The Western Hemisphere Species of *Rhyssemus* and *Trichiorhyssemus* (Coleoptera: Scarabaeidae)

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ABSTRACT

Gordon, Robert D., and Oscar L. Cartwright. The Western Hemisphere Species of *Rhyssemus* and *Trichiorhyssemus* (Coleoptera: Scarabaeidae). *Smithsonian Contributions to Zoology*, number 317, 29 pages, 31 figures, 8 maps, 1980.—A taxonomic treatment of the species of *Rhyssemus* and *Trichiorhyssemus* occurring in the Western Hemisphere is presented along with keys, morphological illustrations, and distribution maps. Five new species, *Rhyssemus brownwoodi*, *R. spangleri*, *R. lineatus*, *R. mimicus*, and *R. intrinsecus*, are described.

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Contents

The Western Hemisphere Species of *Rhyssemus* and *Trichiorhyssemus* (Coleoptera: Scarabaeidae)

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Introduction

Species of *Rhyssemus* and *Trichiorhyssemus* are small, dark, rough scarabs with secretive habits. They are not commonly collected because many of them are not attracted to light nor are they associated with a particular type of dung as are many of the other aphodiine scarabs. From what is known of their habits, they are apparently associated with the upper layer of soil. Hamilton (1889) states that *Rhyssemus scaber* Haldeman was taken on Brigantine Island, New Jersey, in a salt marsh on a sandy spot about six inches above the level of the ordinary tides. He further states that *R. scaber* does not burrow but "lives beneath a thin layer of confervoid growth that forms on the marshes and about the roots of grass." Gordon and Cartwright also collected *R. scaber* among the roots of grasses behind the beach dunes south of Rehoboth, Delaware. Gordon collected *R. sonatus* LeConte in prairie dog mounds in southwestern North Dakota where they were associated with the fringes of the mound where the soil was loose and thin. All dissected specimens had the gut contents composed of particles of sandy soil. Gordon also found *R. sonatus* in large numbers in the burrows of *Spermophilus richardsoni* (ground squirrel) in north central North Dakota.

Both *Rhyssemus* and *Trichiorhyssemus* are distributed worldwide. Prior to the present paper, 12 species of these genera were known from the Western Hemisphere, nine from Mexico or north, and three from South America. Five new species of *Rhyssemus* are described herein: one from the United States, one from Mexico, and three from South America. All species discussed are apparently native to the Western Hemisphere except *Rhyssemus germanus* (L.), an Old World species that has become established in the northeastern United States and southern Canada. It was probably introduced in soil from European ports since the known North American specimens are all from the vicinity of the St. Lawrence River and the Great Lakes. The soil inhabiting tendency of members of *Rhyssemus* would seem to make their distribution by artificial means likely.

The illustrations presented herein were done by Mrs. Elsie Froeschner, Smithsonian staff artist. Most of the material studied is in the U.S. National Museum (USNM) collection located in the National Museum of Natural History, Smithsonian Institution, but several other sources gener-

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ously loaned types and other specimens: John Chemsak, Division of Entomology, University of California; Henry Howden, Biology Department, Carleton University and Canadian National Collection, Ottawa; Rabinder Kumar, Entomology Section, University of Wyoming, Laramie; John Lawrence, Museum of Comparative Zoology, Harvard University, Cambridge; Hugh Leech, California Academy of Sciences, San Francisco; A. T. McClay, Los Angeles County Museum, Los Angeles; Tord Nyholm, Naturhistoriska Riksmuseet, Stockholm; David Rentz, Philadelphia Academy of Sciences; Paul Ritcher, Department of Entomology, Oregon State University, Corvallis; Robert Pope, British Museum (Natural History), London; Henry Dietrich, Cornell University, Ithaca; J. Jelinek, National Museum of Natural History, Prague, Czechoslovakia; Ivan Löbl, Muséum d'Histoire Naturelle, Geneva, Switzerland.

Key to Genera

Dorsal surface lacking setae; ventral surface lacking scalelike setae ..... ***Rhyssemus***

Dorsal surface with setae; ventral surface with scalelike setae on meso- and metasterna, abdominal sterna, and hind femora ..... ***Trichiorhyssemus***

Genus *Rhyssemus* Mulsant

Rhyssemus Mulsant, 1842:314.—Horn, 1871:290; 1887:87.—Clouët, 1901:8.—Schmidt, 1922:497.—Balthasar, 1964: 556.

TYPE-SPECIES.—*Ptinus germanus* Linnaeus, by subsequent designation of Balthasar, 1964.

Elongate; upper surface dull, usually rough, usually encrusted with soil particles, black, blackish brown or reddish brown in color; dorsal surface lacking visible setae or scales. Head tuberculate, tubercles usually dense and variable in size; vertex with a large, usually elongate, oblique swelling or tubercle on each side; clypeus rounded, angulate or dentate on each side of median emargination; gena distinct, usually angularly rounded. Pronotum with transverse ridges (1 to 5 in number), transverse furrows, and a short, longitudinal, median furrow usually interrupting posterior transverse ridges; lateral and basal borders finely margined, often fringed with flattened setae; anterior margin of pronotum with a pale, membranous area. Elytral striae impressed, intervals carinate, tuberculate or otherwise distinctly sculptured. Epipleuron extending to extreme apex of elytron. Metasternum with longitudinal groove or impressed midline. Last abdominal sternum transversely impressed. Foretibia with 3 lateral teeth and an apical spur. Middle and hind tibiae only slightly broadened apically, apices fringed with setae and 2 acute apical spurs.

More than 50 species of *Rhyssemus* have been described from all parts of the world with the majority of the species occurring in the Palearctic and Oriental regions. Only 14 species are known from the Western Hemisphere, including five described herein for the first time. The Western Hemisphere species are distinctive and readily distinguished from one another by use of external morphological characters.

All known members of this genus from South America lack the pronotal fringe of flattened setae present in all species from Central America and northward. No other differences of consequence could be found, however, and we have kept all species in *Rhyssemus*.

The Western Hemisphere species of *Rhyssemus* were last treated by Schmidt (1922) in his work on the Aphodiinae of the world. At that time only one species was known from South America and no illustrations were provided. Prior to Schmidt, Clouët (1901) monographed the genus for the world, and Horn (1887) included *Rhyssemus* in his work on the Aphodiini of the United States.

Rhyssemus and *Trichiorhyssemus* apparently differ in only one respect: *Trichiorhyssemus* has elytral setae and ventral, scalelike setae; *Rhyssemus* has no visible elytral setae and only some fine, ventral, hairlike setae. It is possible that *Trichiorhyssemus* should be placed as a junior synonym of *Rhyssemus*; however, because we are treating only the Western Hemisphere species, which represent only a small percentage of the total number of species, we elect to retain both names in their current usage.

Key to Western Hemisphere Species of *Rhyssemus*

1. Pronotum fringed laterally and basally with closely spaced, flattened setae (Figure 1); North America and Mexico 2
   Pronotum lacking fringe of setae (Figure 11); South America 9
2. Species known from the Atlantic Coast from Rhode Island to Virginia; elytral intervals appearing costate (Figure 1) ..... ***scaber*** Haldeman
   Species not known from the Atlantic Coast, or if so, then elytral intervals tuberculate 3
3. Pronotal ridges entire, shining, strongly developed, with practically all traces of individual tubercles obliterated (Figure 3) .... ***germanus*** (L.)
   Pronotal ridges not entire, individual tubercles visible 4
4. Elytral intervals costate or with very close, elongate tubercles narrowly separated so as to appear costate; Mexico 5
   Elytral intervals tuberculate; not known from Mexico 6
5. Elytral intervals completely costate (Figure 8) ... ***spangleri***, new species
   Elytral intervals appearing costate but costae composed of elongate, narrowly separated tubercles (Figure 7) ..... ***mexicanus*** Hinton
6. Elytral intervals with a single row of tubercles 7
   Elytral intervals with a double row of tubercles 8
7. Elytral intervals with a median row of large, distinct tubercles; most of the large tubercles on the transverse ridges of pronotum fused and shining, all ridges frequently interrupted at middle (Figure 2); Great Plains, southern Canada to Texas ..... ***neglectus*** Brown
   Elytral intervals having an outside row of low, inconspicuous tubercles; large tubercles on pronotal ridges fused but more or less distinct (Figure 6), only posterior ridge interrupted at middle; Texas ..... ***brownwoodi***, new species
8. Elongate species, elytra nearly parallel sided; pronotal ridges distinct, furrows between ridges deep (Figure 5); California, Arizona ..... ***californicus*** Horn
   Short, broad species, elytra not parallel sided; pronotal ridges usually not distinct, completely tuberculate with furrows between ridges shallow (Figure 4); Great Plains, Alberta and Saskatchewan to Kansas and Arkansas ..... ***sonatus*** LeConte
9. All elytral intervals costate (Figure 9) 10
   Alternate elytral intervals costate 11
10. Clypeus separated from front by a deep groove; frontal area scabrous, tuberculate ..... ***minutus*** Petrovitz
    Clypeus not separated from front by deep groove; frontal area longitudi-

nally, finely, densely furrowed by very elongate punctures or lines ..... ***mimicus***, new species

11. Form short, robust, elytra rounded laterally (Figure 14); longitudinal ridges of pronotum completely dividing the posterior 4 transverse ridges ..... ***intrinsecus***, new species

Form elongate, slender, elytra parallel sided; posterior 3 pronotal ridges divided by longitudinal ridges 12

12. Pronotal ridges low, rounded, polished; longitudinal ridges narrowly separated (Figure 12); British Guiana ..... ***beccarii*** Balthasar

Pronotal ridges sharp, distinct; longitudinal ridges widely separated; Brazil 13

13. Longitudinal pronotal ridges joined anteriorly, extending to short transverse ridge (Figure 11); elytral costae rounded ..... ***quinquecostatus*** Schmidt

Longitudinal pronotal ridges not joined anteriorly, not extending to short transverse ridge (Figure 13); elytral costae carinate ..... ***lineatus***, new species

Rhyssemus scaber Haldeman

FIGURES 1, 18; MAP 1

Rhyssemus scaber Haldeman, 1848:107.—Horn, 1871:290; 1887:88.—Leng, 1920:251.—Schmidt, 1922:503.

MALE.—Length 3.3 mm, greatest width 1.5 mm. Elongate, widest behind middle of elytra, lateral margin of elytron not straight. Color dark reddish brown, pronotum and elytron black. Surface of head tuberculate, tubercles discrete, becoming smaller and denser toward posterior margin; anterior clypeal margin distinctly emarginate between rounded angles, feebly, narrowly reflexed. Pronotum 1.0 mm long by 1.25 mm wide; closely, densely tuberculate, with 4 transverse ridges, tubercles large on ridges, small in furrows, posterior 3 ridges narrowly broken at middle (Figure 1); lateral and basal borders narrowly margined, with a fringe of closely spaced, flattened setae. Elytra 2.2 mm long, 1.5 mm wide, humerus sharply dentate; striae deeply impressed, coarsely punctured, punctures separated by 2 to 3 times their diameter; interval wide, flat, with median costa, costa narrowly, irregularly broken, an elongate tubercle present at inner margin of interval opposite each strial puncture. Mesosternum densely punctured, feebly carinate between coxae. Metasternal midline distinctly impressed, extending from apex to base of metasternum; surface smooth, feebly alutaceous medially, becoming strongly alutaceous and roughened laterally. Abdominal sterna alutaceous, dull with narrow fluting on anterior margin, fluting becoming longer on successive sterna, each sternum with a row of indistinct tubercles extending from lateral border nearly to midline. Pygidium rough with scattered, fine tubercles and alutaceous sculpture, 2 erect setae present apically. Foretibia smooth with 3 lateral teeth, the posterior tooth at middle of tibia; spur long, slender, slightly sinuate, angled slightly downward. Middle and hind tibiae equal in length to femora, each apex fringed with short, somewhat unequal setae and 2 spurs, outer spur short, straight, half as long as inner spur, inner spur slightly longer than first tarsal segment, feebly sinuate. Hind tarsus shorter than tibia, basal segment as long as 2nd and 3rd combined, segments 2–4 successively decreasing in length, 5th segment nearly twice as long as 4th. Genitalia with lateral lobe short, broad, feebly bent downward at apex; internal sac lined with tiny teeth (Figure 18).

FEMALE.—Similar to male except the pygidium is wider and the penultimate abdominal sternum slightly longer at middle.

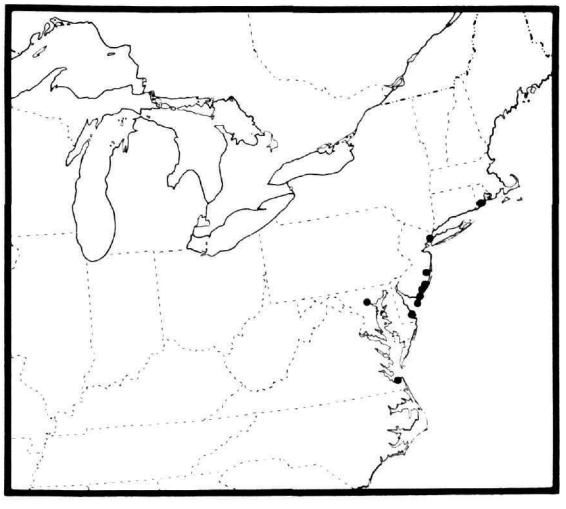
VARIATION.—Length 3.2 to 3.4 mm, width 1.5 to 1.8 mm. The dorsal color varies from black to

a light reddish brown. The reddish-brown specimens are nearly always slightly teneral. The carinae on the elytral intervals are not as strongly raised in some specimens and are occasionally broken into narrow, elongate tubercles.

TYPE-LOCALITY.—"Middle States."

TYPE DEPOSITORY.—Museum of Comparative Zoology, Harvard University.

