

ETYMOLOGY: *Typhlusechus balsasensis* is named after the Balsas River Valley in Michoacan and Guerrero, Mexico.

DIAGNOSIS: *Typhlusechus balsasensis* could almost be placed in a separate genus, since it does not exhibit a number of apomorphic characters commonly shared by the other species (see Tables II and III). It is the smallest and least modified species of the genus, easily distinguished from the other species by the following characters: (1) Shallower genal antennal fossae; (2) less separated ommatidial pairs (Fig. 13); (3) the absence of posterior pronotal elevations and sinuate pronotal margins (Fig. 3); and (4) the unique, anteriorly broadened head (Fig. 14), and shortened legs (the tarsi equal in length to the tibiae).

Typhlusechus peninsularis—New Species.
(Figs. 4, 9, 7)

DESCRIPTION: Length 2.1 mm. Width 0.8 mm body reddish brown. HEAD horizontal, slightly wider than long, subparallel, posterior angles slightly wider than long, subparallel, posterior angles slightly produced, quadrate, narrowing anteriorly, anterior angles obtusely rotundate, surface moderately convex, finely punctate; eyes with upper pair with one ommatidium on posterior angle; antennae equal in length to head, set in deep sharp fossae

in genae extending to posterior apical angles with last segments resting under (only slightly modified) apical angles of thorax, third antennal segment subequal to next two segments. THORAX broader than long, sides strongly explanate, much wider anteriorly, anterior angles obtuse, base broadly lobed posteriorly forming 2 acute oblique elevations at lateral $\frac{1}{4}$, separated by depressed truncate medial area. ELYTRA slightly longer than head, thorax together, finely punctate, base deeply emarginate, scutellar region broadly depressed, humeri deeply prominent on sides, embracing lateral base of thorax, sides explanate, margins parallel around middle becoming arcuate posteriorly, slightly arcuate, elevated anteriorly to humeral edge, disc both laterally, longitudinally convex, slightly elevated posteriorly to humeral depression, forming rounded ridge lateral to scutellar depression corresponding to pronotal prominences; epipleurae broad, projecting at base, extending past humeral angles where widened to form acute, tooth-like, lateral prominence; gradually narrowed behind, reaching apex; procoxae, mesocoxae each separated by distance of approximately $\frac{1}{3}$ diameter of coxae; first 2 abdominal sterna only slightly decreasing in length, third, fourth decreasing in length; femora slightly flattened; tarsi subequal to length of their tibia.

TYPE: MEXICO, Baja California Sur, San Jose Del Cabo, in silvestri's trap for soil fauna 58-7405, M. Correa col. (only type is known) type deposited in California Academy of Sciences Collection.

DIAGNOSIS: *Typhlusechus peninsularis* most closely resembles *T. chemehuevii* by the general broad shape and strongly explanate anterior lateral margins of the thorax. It differs from *T. chemehuevii* and agrees with *T. singularis* in not having gibbose prominences on the elytra (only broadly rounded ridges) and having the two oblique elevations on the thorax at one-quarter the distance in from the lateral margins (Fig. 4). It differs from *T. singularis* in having the epipleurae clearly extended forward past the humeral angles where they widen to form an acute, toothlike, lateral prominence (Fig. 9) and by the wider, subparallel margins of the head.

Typhlusechus spilmani—New Species.
(Figs. 5, 17)

DESCRIPTION: Length 2.1 to 2.5 mm. Width 0.6 mm. HEAD quadrate, parallel, posterior angles truncate, anterior angles obtusely rotundate, surface slightly convex, moderately punctate; eyes with lower pair on lateral-basal portion of antennal fossae, in genae; antennae slightly longer than head; fossae in genae deep, sharp, extending to posterior apical angles of thorax, third segment elongate, approximately equal to next two combined, THORAX slightly longer than broad, surface moderately punctate, slightly convex, apical angles slightly produced, sides explanate,

margin broadly sinuate, widening, more strongly explanate apically, posterior angles obtuse, base broadly lobed posteriorly, center third sharply excavate, margin truncate, forming acute angles with posterior projecting elevated sides. ELYTRA finely punctate, base deeply emarginate, humeri prominent, embracing lateral edge of thorax, scutellar region depressed, extending forward around two elongate gibbose elevations with laterally acute projecting angles (laterally corresponding to two pronotal prominences) at interior margins of humeri forming deeply excavate grooves; margins parallel around middle becoming arcuate posteriorly, feebly arcuate, elevated anteriorly to humeral edge of depression, disc moderately convex; epipleurae slightly overlapped by third, fourth, and fifth abdominal sterna, narrowly reaching apex; procoxae, mesocoxae each separated by distance of approximately $\frac{1}{3}$ diameter of coxae, metacoxae separated by distance of approximately $1.5 \times$ diameter of coxae; first 3 abdominal sterna only slightly decreasing in length, fourth smaller; tarsi subequal to length of their tibia.

TYPE: Texas, Val Verde County, Diablo Cave, VIII-10-63, J. Reddell and D. MacKenzie colls. Type deposited in the United States National Museum Collection.

PARATYPES: Same data (4) USNM; MEXICO, Durango, 27.1 mi. S. Ceballos, VII-10/11-82, dry wash, elevation 4,000 feet, Rolf L. Aalbu col. Collected in dry pitfall trap at night at entrance to rodent burrow (1) RLAC.

DIAGNOSIS: *Typhlusechus spilmani* most closely resembles *T. singularis*, in about the same size and general shape; having the margin of the thorax subparallel, only slightly wider at apex (although less abruptly explanate at the apex in *T. spilmani*); by having the two acute oblique elevations on the thorax at about $\frac{1}{4}$ the distance in from the lateral margins (although the medial depressed area is slightly wider in *T. singularis*) and in having the elytral elevations laterally elongate. It differs from all other species by the presence of acute, deep, lateral, excavate grooves above the humeral angles (Figs. 5 and 8).

This species is named for Mr. T. J. Spilman who first brought the attention of the authors to this series of specimens.

Typhlusechus singularis Linell
(Figs. 2, 7, 17)

Typhlusechus singularis Linell, 1897:155.

DESCRIPTION: Length 1.7-2.1 mm. Width 0.5-0.6 mm. HEAD quadrate, subparallel, posterior angles slightly produced, anterior angles obtusely rotundate, surface slightly convex, finely punctate; antennae equal in length to head, set in deep sharp fossae in genae, extending to posterior apical angles with last seg-

ments resting under only slightly modified apical angles of thorax, second antennal segment slightly longer than third. THORAX slightly longer than broad, surface slightly to moderately punctate, punctures coarser near explanate margins, slightly convex, apical angles only slightly produced, sides explanate, margin more strongly explanate, distinctly widening toward apex, posterior angles obtuse, base broadly lobed posteriorly, center half excavate, laterally forming obtuse, oblique elevations, margin subtruncate. ELYTRA finely punctate, base deeply emarginate, humeri prominent, embracing lateral edge of thorax, scutellar region posterior to depression extending forward, laterally forming two elongate elevations, laterally corresponding to two pronotal prominences, margins subparallel to slightly sinuate, arcuate posteriorly, feebly arcuate, elevated anteriorly to acute humeral angle, disc slightly to moderately convex, less so medially; epipleurae slightly overlapped by third, fourth, fifth abdominal sterna, narrowly reaching apex; procoxae, mesocoxae each separated by distance of approximately $\frac{1}{2}$ diameter of coxae, metacoxae separated by distance of approximately $1.5 \times$ diameter of coxae; second abdominal sternum slightly longer than third, fourth smaller; tarsi subequal to length of their tibia.

