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South American species of the subgenus *Anisotarsus* Chaudoir (genus *Notiobia* Perty: Carabidae: Coleoptera). Part I: Taxonomy and Natural History

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Abstract: This is part I in a two part series on the South American species of subgenus *Anisotarsus* Chaudoir (genus *Notiobia* Perty: Carabidae: Coleoptera). Part II will treat the evolution and historical zoogeography of the species and geographical differentiation in Pleistocene and post Pleistocene refugia in the Andes of Ecuador and Peru and the coastal lomas of Peru. The present paper is a systematic revision of the species with notes on their natural history.

I recognize ten valid species. Two of these are new: *N. aquilarorum* (type locality 56.9 km west of Cajamarca on road to Pacasmayo, Cajamarca D., Peru, 1620 m); and *N. moffetti* (type locality 43.7 km southest of Huaraz on road to Lima, Ancash D., Peru, 3720 m). The eight valid previously described species are: *N. tucumana* Dejean; *N. latiuscula* van Emden; *N. cupripennis* Germar; *N. schnusei* van Emden; *N. chalcites* Germar (with *Harpalus amethystinus* Dejean, as new synonym); *N. praeclara* Putzeys; *N. peruviana* Dejean (with new synonymies *Anisodactylus elatus* Erichson, *Anisotarsus (A.) margaretae* van Emden, *Anisotarsus (A.) stubeli* van Emden); and *N. bradytoides* Bates. I designate lectotypes for: *Anisotarsus bradytoides* Bates; *Harpalus cupreonitens* Dejean; *Harpalus fulgens* Dejean; *Harpalus peruvianus* Dejean; *Harpalus tucumanus* Dejean; *Notiobia praeclara* Putzeys; *Poecilus chalcites* Germar; and *Poecilus cupripennis* Germar. The revision includes a key to the species; subgeneric and specific descriptions; discussions of synonymies; notes on character variation; and discussions and maps for geographical ranges of the species.

For each species the paper provides available data on natural history. A section on general trends in natural history summarizes this information and outlines the following general trends.

Anisotarsus are adapted primarily to climates of temperate and semi-arid southern South America, polar and temperatue Andean areas, and (for *N. peruviana* only) the arid climate of lomas along the Peruvian coastal desert. Fog is a moisture source for *N. peruviana* in lomas and in the Andes and for many Andean species. Species are in general adapted to grassy semi-arid to mesic habitats and thrive in many pastures and other areas disturbed by man. Adults of *N. peruviana* and N. *aquilarorum* aggregate in the driest habitats occupied by each species. Adult *Anisotarsus* are apparently opportunistic or phytophagous in feeding habits and are nocturnal. Species usually do not occur together and instead replace one another geographically. Adults vary in body size, with those from lowlands generally larger than those from the high Andes; variation appears to be due to environmental factors. Hind wings are reduced in *N. bradytoides* and *N. moffetti,* dimorphic in *N. chalcites* and *N. peruviana,* and long in the remaining species. Variation in wing length for *N. peruviana* agrees with Darlington's (1943, 1971) hypotheses for hind wing dimorphism in Carabidae.

Resumen

Este artículo es la primera de dos partes en una serie sobre las especies sudamericanas del subgénero *Anisotarsus* Chaudoir (género *Notiobia* Perty: Carabidae: Coleoptera). La segunda parte hablará sobre la evolución y la zoogeografía histórica de las especies y de la diferenciación geográfica en la "refugia" de los períodos pleistocénico y post-pleistocénico en los Andes de Ecuador y del Perú, y en las "lomas" costeras del Perú. Esta monografía es una rectificación sistemática de las especies con anotaciones sobre su historia natural.

Reconozco diez especies válidas. Dos de éstas son nuevas: *N. aquilarorum* (tipo localitativo 56.9 km al oeste de Cajamarca, camino a Pacasmayo, Cajamarca D., Perú, a 1620 m de altura); y *N. moffetti* (tipo localitativo 43.7 km al sureste de Huaraz, camino a Lima, Ancash D., Perú, a 3720 m). Las ocho especies válidas que ya han sido nombradas son: *N. tucumana* Dejean; *N. latiuscula* van Emden; *N. cupripennis* Germar; *N. schnusei* van Emden; *N. chalcites* Germar (con *Harpalus amethystinus* Dejean como sinónimo nuevo); *N. praeclara* Putzeys; *N. peruviana* Dejean (con los nuevos sinónimos *Anisodactylus elatus* Erichson, *Anisotarsus (A.) margaretae* van Emden, *Anisotarsus (A.) stubeli* van Emden); y *N. bradytoides* Bates. Designo lectotypes para: *Anisotarsus bradytoides* Bates; *Harpalus cupreonitens* Dejean; *Harpalus fulgens* Dejean; *Harpalus peruvianus* Dejean; *Harpalus tucumanus* Dejean; *Notiobia praeclara* Putzeys; *Poecilus chalcites* Germar; y *Poecilus cupripennis Germar. La rectificación* incluye lo siguiente: una clave para las especies; descripciones subgenéricas y específicas; discusiones de los sinónimos y de las variaciones en las características morfológicas u otras; y discusiones y mapas para las distribuciones geográficas de las especies.

Para cada especie, la monografía proporciona los datos disponibles con respecto a su historia natural. Una sección presenta las direcciones generales en la historia natural. Las resume y traza las líneas generales según el formato siguiente; *Anisotarsus* se adaptan principalmente a los climas templados y semiáridos del sur de Sudamérica, a las áreas de tierras frías y templadas de los Andes, y (para *N. peruviana* solamente) al clima árido de las lomas peruanas. La neblina proporciona humedad para *N. peruviana* en las lomas y en los Andes, y también para muchas especies andinas. Por lo general, las especies se adaptan a los medios herbosos y semiáridos, a las regiones ni húmedas ni áridas, y a las áreas trabajadas por mano humana como los pastos. Los *N. peruviana* y *N. aquilarorum* se agregan en los medios más secos de cada especie. Los *Anisotarsus* adultos son nocturnos y para alimentarse son fitófagos o aparentemente comen lo que encuentren. Las distribuciones de las varias especies por lo general no coinciden sino cada una tiene su área geográfica específica. Los tamaños del cuerpo de los adultos varían. Por lo general, los de las tierras bajas son más grandes que los de los Andes altos. La variación parece ser resultado de factores ambientales. Las alas traseras son cortas en *N. bradytoides* y *N. moffetti,* cortas o largas en *N. chalcites* y *N. peruviana,* y largas en las demás especies. La variación de la longitud de las alas de *N. peruviana* coincide con las hipótesis de Darlington (1943, 1971) sobre la variación de la longitud de las alas de Carabidae.

Introduction

Species of the subgenus *Anisotarsus* (genus *(Notiobia* Perty) occur naturally in the Australian Region and in North, Central, and South America. In 1973 I revised the genera and subgenera of the subtribe Anisodactylna (to which *Anisotarsus* belongs), the North American species of *Gynandrotarsus* and *Notiobia (sensu stricto),* and the North and Central American species of *Anisotarsus.* The work for this paper caused me to examine representatives of the South American species of *Anisotarsus.* The examination suggested that: (1) the taxonomy of this group needed revising mainly because van Emden (1953) had only small samples when he studied the species; and (2) Andean forms posed very interesting problems in evolutionary history and biogeography.

In his excellent discussion of South American biogeography, Darlington (1965) suggested that a "good biologist" should "see things for himself." Primary funding from the National Science Foundation (grant # DEB-7681446) with supplementary and crucial funding from the Friends of the Museum, Inc. (Milwaukee Public Museum) made it possible to follow this advice. From 18 October 1977 through 7 April 1978 I studied *Anisotarsus* in Ecuador and Peru and thereafter briefly collected in

northern Bolivia and Argentina. Mark Moffett (then an undergraduate student at Beloit College, now a graduate student at Harvard University) was with me throughout the trip. Throughout much of Peru we were accompanied by Daniel Aguilar, a Peruvian student. Laborers were hired as needed.

During the expedition my assistants and I traversed more than 14,000 km of mostly rough roads and intensively collected and studied *Anisotarsus* in the Andes of Ecuador and Peru and the coastal desert lomas of Peru. The expedition let me collect and observe *Anisotarsus* as living organisms, rather than as merely dried museum specimens. Such fieldwork proved crucial to my study, and I use the term "expedition" to denote collections and observations done during the trip.

Study of specimens collected during the expedition and of those borrowed from museums confirm the taxonomy of the South American species needs revising and that the phylogeny and biogeography of the Andean forms are especially interesting. My studies of the taxonomy are the essential foundation for understanding evolutionary history and biogeography of the Andean and other forms; however, not all biogeographers may be interested only in data useful for identification of species. Therefore, the results of my studies are published in two parts. Part I is a revision of all South American species of *Anisotarsus* with notes on their natural history. Part II (Milwaukee Public Museum, Contributions in Biology and Geology No. 45) covers evolutionary history of the species and biogeographic topics such as present and past refugia and centers of evolution in the Andes.

Parts I and II are based on a study of adults. During the expedition my assistants and I placed adults in culture to obtain eggs and larvae. After much work caring for cultures we accumulated larvae of *N. aquilarorum, N. peruviana,* and *N. mofetti.* These larvae will be described elsewhere in a short paper relating them to previously described larvae of *Anisotarsus.*

Materials and Methods

This study is based on 22,396 adults, 18,726 collected during the expedition and 3,670 borrowed from other museums. Unless otherwise noted, I have seen the types of all species and associated synonyms.

The following abbreviations identify institutions or private collections containing specimens:

BMNH	British Museum (Natural History) London S.W. 7, England
CAS	California Academy of Sciences, Golden Gate Park, San Francisco, California
FMNH	Field Museum of Natural History, Chicago, Illinois

IRSNB	Institut Royal des Sciences Naturelles de Belgique, Rue Vautier, 31, Bruxelles, Belgium
LAC	Los Angeles County Museum of Natural History, 900 Exposition Blvd, Los Angeles, California
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
MNHB	Museum für Naturkunde der Humboldt-Uni. Invalidenstrasse 43, 104 Berlin, DDR
MNHP	Museum National d'Histoire Naturelle, 45 bis rue de Buffon, Paris (V), France
MPM	Milwaukee Public Museum, Milwaukee, Wisconsin
Nègre	Private collection of Jacques Nègre, 9 Bd. de Lesseps, Versailles, France
UNAM	Entomology Museum of Departmento de Biologia, Universidad Nacional Agraria, La Molina, Lima, Peru
UNP	Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina
USNM	Smithsonian Institution, Washington, D.C.
ZSBS	Zoologische Sammlung der Beyerischen Staates, 8 Munchen 19, DDR

To observe the color of specimens I used a Wild M 5 microscope illuminated by a 360 degree fiber optic ringlight powered by a Volpi 250 HL light source. This light source regulated light intensity by an iris diaphragm and provided illumination at a constant 3400 degrees Kelvin, ensuring consistency in perception of color.

Arrangement of species follows that of the phylogeny presented in part II. Other methods, including criteria for recognition of species and subunits of species, are as described by Noonan (1973).

TAXONOMY

subgenus *Anisotarsus* Chaudoir

Anisotarsus Chaudoir, 1837: 41. TYPE SPECIES: *Anisotarsus brevicollis* Chaudoir, 1837, designated by van Emden, 1953: 519.

Diaphoromerus Chaudoir, 1843: 402. TYPE SPECIES: *Diaphoromerus iridipennis* Chaudoir, 1843: 405, by monotypy.

Eurytrichus LeConte, 1847: 287 (page incorrectly numbered 387 in paper). TYPE SPECIES: *Feronia terminata* Say, 1823, designated by van Emden, 1953: 525.

Stilbolidus Casey. 1914: 171, 206. TYPE SPECIES: *Harpalus mexicanus* Dejean, 1829, by original designation of Casey, p. 206-207.

Description. (For adults of Australian and all American species) Body length 5.9 to 17.3 mm.

Color. Antennae of most specimens with distal 8 to 9 articles each with longitudinal median stripe darker than lateral portions of article; in many specimens such darker stripes progressively narrowed in successively distal articles. Mandibles red, reddish brown to black, in most specimens darkest apically and basally.

Microsculpture. Venter with predominantly isodiametric mesh; such mesh in some specimens transverse or weak on portions of sclerites.

Head. Labral apex moderately to markedly emarginate medially. Frontal fovea punctiform to irregularly shaped, lacking clypeo-ocular prolongations, in some specimens each in larger depression of varied depth and size. Widths of narrowest part of genae relative to maximum widths of first antennal articles various (greater in South American specimens). Supra-antennal ridges varied from not divergent to markedly divergent anteriorly. Eyes small to large and prominently protruded (small in *N. aguilarorum* and moderate in size in other South American species). Mentum with moderate median tooth, except tooth absent from all *N. tucumana* and varied from vestigial to moderate in *N. peruviana* (most specimens with moderate tooth) and *N. bradytoides* (most specimens with vestigial tooth). Ligula apex markedly expanded laterally in *N. tucumana,* not expanded laterally in other species.

Thorax. Pronotum with lateral beads complete, thick and prominent in species of the *mexicana* group and narrow and not prominent in species of other groups; anterior bead progressively flattened and indistinct mesad of anterior angles until effaced; posterior bead flattened or not medially, evident medially in most specimens. Prosternum of all South American and most specimens from elsewhere with short fine setae anteriorly and posteriorly (some North American specimens also with such setae medially). Mesosternum with fine short setae anteriorly and posteriorly. Metasternum with fine short setae near midcoxae. Other ventral sclerites of some specimens with few fine short setae anteriorly.

Legs. Posterior margins of hind femora each with 1 to 16 setae. Tarsal dorsa glabrous to pubescent. Fore and midtarsi of ♂ with articles 2 to 4 (and in many specimens also apices of articles 1) laterally expanded and spongy pubescent beneath. Hindtarsi with articles slender and elongate; first articles each 3 to 4 times as long as wide at apex and slightly shorter to slightly longer than 2 + 3.

Elytra. Humeri with or without small teeth (lacking teeth in South American specimens); scutellar striae short to long, joined distally to striae 1 in some specimens, in most specimens with ocellate puncture at origin between bases of striae 1 and 2; 9 regular striae, moderate in depth; 10 intervals, flat to moderately convex; intervals 3 each with or without setigerous puncture near distal 1/3; sutural apices rounded to

angulate and each lacking tooth (Fig. 39), except many specimens of *N. cupripennis* with tooth (Figs. 40, 41).

Hind wings. Fully developed to vestigial depending on species.

Abdomen. Sterna 2, and 3 with fine short setae beneath hind trochanters and basal portions of hind femora in repose; sterna 3 to 6 each with 1 pair of median ambulatory setae; sternum 6 also with 1 pair of lateromedial ambulatory setae in all females but *N. aguilarorum* and all South American males but *N. aguilarorum,* such lateromedial setae present or absent in males from elsewhere than South America.

Male genitalia. Median lobe with dorsal membranous area extended to basal bulb in all American and many Australian species and nearly to basal bulb in some Australian species; symmetrical except in *N. tucumana;* lacking apical disc.

Ovipositor. Valvifers flat to slightly convex; lateral margins semi-membranous, lacking distinct boundaries; apices each lacking or with several setae. Styli unmodified.

Key to South American Species of *Anisotarsus*

1. Posterior margins of hind femora each with 9 or more setae; ligula apex expanded laterally (Fig. 16); mental tooth absent. . . . . *N. tucumana* Dejean p. 10
   Posterior margins of hind femora each with 5 or less setae; ligula apex not expanded laterally (Fig. 15); mental tooth present or absent. 2
2 (1). Elytral sutures each with spine at apex (Fig. 41) . . . . . (in part) *N. cupripennis* Germar p. 16
   Elytral sutures each lacking spine at apex (Fig. 39). 3
3 (2). Posterior margins of hind femora each with 1 seta; body length 11.4 to 17.3mm . . . . (in part) *N. aguilarorum* new species p. 11
   Posterior margins of hindfemora each with 2 or more setae; body length various 4
4 (3). Sternum 6 with 1 pair of ambulatory setae; AND dorsum black to greenish black; body length 11.4 to 17.3mm. . . . . (in part) *N. aguilarorum* new species p. 11
   Sternum 6 with 2 pairs of ambulatory setae; OR dorsum other than black to greenish black; body length various 5
5 (4). Pronotal lateral beads thick and prominent (Figs. 1, 2, 4); posterior hind femora margins each with 2 setae; body length 12 to 16.2mm. 6
   Pronotal lateral beads not thick or prominent (Figs. 5, 6, 11); posterior margins of hind femora each with 2 to 5 setae; body length 5 to 18.8mm 7
6 (5). Pronotum with sides posteriorly straight and convergent to obtusely rounded posterior angles (Fig. 4); AND elytral mesal microsculpture indistinct and irregular; specimen from Colombia . . . . . *N. praeclara* Putzeys p. 26

Pronotum with sides posteriorly straight to sinuate, and posterior angles prominent and dentate (Fig. 1) to obtusely rounded (Fig. 2); AND elytral microsculpture of moderate to prominent isodiametric mesh medially; specimen from Argentina, Bolivia, Brazil, Paraguay, or southern Peru. . . . . (in part) *N. chalcites* Germar p. 22

7 (5). Posterior margins of hind femora each with 2 setae; AND dorsum concolorous dull black or greenish black; body length 11.4 to 17.3mm; specimen from northwestern Peru (Fig. 43). . . . . (in part) *N. aguilarorum* new species p. 11

Posterior margins of hind femora each with 3 to 5 setae; OR dorsum not colored as above; body length 5 to 19mm; geographical distribution various 8

8 (7). Body length less than 11mm; AND dorsum brown to dark reddish brown with green tinge on elytra of some specimens; AND pronotum with sides convergent posteriorly to broadly rounded posterior angles (Fig. 14); AND male median lobe with apex broadly rounded at tip and not bent ventrad (Figs. 28a,b); AND internal sac of male median lobe lacking fields of macrotrichia; AND specimen from Ecuador or northern Peru . . . . . *N. bradytoides* Bates p.34

One or more features not as above 9

9 (8). Body length less than 10mm; AND specimen from Peru. . . . 10

Body length at or more than 10mm; OR specimen not from Peru 13

10 (9). Pronotum with sides indistinctly arcuate and only slightly convergent posteriorly (Figs. 7,8); AND frons and pronotum reddish brown to reddish black, in some specimens pronotum (but not frons) with greenish tinge; median lobe with apex moderately long (Figs. 21a,b); specimen from Ancash Department of central Peru (Fig. 46). . . . . *N. moffetti* new species p.37

Pronotum with sides more arcuate or convergent posteriorly (Figs. 5-6, 9-12); OR color of frons or pronotum not as above; median lobe with apex broad and short to elongate and narrow (Figs. 19, 25, 26, 27); specimen from Ancash Department or elsewhere in Peru 11

11 (10). Medial microsculpture of elytra obsolete . . . . . (in part) *N. peruviana* p. 27

Medial microsculpture of elytra moderately prominent isodiametric mesh. 12

12 (11). Median lobe with moderately long to broad short apex and lacking sclerotized pillow of stout spines under ostium flap (Figs. 25, 26, 27, 29-31); abdominal sternum 4 of some specimens with 2 lateromedial fields of short setae; specimen from north of Puno Department in Peru. . . . . (in part) *N. peruviana* p. 27

Median lobe with narrow and elongate apex and with sclerotized

pillow of stout spines under left flap of ostium (Figs. 19a, 36, 37); abdominal sterum 4 lacking fields of short fine setae and at most with total of 4 short fine setae adjacent to anterior intersegmental membrane; specimen from Puno Department, Peru along northern border of Lake Titicaca. (Fig. 47)..... ..... (in part) *N. schnusei* p. 20

13 (9). Specimen from Colombia, Ecuador or Peru 16
Specimen from elsewhere 14

14 (13). Median lobe with sclerotized pillow under left flap of ostium (Figs. 19a, 20a, 33, 36, 37); specimen from Argentina, Bolivia, southern Brazil, Paraguay, or Uruguay..... 15
Median lobe lacking sclerotized pillow under left flap of ostium (Figs. 18a, 32); specimen from locality within 300 kilometers of coast of Uruguay and northeastern Argentina (Fig. 51)..... ..... *N. latiuscula* van Emden p. 14

15 (14). Everted internal sac of median lobe with single distally located narrow field of macrotrichia (Fig. 33); specimen from Argentina, southern Brazil, Bolivia, Paraguay, or Uruguay .... (in part) *N. cupripennis* Germar p. 16
Everted internal sac of median lobe with 2 distally located confluent fields of macrotrichia (Figs. 36, 37); specimen from Bolivia ..... (in part) *N. schnusei* van Emden p. 20

16 (13). Median lobe with elongate narrow apex (Figs. 17a, 19a); elytral medial microsculpture of isodiametric mesh; abdominal sternum 4 lacking fields of short setae and at most with total of 4 short fine setae adjacent to anterior intersegmental membrane; specimen from southern half of Peru 17
Median lobe with apex short and broad (Fig. 27a) to slightly elongate (Figs. 25a, 26a); elytral medial microsculpture obsolete to prominent isodiametric mesh; abdominal sternum 4 of some specimens with 2 lateromedial fields of short fine setae; specimen from Colombia, Eduador, or Peru .... (in part) *N. peruviana* Dejean p. 27

17 (16). Pronotal bead more prominent (Figs. 1,2); median lobe lacking sclerotized pillow under left flap of ostium (Fig. 17) .... (in part *N. chalcites* Germar p. 22
Pronotal bead less prominent (Fig. 6); median lobe with sclerotized pillow under left flap of ostium (Figs. 19a, 36, 37);..... (in part) *N. schnusei* van Emden p. 20

The *tucumana* group

Included is the South American *N. tucumana* and all North American species except *N. mexicana* and *N. lamprota* of the *mexicana* group. The species share a large spine located proximally on the internal sac of the male median lobe.

Notiobia (Anisotarsus) tucumana Dejean
(Figs. 3, 16, 24, 38, 50)

Harpalus tucumanus Dejean, 1831: 839. Lectotype (MNHP), here designated, a ♂ labeled "tucumanus. m. in Tucuman. D."; "Lacordaire."; "Ex Musaeo Chaudoir." (First two labels are green with black lettering; last is white with red lettering.) Additional label added stating: "LECTOTYPE Harpalus tucumanus Dejean By G.R. Noonan". TYPE LOCALITY: Argentina, Tucuman Province, as originally cited. NOTES ON TYPE MATERIAL: Dejean (1831) recorded several specimens, all with antennae. The lectotype lacks antennae and is the only specimen in Chaudoir's collection which has green labels, bears a species name label, and is labeled as from "Tucuman." The other Chaudoir specimens consist of one male from Bolivia, one male and two females from "Pampas," and two males and two females without locality labels.

Description. Body length 9 to 10.5 mm.

Color. Dorsum with head and pronotum purplish blue; elytra green to bluish green. Venter reddish brown to reddish black, greenish or purplish black. Legs reddish yellow to reddish brown or reddish black, black, purplish black; tibiae and tarsi of most specimens lighter than more proximal articles. Antennae reddish yellow to reddish brown. Palpi reddish yellow to reddish brown.

Microsculpture. Dorsum with isodiametric mesh.

Head. Ligula with apex markedly expanded laterally (Fig. 16).

Thorax. Pronotum (Fig. 3) with sides evenly arcuate; anterior angles slight; posterior angles broadly rounded; lateral depressions slight; posterior lateral impressions indistinct to irregularly elliptical.

Legs. Posterior margin of hind femora each with 9 to 16 long setae. Tarsal dorsa each glabrous except for 1 to 3 spine like setae.

Elytra. Scutellar striae each with ocellate puncture at origin, moderate in length; intervals 3, 5, 7 respectively each with 0 to 1, 0 to 2, 2 to 7 posterior setigerous punctures; intervals 3 lacking setigerous puncture near distal 1/3; subapical sinuations slight.

Hind wings. Fully developed.

Abdomen. Sterna 4 and 5 pubescent laterally.

Male genitalia. Median lobe (Fig. 24) asymmetrical; right side with ventral ridge; apex moderate in length; many specimens (internal sac inverted) with tip of large spine and tips of spine like macrotrichia projected from ostium. Everted internal sac (Fig. 38) with 4 fields of macrotrichia (1 larger and proximal, 3 smaller and distal) and large elongate proximal spine serrate basally on one side.

Natural History. Three specimens are labeled as collected in October: one male and one female from Estancia Don Roberta, Lavaisse, San Luis; and one male from La Pampa. A male from Pica is labeled as "attacking wheat-head armyworm."

Geographical Distribution and Material Examined. This species is known from northwestern Argentina and Bolivia (Fig. 50). The lectotype is from Tucuman Province, Argentina. One paralectotype is labeled as from Bolivia and three as from "Pampas." The latter locality may refer to one of several sites in Argentina: several places termed "Pampas"; La Pampa Province; several places termed "Pampa"; or the "pampa" or grassland regions. In addition to the type material I have seen 11 specimens from: ARGENTINA: SAN LUIS DEL PALMAR PROVINCE: San Luis, 1948, 1 ♂, 1 ♀; Estancia Don Roberto, Lavaisse, Oct., 1 ♂, 1 ♀. LOCATION OF LOCALITY NOT DETERMINED: La Pampa, Oct., 1 ♂ and 3 ♂, 2 ♀ with no dates; Pica 278 lot 20623, attacking wheat-head armyworm, 1 ♂.

The *cupripennis* group

Included are *N. aguilarorum, N. latiuscula, N. cupripennis,* and *N. schnusei.* Adults are characterized by: pubescent tarsal dorsa; ocellate puncture at origin of each scutellar stria; and (on average) a large body size with most specimens having a length greater than 11 mm. Males have median lobes with elongate apices.

Notiobia (Anisotarsus) aquilarorum new species
(Figs. 13, 15, 22, 43, 60, 62, 63)

TYPE LOCALITY. 56.9 km west of Cajamarca on road to Pacasmayo, Cajamarca D., Peru, 1620 m (Fig. 62).

