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SCARAB BEETLES OF THE GENUS
ONTHOPHAGUS LATREILLE NORTH OF MEXICO
(COLEOPTERA: SCARABAEIDAE)

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The purpose of this paper is to facilitate the identification of the species of *Onthophagus* of the United States and Canada and to present information on their habits and life histories. Twenty-three species and subspecies described from North America, two species introduced from Europe and Africa, and eleven previously unrecognized species are included. A key to the species, bibliographical references, complete new descriptions, photographs of both sexes, and maps of distribution are given. Important nomenclatural changes are presented.

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Review of literature

The genus *Onthophagus* was established by Latreille in 1802. Since that time parts of the genus have received considerable attention. The American species north of Mexico were discussed by Horn in 1875. In this work he listed only five species; actually he included five species under one of these names and started much of the confusion of later authors. In 1881, he described three more. In 1887, Bates described and listed many of the species occurring in Mexico and in Central and South America. In Blatchley's 1910 work on the Coleoptera of Indiana, eight species and varieties are listed; incorrect placement of several of these continued and compounded the subsequent confusion. In 1914, Schaeffer included 18 species in "A Short Review of the North American Species of *Onthophagus*," the most recent comprehensive paper on the American species north of Mexico. The list of the *Onthophagus* of the world published by Boucomont and Gillet in 1927 greatly facilitated the study of the group. Subsequently a number of new North American species were described by Brown (1927; 1929a; 1929b). These papers were followed by a synopsis of the Mexican and Central and South American species by Boucomont in 1932. Boucomont's paper was intended to be used mainly to identify the Mexican and South American forms, but the inclusion of many species from the United States, in both keys and footnotes, made it useful for all the Americas.

The habits of our North American species are still almost unknown. Sim, in 1930, discussed the habits of *Onthophagus subaeneus* (under the name *cribricollis*). In 1935, Lindquist mentioned some of the habits of *O. pennsylvanicus* and *O. alluvius* (under *anthracinus*). A few additional observations on *O. pennsylvanicus* and *O. hecate* were included in Miller's 1954 paper on dung beetles.

The only descriptive work on the immature stages of North American *Onthophagus* was published by Ritcher in 1945. In this work on the larvae of the Coprinae of eastern North America, he described in detail the larvae of *O. hecate* and *O. pennsylvanicus*. He also gave a short discussion of their habits. The larva and pupa of *O. texanus* were pictured and the biology summarized in a paper by Howden (1957).

The habits of many of the European species of *Onthophagus* have been studied rather intensively, the information on these being summarized in a book by von Lengerken in 1954. In this work the habits of *O. nuchicornis*, now established in Canada and the United States, are described in some detail. The habits of a number of other North American species have received casual mention in numerous papers; these papers are cited in the discussion of habits following the description of each species.

Methods

In the course of this study most of the larger collections of North American *Onthophagus* were examined by one or both of the authors. Almost all the distribution data contained in this paper were taken from specimens personally examined; most place names were taken from pin labels and obvious misspellings have been corrected by the authors. Complete data are given only when less than 20 specimens of a species are known or when all are from one or two localities. In addition to borrowed material, all the type material available in the eastern United States and Canada was studied. Type specimens were borrowed from museums in London, Berlin, and Munich, and specimens were compared with types in Paris, as stated in acknowledgments.

Descriptions of adults are based entirely on external characters. Male genitalia were found useful in some species, but proved more difficult to use than the external characteristics. Separation of closely related forms by characters of the genitalia appeared impossible, and for that reason descriptions of genitalic features have been omitted.

Additional adult material and much of the biological information was procured personally during extensive trips (see Acknowledgments, p. 1).

Adult specimens were collected at dung, carrion, or fungi, and by trapping. Traps were made of tin cans, the 16 to 32-ounce sizes, with the tops cut out, sunk level with the ground surface and partly filled with dung, fungi, or a fermenting bait. One of the more successful baits was a mixture of one pint of malt extract to one gallon of water with a pinch of dried yeast added. An inch of the fermenting mixture was poured in the sunken can and usually 2 to 3 cc. of propionic acid was added to the can. The malt by itself attracted mainly the fungus feeders; the acid was attractive to the dung feeders. The mixture attracted both of these groups in numbers.

Many of the rarer species were found in animal nests or burrows and were seldom, if ever, taken outside of their particular niche. Occasional specimens were taken at light. Some of the more unusual habitat niches in which *Onthophagus* have been found are wood rat nests, gopher tortoise burrows, prairie dog burrows, woodchuck burrows, and caves containing bat dung. Other types of mammal and bird nests were also investigated, but generally proved unproductive.

Larvae of a number of the species were obtained by simply placing adults in 12-inch soil-filled flower pots covered with a piece of glass. Fresh dung was placed on top of the soil in the pot and the beetles left undisturbed for several weeks. In nearly all cases where a number

of adults were placed in a single pot, at least a few brood cells were formed. These cells were removed and placed in 3-ounce metal salve boxes with a small amount of soil. Many of the cells were partly opened, and the larval development observed from day to day. Some of the larvae were preserved, usually by dropping them for 3 minutes in water heated nearly to boiling and then transferring them to 70 percent alcohol. Most of the preserved larvae are now in the collection of the U.S. National Museum.

Although Howden was chiefly responsible for the biological parts of the study and Cartwright for the library research, the study of the specimens and the writing of this review of our *Onthophagus* has been a joint undertaking with each author sharing equally in all of it so far as was possible. Responsibility for any shortcomings or errors in fact or judgement in the following must devolve equally upon both.

Genus *Onthophagus*

Onthophagus Latreille, 1802, p. 141.—Lacordaire, 1856, pp. 107–110.—Horn, 1875, pp. 137–141.—Bates, 1887, pp. 66–82.—Blatchley, 1910, pp. 917–920.—Schaeffer, 1914, pp. 290–300.—Leng, 1920, pp. 248–249.—Boucomont and Gillet, 1927, pp. 118–217.—Boucomont, 1932, pp. 293–332.—Ritcher 1945, pp. 13–23.

Type of genus: Scarabaeus taurus Schreber. By monotypy.

Latreille in his original description of the genus *Onthophagus* cited only one species as an example, "*Copris taurus* Oliv." *Copris taurus* of Olivier (1790, p. 168) was first described under the name *Scarabaeus taurus* by Schreber (1759, p. 7), Schreber's description being among some 16 references to the species listed by Olivier. Inasmuch as *Copris taurus* was the only species listed by Latreille, the Curtis (1825) designation of *nuchicornis* Linnaeus as type was invalid and cannot be accepted under the international rules of zoological nomenclature. The type of the genus must be *Scarabaeus taurus* Schreber.

The genus *Onthophagus*, placed in the tribe Onthophagini of the subfamily Coprinae and family Scarabaeidae, is perhaps the largest genus of beetles known. Nearly 1500 species have been described. In 1930, F. Burmeister stated the worldwide total number of species was somewhat over 1400. More than half, 761, were listed from Africa, 332 from Asia, 152 from Oceania, 85 from Europe, and 84 from America. The Blackwelder checklist, published in 1957, enumerated 79 species from Mexico, the West Indies, and Central and South America. The present paper includes 37 known species from the United States and Canada, only 7 of which are also found south of our borders. Inasmuch as 5 of the 7 are new species, the total number for the Western Hemisphere is now 114.

In the present study we have examined *Onthophagus* from every state in the United States except Washington, Oregon, California, and Nevada. A fossil species, however, has been described from California. Pierce (1946) described *Onthophagus everestae* on the basis of a head and front tibia found in the La Brea tar pits.

The original description follows:

Genre. Onthophage; onthophagus. Dernier article des palpes maxillaires ovulaire. Palpes labiaux terminés par des articles qui paroissent plus grands et qui sont trèhérisés de poils.

Corps presque rond, un peu déprimé. Chaperon demicirculaire, alongé. Corcelet très grand, se rapprochant de la figure circulaire, échancré en devant. Pattes des bousiers.

Exemple. *Copris taurus* Oliv.

ADULTS.—In the United States and Canada the beetles of the genus *Onthophagus* are small to moderate in size, 2.8 to 14.0 mm. in length, oblong oval, with a short thick compact body, convex above and below, with middle legs far apart and hind legs far back. Males usually have the head horned or tuberculate and (or) the pronotum with horns or other protuberances; females have the head carinate and sometimes the pronotum with a carina or other minor elevation.

Mentum hairy, transverse, quadrangular, emarginate; labial palpi hairy, 3-segmented, the first segment slightly shorter than the second, the third very small and inconspicuous, the first segment obovate in profile and abruptly produced on the upper side while the second is securiform and obliquely truncate. Labrum membranous, densely ciliate, concealed by the clypeus. Mandibles elongate, rounded, without teeth, membranous toward apex, and ciliated on internal edge. Maxillae terminating in a large membranous ciliated lobe, palpi 4-segmented, the first segment short and slender, the second and third short and more robust, the fourth fusiform and truncate at the end. Clypeus relatively smooth in the male, carinate in the female, variable in shape. Antennae 9-segmented, with a densely, finely pubescent 3-segmented club. Pronotum large, convex, rounded downward at sides. No visible scutellum. Elytra short, a little convex, somewhat narrowed and rounded posteriorly; seven striae. Legs moderate; the anterior tibiae quadridentate, sometimes slender and elongate in males, with tarsi present in both sexes; middle and posterior tibiae apically enlarged and truncate; tarsi slender, ciliated on inner edge, the first segment elongate and subparallel; claws small. Metasternum long and somewhat parallel-sided, separated from the very short mesosternum by a rectilinear groove. Pygidium exposed. Males with last abdominal segment broadly emarginate at middle; females with last segment not constricted at middle, practically uniform in length.

LARVAE.—The pronounced hump-backed appearance is a conspicuous characteristic of the larvae of *Onthophagus* as in all Coprinae; however, the humped back is accentuated in the larvae of *Onthophagus* by the presence on the third abdominal segment of a dorsal conical protuberance bearing numerous setae. The known larvae are all very similar morphologically, the last abdominal segment exhibiting some of the most useful characters for the separation of the species.

Larval development is similar for all known species. Three instars are present, each stage lasting from 8 days to 2 weeks. Development from egg to teneral adult is rapid, usually taking only 5 or 6 weeks. Emergence of the adults from the pupal cells may be delayed in hot dry weather and during the winter.

Construction of the brood cells is likewise rather typical. The burrows, made at the edge of or under dung, are often twisted, sometimes branched, and vary in depth from 1 to 9 inches, depending on the species. The oval brood cell, approximately 1½ times as long as wide and filled with dung, is formed nearly horizontally at the end of the burrow or branch. After the egg is fastened on end to the side of a small cavity formed in the upper end of the dung, the cavity wall is sealed with the same material. The burrow may then be partly refilled with soil and the egg and subsequent larva left without further attention.

Despite the similarity of the larvae and larval development in the various species, the study of their habits has been extremely interesting because of the restricted habitat niches of a number of them. A discussion of the preferred food and habitat follows the description of each species.

The species from the United States and Canada have been known under many names. Various authors have used several different names for the same species with resulting confusion and misidentifications. Mistakes made by recognized authorities of an earlier day were frequently followed by subsequent workers. We have attempted to correct all such errors, added names of new species, and compiled the following table in the process.

<i>Name used</i>	<i>Present status</i>
<i>aciculatulus</i> Blatchley, 1928, p. 128	Valid.
<i>aciculatus</i> Blatchley, 1928, p. 128	Misspelling of <i>aciculatulus</i> Blatchley.
<i>aluvius</i> , new species	Valid.
<i>alutaceus</i> Blatchley, 1919, p. 31 (not Wiedemann, 1823, p. 14)	= <i>aciculatulus</i> Blatchley.
<i>ammon</i> Sturm, 1826, p. 177	= <i>Copris minutus</i> (Drury).
<i>anthracinus</i> Dejean, 1836, p. 158	Nomen nudum.
<i>anthracinus</i> Harold, 1873, p. 104 (not Falderman, 1835, p. 247)	= <i>monticolus</i> , new species and (or) <i>aluvius</i> , new species.
<i>arizonensis</i> Schaeffer, 1909, p. 382	= <i>höpfneri</i> Harold.
<i>arnetti</i> , new species	Valid.

<i>Name used</i>	<i>Present status</i>
<i>batsi</i> , new species	Valid.
<i>blatchleyi</i> Brown, 1929, p. 86	Subspecies of <i>hecate</i> (Panzer).
<i>brevifrons</i> Horn, 1881, p. 76	Valid.
<i>browni</i> , new species	Valid.
<i>canadensis</i> (Fabricius), 1801, p. 34	Subspecies of <i>orpheus</i> (Panzer).
<i>carolinus</i> Strum, 1826, p. 177	= <i>Dichotomius carolinus</i> (Linnaeus).
<i>castaneus</i> Melsheimer, 1846, p. 134	= <i>striatulus</i> (Palisot de Beauvois).
<i>cavernicollis</i> , new species	Valid.
<i>cavicornis</i> Lacordaire, 1856, p. 109	Misspelling of <i>cervicornis</i> Kirby.
<i>cervicornis</i> Kirby, 1825, p. 565	Not in U.S. See <i>striatulus</i> (Palisot de Beauvois).
<i>cochisus</i> Brown, 1927, p. 132	Valid.
<i>concinus</i> Dejean, 1836, p. 157	Nomen nudum.
<i>concinus</i> Laporte, 1840, p. 87	Valid.
<i>coproides</i> Horn, 1881, p. 79	Valid.
<i>cribricollis</i> Dejean, 1836, p. 158	Nomen nudum.
<i>cribricollis</i> Horn, 1881, p. 76	= <i>subacneus</i> (Palisot de Beauvois).
<i>cynomysi</i> Brown, 1927, p. 131	Valid.
<i>depressus</i> Harold, 1871, p. 116	Valid.
<i>falcipes</i> Harold, 1871, p. 115	Attributed to Germar in litt. Nomen nudum.
<i>flavicornis</i> Germar, 1824, p. 105	= <i>aenescens</i> Wiedemann ex Java. Not in U.S.
<i>floridanus</i> Blatchley, 1928, p. 128	Subspecies of <i>striatulus</i> (Palisot de Beauvois).
<i>furcicollis</i> Dejean, 1836, p. 157	Nomen nudum.
<i>gracilicornis</i> Sturm, 1843, p. 107	= <i>gracilicornis</i> Germar ex India. Not in U.S.
<i>granarius</i> Dejean, 1836, p. 158	Nomen nudum.
<i>guatemalensis</i> Bates, 1887, p. 73	Not in U.S. See <i>medorensis</i> Brown.
<i>haemorrhous</i> Sturm, 1843, p. 108	Nomen nudum.
<i>hastator</i> (Fabricius), 1798, p. 28	= <i>hecate</i> (Panzer).
<i>hecate</i> (Panzer), 1794, p. 5	Valid.
<i>höpfneri</i> Harold, 1869, p. 512	Valid.
<i>incensus</i> Say, 1835, p. 173	Valid (Hawaii but not mainland U.S.).
<i>janus</i> (Panzer), 1794, p. 5 (not Olivier, 1789, p. 101)	= <i>striatulus</i> (Palisot de Beauvois).
<i>knausi</i> Brown, 1927, p. 130	Valid.
<i>knalli</i> , new species	Valid.
<i>lama</i> Dejean, 1836, p. 157	Nomen nudum.
<i>landolti</i> Harold, 1880, p. 34	Subspecies found in U.S. See <i>landolti texanus</i> Schaeffer.
<i>latebrosus</i> Buquet (Dejean, 1836, p. 159)	Nomen nudum.
<i>latebrosus</i> (Fabricius), 1801, p. 134	= <i>hecate</i> (Panzer).
<i>lecontei</i> Harold, 1871, p. 115	Not in U.S. See <i>subopaeus</i> Robinson.
<i>medorensis</i> Brown, 1929, p. 204	Valid.
<i>minutus</i> Sturm, 1843, p. 108	Nomen nudum.
<i>moeris</i> Sturm, 1826, p. 178	Attributed to Melsheimer. Nomen nudum.
<i>monstrosus</i> Dejean, 1836, p. 157	Nomen nudum.
<i>monticolus</i> , new species	Valid.

<i>Name used</i>	<i>Present status</i>
<i>niger</i> Melsheimer, 1846, p. 134	= <i>striatulus</i> (Palisot de Beauvois).
<i>nigrescens</i> Blatchley, 1916, p. 94 (not d'Orbigny, 1902, p. 21)	= <i>striatulus floridanus</i> Blatchley.
<i>nuchicornis</i> (Linnaeus), 1758, p. 547	Valid.
<i>obtectus</i> (Palisot de Beauvois), 1805, p. 25	= <i>hecate</i> (Panzer).
<i>obscurus</i> Sturm, 1826, p. 178	Nomen nudum.
<i>oklahomensis</i> Brown, 1927, p. 128	Valid.
<i>orpheus</i> (Panzer), 1794, p. 5	Valid.
<i>oratus</i> (Linnaeus), 1767, p. 551	Not in U.S. See <i>pennsylvanicus</i> Harold.
<i>pennsylvanicus</i> Harold, 1871, p. 115	Valid.
<i>polyphemi</i> Hubbard, 1894, p. 311	Valid.
<i>protensus</i> Melsheimer, 1846, p. 134.	= <i>concinnus</i> Laporte.
<i>pseudorpheus</i> , new subspecies	Subspecies of <i>orpheus</i> .
<i>rhinoceros</i> Melsheimer, 1846, p. 134	= <i>nuchicornis</i> (Linnaeus).
<i>sayi</i> Laporte, 1840, p. 87	= <i>hecate</i> (Panzer).
<i>scabricollis</i> Kirby, 1837, p. 126	= <i>hecate</i> (Panzer).
<i>schaefferi</i> , new species	Valid.
<i>sparsisetosus</i> , new subspecies	Subspecies of <i>polyphemi</i> Hubbard.
<i>striatulus</i> (Palisot de Beauvois), 1809, p. 92	Valid.
<i>subaeneus</i> (Palisot de Beauvois), 1811, p. 105	Valid (<i>cribricollis</i> of authors).
<i>subopacus</i> Robinson, 1940, p. 142	Valid.
<i>substriatus</i> Schaeffer, 1914, p. 292	= <i>striatulus</i> (Palisot de Beauvois).
<i>subtropicus</i> , new species	Valid.
<i>texanus</i> Schaeffer, 1914, p. 299	Subspecies of <i>landolti</i> Harold.
<i>tuberculatus</i> Gemminger and Harold, 1869, p. 1038	Attributed to Zimmerman in litt. Nomen nudum.
<i>tuberculifrons</i> Harold, 1871, p. 115	Valid.
<i>velutinus</i> Horn, 1875, p. 140	Valid.
<i>viridicatus</i> Say, 1837, p. 173	= <i>Canthon viridis</i> (Palisot de Beauvois).
<i>viridicollis</i> Sturm	Attributed to Megerle. Nomen nudum.
<i>ziphias</i> LeConte, 1863, p. 36 (footnote)	= <i>nuchicornis</i> (Linnaeus).