TYPE: Two specimens have been found, both having the same data and type number (U.S.N.M. Type #1391) in the same tray. These are no doubt the two specimens Linell used for the original description. We have designated one of these specimens as the Lectotype and the other as a paralectotype.

DIAGNOSIS: *Typhlusechus singularis* most closely resembles *T. spilmani* in being about the same size and general shape; in having the margin of the thorax subparallel (although more abruptly wider at the apex in *T. singularis*) and by having the two oblique elevations on the thorax at about $\frac{1}{4}$ the distance in from the lateral margins, although these elevations are more obtuse in *T. singularis*. It differs from *T. spilmani* and agrees with *T. peninsularis* by the absence of excavate grooves on the upper margins of the humeral angles. It differs from *T. peninsularis* in not having the epipleurae widened at the humeral angles and forming a tooth-like prominence, and by the narrower parallel margins of the head (Figs. 2 and 7).

Material examined: Los Angeles Co. Cal. Mar. (2) TYPE #1391 USNM (label has no date but must be prior to or 1897); Los Angeles Co. Cal. Casey bequest 1925 (1) USNM; Southern California, Van Dyke Collection (2) CASC; California, Orange County, Cleveland National Forest, 0.4 miles east San Juan Guard Station III-2-58, I. M. Newell Col. (1) CDAE: California Riverside County, 2 miles northwest Gilman Hot Springs, IX-23-66, F. G. Andrews col. (6) CDAE; California, Riverside County, 2 miles northwest Gilman Hot Springs, Lamb Canyon, Coastal Sage Scrub, Elevation 1529 feet, IX-78 to III-4-79, ethylene glycol pitfall trap, Rolf L.

RLAC and CDAE; California, San Benito County, 3.5 miles northwest Idria, III-25 to VI-8-1981, A. J. Gilbert, N. J. Smith colls., antifreeze pit trap under oak, (1) CDAE; California, Fresno County, 8 mi. NNW Coalinga in Los Gatos Canyon, V-3 to VIII-7-81, antifreeze pit trap on sand under cliffs with swallow nests (1) RLAC.

BIOLOGY

The scarcity of these beetles in museum collections is likely unrelated to their rarity in nature and is due to their ecological niche being infrequently investigated. A number of different collecting methods have yielded specimens. Among these are: dry pitfall traps (overnight), ethylene-glycol (antifreeze) pitfall traps (1 month to 1 year). Berlese samples from rodent nests and Silvestri's trap for soil fauna. The known placement locations of traps yielding specimens of *Typhlusechus* has also varied from the interior and immediate exterior of caves, near the entrances to rodent burrows, on dry, powdery surface soils under cliffs, to open surface soil areas (see Table 1). To illustrate one of these examples, of all the traps deployed during the Mitchell Caverns faunal survey (Aalbu, 1979), about 80 percent of the specimens of *Typhlusechus* were collected from only two traps: one (#13) located in the cave along a packrat (*Neotoma lepida*) runway against a limestone wall near a nest; the other (#15) was located against a stone cliff on the outside of the caverns with a packrat burrow entrance hole approximately a foot above the trap (these two traps were not retrieved after the primary survey, in order to acquire additional specimens). Dates of collection are spread throughout the year, which may indicate long-lived species which are active and may surface at night during favorable environmental conditions. These methods and locations would suggest that the beetles are cave, soil, soil crevice, or rodent burrow inhabitants.

Soil dwelling Coleoptera are mainly known from Mediterranean climate areas, and subsequently, most work on these beetles has been done by European workers, especially the French. They proposed the term "endogees" (see Coiffait, 1957) to designate species which spend their entire life cycles underground, seldom if ever coming to the surface. This term seems to have been accepted (Crowson, 1981) and is currently used by European workers. Soil Coleoptera are poorly known from the Western Hemisphere and practically unknown from very arid desert areas.

Soil dwelling Coleoptera and cave Coleoptera share a number of characteristics including: reduction of the eyes to anophtalmly, apterism, general reduction in pigmentation, a low degree of mobility, and high geographical localization. Unlike cave beetles which tend to have elongate appendages, medium size, rounded bodies (on which may be found long trichobothria), soil inhabiting beetles have very small (not exceeding 3 mm), compact, slightly

elongate bodies which are either dorso-ventrally flattened or cylindrical. They are also characterized by having unmodified short legs and a large, well developed head (sometimes more developed than the prothorax) with increased apical chitinization, shortened antennae (which may be slightly clubbed) and strong mandibular development. There may also be a reduction in the number of tarsal and antennal segments (see Coiffait, 1957; Saiz, 1979; and Crowson, 1981). This general adaptive strategy for endogean life, termed by Saiz, 1973 as "cephalodiggers," is opposed to "leg diggers," an adaptive strategy (usually accompanied by a strong development of the front legs) seldom employed by endogean Coleoptera but widely used in coarser grained soil (such as sand) by many tentyriine genera such as *Eusattus*, *Anepsius*, *Cryptadius* and others which are very often associated with sand dunes or very coarse grained, sandy soils.

The tenebrionid Subfamily Tentyriinae occurs primarily in arid areas of temperate and subtropical climates in all major continents except Australia and Antarctica. Although most of these have soil dwelling larvae, very few (if any) true soil inhabiting adults are known. *Typhlusechus*, indeed, exhibits all of the characteristics associated with a true endogean life. These include a small dorso-ventrally flattened, slightly elongate body with unmodified short legs, a large head with shortened (slightly clubbed) antennae, as well as very reduced eyes associated with underground life. *Typhlusechus* also exhibits some truly unique characteristics, among which are widely separated eye facet pairs, the lower pair found in deeply excavated grooves in the genae and in the peculiar dorsal modifications on the posterior portion of the prothorax and apical area of the elytra found in some of the species (this character is also found in the genus *Alaudes* Horn discussed below, which is thought to be associated with ants). These characteristics seem to be unique to endogean Coleoptera. It is possible that instead of being "cephalodiggers," as clearly exhibited in *Typhlusechus balsasensis* by the very large, anteriorly widened head and small unmodified thorax, the other species of *Typhlusechus* may be tending toward "cephalothorax" digging, taking advantage of the extra surface area of the thorax as well as also using the legs in digging by helping to push up soil without bending the head and thorax up away from the abdomen (which is prevented by the pronotal and abdominal modifications).

Coiffait (1957) suggested that there may be some movement between various underground habitats; as between endogean habitats and caves, rodent nests, ant nests, underground holes left by ground water, etc. We believe that in very arid areas, endogean genera such as *Typhlusechus* may be opportunistically cave dwelling or pholeophillic (rodent nest inhabitants) to take advantage of the higher moisture and organic content of these areas. Recently, other minute soil dwelling beetles have also been trapped using

ly, other minute soil dwelling beetles have also been trapped using ethylene glycol pitfall traps in Southern California and Baja California (Andrews, M.S.). We believe a number of endogean Coleoptera still remain to be discovered in arid and semi-arid areas of the Nearctic region. Further use of pitfall traps (especially those of long duration) in these areas will greatly add to our knowledge of the endogean fauna there.