Type Material. Holotype a ♂ labeled: "Peru, Cajamarca D. 35.3 mi. W. Cajamarca on rd. to Pacasmayo I-26-78 G. Noonan, M. Moffett, D. Aguilar"; "under rocks on xeric hillside w. mesquite, scattered 10-18 inch tall dry grass 1620 m."; red label stating "HOLOTYPE Notiobia (Anisotarsus) aguilarorum new sp. Det. Noonan." Allotype a ♀ with first 2 labels as in holotype and red label stating "ALLOTYPE Notiobia (Anisotarsus) aguilarorum new sp. Det. Noonan." Paratypes, 1,288 with following label data: PERU: CAJAMARCA DEPARTMENT: 36.7 mi. SE Cajamarca on rd. to Cajabamba II-2-78, G. Noonan, M. Moffett, D. Aguilar collrs., under rocks on hillside w. mesquite; xeric shrubs; large cacti ; green to dry sparse to mod. dense short grass 2540 m, 9 ♂, 7 ♀; 39.0 mi. SE. Cajamarca on rd. to Cajabamba, I-31-78 Moffett, D. Aguilar collrs. under rocks in area w. mesquite; xeric shrubs, large cacti and short dry grass 2420 m, 1 ♂, 7 ♀; 39 mi. SE Cajamarca on rd. to Cajabamba II-2-78 G. Noonan, M. Moffett, D. Aguilar under rocks on hillside w. mesquite; xeric shrubs; large cacti; green to dry, sparse to mod. dense short grass 2420-2430 m, 4 ♂, 10 ♀; 27 mi. W. Cajamarca on rd. to Pacasmayo I-27-78 G. Noonan, M. Moffett, D. Aguilar under rocks on hill in area w. xeric shrubs, scattered tall dry grass 2100 m, 34 ♂, 18 ♀; 29.0 mi. W. Cajamarca on rd. to Pacasmayo I-30-78 M. Moffett, D. Aguilar

collrs. under rocks on steep, dry slope with shrub growth and little grass 2000 m, 1 ♀; 32.0 mi. W. Cajamarca on rd. to Pacasmayo I-30-78 M. Moffett, D. Aguilar collrs. under rocks on xeric hillside w. mesquite, scattered tall dry grass and little short green grass 1800 m, 6 ♂; 9 ♀; 32.2 mi. W. Cajamarca on rd. to Pacasmayo I-27-78 G. Noonan, M. Moffett, D. Aguilar under rocks on xeric hillside w. scattered 10-18; tall dry grass 1730 m, 6 ♂, 6 ♀; 35.1 mi. W. Cajamarca on rd. to Pacasmayo I-27-78 G. Noonan, M. Moffett, D. Aguilar under rocks on xeric hillside w. mesquite, scattered 10-18" tall dry grass 1630 m, 303 ♂, 264 ♀; 35.3 mi. W. Cajamarca on rd. to Pacasmayo I-24-78 G. Noonan, M. Moffett, D. Aguilar collrs. under rocks on xeric hillside w. mesquite, scattered 10-18" tall dry grass 1620 m. 165 ♂, 194 ♀; same labels as previous but dated I-26-78, 61 ♂, 57 ♀; 38.2 mi. W. Cajamarca on rd. to Pacasmayo I-26-78 G. Noonan, M. Moffett, D. Aguilar under rocks on xeric hillside w. wilted mesquite, xeric shrubs, scattered 10-18" tall dry grass 1490 m, 24 ♂, 52 ♀.

PIURA DEPARTMENT: 33 mi. E of Olmos, I-18-1959, E.I. Schlinger & E.S. Ross collectors (CAS) 4 ♂, 1 ♀; 35.9 mi. E. Olmos on rd. to Bagua II-7-78 G. Noonan, M. Moffett, D. Aguilar collrs. under rocks on wind and fog swept ridge w. scattered grass, trees, large cacti 2070 m, 13 ♂, 16 ♀; same labels as previous but dated II-8-78, 7 ♂, 4 ♀.

CAJAMARCA OR LA LIBERTAD DEPARTMENTS: (Río Chusgon flows through both departments.) Río Chusgon 1600 m II-1940 leg. W. Weyrauch WKW 5481, (Nègre) 3 ♀; same label as previous but dated III 1940, (Nègre) 1 ♂; Rió Chusgon 1500 m 22-IX-55 leg Weyrauch WKW 6394, (Nègre) 1 ♂.

Deposition of type material. The holotype, allotype and most MPM expedition collected paratypes are deposited in MPM: approximately 1/3 of the MPM collected paratypes are deposited in UNAM. The CAS and Négre paratypes are deposited in the CAS and Nègre collections respectively. Paratypes are also deposited in other collections listed in the section entitled "Materials and Methods."

Description. Body of most specimens relatively large for *Anisotarsus* (11.4 to 17.3 mm in body length); pronotum relatively small in proportion to elytra.

Color. Dorsum black to greenish black; frons with or without 2 faint median confluent reddish spots. Venter and legs reddish brown to reddish black or black. Antennae with articles 1 to 3, 4, 5, or 6 reddish brown to black; articles 4, 5 or 6 to 11 reddish yellow to dark reddish brown (in most specimens distal articles lighter than proximal ones). Palpi reddish brown to reddish black.

Microsculpture. Dorsum with isodiametric mesh.

Thorax. Pronotum (Fig. 13) relatively small in appearance proportional to elytra; sides anteriorly evenly arcuate, posteriorly evenly arcuate to straight and convergent posteriorly; anterior angles slight; posterior angles obtusely rounded; lateral depressions narrow to moder-

ate, in many specimens widened and less evident posteriorly; posterior lateral impressions slight, somewhat elliptical in shape, not discretely delimited.

Legs. Posterior margins of hind femora each with 1 seta distal to trochanter and in a few specimens with 1 shorter seta opposite trochanter. Tarsal dorsa pubescent.

Elytra. Scutellar striae each with ocellate puncture at origin, moderately long, joined distally to striae 1 in some specimens; intervals 3 lacking setigerous puncture near distal 1/3; intervals 3, 5, 7 respectively each with 1 to 7, 0 to 5, 3 to 16 posterior setigerous punctures; subapical sinuations slight to moderate; sutural apices obtusely to acutely angulate.

Hind wings. Fully developed.

Abdomen. Sterna 4 and 5 of many specimens with very fine and very short setae.

Male genitalia. Median lobe (Fig. 22) with apex elongate and in most specimens with median elliptically shaped concavity; tip bent ventrad. Everted internal sac relatively short and wide, lacking macrotrichia.

Variation. Described variation is intrapopulational. Absence of lateromedial pair of ambulatory setae on the sixth abdominal sterna of some females is unique within genus *Notiobia.* The only other anisodactylines lacking these outer setae are females of the New Zealand genus *Allocinopus.*

Natural History. Specimens were collected in xeric semi-desert areas (Figs. 62-64) with scattered mesquite like plants, cacti, and scattered approximately 40 cm tall dry grass. Most specimens were under large stones approximately 40 or more cm in diameter. At 59.2 km (36.7 miles) south east of Cajamarca, 2540 m elevation, a few specimens were also taken under smaller rocks and plant debris in shaded areas within groves of large cacti.

Restriction of *N. aguilarorum* to semi-desert areas is suggested by the results of a transect on the Cajamarca-Pacasmayo road down from 3200 m high pass near Cajamarca, to 1260 m. Xeric appearing areas were first evident on steep slopes at approximately 2300 m. The highest xeric areas that could be reached on foot occurred on steep cliffs 43.5 km (27 miles) west of Cajamarca at an elevation of 2100 m. Both *N. aguilarorum* and a few *N. peruviana* occurred in these semi-desert appearing areas with cacti, mesquite, and scattered dry grass. Moderately flat areas at the base of this cliff had dense green grass similar in appearance to that at higher elevations and contained only *N. peruviana.* Presumably rain water runs off the steep cliffs (hence the semi-desert appearance of areas on them) and provides moisture for the grass in the lower moderately flat areas. Possibly this additional moisture is detrimental to members of *N. aguilarorum.* The lowest elevation at which *N., aguilarorum* were found was 1490 m where the grass was sparser than in higher areas with these beetles, and the mesquite was (unlike in other areas) wilted. The lowest site sampled on the transect, 1260 m, lacked mesquite and grass.

Fog probably provides important moisture for survival of *N. aguilarorum*. Epiphytes grew on cacti at several localities with this species. During most of the day fog shrouded the locality 57.8 km (35.9 miles) east of Olmos (Fig. 63). Other localities for the species appeared suitable for lodgement of fog at night but were not visited then because frequent nocturnal fogs made night driving unsafe in the Cajamarca area. All localities for *N. aguilarorum* had numerous live snails attached to the plants. These snails were scarce or absent at localities below which the species occurred on the Cajamarca-Pacasmayo transect.

All captured specimens were agile and climbed readily over twigs and grass stems held against their containers. The two localities (56.6 and 56.9 km [35.1 and 35.3 miles] west of Cajamarca) with the most specimens had been plowed (Fig. 62) in the past (unlike other sites) to encourage growth of grass for fodder and had few cacti or mesquite. Grass was much more abundant than in other localities. The adults' agility and their abundance in the two areas with the most grass suggest they climb into the grass and feed on its seeds.

Collecting during the MPM expedition was in January and early February. A few of the specimens from Cajamarca Department were slightly teneral. Ten of the museum specimens seen were also collected during these months and one each also from March and September.

Derivation of specific epithet. The genitive patronym honors my friends Doctor Pedro Aguilar and his son Daniel Aguilar. Pedro Aguilar gave valued advice and assistance in field work in coastal lomas and aided in procurement of Peruvian collecting permits. Daniel Aguilar ably served as field assistant during much of the Peruvian work and collected the first specimens of *N. aguilarorum*.

Geographical Distribution. Members of this species have been taken from semi-desert habitats in the Andes of northern Peru at altitudes from 1490 to 2540 m (Fig. 43). Additional collecting may reveal the species to be present also in the semi-desert coastal areas of extreme northern Peru and southern Ecuador.

Notiobia (Anisotarsus) latiuscula van Emden
(Figs. 12, 18, 32, 51)

Anisotarsus (A.) latiusculus van Emden, 1953: 524, 535-537. Holotype (MCZ), ♂ labeled: "La Plata Argentine Spegezzini"; "1 +" "A. latiusculus Emd., type"; "M.C.Z. Type 30856"; "Anisotarsus cuprip latiusculus n. sp. van Emden det 1938". TYPE LOCALITY: La Platta, Argentina, as originally cited. (La Platta is in Buenos Aires Province.)

Description. Body moderately large, 10 to 16.5 mm long.

Color. Dorsum with frons and pronotum black, greenish black to green, bluish black to blue, bluish green, brassy green, green; elytra as above, with bronzish tinges, or bronze. Venter and legs reddish brown to reddish black. Antennae with scapes reddish yellow to reddish brown;

articles 2 and in some specimens 3 reddish brown to reddish black; articles 3 or 4 to 11 reddish yellow to reddish brown. Palpi reddish yellow to reddish black; apices of articles lighter.

Microsculpture. Dorsum with moderately prominent isodiametric mesh, such mesh slightly to moderately transversely stretched medially on pronotum.

Thorax. Pronotum (Fig. 12) with sides anteriorly arcuate, posteriorly arcuate to straight and convergent; anterior angles slight; posterior angles obtusely rounded and evident to broadly rounded and indistinct; lateral depressions moderate, in most specimens each narrower near anterior angle than maximum width of second antennal article; posterior lateral impressions not sharply defined, somewhat elliptical in shape.

Legs. Posterior margins of hind femora each with 3 or 4 long setae. Tarsal dorsa pubescent.

Elytra. Scutellar striae each with ocellate puncture at origin, moderately long, in many specimens joined distally to striae 1; intervals 3 in most specimens each with setigerous puncture near distal 1/3; intervals 3, 5, 7 respectively with 0 to 3, 0 to 6, 0 to 6 posterior setigerous punctures; subapical sinuations slight; sutural apices rounded.

Hind wings. Fully developed.

Male genitalia. Median lobe (Fig. 18) with apex elongate, narrow; dorsum with smooth lightly sclerotized patch distally on left side of ostium. Everted internal sac (Fig. 32) distally with 2 far separated fields of sparsely distributed macrotrichia.

Variation. Described variation is intrapopulational.

Discussion. Characters states in van Emden's (1953) species key are not sufficiently constant for species identification.

The key distinguishes *N. latiuscula* and *N. schnusei* from *N. cupripennis* on the basis of adult *N. cupripennis* having: pronotal lateral depressions each wider at the anterior angle than width of each second antennal article; prothorax markedly narrower than elytra in general appearance; sutural apices of elytra usually each with spine; median lobe apex less tapered distally; dorsum differently colord. It distinguishes adults of *N. latiuscula* from *N. schnusei* on the basis of the former having: the pronotum less narrowed posteriorly and with the lateral depressions more prominent posteriorly; elytral anterior margins less curved; average body size larger; and dorsal coloration different in some specimens.

Elytral sutural apices lack teeth in all *N. latiuscula* and *N. schnusei* specimens but also in some of *N. cupripennis.* While the apex of the median lobe of many male *N. cupripennis* is less tapered than that of the other two species, specimens of *N. cupripennis* do occur (especially towards the eastern edges of its geographical range) with apices as tapered as in the other forms. The remaining character states vary too much within populations of all three species to be of use in species recognition.

Despite these variations *N. latiuscula* warrants specific rank because its males all have: median lobe lacking the crescent shaped pillow of

spines found under the left ostium flap in the other two species; and everted internal sac distally with two far separated fields of macrotrichia.

Natural History. Adults are probably similar to those of *N. cupripennis* in seasonal periodicity and habitat (see "Natural History" section for that species). Totals of dated specimens seen for each month are: January, 6; March, 1; October, 5; November, 50; December, 16. Among adults from the Montevideo region of Uruguay, three were collected under detritus on the ocean shore, three were taken under detritus on shores (whether of lake, stream, or ocean not specified), and one was taken under rocks. Adults are apparently capable fliers; sixteen specimens from the Montevideo region of Uruguay are labeled as collected at lights.

Geographical Distribution and Material Examined. This species occurs in Uruguay and northeastern Argentina (Fig. 51). In addition to type material I have seen a total of 112 specimens from:

ARGENTINA

BUENOS AIRES PROVINCE: Flores, Nov. 1♀; La Plata, 10♂, 14♀; province only, Jan. 2♂. ENTRE RÍOS PROVINCE: Pronunciamento, Nov. 1♂. SANTE FE PROVINCE: province only, 2♂, 1♀. COUNTRY ONLY: 1♂, 1♀.

URUGUAY

MALDONADO DEPARTMENT: Gorrite Island, off Maldonado, 1♂. MONTEVIDEO DEPARTMENT: Arroyo Malvin, debajo de piedros, Oct. 1♀; Montevideo, Jan. 1♂, 3♀, Oct.-Nov. 1♂, no date 1♂ and 1♀; either city or department, Mar. 1♀, Oct. 1♂ and 1♀ Detr. costa s., Nov. 3♂ 1♀ and 12♂ 14 ♀ á lá lámpara and 1♂ á lá luz electr and 2♂ 1♀ detr. costa s. and 2♀ Detritus orilla del mar, Dec. 2♂ 2♀ and 1♂ á lá luz eléctrica and 8♂ 3♀ á los focos electricos, no date, 6♂ 1♀. LOCATION NOT DETERMINED: Pico, Alg. So. Amer Paras. Lab, Oct. 1♂.

COUNTRY NOT DETERMINED

Calle de la ciudad Con el Pampero, Nov. 5♂, 3♀; La Pampa, Nov. 1♂.

Notiobia (Anisotarsus) cupripennis Germar
(Figs. 5, 20, 33, 39, 40, 41, 49)

Poecilus cupripennis Germar, 1824: 16. Lectotype (MNHB), here designated a ♂ labeled: "3556" — white label with black print; "Brasil" — green label with black handwriting; "cupripennis gm Dej. 77" — green label with black handwriting. Additional label added stating: "LECTOTYPE Poecilus cupripennis Germar By G. Noonan". TYPE LOCALITY: Argentina, Buenos Aires Province, Buenos Aires, as originally cited. NOTES ON TYPE MATERIAL: The type series at MNHB consists of the lectotype and one ♂ and two ♀ paralectotypes from Brazil.

Description. Body moderately large, 12.0 to 18.8 mm long.

Color. Dorsum with frons and pronotum black, greenish black to green, bluish black to blue, bluish green, green; elytra colored same or

brassy green, bronze, or with bronzish tinges. Venter and legs reddish brown to reddish black. Antennae with scapes reddish yellow to reddish brown; articles 2 and in some specimens 3 reddish brown to reddish black; articles 3 or 4 to 11 reddish yellow to reddish brown. Palpi reddish yellow to reddish black; apices of articles lighter.

Microsculputure. Dorsum with moderately prominent isodiametric mesh, except such mesh slightly to moderately stretched transversely on pronotum.

Thorax. Pronotum (Fig. 5) with sides anteriorly arcuate, posteriorly arcuate to straight and convergent; anterior angles slight; posterior angles obtusely rounded and evident to broadly rounded and indistinct; lateral depressions moderate, in most specimens each narrower near anterior angle than maximum width of second antennal article; posterior lateral impressions not sharply defined, somewhat elliptical in shape.

Legs. Posterior margins of hind femora each with 3 or 4 long setae. Tarsal dorsa pubescent.

Elytra. Scutellar striae each with ocellate puncture at origin, moderately long, in many specimens joined distally to striae 1; intervals 3 in most specimens each with 1 setigerous puncture near distal 1/3; intervals 3, 5, 7 each with 0 to 6 posterior setigerous punctures; subapical sinuations slight; sutural apices of most specimens each with spine (Figs. 40, 41) of varied prominence, lacking spine in some specimens (Fig. 39).

Hind wings. Fully developed.

Male genitalia. Median lobe (Fig. 20) with apex moderately elongate, narrow; dorsum with sclerotized pillow of stout spines under left flap of ostium. Everted internal sac (fig. 33) distally with narrow field of macrotrichia.

Variation. Described variation is intrapopulational.

Natural History. Adults are apparently most active during approximately November through February or March, less active March or April through June and in October, and least active July through September. Totals of dated specimens seen for each month are: January, 103; February, 193; March, 31; April, 50; May, 69; June, 47; July, 23; August, 5; September, 13; October, 37; November, 87; December, 143. In the La Plata Region of Argentina adults of *N. cupripennis* and *N. latiuscula* are most abundant during February and March (Mr. Armando Cicchino, UNP, pers. comm.).

Adult seasonal periodicity is probably regulated principally by monthly minimum temperature extremes. Over all of the species' geographical range except possibly mountainous areas of Bolivia, freezing temperatures occur from April or May through September or October, with July or August having the lowest temperatures (Johnson, 1976; Prohaska, 1976; Ratisbona, 1976). Precipitation is probably not an important regulating factor except possibly in Bolivia and northwestern Argentina where it is greatest during the months of maximum adult abundance.

Elsewhere toward the east precipitation becomes greater and more uniformly spread throughout the year until the Atlantic Coast is reached where precipitation is not only moderately uniform but even during the "driest" months is five or six times greater than that of the "driest" months in northwestern Argentina (Johnson, 1976; Prohaska, 1976; Ratisbona, 1976).

Adults occur under debris on the ground and under loose bark on *Eucalyptus* trees. They apparently fly readily; of the specimens seen, 103 are labeled as taken at lights or light traps. In the La Plata Region of Argentina adults of this species and *N. latiuscula* aggregate at night in numbers by lights (Mr. Armando Cicchino, UNP, pers. comm.). Specimens of *N. cupripennis* have been collected from sea level along the Atlantic Coast to 4000-5000 m in the Bolivian Andes.

Geographical Distribution and Material Examined. This species occurs in Argentina north of 42° S, Bolivia, Brazil south of approximately 23° S, Paraguay, and Uruguay (Fig. 49). In addition to type material I have seen a total of 1201 specimens from:

ARGENTINA

BUENOS AIRES PROVINCE: Acassuso, My. 2♀; Ajo, Jly.-Sept. 2♂, 5♀; Azul, Jan. 1♂; Carhué, Dec. 1♂; Buenos Aires, Jan. 2♂, Mar. 1♀, Jun. 1♀; Oct. 1♂ & 3♀, Nov. 1♀, Dec. 2♂, no date 2♂ & 2♀; 39-40 km SE Buenos Aires on rd. to La Plata, under loose bark on live *Eucalyptus* trees ca. 12-50 cm above ground, ca. 20 m, Ap. 1♀; Isla Martin Garcia, Ap. 2♂; Isla de Santiago nr. La Plata, Ap. 1♀; Junín, Jun. 1♀; La Plata, Jan. 10♂ & 5♀, Feb. 4♂, Jun. 3♂ & 1♀, Nov. 1♂, Dec. 2♂ & 3♀, no date 11♂ & 15♀; Mar del Plata, Jan. 1♂; Olivos, Nov. 9♂, 1♀; Parque Pereyra Iraola, under bark, My. 22♀; Rió Paraná Guazu, 1♂; Rió Salado, 2♂; San Fernando, 6♂, 4♀; Tandil, Feb. 2♂, 4♀; Temperley, Ap. 1♂; Zelaya, June. 3♂ & 1♀, no date 4♂ & 2♀; either city or province, Jan. 1♂, Feb. 1♂, no date 2♂ & 1♀. CATAMARCA PROVINCE: Villa El Alto, 950 m, Dec. 5♂, 7♀. CHACO PROVINCE: Roque Sáenz Peña, 1♂; Santafecina, Colonia, Aug. 4♂, 8♀; CORDOBA PROVINCE: Agua de Oro, Jan. 1♂, 1♀; Alta-gracia, Jan. 1♂, Oct. 8♂ & 6♀; Arguello, Nov. 1♂; Bialet-Massé, Oct. 1♀; near Cosquín, Sept. 2♂, 1♀; 8.1 km N Déan Funes, Feb. 1♀; La Falda, 3♂, 4♀; Manfredi, Dec. 3♂, 2♀; Río Ceballos, Jan. 2♂, 1♀; San Francisco, 5♂; Villa Valeria, Dec. 2♂, 1♀; Estancia Zelegua, Dec. 1♂ & 1♀; either city or province, Feb. 1♂ & 3♀, Ap. 1♂ & 1♀, Dec. 1♂, no date 12♂ & 22♀. ENTRÉ RIOS PROVINCE: Gualeguay, Dec. 1♂; Pronunciamento, Aug. 1♀, Oct. 1♂ & 3♀, Nov. 13♂ & 19♀. JUJUY PROVINCE: Palma Sola, Sept. 1♀; Palpá, Nov. 1♂, 1♀; San Rafael, Sept. 1♂; Santa Catalina Department, Escuela Agron., 3♂, 3♀; Santa Catalina Department, Escuela Reg., Ap. 8♂ & 11♀; 4.8 km S. Volcan, 200 m, Feb. 22♂, 28♀. LA PAMPA PROVINCE: Loma Negre, My. 1♂. LA RIOJA PROVINCE: Chamical, Dec. 1♀; Patquía, 2♂, 2♀; province only, 3♂. MENDOZA PROVINCE: Cerro Largo, Coñada de los Burros, 6♀; either city or province, Feb. 1♂ & 1♀, no date 1♂ & 11♀. MISSIONES PROVINCE: Frontera Department, My. 3♀. RÍO NEGRO PROVINCE: San Javier, Dec. 1♂; Villa Regina, Jan. 3♂; SAN JUAN PROVINCE: either city or province, 1♀. SALTA PROVINCE: Aguaray & Tartegal, Oct. 2♂, 2♀; Cabeza de Buey, My. 7♂, 12♀; Cafayate Department, Quebrada de Yacochuva, Dec. 4♂, 1♀; Cafayete Department or city, desierto 1♂ & 2♀, Dec. 5♂ & 3♀; Embarcacion, 1♀;

General Ballivián, Feb. 2♂ & 2♀, Mar.-Ap. 1♂, Aug. 3♂ & 1♀, Dec. 1♂; Juramento, 25° S, 65° W, Jan. 3♂, 3♀; 2 mi S Lumberas, Feb. 3♂, 1♀; Río Salta, at light, Oct. 1♂; Salta, Nov. 1♂; Tabacal, Jun. 2♂; either city or province, Feb. 2♀, Jun. 10♂ & 5♀, no date 13♂ & 11♀. SAN LUIS PROVINCE: province only, 1♂, 2♀. SANTA FE PROVINCE: Arroyo Canelones, 1♂, 2♀; Estancia la Noria, Río San Javier, Dec. 1♂; Garzas, 1♀; Rosario, Jan. 1♀; Río Salado, Mar. 4♂, 3♀; Villa Ana, Jan. 1♀; either city or province, Feb. 1♂, no date 8♂ & 4♀. SANTIAGO DEL ESTERO PROVINCE: Chaya, Oct. 1♂; Frías, in decayed cactus, My. 9♂, 7♀; Pinto, Nov. 1♀; Río Salado, 1♂, 2♀; Santa Felisa, Aug. 1♂; either city or province, Nov. 1♂, Dec. 1♂, no date 3♂. TUCUMÁN: Burruyacú, Jan. 1♂; Conception, 1♂; Crest Ridge N.W. Tucumán, Feb. 4♂, 1♀; Güemes, Jan. 1♀; Horco Molle & vic., 900-1150 m, wet myrtaceous for., Jan. 1♂; La Banderita, Dec. 1♀; Monte Bello, Jan. 1♂; Quebrade de Lules, Feb. 2♂, 1♀; Río Medina, 140 m, 26° S, 65° W, Jan. 2♂, 1♀; Río Sali, Jan. 1♂; San Miguel de Tucumán, garden of Inst. M. Lillo Jan.-Feb. 1♂ & Mar. 1♂; Siambón, Dec. 2♂, 2♀; Tafí del Valle, lights, Jan. 2♀, & 2000 m rocky pasture Jan. 2♂ & 2♀; Tacanas, Feb. 2♂; province only, Jan. 1♂, Feb. 17♂, 16♀, Mar. 3♂, 1♀, Ap. 1♀, collected at light, My. 1♂, Oct. 1♂, Nov. 1♂, Dec. 13♂ & 24♀ to light 1♂ & 1♀, no date 8♂ & 7♀. LOCATION NOT DETERMINED: Canelones (Pando), Sept. 1♂; Cerro Largo (Cuch de Melo), Feb. 2♂, 1♀; Choscomus, 2♂; El Algarrobal, Jul. 5♂, 5♀; Pico, 1♂; Pilar, 1♀; Río Negre (Menatra), Nov. 1♂; Río Saliedo, 3♂, 1♀; Soriano (Mercedes), Ap. 3♂, 2♀. COUNTRY ONLY: 8♂, 11♀.