REMARKS.—This species is distinguished from other United States species of *Rhyssemus* by the costate elytral intervals and presence of two pygidial hairs. *Rhyssemus scaber* is the only species of the genus known from the Atlantic Coast of the United States, to which it is apparently restricted. Nearly all specimens examined have been from Atlantic City, Rehoboth Beach, or some seaside locality. One apparently reliably labeled specimen has been seen from Fort Monroe, Virginia, which is considerably south of the area occupied by the rest of the known specimens. Two other specimens in the USNM collection are labeled "Calif" and "Jeanette, Pa.," both of which are assumed to be incorrectly labeled. According to Haldeman's description, he obviously had only one specimen of *R. scaber*, which must be considered the holotype. This specimen is in the LeConte collection, Museum of Comparative Zoology, labeled "[pink disc]/Type 8360/*Rhyssemuss scaber* Hald."



MAP 1.—Distribution of *Rhyssemus scaber* Haldeman.

MATERIAL EXAMINED (Map 1).—63 specimens. UNITED STATES: DELAWARE: Rehoboth Beach; Henlopen Dunes. MARYLAND: Baltimore. NEW JERSEY: Anglesea; Atlantic City; Brigantine; Ocean City; Seaside Heights. NEW YORK: "New York"; Coney Island. RHODE ISLAND: "R.I." VIRGINIA: Fort Monroe.

Rhyssemus neglectus Brown

FIGURES 2, 19; MAP 2

Rhyssemus neglectus Brown, 1929:92–93.—Leng and Mutchler, 1933:39.

MALE.—Length 3.4 mm, greatest width 1.6 mm. Elongate, widest behind middle of elytra, lateral margin of elytron not straight. Color black except clypeus, ventral surface of head, prosternum, legs, and median portion of abdomen reddish brown. Surface of head densely tuberculate, tubercles coarse medially, becoming finer and denser laterally and posteriorly; anterior clypeal margin distinctly emarginate between angulate angles, narrowly, feebly reflexed. Pronotum 2.0 mm long by 1.5 mm wide; pronotal surface densely tuberculate between 4 irregular, transverse ridges (Figure 2), surface of ridges smooth, anterior ridge irregularly complete, made up of large, connected tubercles, 2nd ridge narrowly incomplete medially, strongly raised and uniform from middle halfway toward lateral border, 3rd ridge irregular, incomplete medially, made up of large, incompletely connected tubercles, 4th ridge composed of separated, transversely elongate tubercles, widely incomplete medially; lateral and basal border narrowly margined, with fringe of coarse, flattened setae. Elytra 2.3 mm long, 1.6 mm wide, humerus strongly dentate; strial groove strongly impressed, punctate, punctures separated by 2 to 3 times their diameter; sutural interval smooth, lacking tubercles, rest of intervals with median row of very large, discrete tubercles and an irregular row of small tubercles on inner margin adjacent to strial punctures. Mesosternum densely punctured, feebly carinate between coxae. Metasternum as described for *scaber*. Abdominal sterna as described for *Rhyssemus scaber* except lateral tubercles nearly obsolete. Pygidium scabrous, with scattered tubercles and 2 erect

setae present apically. Foretibia smooth, with 3 lateral teeth, the posterior tooth at middle of tibia; spur long, slender, curved downward slightly at apex. Middle and hind tibiae each fringed with short, unequal setae and 2 spurs, outer spur less than half as long as inner, inner spur slightly longer than first tarsal segment, feebly sinuate, apex sharp. Hind tarsus shorter than tibia, basal segment as long as segments 2–4 combined, segments 2–4 slightly decreasing in length successively, 5th segment nearly twice as long as 4th. Genitalia with lateral lobe short, feebly bent downward and membranous at apex; internal sac lined with tiny teeth (Figure 19).

FEMALE.—Similar to male except the pygidium is wider and the penultimate abdominal sternum slightly longer at middle.

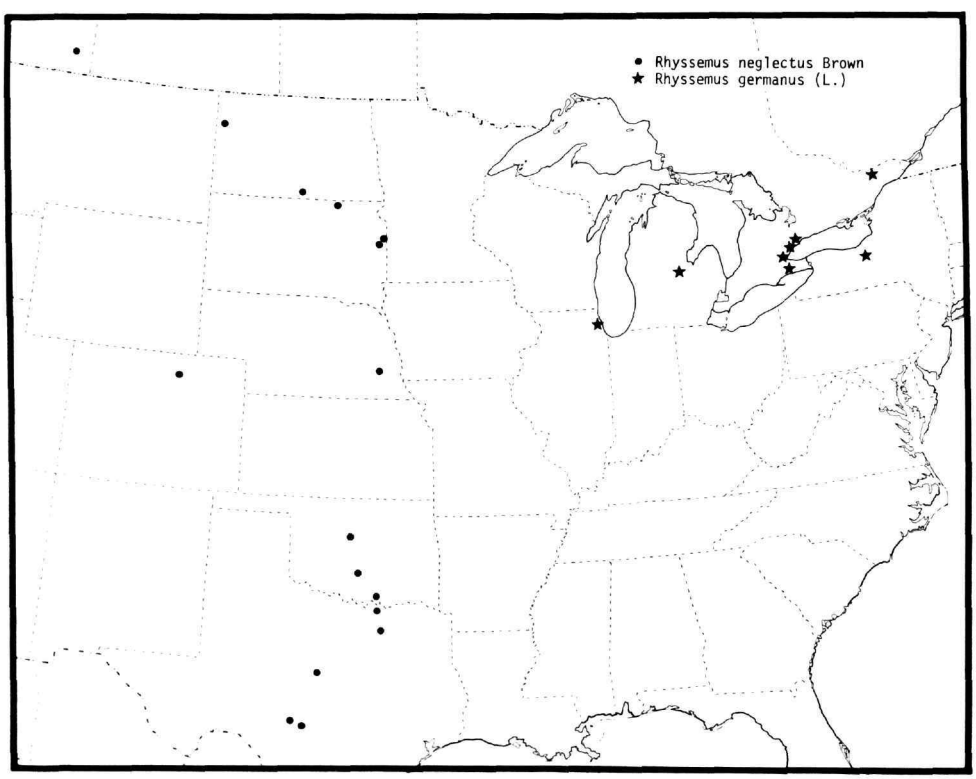
VARIATION.—Length 3.3 to 3.8 mm, width 1.6 to 1.9 mm. The dorsal color becomes brown or reddish brown in specimens not fully mature. The transverse pronotal ridges vary in degree of fusion and size of the tubercles of which they are composed. Two specimens observed had three pygidial setae rather than two.

TYPE-LOCALITY.—Payne Co., Oklahoma.

TYPE DEPOSITORY.—Canadian National Collection, Ottawa.

REMARKS.—*Rhyssemus neglectus* resembles *R. sonatus* in external appearance, but *R. sonatus* is a smaller, more slender species with the pronotal ridges finely tuberculate as in the intervening furrows and usually with six pygidial hairs. Based on male genitalia and pygidial hairs, *R. neglectus* is more closely related to *R. scaber* than to *R. sonatus*. *Rhyssemus neglectus* is a Great Plains species. We regard a single specimen in the USNM collection labeled "Woodridge, DC" as extremely questionable.

MATERIAL EXAMINED (Map 2).—56 specimens. CANADA: ALBERTA: Medicine Hat. UNITED STATES: COLORADO:



MAP 2.—Distribution of *Rhyssemus* species.

"Colo.": Greeley. NEBRASKA: Lincoln. NORTH DAKOTA: Emmons Co.; Williams Co. OKLAHOMA: Marshall Co., Lake Texoma; McClain Co.; Payne Co. SOUTH DAKOTA: Astoria; Hecla; Oak Lake. TEXAS: "Texas"; Dallas; Goldthwaite; Grayson Co., Juniper Pt., Lake Texoma (12 mi N of Whitesboro), in lake shore debris; Kerrville; 6 mi NE, Mt. Home, Kerr Co., in nest of *Solenopsis xyloni*.

Rhyssemus germanus (Linnaeus)

FIGURES 3, 20; MAP 2

Ptinus germanus Linnaeus, 1767:566.
Rhyssemus germanus.—Mulsant, 1842:314.—Brown, 1950: 210.—Schmidt, 1922:501.
Scarabaeus asper Fabricius, 1775:20.
Rhyssemus asper.—Erichson, 1848:910.
Rhyssemus aspericeps Chevrolat, 1861:266.
Rhyssemus geminatus Reitter, 1890:390.
Rhyssemus obsoletus Rey, 1890:171.
Rhyssemus parallelus Reitter, 1892:28.
Rhyssemus puncticollis Brown, 1929:91; 1950:201.

MALE.—Length 3.1 mm, greatest width 1.5 mm. Elongate, widest at middle of elytra. Color black except anterior clypeal margin, ventral surface of head, propleuron, legs, and last abdominal sternum reddish brown. Surface of head roughly tuberculate in apical half, posterior half granulate except a large tubercle present on each side of middle; anterior clypeal margin emarginate between dentate angles, narrowly reflexed. Pronotum 0.9 mm long, by 1.2 mm wide; surface with 4 distinct, raised ridges, ridges smooth, not tuberculate or punctured, posterior 2 ridges interrupted medially; area between ridges densely, coarsely punctured, anterior third of pronotum densely tuberculate (Figure 3); lateral and basal borders narrowly margined, with a fringe of closely spaced, flattened setae. Elytra 2.0 mm long. 1.5 mm wide, humerus dentate; striae distinctly impressed, punctured, punctures separated by 2 to 3 times their diameter; intervals flat except sutural interval slightly raised with faint, mostly distinct, median row of tubercles, other striae with 2 rows of tubercles, outer row large, rounded; inner row of tubercles small, some elongate. Mesosternum strongly alutaceous, sharply, distinctly carinate between coxae. Metasternal midline extending from apex to base of metasternum; surface smoothly shiny medially, becoming rough and scabrous laterally. Abdominal sterna distinctly alutaceous, dull, with fluting along anterior margin of each sternum and a row of small tubercles joined to give appearance of serrated line from lateral border to midline. Pygidium rough, scabrous, strongly alutaceous, 2 erect, apical setae present. Foretibia feebly punctate, with 3 lateral teeth, the posterior tooth slightly behind middle of tibia; spur long, slender, straight, angled slightly downward. Middle and hind tibiae equal in length to femora, each apex fringed with short, unequal setae and 2 spurs, outer spur short, slightly curved, half as long as inner spur, inner spur longer than first tarsal segment, sinuate, apex acute. Hind tarsus shorter than tibia, basal segment longer than 2 and 3 combined, segments 2–4 slightly decreasing in length successively, 5th segment as long as 3 and 4 combined. Genitalia with lateral lobe short, broad at apex; internal sac with 2 triangular, lateral sclerites (Figure 20).

FEMALE.—Similar to male except the pygidium is wider and the penultimate abdominal sternum slightly longer at middle.

VARIATION.—Length 2.8 to 3.3 mm, width 1.2 to 1.6mm. The pronotal ridges are sometimes less distinct than described above. The relative sizes of the tubercles on the elytral striae also vary slightly.

TYPE-LOCALITY.—"Habitat in Germania."

TYPE DEPOSITORY.—Unknown to writers.

REMARKS.—This is the introduced European species described as *Rhyssemus puncticollis* by Brown in 1929 and recognized as *R. germanus* by Brown in 1950. Apparently, it is not yet widely distributed, and all known records are from the vicinity of the Great Lakes and the St. Lawrence River.

The smooth, high, pronotal ridges distinguish *Rhyssemus germanus* from any other presently known Western Hemisphere species. The elytral intervals are of the type found in *R. sonatus* and *R. californicus*, but *R. germanus* does not otherwise resemble those two species.

MATERIAL EXAMINED (Map 2).—106 specimens. CANADA: ONTARIO: Dunnville; Ottawa; Rouge River; Toronto. UNITED STATES: ILLINOIS: Chicago; MICHIGAN: Midland Co. NEW YORK: Ithaca.

Rhyssemus sonatus LeConte

FIGURES 4, 21; MAP 3

Rhyssemus sonatus LeConte, 1881:77.—Henshaw, 1882:232.—Horn, 1887:89.—Leng, 1920:251.—Schmidt, 1922:507.

MALE.—Length 3.6 mm, greatest width 1.7 mm. Elongate, widest at middle of elytra, nearly parallel sided. Color dark reddish brown; head except clypeus, pronotum except anterior border and antero-lateral angle piceous to black. Head tuberculate, tubercles fine, dense on vertex, becoming coarse and less dense across front; clypeus finely tuberculate, anterior margin distinctly emarginate between dentate angles, feebly, narrowly reflexed. Pronotum 1.0 mm long by 1.4 mm wide; closely, densely, finely tuberculate, 4 transverse ridges present with tubercles only slightly coarser than between, all ridges narrowly broken at midline (Figure 4); lateral and basal borders narrowly margined, with fringe of evenly spaced, flattened setae. Elytra 2.4 mm long, 1.7 mm wide, humerus sharply dentate; striae deeply impressed, punctured, punctures separated by 4 to 6 times their diameter; intervals flat except sutural interval raised with single median row of tubercles, other intervals with 2 rows of tubercles, outer row large, rounded, inner row of tubercles small, elongate (Figure 4). Metasternum strongly alutaceous, broadly carinate between coxae. Metasternal midline extending from apex to base of metasternum; surface smooth, shiny medially, becoming alutaceous and slightly tuberculate laterally. Abdominal sterna weakly alutaceous, with fluting along anterior margin of each sternum and a row of indistinct tubercles extending from lateral border nearly to midline. Pygidium scabrous, strongly alutaceous, 6 erect, apical setae present and several short, erect setae scattered over surface. Foretibia smooth, with 3 lateral teeth, the posterior tooth slightly behind the middle of tibia; spur long, robust, feebly sinuate, not curved downward. Middle and hind tibiae equal in length to femora, each apex fringed with long, unequal setae and 2 spurs, outer spur short, sinuate, less than half as long as inner spur, inner spur longer than first tarsal segment, feebly sinuate. Hind tarsus shorter than tibia, basal segment as long as segments 2–4 combined, segments 2–4 slightly decreasing in length successively, 5th segment twice as long as 4th. Genitalia with lateral lobe long, slender, abruptly bent downward before apex; internal sac with 3 large, median sclerites and a patch of small spicules laterally (Figure 21).