PHYLOGENETIC RELATIONSHIPS

A phylogeny for the genus is proposed in Tables II and III. Species level relationships, already discussed in the diagnostic section following each species description and presented on these tables, will not be repeated here. Phylogenetic relationships among species are determined by the presence of shared derived character states (synapomorphies) in the sense of Hennig (1966), polarized by use of the out-group comparison method in the sense of Watrous and Wheeler (1981). We believe this combination of methodologies best represents the evolutionary history of the group. Due to the small number of OTU's and characters, the cladogram representing the proposed phylogeny of *Typhlusechus* (Table III) was assessed intuitively. Use of the Wagner tree method of Farris (1970, 1973) with Wagner program version 25/8/78 yielded the same cladogram. Sister group relationships between *Typhlusechus* and other genera within the Stenosini are discussed below.

Typhlusechus demonstrates an interesting and unique morphology associated with its endogean habits. Because of these sometimes unique characters, the systematic position of *Typhlusechus* has been debated, and most workers have elected to leave this genus in its own tribe Typhlusechini. Linell (1897) believed *Typhlusechus* to be most closely allied to the Nyctoporini by the structure of the head and coxae but excluded it from that tribe by the form of the antennae and antennal grooves. He suggested that *Typhlusechus* may be best placed as a distinct tribe between the Anepsiini and the Nyctoporini at the time in the Asidiini. Casey (1907) rejected the placement of *Typhlusechus* in the subfamily Asidinae, which is characterized by the presence of a trochantin on the middle coxae, since *Typhlusechus* lacks a trochantin. He suggested a much closer relationship with the Araeoschizini, (now Araeoschizina: Stenosini, Doyen and Lawrence, 1979), because of the large convex clypeus, broadly sinuate at tip and concealing all the mouth parts from above, and the convex abdomen, with large and unmodified fifth segment and strongly sinuate third suture. Casey hesitated placing *Typhlusechus* in this tribe because of the small, compact, slender antennae and deep cephalic grooves ending in the anterior part of the propleurae (Casey characterized the Araeoschizini as having long moniliform antennae). Doyen and Lawrence (1979) placed *Typhlusechus* in their "genera of

uncertain affinities" and suggested the placement of *Alaudes* provisionally in the Typhlusechini because of the similar presence of the "peculiar" lobing of the prothorax. This has now been rejected by Doyen (personal communication) because of the dorsal orientation of the aedeagus in *Alaudes* (see below).

Another tentyrine tribe, the Stenosini, has many ground dwelling adults of small to medium sizes, many of which are thought to be associated with ants. In north America, this tribe is represented by the genera *Acaeoschizus* and *Anchomma*, recently transferred from the Colydiidae (Doyen and Lawrence, 1979). In the Neotropical region, the tribe is represented by the genera *Grammicus*, *Hexagonochilus*, *Economoderes*, and *Discopleurus* which are mainly known from the very arid areas of Chile, Argentina, and Peru. Of these, *Discopleurus* deserves further discussion. The size and superficial resemblance between *Discopleurus* and *Typhlusechus* is striking. Closer observation confirms some relationship. Both *Discopleurus* and *Typhlusechus* share a number of characteristics, among which are the reduced eyes divided by the epistomal canthus (the lower part reduced to as few as two facets in one species), reversed aedeagus (tegmen ventral), body size and other adaptations for endogean life. *Discopleurus* further agrees with *Typhlusechus* and disagrees with other Stenosini in having shortened, more compact, less moniliform antennae. We found *Typhlusechus* to also agree with most Stenosini by having the tentorium with the metatentoria subparallel and gradually converging toward the anterior pretentoria, with the corpotentorial bridge simple and transverse and located anteriorly to the middle of the head. *Typhlusechus* does differ from most new world stenosines by the lack of costate ridges found on the dorsal surface of most species, although some old world stenosines lack these ridges *Stenosis*, *Mitotagenia* and others. In *Discopleurus*, these ridges are less pronounced on the elytra but highly pronounced on the head and thorax. Although many characters associated with endogean habits are shared between these two genera, we hesitate to designate *Discopleurus* as the sister genus to *Typhlusechus* because of the following characteristics of *Discopleurus*: (1) The forward genal extensions are truncate (acutely produced to a point in *Typhlusechus*: Fig. 16); (2) The metacoxae are narrowly separated (more widely separated in *Typhlusechus*: Fig. 10); (3) The last 2 sternal sutures are anteriorly convex, with the segments reduced (much less convex and not so reduced in *Typhlusechus*: Fig. 10). In these characteristics *Typhlusechus* agrees more with other new world stenosines (as *Grammicus*), but the exact sister group relationship of *Typhlusechus* to any extant genus of Stenosini is unclear. For the above reasons we place the genus *Typhlusechus* in a subtribe, the Typhlusechina, in the tribe Stenosini. Further studies of the tribe Stenosini should elucidate these relationships.

ACKNOWLEDGMENTS

The following individuals and institutions provided specimens for study: John T. Doyen (CISC); Kirby W. Brown (KWBC); David H. Kavanaugh (CASC); and T. J. Spilman (USNM). Special thanks is given to the California Department of Parks and Recreation for permission to collect additional specimens from Mitchell Caverns, San Bernardino County, California, and to Arthur Gilbert and Kenneth Cooper for help in collection of specimens. Special appreciation is given to Kirby W. Brown, Charles A. Triplehorn, J. Sorensen, R. Somerby and J. T. Doyan for review and comments on the manuscript.

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TABLE I: COLLECTING LOCALITIES AND METHODS

SPECIES

T. singularis Linell
T. chemehuevii n. sp.

T. spilmani n. sp.

T. balsasensis n. sp.

T. peninsularis n. sp.

SPECIFIC LOCALITY

arid fine grain soil
cave interior and immediate exterior, outside entrances to *Neotoma* (packrat) nests.
cave interior, outside entrances to rodent burrows (not near caves).
dry soil (acacia scrub).
dry soil (Cape vegetation).

SPECIES

T. singularis Linell

T. chemehuevii n. sp.

T. spilmani n. sp.

T. balsasensis n. sp.

T. peninsularis n. sp.

COLLECTING METHOD

ethylene-glycol pitfall traps (1 month to 1 year), Berlese of *Neotoma* nest.
ethylene-glycol pitfall traps (3 months to 1 year).
dry pitfall trap (overnight).
Berlese?
Silvestri's trap for soil fauna.