BOLIVIA

CHUQUISACA DEPARTMENT: 25.8 km N Camargo, Feb. 1♂; Parapiti Valley bet. Lagunillas & Yhancoiranza, Oct. 1♂, 1♀; Tacuari, 1♀; Yhancaroinza, Ap. 1♂. COCHABAMBA DEPARTMENT: Carrasco-Comparapa, 1700 m, Jan. 1♂, 4♀; Aguirre, 3500 m, Nov. 1♀; Cerro Tunari, 4000-5000 m, Jan. 2♂ & 6♀, Nov. 1♂; 81 km SE Cochabamba, under stones, Ap. 3♂, 11♀; either city or province, 2800 m & Jan. 2♂ & 2♀, Jan. 3♂ & 4♀, 3500 m Mar. 1♂ & 3♀, 2500 m Mar. 2♂, 2600 m Sept. 1♀, 2600 m Nov. 1♂ & 1♀, Nov. 3♂ & 1♀, 2400 m Dec. 15♂ & 7♀, Dec. 12♂, 2700 m no date 2♂, 2600 m no date 1♂, no date 4♀. LA PAZ DEPARTMENT: Agua Caliente, 3500 m Mar. 1♂, 3300 m Mar. 1♂ & 1♀. POTOSI DEPARTMENT: 64.5 km S. Potosi, Feb. 5♂, 5♀; 80.6 km N Potosi, Feb. 1♂. SANTA CRUZ DEPARTMENT: Boyuibe to Charagua via Cueva Ingr, etc., Jul.-Sept. 1♀; Boyuibe, Oct. 1♂; Cambeiti, Oct. 1♀; Charagua, Jul. 1♂, 2♀, no date 1♀; 4 km SE Comparapa, est. 1700 m, at night, Mar. 4♂, 2♀; Embarcacion, Tartegal, My. 1♀; 48.4 km S El Puente, Feb. 2♂, 1♀; Loa Huesos, 1♀; Santa Cruz, at light Jan. 2♂ & 2♀, Feb. 3♂ & 5♀, Dec. 2♀, no date 1♂, 2♀; 25 km NE Santa Cruz, under debris cotton field Dec. 2♂ & 2♀; 40 km N Santa Cruz, Farm Chocquette, at light Feb. 22♂ & 21♀, black light Jun. 12♂, 20♀; Tatarenda, Oct. 2♂; Villa Montes to Boyuibe, Jul. 1♀; either city or province, Feb. 1♂. LOCATION NOT DETERMINED: Guairui, Sept. 2♀; 8.1 km N Ichcachi S. Bolivia, Feb. 2♂, 3♀. COUNTRY ONLY: 3♂.

BRAZIL

RIO GRANDE DO SUL STATE: Pelotas, Jan. 3♂, Mar. 1♂ & 1♀, Oct. 1♂, Nov. 8♂ & 5♀, Dec. 3♂ & 3♀, no date 3♀; Rio Grande, 2♀; Saõ Francisco de Paula, Jan. 2♂ & 1♀, Feb. 1♂& 2♀; province only 2♂ & 2♀; province only 2♂, 2♀. SANTA CATARINA STATE: Mafra, 780 m, Dec. 1♀, no date 1♂: Nova Teutonia, 300-

500 m Jan. 2♂, Oct. 1♂, Nov. 1♀; province only, 2♂, 3♀. SÃO PAULO STATE: either city or state, Sept. 1♂, 1♀. LOCATION NOT DETERMINED: Pelotas, Jan. 1♀. COUNTRY ONLY: 2♂, 2♀.

CHILI

1♂, 1♀.

PARAGUAY

CONCEPCÍON DEPARTMENT: vic. Horqueta, 1♂. LOCATION NOT DETERMINED: Chaco, Nov. 2♂, 2♀.

URUGUAY

CERRO LARGO DEPARTMENT: department only, Aug. 2♂, 1♀. MALDONADO DEPARTMENT: Gorritte I., off Maldonado, 1♂, 3♀; Zanja del Tigre SW 27, 1♀. MONTEVIDEO DEPARTMENT: Colon, Feb. 2♂ & 2♀, My. 2♂ & 2♀; Mercedes, So. Amer. Paras. Lab., Oct. 1♂; Montevideo (Pocitos section), Jan. 1♂; Prodo, Feb. 1♂, Ap. 1♀; either city or department, luz eléctrica Nov. 3♂, Nov. 1♂, no date 9♂ & 3♀. PAYSANDÚ DEPARTMENT: Paysandú, Feb. 1♂. CITIES LOCATED BUT DEPARTMENT NOT KNOWN: Lascano & Rocha, Feb. 1♀.

SOUTH AMERICA, COUNTRY NOT GIVEN

1♂, 2♀.

UNITED STATES, PRESUMABLY ON OR NEAR FREIGHTERS FROM SOUTH AMERICA

NEW YORK STATE: Brooklyn, My. 1♀; New York, on packing (grape) Argentina-New York, Ap. 1♂.

Notiobia (Anisotarsus) schnusei van Emden
(Figs. 6, 19, 36, 37, 47, 70)

Anisotarsus schnusei van Emden, 1953; 524, 537-538. Holotype (MCZ), ♂ labeled: "Puno Peru"; "A. schnusei Emd. type"; "Anisotarsus schnusei n. sp. van Emden det. 1938"; "M.C.Z. Type 30857". TYPE LOCALITY: Puno, Peru originally cited, this "Puno" is here regarded as referring to the town of Puno in the Department of Puno.

Description. Body moderately large, 10.8 to 15.5 mm long.

Color. Dorsum with frons and pronotum black, greenish black to green, bluish black to blue, bluish green; elytra colored same, brassy green, bronze, or with bronzish tinges. Venter and legs reddish brown to reddish black. Antennae with scapes reddish yellow to reddish brown; articles 2 and in some specimens 3 reddish brown to reddish black; articles 3 or 4 to 11 reddish yellow to reddish brown. Palpi reddish yellow to reddish black; apices of articles lighter.

Microsculpture. Dorsum with moderately prominent isodiametric mesh, except such mesh slightly to moderately transverse medially on pronotum.

Thorax. Pronotum (Fig. 6) with sides arcuate anteriorly, posteriorly arcuate to straight and convergent to posterior angles; anterior angles slight; posterior angles obtusely rounded and evident to broadly rounded and indistinct; lateral depressions slight to moderate, in most specimens each narrower near anterior angle than maximum width of second antennal article; posterior lateral impressions not sharply defined, somewhat elliptical in shape.

Legs. Posterior margins of hind femora each with 3 or 4 long setae. Tarsal dorsa pubescent.

Elytra. Scutellar striae each with ocellate puncture at origin, moderately long, joined distally to striae 1 in many specimens; intervals 3 in most specimens each with 1 setigerous puncture near distal 1/3; intervals 3, 5, 7 respectively each with 0 to 4, 0 to 4, 0 to 7 posterior setigerous punctures; subapical sinuations slight; sutural apices rounded.

Hind wings. Fully developed.

Male genitalia. Median lobe (Fig. 19) with apex elongate, moderately tapered distally; dorsum with sclerotized lobe of stout spines under left ostium flap. Everted internal sac (Figs. 36, 37) distally with two confluent fields of macrotrichia.

Variation. Described variation is intrapopulational.

Discussion. The characters van Emden (1953: 524, 537-538) used to distinguish *N. schnusei* from *N. cupripennis* are more variable than he realized. The only ones constant enough for distinguishing *N. schnusei* are armature of the internal sac of the male median lobe, and presence or absence of spines on the apices of the elytral sutures. In males of *N. cupripennis* the everted internal sac has a single narrow field of macrotrichia (Fig. 33) while in males of *N. schnusei* there are two confluent fields (Figs. 36, 37). Possibly these confluent fields arose by a simple gene mutation approximately doubling the narrower single field of males of *N. cupripennis.* In *N. cupripennis* the apices of the elytral sutures each vary from lacking spines to having a prominent spine (Figs. 39-41). Most specimens have at least a slightly developed spine. All adults of *N. schnusei* lack spines on the apices of the elytral sutures.

Van Emden (1953:538) expressed doubts as to whether *N. schnusei* should be ranked as a subspecies of *N. cupripennis* but ranked it as a separate species. Until intensive field studies can be done, it seems best not to change the ranking of *N. schnusei.*

Natural History. The few dated adults seen do not show a clear pattern of seasonal periodicity. Totals of dated specimens seen for each month are: February, 20; March 1; April, 11; June, 2; July, 55; August, 1; November, 45; December, 17. Seven of the November specimens were teneral. Further collecting may show that seasonal periodicity varies according to local climatic conditions (such as rain shadows and temperature extremes determined by altitudinal and seasonal factors).

During a total of approximately eight hours of collecting on April 4 and 5 we turned thousands of rocks in flat and hilly areas near the town of Puno, Peru but found only four specimens, in fields with fruiting grasses

and small xeric shrubs. Three were under rocks at the edge of a drainage pipe and one was under a rock in a flat area (Fig. 70) where water drained from surrounding hills. Soil under and immediately around these rocks was moist while soil in most of the surrounding countryside was dry to slightly moist in the top seven to thirteen cm. Flat areas in the Puno Region had scattered ponds. Residents stated that the rainy season was over, and that the ponds would soon evaporate. My impression was that *N. schnusei* adults were either uncommon in the Puno area or that most were already underground in dry season retreats. The Puno Region receives less precipitation than most more northern Andean localities with *Anisotarsus,* and this precipitation is more restricted to the rainy season. Eighty-eight per cent of the Puno area precipitation falls between November and April, and the countryside becomes very dry during the other months. (Johnson, 1976; Sick, 1969; pers. comm. from residents.)

Notiobia schnusei has been found at altitudes from 2600 to 4500 m.

Geographical Distribution and Material Examined. This species occurs on the Altiplano of south eastern Peru and north western Bolivia and along the eastern flanks of that altiplano in Bolivia (Fig. 47). In addition to type material I have seen a total of 209 specimens from:

BOLIVIA

COCHABAMBA DEPARTMENT: department only, Mar. 1♀. LA PAZ DEPARTMENT: Ancapata, 5♂, 2♀; Calacoto, 3100 m, Dec. 1♂; Chijmuni, Ap. 2♂; Lake Titicaca, Ap. 1♂ & 1♀, 3800 m Jun. 1♂ & 1♀; La Paz, Feb. 2♂; Nevado Illinani, 4500 m, Feb. 7♂, 5♀; Pongo de Quime, 10,000 ft. Jul. 37♂ & 39♀, no date 2♂; Sorata, Feb. 4♂; Suri, 5♂; Tiahuanaco, Nov. 6♂ & 6♀, Dec. 1♂ & 3♀; Titicas, Huatajata, ca. 4000 m, Aug. 1♂.

PERU

PUNO DEPARTMENT: Chamacani, 3700 m Nov. 8♂ & 5♀, 3500 m Nov. 10♂ & 4♀, 3100 m Nov. 3♂ & 3♀; Puno, 3900 m Feb. 11♂ & 6♀, Ap. 3♂, Jul. 1♂, 1♀; Puno, Lago Titicaca 3850 m Dec. 8♂ & 3♀; 8.7 km NW Puno on rd. to Juliaca, 3910 m, Ap. 1♂, 2♀; 34.1 km NW Puno parallel to rd. to Juliaca, 3860 m, Ap. 1♀; either city or department, 4♂, 1♀.

The *mexicana* group

Included are the South American *N. chalcites* and *N. praeclara,* the Mexican *N. lamprota* and the North and Central American *N. mexicana.* Adults share a thick and prominent pronotal lateral bead. The two South American species have males with apices of the median lobe elongate, and in both sexes have bodies longer than 11 mm.

Notiobia (Anisotarsus) chalcites Germar
(Figs. 1, 2, 17, 48)

Poecilus chalcites Germar, 1824: 15-16. [not *Feronia chalcites* Say, 1823] Lectotype (MNHB), here designated, a ♂ labeled: "3557" — white label with black print; "Bras. Langsdorf" — green label with black

handwriting; "EUCHROUS Zim." — white label with brown hand printing; "amesthyina mus Dej. 78". — green label with black handwriting. Additional label added stating: "LECTOTYPE Poecilus chalcitis Germar By G. Noonan." TYPE LOCALITY: Brazil as originally cited. NOTES ON TYPE MATERIAL: The type series at MNHB consists of the lectotype and two female paralectotypes labeled as from Brazil. All three specimens have the morphological characteristics van Emden (1953) ascribed to *Harpalus amethystinus* rather than those he ascribed to *Poecilus chalcites.* The three specimens of *P. chalcites* at MNHB are part or all of the original type series (F. Hieke, MNHB *in litt.).* Probably another worker added to the lectotype the label stating "amesthyina mus Dej. 78." Nomenclatural stability is best served by designating the male as the lectotype of *P. chalcites.*

Harpalus amethystinus Dejean, 1829: 285-286. Holotype (MNHP), ♂ labeled: "♂"; "amethystinus. m in Brasilia".; "D. Latreille?"; "Ex Musaeo Chaudoir." (First three labels are green with black hand printing; fourth is white with red print.) TYPE LOCALITY: Brazil as originally cited. NEW SYNONYMY. NOTES ON TYPE MATERIAL: Dejean (1829) had only the holotype when he described the species.

Harpalus cupreonitens Dejean, 1829: 287-288. Lectotype (MNHP), here designated, a ♂ labeled: "♂"; "cupreonitens. Sturm in Brasilia."; "Ex. Musaeo Chaudoir". (First two labels green with black ink and third white with red ink.) Additional label added stating: "LECTOTYPE Harpalus cupreonitens Dejean By G.R. Noonan." TYPE LOCALITY: Brazil as originally cited. NOTES ON TYPE MATERIAL: Although the original description was based on several specimens, only the lectotype at MNHP can be identified as part of the type species.

Harpalus fulgens Dejean, 1829: 286-287. [not *Harpalus fulgens* Csiki, 1932] Lectotype (MNHP), here designated, a ♂ labeled: "♂"; "fulgens. m. in Brasilia"; "Ex Musaeo Chaudoir". (First 2 labels are green with black ink; third is white with red ink.) TYPE LOCALITY: Brazil as originally cited. Additional label added stating: "LECTOTYPE Harpalus fulgens Dejean by G.R. Noonan." NOTES ON TYPE MATERIAL: The original description was based on several specimens. The lectotype is the only specimen in the chaudoir collection with the name "fulgens" on it.

Harpalus violaceus Perty, 1830: 13. Type series apparently lost or misplaced (G. Scherer, ZSBS, *in litt.*). TYPE LOCALITY: "ad. fluv. S. Francisci" in Brazil, originally cited. Van Emden (1953) cited this as being in the state of Minas Gerais. The type locality apparently refers to the Rio Saõ Francisco which flows northwards from that state and through Bahia and Pernambuco. I have not seen specimens of *N. chalcites* from the latter two states, and the type locality probably is in Minas Gerais. NOTES ON TYPE MATERIAL: The original descrip-

tion cites a range in body length and is thus based on more than one specimen. Since the type series might be merely misplaced, it seems best not to designate a neotype and instead follow van Emden (1953) in treating *Harpalus violaceus* as a junior subjective synonym.

Description. Body moderate to large in size, 12 to 16.2 mm long.

Color. Dorsum of most specimens purple to purplish black, in some specimens greenish purple, bronzish green, bronze. Venter reddish brown to reddish black or black. Legs reddish brown to reddish black, black, reddish purple. Antennae reddish yellow to reddish brown. Palpi reddish yellow to reddish brown.

Microsculpture. Dorsum with moderate to prominent isodiametric mesh on frons, pronotal margins & elytra; lacking mesh or with weak isodiametric mesh or irregular or transversely stretched mesh medially on pronotal disc.

Thorax. Pronotum (Figs. 1, 2) with sides straight to sinuate immediately anterior to posterior angles; anterior angles slight; posterior angles in most specimens prominent and slightly obtuse to acute and dentate, in a few specimens somewhat rounded; lateral beads thick & prominent, except moderate (but still thicker than in non *mexicana* group species) in Peruvian and some Bolivian specimens; lateral depressions slight; posterior lateral impressions varied.

Legs. Posterior margins of hind femora each with 1 long seta opposite and 1 long seta distal to trochanter. Tarsal dorsa pubescent.

Elytra. Scutellar striae each with ocellate puncture at origin, moderate to long, in some specimens joined distally to striae 1; intervals 3, 5, 7 respectively each with 0 to 2, 0 to 2, 0 to 8 posterior setigerous punctures; intervals 3 each with or without setigerous puncture near distal 1/3; subapical sinuations slight to moderate.

Hind wings. Fully developed to vestigal.

Male genitalia. Median lobe (Fig. 17) with apex narrow, elongate, in some specimens sinutae laterally. Everted internal sac lacking macrotricha.

Variation. Specimens from Argentina, Brazil and Paraguay have pronota with very prominent lateral beads and typically have (Fig. 1) prominent obtuse to actue and dentate posterior angles. The lateral beads and posterior angles are less prominent in Bolivian specimens. The seven Peruvian specimens have pronota with more rounded posterior angles and lateral beads only slightly thicker than in *N. peruviana* (Fig. 2). Peruvian and to a lesser extent Bolivian specimens tend to have somewhat more greenish or brassy green dorsa. Larger series of specimens are needed to determine whether presence or absence of a dorsal setigerous puncture near the distal 1/3 of the third elytral interval is intrapopulational or interpopulational variation. Variation in other characters studied is intrapopulational.

Discussion. Van Emden (1953) distinguished adults of *N. amesthystina* from those of *N. chalcites* by the former having: pronotum anteriorly less convex, anterior angles farther from head, and the posterior margin

emarginate; elytral anterior margin more curved; hind wings fully developed; median lobe apex not sinuate laterally; and third elytral intervals each with setigerous puncture at approximately distal 1/4. All of these characters vary independently. This variation is clearly intrapopulational for all characters except presence or absence of the setigerous puncture on the third elytral interval: This character varies intrapopulationally in other South American *Anisotarsus* and does not warrant retention of specific rank for *N. amethystina.*

Natural History. Adults are apparently most active during approximately September through December and least active during approximately late April through June. Totals of dated specimens seen for each month are: January, 13; February, 17; March, 26; April, 17; May, 7; June, 5; July, 34; August, 15; September, 43; October, 31; November, 39; and December, 60. Teneral specimens were seen from February, March, May, June, July, and October through December. Adult seasonal periodicity in southern and Andean parts of the species geographical range may be mediated by monthly minimum temperature extremes as discussed for *N. cupripennis.*

Notiobia chalcites has been taken at altitudes ranging from approximately sea level to 300 m in Brazil, to at least 1700 and possibly above 3000 m in Bolivia, and from approximately 2000 to 2500 m in southern Peru. One female from Horco Molle, Tucuman, Argentina is labeled as from a wet subtropical forest, and three males and three females are from a subtropical canyon 40 miles west of Cuzco, Peru. Several Brazilian localities where this species occurs are moist, warm temperate to subtropical and forrested.

Geographical Distribution and Material Examined. This species occurs from the southern coastal plateaus of Brazil through the Paraguayian plateaus and into the Bolivian and southern Peruvian highlands (Fig. 48). In addition to type material I have seen a total of 446 specimens from:

ARGENTINA

CATAMARGA PROVINCE: province only, Dec. 1♀. CORDOBA PROVINCE: Coronel Olmedo, Dec. 1♀. JUJUY PROVINCE: El Quemado, Ap. 2♀; Hignerites (or Higuerites; label difficult to read), Aug. 1♂; Santa Clara, Sept. 3♂. MISSIONES: Campo Grande, Dec. 1♂; Dos de Mayo, 300 m Feb. 2♂ & 1♀, Mar. 1♀, Sept. 3♂ & 2♀, Oct. 1♀, Nov. 3♂ & 2♀, Dec. 3♂ & 3♀; San Pedro Departamento, Ap. 3♀. TUCUMÁN PROVINCE: vic. Horco Molle, wet subtropical forest, 750-900 m, Jan. 1♀; Puerta Quemada, Nov. 1♀; Siambon, Oct. 1♂, Dec. 3♂ & 1♀; Tafi del Valle, Ap. 1♀; Tina, Ap. 1♀; province only, Feb. 1♀.

BOLIVIA

CHUQISACA DEPARTMENT: Taperilla, Jul. 1♂, 1♀. LA PAZ DEPARTMENT: Río Beni, 1♂, 1♀; Río Mapiri, Sept. 1♂; Suri, Jul. 1♂, 2♀; Tocoroni, My. 1♀. SANTA CRUZ DEPARTMENT: Tatarenda, Oct. 1♀. YUNGAS REGION: Puente Villa, 1700 m, Dec. 8♂, 5♀; region only, 1♂. LOCATION NOT DETERMINED: Pongo de Quime, Jul. 2♂; Lagunillas, Aug. 1♀.

BRAZIL

DISTRITO FEDERAL: Brasilia, 1♀. GOIÁS STATE: state only, 1♂. MINAS GERAIS STATE: Lambray, Nov. 1♂; Pocinhos do Río Verde, Oct. 1♀; Uberaba, 1♀; Vicosa, Sept.-Oct. 1♀; state only, Dec. 1♂. PARANÁ STATE: Rolândia, Dec. 2♂, 2♀. RIO GRANDE DO SUL STATE: state only, Dec. 2♂, no date 3♂, 6♀. RIO DE JANEIRO STATE: either city or state, 2♂. SANTA CATHARINA STATE: Hansa Humboldt, Jun. 1♀, no date 4♂ & 3♀; Itapiranga, Feb. 2♂ & 4♀, Oct. 3♂; Mafra Hochland, 800 m, 2♂ & 1♀; Nova Teutonia, 300-500 m, Jan. 3♂ & 2♀, Feb. 5♂ & 1♀; Mar. 5♂ & 6♀; Ap. 2♂ 7♀; My. 3♂ & 3♀; Jun. 2♂ & 2♀; Jul. 18♂ & 9♀; Aug. 5♂ & 8♀; Sept. 19♂ & 14♀; Oct. 20♂ & 24♀; Nov. 13♂ & 17♀; Dec. 8♂ & 7♀; no date 23♂ & 20♀; state only, Oct. 5♂ & 3♀, no date 1♂ & 3♀. SÃO PAULO STATE: Batatais, Oct. 1♀; Cantáreira, Mar. 1♀, Oct. 1♂, Nov. 1♀; Magi das Cruzes, Jan. 1♂, Dec. 1♀; Marilla, Nov. 1♂; San Jose dos Campos, Oct. 5♂, 4♀; S. Miguel, Jan. 1♂, 1♀; São Paulo, Feb. 1♂, Mar. 1♂, Ap. 1♂, no date 1♂; Tremembé, Jan. 1♀; Ypiranga Lange de Morretes, Dec. 1♂; province only, Mar. 1♀, Dec. 1♂, no date 3♂ & 3♀. LOCATION NOT DETERMINED: Irpiranga, Jan. 1♂; Pernmburco, Jan. 1♂; Ypiranga, Dec. 1♀. COUNTRY ONLY: 10♂, 7♀.

PARAGUAY

ALTO PARANÁ DEPARTMENT: Puerto Bertoni, 2♂, 1♀. CORDILLERA DEPARTMENT: Nueva Italia, 1♂. ITAPÚA DEPARTMENT: Colonia Fram, Dec. 1♀. LOCATION NOT DETERMINED: Can Guaza Colonia Sommerdelos, Mar. 1♂, 2♀; Region Caa-Guako, Mar. 2♂; vic. Horqueta, Jan. 1♀, Ap. 1♂.

PERU

APURIMAC DEPARTMENT: Río Pampas (Hyw. 7), Mar. 2♀. CUZCO DEPARTMENT: 64.5 km W Cuzco, subtropical cyn, Mar. 3♂, 3♀.

COUNTRY NOT DETERMINED

Chapada, Sept. 1♂; Espir. Sant, 1♀.

SPECIMEN PRESUMABLY MISLABELED OR TAKEN FROM FREIGHTER IN PORT

CANADA: Anisocactylus sp., 1497 [presumably a code], Oct. 1♂.

Notiobia (Anisotarsus) praeclara Putzeys
(Figs. 4, 23, 35, 45)

Notiobia praeclara Putzeys, 1878: 71. Lectotype (IRSNBB), here designated, a ♂ labeled: "Amer. bor. (Say) M. Leyde." — green handwritten label; purple label whose upper half has machine print stating "Coll. R. I. Sc. N. B. Colombia:" and whose lower half has glued on it a green handwritten label stating "Not. praeclara Putz Col. (Cundimarca)"; "Soc. Ent. Beig Coll. Putzeys" — white label with black line around it and machine print; "det. Putzeys: Notiobia praeclara Putz" — white label with "det." machine printed and remainder

handwritten; "Syntype" — white label with red line around it and red machine print. Additional label added stating: "LECTOTYPE Notiobia praeclara Putzeys By G. Noonan". TYPE LOCALITY: Cundimarca Province, Colombia as originally cited. NOTES ON TYPE MATERIAL: Putzeys said his species description was based on two specimens.

Description. Body moderately large for South American *Anisotarsus,* 14.6 to 14.8 mm long.

Color. Dorsum with head and pronotum green to purplish blue; elytra brassy green to coppery. Venter reddish brown to reddish black. Legs reddish brown to reddish black, black. Antennae with articles 1 to 3 reddish yellow, yellowish brown, brown to black. Palpi reddish brown.

Microsculpture. Dorsum laterally with isodiametric mesh; elsewhere with weak irregular mesh.

Thorax. Pronotum (Fig.4) with sides arcuate anteriorly, straight and convergent posteriorly; anterior angles slight; posterior angles obtusely rounded; lateral beads thick & prominent; lateral depressions weak, narrow; posterior lateral impressions irregularly shaped.

Legs. Posterior margins of hind femora each with 1 long seta opposite and 1 long seta distal to trochanter. Tarsa dorsa pubescent.

Elytra. Scutellar striae each with ocellate puncture at origin, moderate in length; intervals 3, 5, 7 respectively each with 0 to 1, 0 to 1, 2 to7 posterior setigerous punctures; intervals 3 lacking setigerous puncture near distal 1/3; subapical sinuations moderate; sutural apices rounded.

Hind wings. Fully developed.

Male genitalia. Median lobe (Fig. 23) with apex narrow, elongate. Everted internal sac (Fig. 35) short and broad, with field of macrotrichia distally.

Geographical Distribution and Material Examined. The species occurs in the Colombian Andes (Fig.45). In addition to the lectotype I saw three males (MNHP and MCZ) labeled as from Colombia. Van Emden (1953) examined specimens labeled as from Cundimarca Province, Colombia and one labeled as from Bogota, which is in Cundimarca Province.

The *peruviana* group

Included are *N. peruviana, N. bradytoides,* and *N. moffetti.* Members of the first species are adapted both to lowland and Andean environments and those of the other two exclusively to Andean habitats.

Notiobia (Anisotarsus) peruviana Dejean
(Figs. 9-11, 25-27, 29-31, 42, 53-56, 63-69)

Harpalus peruvianus Dejean, 1829: 289-291. Lectotype (MNHP), here designated, a ♂ labeled: "S. Lorenzo"; "Ex Musaeo Chaudoir". Additional label added stating: "LECTOTYPE Harpalus peruvianus

Dejean, 1829 By G. Noonan 1973". TYPE LOCALITY: "Santo-Lorenzo", Peru originally cited, here regarded as referring to Isla San Lorenzo, Lima Department, Lima Province, which lies approximately 5 kilometers offshore from the city of Lima. NOTES ON TYPE MATERIAL: Dejean, 1829: 291 stated he had several specimens from "SantoLorenzo". The Chaudoir collection contains several specimens by a label (pinned into the specimen box) with the name "*Harpalus peruvianus*", but only the lectotype bears a "S Lorenzo" locality label.

Anisodactylus elatus Erichson, 1847: 70. Type apparently lost (F. Hieke, *in litt*), see discussion. TYPE LOCALITY: Peru, as originally cited. NEW SYNONYMY.