FEMALE.—Similar to male except the pygidium is wider and the penultimate abdominal sternum slightly longer at middle.

VARIATION.—Length 2.7 to 3.7 mm, width 1.2 to 1.7 mm. The dorsal color varies from reddish brown to black. Specimens from northern Colorado usually have the pronotal ridges smoother and more apparent than described above and usually do not have tubercles on the sutural interval. The pygidial hairs are easily broken and there may be from none to eight present. Specimens with eight hairs are extremely rare.

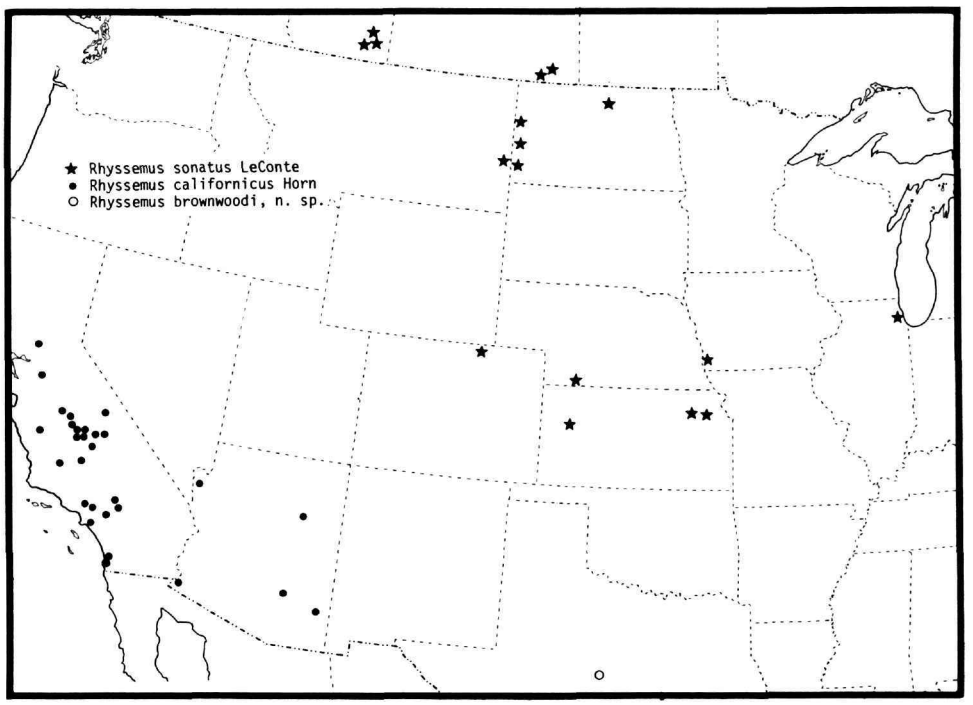
TYPE-LOCALITY.—"near Chicago."

TYPE DEPOSITORY.—Not located.

REMARKS.—This species closely resembles *Rhyssemus californicus*, but *R. sonatus* is usually smaller with larger elytral tubercles, a smoother metasternum, definitely denticulate clypeal angle, and usually six pygidial hairs. *Rhyssemus californicus* is also more elongate and parallel sided. The two species are apparently completely allopatric. At first glance some specimens from Pawnee National Grassland, Colorado, appear different from typical *R. sonatus* for reasons stated under variation above. In addition, these Pawnee specimens appear short and broad apically. Examination of more than 140 specimens from the Pawnee has revealed all degress of intergradation between typical *R. sonatus* and the extreme Pawnee type, and they are regarded as conspecific.

It has not been possible to locate the type specimen of *R. sonatus*. LeConte (1881) stated that he had one specimen "found by Mr. A. Bolter, near Chicago," but there is no specimen so labeled in either the LeConte or Horn collection. It is apparent from the description of the pronotum as being "without ridges" that LeConte's species is the same as that described above.

MATERIAL EXAMINED (Map 3).—250 specimens. CANADA: ALBERTA: Manyberries; Medicine Hat; Orion. SAS-



MAP 3.—Distribution of *Rhyssemus* species.

KATCHEWAN: Oxbow; Roche Perce. UNITED STATES: ARKANSAS: "Ark." COLORADO: Pawnee National Grassland, Fort Collins. ILLINOIS: Chicago. IOWA: Mills Co. KANSAS: "Kans."; Gove Co.; Onaga; Topeka. MONTANA: "Mon"; Glendive. NEBRASKA: McCook. NORTH DAKOTA: McKenzie Co.; Theodore Roosevelt National Park, South Unit; Williston; Rolette Co., Rolette.

Rhyssemus californicus Horn

FIGURES 5, 22; MAP 3

Rhyssemus californicus Horn, 1871:290; 1887:89.—Leng, 1920: 251.—Schmidt, 1922:503.

MALE.—Length 4.0 mm, greatest width 1.8 mm. Elongate, parallel sided, widest at middle of elytra. Color black except clypeus, ventral surface of head, hypopleuron, legs, and last abdominal sternum reddish brown. Surface of head tuberculate, tubercles mostly discrete, subequal in size throughout; anterior clypeal margin emarginate between angulate angles, barely perceptibly reflexed. Pronotum 1.1 mm long by 1.25 mm wide; closely, densely tuberculate with 4 distinct, transverse ridges, tubercles same size on ridges as in furrows, all ridges narrowly interrupted medially (Figure 5); lateral and basal borders narrowly margined, with fringe of flattened setae. Elytra 2.9 mm long, 1.8 mm wide, humerus dentate; striae distinctly impressed, closely punctured, punctures separated by 3 to 4 times their diameter; intervals wide, flat except sutural interval elevated with single median row of tubercles, other intervals with 2 rows of small tubercles, outside row of tubercles larger, rounded, inside row small, slightly elongate. Mesosternum alutaceous, feebly carinate between coxae. Metasternal midline deeply impressed, extending from base to apex of metasternum; surface roughened, shiny medially, becoming alutaceous and slightly tuberculate laterally. Abdominal sterna feebly shiny, slightly alutaceous with fluting along anterior margin of each sternum and indistinct tubercles laterally, especially strong on sterna 3 and 4. Pygidium scabrous, dull, 8 erect apical setae present. Foretibia smooth, with 3 lateral teeth, the posterior tooth at middle of tibia; spur wide

basally, tapered to blunt apex, angled downward. Middle and hind tibiae equal in length to femora, each apex fringed with long, unequal setae and 2 spurs, outer spur short, sinuate, less than half as long as inner spur, inner spur longer than first tarsal segment, feebly sinuate. Hind tarsus equal in length to tibia, basal segment as long as segments 2–4 combined, segments 2–4 slightly decreasing in length successively, 5th segment twice as long as 4th. Genitalia as described for *Rhyssemus sonatus* except apex of lateral lobe blunt, feebly curved downward (Figure 22).

FEMALE.—Similar to male except the pygidium is wider and the penultimate abdominal sternum slightly longer at middle.

VARIATION.—Length 3.0 to 4.2 mm, width 1.4 to 2.0 mm. The dorsal color pattern varies from reddish brown to black. Arizona specimens tend to be larger than California specimens; the specimens measuring more than 4.0 mm in length are nearly all from Arizona. The normal number of pygidial hairs is eight, but they are easily broken, so that any number of hairs from none to eight may be observed.

TYPE-LOCALITY.—Visalia, California.

TYPE DEPOSITORY.—Museum of Comparative Zoology, Harvard University.

REMARKS.—The only species likely to be confused with *Rhyssemus californicus* is *R. sonatus*; see remarks under that species. We have seen specimens of *R. californicus* only from Arizona and California, but it must occur in contiguous parts of Mexico.

Horn (1871) states that this species "occurs in sandy places on the margin of streams near Visalia, California." Horn had several specimens in the type series, all from Visalia. The first of these, a female bearing the labels "Cal/Type No. 3616 Rhyssemus californicus G. H. Horn/Rh. Californicus Horn," is herein designated lectotype, and four additional specimens labeled "Cal/Horn Coll. 5481" are designated paralectotypes.

MATERIAL EXAMINED (Map 3).—184 specimens. UNITED STATES: ARIZONA: Fort Yuma; Graham Co., Geronimo; Peach Spring; Winslow; Yuma Co., Alamo Crossing, Oracle. CALIFORNIA: Bakersfield; Coalinga; Davis; Elizabeth Lake; Fort Tejon; Fresno; Herndon; Independence; Kaweah; Kern Co., Oil City, Walker Pass; La Puerta; Los Angeles Co., Little Mojave Desert; Modesto; Orange Co.; Santa Ana Canyon; Palm Springs; San Bernardino; San Diego; San Diego Co., Poway; San Pasqual Canyon; Selma; Sequoia National Park; Tulare Co., Wood Lake, Three Rivers, El Mirador, Lindsay; Visalia; Waterman.

Rhyssemus brownwoodi, new species

FIGURE 6; MAP 3

FEMALE.—Length 3.8 mm, greatest width 1.8 mm. Elongate, robust. Color dark brown, shiny. Head with anterior clypeal margin moderately, evenly emarginate between bluntly rounded angles, arcuate to inconspicuous genae, edge finely, barely noticeably, reflexed; entire surface of head tuberculate, finely, feebly so just back of anterior margin, more noticeably so with larger tubercles over greatest convexity of clypeus, upper clypeus laterally and frontal area closely, finely tuberculate, with 2 indistinct, large tubercles each side near frontal suture; a deep pit or pore at base of gena in front of eye. Pronotum 1.0 mm long by 1.5 mm wide; finely margined, posterior angle emarginate, invisible from directly above, edge serrate anteriorly, fringed with flattened setae, posteriorly the setae gradually longer, nearly twice as long opposite scutellum and appearing thinner and closer; surface with 6 transverse ridges, first ridge very indistinct with small, low, feeble, scarcely noticeable tubercles, 2nd and 3rd ridges distinct, complete, large tubercles completely fused except at end, 4th ridge bending back at middle, joining 6th, interrupting and enclosing 5th ridge, last 3 ridges with tubercles distinct with few fused together; first transverse furrow filled with fine, close, distinct tubercles, 2nd and remaining furrows with slightly larger tubercles, wider 3rd furrow joins midline furrow to basal margin, interrupting last 3 ridges (Figure 6). Elytra 2.4 mm long by 1.8 mm wide; humerus sharply, strongly dentate; interval finely alutaceous, strongly convex, a row of small tubercles down outside margin; striae narrow, deep, small strial punctures slightly crenating inner side of intervals, 2 lateral striae noticeably wider and with punctures larger and deeper (Figure 6). Me-

sosternum smooth, transversely depressed at middle, midline deeper at ends and extending forward between middle coxae, a moderately deep, punctate marginal line posteriorly around middle coxae; metasternal triangle in front of posterior coxae long, deep, roughened within, transversely depressed. Abdominal sterna convex, anterior margin finely fluted with fluting gradually longer on successive segments, fluting extending more than half the length of terminal segment; posterior margin of sterna scalloped, especially noticeable on 2nd and 3rd sterna; remaining surface alutaceous, more shiny anteriorly and rougher with transverse row of shallow punctures behind small tubercles. Foretibia smooth, 3 lateral teeth present, middle tooth at middle of tibia, spur long, slender, feebly curved downward at apex. Middle and hind tibiae equal in length to femora, each apex fringed with long, unequal setae and 2 spurs, outer spur short, feebly sinuate, half as long as inner spur, inner spur as long as first tarsal segment, feebly sinuate. Middle and hind tarsi broken, missing.

TYPE MATERIAL (Map 3).—Holotype, female, Brownwood, Texas, 5 Oct 1905, W. D. Pierce (USNM 73339).

REMARKS.—*Rhyssemus brownwoodi* is a distinctive species of which we have seen only the female described above. The strongly convex elytral intervals, transversely depressed metasternum and the two large tubercles on the head distinguish *R. brownwoodi*. The species name is a genitive form of the type-locality.

Rhyssemus mexicanus Hinton

FIGURE 7, 23; MAP 4

Rhyssemus mexicanus Hinton 1934:29.—Blackwelder, 1944: 216.

MALE.—Length 2.9 mm, greatest width 1.3 mm. Elongate, nearly parallel sided. Color dark reddish brown except front and clypeus, prosternum, legs and abdomen lighter reddish brown. Head finely, evenly tuberculate except a large, slightly oblique tubercle on each side of middle of vertex; anterior clypeal margin distinctly marginate between angulate angles, feebly reflexed. Pronotum 0.9 mm long by 1.2 mm wide; closely, densely tuberculate except 4 distinct, transverse ridges somewhat smooth, posterior 2 ridges broken medially (Figure 7); lateral and basal borders narrowly margined, with fringe of closely spaced, flattened setae. Elytra 2.0 mm long, 1.3 mm wide, humerus feebly dentate; striae extremely deeply impressed, punctured, punctures separated by 1 to 1 1/2 times their diameter; interval flat with a median row of large, closely spaced, acute tubercles and an inner row of very small tubercles on inner margin (Figure 7). Mesosternum alutaceous, with carinae strong between coxae, finer from coxae to anterior margin. Metasternal midline deeply impressed, complete, broadly foveate medially; surface shiny, roughened, becoming scabrous laterally. Abdominal sterna strongly alutaceous, with fluting along anterior margin of each sternum and a row of indistinct tubercles extending from lateral border nearly to midline; 4th sternum very strongly contracted medially. Pygidium roughly scabrous, tuberculate, 2 erect, apical setae present. Fore tibia smooth, with 3 lateral teeth, the posterior tooth at middle of tibia; spur long, robust, slightly curved downward apically. Middle and hind tibiae equal in length to femora, each apex fringed with short, unequal setae and 2 spurs, outer spur short, sinuate, apex curved, less than half as long as inner spur, inner spur longer than first tarsal segment, slightly sinuate. Hind tarsus shorter than tibia, basal segment as long as segments 2–4 combined, segments 2–4 subequal in length, 5th segment almost twice as long as 4th. Genitalia with lateral lobe thickened at apex, abruptly curved downward; internal sac lined with minute spicules, and 2 elongate, apically hooked sclerites (Figure 23).