TABLE II. COLLECTING LOCALITIES AND METHODS

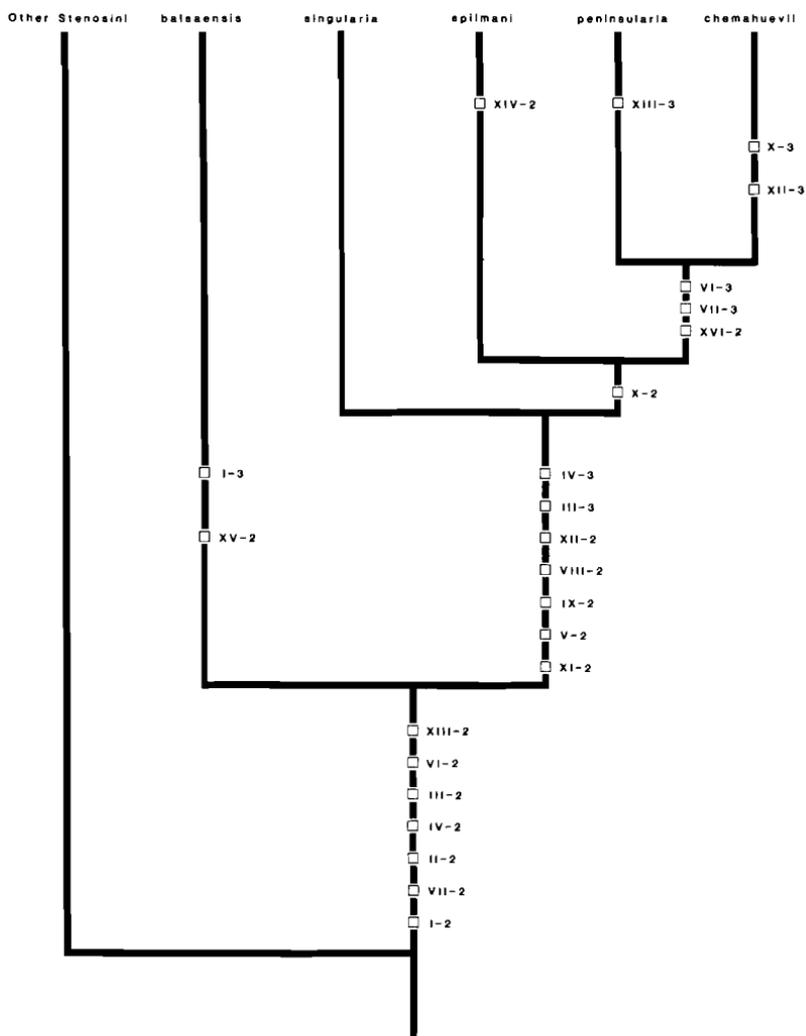
States labeled (P) are considered plesiomorphic; states labeled (A) are considered apomorphic. Numbered postscripts indicate morphoclines. States with lettered postscript G indicate plesiomorphic generic state of Character.

| HEAD | Character | Character States |
|--------------------------------------|-----------|--|
| I. Dorsal form: | | 1. Clearly longer than wide (P); 2. Subquadrate to quadrate (AG); 3. Broadened anteriorly (AI). |
| II. Antennal form: | | 1. Moniliform (P); 2. Compacted, ending in 3 segment loosely joined club (AG). |
| III. Antennal fossae: | | 1. Absent (P); 2. Present, shallow not sharply defined (AG); 3. Deep, sharply defined (AI). |
| IV. Eyes: | | 1. Divided, each with more than two facets (P); 2. With two pairs of single facets (AG); 3. Facet pairs widely divided (AI). |
| THORAX | | |
| V. Pronotum, dorsal lateral aspect | | 1. Subparallel (P); 2. Sinuate (A). |
| VI. Anterior lateral margins: | | 1. Subexplanate (P); 2. Explanate (AG); 3. Widely explanate (AI). |
| VII. Apical angles, dorsal aspect: | | 1. Truncate (P) 2. Produced (AG); 3. Strongly produced (AI). |
| VIII. Apical angles, ventral aspect: | | 1. Unmodified for reception of antennal club (P); 2. Modified to receive antennal club (A). |
| IX. Pronotum, dorsal aspect: | | 1. Unmodified posteriorly (P); 2. Posterior oblique elevations present (A); |

- X. Pronotum,
basal elevations:
1. Small, obtuse (P);
 2. Larger, oblique (A);
 3. Strongly gibbose (AI).
- XI. Scutellar region:
1. Unmodified (P);
 2. Broadly depressed (A).
- XII. Elytra, dorsal aspect:
1. Unmodified basally (P);
 2. Anterior elevations approximately corresponding to pronotal elevations present (A);
 3. Elevations gibbose (AI).
- XIII. Humeri, basal angles:
1. Not apically prominent (P);
 2. Prominent, with epipleurae extended apically (AG);
 3. Epipleurae sharply extended laterally at apical tip (AI).
- XIV. Humeri,
dorso-lateral aspect:
1. Unmodified (P);
 2. Interrupted laterally by deep, escavate grooves (A).
- XV. Legs:
1. Tarsi subequal in length to tibia (P)
 2. Tarsi equal in length to tibia (A).
- BODY*
- XVI. Dorsal aspect:
1. Narrow (P);
 2. Broadened (A).