Anisotarsus (A.) margaretae van Emden, 1953: 523, 532-533. Holotype (BMNH), a ♂ labeled: "Type"; "C. d. Pasco Peru 4000 mtr."; "24. 72. 33 von Grete"; "A. margaretae Emd. type"; "F. van Emden Bequest B.M. 1960-129". *TYPE LOCALITY:* Cerro de Pasco, Pasco Department, Peru, as originally cited. NEW SYNONYMY.

Anisotarsus (A.) stubeli van Emden, 1953: 523, 533-534. Holotype (BMNH), a ♀ labeled: "Type"; "Bowring 63.47*"; "2323"; "Quito"; "A. stubeli Emd., type" — red label with black handwriting; "Anisotarsus stubeli sp. n. van Emden det. 1950". *TYPE LOCALITY:* Quito (Quito Province), Ecuador, as originally cited. NEW SYNONYMY.

Description. Body length 6.4 to 13.6 mm.

Color. Dorsum with clypeus yellow, reddish yellow, reddish brown, reddish black to black, green, blue, or purple; remainder of dorsum green, brassy green, bronzish green, bronze, greenish blue, blue, violet, purple, dark purple, black, greenish black. Venter reddish brown to reddish black. Antennae with scapes reddish yellow to black; articles 2 to 3 or 2 to 4 reddish yellow to dark reddish brown; articles 3 or 4 to 11 same color as previous or slightly lighter or darker. Palpi reddish yellow to reddish brown.

Microsculpture. Dorsum with moderate to prominent isodiametric mesh laterally, mesh absent, weak, or irregular to prominent and isodiametric medially.

Thorax. Pronotum (Figs. 9-11) with sides arcuate anteriorly, posteriorly arcuate to straight and strongly convergent; anterior angles slight; posterior angles obtusely rounded; lateral depressions indistinct; posterior lateral impressions absent to shallow & irregularly shaped.

Legs. Posterior margins of hind femora each with 2 to 5 setae. Tarsal dorsa glabrous to pubescent.

Elytra. Scutellar striae short to long and in most specimens each with ocellate puncture at origin; intervals 3 each with or without 1 setigerous puncture near distal 1/3; intervals 3, 5, 7 respectively each with 0 to 5, 0 to 10, 0 to 18 posterior setigerous punctures; subapical sinuations absent to slight; sutural apices rounded to slightly angulate.

Hind wings. Varied from fully developed to vestigial.

Male genitalia. Median lobe (Figs. 25-27) with apex short and broad to moderately long. Everted internal sac (Figs. 29-31) distally with field of macrotrichia and proximally near ostium with or without field of macrotrichia.

Variation. This species has patterns of variation important in elucidating present and past refugia and centers of differentiation in the Andes of Ecuador and Peru and the coastal lomas of Peru. This variation is therefore fully described in Part II.

Discussion. Van Emden (1953) apparently had only a small series of *N. peruviana* and thus did not recognize the complex patterns of geographical and intrapopulational variation characterizing the species. He distinguished *N. elata* on the basis of its adults having: characteristic pronotal shape; mandibles colored ferruginous except piceous at apex; dorsum colored brassy green; geographical range in the high Andes of Peru. Pronotal shape and color of the mandibles vary within populations throughout the species range, although characters states ascribed to *N. elata* are most common in populations from the high Andes of Peru. Dorsal body color varies in a complex geographical manner not warranting separate status for specimens from the high Andes.

It seems best to treat *N. elata* as a junior synonym of *N. peruviana.* The types of the former are lost (F. Hieke, *in litt*), but as characterized by van Emden, *N. elata* is a form of *N. peruviana.*

Van Emden distinguished adults of *N. margaretae* and *N. stubeli* from those of *N. peruviana* and *N. elata* primarily on the basis of color of the scape. This color varies geographically, with extensive zones of intergradation; color differences do not warrant separate status for the former two forms. Adults of *N. margaretae* were distinguished from those of *N. stubeli* on the basis of: different pronotal shape; short hind wings; relatively short metepisterna; ocellate puncture absent in most specimens at base of scutellar striae; median lobe with apex elongate. Pronotal shape varies intrapopulationally throughout the range of *N. peruviana.* Populations grade from completely macropterous in northern Ecuador to completely brachypterous in the Andes of central and southern Peru and mostly brachypterous in the coastal lomas of Peru. Length of the metepisterna varies intrapopulationally among both macropterous and brachypterous forms. Elytra of specimens from near the town of Junin on the Junin Plateau (Junin Department, Peru) lack an ocellate puncture at the base of the scutellar stria. Northwards from there populations grade on the Junin Plateau from having all specimens lacking such punctures to all specimens having them. Length of the apex of the male median lobe varies geographically in a complex pattern not suggesting specific rank for forms with a longer apex.

Natural History. Preference for suitable microhabitats and tolerance of or local adaptations to temperature and moisture extremes presumably

explain the species' distribution from xeric moderately warm macrohabitats such as those of the coastal lomas to moister, cooler ones of the higher Andes of Peru.

Lomas are isolated areas in the coastal desert of Peru on slopes at elevations between approximately 100 and 800 m and from approximately 8° S near Trujillo to approximately 16° S near Chala (Johnson, 1976; and pers. obs.). Lomas result from dense fog present from May to October and producing then up to 100 or 200 mm of precipitation in the form of an almost continuous drizzle in the contact zone of the slopes of the lomas with the clouds. This moisture together with greatly reduced evaporation supports growth of vegetation, which catches additional moisture and increases the amount of water reaching the soil. During May to October the lomas are isolated zones of green vegetation with desertic landscapes below and above, corresponding respectively to lower and upper cloud or fog limits. Clouds disappear in November and December, and the landscape changes almost completely back to that found elsewhere in the desert (Johnson, 1976; P. Aguilar, pers. comm.; pers. obs.). The surrounding coastal desert has an average mean annual precipitation of approximately 13 to 35 mm and average mean annual temperatures of approximately 19° to 21° C. Approximately every 25 to 50 years during the "El Niño"phenomena the coastal waters warm, coastal desert temperatures may increase as much as 3° C, and rainfall may total nearly 400 mm (Johnson, 1976).

The opposite climatic extremes occur in the high Andes where mean annual temperatures are much lower, and total annual precipitation generally averages 700 or more mm. The highest location where specimens were found was at 4120 m near Junin on the Junin Plateau (Junin Department, Peru). An elevation-temperature table in Johnson (1976) suggests an approximate mean annual temperature of 6° C at 4000 m. The annual average precipitation at Cerro de Pasco, located approximately 60 km northwest of Junin on the Junin Plateau at 4333 m, is 882 mm (Johnson, 1976).

Fog during May to October in the coastal lomas presumably supplies most or all of the species' moisture needs. (Specimens might gain additional moisture by feeding on plant material; feeding behavior in the lomas has not been studied.) During approximately May to October the sun is often obscured by fog, and adults are commonly found during the day beneath small pieces of surface debris such as leaves (P. Aguilar, pers. comm.). During the long dry season there is little precipitation, the sun is only rarely obscured by fog, and adults retreat to pockets beneath large boulders (P. Aguilar pers. comm.; and pers. obs. 24-31 December 1977).

An annual activity period in the lomas coinciding with the May to October fog would decrease moisture and temperature stresses as would retreat to dry season pockets. At least the adults, however, must have a

In the Andes of Peru eggs are probably laid during the rainy season to allow larval development during the period of maximum moisture. During nighttime collecting at the second pasture we saw at least 12 pairs of mating adults. Females, from several localities in the Andes of Peru, put into cultures laid eggs sporadically. In January all of four dissected females from the third pasture appeared to have mature eggs in their abdomens.

Adults apparently are present during most of the year in the Andes, but most numerous (especially in Peru) during approximately October through March, the general rainy season for much of the Andes (Johnson, 1976). Totals of dated Andean museum specimens seen for each month were: January, 27; February, 41; March, 91; April, 1; May, 19; June, 18; July, 35; August, 0; September, 3; October, 23; November, 114; December, 71. During the expedition, adults were common at many Andean habitats in Peru, supporting a thesis of maximum abundance during the rainy season.

At many Andean sites rocks in some places had adults under them while those in similar appearing places lacked them. Flooding was a major cause of such patchy distributions. During rainstorms at several sites water either ran over or pooled in many of the areas devoid of specimens but ran around or sank into the ground in areas in which specimens were found.

Body size shows interesting variation. In the analysis below body length serves as a convenient measurement or index of body size. For this analysis 6491 males and 6525 females from 94 sites in Ecuador and Peru were measured. Means, standard deviations, and standard errors were calculated separately for each sex at each site. Specimens from Ecuador tend to be smaller than those from comparable elevations in the Andes of Peru. Body size decreases with elevation.

Figure 53 is a graph illustrating mean values for body lengths of each sex at the 33 sites with sample size of 30 or greater for each sex. The three sites below 700 m are in coastal lomas; the others are in the Andes of Ecuador and Peru. Mean values for body lengths of females are greater than those of males at 25 sites. At the 95 percent significance level, F and t tests show that the variances or means are significantly different at nine of these 25 sites, with no geographical or altitudinal patterns for these nine sites. Mean values for body lengths of males are greater than those of females at eight sites. At the 95 percent significance level, F and t tests indicate that two of these eight sites have variances significantly different for the sexes. There is thus a slight tendency for females at some sites to be larger than males.

Figure 53 shows that body length for both sexes decreases irregularly with increased elevation above approximately 2600 m. Figures 54 and 55 illustrate the means and ranges of body length for males and females

respectively along a single transect in Peru south from 2000 m near Huanuco, Huanuco Department to 4120 m near Junin, Junin Department. Means and ranges clearly decrease with elevation. From 2000 to 4120 m there is a 4.48 mm or 41.6 percent decrease in mean body length of males and a 4.65 mm or 39.58 percent decrease for females.

Factors possibly influencing body size are discussed in the section entitled "General trends in natural history".

Abundance of adults at many localities suggests that they and their larvae are important components of ecosystems. Adults seemed moderately abundant in the coastal lomas, allowing for movement from the dry season pockets and dispersion throughout the lomas. Adults in the Andes of Peru were patchily distributed within fields but generally seemed to average more than two per square meter in sites where beetles were found under rocks by hand collecting. Many adults were probably also in tunnels in the soil or under dense grass and were not found during daytime searches. Thus, in many sites in the Andes of Peru the total number of adults was possibly much greater than four per square meter; at these sites adult *N. peruviana* and to a far lesser degree (based on apparent biomass) adult Curculionidae appeared to be the most significant primary consumers above ground.

Geographical Distribution and Material Examined. This species occurs in the Andes of Ecuador and Peru and isolated lomas in the coastal desert of Peru (Fig. 42). In addition to type material I have seen a total of 14,533 specimens including 13,571 collected during the expedition. Part II includes an analysis of the geographical differentiation of *N. peruviana* and describes sites from which specimens were seen throughout the species' range.

Notiobia (Anisotarsus) bradytoides Bates
(Figs. 14, 28, 44, 57, 69)

Anisotarsus bradytoides Bates, 1891: 8. Lectotype (BMNH), here designated, a ♂ labeled: "Machachi, Ecuador. 9-10,000 feet. Ed. Whymper".; "Anisotarsus bradytoides (syntype) Bates". Additional labels added stating: "Lectotype"; "LECTOTYPE Anisotarsus bradytoides Bates By G. R. Noonan". TYPE LOCALITY: Type locality originally stated to be from Ecuadorian localities of: Penipe toRiobamba (9000 feet); Machachi (9-10,000 feet); Illiniza (14,000 feet). Here restricted to: Ecuador, Pichincha Province, Machachi, 9,000 to 10,000 feet. NOTES ON TYPE MATERIAL: Bates (1891:8) stated he had numerous examples of this species. There are two males in BMNH labeled as syntypes from Machachi; both specimens fit Bates description. No other type material was found at the BMNH.

Description. Body stout and short in general habitus, 7.8 to 10.2 mm long.

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Figure 53 shows that body length for both sexes decreases irregularly with increased elevation above approximately 2600 m. Figures 54 and 55 illustrate the means and ranges of body length for males and females

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Description. Body stout and short in general habitus, 7.8 to 10.2 mm long.

Color. Dorsum dull brown to dull reddish brown; frons of some specimens with irregular shaped median reddish area; pronotal lateral margins of some specimens transluscent; elytra of some specimens with slight to moderate greenish tinge. Venter, legs, and palpi reddish yellow to brown or dark reddish brown. Antennae with articles 1 to 3 or 1 to 4 yellow, reddish yellow to reddish brown; articles 1 of some specimens black medially.

Microsculpture. Dorsum with isodiametric mesh, such mesh prominent and somewhat granulate (especially in ♀♀) on elytra.

Thorax. Pronotum (Fig. 14) short and transverse with greatest width at mid point near lateral setae; sides anteriorly arcuate, posteriorly straight or nearly straight & convergent; anterior angles slight; posterior angles broadly rounded; lateral depressions slight; posterior lateral impressions varied, shallow or obsolescent to deeper & somewhat elliptical in shape.

Legs. Posterior margin of hind femora each with 4 to 6 long setae. Dorsa of ♀ tarsi, ♂ hind tarsi glabrous; dorsa of articles 1 to 4 of ♂ fore and mid tarsi with scattered setae.

Elytra. Scutellar striae each with ocellate puncture at origin, short to long, in some specimens joined distally with striae 1; in most specimens intervals 3 lacking setigerous seta near distal 1/3, in a few specimens one or both intervals 3 each with such puncture; intervals 3, 5, 7 respectively each with 0 to2, 0 to 4, 1 to 10 posterior setigerous punctures; subapical sinuations moderate; sutural apices rounded.

Hind wings. Vestigial.

Male genitalia: Median lobe (Fig. 28) with apex broad but moderately elongate. Everted internal sac lacking macrotrichia.

Variation. Described variation is intrapopulational.

Natural History. Adults are probably active all year. Totals of dated specimens seen are: zero from January, March, September, and December; February, 154; April, 41; May, 37; June, 167; July, 254; August, 22; October, 49; November, 128. Teneral adults were seen from each of the latter eight months. All specimens seen from October and November were collected during the MPM expedition. Collecting during the other months for which museum specimens are not yet known will probably yield many adults.

Climatic factors probably explain the apparent lack of seasonal periodicity in adult activity. The main (Ecuador) geographical range of *N. bradytoides* centers around the equator, and annual temperature variation is slight (Johnson, 1976). Precipitation within Ecuador shows strong geographical variation, but in most areas there is no completely dry season (Johnson, 1976).

South of the Ecuadorian Azuay Nuda climatic factors may restrict this

species to small islands of favorable habitat. Southward in Ecuador from this Nuda the central valley has increasing aridity and desert like conditions; within the ecuadorian and Peruvian Andes both temperature and precipitation show greater seasonal variation southwards from the equator (Johnson, 1976). The six specimens from south of the Nuda were collected from a 3180 m high locality in northern Peru (17.9 km east of Agallpampa, La Libertad Department). This was situated on the crest of a hill, appeared to be a place where fog and rain clouds lodged, and had more luxuriant vegetation than nearby lower areas.

Adults taken by MPM expedition were found in grassy areas with most found beneath rocks on the ground. Many adults were in disturbed places such as plowed or fallow fields (Fig. 69), road shoulders, and near dwellings. Specimens were taken at altitudes from 2200 to 3180 m. (Museum specimens were labeled as from altitudes as high as 3800 m, and van Emden, 1953, cited specimens from 2000 m.) Both *N. peruviana* and *N. bradytoides* occurred together at eight localities visited during the expedition and at four represented by museum specimens. Observations the night of 3 November 1977 revealed numerous adults climbing into grass and eating (Fig. 57) the seeds at 13 km south of Latacunga, Cotopaxi Province, Ecuador, 2600 m.

Geographical Distribution and Material Examined: This species is known from the Ecuadorian Andes from near the Colombian border south to Alausi in Chimborazo Province and from one locality in the Andes of northern Peru (Fig. 44). It probably also occurs in the southern Colombian Andes.

In addition to type material I have seen the following 1853 specimens from:

ECUADOR

CHIMBORAZO PROVINCE: 10 km N. Alausi, 2700 m, Feb. 10♂, 13♀; 25 km. S. Guamote, 3100 m, Feb. 29 ♂, 21 ♀; 6.5 km W. Riobamba, 3200 m, Feb. 4 ♂ 3 ♀; Vulcan Chimborazo, 3300 m, Feb. 32 ♂, 32 ♀. COTOPAXI PROVINCE: Latacunga to Pilaló, 3700 m. Jul. 116 ♂ 145 ♀, Aug. 9 ♂ 13 ♀; 34.5 km. N. Latacunga along Pan Am., 3100 m, Nov. 1 ♂; 13 km. S. Latacunga along Pan Am., 2600 m, Nov. 129 ♂, 888 ♀; 15 km. W. Latacunga, My. 13 ♂, 24 ♀; 48.4 km W. Latacunga, 3800 m, Feb. 13 ♂, 9 ♀; 10 km. W entrance P.N. Cotopaxi, Ap. 10 ♂, 13 ♀; 15 km. W. entrance P.N. Cotopaxi, Ap. 9 ♂, 9 ♀. IMBABURA PROVINCE: 9 km. W. Cotacachi on rd. to Lago Cuicochi, 2590 m, Nov. 10 ♂, 13 ♀; 12.1 km. W. Cotacachi on rd. to Lago Cuicochi, 3000 m, Nov. 1 ♀; 5.7 km, N. Ibarra on Pan Am., 2300 m, Nov. 4 ♂, 3 ♀; Laguna Yahuarcocha, Jn. 75 ♂, 91 ♀. PICHINCHA P.: Guayllabamba on Pan Am., 2200 m, Nov. 1 ♀; 13.6 km. NE Guayllabamba on Pan Am., 2600 m, Nov. 4 ♂, 3 ♀; Pomasqui N. Quito, Jn. 1 ♂, 1 ♀; 2.2 km. S. Quinche on rd. between Pifo and Santa Rosa, 2500 m, Oct. 2 ♀; Quito, 1 ♂, 38.8 km. N.E. Quito on Pan Am., 2200 m, Nov. 1 ♀, 22.8 km. S.E. Quito on rd. to Palpallacta, 2500 m, Oct. 31 ♂, 16 ♀. TUNGURAHUA PROVINCE: S.E. end Ambato, 2500 m, Nov. 3 ♂, 8 ♀; 6.6 km. S.E. Ambato, 2.3 km. S.E. Totoras, 2800

m, Nov. 9 ♂, 9 ♀; 23.8 km. S.E. Ambato, 9.2 km. S.E. Pelileo, 2400 m, Nov. 17 ♂, 18 ♀.

PERU

LA LIBERTAD DEPARTMENT: OTUZCO P.: 17.9 km E. Agallpamba on rd. to Trujillo, 3180 m, Nov. 3 ♂, 3 ♀.

Notiobia (Anisotarsus) moffetti new species
(Figs. 7, 8, 21, 34, 46, 61)

TYPE LOCALITY. 43.7 km southeast of Huaraz on road to Lima, Ancash D., Peru, 3720 m (Fig. 61).

TYPE MATERIAL. Holotype a male labeled: "Peru, Ancash D. Recuay P. 27.1 mi. SE Huaraz on rd. to Lima I-13-15-78 G. Noonan, M. Moffett, D. Aguilar collrs."; "under rocks in areas w. sparse to mod. short green grass 3720 m."; red label stating "HOLOTYPE Notiobia (Anisotarsus) moffetti new sp. Det. Noonan." Paratypes, 2720 with following label data: PERU: ANCASH DEPARTMENT: HUARAZ PROVINCE: Huaraz VI-49 leg. Löffler (Nègre) 3 ♂, 4 ♀; same label as previous but dated VI-54 (Nègre) 1 ♀. RECUAY PROVINCE: 18.6 mi. SE. Huaraz on rd to Lima I-6-78 M. Moffett, D. Aguilar under rocks in area w. sparse short green grass 3480 m. 1 ♀; 27.1 mi. SE. Huaraz on rd. to Lima I-13-78 G. Noonan, M. Moffett, D. Aguilar collrs. under rocks in areas w. sparse to mod. short green grass soil surface moist under rocks 3720 m. 5 ♂, 3 ♀; 27.1 mi. S.E. Huaraz on rd. to Lima I-13-15-78 G. Noonan, M. Moffett, D. Aguilar collrs. under rocks in areas w. sparse to mod. short green grass 3720 m. 1440 ♂, 1234 ♀; 33.7 mi. SE. Huaraz on rd. to Lima I-7-78 M. Moffett, D. Aguilar under rocks on hillside w. paramo vegetation 3880 m. 7 ♂; 40.5 mi. SE. Huaraz on rd. to Lima I-7-78 M. Moffett, D. Aguilar under rocks in paramo most Anisotarsus in areas disturbed in past w. soil churned up 3950 m. 11 ♂, 11 ♀.

Deposition of type material. The holotype, allotype and most MPM expedition collected paratypes are deposited in MPM; approximately 1/3 of the MPM collected paratypes are deposited in UNAM. The Nègre paratypes are deposited in his collection. Paratypes are also deposited in other collections listed in the section entitled "Materials and Methods".

Description. Body stout in general habitus, small, 7.5 to 9.8 mm long.

Color. Dorsum with frons, elytral epipleura & anterior margins red, reddish yellow, reddish brown, reddish black; pronotum of most specimens red, reddish brown to reddish black, in some specimens greenish brown; elytral disc dark reddish brown, greenish reddish brown to greenish brown, green, bronzish, or brassy green. Venter red, reddish yellow, reddish brown to reddish black. Palpi, legs, and first 3 or 4 antennal articles red, reddish yellow or light reddish brown. Antennal articles 4 or 5 to 11 reddish yellow, yellow, yellowish brown, or reddish brown.

Microsculpture. Dorsum with head bearing isodiametric mesh posterior to eyes and on frons a rudimentary to isodiametric mesh; pronotum with isodiametric mesh near margins, mesh on disc indistinct or irregular to isodiametric; elytral disc of most specimens with prominent isodiametric mesh, mesh indistinct or irregular in a few.

Thorax. Pronotum (Figs. 7, 8) moderately transverse; sides anteriorly straight to slightly arcuate, posteriorly straight to nearly straight, in some specimens briefly and shallowly sinuate anterior to posterior angles; anterior angles slight; posterior angles broadly rounded; lateral depressions slight in most specimens, wider and shallower posteriorly; posterior lateral impressions absent to moderate sized, when evident, smooth to punctate, rugose or wrinkled.

Legs. Posterior margins of hind femora each with 3 to 5 long setae. Tarsal dorsa glabrous except for 1 or 2 setae on some articles.

Elytra. Scutellar striae each lacking ocellate puncture at origin, short to moderate in length; intervals 3 lacking setigerous puncture near distal 1/3; intervals 3, 5, 7 respectively each with 0 to 3, 0 to 3, 2 to 12 posterior setigerous punctures; subapical sinuations slight; sutural apices broadly rounded.

Hind wings. Vestigial.

Abdomen. Sterna 4 & 5 of some specimens each with 0 to 20 very fine and very short setae anteriorly near intersegmental sutures.

Male genitalia. Median lobe (Fig. 21) with apex bent slightly dorsad then sharply ventrad, moderately long, strongly tapered. Everted internal sac (Fig. 34) distally with broad field of macrotrichia.

Variation. Among eight specimens from the Nègre collection labeled Huaraz, the elytral discal microsculpture is indistinct in three males and two females, moderate in one female, and prominent in two females. All of the *N. moffetti* collected during the expedition have prominent isodiametric mesh on the elytral disc. The remaining described variation is intrapopulational.

Much dorsal color variation may result from colors grading from light to dark, corresponding with apparent increased tanning of the integument: entire dorsum yellow, reddish yellow, or yellowish brown to reddish brown (very teneral; median lobe of male collapsed in dried specimens, integument wrinkled and collapsed in part); elytra and forebody contrasting in color, with head and pronotum red, reddish yellow to reddish brown and elytral disc a darker reddish brown to reddish black, slight to strong greenish tinges on elytral disc of some specimens (median lobe of male not collapsed, integument not wrinkled or collapsed); forebody red, reddish yellow to reddish brown and elytral disc green, or brassy or bronzish green (body and median lobe relatively harder to crush); head and pronotum dark reddish brown to reddish black, elytra green or bronzish or brassy green (body and median lobe

harder to crush with forceps than in above); color as in last above except pronotum of some specimens with slight to strong greenish tinges (body and median lobe the hardest to crush with forceps). Possibly none of the specimens were fully mature; fully tanned adults might have a completely green pronotum.

Natural History. During the MPM expedition specimens were taken in four localities at the southern end of the Rió Santa Valley of Peru. In the southernmost and highest site (65.3 km [40.5 miles] southeast of Huaraz, 3950 m) the countryside had paramo vegetation including bunch grass. Most of the 22 specimens taken during approximately 90 minutes collecting by two persons were found under rocks in areas where the soil had been plowed up in the past and vegetation was scarce; only a few specimens were found under rocks in undisturbed areas. The second site (54.4 km [33.7 miles] southeast of Huaraz, 3880 m) had undisturbed paramo vegetation including bunch grass; approximately 60 minutes collecting by two persons yielded only seven specimens. The third site (Fig. 61; 43.7 km [27.1 miles] southeast of Huaraz, 3720 m) was at the top of a pass and consisted of flat and hilly sheep grazed pastures adjacent to a small village. The area had green sparse to moderately dense five to eight cm tall grass and scattered plants of a similar height. Specimens seemed to be much more common there than at the other localities. Approximately ten persons collected 2380 specimens during two days. At the fourth site (29.9 km [18.6 miles] southeast of Huaraz, 3480 m) two people collected for 105 minutes by turning rocks fallen from an old stone wall in areas with sparse to moderately dense green grass and scattered shrubs. A single female beetle was taken.

Moisture from fog is probably important for *N. moffetti.* The first two sites were located in a high altitude area and were foggy on the three days when visited. The third site was at the top of a pass. Six months of work in the Andes showed that fog often lodges at the tops of passes while areas only a few meters lower may receive much less fog. Six people collected for approximately 45 minutes at a site only 1.1 km northwest of the pass and 20 m lower. This lower site had a pasture similar in appearance to that at the pass but did not appear to be an area where clouds lodge. Thirty-three *N. peruviana* were taken there but no *N. moffetti.* During ten days of intensive field work in the Rió Santa Valley, we found only one *N. moffetti* at a place (fourth site) lower than the third and apparently lacking fog.

Many adults may remain partly teneral throughout their life. All eight specimens in the Nègre collection labeled as from Huaraz in June were slightly teneral, and most specimens obtained during the expedition in January were at least slightly teneral when collected. Specimens kept alive in culture from 15 January until 1 April 1978 appeared on average to be identical in degree of tanning of the exoskeleton to specimens killed on the day they were collected.