FEMALE.—Similar to male except the pygidium is wider and the penultimate abdominal sternum slightly longer at middle.

VARIATION.—Length 2.8 to 2.9 mm, width 1.2 to 1.3 mm.

Type-Locality.—Temascaltepec, Tejupilco, Mexico.

TYPE DEPOSITORY.—Type 3814, California Academy of Sciences.

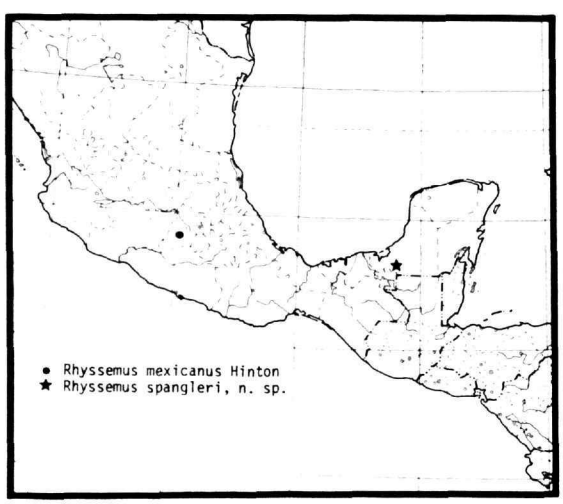
REMARKS.—The combination of very deeply impressed elytral striae and high tubercles on the intervening intervals is unique to *Rhyssomus mexicanus*. In addition, the middle of the 4th abdominal sternum is more strongly contracted in *R. mexicanus* than in any other known species of *Rhyssemus*.

MATERIAL EXAMINED (Map 4).—6 specimens. Known only from the type-locality.

Rhyssemus spangleri, new species

FIGURES 8, 24; MAP 4

MALE.—Length 2.9 mm, width 1.4 mm. Elongate oval, dark reddish brown, shiny. Head with anterior margin of clypeus deeply emarginate between sharply dentate angles, slightly rounded to inconspicuous gena, edge finely, weakly reflexed; surface of head tuberculate, tubercles of upper clypeus elongate, moderate in size and closer than anteriorly where they become transversely elongate between marginal teeth and greatest convexity; 6 large, elongate tubercles lengthwise across frontal area with small, close tubercle between. Pronotum 0.8 mm long by 1.2 mm wide; finely margined edge serrate, bordered with close, spatulate setae, very slightly longer opposite scutellum; most of surface covered with close, coarse, longitudinally elongate tubercles, only in transverse furrows and short basal longitudinal furrow tubercles smaller, closer more rounded; anterior transverse furrow deeper in anterior pronotal angle, almost disappearing at middle; a deeper furrow slightly posterior to middle, starting in lateral furrow, extending from side to side, joining midline furrow extending to base of pronotum (Figure 8). Elytra 2.0 mm long, 1.4 mm wide, humerus sharply, strongly dentate; interval sharply costate with summits narrowly alutaceous, broken into very short segments, sides of interval concave, evenly curving into sides of next interval; coarse, deep strial punctures separated by 3 to 5 times their diameter, conspicuous (Figure 8). Mesosternum densely, shallowly punctate; indistinctly doubly carinate between coxae. Metasternal midline long, deep, anterior end extending to mesosternal junction; surface extremely rough, coarsely so at middle, more finely so at sides and in metasternal triangle in front of posterior coxae, rough middle surface under high magnification with close, coarse punctures bearing short, recurved setae. Abdominal sterna convex with complicated surface sculpture; anterior margin finely fluted with fluting gradually longer on successive segments, fluting extending half the length of terminal segment; posterior margins of sterna scalloped, especially noticeable on 2nd and 3rd sterna, remaining surface alutaceous, most noticeable in front of and between scallops, more shining anteriorly and rougher with transverse row of widely spaced, shallow punctures behind small tubercles bearing short, recurved, spatulate hairs; penultimate sternum narrowed at middle, middle third half as long as length at sides. Foretibia smooth, 3 lateral teeth present, middle tooth at middle of tibia, spur long, slender, curved downward. Middle and hind femora with complete posterior marginal lines, surface rough, bearing numerous short, recurved hairs; tarsus shorter than tibia, fringed with short, unequal setae and 2 spurs, outer spur short, sinuate, apex curved, less than half as long as inner spur, inner spur longer than first tarsal segment, slightly sinuate. Hind tarsus shorter than tibia, basal segment as long as segments 2–4 combined, seg-



MAP 4.—Distribution of *Rhyssemus* species.

ments 2–4 subequal in length, 5th segment almost twice as long as 4th. Genitalia with lateral lobe short, apex enlarged; internal sac lined with minute spicules, spicules becoming heavily clumped just beyond middle (Figure 24).

FEMALE.—Similar to male except pygidium wider and penultimate sternum slightly longer at middle.

VARIATION.—Length 2.8 to 3.0 mm, width 1.3 to 1.4 mm.

TYPE MATERIAL (Map 4).—Holotype, male, Ciudad del Carmen, Campeche, Mexico, 5 Aug 1964, Paul J. Spangler (USNM 73340). Twelve paratypes with same data as holotype and two paratypes from the same locality, collected 4 Jun 1964, by L. A. Willahan, in USNM collection.

REMARKS.—*Rhyssemus spangleri* resembles *R. mexicanus* in external appearance, but the elytral intervals are costate rather than tuberculate as in *R. mexicanus*, and the striae are not nearly as deeply impressed as those of *R. mexicanus*. The species name is a genitive of the surname of Paul J. Spangler, to whom we dedicate this species.

Rhyssemus minutus Petrovitz

FIGURES 9, 25; MAP 5

Rhyssemus minutus Petrovitz, 1970:238.

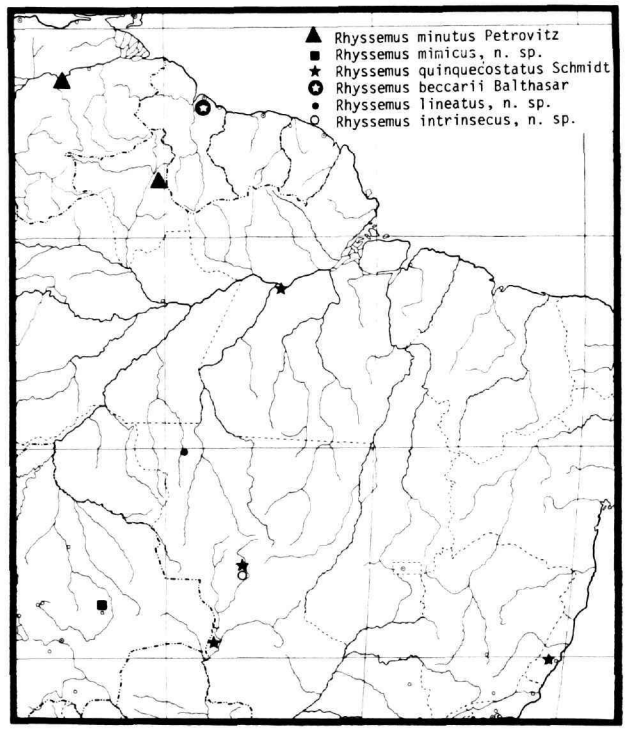
MALE.—Length 1.8 mm, greatest width 0.8 mm. Elongate, slender, widest at middle of elytra, nearly parallel sided. Color dark reddish brown except clypeus, ventral surface of head, prosternum, legs and last abdominal sternum pale reddish brown. Head tuberculate, tubercles on clypeus and front elongate, surface between strongly alutaceous on front, front and vertex separated by a deep sinuate groove, outer end of groove with large, low tubercle, vertex strongly alutaceous, with coarse, irregular punctures; anterior clypeal margin barely perceptibly emarginate between feebly angulate angles, barely perceptibly reflexed. Pronotum 0.4 mm long by 0.7 mm wide; alutaceous throughout, more strongly so in furrows on ridges; anterior third of pronotum slightly raised, convex, indistinctly, coarsely punctured, separated from medium ridge by narrow furrow bearing dense, fine tubercles; median ridge broad, convex, with very coarse, scattered punctures, separated from posterior third of pronotum by narrow furrow bearing dense, fine tubercles; posterior third raised, convex, with coarse, sometimes contiguous punctures; lateral and basal borders narrowly margined, without setae (Figure 9). Elytra 1.3 mm long, 0.8 mm wide, humerus barely perceptibly dentate; striae deeply impressed, punctate, punctures separated by twice their diameter; interval costate, bearing narrowly separated elongate tubercles, each interval appearing almost carinate, a row of feeble, barely perceptible, widely separated tubercles on inner margin next to stria (Figure 9). Mesosternum strongly alutaceous, feebly carinate between coxae. Metasternal midline extending from apex to base of metasternum, deeply impressed; surface shiny, feebly alutaceous, becoming scabrous and finely tuberculate laterally. Abdominal sterna shiny, feebly alutaceous, with fluting along anterior margin of each sternum and a row of irregularly distributed, coarse puncture extending from lateral border to midline. Pygidium scabrous, coarsely, indistinctly punctured, 2 erect, apical setae present. Foretibia smooth, with 3 lateral teeth, the posterior tooth slightly anterior to middle of tibia; spur long, slender, curved downward apically. Middle and hind tibiae equal in length to femora, each apex fringed with short, unequal setae and 2 spurs, outer spur short, curved, half as long as inner spur, inner spur longer than first tarsal segment, curved near apex. Hind tarsus equal in length to tibia, basal segment nearly as long as segments 2–4 combined, segments 2–4 subequal in length, 5th segment as long as 3 and 4 combined. Genitalia with lateral lobe abruptly curved downward at apex; internal sac lined with minute spicules (Figure 25).

FEMALE.—Similar to male in all respects except genitalia.

VARIATION.—Length 1.6 to 1.8 mm, width 0.7 to 0.8 mm.

TYPE-LOCALITY.—"Nord-Brasil, Surumu, Roraima."

TYPE DEPOSITORY.—Departamento do Zoologia, Secretario da Agricultura, São Paulo, Brazil.



MAP 5.—Distribution of *Rhyssemus* species.

REMARKS.—We have examined the paratype material in the Petrovitz collection, Geneva, through the courtesy of Dr. Ivan Löbl.

MATERIAL EXAMINED (MAP 5).—25 specimens. BRAZIL: type-locality. VENEZUELA: Ciudad Bolivar.

Rhyssemus mimicus, new species

FIGURES 10, 26; MAP 5

FEMALE.—Length 2.1 mm, width 0.8 mm. Elongate, slender, nearly parallel sided. Color brownish black except anterior margin of head, ventral parts of head and pronotum, and legs brown. Clypeal margin broadly, weakly emarginate, slightly angulate on each side, margin finely reflexed, gena slightly greater than right angled; clypeal surface tuberculate, moderately shining but extremely minutely alutaceous between tubercles; occiput longitudinally, finely, densely furrowed with very elongate punctures. Pronotum 0.6 mm long by 0.8 mm wide; finely margined, anterior angle narrowly rounded, posterior angle broadly rounded into base; surface generally punctate, the punctures moderate sized, dense and contiguous in 2 transverse furrows, one extending inward from anterior angle almost ⅓ total pronotal width, the other of equal length starting in lateral fovea but not reaching midline; longitudinal midline weakly impressed; transverse furrows about 4 punctures wide, midline 2 or 3 punctures wide; elsewhere punctures generally separated by one or 2 diameters, the intervening surface finely alutaceous (Figure 10). Elytra 1.25 mm long, 0.8 mm wide. Basal margin interrupted by striae. Intervals costate, alutaceous, striae deep, strial punctures weakly crenating sides of intervals, 9th interval not reaching humerus, 10th interval almost flat (Figure 10). Mesosternum strongly alutaceous, carinate between coxae. Metasternal midline long, im-

pressed, metasternum shining but not minutely alutaceous with scattered, very minute punctures, a deep, coarse, impressed line around middle coxa from midline to scabrous and finely tuberculate, triangular area at sides; deep triangular depression anterior to posterior coxa connected to terminal pit of midline. Abdominal sterna finely alutaceous, each sternum with fluting along anterior margin, the fluting slightly longer on each succeeding posterior sternum, a row of fine, shallow, contiguous punctures along posterior border and an irregular, transverse line of similar punctures at middle. Pygidium scabrous, with two strong, erect, apical setae. Legs as described for *Rhyssemus minutus*. Male genitalia as in Figure 26.

MALE.—Similar to female in all respects except genitalia.

VARIATION.—Length 1.85 to 2.2 mm, width 0.75 to 0.9 mm. In some specimens the pronotal midline is deeper, wider, and more evident.

TYPE MATERIAL (MAP 5).—Holotype, Saavedra Exp Sta, 60 mi N, Santa Cruz, Bolivia, 4 Jan 1960, R. B. Cumming (USNM 74077). Thirty-four paratypes from same locality, 4 collected 27 Dec 1959, 10 collected 28 Dec 1959, 2 collected 5 Jan 1960, 10 collected 4 Jan 1960, 8 without date, collected in 1959.

REMARKS.—This South American species is practically the same size as, and resembles very much, another South American species, *Rhyssemus minutus*, known only from Brazil and Venezuela. The frontal characters of the head will easily separate the two. The name *mimicus* is a Latin adjective chosen because of the resemblance between *R. minutus* and *R. mimicus*.