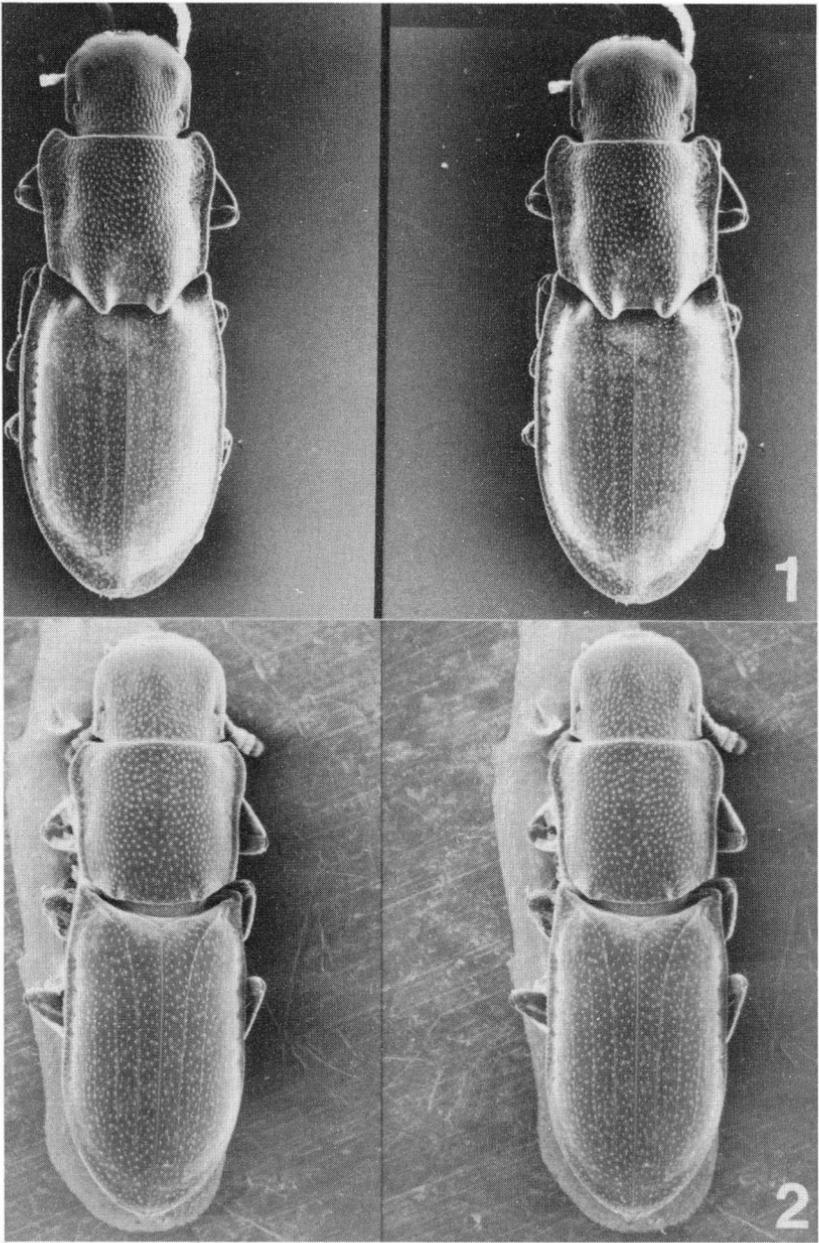
TABLE III: PROPOSED PHYLOGENY OF TYPLHUSECHUS

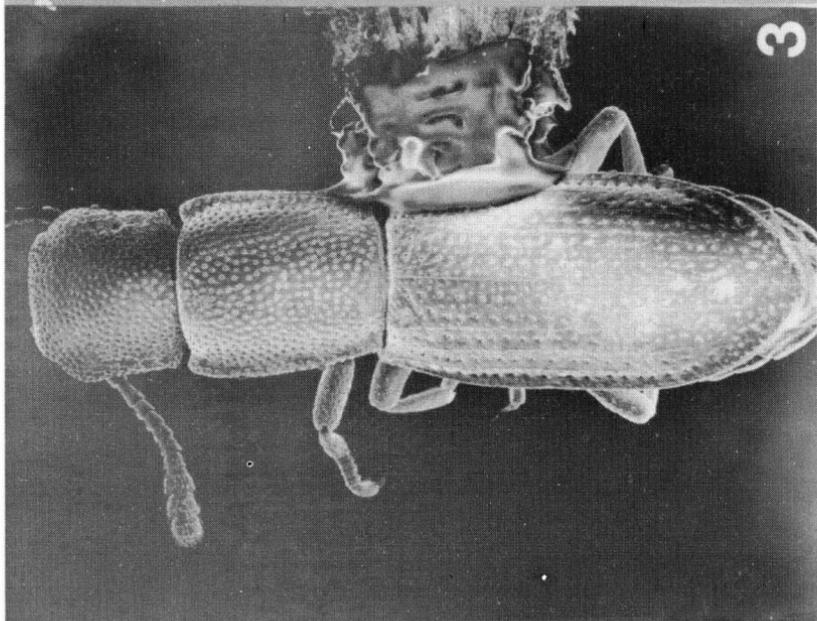
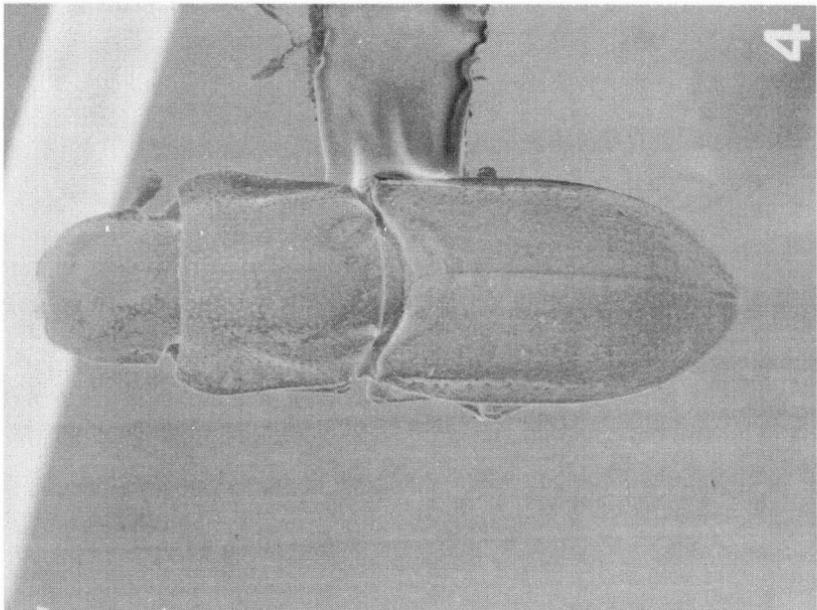
(□ - Apomorphic Character States)

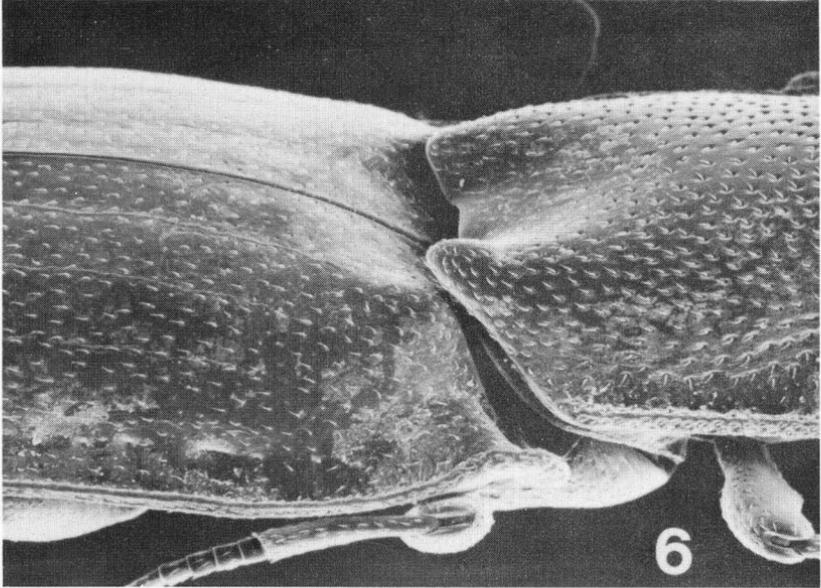
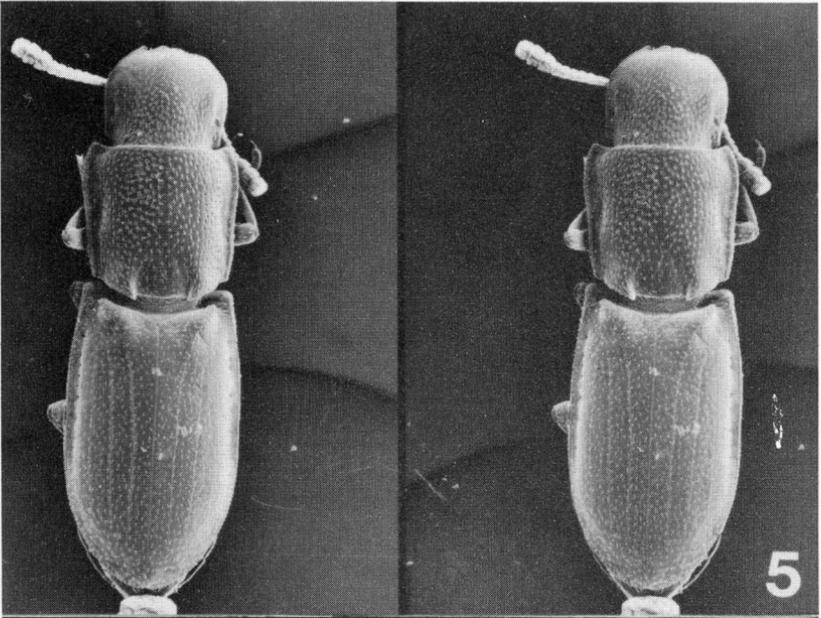