Possibly there is reduced selection pressure for complete tanning of the exoskeleton. The four sites with *N. moffetti* did not appear to have any vertebrate predators, and invertebrate predators such as spiders were rare. Suitable prey for *N. moffetti* also appeared rare. Adults of *N. moffetti* were more sluggish than those of other species taken by us. Probably adults eat vegetable material (mostly grass seeds) as do adults of other South American *Anisotarsus*. (Adults in culture ate bread.) With predators and prey absent or scarce, adults do not need a fully tanned exoskeleton for mechanical protection from predators or for rapid movement. Grass seeds are seasonal in occurrence in the Andes (pers. obs., pers. comm. Andean residents). If adults depend on such seasonal food, it probably is advantageous for them to conserve energy by moving slowly, and it probably is not necessary to tan the exoskeleton beyond a point where the male median lobe is sturdy enough for mating.

Data are not sufficient to determine the species' breeding periods. Less than 15 eggs were obtained from culture; none of them hatched. Larvae were not seen in the collecting sites.

Derivation of specific epithet. The genitive patronym honors Mark Moffett my assistant who turned tens of thousands of rocks and toiled in the Andes for six months, frequently under trying conditions. His able assistance is greatly appreciated.

Geographical Distribution. We collected specimens at the southern end of the Rió Santa Valley of Peru in a small area extending from 29.9 to 65.3 km (18.6 to 40.5 miles) southeast of Huaraz along the road to Lima (Fig. 46). Additional collecting may extend this range southward onto the 4000 m plus highlands to the immediate south of the valley or into the Rió Mosna Valley to the east.

Eight specimens from the Nègre collection are labeled as collected by Löffler in Huaraz in June, but our intensive efforts in and around this town yielded no specimens. The valley floor around Huaraz is approximately 390 m lower than the lowest area where we found *N. moffetti* and is more xeric. We did not collect along the higher reaches of the steep valley sides in the Huaraz area; however, these nearly inaccessible slopes appeared, when viewed with binoculars, to have xeric vegetation. Löffler either found suitable habitats on these slopes or used "Huaraz" as the locality for specimens collected some distance from the city.

GENERAL TRENDS IN NATURAL HISTORY

This section summarizes information presented separately for each species and outlines general trends.

Geographical distribution and climatic adaptations. Figure 52 shows sites with *Anisotarsus* on a map (redrawn from Eidt, 1968) of the climates of South America as defined in the Köppen system. All but six of the

localities occur in: temperate climate of southern South America and Andes; arid climate of southern South America; the coastal lomas of Peru and the Andes; and polar climate of the Andes. The six localities outside these climates represent *N. chalcites* and *N. cupripennis* recorded from the tropical rain climate. Detailed climatic data are not available to determine if these six localities have localized climates other than tropical rain. The general pattern of geographical distribution suggests adaptation primarily for cool to warm climates other than tropical rain. This range of climatic adaptation parallels that of species of *Anisotarsus* in North and Central America and Australia.

The effect of fog. We observed in the Andes that fog frequently lodged near the tops of mountains or against favorably situated hillsides. Most places with such fog appeared moister than adjacent areas, had greener vegetation that was more lush, and some had bromeliads, lichens and snails on cacti or other plants. Fog seemed to wet the habitats and certainly wet us.

Fog provides moisture to habitats through fine drizzle in the habitat-fog contact zone and reduces evaporation by raising relative humidity and obscuring the sun. Observations suggest that in Peru fog is essential for survival of *N. peruviana* in the desert coastal lomas and essential or at least very important for survival of three Andean species.

In the coastal desert of Peru *N. peruviana* occurred only in the lomas, regions where dense fog provides moisture and reduces evaporation during May through October (Johnson, 1976; P. Aguilar, pers. comm.). In the Andes of Peru we saw fog or inferred its frequent presence (from bromeliads, lichens and snails on plants) at all localities with *N. aguilarorum.* In the Rió Santa Valley (Ancash Department, Peru) three of the four areas with *N. moffetti* appeared to receive fog. Ten days of intensive field work in the Rió Santa Valley yielded only one specimen of *N. moffetti* from an area lacking fog. At 3720 m (lowest elevation where more than one specimen found) collectors found 2686 specimens during two days. At 3700 m and only 1.1 km away no *N. moffetti* were found in an area which did not appear to receive fog and looked drier than the pass. The single Peruvian locality with *N. bradytoides* was situated on the crest of a hill, where fog appeared to lodge, and was moister and had more lush vegetation than nearby lower areas.

Habitats. (Figs. 61-70) Members of *Anisotarsus* are in general adapted to grassy, semi-arid to mesic habitats and thrive in many pastures and other areas disturbed by man. Adults are found during the day primarily beneath rocks or debris on the ground, or in burrows in the soil. Larvae are more subterranean in habits than adults and are not found above ground. Many adults of *N. cupripennis* and *N. latiusculus* are found under bark on trunks of *Eucalyptus* trees near the Atlantic coast. Nine adult *N. peruviana* have been taken under bark on the trunks of *Eucalyptus* in Ecuador.

Aggregation. Adults of *N. aquilarorum* and *N. peruviana* aggregate in the driest habitats occupied by each species.

We found *N. aquilarorum* at ten localities in the Andes of northern Peru. In each of the five lowest (1620 m to 1490 m) and most xeric appearing localities, adults occurred in groups of approximately ten to forty closely situated under a large boulder. Boulders lacking adults appeared equivalent to those with them, suggesting aggregation rather than simple seeking of shelter under suitable boulders. During the dry season of the coastal lomas, adults of *N. peruviana* occurred beneath large boulders in pockets each containing approximately forty or more specimens.

Two possible benefits of aggregation in these species are: conservation of moisture due to water given off by adults raising the relative humidity in the pockets and thus reducing further evaporation; and association of the sexes before, during, or after reproductive periods. The aggregation of *N. peruviana* during the dry season in the coastal lomas is paralleled by that of some other Carabidae (summarized by Kavanaugh, 1977 for *Scaphinotus* and Thiele, 1977 for other Carabidae). However unlike dormant *Scaphinotus* the aggregated *N. peruviana* were very active immediately upon being uncovered or dug out of the pockets.

Feeding habits. Adults are apparently opportunistic or phytophagous (Figs. 56, 57) in feeding habits. Such habits are similar to those observed by me (unpublished) for various North American harpaline Carabidae in grasslands and probably reflect adaptation to plentiful plant material and less plentiful prey.

Activity periods. Adults hide during the day and emerge at night to feed and mate. Seasonally, adults in temperate South America are apparently most active during that region's spring and summer (from approximately September through December or February). In the Andes of Peru adults are most active during the rainy season (approximately September through March); those in the Andes of Ecuador are apparently active all year due to the less seasonal precipitation there. Adults of *N. peruviana* in the coastal lomas of Peru are active during May to October, the period of heavy fog.

Species replacement. Species do not often occur together; rather they replace one another. Label data on museum specimens indicate that most species ranges are allopatric or parapatric. Out of approximately 300 localities represented by museum specimens only 13 (Table 1) have more than one species. (Label data on museum specimens provide no information on species distribution within these localities and may represent specimens from different areas lumped for convenience in labeling.) The general pattern for Andean species studied in the field was replacement by one another. Both *N. peruviana* and *N. bradytoides* were collected at the same seven localities in the Andes of Ecuador but at only one locality in the Andes of northern Peru. *Notiobia peruviana* seemed

much less abundant at all sampled Ecuadorian sites than at most in the Andes of Peru. In the Andes of northern Peru *N. peruviana* and *N. aquilarorum* were collected together at five localities, but in general *N. peruviana* replaced *N. aquilarorum* at more mesic and higher elevations while the latter was the only *Anisotarsus* in lower Andean xeric habitats. *Notiobia peruviana* seemed abundant at 4120 m on the Junin Plateau (Junin Department, Peru) but in the Rió Santa Valley (Ancash Department, Peru) only one specimen was taken at or above 3720 m, the lowest elevation with more than one *N. moffetti.* Possibly, the latter species prevented *N. peruviana* from occupying higher elevations in the Rió Santa Valley.

Figure 58 illustrates the general pattern of species replacement and the limited degree of microsympatry. It would be interesting to study the causes of such replacement. Since adults seek the same shelter and apparently the same type of food, competitive exclusion may play a role.

Body size. Most adults from lowlands are larger than those from the high Andes. Adults of *N. chalcites, N. latiuscula, N. cupripennis* and *N. aquilarorum* occur at elevations below approximately 2500 m and have body lengths of 12 to 16.2 mm, 10.0 to 16.5 mm, 12.0 to 18.8mm and 11.4 to 17.3 mm respectively. In contrast, adults of *N. moffetti* and *N. bradytoides* are restricted to elevations in the Andes above approximately 3700 m and 2100 m respectively and have body lengths of 7.5 to 9.8 and 7.8 to 10.2 respectively. Body length clearly decreases with elevation in *N. peruviana* (Figs. 53-55).

Schoener and Janzen (1968) discuss factors probably influencing body size. Five of these factors possibly applicable to South American *Anisotarsus* are: (1) large bodies forms can presumably better resist the greater threat of desiccation in more arid areas; (2) longer growing seasons provide sufficient time for growth of larger bodied individuals; (3) dispersed food sources available for short periods favor a strategy by insects of many small individuals, each with relatively short maturation time; (4) smaller insects are more easily dislodged by movements of wind or water; and (5) larger insects may be better able to resist predators. To these I add a sixth factor, temperature.

How do these six factors relate to the general decrease in body size with elevation? Observations made during the expedition and climatic data from Eidt (1968) and Johnson (1976) are useful in analyzing the relative importance of each factor.

Notiobia aquilarorum typically occur in localities with lesser mean annual precipitation and greater mean annual temperatures than in higher areas of the Andes. In southeastern temperate South America the mean annual precipitation near the Atlantic is similar or somewhat greater than that of the high Andes of Ecuador and Peru, but the mean annual temperature is nearly twice that of Andean elevations of approximately 3500 m. Inland or westward from the Atlantic Coast

precipitation generally decreases and temperature increases until elevations rise along the eastern edge of the Andes. If greater mean annual temperatures increase desiccation stress (which seems likely), then the lowland populations of *N. latiuscula, N. cupripennis,* and *N. chalcites* are subject to such increased stress. Populations of *N. aquilarorum* clearly face increased desiccation stress due to higher temperatures and lower precipitation. Adults of *N. schnusei* range from 10.8 to 15.5 mm in length and occur at elevations from approximately 2600 to 4500 m. Populations on the Bolivian Altiplano near Puno and La Paz in general receive a total annual precipitation similar to that of Huanuco, Peru (where large bodied *N. peruviana* occur) but are subject to a much lower mean annual temperature. Climatic data suggest that the dry season may be more pronounced on the Altiplano than in other Andean areas with *Anisotarsus.* More information is needed to evaluate desiccation stress as an influence on body size of *N. schnusei.*

Larger bodied adults of *N. peruviana* occur in areas of apparently high desiccation stress while smaller ones occur where such stress is presumably lower. Figure 53 illustrates the general decrease in values for mean body length above approximately 2600 m. In the Andes the annual precipitation (except above tropical rain forests along the western rims in northern Ecuador and the eastern rims in Ecuador and Peru) generally increases and mean annual temperatures decrease with elevation. Along a transect from Huanuco to Junin mean values for body length decrease by 41.6 percent or 4.48 mm for males (Fig. 54) and 39.58 percent or 4.65 mm for females (Fig. 55); annual average precipitation and estimated approximate mean annual temperates change from 420 mm and 17°C for Huanuco at 2000 m to approximately 882 mm (for Cerro de Pasco at 4333 m) and 6°C respectively (at 4000 m). The generally large bodied adults found in the coastal lomas exist in habitats with desiccation stress presumably greater than that of the high Andes. Annual precipitation in the lomas averages only 100 to 200 mm, and mean annual temperatures in the deserts around the lomas vary from approximately 19° to 21°C (fog might result in the temperatures of the lomas being lower than those of the surrounding deserts).

The growing season may be longer in temperate coastal southeastern South America than in the Andes of Peru. Precipitation is nearly uniform throughout the year near the Atlantic but becomes more seasonal westward. Adults of *N. cupripennis* and *N. chalcites* (insufficient data for *N. latiuscula)* appear to peak in abundance during a four or five month period roughly equivalent in length to that for adults of *N. peruviana* in the Andes of Peru. However the more seasonally uniform distribution of precipitation near the Atlantic may allow larvae to feed longer. Against longer growing season producing larger body size, precipitation in the Andes of Ecuador is more evenly distributed throughout the year than in the Andes of Peru. Adults of *N. peruviana* from Ecuador should therefore be larger than those from similar elevations in the Andes of

Peru. In fact, they generally are smaller. This smaller body size may be due to reduced desiccation stress because of the more uniform seasonal distribution of precipitation, and/or reduced predation pressure (see below).

If the growing season is relatively short and food sources dispersed, then a good evolutionary strategy for insects may be to have many smaller individuals with shorter development time. The feeding season in the Andes of Peru may be shorter than that near the Atlantic in southeastern South America. Comparative data are needed on the dispersion of food sources within habitats.

Smaller *Anisotarsus* may indeed be more subject to dislodgement by moving water or wind. However, I do not think such dislodgement is an important selective factor on body size of adult *Anisotarsus;* they can find shelter under rocks or in the soil during storms. Adults of *N. peruviana* tend to be patchy in distribution on hillsides, with most occurring in areas not flooded during heavy storms. There are no data suggesting that danger of dislodgement correlates with elevation.

Predator pressure may select for large body size. The only significant predators on adult *N. aguilarorum* and *N. peruviana* appear to be spiders and scorpions. (Other potential geodephagous invertebrate or vertebrate predators seemed absent or scarce in localities visited during the expedition; birds are probably not important predators because *Anisotarsus* are nocturnal.) Larger adults may be able to tear through spider webs or withstand attacks by spiders and scorpions (especially by smaller juveniles). Spiders and/or scorpions seemed common at all coastal lomas and at most localities with *N. peruviana* below approximately 3300 m in the Andes of Peru. Above approximately 3500 m in Peru these predators seemed scarce or absent. Probably, *N. moffetti* and *N. peruviana* suffer little predation above this elevation. Spiders and scorpions seemed much less common at most Ecuadorian localities than at Peruvian ones at comparable elevations. This relative scarcity of predators in Ecuador may partly explain the generally smaller size of adult *N. peruviana* from there compared to those from the Peruvian Andes.

Temperature correlates with body size. The mean annual temperatures of localities with larger lowland forms are greater than are those of the high Andean localities with smaller adults. Higher mean annual temperatures might permit faster growth during the growing season and thus favor larger body size.

In summary, the larger body size of lowland *Anisotarsus* is probably due to a mixture of factors such as: higher desiccation stress; longer feeding seasons for larvae; predator pressure; and higher mean annual temperatures.

Hind wings. All adults of *N. aguilarorum, N. cupripennis, N. latiuscula, N. praeclara, N. schnusei,* and *N. tucumana* are macropterous. The hind wings are dimorphic in *N. chalcites* and *N. peruviana* and vestigial in *N. bradytoides* and *N. moffetti.*

Darlington (1943, 1971) suggested that carabids tend to evolve brachyptery when flight is not advantageous and that an important function of flight is maintenance of sparse unstable populations in large unstable areas. *Notiobia moffetti* is apparently restricted to an area less than 50 kilometers in diameter. In apparent contrast, the geographical range of *N. bradytoides* is approximately 1000 km between the two most distant localities and thus larger than that of the macropterous *N. aguilarorum, N. latiuscula, N. praeclara, N. schnusei,* and *N. tucumana* (see distribution maps for these species). Comparative data are needed on dispersion of populations within the range of each species. As discussed fully in part II, *N. peruviana* is dimorphic. Populations with macropterous adults predominate in northern Ecuador, where the species may have recently arrived in geologic time and where populations are sparsely distributed in a checkerboard fashion. Dimorphic populations occur in a broad transition region between the Andes of northern Ecuador and those of central and southern Peru; and dimorphic populations occur in at least three of the coastal lomas, with all such lomas arranged in an isolated checkerboard fashion in the desert. The short hind wings of adults of *N. bradytoides* may be partly due to populations in Ecuador being more continuously distributed than those of *N. peruviana.*

Habitats for *N. aguilarorum* are *possibly* less continuous than those for *N. bradytoides* in Ecuador. Field work is needed on *N. latiuscula, N. praeclara, N. schnusei,* and *N. tucumana.*

Anisotarsus offer exceptional opportunities for study of problems such as environmental determinants of body size and geographical range, competitive displacement, behavior, and the evolutionary significance of flight. The answers are there for those willing to seek them.

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Erratum. *N. aquilarorum* should read *N. aguilarorum*.

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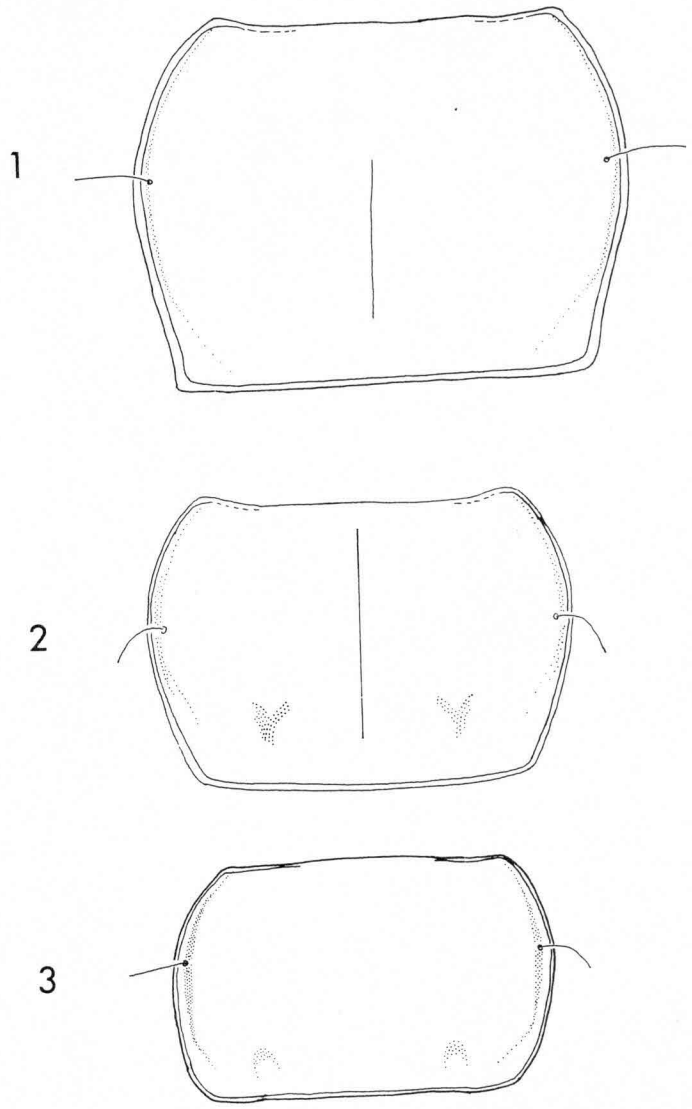
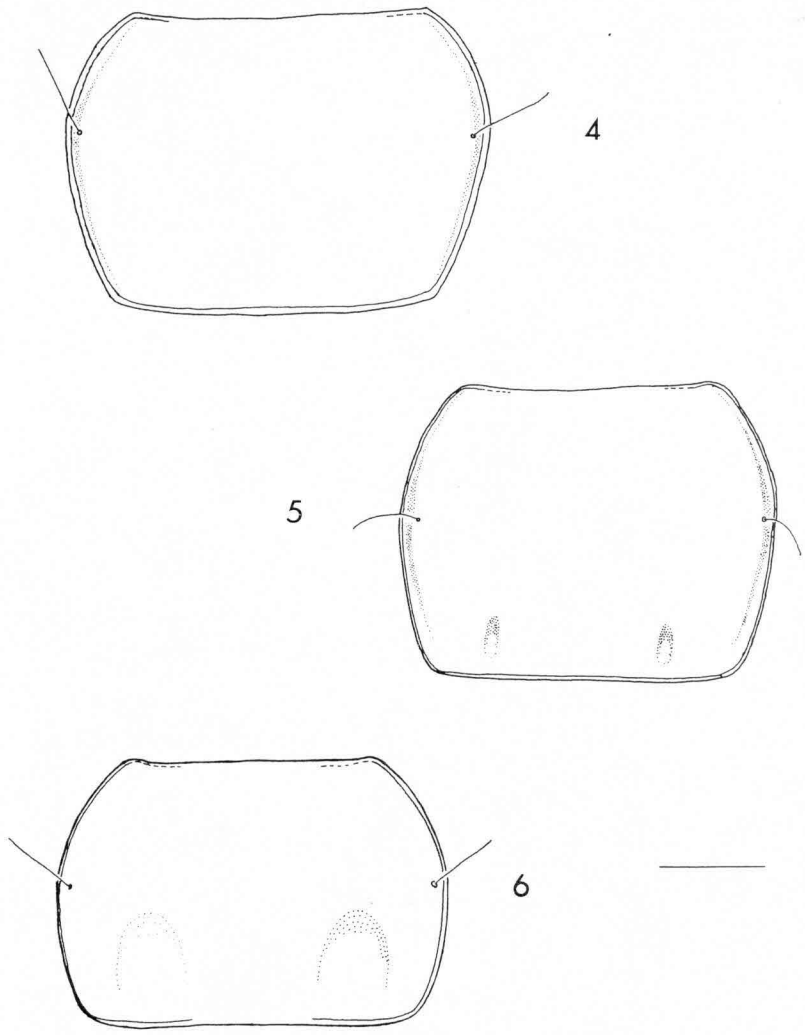
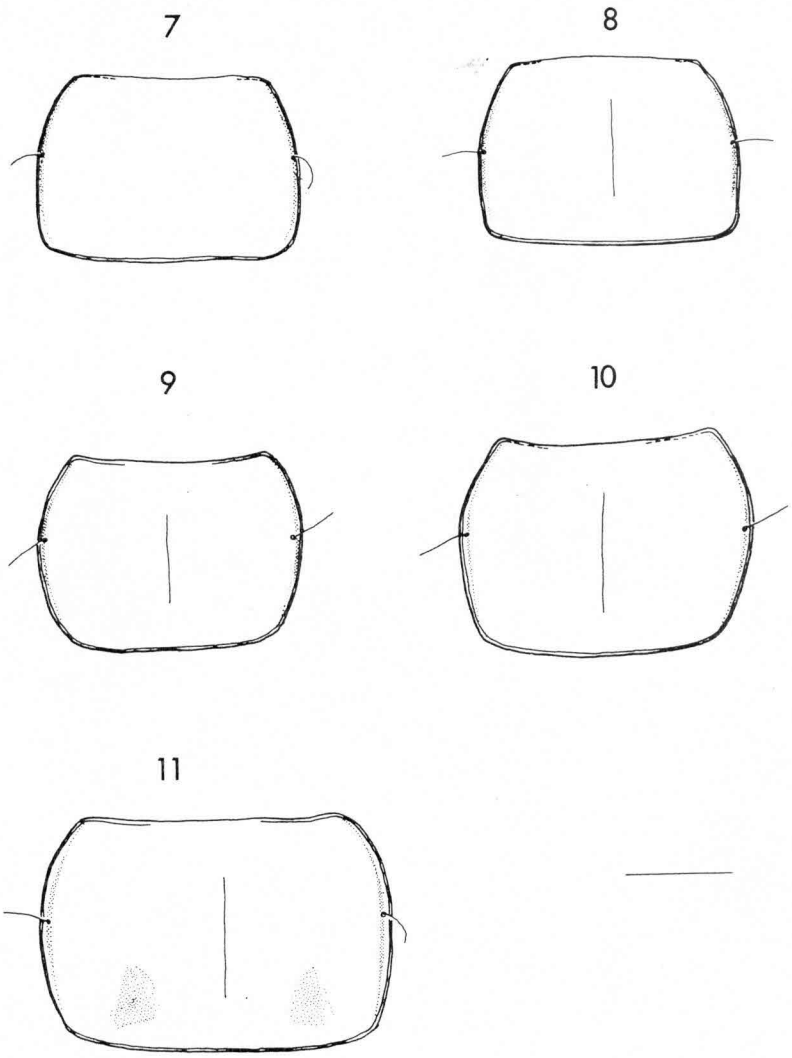


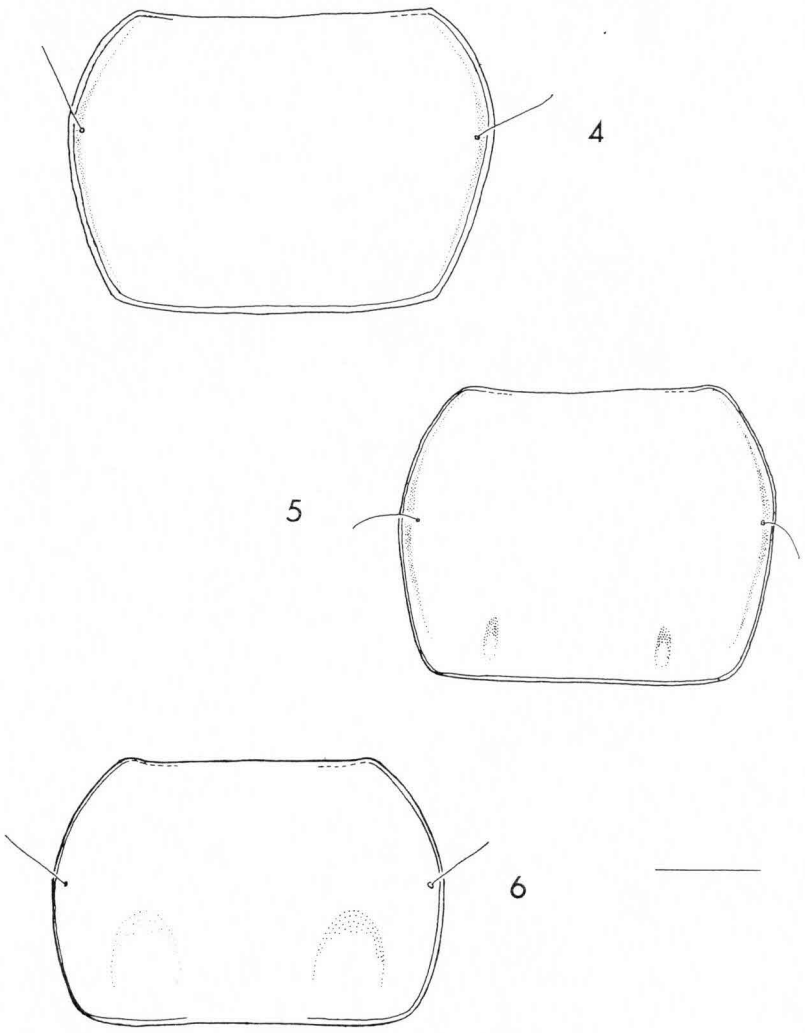
Figs. 1-3. Pronota. 1.*N. chalcites* (Nova Teutonia, Santa Catharina S., Brazil). 2. *N. chalcites* (64.5 km W Cuzco, Cuzco D., Peru). 3. *N. tucumana* (La Pampa, Argentina).