Rhyssemus quinquecostatus Schmidt

FIGURE 11; MAP 5

Rhyssemus quinquecostatus Schmidt, 1911:15.—Blackwelder, 1944:216.

HOLOTYPE FEMALE.—Length 2.1 mm, greatest width 0.9 mm. Elongate, slender, widest at middle of elytra, lateral margin of elytron slightly rounded from base to apical declivity. Color light reddish brown except pronotum and head slightly darker. Head tuberculate, surface alutaceous, tubercles on front slightly elongate, tubercles on clypeus conical, pointed, front and vertex separated by a deep, sinuate groove; anterior clypeal margin distinctly emarginate between rounded angles, barely perceptibly reflexed. Pronotum 0.5 mm long by 0.8 mm wide; alutaceous throughout, more strongly so in furrows than on ridges; 5 transverse ridges present, anterior ridge near anterior margin, sinuate, 2nd ridge short, continuous, posterior 3 ridges incomplete, broken medially by 2 distinct, widely separated longitudinal ridges, longitudinal ridges joined anteriorly; lateral and basal borders of pronotum narrowly margined, without setae (Figure 11). Elytra 1.6 mm long, 0.9 mm wide, humerus not dentate; striae feebly impressed, punctate, punctures separated by twice their diameter; intervals 1, 3, 5, 7, 9 costate, each costa rounded, intervals 2, 4, 6, 8, 10 flat, broad, impunctate (Figure 11). Mesosternum flat, not carinate. Metasternal midline extending from apex to base of metasternum, deeply, longitudinally impressed medially; surface feebly shining, alutaceous. Abdominal sterna feebly shining, with fluting along anterior margin of each sternum. Pygidium scabrous, indistinctly punctured, 2 erect, apical setae present. Legs as described for *Rhyssemus minutus*.

MALE.—Not available for examination.

VARIATION.—Length 1.9 to 2.1 mm, width 0.9 to 1.0.

TYPE-LOCALITY.—Espirito Santo, Brazil.

TYPE DEPOSITORY.—British Museum (Natural History), London.

REMARKS.—This species resembles only *Rhyssemus lineatus*, new species. See remarks under *R. lineatus*. Schmidt (1911) discussed only one specimen and stated that it was in the British Museum. That specimen, a female, bearing the following labels, has been examined; "Type [orange-bordered disc]/Espirito Santo/Fry Coll 1905.100/42474/Schmidt/Type." In the Schmidt collection in the Riksmuseum, Stockholm, is another specimen labeled "Type/Espirito Santo/Fry Coll 1905.100." The labels are identical to those of the British Museum specimen, and it is very likely that the Riksmuseum specimen should also be

considered a type. Since Schmidt mentioned only one in his original description, the specimen in the Riksmuseum cannot be considered a type, and the specimen in the British Museum must be the holotype. Two additional specimens are in the Schmidt collection, these from the Matto Grosso. All specimens examined are females.

MATERIAL EXAMINED (Map 5).—4 specimens. BRAZIL: Espirito Santo; MATTO GROSSO, Cuyaha; MATTO GROSSO, Corumba; PARA, Santarem.

Rhyssemus beccarii Balthasar

FIGURE 12; MAP 5

Rhyssemus beccarii Balthasar, 1939:27.—Blackwelder, 1944: 216.

FEMALE.—Length 1.9 mm, greatest width 0.8 mm. Elongate, slender, parallel sided, widest at middle of elytra. Color dark reddish brown except anterolateral angle of pronotum, mouth parts, legs, and abdomen light reddish brown. Head tuberculate, tubercles larger at center of front than on clypeus, surface between tubercles alutaceous, front and vertex separated by a deep, sinuate groove, vertex strongly alutaceous, feebly punctured; anterior clypeal margin distinctly emarginate between rounded angles, weakly reflexed. Pronotum 0.5 mm long by 0.7 mm wide; alutaceous throughout; 5 transverse ridges present, anterior ridge low, broad, near anterior margin, 2nd ridge short, complete, posterior 3 ridges incomplete, broken medially by 2 narrowly separated longitudinal ridges, longitudinal ridges not joined anteriorly; lateral and basal borders of pronotum narrowly margined, without setae (Figure 12). Elytra 1.4 mm long, 0.8 mm wide, humerus not dentate; striae distinctly impressed, punctate, punctures separated by 1 1/2 times the diameter of a puncture; intervals 1,3,5,7,9 costate, each costa rounded, intervals 2,4,6,8,10 flat, broad, impunctate (Figure 12). Mesosternum feebly carinate between coxae. Metasternal midline extending from apex to base of metasternum, deeply, longitudinally impressed medially. Abdominal sterna feebly shining, with fluting along anterior margin of each sternum. Pygidium scabrous, feebly punctured, 2 erect, apical setae present. Legs as described for *Rhyssemus minutus*.

MALE.—Not available for examination.

VARIATION.—Length 1.7 to 1.9 mm, width 0.7 to 0.8 mm.

TYPE-LOCALITY.—Demerara, British Guiana.

TYPE DEPOSITORY.—National Museum of Natural History, Prague, Czechoslovakia.

REMARKS.—We have seen only the four female type specimens loaned to us by the National Museum of Natural History, Prague, Czechoslovakia. These specimens bear labels as follows: "Guiana Inglese, Campo III Sul Demerara Tibicuri-cujaha, X-931, sped. Prof. N. Beccari/Typhus/Rhyssemus beccarii n. sp., Dr. V. Balthasar det." Since Balthasar did not designate a holotype, we herein designate one specimen as lectotype, three specimens as paralectotypes, and so label them. The form of *Rhyssemus beccarii* is most like that of *R. quinquecostatus*, but the pronotum is most like that of *R. intrinsecus* except that the short, transverse pronotal ridge is not divided by the two longitudinal ridges as it is in *R. intrinsecus*.

MATERIAL EXAMINED (Map 5).—4 specimens. Type material.

Rhyssemus lineatus, new species

FIGURES 13, 27; MAP 5

MALE.—Length 1.6 mm, greatest width 0.7 mm. Elongate, slender, widest at middle of elytra, parallel sided. Color dark reddish brown except head and pronotum slightly darker. Head tuberculate, tubercles small on clypeus, becoming larger on front with a single large, median tubercle in front of sinuate groove, front and vertex separated by deep, sinuate groove, outer end of groove with large, angulate tubercle; anterior clypeal margin feebly emarginate between rounded angles, weakly reflexed. Pronotum 0.4 mm long by 0.6 mm wide; alutaceous throughout, more strongly so in furrows than on ridges; 5 transverse ridges present, anterior ridge near anterior margin, sinuate, 2nd ridge short, narrowly broken medially, posterior 3 ridges incomplete, broken medially by 2 widely separated longitu-

dinal ridges, longitudinal ridges angled toward each other apically but not joined; lateral and basal borders of pronotum narrowly margined, without setae (Figure 13). Elytra 1.2 mm long, 0.7 mm wide, humerus not dentate; striae deeply impressed, punctate, punctures separated by twice their diameter; intervals 1,3,5,7,9 costate, each costa carinate, intervals 2,4,6,8,10 flat, broad, impunctate (Figure 13). Mesosternum strongly alutaceous, feebly carinate between coxae. Metasternal midline extending from apex to base of metasternum, deeply, longitudinally impressed medially; surface shining, slightly alutaceous. Abdominal sterna feebly shining, with fluting along anterior margin of each sternum. Pygidium scabrous, indistinctly punctured, 2 erect, apical setae present. Legs as described for *Rhyssemus minutus*. Genitalia with lateral lobe sharply curved downward at apex, apex broadly rounded; internal sac lined with minute spicules (Figure 27).

FEMALE.—Similar to male in all respects except genitalia.

VARIATION.—Length 1.6 to 1.7 mm, width 0.7 to 0.8 mm.

TYPE MATERIAL (Map 5).—Holotype, male, PN Xingu, Jacare, Matto Grosso Brazil, Nov 1966, M. Alvarenga (USNM 73341). Seven paratypes with the same data as holotype (USNM; Museu de Zoologia da Universidad de São Paulo, Brazil).

REMARKS.—*Rhyssemus lineatus* is similar in appearance to *R. quinquecostatus* except that the elytral striae are deeply impressed, the odd elytral intervals are carinate, and the longitudinal ridges of the pronotum are not joined anteriorly in *R. lineatus*. In addition, the longitudinal pronotal ridges do not reach the short, anterior horizontal ridge in *R. lineatus*, but do reach it in *R. quinquecostatus*. The species name is a Latin adjective referring to the elongate, narrow form.

Rhyssemus intrinsecus, new species

FIGURES 14, 28; MAP 5

MALE.—Length 1.8 mm, greatest width 0.9 mm. Elongate, widest at middle of elytra, lateral margin of elytron rounded from base to apex. Color reddish black except anterolateral angle of pronotum, mouthparts, hypopleuron, legs and abdomen reddish brown. Head tuberculate, surface alutaceous, tubercles sharp, distinct on clypeus and front, becoming eroded, indistinct on vertex, front and vertex separated by a feebly impressed, barely perceptible, sinuate groove; anterior clypeal margin emarginate between rounded angles, feebly reflexed. Pronotum 0.5 mm long by 0.7 mm wide; alutaceous throughout, more strongly so in furrows than on ridges; 5 transverse ridges present, anterior ridge near and parallel to anterior margin, 2nd ridge short, completely interrupted medially by median longitudinal ridges, posterior 3 ridges incomplete, broken medially by 2 parallel, longitudinal ridges, longitudinal ridges not joined anteriorly; lateral and basal borders of pronotum narrowly margined, without setae (Figure 14). Elytra 1.3 mm long, 0.9 mm wide, humerus not dentate; striae distinctly impressed, punctate, punctures separated by twice their diameter; intervals 1,3,5,7,9 costate, each costa rounded, intervals 2,4,6,8,10 flat, broad, impunctate (Figure 14). Mesosternum strongly alutaceous, rounded between coxae, not carinate. Metasternal midline extending from apex to base of metasternum, deeply, longitudinally impressed; surface shining, feebly alutaceous. Abdominal sterna feebly shining, with fluting along anterior margin of each sternum. Pygidium scabrous, impunctate, alutaceous with 2 blunt, median tubercles, 2 erect apical setae present. Foretibia smooth, with 3 lateral teeth, the posterior tooth slightly anterior to middle of tibia; spur long, slender, curved downward apically. Middle and hind tibiae equal in length to femora, each apex fringed with long, unequal setae and 2 spurs, outer spur short, straight, half as long as inner spur, inner spur longer than first tarsal segment, slightly sinuate. Hind tarsus shorter than tibia, basal segment nearly as long as segments 2–4 combined, segments 2–4 subequal in length, 5th segment as long as 3 and 4 combined. Genitalia with lateral lobe abruptly bent downward at apex, apex bluntly pointed; internal sac

lined with minute spicules (Figure 28).

FEMALE.—Similar to male in all respects except genitalia.

VARIATION.—Length 1.7 to 2.0 mm, width 0.8 to 2.0 mm.

TYPE MATERIAL (Map 5).—Holotype, male, PN Xingu, Jacare, Matto Grosso Brazil, Nov 1966, M. Alvarenga (USNM 73342). Nine paratypes with the same data as holotype (USNM; National Museum of Natural History, Prague, Czechoslovakia; Museu de Zoologia da Universidad de São Paulo, Brazil).

REMARKS.—*Rhyssemus intrinsecus* most nearly resembles *R. beccarii*, but may be separated from that species and all other South American *Rhyssemus* by form alone. All other species are slender, elongate, and parallel sided, or nearly so; *R. intrinsecus* is comparatively short and robust. In addition, *R. intrinsecus* has the four posterior, transverse ridges of the pronotum completely divided by the longitudinal ridges; the other species have, at most, only posterior three ridges divided. The groove separating the vertex and front is faint and difficult to see in *R. intrinsecus*, deep and obvious in the other species. The species name is a Latin adjective referring to the type-locality in the interior of the South American continent.

Genus *Trichiorhyssemus* Clouët

Trichiorhyssemus Clouët, 1901:8—Schmidt, 1922:518—Balthasar, 1964:587.

TYPE-SPECIES.—*Rhyssemus riparius* Horn, by subsequent designation of Balthasar, 1964.

Description as for *Rhyssemus* except as follows: elytron with short, erect or semierect setae on intervals; meso- and metasterna, abdominal sterna and middle and hind femora with short, mostly decumbent, scalelike setae.

Approximately 10 species of *Trichiorhyssemus* have been described from widely scattered localities worldwide. Of these, three species are known from the Western Hemisphere. See comments under *Rhyssemus*.

Key to Western Hemisphere Species of *Trichiorhyssemus*

1. Elytra with setae minute, nearly invisible, alternate intervals costate (Figure 17) ..... ***alternatus*** Hinton
   Elytra with setae apparent, easily visible, all intervals costate 2
2. Pronotal ridges and furrows not sharply defined, furrow between 3rd and 4th ridges widely interrupted medially (Figure 15); southwestern United States ..... ***riparius*** (Horn)
   Pronotal ridges and furrows sharply defined, furrow between 3rd and 4th ridges continuous medially (Figure 16); El Salvador to Sinaloa, Mexico ..... ***cristatellus*** (Bates)

Trichiorhyssemus riparius (Horn)

FIGURES 15, 29; MAP 6

Rhyssemus riparius Horn, 1871:290; 1887:90.
Trichiorhyssemus riparius.—Clouët, 1901:28.—Schmidt, 1922:520.
Rhyssemus caelatus LeConte, 1881:77.—Horn, 1887:90.