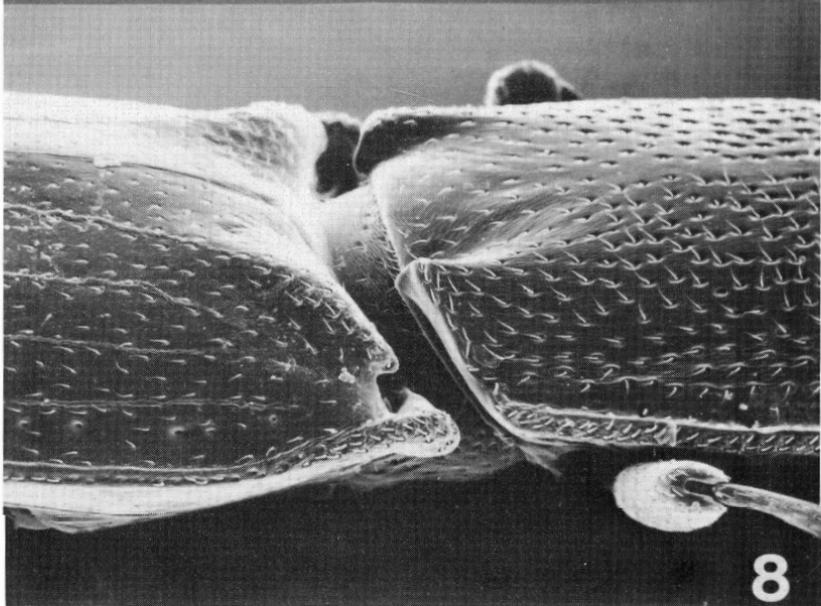
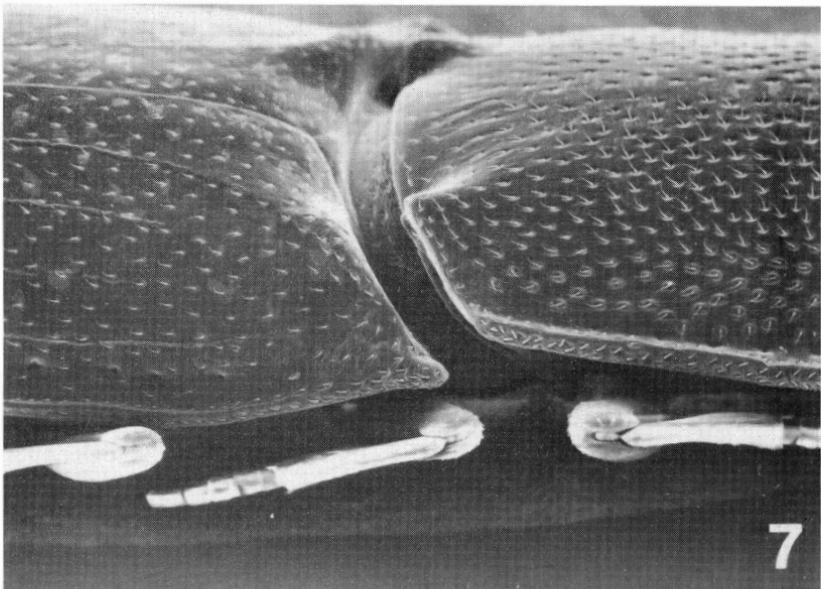
Legends for figures

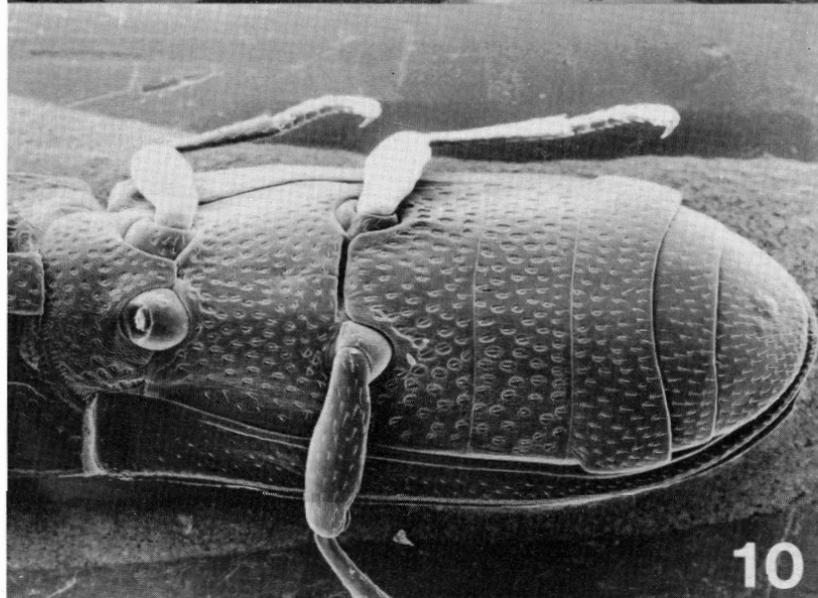
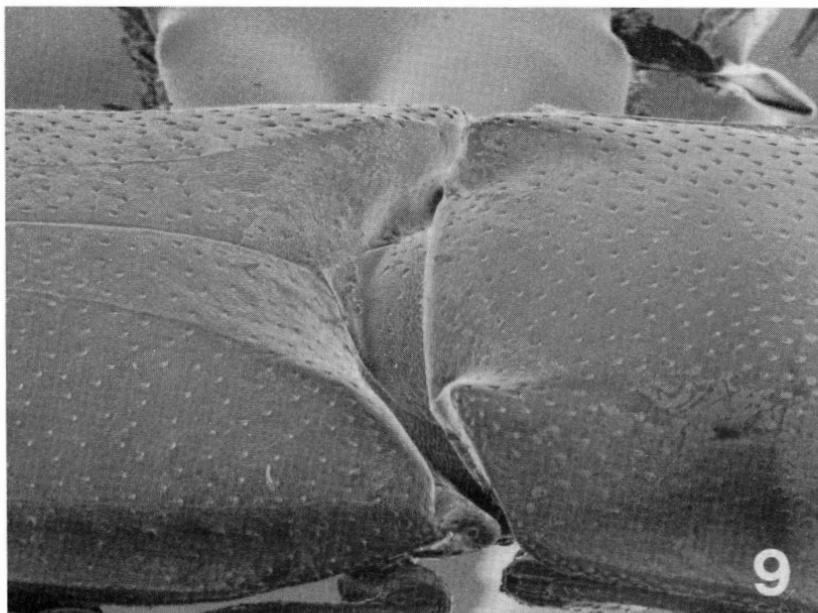
- Figures 1–2. *Typhlusechus* spp. Dorsal aspect (Stereo pair)
1) *chemehuevii* 2) *singularis*.
- Figures 2–4. *Typhlusechus* spp. Dorsal aspect 1) *balsasensis*.
2) *peninsularis*.
- Figures 5–6. *Typhlusechus* spp. 5) Dorsal aspect (Stereo pair)
spilmani. 6) Dorsal-lateral aspect, base of elytra and thorax,
chemehuevii.
- Figures 7–8. *Typhlusechus* spp. Dorsal-lateral aspect, base of tho-
rax and elytra. 7) *singularis*. 8) *spilmani*.
- Figures 9–10. *Typhlusechus* spp. 9) Dorsal lateral aspect, base of
elytra and thorax, *peninsularis*. 10) Ventral aspect, abdomen,
singularis.
- Figures 11–12. *Typhlusechus singularis*. 11) Antennae. 12) Eye,
showing separated double facets.
- Figures 13–14. *Typhlusechus balsasensis* 13) Lateral aspect,
head. 14) Dorsal aspect, head.
- Figures 15–16. *Typhlusechus singularis*. 15) Lateral aspect, head.
16) Ventral aspect, head.
- Figure 17. *Typhlusechus* species. Known geographic distribu-
tion.