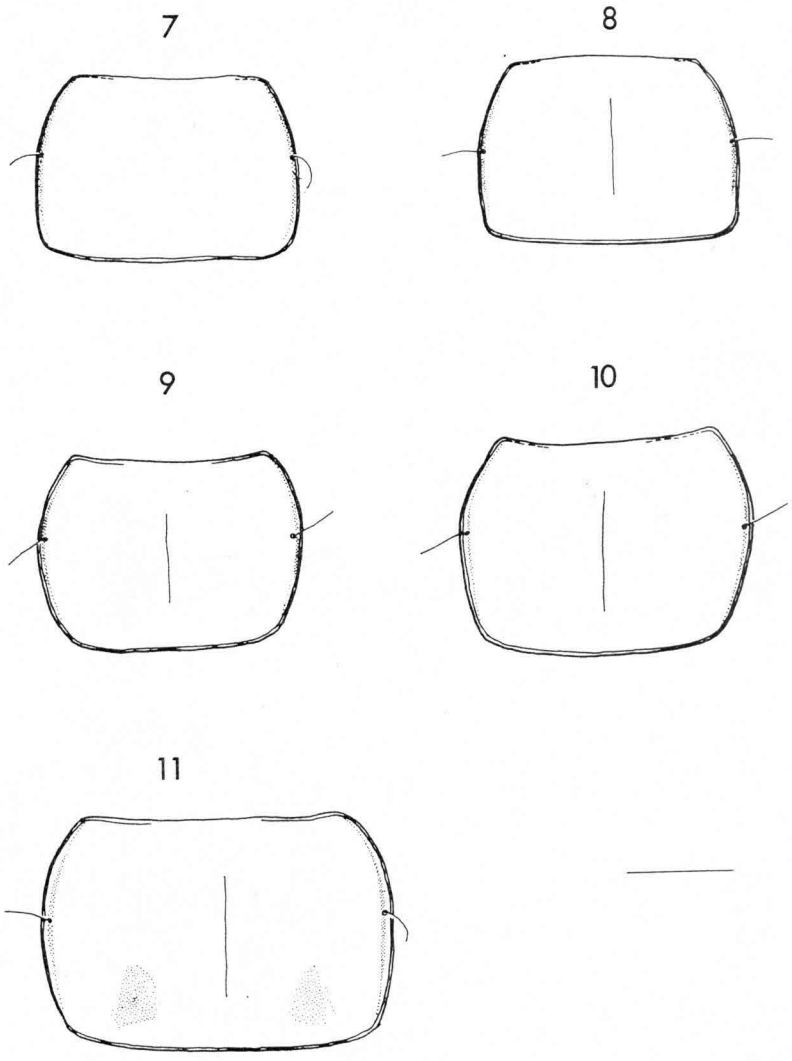
Figs. 4-6. Pronota. 4. *N. praeclara* (Colombia). 5. *N. cupripennis* (Pelotas, Rio Grande do Sul S., Brazil). 6. *N. schnusei* (Pongo de Quieme, La Paz D., Bolivia).



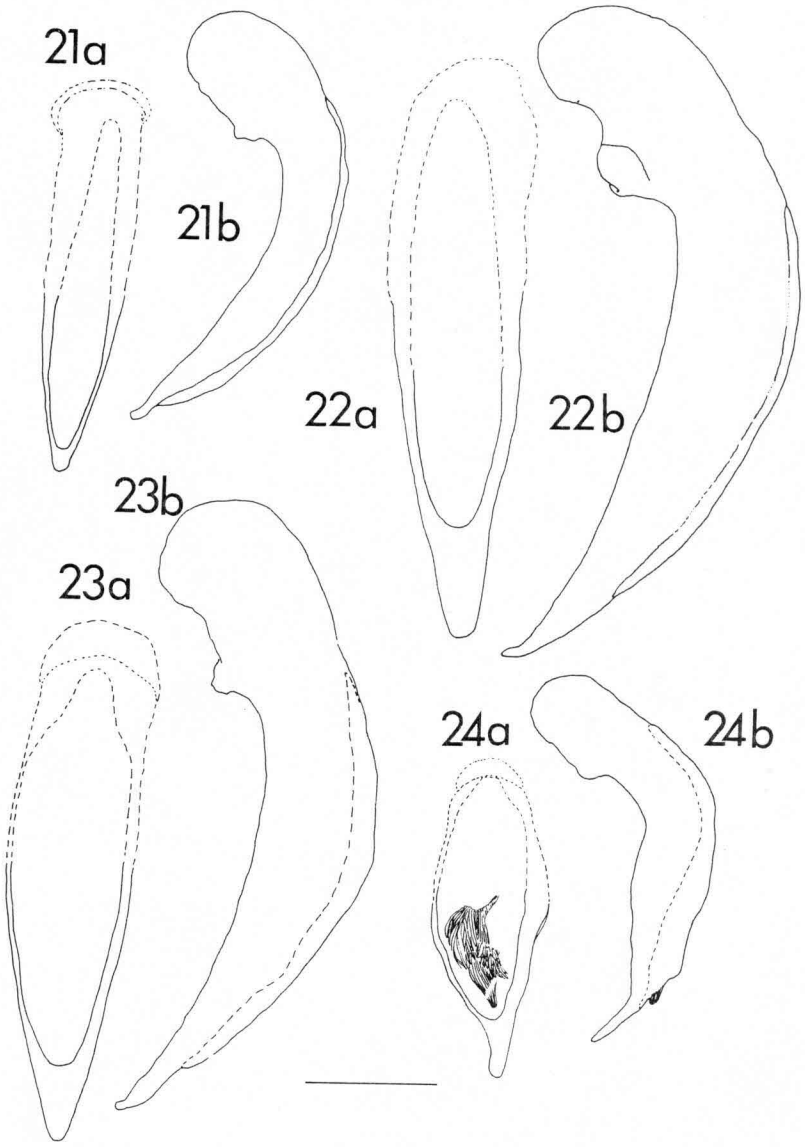
Figs. 7-11. Pronota. 7-8. *N. moffetti* (43.7 km, 27.1 mi, SE Huaraz, Ancash D., Peru). 9-11. *N. peruviana*. 9-10. (Sacsayhuaman, 3 km NE Cuzco, Cuzco D., Peru). 11. (Loma Pachacamac, nr. Pachacamac, ca. 29-32 km S. Lima, Lima D., Peru).



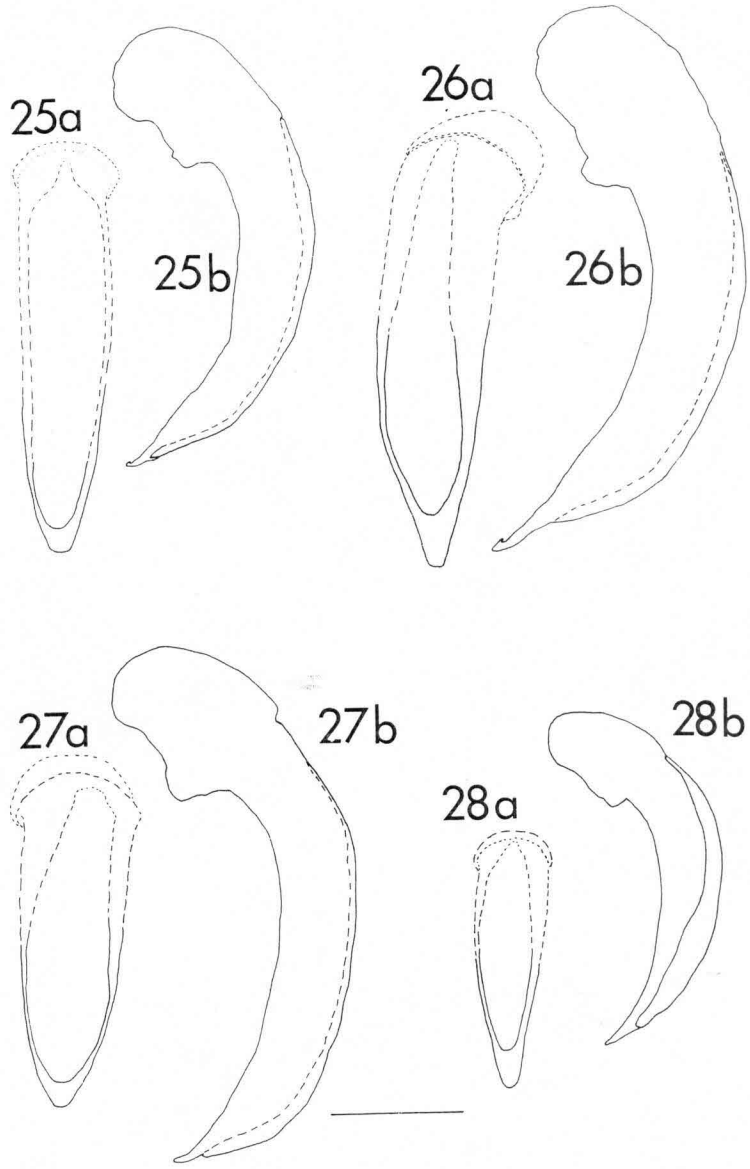
Figs. 4-6. Pronota. 4. *N. praeclara* (Colombia). 5. *N. cupripennis* (Pelotas, Rio Grande do Sul S., Brazil). 6. *N. schnusei* (Pongo de Quieme, La Paz D., Bolivia).



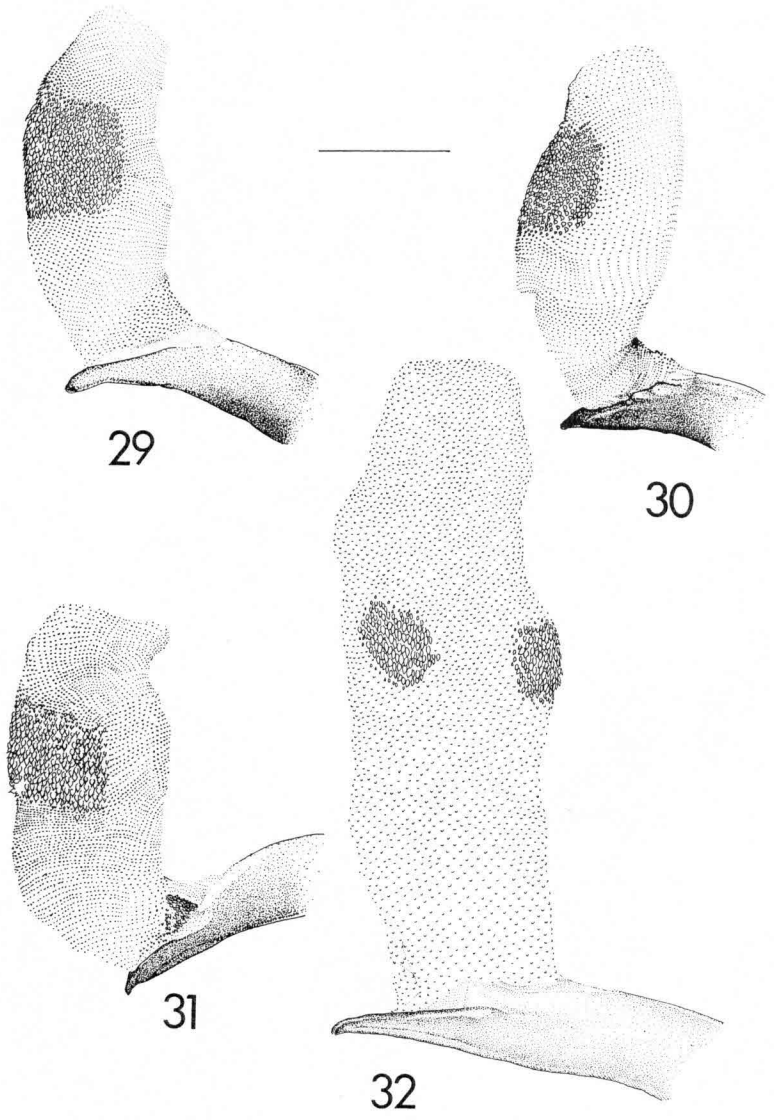
Figs. 7-11. Pronota. 7-8. *N. moffetti* (43.7 km, 27.1 mi, SE Huaraz, Ancash D., Peru). 9-11. *N. peruviana.* 9-10. (Sacsayhuaman, 3 km NE Cuzco, Cuzco D., Peru). 11. (Loma Pachacamac, nr. Pachacamac, ca. 29-32 km S. Lima, Lima D., Peru).



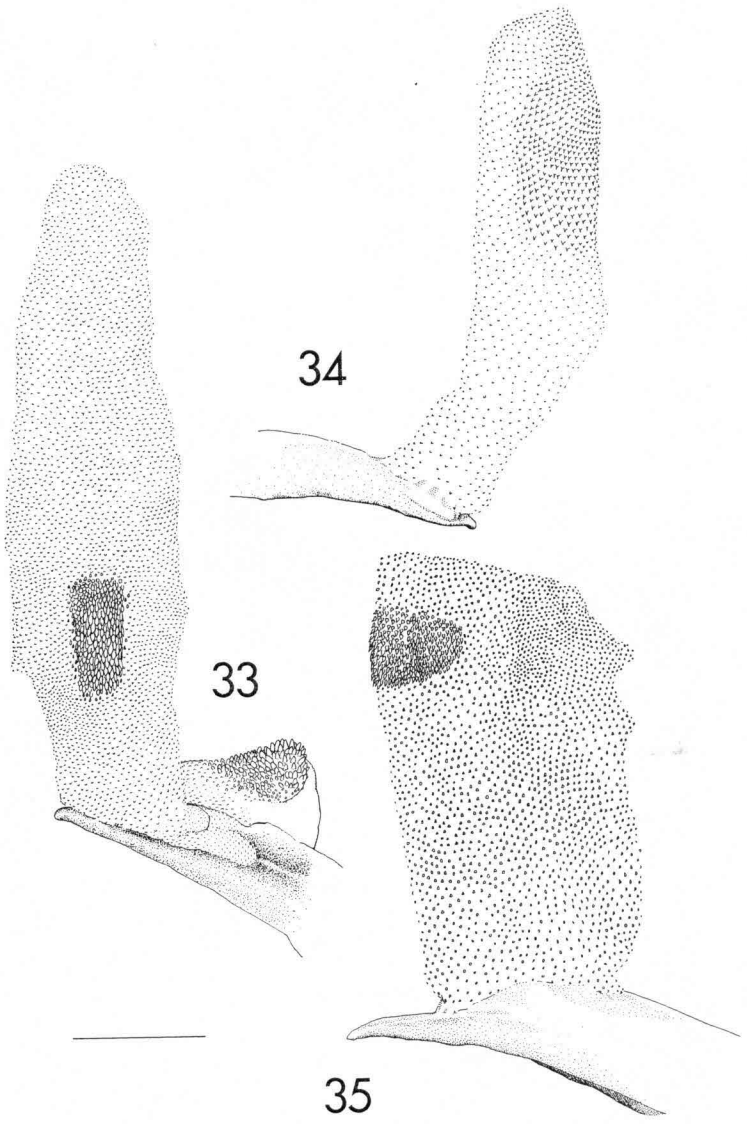
Figs. 21-24. Median lobes of male genitalia (a. dorsal aspect, b. lateral aspect). 21. *N. moffetti* (43.7 km, 27.1 mi., SE Huaraz, Ancash D., Peru). 22. *N. aquilarorum* (56.9 km, 35.3 mi, W Cajamarca, Cajamarca D., Peru). 23. *N. praeclara* (Colombia). 24. *N. tucumana* (Pico, Argentina).



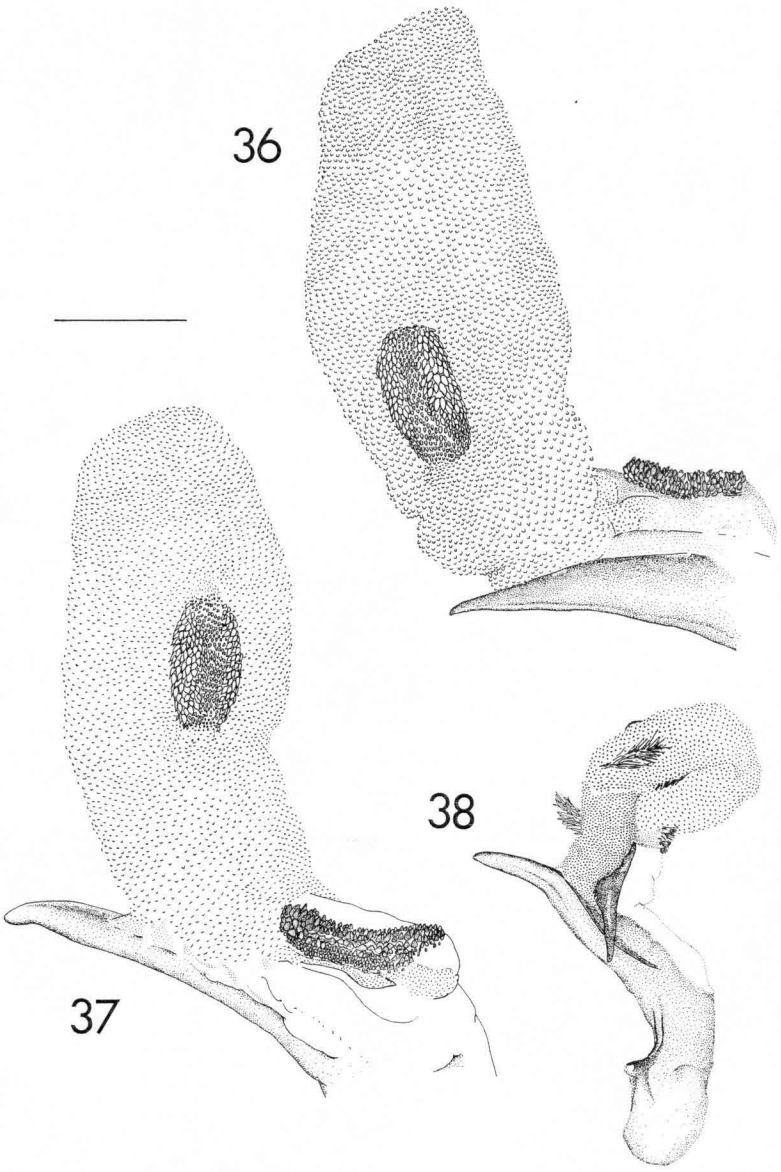
Figs. 25-28. Median lobes of male genitalia. (a. dorsal aspect, b. lateral aspect). 25. *N. peruviana* (13 km S Latacunga, Cotopaxi P., Ecuador). 26. *N. peruviana* (59.2 km SE Cajamarca, Cajamarca D., Peru). 27. *N. peruviana* (Loma at Atocongo, 25.2 km S Lima, Lima D., Peru). 28. *N. bradytoides* (13 km S Latacunga, Cotopaxi P., Ecuador).



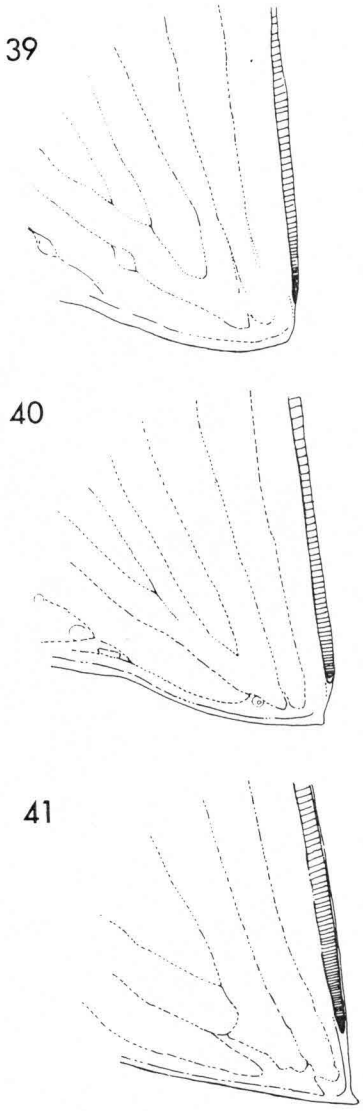
Figs. 29-32. Everted internal sacs of male genitalia. 29. *N. peruviana* (1.9 km NW Agallpampa, La Libertad D., Peru, with weak proximal field). 30. *N. peruviana* (same locality as 29, with weak proximal field). 31. *N. peruviana* (Loma at Atocongo, 25.2 km S Lima, Lima D., Peru, with prominent proximal field). 32. *N. latiuscula* (La Plata, Buenos Aires P., Argentina).



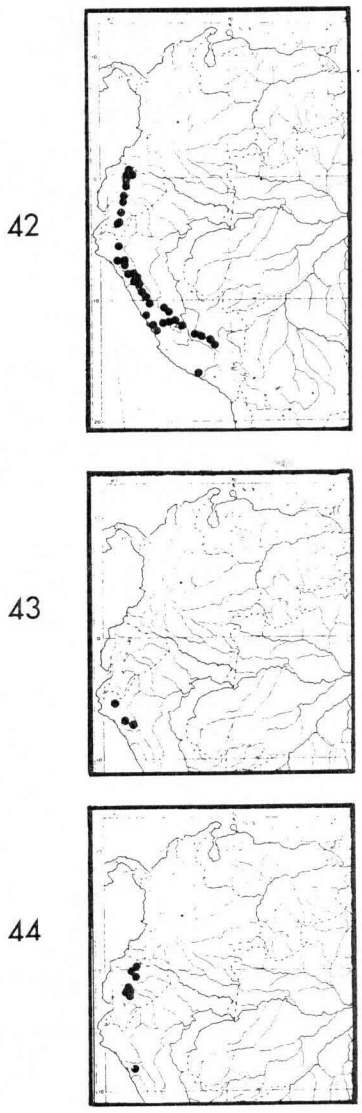
Figs. 33-35. Everted internal sacs of male genitalia. 33. *N. cupripennis* (Pelotas, Rio Grande Do Sul S., Brazil). 34. *N. moffetti* (43.7 km. 27.1 mi. SE Huaraz, Ancash D., Peru). 35. *N. praeclara* (Colombia).



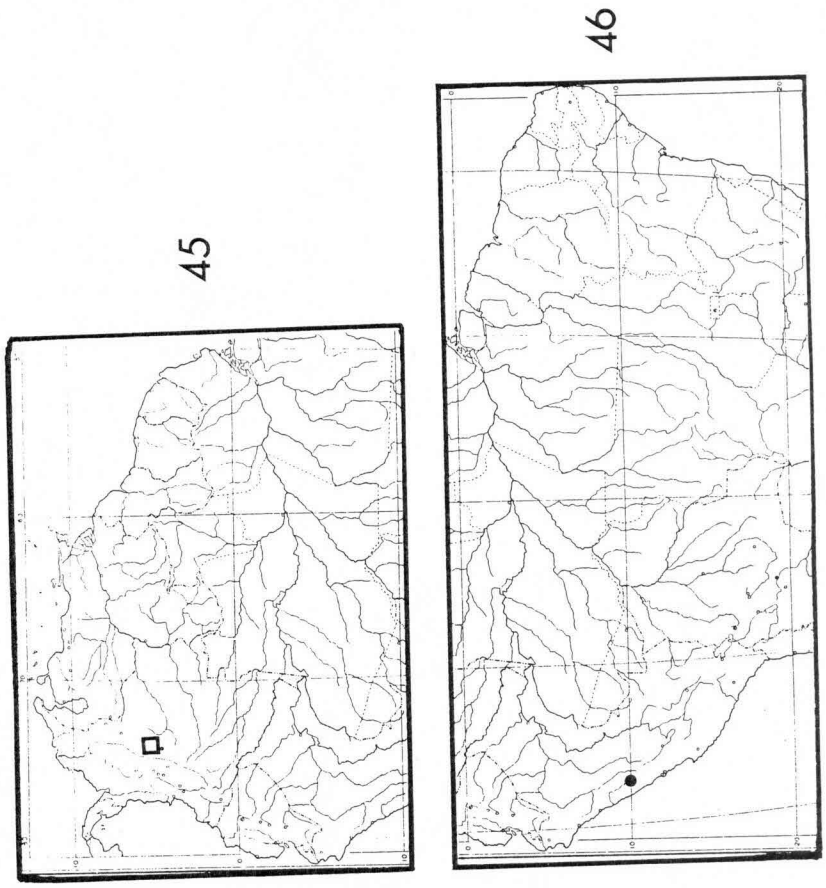
Figs. 36-38. Everted internal sacs of male genitalia. 36. *N. schnusei* (Pongo de Quieme, La Paz D., Bolivia). 37. *N. schnusei* (Ancapata, La Paz D., Bolivia). 38. *N. tucumana* (La Pampa, Argentina).



Figs. 39-41. Apices of elytra of *N. cupripennis*. 39. (4 km SE Comparapa, Santa Cruz D., Bolivia, no sutural tooth). 40. (Buenos Aires P., Argentina, slight sutural tooth). 41. (Altagracia, Cordoba P., Argentina, prominent sutural tooth).