Species of *Onthophagus* of the United States and Canada may perhaps be most easily separated from other Scarabacidae by using the following combination of characters: body more or less oval in shape from dorsal view; scutellum not visible; elytra with striae not deeply impressed and the intervals not distinctly convex; last abdominal spiracle hidden by the elytra; front coxae large, elevated, front legs with tarsi; middle coxae widely separated; middle and hind tibiae widened at apex; males with last abdominal segment narrowed

medially to receive the pygidium, last segment not narrowed medially in the female.

Key to the *Onthophagus* of the United States and Canada

1. Disc of pronotum tuberculate or simply punctate; setae not flattened if present 2
 - Disc of pronotum closely, setigerously, annularly punctate, the ringlike punctures separated by less than their diameters; each puncture anteriorly with a distinct tubercle, centrally with a short recumbent flattened yellow seta; Georgia, Florida, and South Africa.
 - depressus** Harold (p. 126)
- 2(1). Disc of pronotum smooth or distinctly punctate, tubercles lacking on disc or if present, less than one-half of the diameter of nearest puncture in basal area 3
 - Disc of pronotum tuberculate; punctures, if present, vague with diameters approximately equal to that of the tubercles 33
- 3(2). Color uniform, rarely with humeral umbone or entire elytra lighter in general specimens 4
 - Pronotum and elytra decidedly different in color, or elytra bicolored or spotted 26
- 4(3). Species over 7.5 mm. in length, except rarely in *batesi* in which the nonsetate, finely punctate shining pronotum will distinguish it from the small western species considered here; species occurring west of the Mississippi River 5
 - Species under 7.5 mm. in length or, if over 7.5 mm., occurring east of the Mississippi River 11
- 5(4). Basal half of pronotal disc smooth and minutely punctate or very much more finely punctate basally than anteriorly, shiny black or brown . . 6
 - Pronotum more or less uniformly punctate except near posterior edge . . 8
- 6(5). Lateral margin of pronotum lacking an abrupt angle between anterior and posterior pronotal angles 7
 - Lateral margin of pronotum with an abrupt angle between anterior and posterior pronotal angles; New Mexico, Colorado, Arizona.
 - coproides** Horn (p. 14)
- 7(6). Cephalic horns of male united by a sharp carina evenly arcuate down one horn across the front and up the other; female with a low, evenly elevated anterior clypeal carina; Texas to Panama.
 - batesi**, new species (p. 21)
- Cephalic horns of male not united by a carina across the front; female with anterior clypeal carina noticeably higher at middle; Mexico to Costa Rica, Hawaii **incensus** Say (p. 24)
- 8(5). Punctures of pronotum close and more or less uniform in size, separated by less than their diameters, each with a short black inconspicuous seta; surface dull black, finely alutaceous; Arizona.
 - cochisus** Brown (p. 18)
- Large punctures of pronotum usually separated by one or more diameters, with or without setae; pronotum alutaceous or smooth and shining 9
- 9(8). Pronotal punctures, at least laterally, with moderately long setae; elytra shining **orpheus** complex; see couplet 17
 - Pronotal punctures, at most, with minute setae; clytra dull, distinctly alutaceous 10

- 10(9). Pronotum largely smooth between punctures; frontal carina of male extending almost to eye; female frontal carina gradually elevated from middle to rounded ends which drop sharply to head surface, the ends nearer to eye than to middle; Kansas to Arizona.
brevifrons Horn (p. 27)
 Pronotum finely alutaceous; male frontal carina extending not more than one-half distance from middle to eye; female frontal carina with each side elevated to a sharp tubercle, the tip of each nearer to the middle than to the eye; Texas . . . *subtropicus*, new species (p. 30)
- 11(4). Disc of pronotum virtually impunctate, shiny black or brownish black; males without horns or protuberances on head or pronotum, 5 to 7 mm. in length; found in burrows of gopher tortoise 12
 Disc of pronotum distinctly punctate 13
- 12(11). Elytral intervals with one or two rows of setigerous punctures, punctures often with a tubercle at anterior margin; east coast of Florida, South Carolina *polyphemi polyphemi* Hubbard (p. 35)
 Elytral intervals 2 and 4 with only a few scattered setae, nearly impunctate; Florida west of Apalachicola River to Mississippi.
polyphemi sparsisetosus, new subspecies (p. 38)
- 13(11). Shining, black, brown, blue, green, or cupreous; more than 4 mm. in length; pronotum lacking numerous smaller secondary punctures . . 14
 Dull or feebly shining, alutaceous, brown or black, or if shining only 3 to 4 mm. in length; some species with small secondary punctures on pronotum 19
- 14(13). Pronotum without basal margin; clypeal emargination, if any, not dentate on each side 15
 Pronotum narrowly margined basally; clypeus usually more or less bidentate, the teeth low, triangular, and well separated; male with conical pronotal protuberance, without tubercles or horns behind eyes; less than 5.5 mm. in length; shining blackish green or coppery; Atlantic coast to Kansas, Oklahoma, and Texas.
subaeneus (Palisot de Beauvois) (p. 72)
- 15(14). Second and third elytral intervals with three rows of setigerous tubercles; male with long slender horn above each eye; pronotal protuberance of male rounded not projecting above head 16
 Second and third elytral intervals with one or two rows of setigerous punctures or tubercles; male pronotum with bifurcate protuberance projecting above head 17
- 16(15). Elytral intervals alutaceous between tubercles; Vermont to Florida, west to Nebraska and Texas.
striatulus striatulus (Palisot de Beauvois) (p. 41)
 Elytral intervals smooth and shining between tubercles; Florida to South Carolina. *striatulus floridanus* Blatchley (p. 45)
- 17(15). Elytral intervals with small tubercles anterior to each indistinct puncture; pronotal punctures usually large and close, often anteriorly tuberculate; body commonly green above, the head and pronotum rarely with slight coppery cast, elytra often blackish 18
 Elytral intervals, particularly the fifth, distinctly punctate, the anterior tubercles lacking or barely indicated; pronotal punctures more widely spaced, usually shallow, lacking anterior tubercles; body above shining green to distinctly coppery red; Ontario, northeastern United States, and Appalachian Mountains to South Carolina.
orpheus canadensis (Fabricius) (p. 50)

- 18(17). Male major lacking a distinct clypeal carina; female with frontal carina evenly elevated or highest at middle; setae of pronotum and elytra not conspicuous; in forested areas of eastern United States.
orpheus orpheus (Panzer) (p. 47)
 Male major with a distinct clypeal carina, often elevated medially; females with frontal carina highest near eyes; setae of pronotum and elytra conspicuous; Great Plains from Manitoba to Kansas.
orpheus pseudorpheus, new subspecies (p. 53)
- 19(13). Pronotal punctures not crowded, separated by at least 1 diameter 20
 Punctures of pronotum shallow, dense, and crowded; punctures from nearly contiguous to separated by less than 1 diameter, somewhat annular, mixed setigerous and nonsetigerous; male with conical pronotal protuberance; brownish black; Illinois, Nebraska, east Texas.
knausi Brown (p. 76)
- 20(19). Anterior edge of pronotal punctures lacking tubercles 22
 Anterior edge of pronotal punctures with a small shining tubercle 21
- 21(20). Length 4 to 4.5 mm.; feebly shining; punctures separated by 1 diameter; basal carina of head reduced to two tubercles in male; Florida.
aciculatulus Blatchley (p. 79)
 Length 4.5 to 6.5 mm.; dull, alutaceous; punctures usually separated by 2 to 3 diameters; pronotal protuberance of male short, moderately broad, flat, slightly emarginate, and depressed at middle; Arizona.
subopacus Robinson (p. 59)
- 22(20). Pygidial punctures very shallow, at least in basal half, sometimes deep and distinct if apical half of pygidium is shining; male with conical pronotal protuberance; female with protuberance usually feebly indicated 23
 Punctures of pygidium deep, only slightly smaller basally; males and females without any indication of pronotal protuberance 25
- 23(22). Pygidium apically convex, shining, distinctly punctate; nearly impunctate and alutaceous basally; pronotal punctures usually lacking distinct margins, fairly uniform in size; Texas and Arizona 24
 Pygidium almost flat, very shallowly, indistinctly punctate, alutaceous almost to apex; pronotal punctures with distinct margins, often appearing annular; small shallow nonsetate secondary punctures scattered among large punctures; Big Bend region of Texas and mountains of northeastern Mexico.
monticolus, new species (p. 61)
- 24(23). Posterior half of metasternum medially impunctate or with one or two shallow punctures; Texas *alluvius*, new species (p. 65)
 Posterior half of metasternum medially with a few very large punctures near midline; Arizona *knulli*, new species (p. 69)
- 25(22). Dull brownish-black species with pronotal punctures generally the same size, usually all with setae; New Hampshire to Florida and South Dakota to Texas *pennsylvanicus* Harold (p. 82)
 Shining black species with pronotal punctures of two sizes, very small punctures lacking setae scattered among the large punctures; Virginia to Texas *oklahomensis* Brown (p. 80)
- 26(3). Large species over 7.5 mm. in length, with unicolorous elytra; west of the Mississippi River from Arkansas to Texas 27
 Species under 7.5 mm. or having spotted or bicolored elytra 28

- 27(26). Pronotum shining green, frontal carina of male extending almost to eye; female frontal carina wide, gradually elevated from middle to the rounded ends which drop sharply to surface of head, the ends nearer eye than middle; in bat caves, Arkansas to Texas.
cavernicollis, new species (p. 32)
 Pronotum with at most a greenish cast; male frontal carina extending not more than one-half distance from middle to eye; female frontal carina with each side elevated to a sharp tubercle, the tip of each tubercle nearer the middle than to the eye; Texas.
subtropicus, new species (p. 30)
- 28(26). Head and pronotum dull black, elytra largely brown speckled with black; length 6.7 to 9.5 mm.; male with median horn on vertex behind eyes; female usually with small prortal hump behind head; southern Canada and northern United States except Central Plains area.
nuchicornis (Linnaeus) (p. 123)
 Characters not as above 29
- 29(28). Pronotum shining between punctures, not dull brownish black; pygidium usually distinctly punctate with at least apical half shining . . . 30
 Pronotum dull brownish black, alutaceous between setigerous punctures; pygidium shallowly punctate, usually alutaceous at least to apical third; elytra dull black with scattered small round yellowish spots, particularly along apical margin; eastern United States to Kansas and Oklahoma, rarely Texas and Arizona.
tuberculifrons Harold (p. 85)
- 30(29). Punctures of pronotum lacking tubercles at anterior margins; males without horns on the head 31
 Punctures of pronotum with small tubercle in front of each seta; base and apex of elytra brownish yellow; head of male with two slender horns extending upward behind the eyes; Vermont to Florida, west to Nebraska and Texas.
striatulus striatulus (Palisot de Beauvois) (p. 41)
- 31(30). Pygidium bicolored, rarely all yellow 32
 Pygidium uniformly dark; pronotum and elytra shining greenish brown to black; elytra with a reddish-yellow spot just inside each humerus and frequently smaller round discal spots scattered elsewhere but always showing on the fifth interval first; Texas.
schaefferi, new species (p. 88)
- 32(31). Base of pronotum finely margined only at middle; pronotum black or brownish black, occasionally greenish black; anterior angles of pronotum and frequently lateral and anterior margins yellow; yellow of elytra often forming stripes; apex of elytra frequently yellow but usually broken by a dark marginal spot at end of fourth interval; fifth interval never with discal spots, rarely with base and apex yellow; Texas *landolti texanus* Schaeffer (p. 91)
 Base of pronotum completely margined; pronotum green or coppery, anterior angles not lighter in color; elytra usually with irregular yellow areas at base and apex and with at least a few small round spots on disc; Arizona *höpfneri* Harold (p. 95)
- 33(2). Tubercles of pronotum very conspicuous. Clypeus of males triangularly produced upward at middle, clypeus of females evenly rounded; if not, elytra bicolored 37
 Tubercles of pronotum moderate with moderate to vague punctures at their bases; clypeus of both sexes broadly rounded or slightly emarginate 34

- 34(33). Surface of pronotum and (or) elytra finely alutaceous. 35
 Surface of pronotum and elytra between tubercles smooth and shining;
 in prairie dog burrows; Oklahoma, New Mexico.
synomysi Brown (p. 57)
- 35(34). Uniformly brown or black; eyes flat and narrow, 6 to 7 facets wide;
 anterior pronotal angles sharply rounded, posterior angles more
 broadly rounded, 140° to 145°. 36
 Pronotum greenish, elytra black; eyes noticeably convex, 10 facets
 wide; anterior pronotal angles broadly rounded, posterior angles
 more sharply rounded, 130°. Length 6.6 to 8.6 mm.; southern
 Arizona. *arnetti*, new species (p. 98)
- 36(35). Pronotum of male with flat projecting protuberance, its wide shallow,
 usually angular emarginate anterior edge wider than base, and its
 external angles rounded; females with carina of vertex distinctly
 bent posteriorly at middle; female pronotal protuberance distinct,
 sharply defined; western Texas to Arizona.
browni, new species (p. 101)
- Head of male with two upright diverging slender horns in front of the
 high angulate anterior margin of pronotum; females with carina of
 vertex nearly straight; thoracic protuberance of female very weak,
 poorly defined; Texas, Colorado to Arizona. *velutinus* Horn (p. 105)
- 37(33). Pronotum bright shiny green or bluish; elytra usually bicolored, green
 with yellow base and apex; Pennsylvania to Florida and Louisiana.
concinnus Laporte (p. 108)
- Color feebly shining to dull uniform dark green, blue, or black, sometimes
 with brown spots at apex of elytra 38
- 38(37). Elytral intervals triserially tuberculate; male without basal cephalic
 horns 39
 Elytral intervals biserially punctate-tuberculate; green, blue, or black;
 male with short acute basal horn directed upward and outward behind
 each eye; Kansas to Texas and Louisiana.
medorensis Brown (p. 112)
- 39(38). Pronotal setae fine and long, length much greater than distance between
 elongate oval tubercles; east of Rockies.
hecate hecate (Panzer) (p. 115)
- Pronotal setae short, inconspicuous, scarcely longer than distance
 between small round tubercles; usually brown spots at apex of elytra;
 Florida to South Carolina *hecate blatchleyi* Brown (p. 120)

Onthophagus coproides Horn

PLATE I, FIGURES 4 AND 5

- Onthophagus coproides* Horn, 1881, p. 75.—Henshaw, 1885, p. 87.—Schaeffer,
 1914, p. 293.—Leng, 1920, p. 248.—Dawson, 1922, p. 178.—Boucomont
 and Gillet, 1927, p. 205.—Boucomont, 1932, p. 297.
- Onthophagus cuboidalis* Bates, 1887, p. 79.—Boucomont, 1932, p. 297—Black-
 welder, 1944, p. 211.

MALE MAJORS.—Length 11.5 to 14.0 mm., width 7.1 to 7.3 mm.
 Dorsally and ventrally brown to piceous, with legs same color. Cly-
 peus transverse, somewhat quadrangular; lateral anterior angles
 sharply bent and sometimes extending beyond the lateral margins of
 the genae; clypeus gradually reflexed between the anterior angles;

margin slightly thickened and slightly emarginate or truncate medially; clypeal disc closely, shallowly, rugosely punctate, the punctures fine to moderate in size, separated by less than a diameter, many confluent; clypeal carina fine, low, evenly elevated, relatively straight, impunctate. Frons slightly convex medially; shallowly, rugosely punctate but less closely than clypeal disc; delimited laterally from the gena by a definite sutural line. Carina of the vertex very strong, bowed forward slightly, almost straight, lowest medially, elevated at each end into a strong horn near the eyes, the carina and horns shallowly punctate anteriorly; genae not distinctly flared laterally, extending no further than the anterior angles of the clypeus, punctures as on clypeus.

Pronotum completely margined, anterior angles rounded and flattened, lateral margins bent downward sharply just in front of the middle. Pronotum convex and tumid anteriorly, not overhanging the head; the tumosity widely and bluntly shaped like an inverted V, the arms of the V extending posteriorly as well-defined ridges, sharply declivous in front of the ridge and weakly concave from lateral end of the ridge down to the margin opposite the eye; the median line weakly impressed over posterior third. The tumosity with a scattered group of 10 to 15 coarse intermixed punctures high on each side of the anterior face; the surface otherwise from closely, moderately punctate anteriorly (the punctures separated by less than a diameter) to gradually much finer over the posterior part of the disc which is smooth and shining between the punctures. Elytral striae shallowly punctate; intervals slightly convex, generally smooth and shining, with scattered fine punctures; a few setae evident posteriorly, largely in the punctures of the sutural interval.