MALE.—Length 3.0 mm, greatest with 1.3 mm. Elongate, widest behind middle of elytra. Color reddish black except clypeus, ventral surface of head, prosternum, legs, and last abdominal sternum reddish brown. Head tuberculate, tubercles uniform and evenly distributed on front and clypeus, vertex with 2 long, obliquely transverse tubercles surrounded by small, close tubercles; anterior margin of clypeus emarginate between angulate angles, feebly reflexed. Pronotum 0.9 mm long by 1.1 mm wide; surface evenly, coarsely tuberculate except 4 transverse ridges composed of large, discrete tubercles, ridges nearly obsolete, posterior 3 ridges broken medially, furrow beween 2nd and 3rd ridges deep, distinct on each side of middle, interrupted medially (Figure 15); lateral

and basal borders narrowly margined, with fringe of evenly spaced, flattened setae. Elytra 2.0 mm long, 1.3 mm wide, humerus sharply dentate; striae distinctly impressed, punctured, punctures separated by 1 to 2 times their diameter; intervals flat except sutural interval raised, with single row of indistinct tubercles, other intervals with a median row of distinct tubercles each bearing a scalelike seta and a row of small, indistinct tubercles on inner margin (Figure 15). Mesosternum strongly alutaceous, distinctly carinate between coxae, more finely so from coxae to apex. Metasternal midline extending from base to apex of metasternum, deeply impressed; surface shiny, becoming rough, alutaceous laterally. Abdominal sterna alutaceous, feebly shining, covered with scattered scalelike setae. Pygidium scabrous, indistinctly tuberculate, 2 erect apical setae present. Foretibia smooth, with 3 lateral teeth, posterior tooth at middle of tibia; spur long, slender, slightly curved downward at apex. Middle and hind tibiae equal in length to femora, each apex fringed with long, unequal setae and 2 spurs, outer spur short, feebly sinuate, half as long as inner spur, inner spur longer than first tarsal segment, feebly sinuate. Hind tarsus shorter than tibia, basal segment as long as segments 2–4 combined, segments 2–4 subequal in length, 5th segment twice as long as 4th. Genitalia with lateral lobe short, nearly truncate apically, apex slightly bent downward, internal sac lined with minute spicules, spicules becoming dense medially (Figure 29).

FEMALE.—Similar to male except pygidium wider and the penultimate abdominal sternum slightly longer at middle.

VARIATION.—Length 2.7 to 3.1 mm, width 1.1 to 1.4 mm. Dorsal color varies from reddish brown to black. The transverse pronotal ridges are slightly more distinct in some specimens as the disparity in size between ridge punctures and furrow punctures is greater.

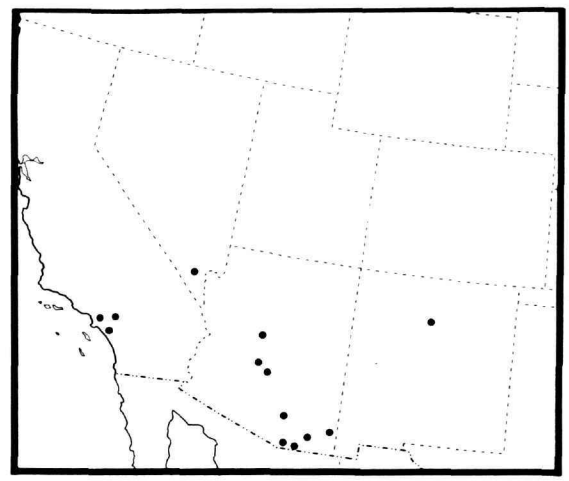
TYPE-LOCALITY.—San Pedro River, Arizona.

TYPE DEPOSITORY.—Museum of Comparative Zoology, Harvard University.

REMARKS.—This species resembles *Trichiorhyssemus cristatellus* very closely; *T. cristatellus* is usually less than 2.8 mm in length, whereas *T. riparius* is usually longer than 2.8 mm, and *T. cristatellus* has the pronotal ridges better defined than does *T. riparius*. Also, see remarks under *T. cristatellus*.

Trichiorhyssemus riparius is attracted to light and therefore is not uncommonly collected.

Horn (1871) stated that he had a single specimen of this species; therefore, that specimen in the Horn collection labeled "Ar/Type No. 3617 Rhyssemus riparius G. H. Horn" must be considered the holotype.



MAP 6.—Distribution of *Trichiorhyssemus riparius* (Horn).

MATERIAL EXAMINED (Map 6).—151 specimens. UNITED STATES: ARIZONA: Patagonia; Pena Blanca Lake; Phoenix; Portal, Southwest Research Station; Sierra Vista; Tucson; Wickenburg; Yavapai Co., Red Rock Camp. CALIFORNIA: Colton; Orange Co., Santa Ana Canyon; Pasadena. NEVADA: Las Vegas. NEW MEXICO: Santa Fe Canyon.

Trichiorhyssemus cristatellus (Bates)

FIGURES 16, 30; MAP 7

Rhyssemus cristatellus Bates, 1887:102.

Trichiorhyssemus cristatellus.—Clouët, 1901:27.—Blackwelder, 1944:216.—Schmidt, 1922:519.

MALE.—Length 2.4 mm, greatest width 1.1 mm. Description as for *Trichiorhyssemus riparius* except differences as follows; pronotum with large, median, transverse furrow complete across midline, transverse ridge anterior to median fur-

row narrow, sharply defined, composed of 1 or 2 rows of fused tubercles (Figure 16); elytra with interval raised, not flat, inner row of small tubercles nearly obsolete; genitalia with apex nearly straight (Figure 30).

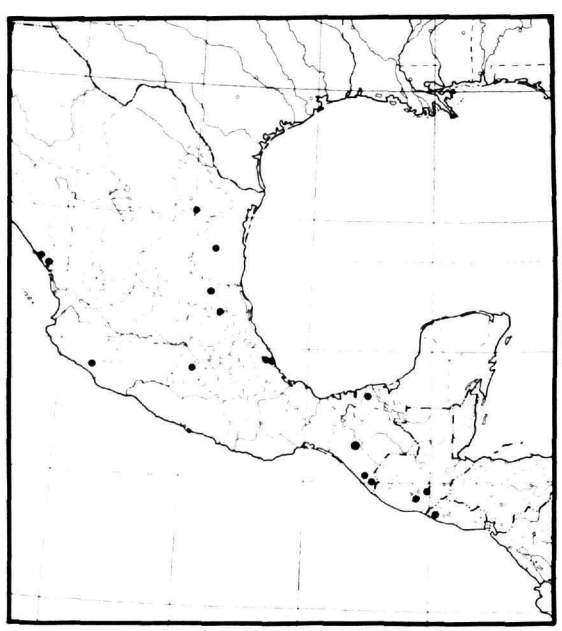
FEMALE.—Similar to male except pygidium wider and the penultimate abdominal sternum slightly longer at middle.

VARIATION.—Length 2.3 to 2.8 mm, width 1.0 to 1.2 mm. Dorsal color varies from reddish brown to black. The pronotal sculpture is more distinctive in some specimens; the transverse ridges are higher and sharper than on others.

TYPE-LOCALITY.—Presidio, Mexico (lectotype herein designated).

TYPE DEPOSITORY.—British Museum (Natural History), London.

REMARKS.—This species and *Trichiorhyssemus riparius* are very similar in appearance but can be separated by the external characters used in the key. In addition, the male genitalia of *T. cristatellus* are smaller proportionately than those of *T. riparius*, less robust and not curved downward at apex as much as those of *T. riparius*. *Trichiorhyssemus cristatellus* has a southern distribution and *T. riparius* is a northern species. Six type specimens were examined and a specimen labeled: "Syntype/Type/Presidio, Mexico, Forrer/Rhyssemus cristatellus Bates/B.C.A., Col., II(2)" is herein designated lectotype and so labeled. Three other type specimens were from the same locality, one was from Tabasco, San Juan Bautista, and one from Paso Antonio, Guatemala.



MAP 7.—Distribution of *Trichiorhyssemus cristatellus* (Bates).

MATERIAL EXAMINED (Map 7).—57 specimens. EL SALVADOR: Sonsonate. GUATEMALA: Agua Caliente; Paso Antonio. MEXICO: CHIAPAS: Huitla; Junction Hwys. 190, 195; Mapastepec. NUEVO LEON: 13 mi W Montemorelas, Chorros de Agua. COLIMA: Colima. MEXICO: Presidio. SAN LUIS POTOSI: El Salto de Agua; Tamazunchale. SINALOA: Chupaderos; Villa Union. TABASCO: San Juan Bautista. TAMAULIPAS: San Fernando. VERACRUZ: Jalapa Puente Nacional; La Gloria Cardel; Paso Cano.

Trichiorhyssemus alternatus Hinton

FIGURES 17, 31; MAP 8

Trichiorhyssemus alternatus Hinton, 1938:127.—Blackwelder, 1944:216.

MALE.—Length 2.7 mm, greatest width 1.2 mm. Elongate, slender, nearly parallel sided, widest at middle of elytra. Color dark reddish brown except front and clypeus, prosternum, and legs lighter reddish brown. Head tuberculate with large, subequal tubercles of front and clypeus, a large, obliquely elongate tubercle on each side of middle on vertex, several large, irregular tubercles anterior to eye; anterior clypeal margin feebly emarginate between dentate angles, barely perceptibly reflexed. Pronotum 0.8 mm long by 1.0 mm wide; surface densely, evenly tuberculate throughout with 4 distinct transverse ridges, posterior 2 ridges broken medially (Figure 17); lateral and basal borders narrowly margined, with fringe of evenly spaced, flattened setae. Elytra 1.9 mm long, 1.2 mm wide, humerus sharply dentate; striae deeply impressed, punctured, punctures separated by slightly more than their diameter; sutural and all odd intervals with a high carina, alternate intervals with a row of low, rounded tubercles (Figure 17), each tubercle with a barely visible seta and a corresponding seta on alternate carina. Mesosternum alutaceous, strongly cari-

nate. Metasternal midline deeply impressed, complete, somewhat foveate medially; surface rough, scabrous, with short, flattened, scalelike setae. Abdominal sterna alutaceous, with regularly spaced, short, flattened, scalelike setae. Pygidium strongly alutaceous, feebly tuberculate, with two flattened apical setae. Foretibia smooth, with 3 lateral teeth, posterior tooth at middle of tibia; spur long, slender, abruptly curved downward at apex. Middle and hind tibiae equal in length to femora, each apex fringed with short, unequal setae and 2 spurs, outer spur slightly shorter than first tarsal segment, feebly sinuate. Hind tarsus shorter than tibia, basal segment as long as segments 2–4 combined, segments 2–4 subequal in length, 5th segment almost twice as long as 4th. Genitalia with lateral lobe short, broad, nearly truncate apically; internal sac lined with minute spicules becoming dense apically (Figure 31).

FEMALE.—Similar to male in all respects except genitalia.

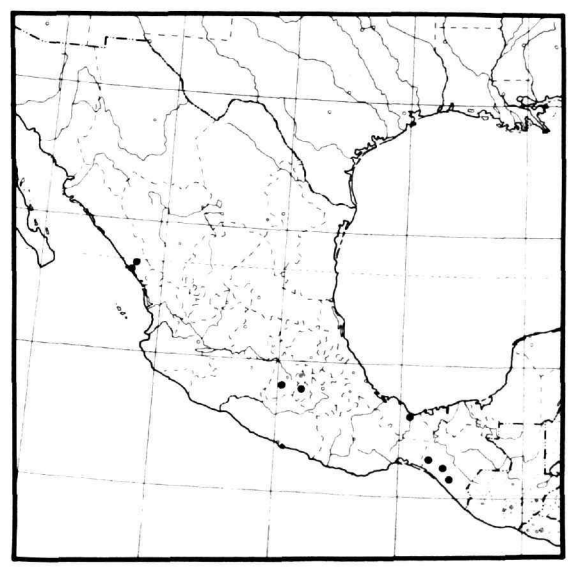
VARIATION.—Length 2.5 to 2.8 mm, width 1.0 to 1.3 mm.

Type-LOCALITY.—Temascaltepec, Tejupilco, Mexico.

TYPE DEPOSITORY.—USNM 53107.

REMARKS.—The elytral sculpture composed of alternate carinae and rows of tubercles is unique, and enables *Trichiorhyssemus alternatus* to be easily recognized. The other species of *Trichiorhyssemus* have distinct, easily visible dorsal setae, but *T. alternatus* has the dorsal setae extremely short, not visible on dirty specimens. Unless the ventral surface is examined for scales, *T. alternatus* can easily be mistaken for a species of *Rhyssemus*. The holotype and 17 paratypes in the USNM collection have been examined.

MATERIAL EXAMINED (Map 8).—301 specimens. MEXICO: CHIAPAS: "Chiapas"; Junction Hwys. 190, 195; Lazardo Cardenas; Zanatapec. MEXICO: Temascaltepec, Tejupilco. MORELOS: Cuernavaca. SINALOA: Concordia; Villa Union. VERACRUZ: Santecomapan.



MAP 8.—Distribution of *Trichiorhyssemus alternatus* Hinton.