Figs. 42-44. Distribution of species. 42. *N. peruviana.* 43. *N. aquilarorum.* 44. *N. bradytoides.*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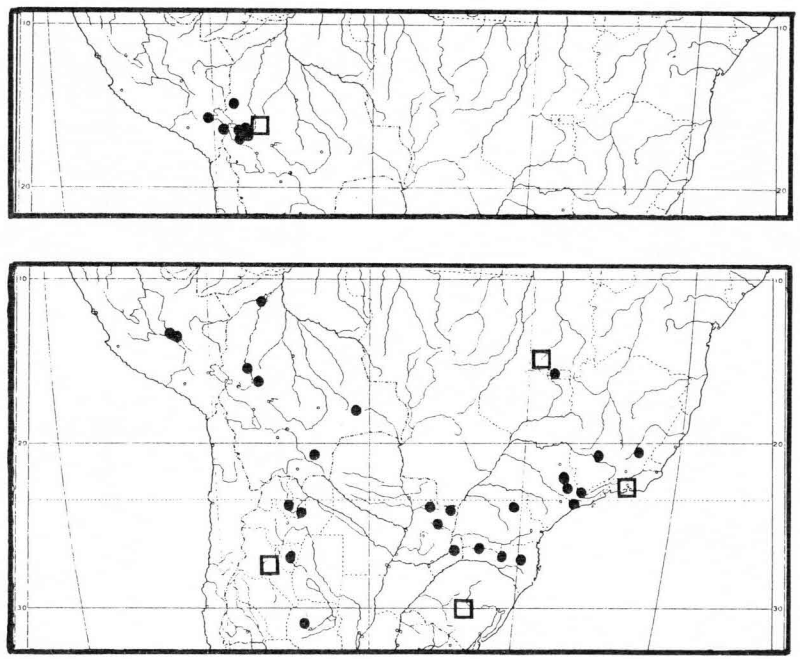
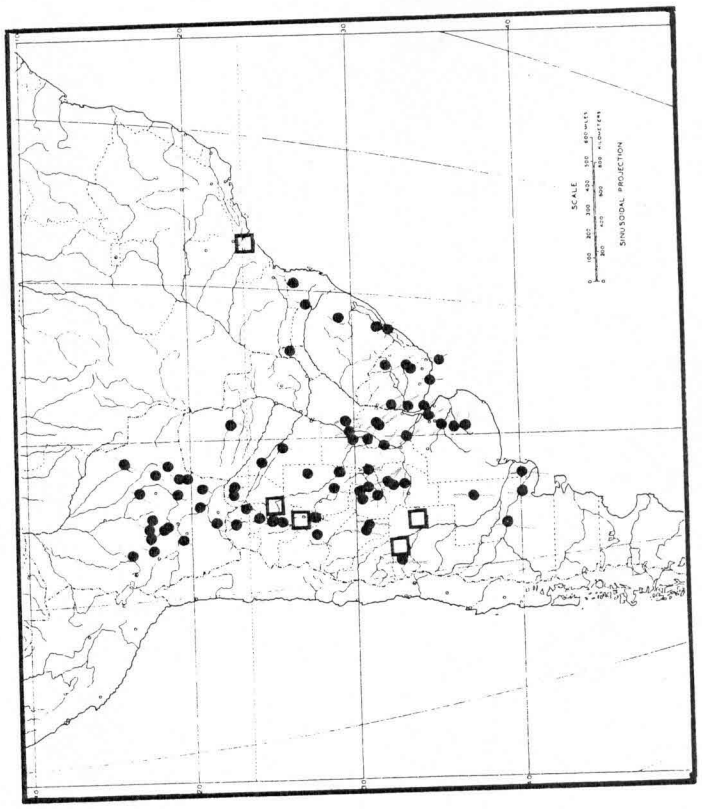
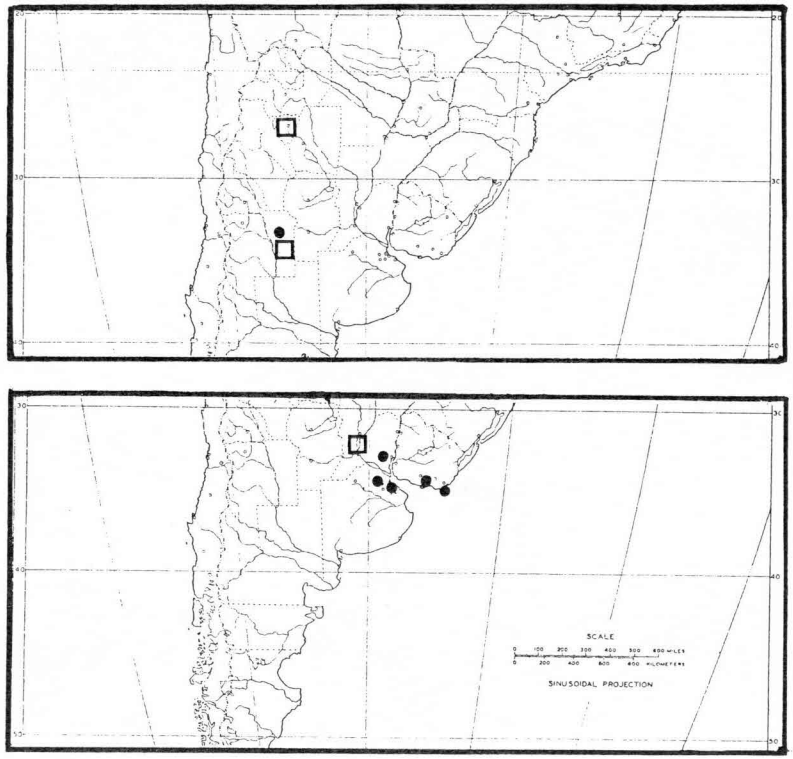


Figs. 45-48. Distribution of species (hollow squares denote records based on only departments, provinces, or states). 45. *N. praeclara.* 46. *N. moffetti* 47. *N. schnusei.* 48. *N. chalcites.*

49
16 dots
These localities are listed starting on p. 16





Figs. 49-51. Distributions of species (hollow squares denote records based on only departments, provinces, or states). 49. *N. cupripennis.* 50. *N. tucumana.* 51. *N. latiuscula.*

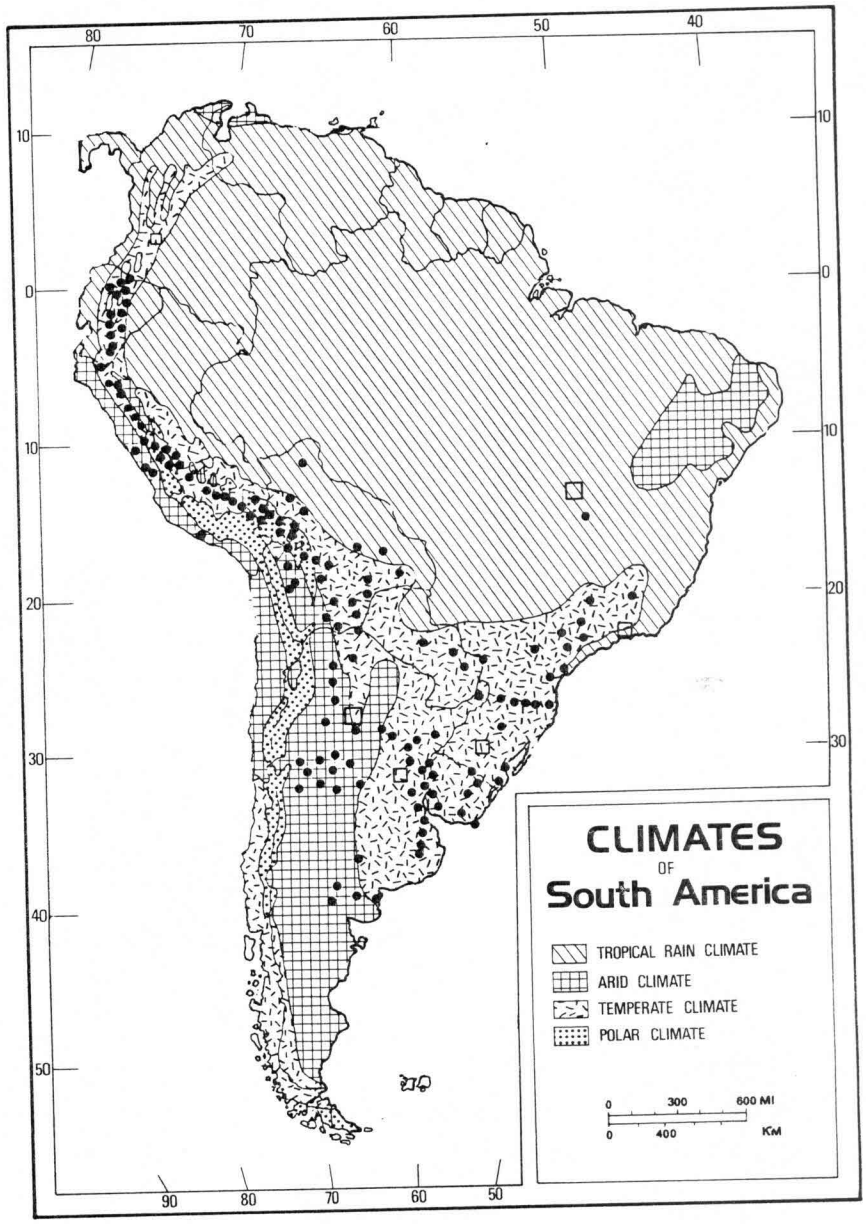


Fig. 52. Distribution of species of *Anisotarsus* in relation to major Köppen System Climates (hollow squares denote records based on only departments, provinces, or states; map of climates redrawn from Eidt, 1968).

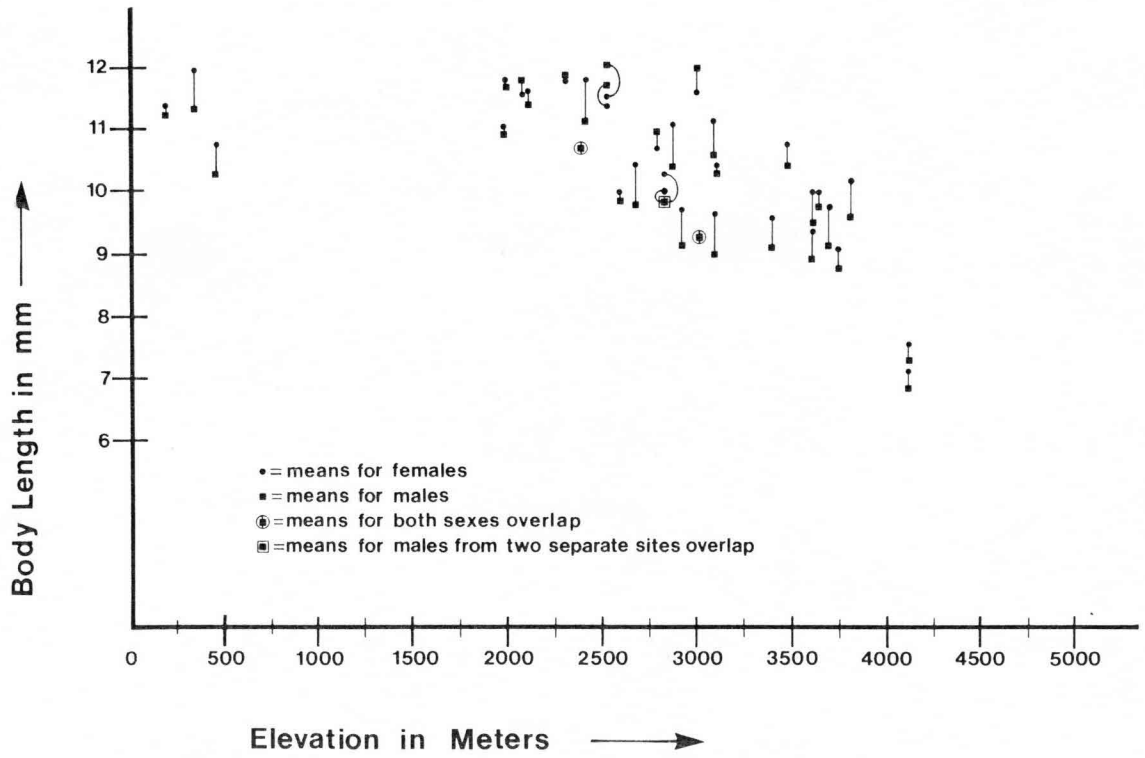


Fig. 53. Variation with elevation of mean body lengths of *N. peruviana* for sites where sample size 30 or greater for each sex. (Lines connect means for males and females from each site).

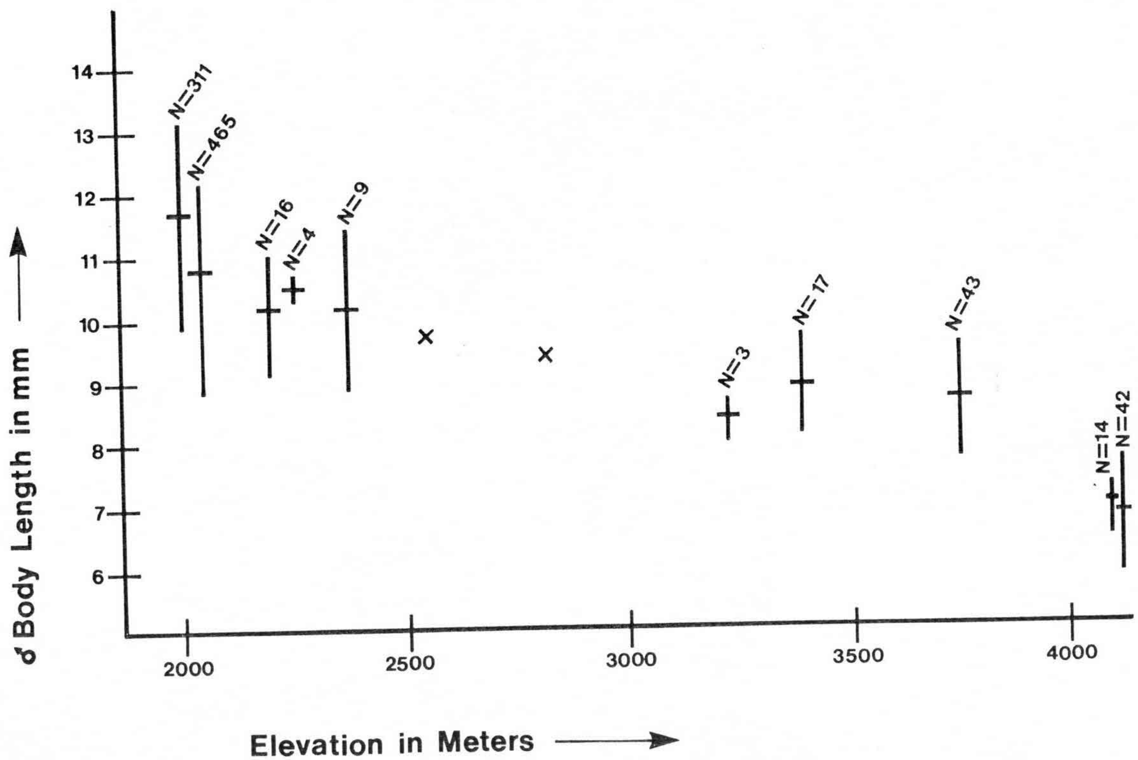


Fig. 54. Variation in body length of male *N. peruviana* along altitudinal transect from Huanuco, Huanuco D. to near Junin, Junin D., Peru. (Horizontal lines indicate means. Vertical lines indicate measured ranges. "X" indicates sample of only one specimen. "N" indicates sample size.)

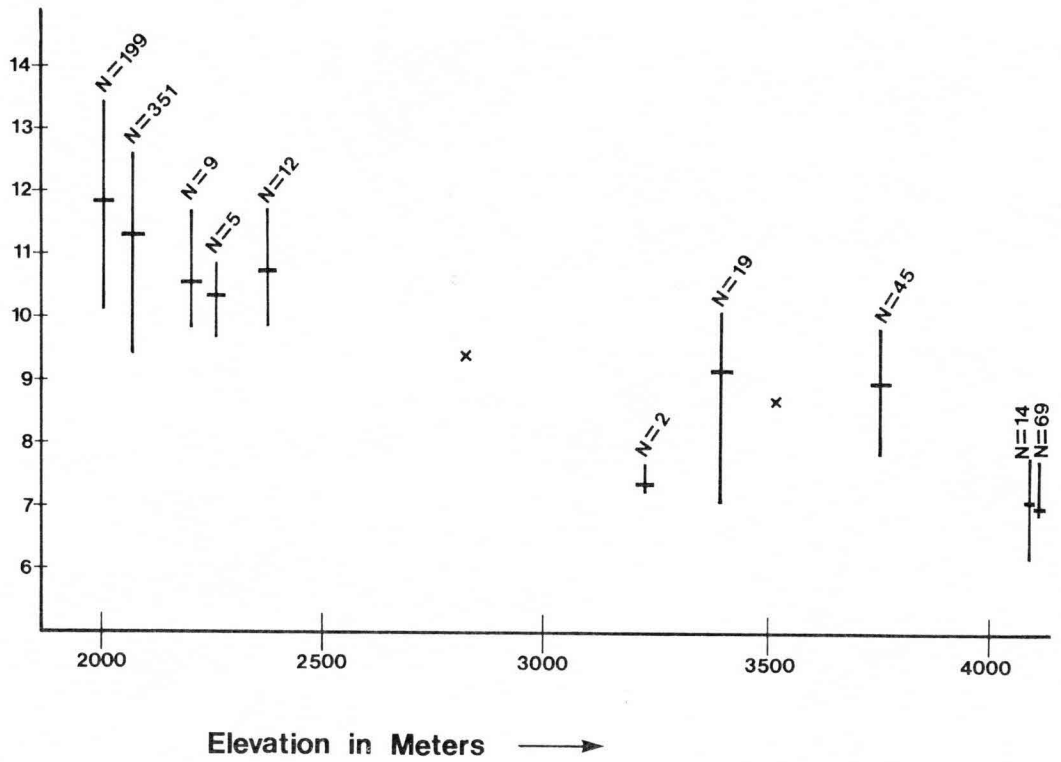


Fig. 55. Variation in body length of female *N. peruviana* along altitudinal transect from Huanuco, Huanuco D. to near Junin, Junin D., Peru. (Horizontal lines indicate means . Vertical lines indicate measured ranges. "X" indicates sample of only one specimen. "N" indicates sample size.)

Fig. 56. Photograph taken at night of *N. peruviana* climbing into grass in search of seeds (numerous adults seen climbing into grass, searching for and eating seeds, 13 km S Latacunga, Cotopaxi P., Ecuador, 2600 m, XI-3-77).

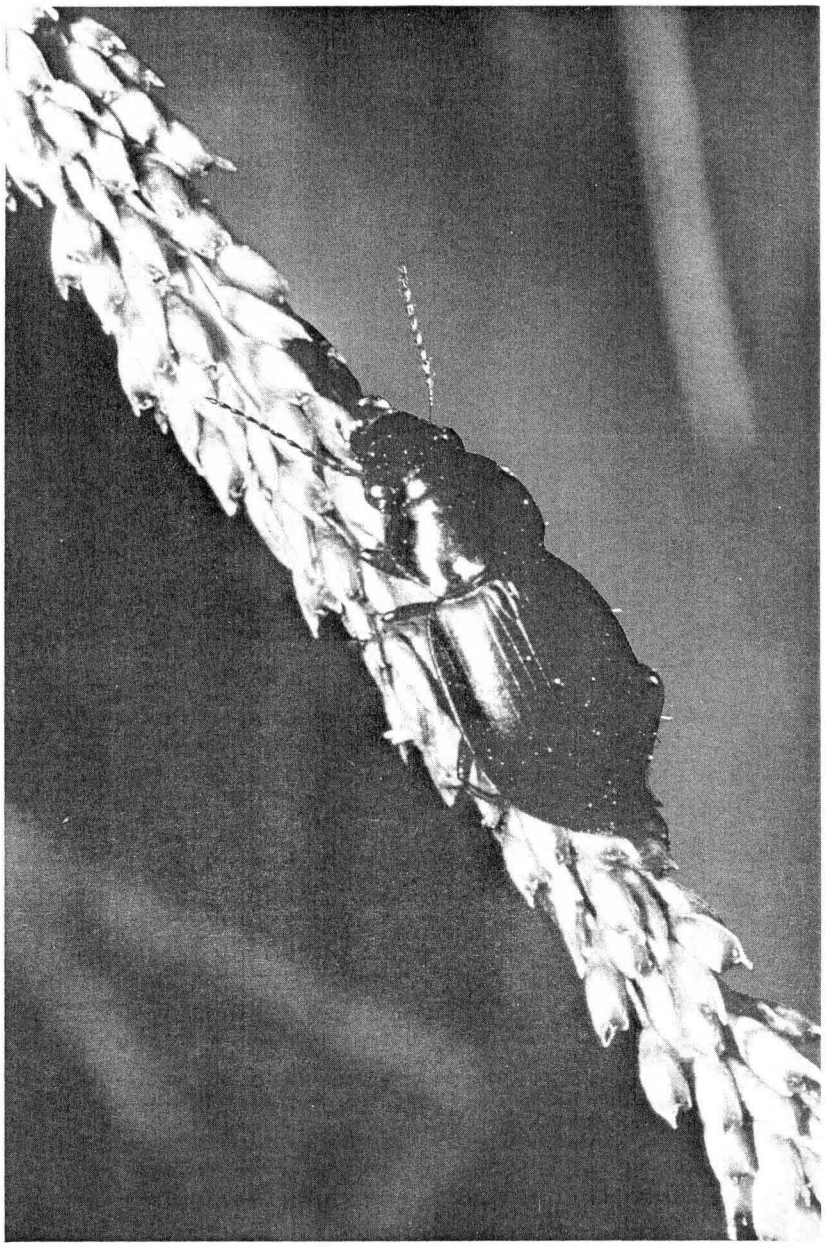


Fig. 57. Photograph taken at night of *N. bradytoides* feeding on grass seeds (13 km S Latacunga, Cotopaxi P., Ecuador, 2600 m, XI-3-77. Photograph airbrushed along right side to distinguish beetle from dark background.)

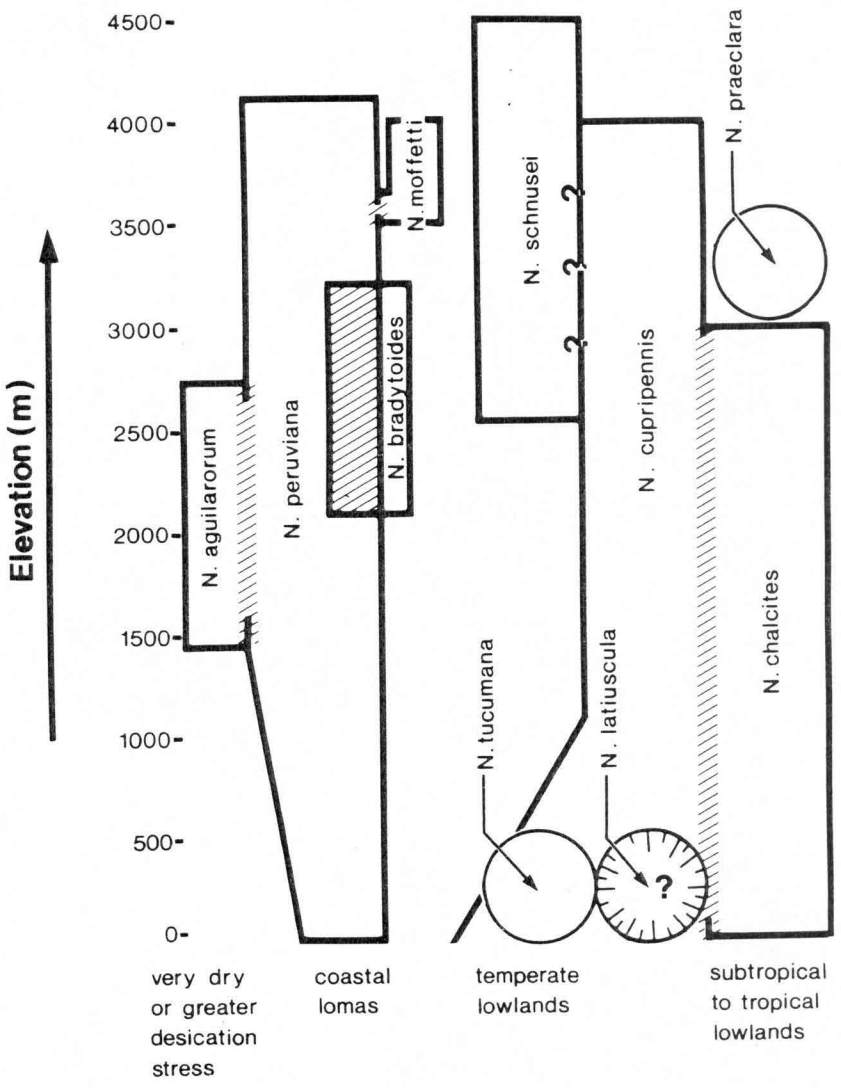
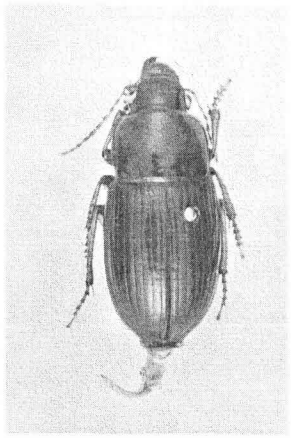


Fig. 58 Diagram illustrating species replacement. Each polygon represents a species whose name is thereby enclosed. Cross hatching indicates degree of microsympatry. Cross hatching and question marks in polygon for *N. latiuscula* indicate that microsympatry may not be complete. Question marks on boundary between *N. schnusei* and *N. cupripennis* indicate parapatric microsympatry probable but not yet demonstrated. Nature and breadth of habitat, and microsympatry determine size and position on diagram.



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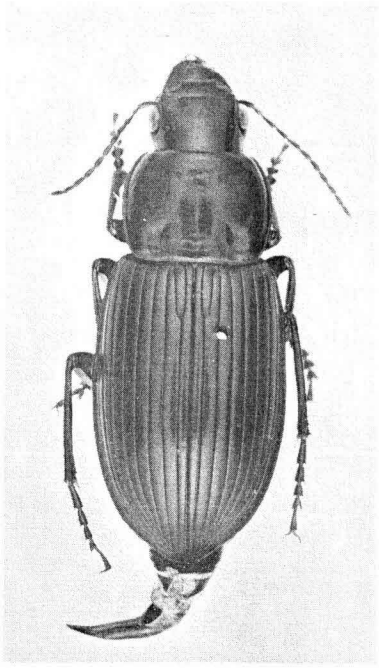

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Figs. 59 and 60. Photographs of adult males of new species, with median lobes everted. 59. *N. moffetti* (from type locality; body length 9.0 mm). 60. *N. aquilarorum* (56.9 km W Cajamarca on rd. to Pacasmayo, Cajamarca D., Peru; body length 15.9 mm).