Pygidium shining, moderately punctate, the punctures each bearing a short yellow seta. Ventrally the thorax coarsely punctate laterally, the punctures becoming smaller and finer medially; metasternum smooth and shining, with median line finely, slightly impressed; laterally the punctures bearing long thin dark reddish setae. Abdomen medially impunctate, the last three segments each bearing a row of small setigerous punctures laterally; last segment lighter in color and narrowed medially to receive the pygidium. Forelegs lengthened, the tibia considerably longer and thinner than in the female, with four teeth, the basal one often obsolete; the margin between the teeth smooth, differing in this respect from the other species which have the margin serrated. Middle and hind femora with a few large coarse punctures apically; scattered fine punctures over the entire ventral surface.

MALE AND FEMALE MINORS.—These show only a vague anterior pronotal carina and are quite similar in every way except in the shape

of the frontal carina. In the male the carina is slightly arcuate forward and evenly elevated, with rounded ends. In the female the frontal carina is sharply angulate anteriorly at the middle, and the ends are also sharply angulate and prominent. The front tibia is slightly wider in the female.

FEMALES.—Length 11 to 11.3 mm., width 6.5 to 7.2 mm. Differing from male majors in the following respects: Clypeus almost evenly arcuate, anteriorly broadly slightly emarginate and only slightly reflexed; laterally not extending beyond the genae; disc flat and not concave as in male major, surface moderately rugosely punctate; a low clypeal carina separating the clypeus from the frons and extending laterally to the juncture with the genae. Frons moderately coarsely, almost rugosely punctate as are the genae; carina of the vertex strongly developed and strongly angularly bowed forward medially, ending on each side in a long horn as described for the male major.

Pronotum with outline, punctuation, convexity, and tumosity similar to the male major. The elytra are similar also. The pygidium is slightly convex apically, shining, and with scattered close setigerous punctures. Ventrally the major differences from male majors are the more pronounced thoracic punctures, the even length of the last abdominal segment, and the shorter, thicker foretibia. The four teeth on the foretibial margin are broader than in the male, but the margin is still smooth and nonserrated. Females show more variation than is usually found in this sex, the horns at the ends of the frontal carina in fully developed individuals being longer than in most males and the high connecting carina being angularly bent far forward with a short but noticeable longitudinal carina extending back from the angle.

TYPE.—Lectotype, present designation, a large female in Academy of Natural Sciences of Philadelphia, Type 3569. Horn stated that the three specimens before him were males, but examination shows all are females.

TYPE LOCALITY.—Santa Fe Canyon, New Mexico (700 ft.).

SPECIMENS EXAMINED.—43.

DISTRIBUTION.—(See fig. 1, p 17.)

NEW MEXICO: Santa Fe Canyon, Water Canyon (5000 ft.), Clouderoft, Fort Wingate, Las Vegas, El Porvenir (San Miguel Co.), Torrance, 6 mi. south of Thoreau (McKinley Co.) from stomach of *Ambystoma tigrinum*. ARIZONA: Chiricahua Mts., Douglas, Prescott, 8 mi. south of Showlow, Springerville (Apache Co.), General Springs (Coconino Co.), Woolaroc. COLORADO: Colorado Springs. NEBRASKA: Halsey.

REMARKS.—*Onthophagus coproides*, the largest North American *Onthophagus*, can be distinguished by the nonserrated margin between

the tibial teeth of the foretibia, by the high carina of the vertex which ends over each eye in a long horn in both sexes, by the smooth, finely punctate basal portion of the pronotum, by the minute punctures of the elytral intervals, and by the dark brown to piceous overall color.

Though *coproides* appears to be widely distributed in the higher mountains of Arizona, New Mexico, and Colorado, it has also been taken in Nebraska at a lower elevation. The scarcity of specimens in collections indicates a restricted habitat. Quite likely



FIGURE 1. Distribution of species of *Onthophagus*:

- × *coproides* Horn
- *striatulus striatulus* (Palisot de Beauvois)
- *striatulus floridanus* Blatchley
- ★ *landolti texanus* Schaeffer

the species occurs in some rodent nest or animal burrow. It is one of the few species about which little or nothing is known.

Among closely allied Mexican species, a female cotype of *O. hippopotamus* Harold loaned by the British Museum differs in having (1) much denser pronotal punctation which is only very slightly finer even in the basal areas, (2) the pronotal protuberance rounded, not angulate in front as in *coproides*, and (3) the frontal carina on the head straight and evenly elevated its entire length, not angulate forward medially and not elevated into horns at the ends.

Onthophagus cochisus Brown

PLATE 2, FIGURES 9 AND 10

Onthophagus cochisus Brown, 1927, p. 132.—Boucomont, 1932, p. 317—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 8.5 to 9.8 mm., width 5.3 to 6.2 mm., color black. Head with clypeus reflexed anteriorly, the disc appearing slightly concave; margin anteriorly broadly arcuate, laterally sharply angulate with sides almost parallel; disc coarsely punctate, punctures becoming more crowded laterally and posteriorly; clypeal carina obsolete, indicated only by a slight convexity medially between the clypeus and frons. Frons coarsely and densely punctate as is the gena; carina of vertex low, bowed anteriorly, ending shortly behind each eye in a slightly elevated sharp ridge. Vertex coarsely punctate for a short distance behind the carina, the surface then becoming smoothly alutaceous. Genae with lateral margins extending a short distance beyond the lateral margins of the clypeus, but with the sides only slightly arcuate, nearly parallel.

Pronotum completely margined, poorly so posteriorly; anterior angles almost forming right angles; lateral pronotal margin bent abruptly upward approximately 1 mm. behind the anterior angles, forming a sharp, nearly tuberculate angulation. Pronotum widest at the middle, approximately 1 mm. behind the angulation, convex, similar in shape to the related Mexican species *O. chevrolati* Harold; the anterior tumosity rising almost perpendicularly behind the anterior margin, with face of the tumosity broadly rounded and laterally concavely arcuate to the small lateral tubercles. Surface of the pronotum smoothly, shallowly concave between the tumosity, tubercles, marginal angulations, and anterior angles; discal surface of pronotum coarsely, densely punctate; anteriorly the surface of the tumosity shining, with the punctures large and often bearing short setae; posteriorly the surface between the punctures dull and alutaceous, with the punctures smaller and bearing short but distinct setae. Elytral striae punctate, scarcely impressed; intervals, except for sutural interval, with from three to five irregular rows of small shiny tubercles, each with a short black seta at its base; surface alutaceous between the tubercles.

Pygidium alutaceous except for smooth apex, the entire surface with scattered shallow punctures, each with a short seta. Ventral surfaces of thorax shining, laterally coarsely punctate, most of the punctures bearing long fine reddish setae; metasternum finely punctate along the shallowly impressed median line; abdominal segments finely alutaceous, laterally sparsely punctate; last segment piceous in color, narrowed medially, emarginate to receive the pygidium. Fore-

legs moderately elongate; foretibia slender and bent in the apical third, tibial margin serrate above and between the four teeth. Femora with ventral surface having a mixture of scattered large and minute punctures, the coarse punctures usually bearing long setae.

MALE MINORS.—Length 6.1 to 7. mm., width 3.4 to 4 mm. Differing from the male majors in the following characteristics: Clypeus rounded, not flared laterally, reflexed and slightly truncate anteriorly; disc flat, coarsely, evenly, rugosely punctate, posterior clypeal carina obsolete; frons coarsely punctate to shallowly, moderately punctate, laterally and posteriorly alutaceous; carina of vertex evenly bowed, highest medially, the sharp lateral portions of the carina near the eyes greatly reduced; gena with sides broadly rounded, extending slightly beyond the margins of the clypeus. Pronotum evenly convex, coarsely punctate, less so near the anterior angles; surface alutaceous between the punctures, an occasional small anterior smooth area being the only indication of the median tumosity of the male major; lateral pronotal margin only slightly bent in anterior third, not at all angulate. Elytra not significantly different. Pygidium of male minor quite convex, but otherwise similar to male major. Ventral surface similar except for the foretibia, which is slightly bent in the apical half and is shortened and thickened, but to a lesser degree than in the female.

FEMALES.—Length 8.5 to 9.5 mm., width 4.8 to 5.1 mm. Differing from the male majors in the following respects: Clypeus longer and narrower, anteriorly reflexed, truncate or slightly emarginate, sides laterally obliquely arcuate; disc flat, rugosely punctate, posteriorly delimited by a low arcuate carina which is highest medially; frons very coarsely, almost rugosely punctate; carina of vertex pronounced medially, obsolete near the eyes, in some specimens thickened or indented at the median line; vertex behind the carina with scattered coarse punctures, surface finely alutaceous. Pronotum similar to that of male minor; the median tumosity slightly more pronounced, as is the angulation in the anterior third of the pronotal margin. Elytra similar except that the tubercles on the intervals are more pronounced. Pygidium similar. Ventral surface showing the major difference in the foretibia, which is straight, short, and thickened in width, and in the last abdominal segment, which is not emarginate medially.

TYPE.—Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—Pinery Canyon, Chiricahua Mts., Cochise Co., Arizona.

SPECIMENS EXAMINED.—346.

DISTRIBUTION.—(See fig. 2, p. 20.)

UNITED STATES: ARIZONA: Pinery Canyon (7000 ft.), Onion Saddle (7000 ft.), Rustler Park (8400 ft.), Southwestern Research Station (5 mi. west of Portal), and Cave Creek Canyon (5400 ft.), all in the Chiricahua Mts.

MEXICO: CHIHUAHUA: Guerrero.



FIGURE 2. Distribution of species of *Onthophagus*:

● *pennsylvanicus* Harold

○ *cochisus* Brown

REMARKS.—In the United States this uncommon species appears to be restricted to the higher elevations (5000 to 8000 ft.) of the Chiricahua Mountains of southeastern Arizona. It seems to be a fairly general feeder as an adult, being taken on carrion and under fresh horse droppings. Howden took 64 specimens on July 3 under leaf litter at Onion Saddle in the Chiricahua Mountains. The specimens were kept alive and attempts were made to rear the specimens in flower pots. Both horse and cow dung were supplied, but owing to higher laboratory temperatures or other unknown factors, no larval cells were formed.

O. cochisus Brown can be separated from other American species north of Mexico by its large size, its dull black alutaceous dorsal surface, and the combination of a densely coarsely punctate pronotum coupled with the conspicuously tuberculate elytral intervals.

Type material of closely allied species from south of our borders was examined and the following differences noted:

O. hippopotamus Harold is slightly larger, is shining, and has punctate rather than tuberculate elytral intervals.

O. totonicapanus Bates is much smoother, with shallow pronotal punctures and practically no elytral tubercles, those showing being scarcely visible and very widely scattered.

O. chevrolati Harold also is smoother in appearance, with pronotal punctures finer, not as close nor as deep, and elytral tubercles much finer and less conspicuous.

O. retusus Harold is also much less closely and evenly punctate, with punctures smaller and with elytral tubercles and striae finer.

O. cyanellus Bates has pronotal punctures very noticeably of two sizes, not uniform as in *cochisus*, and with very much finer tubercles; it is deep blue rather than black.

Onthophagus batesi, new species

PLATE 2, FIGURES 6 AND 7

Onthophagus incensus (Say), Howden, 1955, p. 264.

HOLOTYPE.—Male major, length 8 mm., width 5 mm. Shining, black, with legs and marginal areas of head and pronotum reddish brown. Anterior margin of clypeus abruptly, strongly reflexed; the apex moderately, widely emarginate-truncate; lateral margins not reflexed. Head wider than long, flat, without clypeal carina; genae weak, widely rounded; the eyes convex, 11 facets wide, two-fifths as wide as long; vertex with two long, widely separated, very slightly diverging vertical horns; the horns nearly straight, weakly flattened transversely, with a very distinct U-shaped carina extending down one horn, across the front, and up the other; punctures of head fine, quite evenly distributed in front of carina, separated generally by 2 to 3 diameters, smooth behind carina except at extreme occiput.

Pronotum finely, completely margined; anterior angles moderately, sharply rounded but not acute, posterior angles broadly rounded; median protuberance high, slightly bulbous, nearly vertical, gradually rounding into the relatively shallow, vertical cavity on each side which receives the cephalic horn; surface very finely punctate laterally and medianly over protuberance; lateral cavities, disc, and basal areas very minutely punctate, almost impunctate. Elytra shining; striae fine; strial punctures scarcely crenating the intervals which are almost flat, all very finely, quite closely and confusedly punctate, the punctures separated by 3 to 4 diameters. Pygidium nearly flat, alutaceous except at apex; moderately, coarsely punctate each side of a slightly elevated impunctate median line; the punctures separated by 1 to 2 diameters, those in the basal angles and adjacent lateral areas bearing setae about as long as distance between punctures; setae decumbent and pointing inward and downward toward apex; marginal bead extending upward at apex to a short toothlike process (not evident in other specimens). Legs reddish brown, anterior tibia ending in a blunt, slightly up-turned tooth above the apical spur. Club of antennae fuscous.

MALE MINORS.—Length 6 to 9.5 mm., width 4 to 5 mm. Male minors tend to resemble the female in elevation of clypeal apex, length of cephalic horns, pronotal protuberance, and lateral cavities;

many almost duplicate the female except for a trace of a tubercle at each end of the frontal carina, an apical tooth on anterior tibia, and a narrowed middle of the terminal segment of the abdomen.

ALLOTYPE.—Female, length 7 mm., width 4 mm. The clypeus differs from that of the male as follows: Relatively longer; the anterior margin slightly truncate and only very weakly reflexed; the clypeal carina evenly elevated throughout, not higher at middle; the frontal carina evenly elevated, straight except for ends slightly arcuate posteriorly; surface of the clypeus transversely rugose-punctate; the punctures between the rugae moderately coarse, separated by 1 diameter or less, and except for the very fine punctures of the more gentle posterior slope of the clypeal carina and the area back of the frontal carina, the remaining surface similarly closely, moderately coarsely, and deeply punctate. The pronotum with a similar but very weak median protuberance and traces of the lateral cavities; the punctation in the anterior angles generally more noticeable, being about as on the head, gradually finer medially across the anterior, and gradually much finer and sparser over the disc to the base where the fine punctures are generally separated by 4 to 5 diameters. Other characters very similar to male except that the pygidium is more widely shining apically, the anterior tibia lacks the apical tooth, and the terminal abdominal segment is not narrowed medially.

TYPE.—USNM 65681.

TYPE LOCALITY.—La Union, El Salvador.

SPECIMENS EXAMINED.—161.

DISTRIBUTION.—(See fig. 3, p. 24.)

UNITED STATES: TEXAS: 3 ♂♂, 2 ♀♀, Brownsville, June 1, 1954, H. F. Howden (Howden, USNM); 1 ♀, Brownsville, June 21, 1955, Allen (USNM).

MEXICO: 1 ♂, 1 ♀, no locality data, (USNM). CHIAPAS: 1 ♂, Cerro Huaco, Sept. 19, 1949, G. Halffter (CNC); 1 ♀, Chiapas, Pacific slope Cordilleras (800-1000), L. Hotzon (USNM); 2 ♂♂, 1 ♀, Tuxtla, Dr. Berendt (USNM). MORELOS: 1 ♂, Cuernavaca, July 1955, N. L. H. Krauss (USNM); 1 ♂, 3 ♀♀, Cuernavaca, August 1955, cow dung, N. L. H. Krauss (USNM); 1 ♂, 1 ♀, Cuernavaca, June 10, 1957 (USNM); 1 ♂, Cuatla, July 20, 1956, A. W. Vasquez (USNM). JALISCO: 1 ♂, L. Chapala, July 1940, L. W. Saylor (CNC). SAN LUIS POTOSÍ: 1 ♂, El Salto, Aug. 3, 1949, L. J. Bottimer (LJB); 5 ♂♂, 2 ♀♀, El Salto de Agua, Aug. 13-14, 1958, H. F. Howden (CNC); 2 ♀♀, Tamazunchale, Aug. 15, 20, 1956, A. W. Vasquez (USNM). YUCATÁN: 1 ♂, 3 ♀♀, Temax, Gaumer (USNM). JALISCO: 1 ♀, Guadalajara, Aug. 22, 1903 (USNM); 2 ♀♀, Chapala, Aug. 13-16, 1949, L. J. Bottimer (LJB). VERACRUZ: 1 ♀, Veracruz, Apr. 1, 1955, J. Camelo (USNM); 1 ♂, 2 ♀♀, Orizaba (Veracruz?), H. T. Osborn (USNM); 1 ♂, Orizaba (Veracruz?), Salle coll. (USNM); 7 ♂♂, 12 ♀♀, Lake Catemaco, Aug. 8-16, 1960, H. F. Howden (CNC); 1 ♂, 1 ♀, Cotaxtla, July 6, 1957, W. W. Gibson (USNM); 2 ♂♂, 1 ♀, Cotaxtla, Oct. 25, 1957, W. W. Gibson (USNM); 1 ♂, Cotaxtla, Sept. 11, 1957, Campo Exp., W. W. Gibson (CNC); 1 ♂, Cotaxtla, Nov. 11, 1957, W. W. Gibson (USNM). OAXACA: 1 ♂, Oaxaco, Hoega (USNM); 1 ♂, 2 ♀♀, Tuxtepec, J. Camelo G. (USNM); 2 ♀♀, Tuxtepec, J. Camelo G., 1934 (USNM); 2 ♂♂, 2 ♀♀,

Tuxtepec, J. Camelo G., November 1932 (USNM); 1 ♀, Tuxtepec, J. Camelo G., Nov. 7, 1934 (USNM). GUERRERO: 2 ♀ ♀, 3 mi. north of Mexcala, Aug. 23-24, 1958, H. Howden (CNC). COLIMA: 2 ♀ ♀, Colima, L. Conrads (USNM); 1 ♀, Volcán de Colima, L. Conrads (USNM).

CANAL ZONE: 1 ♂, Corozal, June 20, 1937, R. Bliss (USNM); 1 ♂, Gamboa, E. E. Frick (CNC); 1 ♂, without locality, June 1944, K. E. Frick (CNC); 1 ♀, Barro Colorado Id., P. Rau (USNM); 1 ♀, Tabernilla, July 1907, August Busck (USNM).