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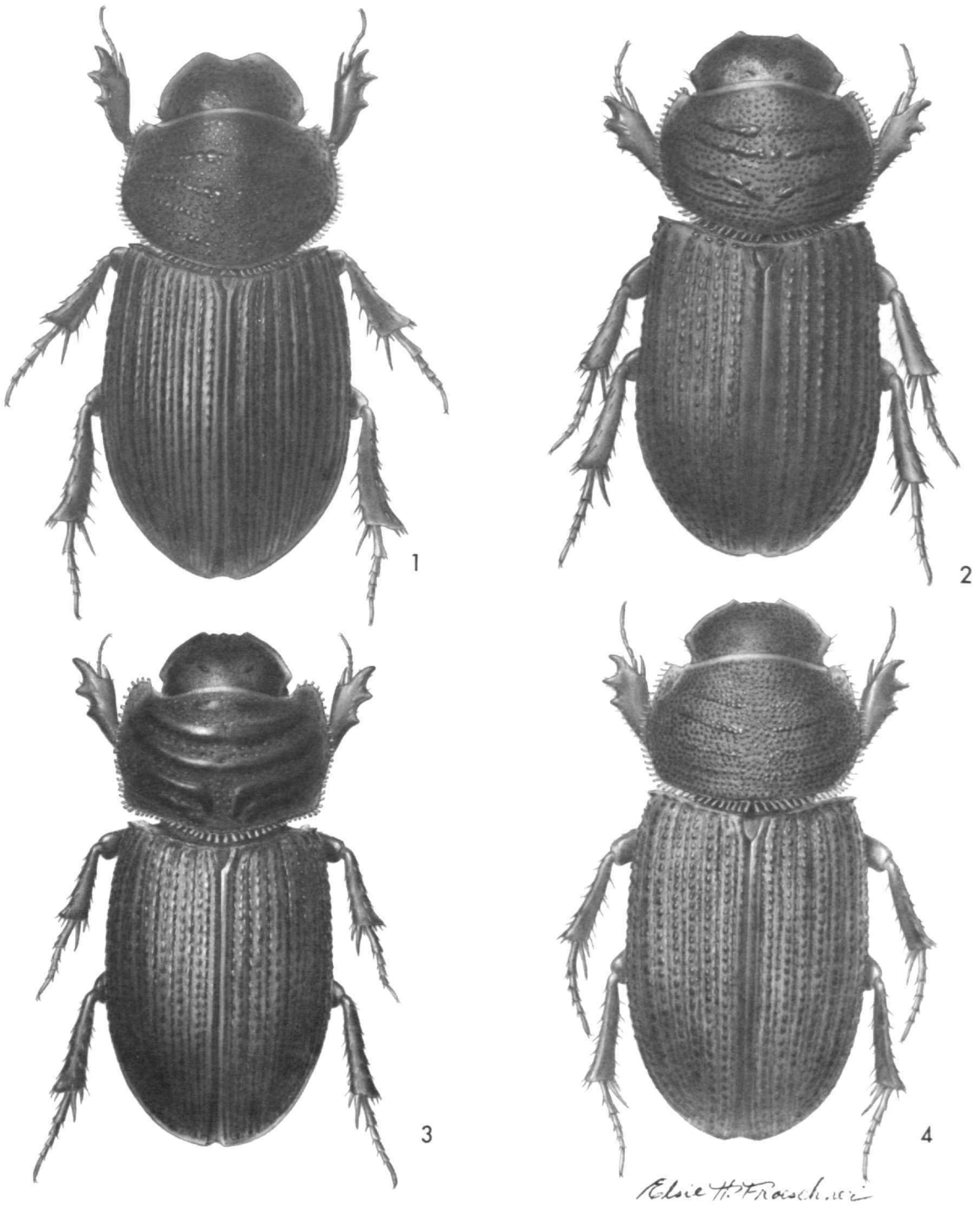
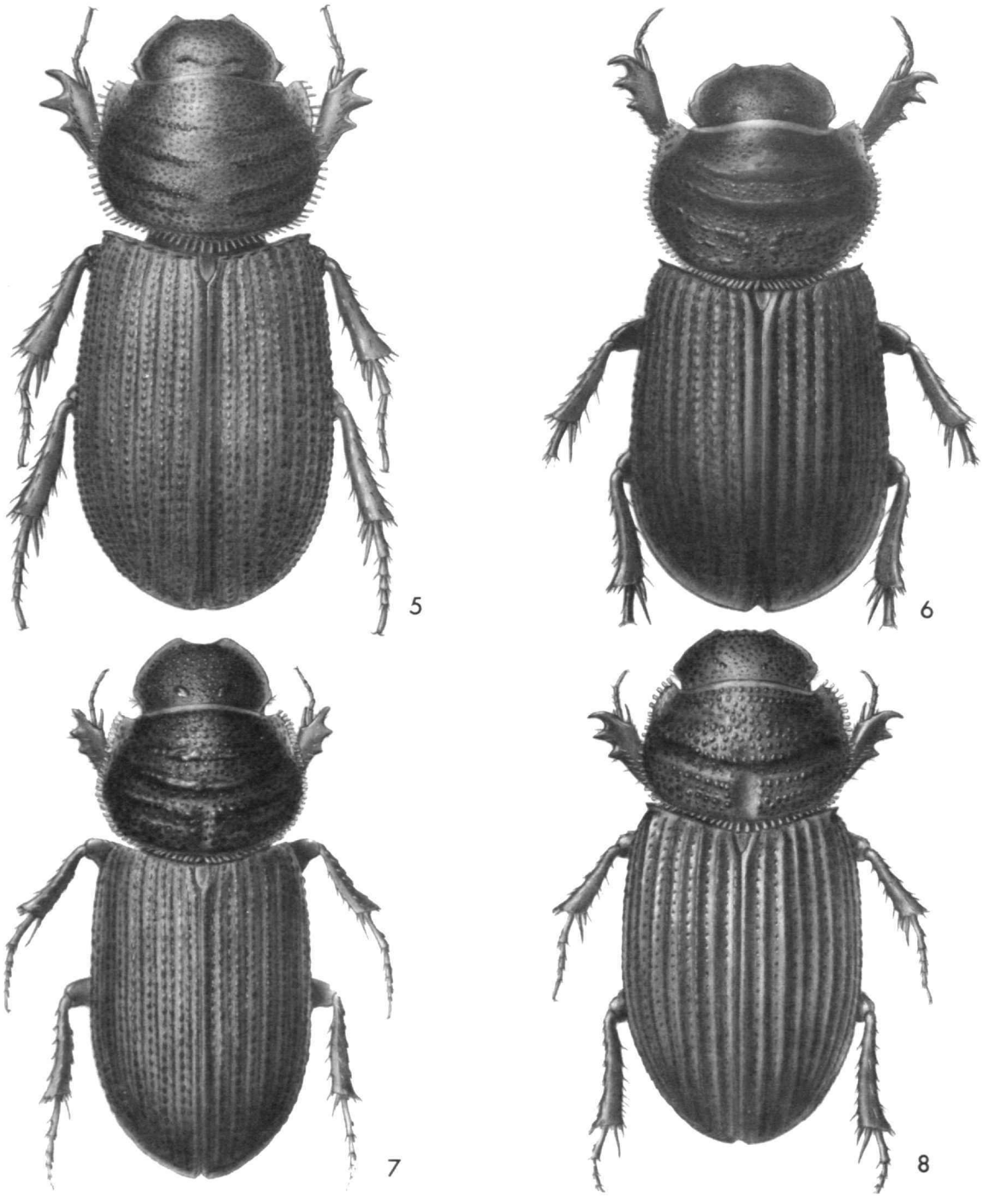
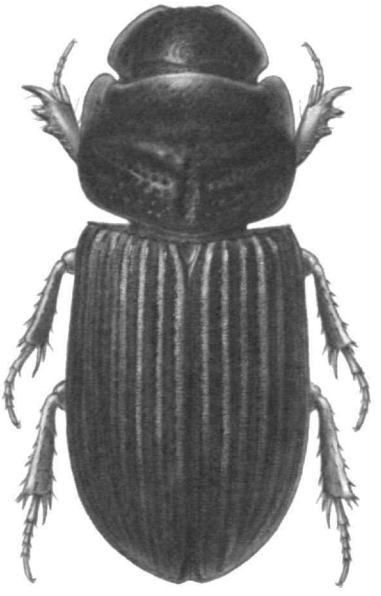
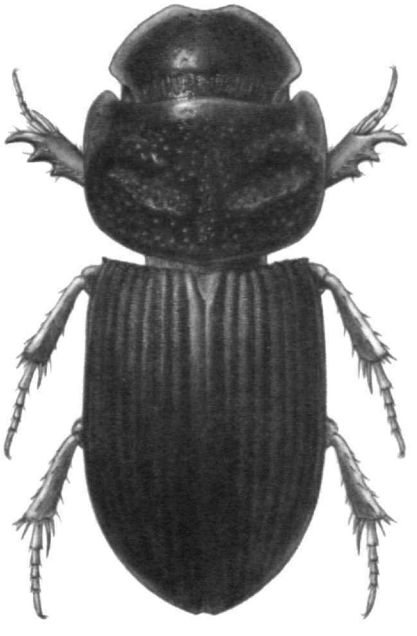


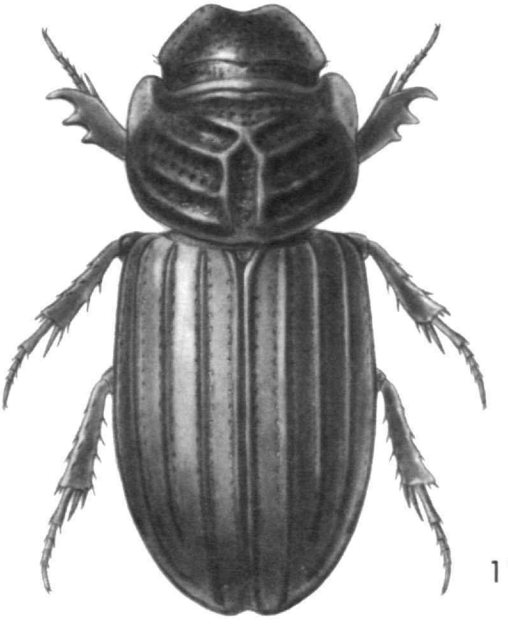
FIGURES 1–4.—1, *Rhyssemus scaber* Haldeman; 2, *Rhyssemus neglectus* Brown; 3, *Rhyssemus germanus* (L.); 4, *Rhyssemus sonatus* LeConte.



FIGURES 5–8.—5, *Rhyssemus californicus* Horn; 6, *Rhyssemus brownwoodi*, new species; 7, *Rhyssemus mexicanus* Hinton; 8, *Rhyssemus spangleri*, new species.







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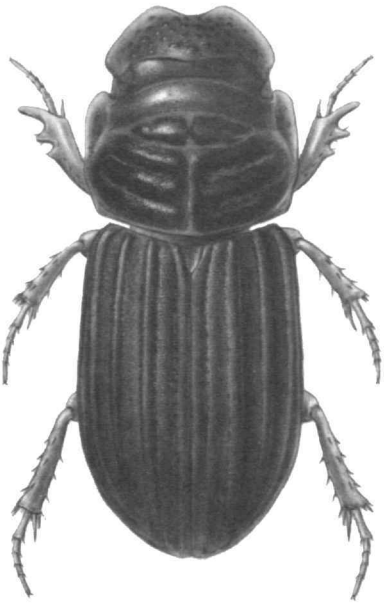
FIGURES 9–11.—9, *Rhyssemus minutus* Petrovitz; 10, *Rhyssemus mimicus*, new species; 11, *Rhyssemus quinquecostatus* Schmidt.



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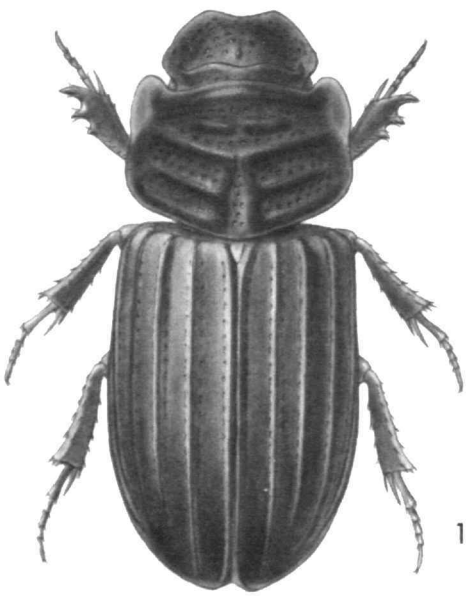

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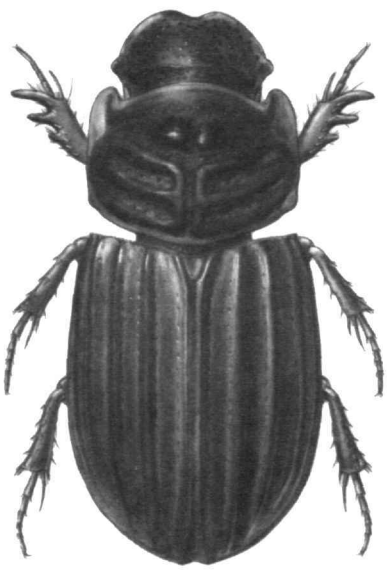