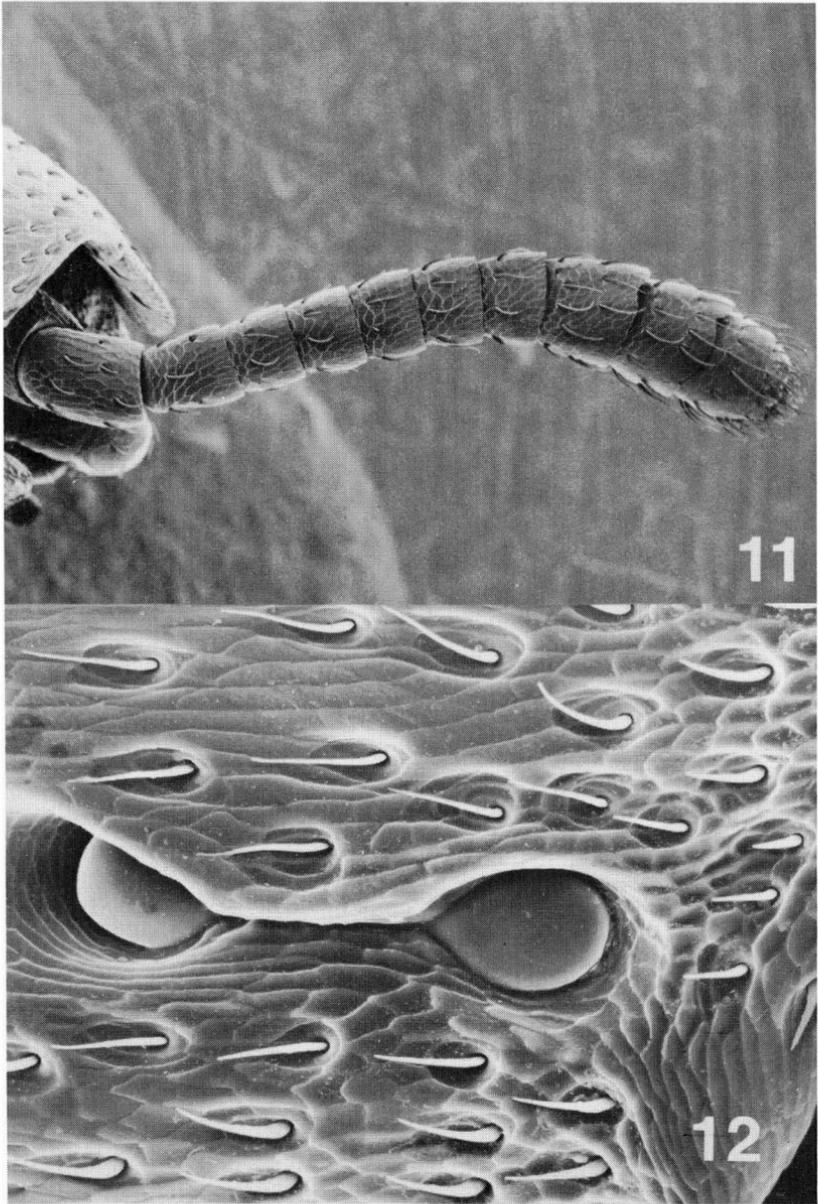


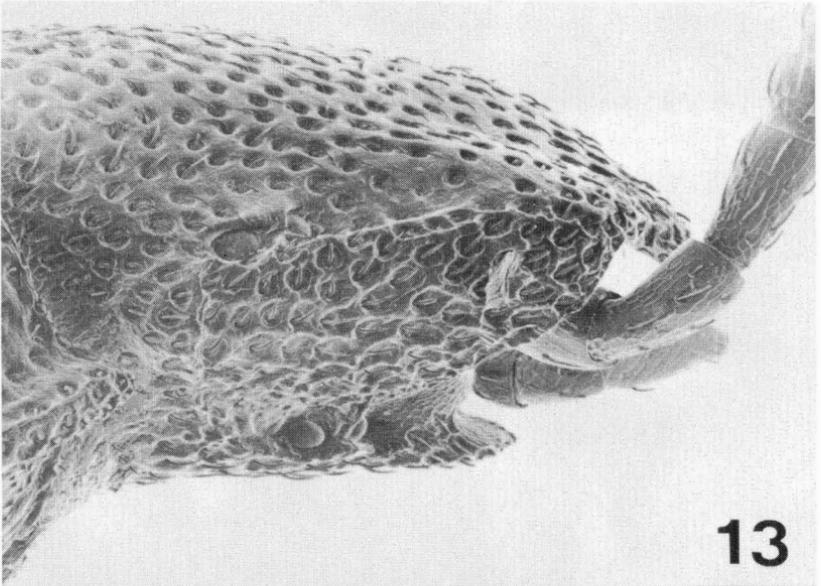




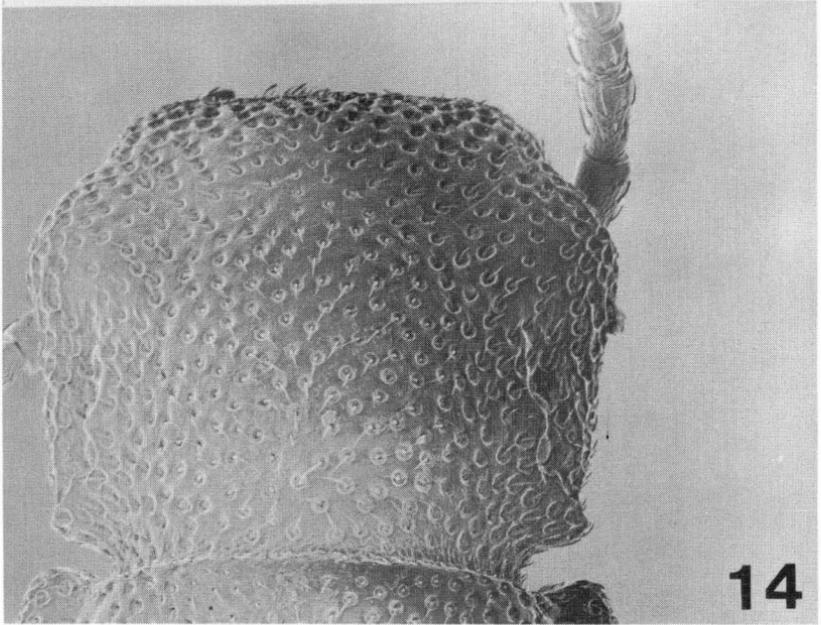




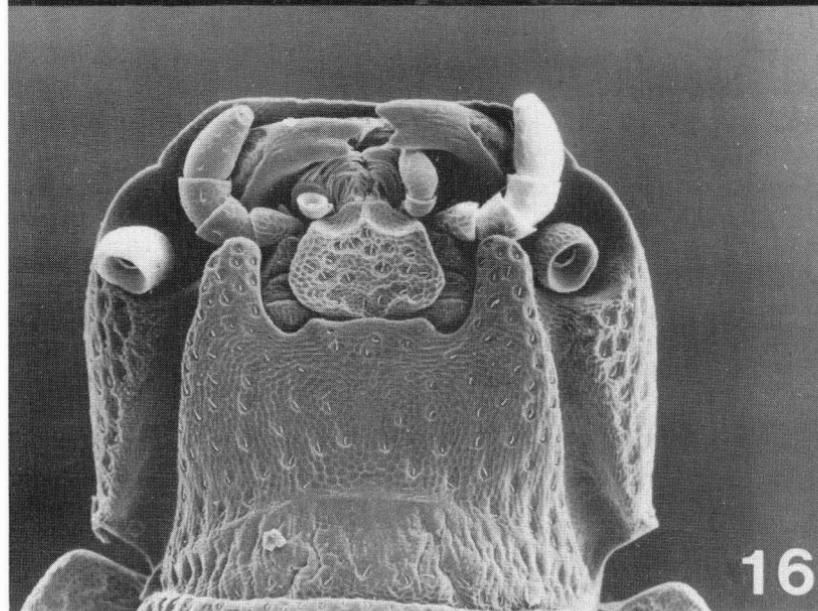
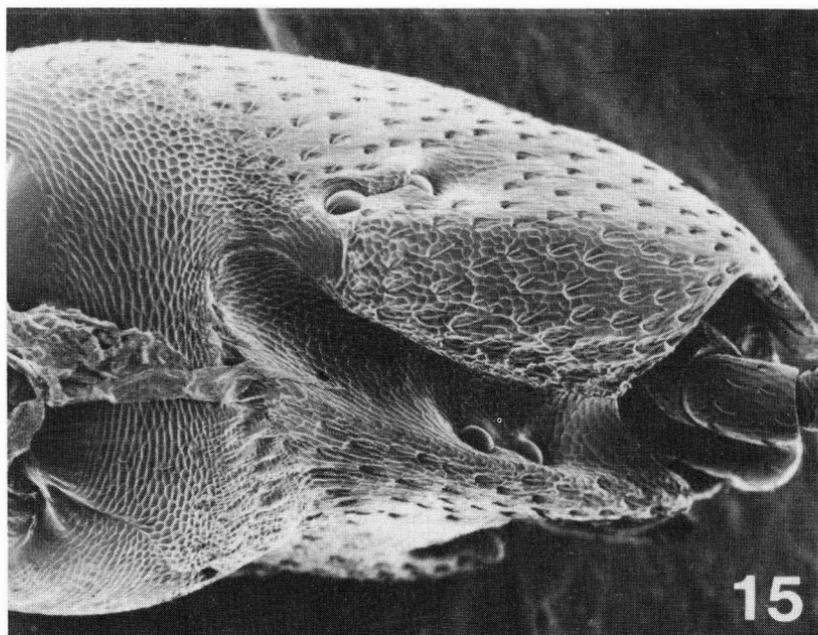


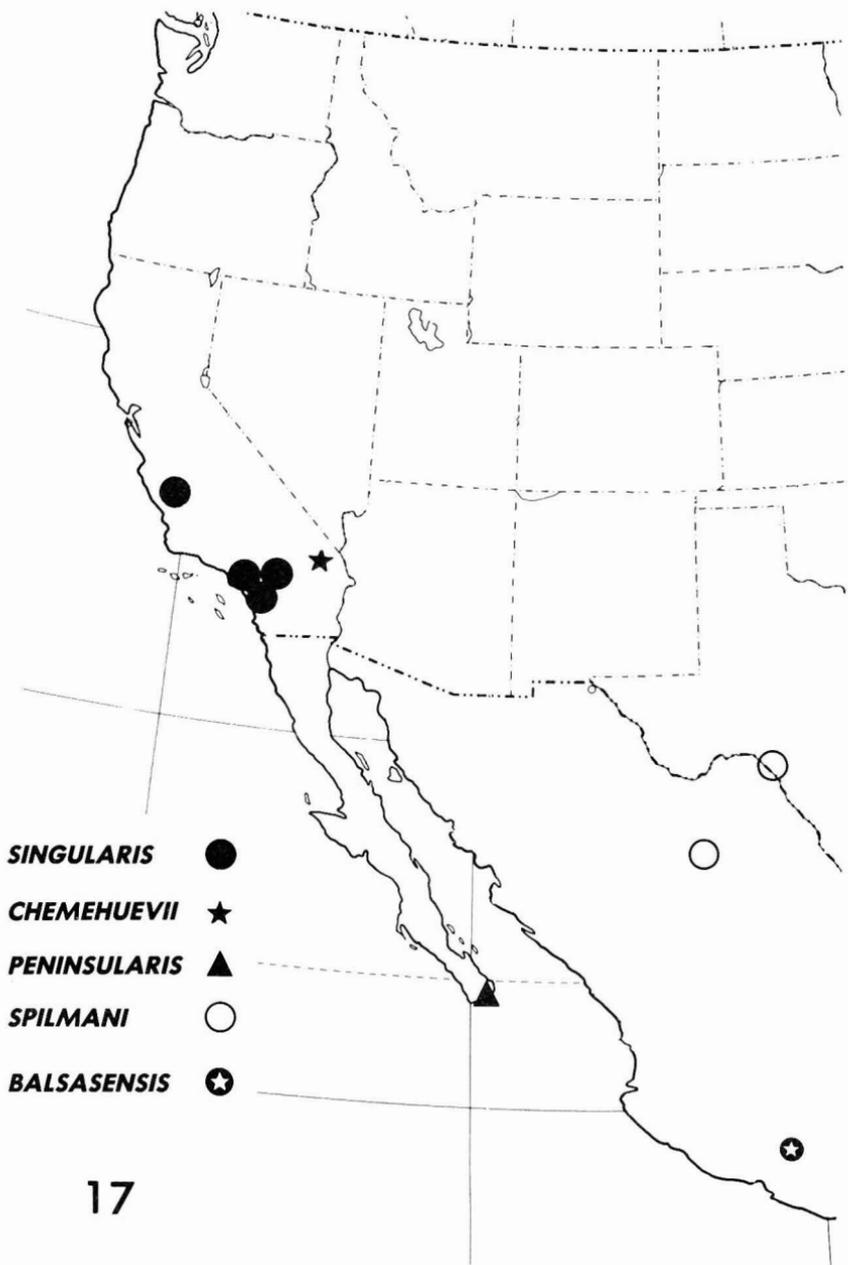


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DR. FRED G. ANDREWS

Dr. Fred G. Andrews has been employed by the California Department of Food and Agriculture for the past fifteen years. His area of specialization is Coleoptera. His research is concerned with the systematics of larval and adult Lathridiidae including studies on host preferences, distribution and life histories. Other interests include the coleoptera associated with sand dunes in the western United States.

Fred is a native Californian, born and raised in Glendale, California. His wife's name is Julie and they have a daughter, Laura, and a son, Daniel. He received his B.A. in Education at California State University at Los Angeles and subsequently taught in the Montebello School District in Southern California. This was followed by graduate work in zoology at California State University, Los Angeles, followed by two years as a technician in the field of medical entomology at the University of California, Riverside. His doctoral work was also at Riverside and was a biosystematic study of the hymenopterous aphid hyperparasites in the subfamily Alloxystinae. Employment in Sacramento followed graduation.



ROLF L. AALBU

Rolf L. Aalbu is currently a Graduate Research Associate completing a Ph.D. in Entomology at the Ohio State University, Columbus, Ohio. His primary research is centered on the systematics and biology of the tribe Cryptoglossini (Coleoptera: Tenebrionidae: Tentyriinae). The major objectives are to determine the limits of the genera and species within the tribe, using adult, immature, internal, and ecological characters to reconstruct the phylogeny and historical biogeography of these taxa; to describe the immature stages; and to examine the biology of each species. Other research interests include the higher relationships within the Tentyriinae, especially using internal and immature stage characters, systematics and biology within the tribes Triorophini and Stenosini. Other current research interests include the Pedinini and Eleodini.

Born in Paris, France, Rolf traveled extensively when young, living in North Africa, Spain, France, Minnesota and Arizona. He attended High School in Long Beach, California and later received his B.S. in Zoology and M.A. in Entomology from California State University, Long Beach. Following graduation, Rolf and his wife, Denise, joined the U.S. Peace Corps, where they served in Cameroon, West Africa. Later, Rolf worked for the California Department of Food and Agriculture-Laboratory Services on a seasonal basis.