GUATEMALA: 2 ♀ ♀, no locality, (USNM); 1 ♀, south of Geronimo, Champion (USNM); 1 ♂, Palín, May 1924, W. M. Mann (USNM); 1 ♀, Lake Thiel, 1925, S. Sebastian Retalhuleu (USNM).

HONDURAS: 1 ♂, San Pedro Sula, W. M. Mann (USNM); 1 ♂, Carmelina, W. M. Mann (USNM); 1 ♀, La Ceiba, W. M. Mann (USNM); 1 ♀, San Juan Pueblo, W. M. Mann (USNM).

EL SALVADOR: 2 ♂ ♂, 2 ♀ ♀, San Salvador, May 11-15, 1958, O. L. Cartwright (USNM); 1 ♂, 2 ♀ ♀, San Salvador, June 24, 1958, O. L. Cartwright (USNM); 2 ♀ ♀, San Salvador, June 9, 1958, O. L. Cartwright (USNM); 2 ♀ ♀, San Salvador, June 17, 1958, O. L. Cartwright (USNM); 1 ♀, San Salvador, June 7, 1958, O. L. Cartwright (USNM); 2 ♂ ♂, 2 ♀ ♀, San Salvador, June 1-5, 1958, O. L. Cartwright (USNM); 1 ♂, San Salvador, June 20-23, 1958, O. L. Cartwright (USNM); 1 ♀, San Salvador, June 21, 1958, O. L. Cartwright (USNM); 6 ♀ ♀, San Salvador, May 1, 1957, P. A. Berry (USNM); 1 ♂, 1 ♀, San Salvador, June 21, 1958, L. J. Bottimer (LJB); 1 ♂, San Salvador, June 10, 1958, L. J. Bottimer (LJB); 1 ♂, San Salvador, June 15, 1958, L. J. Bottimer (LJB); 2 ♂ ♂, 2 ♀ ♀ (includes holotype and allotype), La Union, May 30, 1958, O. L. Cartwright (USNM); 1 ♂, La Union, May 30, 1958, L. J. Bottimer (LJB); 1 ♀, La Palma, June 24, 1958, O. L. Cartwright (USNM); 1 ♂, Tonocatepeque, June 20, 1958, L. J. Bottimer (LJB); 1 ♂, 1 ♀, Volcán Conchagua, June 27-29, 1958, L. J. Bottimer (LJB); 1 ♀, Santa Tecla, Apr. 29, 1954, P. A. Berry (USNM); 1 ♂, La Ceiba, Vera Wellborn (USNM); 1 ♂, no locality; 1 ♂, 1 ♀, Lake Olomega, Dept. San Miguel, July 14, 1925, R. A. Stirton (CNC, Howden); 2 ♀ ♀, Mt. Cacaquatique, Dept. San Miguel, Dec. 22, 1925, R. A. Stirton (CNC, Howden); 1 ♀, Sonsonate, Aug. 26, Fredk. Knab (USNM).

NICARAGUA: 1 ♂, Managua (8 mi. north), July 28, 1958, S. E. Neff and E. G. Matthews (USNM).

COSTA RICA: 2 ♂ ♂, 5 ♀ ♀, Hamburg farm, Reventazón above Limón, Aug. 1, 1928, F. Nevermann (USNM); 1 ♀, Hamburg farm, Reventazón, May 23, 1935, F. Nevermann (USNM); 1 ♀, Hamburg farm, Reventazón, July 28, 1926, F. Nevermann (USNM); 1 ♂, Esparta, Sept. 18, 1905, Fredk. Knab (USNM); 1 ♂, no data (USNM).

REMARKS.—*O. batesi* is normally black, occasionally with faint greenish lustre, and with legs reddish brown. Quite often traces of reddish brown are found narrowly along the base and sides of the pronotum and head. Reddish-brown (teneral?) specimens are also found. The coppery reflections seen in the type and other specimens of *O. incensus* have not been observed in *batesi*. The antennal club is a lighter, redder brown in *batesi*, more fuscous in *incensus*.

This species is more finely punctate than is *incensus* Say, the male horns are united by a rather sharp continuous carina down one horn, arcuate across the front, and up the other, the female clypeal carina is evenly elevated and not higher in the middle as in *incensus*, the

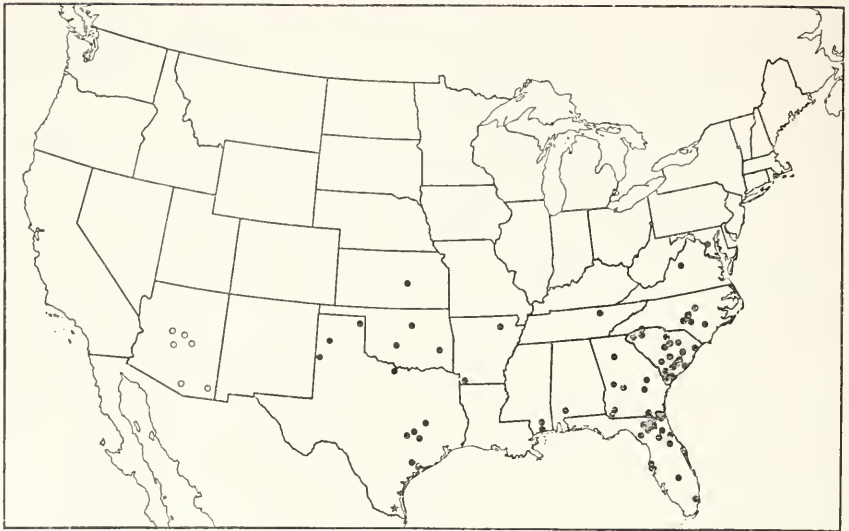


FIGURE 3. Distribution of species of *Onthophagus*:

- ★ *batesi*, new species
● *oklahomensis* Brown

○ *subopacus* Robinson

frontal carina sometimes breaks downward suddenly, rather angularly at the ends, the eyes are slightly shorter and wider, and in *batesi* the pygidium usually shows a more or less impunctate, slightly elevated median line. If the specimen is turned in reflected light, the even curvature of the pygidium is seen to be slightly broken dorsoventrally by the midline. Many of the male minors show traces of the clypeal carina.

The Brownsville, Tex., specimens were collected in shallow burrows under fresh horse droppings in the area known as the "palm jungle" on the McCormick ranch 7 miles east-southeast of the city.

Onthophagus incensus Say

PLATE 1, FIGURES 1-3

Onthophagus incensus Say, 1835, p. 173.—Lacordaire, 1856, p. 109.—Harold, 1880, p. 30.—Bates, 1887, p. 66.—Boucomont and Gillet, 1927, p. 206.—Boucomont, 1932, p. 308.

Onthophagus curvicornis Latreille var. *incensus* (Say), Boucomont, 1932, p. 308.

MALE MAJORS.—Length 7 to 10 mm., width 4 to 6 mm. Black, shining, sometimes with greenish or coppery lustre at base of head and anteriorly on the pronotum. Anterior margin of clypeus rather widely, shallowly emarginate and sharply reflexed; lateral margins only feebly or not at all reflexed. Head without carinae, slightly wider than long, the genae prominent but obtusely rounded; disc

very slightly convex, basally with two long, widely separated vertical horns slightly curved forward and weakly bowed laterally, the horns somewhat flattened transversely with rounded edges, not connected by a basal carina; punctures of head very fine medially, separated by two or more diameters, somewhat larger laterally, particularly on the genae.

Pronotum finely, completely margined; anterior angles sharply rounded but not acute, posterior angles broadly rounded; median protuberance vertical in front, quite high, the broad rounded summit with a very weak longitudinal, median depression, laterally rounded into a strong vertical cavity each side to receive the cephalic horns. Punctures fine in anterior angles and median groove of protuberance, about as on genae, gradually finer away from these areas to the disc and base; the disc sometimes almost impunctate, lateral foveae strong. Elytra shining, rarely very finely alutaceous; striae fine, the punctures slightly crenating the intervals; intervals weakly convex, all finely, quite closely, confusedly punctate, the scattered punctures separated by 1 to 2 diameters. Pygidium weakly, evenly convex, very finely alutaceous, and not as shining as upper surfaces; punctures close, very slightly larger and deeper than on elytra, occasionally with a few in rows between transverse wrinkles. Legs dark, almost black, the anterior tibia with a blunt, slightly upturned tooth at the tip above the spur; club of antennae fuscous.

MALE MINORS.—Variation is toward the female in reduction in the length of the cephalic horns, the pronotal prominence, and the accompanying lateral cavities. The only noticeable difference between the least developed male seen and a female was the complete absence of the clypeal carina, the presence of the anterior tibial tooth, and the narrowed apex of the terminal abdominal segment.

FEMALES.—Length 7.5 to 10 mm., width 4.75 to 6 mm. Differing from males as follows: Punctation usually more noticeable, closer, and deeper on the upper surface; no tooth or tubercle above the spur of the anterior tibia; the terminal abdominal segment not narrowed apically; clypeus longer, rounded, and not noticeably emarginate-truncate or reflexed; clypeal carina well developed and noticeably higher at middle; frontal carina also well developed but usually slightly lower and posteriorly angulate at middle; anterior prominence of pronotum weak, similar to that of male, but widely depressed medially and laterally reduced to rounded tubercles.

TYPE.—Museum of Comparative Zoology, Harvard College, Cambridge, Mass.

TYPE LOCALITY.—“Mexico.” Barber (1928) stated, “It is probable that all of his (Say’s) Mexican forms were collected along the old road between Veraacruz, Jalapa, Mexico City, and Tacuba.”

SPECIMENS EXAMINED.—196.

DISTRIBUTION.—

UNITED STATES: HAWAII: Oahu: Pohakea Pass, Schofield Plateau; Hawaii: Kona, Kealahou.

MEXICO: MÉXICO, D.F. HIDALGO: Jacala. VERACRUZ: Jalapa, Córdoba, Orizaba, south of Veracruz, Banderilla.

GUATEMALA: Senahú (Alta Verapaz), Capetillo.

EL SALVADOR: Monte Cristo.

COSTA RICA: Meseta (central Costa Rica), Aurora Farm (Estrella Valley), La Carpintera, Coronado, San José, Coliblanco, Tablaco, Zarzero, Turrialba, Volcán Irazú.

PANAMA: Volcán Chiriquí, Boquete (Chiriquí Province), Bambito (Chiriquí Province), Bugaba.

BIOLOGY.—Taken in numbers in sparse woods near Jacala, Mexico, in cow and horse dung. Burrows in clay soil were 4 to 8 inches deep.

REMARKS.—Say's description of *O. incensus* was published posthumously in the Boston Journal of Natural History for May 1835. The holotype female (pl. 1) is in the Museum of Comparative Zoology at Harvard; it is in fair condition but lacks mouth parts, pygidium, and part of the legs. The pronotum of the type specimen is a very dark green, with reddish-brown lateral spots below the fovea and with narrowly reddish-brown anterior margin opposite the head area between the eyes; the carinae of the head and the pronotal prominence are faintly but distinctly coppery; the elytra are dark blue-black. The narrow brownish anterior margin of the pronotum is found in other Mexican specimens also. The clypeal carina is noticeably higher at middle.

The cephalic horns in fully developed males are only rarely completely connected basally and then by a low swelling or obtuse carina, straight across from one to the other. In *batesi* the connecting carina is nearly always present even in the male minors, curves arcuately from one horn to the other, and is sharply ridged on top.

This species which is very closely related to *batesi*, new species, has not been taken in mainland United States but has been introduced into Hawaii. It was introduced in 1923 by H. T. Osborn from material collected at Morelos, Mexico, to assist in control of the hornfly, *Siphona irritans* (Linnaeus), and was recovered on the island of Hawaii in 1934 and on Oahu in 1940 (see Swezey, 1935; 1940).

Some females of *curvicornis* Latreille from Colombia are superficially almost identical with *incensus* Say; however, *curvicornis* is usually larger and the fully developed male pronotal protuberance extends forward in a sharply pointed but somewhat flattened cone. Females of *O. acuminatus* Harold also resemble those of *incensus* and *batesi* but are much smaller. The male clypeus in *acuminatus* anteriorly is pointed. *O. nitidor* Bates is slightly smaller and is a

brighter, shining green, with black clypeus; pronotal protuberance in both sexes not as wide.

Onthophagus brevivrons Horn

PLATE 2, FIGURES 12 AND 13

Onthophagus brevivrons Horn, 1881, p. 76.—Henshaw, 1885, p. 87.—Shaeffer, 1914, p. 300.—Leng, 1920, p. 49.—Boucomont and Gillet, 1927, p. 204.—Boucomont, 1932, p. 315.—Howden, Cartwright, and Halfter, 1956, p. 6.

MALE MAJORS.—Length 8.6 to 10.3 mm., width 5.3 to 5.7 mm. Color uniformly brown, piceous, or black; head and pronotum shining, occasionally with violaceous luster, elytral intervals dull, finely alutaceous. Head with clypeus reflexed, more so anteriorly than laterally, anterior edge vaguely emarginate (Horn's Kansas specimens) or truncate, rounded in worn specimens; lateral margin delimited from gena by faint notch, gena scarcely flared, broadly arcuate; disc of clypeus and genae with scattered large shallow punctures, clypeus often rugosely punctate laterally, base of clypeus and anterior portion of frons tumid, the clypeal carina barely indicated by an impunctate line across the tumosity. Frons coarsely punctate, the punctures half the size of the larger clypeal punctures. Surface of clypeus, genae, and frons between the punctures smooth and shining. Carina of vertex low, bowed anteriorly on each side of a raised median point, and ending laterally near the posterior margin of the eyes; scattered coarse punctures behind the carina, smooth areas between the punctures very finely alutaceous.

Pronotum margined anteriorly and laterally, lateral margins noticeably bent downward in anterior third; pronotum convex, with a large, rounded, anterior tumosity rising abruptly behind the anterior margins and ending on each side in a small raised ridge. Below the ridge on each side of the tumosity a shallowly concave area extending to the bend in the lateral pronotal margins and forward to the anterior angles; surface of the concavity finely alutaceous near the anterior angles, otherwise the surface smooth and shining between the pronotal punctures. Punctures of two sizes, large, deep, sharply delimited circular punctures separated by 1 to 2 diameters, and, between these, scattered small well-defined punctures less than one-fourth the diameter of the larger ones; both types of punctures most numerous on the face and along the top of the tumosity, becoming more widely separated posteriorly and near the anterior angles; large punctures on the face of the tumosity often bearing setae.

Elytral striae coarsely punctate, shallowly impressed; intervals with numerous small shining tubercles with fine setae at their bases, the surface between the tubercles finely alutaceous, tubercles on the third,

fourth, and fifth intervals forming two irregular rows. Pygidium convex near apex, surface finely alutaceous with scattered poorly defined punctures usually bearing minute setae. Underside of thorax with coarse punctures laterally, the punctures bearing moderately long reddish setae; impunctate or with very fine punctures medially. Abdominal segments bearing scattered punctures laterally, last segment moderately emarginate medially. Foreleg scarcely longer than in female, not slender or bent in anterior third; four teeth of the tibia broad and stubby; tibial margin only serrate or finely denticulate above the last tooth, not serrate on or between the teeth. Ventral surfaces of femora with a few widely scattered coarse punctures and with more numerous but still scattered, fine punctures.

MALE MINORS.—Length 7.2 to 8.4 mm., width 4.1 to 4.7 mm. Similar to females in clypeal outline and pronotal configuration. Clypeal carina present but not as pronounced as in females; frontal carina low, nearly straight, highest in middle instead of at ends as in females. Similar to male majors in other respects.

FEMALES.—Length 7.1 to 9.6 mm., width 4.0 to 5.2 mm. Differing from the male majors in the following respects: Head with broadly arcuate clypeus, shallowly reflexed anteriorly and laterally, anterior margin slightly emarginate; disc flat, transversely rugosely punctate; clypeal carina broadly raised, highest medially, laterally becoming merely a raised line between the clypeus and genae. Frons and genae coarsely, irregularly punctate, some of the punctures bearing fine reddish setae. Carina of vertex distinct, lowest at the midpoint, rising evenly (in the majority of specimens) to the point where the carina terminates near the base of each eye; in a few of the diminutive females the carina straight across, not raised laterally, but in the larger specimens the carina distinctly elevated near each eye, horns not present, the elevated portions being merely the ends of a very obtuse V-shaped carina. Behind the carina the vertex bears some scattered coarse punctures, with impunctate areas finely alutaceous.

Pronotum moderately convex, broadly tumid in the large females, only slightly so in small specimens; tumosity, when developed, approximately as wide as head with only faint concave areas on each side; lateral margins of the pronotum only vaguely bent in anterior third; surface of pronotum bearing large and small punctures similar to male major, many of the large punctures of the disc bearing short inconspicuous setae. Elytra and pygidium similar to those of male major. Ventral surface generally with more pronounced punctures than in male. Last abdominal segment not narrowed medially. Foretibia slightly shorter and wider than in male major but not greatly different, outer margin serrate or denticulate only above the four tibial teeth and not between them.

TYPE.—Lectotype, present designation, a male in Academy of Natural Sciences of Philadelphia, Type 3570.

TYPE LOCALITY.—“Plains of Kansas.”

SPECIMENS EXAMINED.—101 and fragments.

DISTRIBUTION.—(See fig. 4.)

KANSAS: “Plains of Kansas.” ARIZONA: Paradise, base of Pinal Mts., Globe, Prescott, Yavapai Co., Portal. TEXAS: (Cited without locality by Horn, 1881, p. 76).