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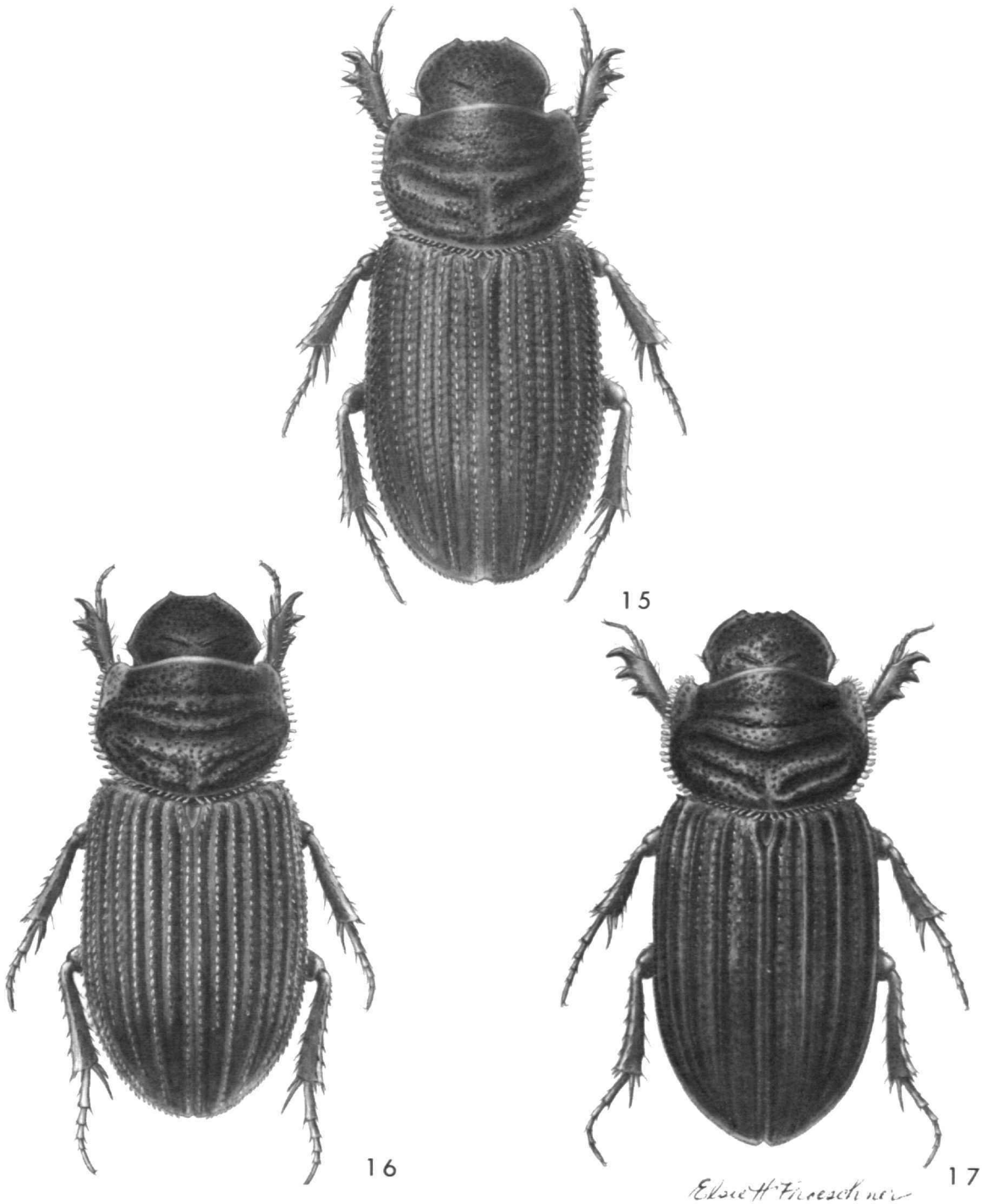
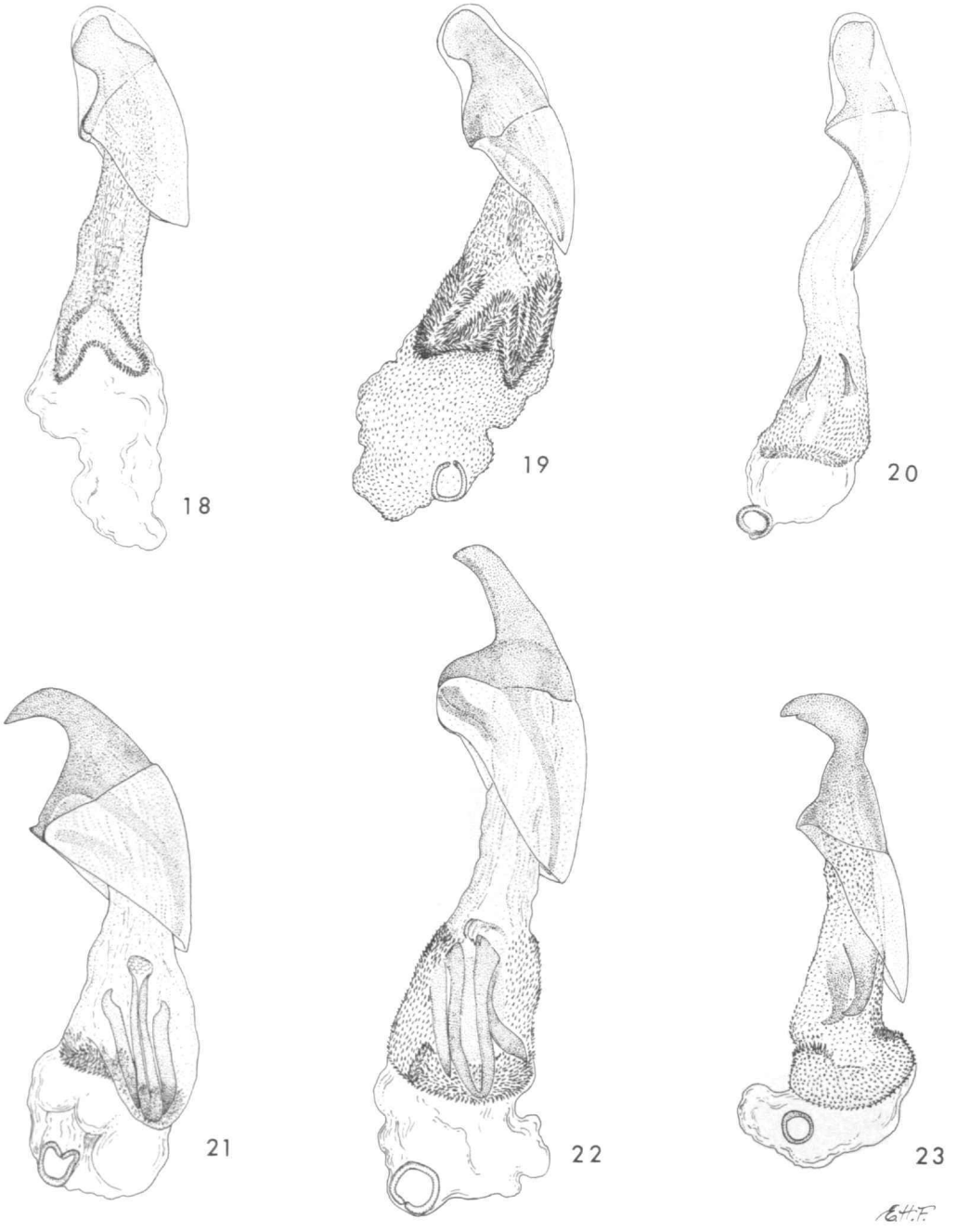
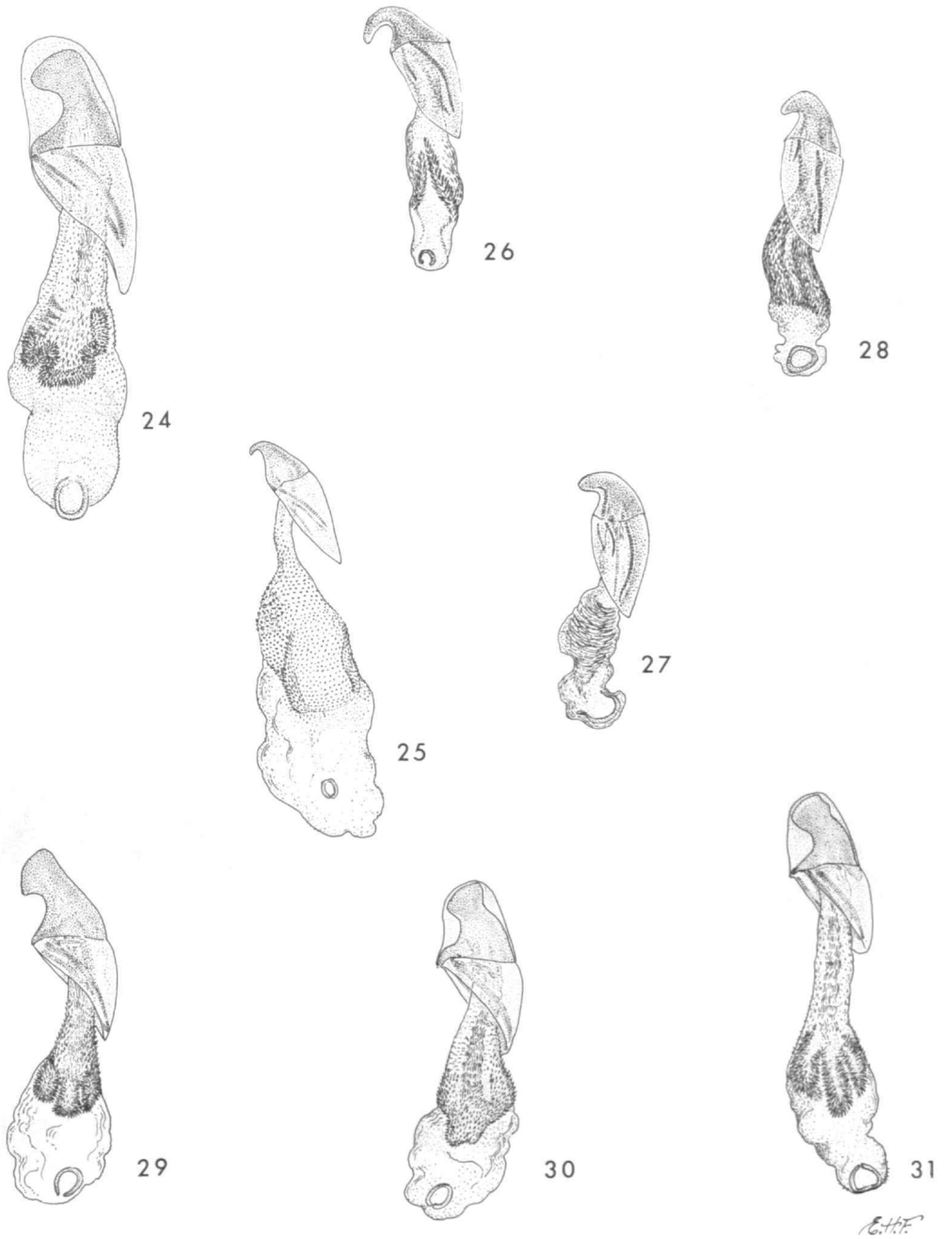
FIGURES 12–14.—12, *Rhyssemus beccarii* Balthasar; 13, *Rhyssemus lineatus*, new species; 14, *Rhyssemus intrinsecus*, new species.



FIGURES 15–17.—15, *Trichiorhyssemus riparius* (Horn); 16, *Trichiorhyssemus cristatellus* (Bates); 17, *Trichiorhyssemus alternatus* Hinton.



FIGURES 18–23.—Male genitalia: 18, *Rhyssemus scaber* Haldeman; 19, *Rhyssemus neglectus* Brown; 20, *Rhyssemus germanus* (L.); 21, *Rhyssemus sonatus* LeConte; 22, *Rhyssemus californicus* Horn; 23, *Rhyssemus mexicanus* Hinton.



FIGURES 24–31.—Male genitalia: 24, *Rhyssemus spangleri*, new species; 25, *Rhyssemus minutus* Petrovitz; 26, *Rhyssemus mimicus*, new species; 27, *Rhyssemus lineatus*, new species; 28, *Rhyssemus intrinsecus*, new species; 29, *Trichiorhyssemus riparius* (Horn); 30, *Trichiorhyssemus cristatellus* (Bates); 31, *Trichiorhyssemus alternatus* Hinton.

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Front matter (preceding the text) should include: **title page** with only title and author and no other information, **abstract page** with author/title/series/etc., following the established format, **table of contents** with indents reflecting the heads and structure of the paper.

First page of text should carry the title and author at the top of the page and an unnumbered footnote at the bottom consisting of author's name and professional mailing address.

Center heads of whatever level should be typed with initial caps of major words, with extra space above and below the head, but with no other preparation (such as all caps or underline). Run-in paragraph heads should use period/dashes or colons as necessary.

Tabulations within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or formal, numbered table heads.

Formal tables (numbered, with table heads, boxheads, stubs, rules) should be submitted as camera copy, but the author must contact the series section of the Press for editorial attention and preparation assistance before final typing of this matter.

Taxonomic keys in natural history papers should use the alined-couplet form in the zoology and paleobiology series and the multi-level indent form in the botany series. If cross-referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa with their corresponding heads in the text.

Synonymy in the zoology and paleobiology series must use the short form (taxon, author, year:page), with a full reference at the end of the paper under "Literature Cited." For the botany series, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in the "Literature Cited") is optional.

Footnotes, when few in number, whether annotative or bibliographic, should be typed at the bottom of the text page on which the reference occurs. Extensive notes must appear at the end of the text in a notes section. If bibliographic footnotes are required, use the short form (author/brief title/page) with the full reference in the bibliography.

Text-reference system (author/year/page within the text, with the full reference in a "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all scientific series and is strongly recommended in the history and technology series: "(Jones, 1910:122)" or ". . . Jones (1910:122)."

Bibliography, depending upon use, is termed "References," "Selected References," or "Literature Cited." Spell out book, journal, and article titles, using initial caps in all major words. For capitalization of titles in foreign languages, follow the national practice of each language. Underline (for italics) book and journal titles. Use the colon-parentheses system for volume/number/page citations: "10(2):5–9." For alinement and arrangement of elements, follow the format of the series for which the manuscript is intended.

Legends for illustrations must not be attached to the art nor included within the text but must be submitted at the end of the manuscript—with as many legends typed, double-spaced, to a page as convenient.

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A few points of style: (1) Do not use periods after such abbreviations as "mm, ft, yds, USNM, NNE, AM, BC." (2) Use hyphens in spelled-out fractions: "two-thirds." (3) Spell out numbers "one" through "nine" in expository text, but use numerals in all other cases if possible. (4) Use the metric system of measurement, where possible, instead of the English system. (5) Use the decimal system, where possible, in place of fractions. (6) Use day/month/year sequence for dates: "9 April 1976." (7) For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc.

Arrange and paginate sequentially EVERY sheet of manuscript—including ALL front matter and ALL legends, etc., at the back of the text—in the following order: (1) title page, (2) abstract, (3) table of contents, (4) foreword and/or preface, (5) text, (6) appendixes, (7) notes, (8) glossary, (9) bibliography, (10) index, (11) legends.