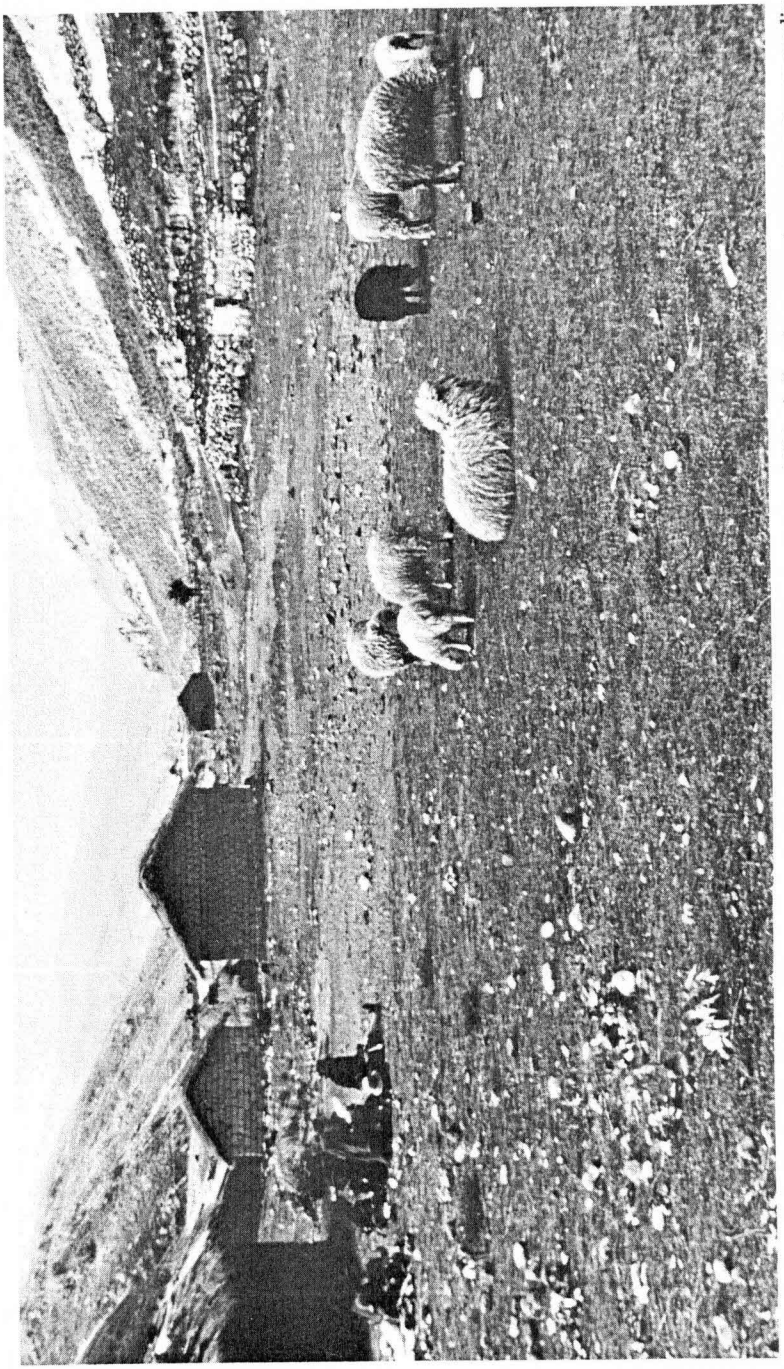

Fig. 61. Photograph taken at type locality for *N. moffetti* (43.7 km SE Huaraz, Ancash D., Peru, 3720 m). Specimens most numerous on surrounding hills but also found on ground in village.

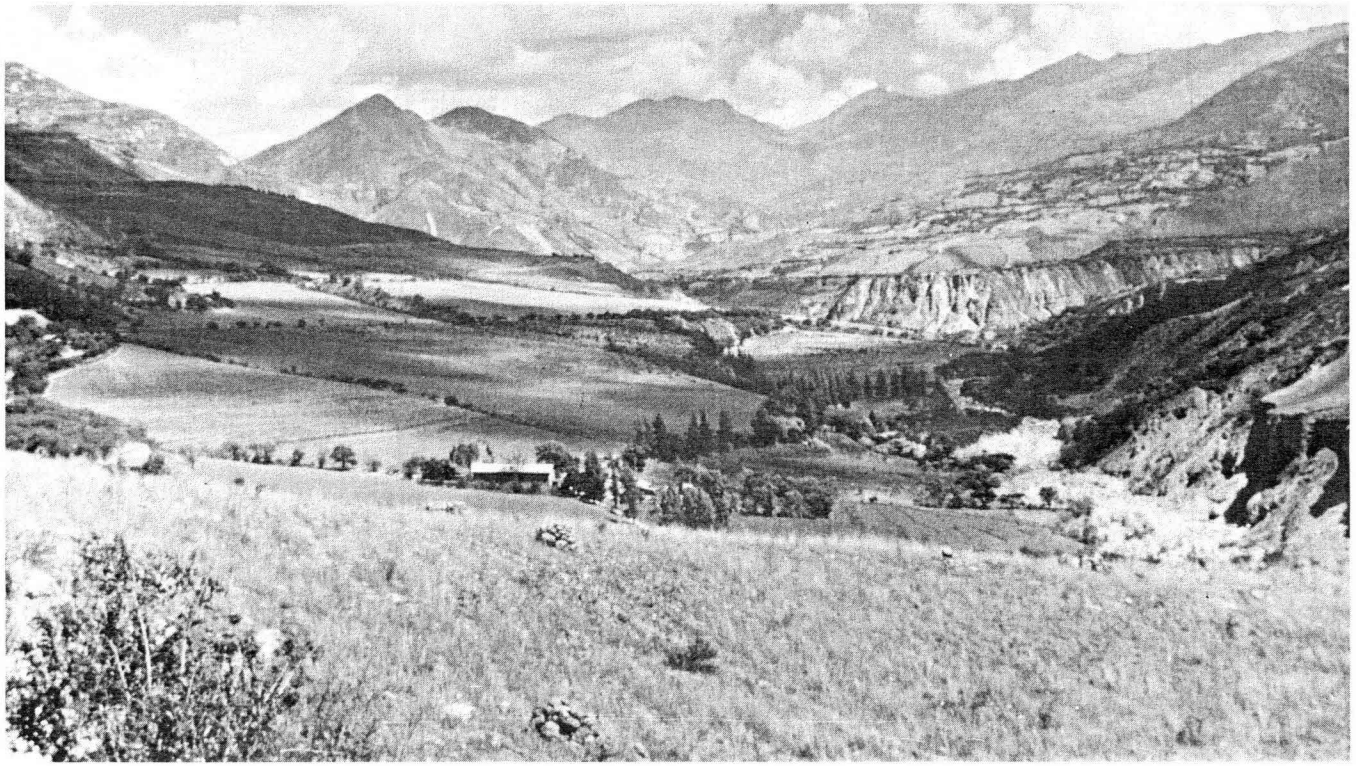

Fig. 62. Photograph take at type locality for *N. aquilarorum* (56.9 km W Cajamarca along road from Cajamarca to Pacasaymo, Cajamarca D., Peru, 1620 m). Most specimens from fallow field in foreground.

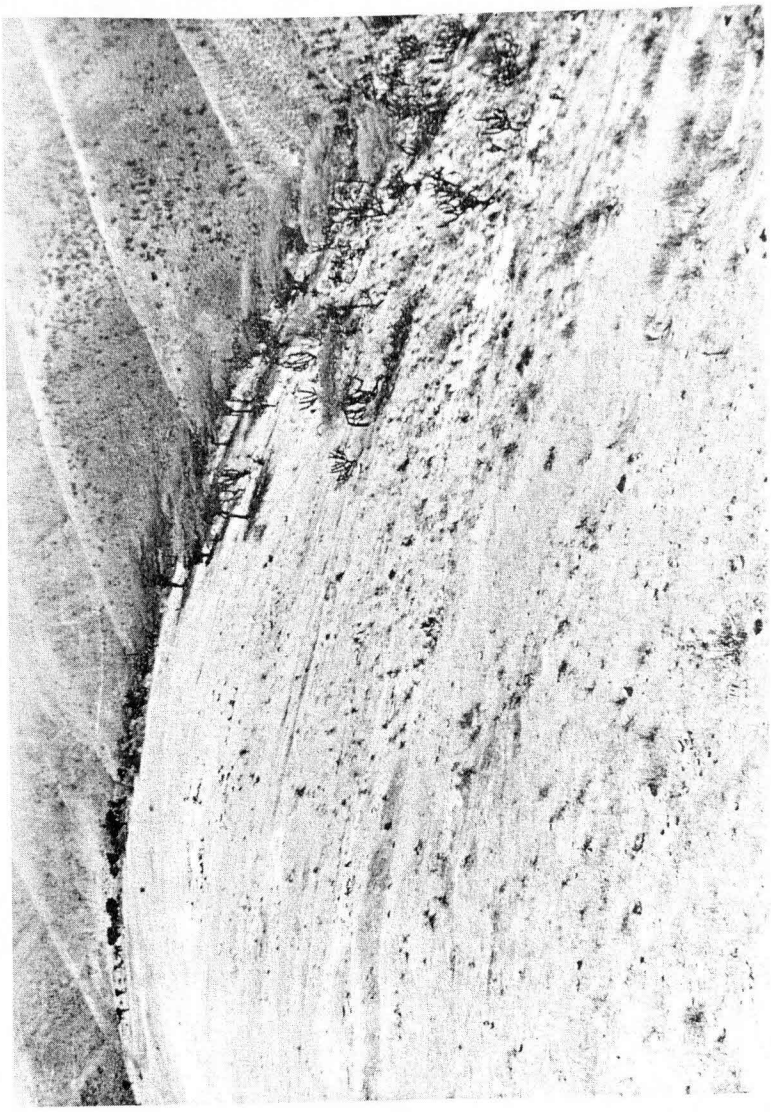

Fig. 63. Photograph of area where adults of *N. aquilarorum* and *N. peruviana* collected along top and upper sides of ridge (Abra de Porculla, 57.8 km E Olmus, Piura D., Peru, 2105 m, 11-8-78).

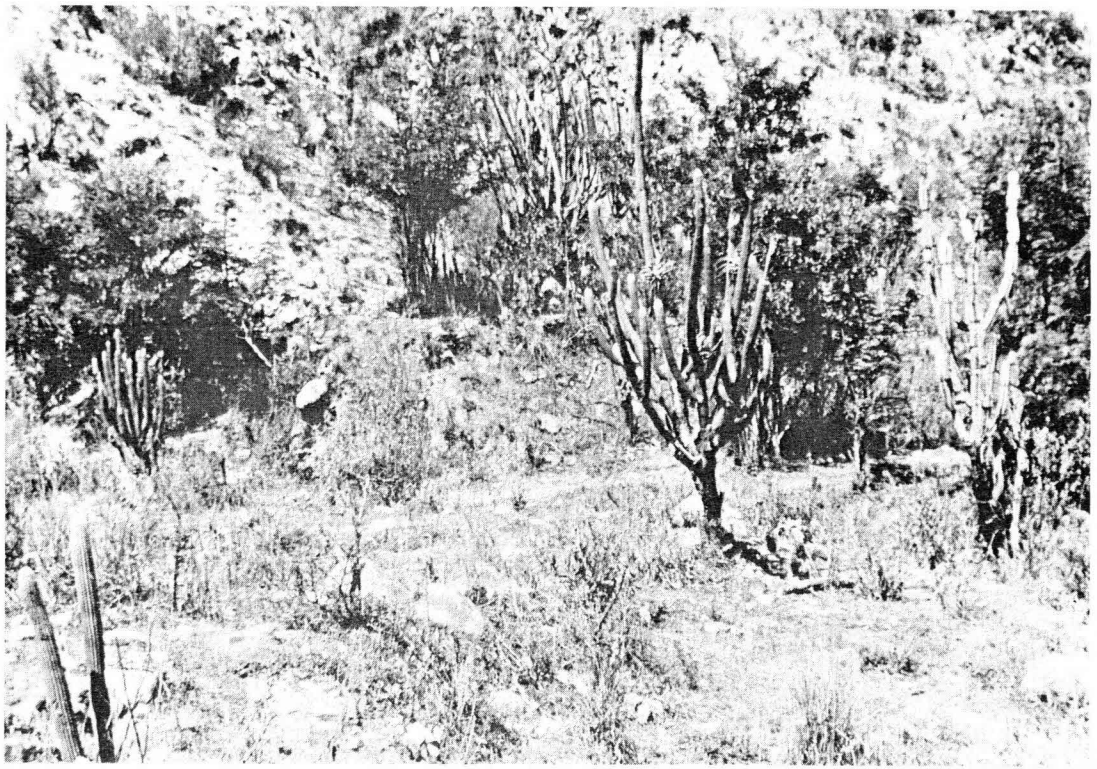

Fig. 64. Photograph of area where adults of *N. aquilarorum* and *N. peruviana* were collected (62.9 km SE Cajamarca, Cajamarca D., Peru, 2420-2430 m, II-2-78).

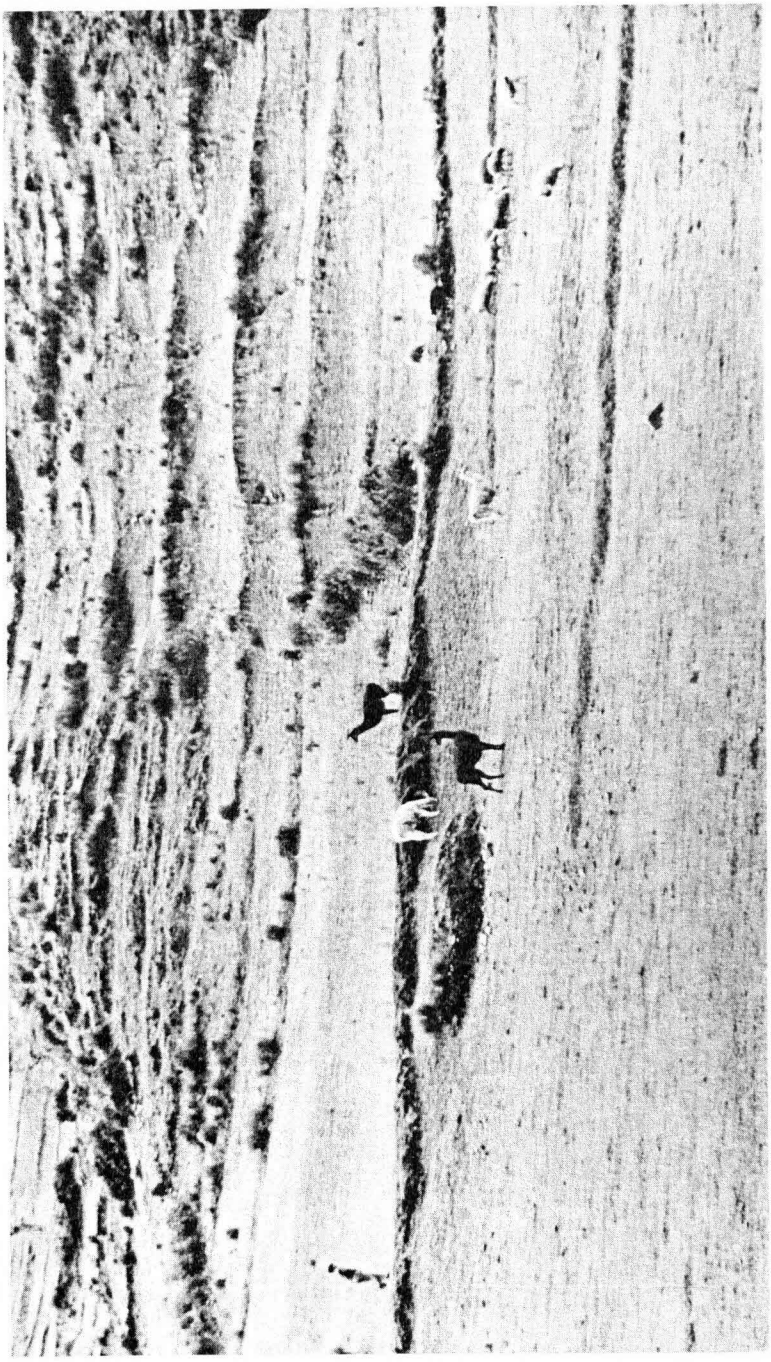

Fig. 65. Photograph of area where adults of *N. peruviana* were collected (14.3 km NE Cuzco along road to Pisac, Cuzco D., Peru, 3600 m, IV-1-78). Specimens found on sides of hill in background but not in flat foreground area.

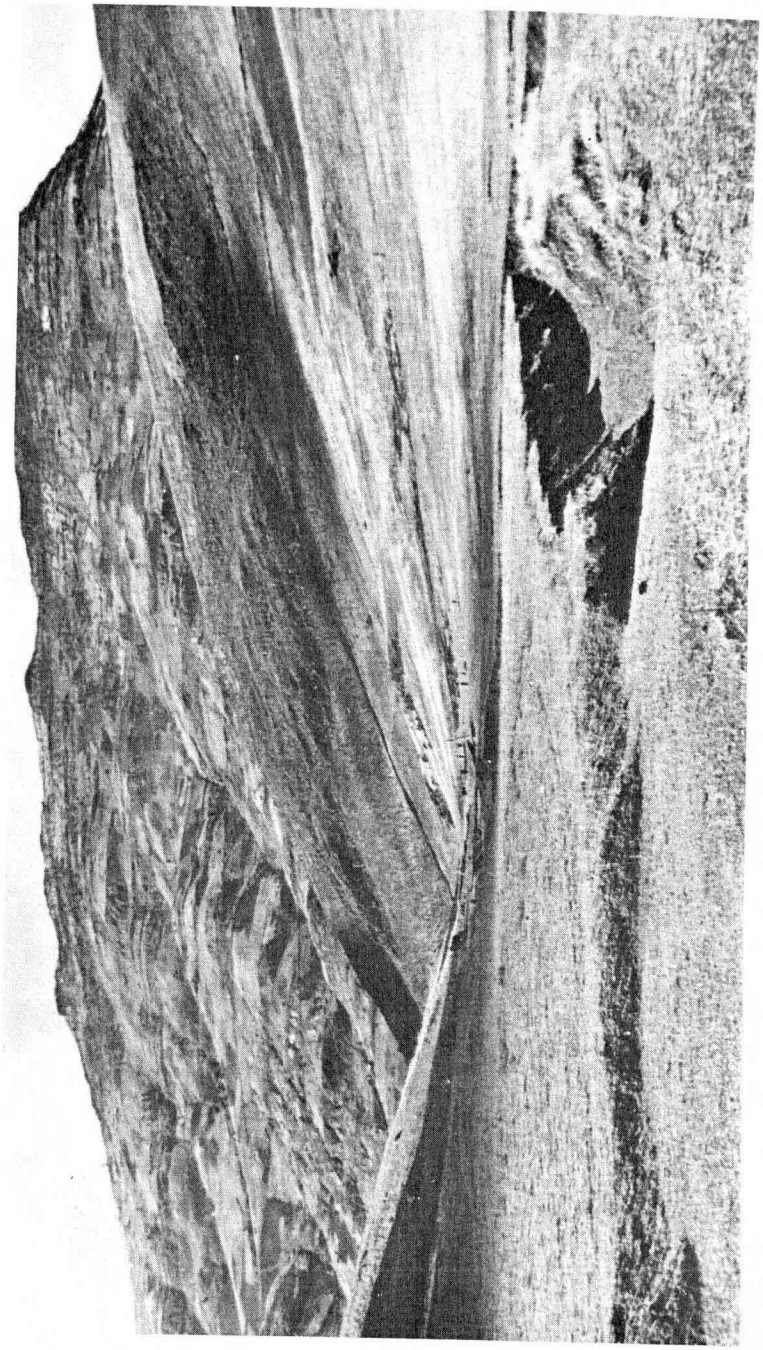

Fig. 66. Photograph of area where adults of *N. peruviana* collected (21.1 km NE Otuzco on road to Usiquil, La Libertad D., Peru, XI-26-77).

Fig. 67. Photograph of habitat where adults of *N. peruviana* collected (13.5 km N Junin on road from Cerro de Pasco to Junin, Junin D., Peru, III-5-78; photograph of M. Moffett).

Fig. 68. Photograph of habitat in which adults of *N. peruviana* were collected in coastal loma (25.2 km S Lima, Loma at Atacongo, Lima D. Peru, 200-400 m, XII-25-77). Approximately 300 adults were collected from under edge of large boulder (in right side of photograph) in pocket full of plant debris. Scorpions were also numerous in pocket which serves as a shelter during the dry season.

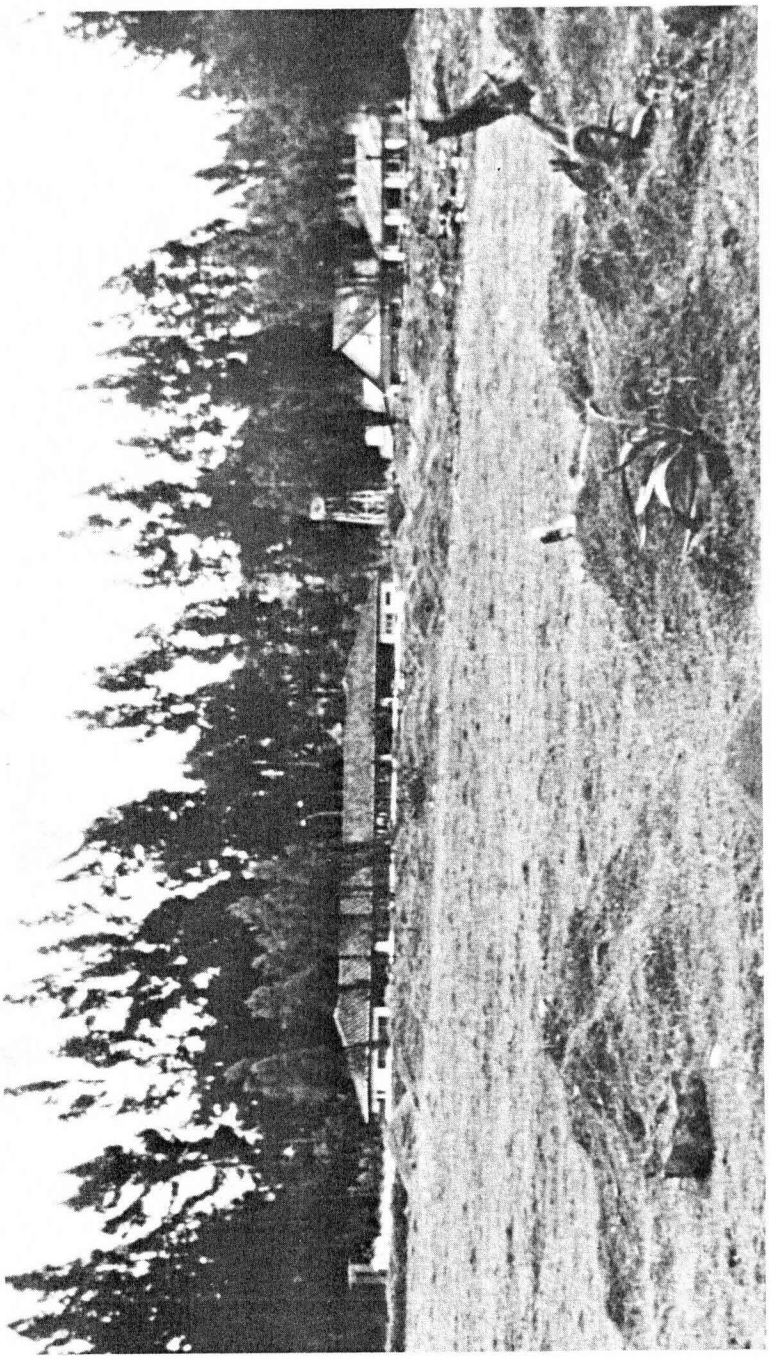

Fig. 69. Photograph of area where adults of *N. bradytoides* and *N. peruviana* were collected in fallow field (13 km S Latacunga, Cotopaxi P., Ecuador, 2600 m, XI-4-77).

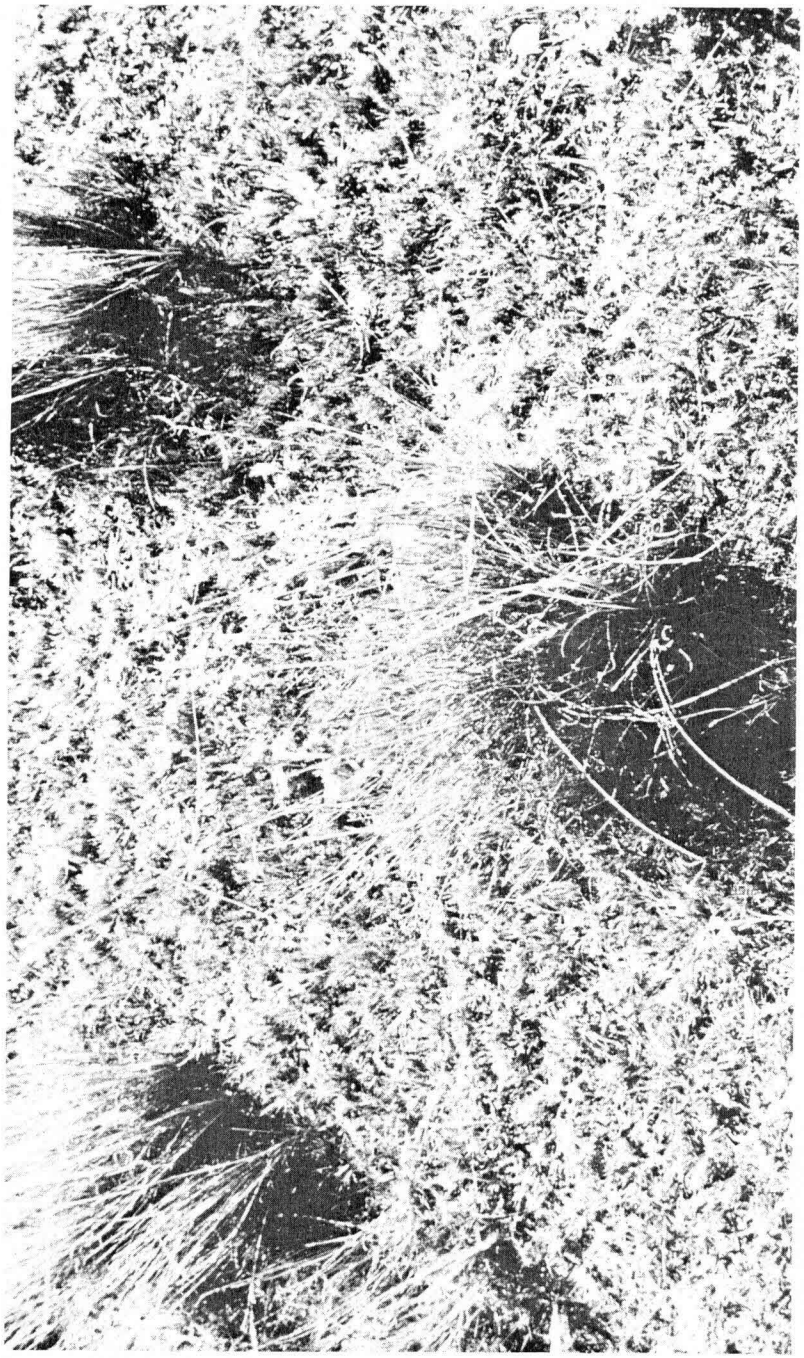

Fig. 70. Photograph of habitat in which adult female of *N. schnusei* was collected (34.1 km NW Puno along road to Arequipa, Puno D., Peru, IV-4-78).

Table 1. Microsympatry suggested by locality label data on museum specimens.

species	labeled as from same locality
N. cupripennis & *N. chalcites*	total of 5 localities in Argentina and Brazil
N. cupripennis & *N. latiuscula*	total of 4 localities in Argentina and Uruguay
N. peruviana & *N. bradytoides*	4 localities in Andes of Eduador

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