REMARKS.—This species can be distinguished by its large size, black or brown color, and shining, usually tumid pronotum. The head may occasionally have greenish or violaceous reflections, but the pronotum is never distinctly green, as stated by Horn (1881, p. 76). Pronotal disc with numerous, sharply delimited circular coarse and fine punctures. Elytral intervals tuberculate, flat areas finely alutaceous, not smooth and shining. Foretibia not greatly differing between the sexes; tibial margin of both with four broad teeth, the margin serrate basally, but smooth between the teeth. This species may be distinguished from the following species, *subtropicus*, new species, by the shape of the carina on the vertex of the female.

Because there were no specimens available to Schaeffer for study when he presented his review of the genus in 1914, he merely repeated Horn’s description. The present description of the male major is in part based on one of Horn’s Kansas cotypes which was carefully

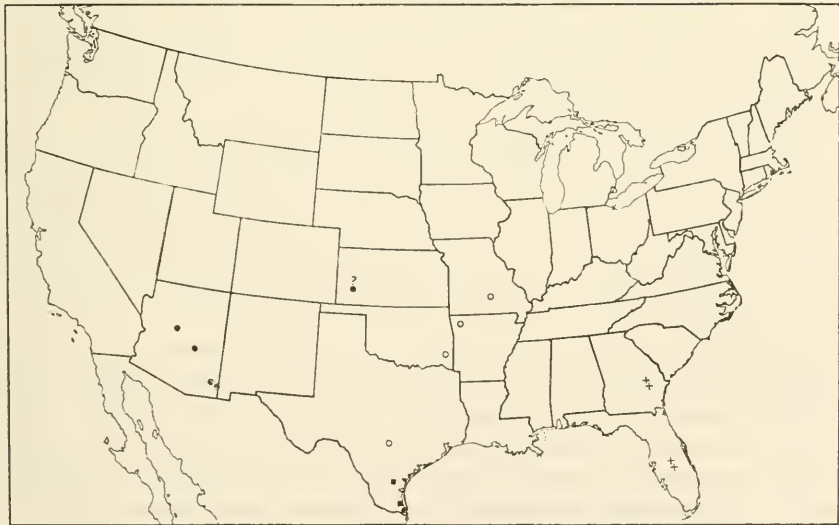


FIGURE 4. Distribution of species of *Onthophagus*:

- *brevifrons* Horn
- *cavernicollis*, new species
- *subtropicus*, new species
- + *depressus* Harold

examined by Howden. About 20 of the specimens seen apparently were collected in 1920 by H. H. Kimball at Paradise, Ariz.; 41 were collected in wood rat nests at Portal, Ariz., in September 1960 by Howden. The writers found a few specimens and fragments a mile east of Portal in wood rat nests in late June 1956. The Arizona specimens are almost identical with Horn's Kansas specimens except that the eyes are narrower and the specimens appear darker, with only occasional traces of greenish lustre on the head of a female.

Although no recently collected specimens from Kansas have been seen, the Kansas label of the type series (collected by Dr. H. A. Brons) should be accepted because at least two species of wood rats occur in the state.

The unconnected distribution can at present be explained only by the seemingly restricted habits of *O. brevifrons*, the only biological information being that they occur in the soil under the large stick nests of the wood rats (*Neotoma* species).

***Onthophagus subtropicus*, new species**

PLATE 2, FIGURES 8 AND 11

HOLOTYPE.—Male, length 8 mm., width 4.5 mm. Head and pronotum shining, dark blackish green; clytra black, alutaceous, weakly shining. Clypeus arcuate, margin moderately reflexed over anterior half; disc densely, shallowly, moderately punctate, with some anastomosing and tendency to rugosity near edges; clypeal carina rather high and distinct over middle third of a raised area between the interior ends of the distinctly carinate sutures between clypeus and genae. Frons closely, moderately punctate, a few coarser punctures laterally near the frontal carina; frontal carina moderately high, strongly sinuate, the middle and ends arcuate posteriorly and not as high at middle as near the ends; somewhat finer punctures behind the frontal suture, separated 1 diameter or less, otherwise minutely alutaceous. Genae widely rounded, margin joining clypeus without a break, surface closely coarsely punctate. Eyes wider than in *brevifrons*, two-fifths as wide as long, about 7 facets wide.

Pronotum margined anteriorly and laterally, basally very finely so for a short distance at middle; disc very convex, high in front with a broad vertical concavity on each side; upper edges of the concavities sharp, almost cariniform for a short distance; anterior angles not sharply rounded; surface of disc everywhere with close, mixed, moderately coarse and fine punctures, the coarse punctures separated by a diameter or more, the fine punctures everywhere in between; surface otherwise smooth and shining except for alutaceous sculpture narrowly across the base. Elytra strongly alutaceous,

striae shining; stria punctures distinct, slightly crenating the intervals; intervals flat with irregular rows of widely spaced fine tubercles. Pygidium alutaceous throughout, with scattered, moderately fine, shallow punctures slightly closer laterally and apically. Ventral surfaces smooth and shining; metasternum with very fine, scattered punctures at middle and moderate punctures forward and to sides; terminal abdominal segment with a single transverse row of setigerous punctures scarcely larger than those of the preceding segment; segment narrowed apically to receive the pygidium. Forelegs slightly longer and thinner than in the female.

ALLOTYPE.—Female, length 8 mm., width 4.5 mm. Shining; head black in front of clypeal carina, green behind; pronotum dark bluish green, elytra black. Clypeus narrowly reflexed anteriorly, gradually less so to genae; broadly truncate-emarginate at middle; disc moderately, transversely punctate-rugose, most of the punctures anastomosing and more or less indistinct; clypeal carina with narrow band of close fine punctures on anterior slope, carina almost angularly higher at middle. Frons quite closely punctate, the punctures separated by 1 to 2 diameters; punctures fine anteriorly to moderately coarse at frontal carina; frontal carina weakly arcuate posteriorly, low and sharp medially, elevated each side to a high, acutely tipped tubercle; tips of the tubercles slightly nearer the middle than to the edges of the eyes; occiput, moderately finely punctate, more coarsely so around the tubercles to the eyes. Genae closely coarsely punctate, many of the punctures anastomosing; margin evenly obtusely rounded to clypeus with only a tiny notch marking the juncture.

Pronotum finely margined, faintly and very finely so basally; disc strongly convex, a wide, vague prominence in front with a shallow vertical concavity on each side; anterior angles not sharply rounded; surface everywhere with close mixed moderate and fine punctures, the moderate punctures separated by 1 to 2 diameters; surface otherwise smooth except for very fine alutaceous sculpture narrowly along the base. Elytra alutaceous except at shoulders; striae shining and sparsely, shallowly punctate; intervals flat, the first with one, the second with two and part of a third, and the next four with two irregular rows of fine tubercles, separated by four to six or more times their diameters; tubercles overhanging setigerous punctures but the setae so short as to be almost invisible. Pygidium apically convex and shining, alutaceous basally; scattered fine punctures becoming closer and deeper apically. Ventral surfaces smooth and shining; metasternum with a distinct, shallowly impressed midline, some fine scattered punctures at middle, and moderate to coarse punctures forward and to sides. Abdominal segments finely alutaceous, each with transverse row of very fine tubercles overhanging very fine setae; setae relatively short

and scarcely longer than the distance between them; apical segment with an irregular band of coarse punctures separated by about a diameter. Legs normal for females of the genus.

TYPE.—USNM 65682.

TYPE LOCALITY.—Laguna Madre, 25 mi. southeast of Harlingen, Tex.

SPECIMENS EXAMINED.—3.

DISTRIBUTION.—(See fig. 4, p. 29.)

TEXAS: Holotype, ♂, Laguna Madre, 25 mi. southeast of Harlingen, Sept. 20, 1945, D. E. Hardy and V. L. Woolley, nest of *Neotoma micropus* Baird (Robinson coll., USNM). Allotype, ♀, Brownsville, Mar. 12, 1908 (Jones and Pratt coll., USNM). Paratype, ♀, Kingsville (C. T. Reed coll., CU).

REMARKS.—This species is very closely related to *O. brevifrons* and *cavernicollis* and is intermediate in size. In *brevifrons*, the color is all black; in *cavernicollis*, the largest species, the pronotum is a bright, shiny green; in *subtropicus*, the pronotum is not so shiny and is a bluish or blackish dark green. The females of *subtropicus* may be separated from the other two species by the shape of the frontal carina, which is elevated on each side to a sharp median tubercle, the tips of the tubercles being nearer the middle of the carina than to the eyes. In *brevifrons*, this carina is wider and slopes evenly from the middle to elevated rounded ends which are nearer to the eyes than to the middle of the carina; the carina ends on each side in a sharp vertical drop to the head surface. In *subtropicus*, the tubercles slope evenly away from their tips in both directions. In *cavernicollis*, the frontal carina is similar to *brevifrons*. The eyes of *cavernicollis* are larger and wider, being a third as wide as long, 7 to 8 facets wide; those of *subtropicus* are two-fifths as wide as long, 6 to 7 facets wide; those of *brevifrons* are sometimes no more than a fourth as wide as long and only 4 to 5 facets wide. In *brevifrons*, there is a greater disparity in the sizes of the pronotal punctures, with the coarse punctures closer together.

The holotype may be a male minor.

The type locality (given on the label as 25 mi. southeast of Harlingen) was placed by a speedometer reading. Dr. Hardy informed us the exact locality would be on the Laguna Madre about 10 miles northwest of Port Isobel in an area used by Harlingen Air Force Base for its gunnery school.

Onthophagus cavernicollis, new species

PLATE 3, FIGURES 22 AND 23

O. brevifrons Horn, 1881, p. 76, in part.

HOLOTYPE.—Male major, length 11 mm., width 6.4 mm. Head and pronotum shining, bright green; elytra weakly shining, black;

pygidium shining, dark green; ventral surfaces, excluding tibiae, black with a more or less shining, greenish luster; tibiae dark brown with only a faint greenish cast. Clypeus widely reflexed anteriorly, less so laterally; margin broadly arcuate anteriorly (not even vaguely emarginate as is often the case in unabraded *brevifrons*), becoming sharply rounded laterally near the genae; disc concave near the center, with coarse punctures shallow and usually separated by approximately their own diameters. Clypeal carina obsolete, the base of the clypeus and the anterior portion of the frons medially forming a low rounded hump; frons more finely, closely punctate than clypeus. Gena with arcuate margin slightly flared, surface coarsely punctate. Carina of vertex raised medially to a point, low and bowed on each side, terminating near the base of the eyes, similar to that described for *brevifrons*; scattered coarse punctures behind the carina, with smooth surfaces finely alutaceous.

Shape of pronotum nearly identical with that of the male major of *brevifrons*, the only differences in the pronotum of *cavernicollis* being in the posterior, vaguely indented median line and in the punctures (also a mixture of large and small ones) which are not as sharply delimited and appear slightly smaller and shallower. Most of the large punctures bearing short, inconspicuous, reddish setae. The convexity of the pronotum seemingly more pronounced than normal in *brevifrons*, but this apparent variation is perhaps an illusion caused by the overall larger size of *cavernicollis*. The elytra likewise very similar to those of *brevifrons*, differing only slightly by having smaller tubercles on the intervals. Pygidium with scattered irregular punctures bearing short, fine setae; the surface basally alutaceous, becoming somewhat shiny and rugose near the apex, the smooth areas dull green. Ventral surfaces and legs lacking any characteristics, other than color, that would readily separate *cavernicollis* from *brevifrons*.

MALE MINORS.—No specimen seen.

ALLOTYPE.—Female, length 11.2 mm., width 6 mm. Differing from the holotype male major in the following respects: Clypeus arcuate but feebly emarginate anteriorly, clypeal margin scarcely reflexed; disc transversely rugose, more closely so than in females of *brevifrons*; clypeal carina pronounced, highest medially, becoming obsolete by the genae. Frons coarsely punctate behind the carina, punctures not so sharply delimited as in *brevifrons*; genae with margin arcuately curving inward by the eyes, anteriorly not delimited from the clypeal margin. Carina of vertex very similar in shape to that described for the female of *brevifrons* but raised terminally to form small horns, the carina extending at least two-thirds the distance from the midline to the eye but still terminating nearly twice as far from

the eye as in *brevifrons*; a few scattered coarse punctures behind the carina, the smooth areas finely alutaceous.

Pronotum quite convex, tumid anteriorly, but considerably less so than in the male major; the tumosity more rounded but still similar to that of the male, and the lateral concavities much reduced, extending neither to the lateral margins nor to the anterior angles; margin only slightly bent in the anterior third; punctures slightly more pronounced than in the male, but still smaller and more scattered than in *brevifrons*; midline of pronotum slightly depressed posteriorly and with fewer coarse punctures. Elytra not noticeably different from those of the male. Pygidium rather convex apically and more shining than in the male but otherwise similar. Ventrally, differences from the male are noted in the shorter and wider foretibia and in the last abdominal segment, which is not emarginate in the female.

VARIATION.—In the males the length varies from 9.5 to 11 mm., the width from 5.7 to 6.4 mm., and in the females the length varies from 9.1 to 11.2 and the width from 5.4 to 6 mm. The 10 specimens seen exhibit remarkably few noteworthy differences. The brightness of the greenish color of the pronotum is slightly more pronounced in some of the specimens, but in all it is quite evident. In the smaller specimens, both male and female, the pronotal punctures are slightly more pronounced than in larger specimens of the same sex. The male paratypes have the carina of the vertex more sharply indicated laterally than in the holotype, but otherwise the carinae are similar.

TYPE.—USNM 65683.

TYPE LOCALITY.—Waglers Cave, Harrison, Ark.

SPECIMENS EXAMINED.—10.

DISTRIBUTION.—(See fig. 4, p. 29.) Holotype, ♂, and allotype, ♀, Harrison, Waglers Cave, Ark., Apr. 13, 1935, in bat dung, J. M. Valentine. And the following paratypes:

ARKANSAS: Washington Co., Apr. 24, 1938 (INHS). OKLAHOMA: 1 ♀, Tahlequah, Adair Co., Sept. 26, 1954, O. C. Schomberg (LJB). TEXAS: Vicinity "cave without name" near Boerne, Kendall Co., July 30, 1948, G. E. Ball (AMNH); no locality (MCZ); 1 ♀ (ANSP). MISSOURI: 4 ♂♂, 2 ♀♀, Bat Cave, Liking, June 20, 1956, Condé (Muséum National d'Histoire Naturelle, CNC).

REMARKS.—*Onthophagus cavernicollis* can be distinguished from other North American species by its large size and bright, shining green pronotum. Except for size and color, the characteristics listed for separating *O. brevifrons* will also separate this species from the other North American forms. Coloration, size, the smaller pronotal punctures, and the shape of the carina on the vertex of the female will separate *cavernicollis* from either *brevifrons* or *subtropicus*.

In addition to the characteristics given above, the habitat in which the majority of specimens have been taken seems to set the species

apart from the other North American forms. The eight specimens bearing biological data were all taken associated with bat dung in caves. Collecting the specimens in this extremely unusual niche might be considered chance except for the occurrence of a related Mexican species on bat dung in caves. This latter species was described, compared with *brevifrons*, and its biology discussed by Howden, Cartwright, and Halfiter (1956). There are probably other species with similarly odd habits. Such an unusual habitat helps explain why *O. carvernecollis* has been so long undescribed and why there are still so few specimens known.

The specimen from Texas, without definite locality, in the collection of the Academy of Natural Sciences of Philadelphia, bears a blue paratype label, No. 3570.3, and is presumably one of the original cotypes of *brevifrons* Horn.

***Onthophagus polyphemi polyphemi* Hubbard**

PLATE 3, FIGURES 14 AND 15

Onthophagus polyphemi Hubbard, 1894, p. 311.—Henshaw, 1895, p. 22.—Schaefer, 1914, p. 293.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 207.—Cartwright, 1939, p. 285.—Howden, Cartwright, and Halfiter, 1956, p. 10.

MALE MAJORS.—Length 5.5 to 6.9 mm., width 3.5 to 4.1 mm. Dorsal color very dark reddish brown to black, the head and pronotum sometimes slightly darker than the elytra. Clypeus gradually, slightly reflexed anteriorly, truncate, occasionally barely emarginate, laterally slightly arcuate, joining almost evenly with the margin of the gena; disc bearing from 15 to 30 small scattered tubercles, at the base of each tubercle a long reddish seta. Posterior margin of clypeus delimited by a long, very distinct, evenly elevated, strongly anteriorly arcuate carina. Front of head behind clypeal carina nearly flat with a dozen or more widely scattered, setose tubercles; genae scarcely extended laterally, their sides often almost parallel; plane of genae slightly lower than frons and gradually sloping downwards, surface smooth sometimes with two or more setigerous tubercles. Carina of vertex nearly straight, obsolete medially (type series), or distinct for its entire length, being highest laterally; when absent medially, it has the appearance of two small separated carinae, one above each eye (as noted in Hubbard's original description); behind the frontal carina an irregular row of six or more tubercles each with a seta.

Pronotum convex, margined anteriorly, laterally, and obsoletely at middle of base. Pronotal protuberance represented by a broad anterior swelling slightly wider than the head, vague at the middle, more distinct laterally, the steep declivity weakly concave high up at the sides above the anterior angles; anterior angles with scattered, moderate, setigerous punctures, finer and fewer toward middle of de-

clivity; each puncture with a small tubercle in front of the seta, the tubercles disappearing laterally and posteriorly and the punctures becoming much coarser and farther apart, with a few fine punctures intermixed, the surface otherwise smooth and shining. Elytral striae vaguely punctate, intervals smooth and shiny and, except for the sutural one, each with a double row of minute tubercles having setigerous punctures at their bases. Pygidium feebly convex, with scattered, coarse, setigerous punctures, the punctures becoming smaller apically; surface between the punctures finely alutaceous basally, apically almost smooth.

Ventral surfaces and legs reddish brown to black. Antennae reddish brown, the club slightly lighter in color. Proepisternum only slightly excavated to receive antennae. Mesothorax and lateral areas of prothorax and metathorax coarsely setigerously punctate and finely alutaceous. Median area of metathorax smooth and shiny, with scattered nonsetigerous punctures, often with a vague sulcus along the median line. Abdomen except for first segment with a basal row of minute setigerous punctures extending across each segment, last segment narrowed medially. Forelegs approximately the same length as those of female, tibia stoutly and conspicuously quadridentate; outer margin smooth between the teeth, occasionally vaguely serrate above them; conical projection lacking above apical spine. Femora of all legs with numerous setae in an irregular row at their anterior and posterior edges, the flattened ventral surface with scattered coarse setigerous punctures.

MALE MINORS.—Length 4.7 to 6. mm., width 2.7 to 3.7 mm. Very similar to male majors. Anterior clypeal margin slightly less reflexed but of approximately the same shape; clypeal carina and frontal carina less pronounced than in male majors but of the same configuration. Pronotum considerably less convex with pronotal protuberance scarcely evident, disc often with minute scattered punctures. Except for slightly more pronounced punctures and setae on elytra and other parts of body, the male minors do not differ conspicuously from the male majors.

FEMALES.—Length 5.5 to 6.4 mm., width 3.0 to 3.6 mm. Very similar to male minors, the major difference being in the slightly more elongate shape of pygidium and in the last abdominal segment which is not narrowed medially. Little indication of a pronotal protuberance; the punctures and setae usually more in evidence than in the male. Little apparent difference in other aspects (carinae, legs, etc.) between the male minors and the females.

TYPE.—Lectotype, present designation, USNM 1300, a female specimen collected at Crescent City, Fla., July 15 by H. G. Hubbard; deposited in USNM in 1896 as type.

TYPE LOCALITY.—Crescent City, Fla.

SPECIMENS EXAMINED.—159.

DISTRIBUTION.—(See fig. 5.)

FLORIDA: Crescent City, 4 mi. north of High Springs, Gainesville, Leesburg, Lutz, Miami, Stemper. SOUTH CAROLINA: Tillman.

REMARKS.—This moderate-sized species is quite distinct from other American *Onthophagus*. It can be separated by its uniformly shining, dark brownish-black dorsal surface, the presence of small tubercles with setigerous punctures at their bases on the head and near the anterior pronotal angles, the smooth shining disc of the pronotum, the smooth margin of the fore tibia between the four teeth, and the lack of pronounced sexual differences, the male majors having only a widely rounded pronotal protuberance and the forelegs being the same length as those of the female. Pronounced tubercles, setae, and punctures on the head, pronotal angles, and elytra will separate typical *polyphemi* from the west Florida, Alabama, Mississippi subspecies subsequently described.

O. polyphemi polyphemi and its subspecies have been collected only in the burrows of the gopher tortoise, *Gopherus (Xerobates) polyphemus*. Adult specimens have been collected in March, June, July, and August, appearing freshly emerged in March. Hubbard (1894, p. 305) stated, "I did not find this beetle in the few galleries examined in the winter, and it was probably in pupa at that season." In July it was not rare.

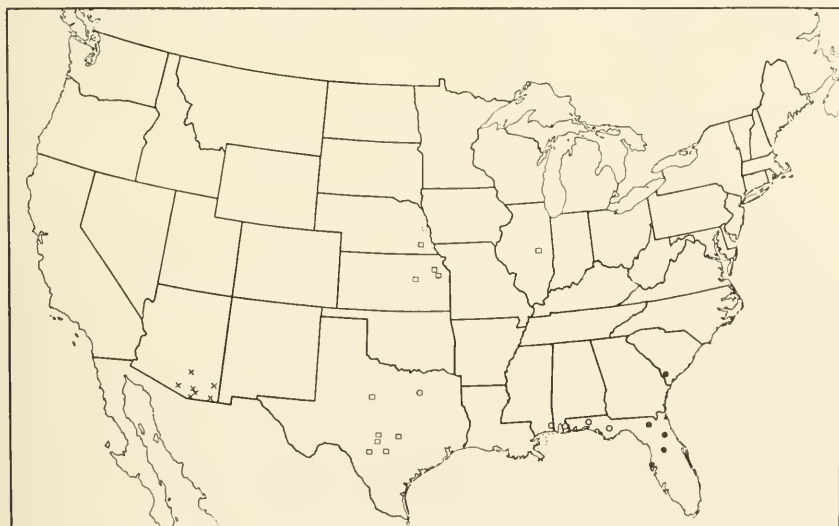


FIGURE 5. Distribution of species of *Onthophagus*:

□ *knousi* Brown
 × *höpfneri* Harold

● *polyphemi polyphemi* Hubbard
 ○ *polyphemi sparsisetosus*, new subspecies

One of the burrows produced 21 specimens. "Its larva was not seen." At the present writing the larva is still unknown.

Collecting even the adults is a difficult job, best accomplished by at least partial excavation of the gopher burrow. In the spring it is often unnecessary to excavate the burrow completely, the *Onthophagus* being found 4 to 8 feet inside the entrance in the sand at the sides of the burrow. Excavation of the complete burrow is quite difficult because they are often 18 to 20 feet long and may reach a depth of 8 to 12 feet. Hubbard, who first investigated the insects associated with the gopher tortoise, wrote (1894, p. 303), "The excavation was in the loose yellow sand of our pine woods subsoil, and when my exploration was completed, so large a pit had been dug that a coach and span of horses might have been swallowed up in it." The authors found Hubbard's statement very true, the only detail seemingly omitted that, when possible, the gopher seems to terminate its burrow under the roots of a tree, adding to the already difficult job of excavation.

Occasionally specimens may be procured by the simple process of placing a trap can containing fermenting malt and propionic acid inside the entrance of the burrow and then sealing the burrow with cardboard, paper, sticks, and sand. The next day, if the can is not filled with sand by the tortoise, it often yields a number of the insects residing in the burrow. A few *Onthophagus* have been taken in this manner.

Typical *O. polyphemi polyphemi* seems to occur in the sandhill regions of the east coast from central Florida to southern South Carolina, wherever the gopher tortoise occurs.

***Onthophagus polyphemi sparsisetosus*, new subspecies**

PLATE 3, FIGURES 16 AND 17

HOLOTYPE.—Male major, length 6.6 mm., width 3.8 mm. Very similar in form and color to the typical *p. polyphemi*, differing largely in the number and size of the tubercles, setae, and punctures. In the following description only the features distinguishing *p. sparsisetosus* from *polyphemi* are given: Head with clypeal disc having 12 or fewer small punctures with tuberculate anterior margins, punctures often with fine setae; frons smooth and nearly impunctate, only seven punctures being evident; low carina of vertex complete, slightly gradually depressed medially, highest laterally near the eyes; vertex behind carina with a row of coarse punctures; genae smooth and impunctate.

Pronotum similar in size, outline, and shape of protuberance to that of typical *polyphemi*; pronotal surface impunctate except near

anterior angles, along anterior margins, and with scattered fine punctures near posterior edge, the punctures anteriorly finely tuberculate at front margins and usually bearing long reddish setae. In *polyphemi*, the punctures are more numerous anteriorly, with conspicuous tubercles. Posterior half of pronotal midline shallowly but distinctly impressed. Elytral striae shallow, faintly punctate; intervals impunctate or nearly so except marginally, second and third intervals impunctate on discal portion or having no more than five small punctures which are slightly tuberculate anteriorly; other intervals punctate, but with tubercles and setae much less conspicuous than is typical for *polyphemi*. Pygidium with scattered coarse setigerous punctures, punctures nearly obsolete medially. Ventral surfaces very similar to typical *polyphemi*, but with punctures slightly reduced in number and size. Punctures of legs reduced but similar otherwise.

MALE MINOR (PARATYPE).—Length 4.5 mm., width 2.7 mm. Except for differences in punctures, tubercles, and setae, the morphological modifications of the male minor are the same as described for typical *polyphemi*. Head in the male minor with setae of clypeus and frons more obvious. Pronotum with punctures and setae more pronounced and slightly more numerous; pronotal disc with many minute punctures scattered over surface, all lacking setae. Second and third elytral intervals nearly impunctate, with even fewer punctures than in holotype. Pygidium with smaller punctures and surface less alutaceous than in male major. Ventral surfaces not noticeably differing from male major.

ALLOTYPE.—Female, length 5.7 mm., width 3.3 mm. Differing from male major in the same ways as described for typical *polyphemi*. Disc of clypeus with 16 or fewer setigerous punctures, tubercles at anterior edge of punctures small, smooth surface between finely alutaceous; frons with 12 setigerous punctures; genae largely impunctate. Pronotum sparsely setigerously punctate anteriorly and laterally, impunctate medially except for a few very fine nonsetigerous punctures. In typical *polyphemi* females, the lateral punctures are larger and cover a more extended area, and the secondary punctures are pronounced on fresh specimens. Pronotum with posterior half of midline shallowly impressed. Second interval of the elytra lacking tubercles, the third with only one or two tuberculate punctures, none of the intervals with the fairly regular one or two rows of setigerous punctures noted in *polyphemi*. Ventral surfaces of the two subspecies similar, with *sparsisetosus* having the number and size of the setae and punctures somewhat reduced.

VARIATION.—In the paratypic series, length ranges from 4.5 mm. to 6.9 and width from 2.7 to 3.9 mm. There is some variation

in the number of punctures on the clypeus and frons, with male minors and females usually having several more punctures than is normal for male majors. Usually the punctures and setae are more pronounced in females than in males, particularly on the pronotum and elytra. Sexual differences and the variation in the males have already been noted. Variation in other respects is small. The topotypic series and the few Mississippi specimens usually have the pronotum shallowly indented along the posterior portion of the midline. West Florida specimens lack the distinct indentation, but otherwise are similar.

TYPE.—USNM 65684.

TYPE LOCALITY.—6 mi. southwest of Stapleton, Ala.

SPECIMENS EXAMINED.—137.

DISTRIBUTION.—(See fig. 5, p. 37.) Holotype, ♂, and allotype, ♀, 6 mi. southwest of Stapleton, Ala., Apr. 19, 1957, Howden and B. Dozier, in gopher tortoise burrow. Also the following paratypes:

ALABAMA: 46 ♂♂, 55 ♀♀, same data as type. FLORIDA: 9 ♂♂, 7 ♀♀, near Clarksville, Mar. 21, 1954, H. Howden, in gopher tortoise burrow; 6 ♂♂, 6 ♀♀, Funiak [De Funiak Springs?]. MISSISSIPPI: 3 ♂♂, 3 ♀♀, 6.5 mi. south of Lucedale, Apr. 20, 1957, H. and A. Howden, in gopher tortoise burrow. Paratypes deposited in CNC, USNM, and B. Dozier coll.

REMARKS.—Though *p. sparsisetosus* apparently has habits identical to those of *p. polyphemi*, it seems advisable to separate the forms for both morphological and geographical reasons. Many species of Scarabaeidae occur in both northern and western Florida, but for many others species the Apalachicola River and adjacent swamps appear to be at least a partial barrier between the two areas. The genus *Mycotrupes* is an example of genera that occur in central and northern Florida but do not extend into western Florida, even though suitable habitats exist (Olsen, Hubbell, Howden, 1954). Other species such as *Serica rhypha* Dawson and *Gronocarus autumnalis* Schaeffer extend at least as far eastward as Clarksville, Fla., but have not been recorded east of the Apalachicola River. *O. p. sparsisetosus* is accorded subspecific status because the dorsal punctures, slightly reduced in size and number, of specimens north (Tillman, S.C.) and west (High Springs, Fla.) of Crescent City (type locality) indicate possible intergradation.

As with typical *polyphemi*, the larvae of *sparsisetosus* are unknown. The adults from western Florida, Alabama, and Mississippi were all collected in the spring (March and April) a short distance inside the entrance of the gopher tortoise burrows. The Alabama series of 103 specimens was taken from a single burrow from 1 to 12 feet inside the entrance. Most of the beetles were in small sandy cells in the sides of the burrows. The few Mississippi specimens were taken on a warm (82°–84°F) cloudy April day. One specimen

was on the pile of dirt outside the burrow, and the other specimens were just inside the entrance. Movement of adults from one burrow to another may possibly occur on warm cloudy days or late in the afternoons.

O. polyphemi sparsisetosus may be distinguished from other North American species by the characters given under typical *polyphemi*. It may be separated from typical *polyphemi polyphemi* by the greatly reduced number of punctures, setae, and tubercles. The nearly impunctate second elytra interval seems always to separate *p. sparsisetosus* from the more eastern *p. polyphemi*.

***Onthophagus striatulus striatulus* (Palisot de Beauvois)**

PLATE 3, FIGURES 18-21

- Scarabaeus janus* Panzer, 1794, p. 5 (not Olivier 1789, p. 101).—Melsheimer, 1806, p. 3.
- Onthophagus janus* (Panzer) Dejean, 1836, p. 158.—Sturm, 1843, p. 108.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1034.—Horn, 1875, p. 139.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 296.—Leng, 1920, p. 249.—Boucomont and Gillet 1927, p. 206.—Boucomont, 1932, p. 302.
- Onthophagus niger* Melsheimer, 1806, p. 3; 1846, p. 134 (nomen nudum).—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Horn, 1875, p. 139.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.
- Copris striatulus* Palisot de Beauvois, 1809, p. 92.
- Onthophagus striatulus* (Palisot de Beauvois) Sturm, 1826, p. 178.—Dejean, 1836, p. 158.—Sturm, 1843, p. 108.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Crotch, 1874, p. 57.—Horn, 1875, p. 139.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 296.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.
- Onthophagus cervicornis* Kirby, 1825, p. 565.—Gemminger and Harold, 1869, p. 1030.—Horn, 1875, p. 139.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206. (The habitat of *O. cervicornis* Kirby was given as, "Georgia Amer.?" The two horns were described, however, as "erectis arcuatis subramosis." Since no U.S. species has branched horns, perhaps the true *cervicornis* is an African species.)
- Onthophagus cavicornis* Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.
- Onthophagus castaneus* Melsheimer, 1845, p. 134.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.
- Onthophagus viridicollis* Gemminger and Harold, 1869, p. 1030.
- Onthophagus scabricollis* Horn, 1875, p. 139.—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.
- Onthophagus canadensis* Horn, 1875, p. 139 (not Fabricius, 1801, p. 34).—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.
- Onthophagus subaeneus* Horn, 1875, p. 139 (not Palisot de Beauvois, 1811, p. 105).—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.

Onthophagus concinnus Horn, 1875, p. 139 (not Laporte, 1840, p. 87).—Leng, 1920, p. 249.

Onthophagus protensus Horn, 1875, p. 139 (not Melsheimer, 1845, p. 134).—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.

Onthophagus orpheus Horn, 1875, p. 139 (not Panzer, 1794, p. 5).—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.

MALE MAJORS.—Length 5.2 to 6.8 mm., width 3.2 to 4.1 mm. Color extremely variable, some uniform brown, piceous, or black with iridescent cupreous reflections; some with head and pronotum brown, piceous, or black with iridescent reflections and with elytra brown, piceous, or black except near the apex and base where they are lighter in color, yellow or brown, and form either isolated spots or a basal or apical band. Head with clypeus prolonged, anteriorly reflexed, usually rounded, occasionally broadly emarginate, laterally normally slightly arcuate and extending obliquely to the gena from which it is separated by a faint notch. Clypeus flared laterally in occasional specimens, each side being strongly arcuate and separated from the gena by a distinct notch. Disc of clypeus flat or slightly concave, smooth, and shiny, with a few widely scattered fine or moderate punctures; laterally sometimes coarsely punctate, the punctures occasionally bearing fine short setae. Clypeal carina absent. Frons and base of clypeus flat or slightly convex, smooth, shiny, and lightly to moderately punctate; genae delimited from clypeus and frons by a faint line. Surface concave in front of eyes; surface of vertex lacking a carina, but with a long arcuate horn inside and behind each eye, the horns often reaching a height equal to the top of the pronotal convexity.

Pronotum narrowly margined anteriorly and laterally; anterior angles abruptly, often arcuately rounded and directed outward; lateral margins either arcuate or sinuous, but not sharply bent in anterior half. Pronotum convex, with a large anterior median hump or tumosity which may have an inverted U or V shape or be nearly truncate anteriorly, normally with a concave groove on each side in which the horns of the head may repose. Except for the anterior concavities which may be smooth, shiny, and nearly impunctate, surface of pronotum coarsely punctate, each puncture bearing a short white seta; punctures separated by approximately 1 diameter, the shape of the punctures exhibiting considerable variation, some being shallow and circular, others being deep and circular, often, whether shallow or deep, with a small tubercle indenting the anterior margin; anteriorly on the pronotal tumosity, tubercles often more evident than the punctures, but elsewhere punctures are 2 to 3 times the width of the tubercles.

Elytra with punctate striae, which may or may not be noticeably impressed; intervals shallowly convex or flat with two to three irreg-

ular rows of setigerous tubercles; surface of elytral intervals between the tubercles alutaceous, dully shining. Pygidium largely smooth and shiny with numerous setigerous punctures. Ventral surfaces of thorax laterally bearing large, shallow, setigerous punctures; medially the punctures obsolete, setae shorter, with smooth midline of metasternum lacking both coarse punctures and setae. Abdominal segments finely alutaceous, each segment having an irregular basal row of setigerous punctures, last segment slightly emarginate medially. Forelegs not greatly elongated, tip of the forefemora barely extending to lateral pronotal margin; foretibia quadridentate, slightly longer and considerably more slender than in females, and with an apical conical projection which is lacking in females; outer margin of the foretibia between and above the teeth serrate or finely denticulate; mesothoracic and metathoracic legs similar to those of females; femora of all legs with fairly numerous coarse setigerous punctures.

MALE MINORS.—Length 4.5 to 5.8 mm., width 3 to 4 mm. Differing from male majors in following respects: Dorsal color fully as variable but dark specimens usually with less cupreous iridescence. Head with clypeus not prolonged anteriorly, usually evenly rounded, occasionally broadly, shallowly emarginate; surfaces of clypeus, frons, and genae generally as described in male majors. Carina of vertex often obsolete except laterally where the horns may be reduced to two small sharp humps or are intermediate in length to the male majors; in very small specimens, nearly the entire carina may be indicated as a low ridge, indistinct only at the middle, with no indication of lateral horns.

Pronotum weakly convex, anterior angles acute with lateral margins generally evenly arcuate, protuberance often indicated by a slight swelling delimited laterally by two small rounded or sharp humps, with small concavities beyond them; pronotal punctures as variable as in male majors, but usually more closely grouped. Elytra with the same variable color patterns, tubercles on the intervals usually quite pronounced, as is the alutaceous sculpture. Pygidium often more alutaceous in upper half, setigerous punctures large and close; ventral surfaces generally more heavily punctate. Foretibia shorter, wider, and with only a faint indication of the apical conical projection noted in male majors.

FEMALES.—Length 4.3 to 7.2 mm., width 2.5 to 4 mm. Differing from male majors in the following respects: Head with clypeus rounded, the anterior edge often truncate or very slightly emarginate for a short distance, the margin reflexed anteriorly, less so laterally; disc coarsely transversely rugose; clypeal carina low, complete, highest medially, laterally often only a raised line by the genae; frons and genae with scattered, coarse, setigerous punctures usually separated by a

distance of several diameters; frontal carina complete, of low to moderate height, often lowest medially and abruptly terminated laterally, usually straight or slightly sinuous when viewed from above; vertex behind the carina smooth except for a few scattered punctures.

Pronotum weakly convex, the features as described in male minors, except that in females the tubercles overhanging the pronotal punctures are often more pronounced. Elytra with the same features and varying no more than male minor from the male major. Pygidium more convex, otherwise similar to the males. Ventral surfaces with the punctures slightly more pronounced, similar to the males except that the last abdominal segment is not narrowed medially. Foretibia short, quadridentate, with teeth larger than in male majors and margin of tibia between the teeth serrate or denticulate; lacking apical conical projection noted on the foretibia of male majors.

TYPE.—Unknown to writers.

TYPE LOCALITY.—“Etats-Unis (Caroline du Sud).”

SPECIMENS EXAMINED.—1646.

DISTRIBUTION.—(See fig. 1, p. 17.) Nebraska, Oklahoma, Texas, and all States east of these except possibly New Hampshire and Maine. No records from Canada.

REMARKS.—This species presents interesting problems. Several forms have been described, and because all have similar habits, it has been difficult to decide upon the limit of variability for certain populations. The unicolorous form and the bicolored specimens are considered a single species owing to their sympatric distribution and variable and overlapping morphological characteristics. The form *O. floridanus* Blatchley is subsequently listed and described as an allopatric subspecies (p. 45). Many of the characteristics of *s. floridanus*, such as tuberculate-punctate pronotum and black color, appear separately in populations of *s. striatulus*, but of the many specimens examined none with a range outside the southeastern coastal plain exhibited all the characteristics of *s. floridanus*. This fact coupled with the restricted distribution of *s. floridanus* would seem to make valid its recognition as a subspecies.

O. striatulus is the most variable North American species of the genus, but is easily recognized if a male major is in the series. The two long horns on the head, which fit on each side of the pronotal protuberance, the coarsely punctured pronotal disc (tubercles sometimes at the anterior margin of the punctures), tuberculate-granulate elytral intervals, and the varied color which is never dull black distinguish the male majors. The male minors and females with the evenly rounded or slightly emarginate clypeus, coarsely punctate pronotum, tuberculate-granulate elytral intervals, varied color, and conspicuous setae both dorsally and ventrally can be rather easily separated from

all the related species except the females of the *orpheus* complex. Male minors and females of *s. striatulus* may be distinguished from these species by the fine alutaceous sculpture of the elytral intervals which is lacking in the *orpheus* group. The similarity of the females of these species probably led Blatchley to confuse *orpheus* as a variety of *striatulus* in his "Coleoptera or beetles known to occur in Indiana" (1910, p. 919). Blatchley (1916, p. 95) also stated that *O. janus* and *striatulus* are good species, but his reasons for this separation are not valid.

Onthophagus striatulus is fairly distinct from other North American *Onthophagus* in its habits inasmuch as it prefers rotting fungi to dung as adult food. Specimens can be commonly taken under some of the "toadstool" fungi and have also been found by the writers on a species of *Rhizopogon*. They can be easily taken in sunken can traps baited with bananas, fermenting malt, or malt and propionic acid. Specimens less frequently are taken on rotten melons, animal droppings, or carrion. Brown (1928) found *striatulus* attracted to baits of decaying bananas in damp forests.

In provisioning larval food, however, *s. striatulus* seems to follow the typical pattern of providing dung for the larvae. A number of adult *s. striatulus* collected at Bastrop State Park, Texas, on rotting watermelon during mid-June were placed in a large soil-filled flower pot, furnished with fungi and cow dung, and left undisturbed until July 5th. At that time, the pot was investigated and four cells composed of dung were found at depths of 3, 4, and 5 inches. Each cell contained a single larva. All the larvae, 2 second instars and 2 third instars, were immediately preserved. The cells were oval in shape, 12 to 14 mm. long, and 8 to 10 mm. wide at the widest point, with the cavity containing the larva at the upper end. In none of the cells was there any indication of fragments of fungi, even though fungi was placed in the pot and the adults appeared to feed on it. After July 5th no additional cells were formed. Development of *O. striatulus* seems typically rapid, the third instars taking no more than 3 weeks to develop from the egg. Pupation evidently occurs in mid-summer, for numerous, seemingly freshly emerged adults are common on fungi in September in Tennessee.

***Onthophagus striatulus floridanus* Blatchley, new combination**

PLATE 4, FIGURES 24 AND 25

Onthophagus nigrescens Blatchley, 1916, p. 94 (not d'Orbigny, 1902, p. 21).—Leng and Mutchler, 1933, p. 38.

Onthophagus floridanus Blatchley, 1928, p. 128.—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 5.9 to 7.1 mm., width 3.7 to 4.3 mm. Dorsal color shining black with vague greenish cast. Head with

clypeus prolonged anteriorly, usually evenly rounded, occasionally sharply emarginate. Other features of head as described for *s. striatulus*. Pronotum with margins, angles, and protuberance as described for *s. striatulus*; punctures shallow and poorly defined, anterior margin of each puncture with a pronounced tubercle which bears a short whitish (not usually blackish as stated by Blatchley, 1916, p. 94) seta at its base, often appearing more tuberculate than punctate. Elytra as described for *s. striatulus* except that the surface of the intervals between the tubercles is smooth and shiny, not alutaceous as in *s. striatulus*; tubercles of the intervals in two or three irregular rows, each tubercle with a short white seta at its base. Pygidium and ventral surfaces black and shining with morphological characteristics falling within the limits described for *s. striatulus*.

MALE MINORS.—Length 5.5 to 5.9, width 3.3 to 3.5 mm. Seemingly infrequent in the population. Color black, shining, rarely vaguely greenish. Pronotal tubercles pronounced with whitish setae more evident than in male majors. Elytral intervals still smooth between the two or three rows of tubercles. In other features (carinae of head, pronotal modifications, length of foretibia, etc.) male minors of *s. floridanus* resemble those of *s. striatulus*.

FEMALES.—Length 6.8 to 7.2 mm., width 3.8 to 4.2 mm. Dorsal color shining black, occasionally faintly greenish. Pronotal tubercles more pronounced than in males, punctures shallow. Setae on pronotum, elytral intervals, and ventral surfaces whitish and conspicuous. Elytral intervals between the two or three rows of tubercles smooth and shining. In other respects females of *s. floridanus* resemble those of *s. striatulus*.

TYPE.—Purdue University, Lafayette, Ind.

TYPE LOCALITY.—Dunedin, Fla.

SPECIMENS EXAMINED.—107.

DISTRIBUTION.—(See fig. 1, p. 17.)

GEORGIA: Alma (Bacon Co.). FLORIDA: Bartow, Crescent City, Dunedin, Gainesville, High Springs (Columbia Co.), Lutz, Miami. SOUTH CAROLINA: Aiken, Bulls Island, Goose Creek (Berkeley Co.), Hampton, Longs (Waccamaw River), Marion, Meredith, Summerville. (Fifteen additional specimens from Dunedin, High Springs, and Gainesville, Fla., and from Florence, Longs, Meredith, and Seranton, S.C., show varied amounts of faint alutaceous sculpture on the elytra. These should perhaps be considered intermediate forms.)

REMARKS.—The subspecies *O. striatulus floridanus* Blatchley is largely confined to peninsular Florida and the Atlantic Coast northward to Myrtle Beach, S.C. Blatchley took his type specimen, a male, at Dunedin, Fla., on Nov. 1 from a "decaying fleshy fungus." He stated that the pronotal setae were blackish and the elytral setae very fine. In specimens taken by F. N. Young at Miami and in

others taken by Howden in malt cans from central Florida, the setae are whitish and quite conspicuous. In other respects they match Blatchley's description (1916, p. 94).

O. striatulus floridanus may be distinguished from other North American species by the characteristics given under *s. striatulus*. It may be distinguished from *s. striatulus* by the combination of black color, rather tuberculate pronotum, especially posteriorly, lack of alutaceous sculpture, and more distinct tubercles on the elytral intervals. Usually *O. striatulus floridanus* may be separated from *O. orpheus orpheus* and *o. pseudorpheus* by the presence of three irregular rows of tubercles on the second and third elytral intervals.

As mentioned above, food preferences of *O. s. floridanus* are similar to *s. striatulus* in that they are attracted to fungi and may be trapped in cans baited with malt. Nothing is known of the larval habits.

Onthophagus orpheus orpheus (Panzer)

PLATE 4, FIGURES 26 AND 27

Scarabaeus orpheus Panzer, 1794, p. 5.

Onthophagus orpheus (Panzer) Sturm, 1843, p. 107.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemninger and Harold, 1869, p. 1034.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 295.—Leng, 1920, p. 249.—Dawson, 1922, p. 179.—Boucomont and Gillet, 1927, p. 207.—Boucomont, 1932, p. 311.—Howden, Cartwright, and Halfter, 1956, p. 11.

MALE MAJORS.—Length 6.5 to 9.0 mm., width 3.7 to 5.0 mm. Dorsal surfaces dark green, often with blue or coppery reflections, smooth and shining between punctures; ventral surfaces shining piceous, green, vaguely alutaceous between coarse punctures; legs greenish brown or black; antennae brownish black, the club grayish black. Clypeus sharply reflexed anteriorly, arcuate, truncate, or vaguely emarginate; clypeal disc coarsely, rugosely punctate, more so laterally; numerous fine secondary punctures often between the scattered, coarse, setigerous punctures of the clypeus, vertex, and genae; clypeal carina obsolete to barely indicated; carina on vertex obsolete medially, indicated laterally by a single short tubercle or horn above and behind each eye.

Pronotum margined anteriorly and laterally, convex, with a broad anterior process extending over the head, normally extending almost as far as the posterior edge of the clypeus. Process bifurcating over the posterior part of the vertex and with the ends of the bifurcations usually ending in hatchet-shaped tips; the process curving evenly downward when viewed laterally, tips not approaching the clypeus as closely as in *cynomysi*. Pronotal surface with coarse punctures, laterally each bearing a short seta; most punctures except at posterior

midline with a small tubercle at their anterior margins; tubercles, setae, and punctures most pronounced anteriorly and laterally. Elytra with well-defined striae; all intervals except the sutural interval and the anterior portion of the second and fourth intervals irregularly, biserially punctate-tuberculate, the punctures bearing fine, whitish setae; surface between tubercles smooth and shining, not alutaceous.

Pygidium usually coarsely, setigerously punctate. Ventral surface of metasternum laterally alutaceous and coarsely, setigerously punctate, medially with only fine secondary punctures except for a few large posterior ones and a shallow, longitudinal indentation. Abdominal segments coarsely, shallowly punctate laterally, the punctures becoming obsolete medially; last segment emarginate medially to receive pygidium. Legs piceous to brown with a greenish luster. Forelegs with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the thorax; tibia with four large lateral teeth with serrate margin between and a conical, apical tooth above the short inturned tibial spine. Femora of mesothoracic and metathoracic legs with scattered coarse punctures and a few very fine punctures on their ventral surfaces.

MALE MINORS.—Length 5.1 to 7.3 mm., width 3.2 to 4.3 mm. Usually smaller than male majors or females, differing from the former in the following respects: Clypeus reflexed only slightly more anteriorly than laterally; clypeal carina distinctly indicated; carina of the vertex usually complete, highest laterally, indicative of the conical tubercles above the eyes in male majors. The pronotal protuberance in the smallest specimens reduced to a small hump resembling that of a female, but slightly narrower in width. Forefemora and tibia not greatly elongate, the tibia with only a trace of the apical conical tooth over the tibial spine which is still short and stubby, not as elongate as in females.

FEMALES.—Length 5.2 to 8.0 mm., width 3.7 to 5.0 mm. Differing from the male majors in the following respects: Clypeus evenly arcuate, shallowly emarginate anteriorly, and faintly to moderately reflexed; disc very coarsely, rugosely punctured, much more so than in males; both carinae of clypeus and vertex pronounced, the latter being more pronounced and slightly higher medially; frons, before the carina, slightly more coarsely punctured than in male and often with scattered secondary punctures. Pronotum with the anterior process evidenced by a rounded, broad hump often angulate and pronounced laterally, the swelling not extending over the anterior margin. Elytra and pygidium similar to those of male but with punctures at base of tubercles on elytra often more pronounced. Prothoracic legs not elongate, the apical end of the femur not extending as far as the lateral margin of the pronotum; tibia proportionately shortened, laterally with four

teeth, apically lacking the conical tooth overhanging the long incurved tibial spine. Mesothoracic and metathoracic femora slightly thicker and shorter than in male majors.

TYPE.—Location unknown to us.

TYPE LOCALITY.—“Americas borealis.”

SPECIMENS EXAMINED.—120.

DISTRIBUTION.—(See fig. 6.)

UNITED STATES: FLORIDA: Enterprise, Lake City, Live Oak, Florida Caverns State Park, Key Largo. ILLINOIS: Edwardsville, southern Illinois. INDIANA: LaPorte, Tippecanoe Co. IOWA: Burlington. KANSAS: East Kansas, Lawrence. MARYLAND: Baltimore, College Park, Plummers Island. MINNESOTA: (State label only). NEW JERSEY: Alpine, Cecil, Palisades. NEW YORK: Bear Mountain. OHIO: Adams Co., Champaign Co., Cuyahoga Co., Highland Co., Hocking Co., Licking Co. OKLAHOMA: Payne Co. PENNSYLVANIA: Boyertown, Broomal, Milford, Pittsburgh. SOUTH CAROLINA: Pinnacle Mtn. TENNESSEE: Burrville, Jackson Co. TEXAS: Brazos Co., College Station, Columbus, Fedor, Hunt Co., Sabinal. VIRGINIA: Alexandria, Fairfax Co. WISCONSIN: Lake Geneva.

REMARKS.—The *Onthophagus orpheus* group, instead of being divisible into several subspecies as treated here, may represent a series of sibling species; however, the taxonomy of the group will remain obscure until a great deal more is known about the biology of the complex. The meagre information at hand seems to indicate that all the subspecies are associated largely with animal nests or burrows.

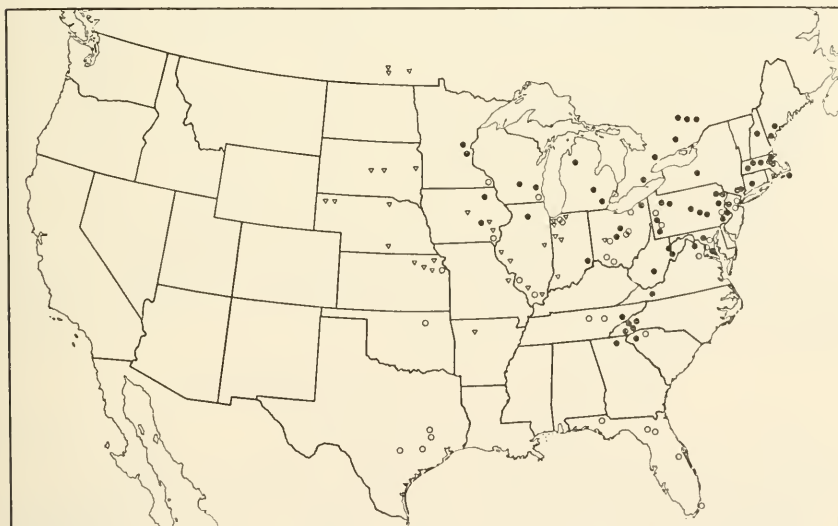


FIGURE 6. Distribution of species of *Onthophagus*:

● *orpheus canadensis* (Fabricius)

▽ *orpheus pseudorphheus* new subspecies

○ *orpheus orpheus* (Panzer)

This widely ranging form, *O. orpheus orpheus*, seemingly has the most diverse habits in the *orpheus* group, and likewise shows the greatest range of variation. Brown (1926) found *O. orpheus* "about manure in moist woodlands." We have taken occasional specimens on cow or other animal dung, and a few were captured in malt traps. Most of the specimens that we examined that had accompanying biological data had been taken in a variety of situations associated with nests or burrows. One long series from Plummers Island, Md., came from a buzzard's nest; other specimens have been taken in woodchuck, *Marmota monas* (Linnaeus), burrows; still other specimens from Florida have been found in wood rat (*Neotoma* sp.) nests. Eight specimens from Tennessee were taken in a cave, possibly attracted to bat guano (as is *O. cavernicollis*). Inasmuch as most of the species of *Onthophagus* that are not general dung feeders seem to have a very restricted host preference, it seems quite likely that further investigation may show that three or four morphologically similar species with quite diversified habits are placed here under the name *orpheus*. This subspecies is mainly a low elevation or southern woodland form, occurring mainly on the coastal plain in the southeastern United States and along the larger river systems in the midwest. (fig. 6).

Onthophagus orpheus can be recognized by its shining green, reddish-green, or greenish-black color; rounded or broadly shallowly emarginate, never bidentate, clypeus; distinctly punctate pronotum, the punctures with or without anterior tubercles; the broad anterior pronotal hump which in male majors becomes a flat bifurcate projection over the head, and the moderate size, from 5 to 9 mm. in length.

The subspecies *orpheus orpheus* can be distinguished by the small tubercles at the anterior margins of the elytral punctures and often by the pronotal punctures with tubercles; short setae are usually present laterally on the pronotum, but are either lacking or very short at the posterior center portion of the disc; on the elytra, setae are usually present behind the tubercles in the vague punctures. In male majors the clypeal carina is never distinct, and in females the frontal carina is normally highest medially.

Onthophagus orpheus canadensis (Fabricius)

PLATE 4, FIGURES 28-30

Copris canadensis Fabricius, 1801, p. 34.—Palisot de Beauvois, 1809, p. 92.

Onthophagus canadensis (Fabricius) Sturm, 1826, p. 177.—Sturm, 1843, p. 107.—

Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 54.—LeConte,

1863, p. 108.—Gemminger and Harold, 1869, p. 1034.—Crotch, 1874, p. 57.

Onthophagus ?concinus (Laporte) Boucomont and Gillet, 1927, p. 207.

MALE MAJORS.—Length 5.5 to 7.0 mm., width 3.5 to 3.8 mm. Dorsal surfaces cupreous to green, smooth and shining between punc-

tures; ventral surfaces green or coppery to black, vaguely alutaceous, shining between punctures; legs greenish brown to black. Head with clypeus sharply reflexed anteriorly, vaguely emarginate, surface rugosely punctate; clypeal carina at most barely indicated; vertex and prominent genae with scattered coarse punctures, some punctures bearing setae; frontal carina represented only laterally, indicated by a single short tubercle above and behind each eye; antennae brownish red, the club grayish brown.

Pronotum convex, with an anterior process extending over the head bifurcating beyond the pronotal margin, the bifurcations ending in blunt hatchet-shaped tips; the process narrowest just posterior to the point of bifurcation, beyond that arcuately increasing in width by approximately one-fifth; from lateral view the process curving downward toward the vertex above the eyes. Pronotum margined anteriorly and laterally, coarsely punctate laterally and on the pronotal process, the punctures becoming shallower and very sparse medially and posteriorly; laterally some of the punctures bearing very short setae which become minute or are absent medially; punctures round or oval and lacking a tubercle at their anterior margin. Elytra with well-defined striae; intervals distinctly, irregularly punctate, the second and fourth intervals poorly so or impunctate, at least in anterior half; setae in the punctures short and inconspicuous, usually absent on the second and fourth intervals; surface strongly shining, not alutaceous.

Pygidium shining; coarsely, setigerously punctate. Ventral surfaces of thorax laterally vaguely alutaceous and coarsely, setigerously punctate; metasternum medially with only fine secondary punctures and a faint longitudinal sulcus. Abdominal segments with numerous punctures laterally, becoming almost impunctate medially, the last segment emarginate medially. Foreleg with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the thorax; tibia with four large lateral teeth, the margin serrate between and above the teeth and with a conical apical tooth above the short inturned tibial spine. Femora of mesothoracic and metathoracic legs having a few scattered coarse setigerous punctures and a few, very fine punctures on their ventral surfaces.

MALE MINORS.—Length 3.9 to 6.1 mm., width 2.6 to 3.4 mm. Usually smaller than male majors or females, differing from the former in the following respects: Clypeal margin scarcely more reflexed anteriorly than laterally; clypeal carina usually pronounced; frontal carina often complete, highest laterally, indicative of the conical tubercles above the eyes in male majors. Pronotal protuberance greatly reduced, sometimes only indicated as it is in females by a round hump extending no farther than the anterior pronotal margin.

Forefemur and tibia not greatly elongate, the tibia lacking the apical conical tooth over the tibial spine, the spine however being still rather short and stubby; the four lateral tibial teeth intermediate in size between those of the male major and the female.

FEMALES.—Length 6 to 6.5 mm., width 3.5 to 4 mm. Differing from the male major in the following respects: Clypeus rather evenly arcuate, scarcely emarginate, only slightly reflexed anteriorly and laterally; disc very coarsely rugosely punctured, much more so than in males; carinae of both clypeus and vertex pronounced, that of the latter usually being slightly more pronounced and highest at the center, occasionally vaguely indented medially; frons before the carina more densely punctured than in male majors, the punctures being separated by only slightly more than their own diameters.

Pronotum similar to male minor with the pronotal process evidenced by a broad hump extending no farther than the anterior pronotal margin. Punctures of the elytra more pronounced than in the majority of males, those of the second and fourth intervals being small, often obsolete; punctures of pygidium more numerous than in males. Prothoracic legs not elongate, the apical end of the femur not extending as far as the lateral margin of the thorax and the tibia proportionately shortened; apical tibial spine long, curved inward near the tip, and lacking the basally overhanging conical projection; laterally the outer margin of the foretibia is serrate between and above the four large teeth. Mesothoracic and metathoracic femora slightly thicker and shorter than in male majors.

TYPE.—Unknown to us.

TYPE LOCALITY.—“Canada.”

SPECIMENS EXAMINED.—336.

DISTRIBUTION.—(See fig. 6, p. 49.)

CANADA: ONTARIO: Chalk River, Constance Bay, Marmora, Ottawa, Toronto, Walsingham.

UNITED STATES: CONNECTICUT: Stamford. DELAWARE: Earleville. DISTRICT OF COLUMBIA. GEORGIA: Neel Gap. INDIANA: Ripley Co. ILLINOIS: Ogle Co. IOWA: Iowa City, Clermont. MAINE: Isle of Springs, Sebago Lake. MARYLAND: Baltimore, Beltsville, C. and O. Canal, Forest Glen, Plummers Island. MASSACHUSETTS: Amherst, Ashland, Brookline, Forest Hills, Framingham, Mount Tom, Nantucket, Natick, Sherborne, Springfield, Tyngsboro, Wellesley. MICHIGAN: Adrian, Crawford Co., Livingston Co. MINNESOTA: Anoka Co., Ft. Snelling. NEW HAMPSHIRE: Rumney, Three Mile Id. NEW JERSEY: Cecil, Duttonsville, Greenwood, Stanhope. NEW YORK: Carmel, Groton, Palisades, West Point. NORTH CAROLINA: Black Mts., Highlands, Pisgah Forest, Retreat, Sunburst. OHIO: Ashtabula, Columbus, Delaware Co., Licking Co. PENNSYLVANIA: Angora, Bear Mtn., Bethlehem, Canadensis, Dauphin Co., Davidsburg, Delaware Co., Easton, Forest Co., Frankford, Germantown, Jefferson Co., Lima, Lititz, New Hope, Pecks Pond, Pocono Mts., Roxborough, State College, Swarthmore, Washington. SOUTH CAROLINA: Sassafras Mt., CCC Camp F2

(Oconee Co.), Pinnacle Mtn. TENNESSEE: Gatlinburg. VIRGINIA: Draper, Mayland, Vienna. WEST VIRGINIA: Lost River State Park, Tucker Co., White Sulphur Springs. WISCONSIN: Madison, Milwaukee Co.

REMARKS.—Of the various forms in the *orpheus* complex, *canadensis* seems to form the most uniform group. The subspecies can be distinguished by the pronotal disc centrally with small nonsetigerous punctures, the punctures lacking tubercles at their anterior margins. The head and pronotum often have a coppery cast that may also be present on the elytra. The elytral intervals, particularly the third and fifth, are distinctly punctate, the punctures lacking tubercles at their anterior margins and with setae fine and inconspicuous. *O. o. canadensis* can be separated from other species of *Onthophagus* in the same manner as typical *orpheus*.

The name *canadensis* is used for this form even though Fabricius did not mention the "coppery color" in his description. However, Palisot de Beauvois (1809) redescribed the "species," supposedly using material taken in "Canada" by the same collector. He also figured *canadensis*, and there can be no doubt about the coppery color. Actually, the coppery cast is not always indicative of the subspecies, but the majority of specimens, particularly those from Canada, show the coppery or reddish hue to some degree.

The subspecies occurs from Ontario and the New England States southward to Maryland and thence down the Appalachian Mountains to South Carolina. Biologically the subspecies seems to be closely associated with the woodchuck, *Marmota monax* (Linnaeus); we have no records of it from any other type of nests or burrows, though a few specimens have been taken on cow dung. It is largely a northern woodland form and occurs only at the higher elevation in the southeastern United States (fig. 6).

Onthophagus orpheus pseudorpheus, new subspecies

PLATE 4, FIGURES 31-33

HOLOTYPE.—Male major, length 8.0, width 4.3 mm. Dorsal surfaces green with a faint coppery cast on the clypeus, frons, and bifurcated portion of the pronotal protuberance; ventral surfaces green to greenish black with tibiae greenish brown; antennal club grayish brown. Clypeus distinctly reflexed anteriorly, noticeably shallowly emarginate medially, sides of emargination broadly rounded; clypeal disc with mixed coarse and fine punctures, slightly more so laterally; many of the coarse punctures with long erect setae; clypeal carina distinct, becoming highest medially where it forms a sharp angle or point. Frons and genae with scattered coarse and fine punctures, most coarse punctures with long, erect setae; frontal carina widely

arcuate, obsolete medially, ending laterally in a short, acute horn above and behind each eye.

Pronotum margined anteriorly and laterally, convex, with a broad anterior process extending over the head almost to posterior edge of clypeus. Process with base and bifurcating arms somewhat thicker than in typical *orpheus*, the process bifurcating over the posterior part of the vertex, the ends of the bifurcations thickened and rather hatchet-shaped; process curving evenly downward, similarly as in typical *orpheus*, when viewed laterally. Pronotal surface with numerous coarse punctures usually separated by less than 1 diameter, most punctures with a small tubercle at their anterior margins; most punctures, including those on the central part of the disc, with long, erect, conspicuous setae that gives the pronotum a much more distinct "hairy appearance" than the other subspecies of *orpheus*; surface between punctures smooth and shining, laterally with some very minute secondary punctures.

Elytra with well-defined, slightly impressed striae; all intervals except the sutural interval and the anterior portion of the second and fourth intervals irregularly biserially punctate-tuberculate, the punctures minute and bearing long, erect, conspicuous setae; surface between tubercles mostly smooth and shining, not alutaceous. Pygidium coarsely, setigerously punctate; medially with fine secondary punctures and a few coarse ones, particularly posteriorly. Midline of metasternum very slightly impressed. Abdominal segments coarsely shallowly punctate laterally, the punctures becoming obsolete medially; last segment emarginate medially to receive pygidium. Legs as described for the male majors of the typical *orpheus* (p. 47).

MALE MINOR.—Paratype, length 6.0 mm., width 3.6 mm. Differing from the male major in the following respects: Clypeus reflexed only slightly more anteriorly than laterally, truncate at anterior edge, not emarginate; clypeal carina slightly higher than that of male major but of same general shape; carina of vertex only vaguely indicated medially, raised laterally in a thin bladelike, sharply arcuate ending above and behind the eyes. Pronotal protuberance still forming a short, flat shelf that extends over the posterior part of the vertex and is deeply emarginate medially (indicative of bifurcation of male major); other male minors lack the pronotal projection, having only a vague median hump that does not extend over the anterior margin. Legs as described for male minor of typical *orpheus*.

ALLOTYPE.—Female, length 6.5 mm., width 4.0 mm. Differing from holotype male major in the following respects: Dorsal color almost entirely green; clypeus rather evenly arcuate, shallowly emarginate anteriorly, and faintly to moderately reflexed; disc coarsely, rugosely punctured, much more so than in male. Both carinae

pronounced; clypeal carina rounded, highest medially; carina of vertex highest laterally, slightly lower medially, the lateral ends turned slightly posteriorly and rounded off abruptly to vertex behind eyes; frons before the carina more coarsely punctate than in male. Pronotum with the anterior protuberance evidenced by a rounded hump which is most pronounced and angulate laterally, the swelling not extending over the anterior margin. Punctures, setae, and tubercles of pronotum, elytra, and pygidium slightly more pronounced but similar to those of male major. Prothoracic legs not elongate, the legs and ventral surfaces very similar to those described for typical *orpheus*.

TYPE.—Canadian National Collection 7526.

TYPE LOCALITY.—Onah (30 mi. east of Souris), Manitoba.

SPECIMENS EXAMINED.—110.

DISTRIBUTION.—(See fig. 6, p. 49.) Holotype, ♂, and allotype, ♀, Onah (30 mi. east of Souris), Manitoba, July 9, 1918, J. B. Wallis.³ And the following paratypes:

CANADA: MANITOBA: 3 ♀ ♀, same data as type (CNC). 12 ♂ ♂, 12 ♀ ♀, Aweme, May 8, 19, 25, June 7, 10, 11, 16, July 20, 23, 26, 28, Aug. 12, 23, Sept. 5, 14, N. Criddle (AMNH, CNC, USNM, Howden); 2 ♂ ♂, 1 ♀, Birds Hill, June 15, L. H. Roberts (CNC, Howden); 1 ♀, Treesbank, July 11, 1914, J. B. Wallis (CNC); 1 ♂, 1 ♀, Winnipeg, Hanham (USNM).

UNITED STATES: ARKANSAS: 1 ♂, Carlisle (Liebeck coll., MCZ). ILLINOIS: 1 ♂, Browning, Apr. 8, 1942, Mohn and Burks (INHS). 2 ♂ ♂, Quincy, June 28, 1883, (Bolter coll., INHS); 1 ♀, Urbana, May 17, 1886, Woodsworth (CNC); 1 ♀, Urbana, Apr. 18, 1915, Fairgrounds (CNC); 2 ♂ ♂, Urbana, July 1, 13, 1939, P. C. Stone, in nest of *Microtus ochrogaster* (USNM); 1 ♂, Urbana, May 13, 1933, Mohr (INHS); 1 ♂, Vienna, Apr. 17, 1941, Ross and Mohr (INHS); 1 ♂, Willow Spring, June 1, 1924 (Howden); 2 ♂ ♂, (State label only) (INHS). INDIANA: 1 ♂, Dunes St. Pk., May 9, 1939, H. Dybas (CNHM); 1 ♀, Lafayette, June 5, 1926, (Texas A. and M.); 1 ♂, Lake Co., May 20, 1905, W. S. B. (CU); 1 ♂, Michigan City, July 7, 1935, H. Dybas (CNHM); 1 ♀, Michigan City, Apr. 30, 1935, H. Dybas (Howden); 1 ♂, 3 ♀ ♀, Pine, May 29, 1905, May 27, 1906, A. B. Wolcott (USNM); 1 ♀, Pine, May 28, 1905, Gerhard (Howden). IOWA: 1 ♂, Ames, May 5, 1941, J. W. Apple (INHS); 1 ♂, Ames, May 25, 1935, B. E. Ferrier (Howden); 1 ♂, Ames, May 22, 1950, W. J. Eckebrecht (IS); 1 ♂, Ames, Apr. 28, 1930, Archie Rolfs (USNM); 1 ♀, Ames, May 17, 1928, T. S. H. (IS); 1 ♂, Ames, May 1941, J. D. Van Eaton (IS); 1 ♂, Ames, Apr. 27, 1927, H. K. R. (IS); 1 ♂, Ames, May 25, 1927, N. H. B. (IS); 1 ♂, Ames, Apr. 14, 1948, R. I. Scott (IS); 1 ♂, Ames, May 26, 1948, L. Tenney (IS); 1 ♀, Ames, Apr. 23, 1924, (IS); 1 ♂, Ames, May 4, 1931, G. R. Hopping (CAS); 1 ♀, Iowa City, May 12, 1917, L. Buchanan (USNM); 1 ♂, 1 ♀, Iowa City, Apr. 3, Oct. 15, Wickham (USNM); 1 ♀, Mt. Pleasant, Apr. 26, 1937, Milspaugh (USNM). KANSAS: 3 ♀ ♀, Argentina, Apr. 27, June 4, 1907 (Enns coll.); 2 ♂ ♂, Douglas Co., May 1920, Oct. 15, 1922, W. J. Brown (CNC, Howden); 2 ♂ ♂, 1 ♀, east Kansas, April, Popenoe (USNM); 1 ♀, Fairview, September 1929, L. W. Brown (CNC); 4 ♂ ♂, 2 ♀ ♀, State label, (CNHM, Purdue);

³ "Aweme" and "Onah" are names for different parts of the Criddle farm which is 3 miles from Treesbank. Souris, Manitoba, is 30 miles to the west.

1 ♂, Riley Co., Apr. 30, Kimball (USNM); 1 ♂, Topeka, Apr. 8, Popenoe (USNM); 1 ♀, west Kansas, Popenoe (USNM). MINNESOTA: 1 ♂, 1 ♀, State label, (Blanchard coll., MCZ; Howden). MISSOURI: 2 ♀ ♀, St. Louis, June 17, 1935, U.S.D.A. traps, (Enns coll.); 1 ♂, 3 ♀ ♀, St. Louis, April (Dury coll.); 1 ♂, 1 ♀, State label, T. Pergande coll. (USNM); 1 ♂, 1 ♀, Valley Park, Apr. 1, 1920, H. R. Painter (USNM). NEBRASKA: 1 ♀, Chadron, May 15, 1955, Jellison (CNC); 1 ♀, Spencer, June 10, 1931, G. E. Hudson (USNM); 1 ♂, Superior, (Liebeck coll., MCZ); 1 ♂, State label, (ANSP); 1 ♂, War Bonnet Canyon (CNC). OHIO: 1 ♂, Champaign Co., Sept. 5, 1954, R. E. Woodruff (OSU). SOUTH DAKOTA: 1 ♂, Capa, May 11, 1922, H. C. Severin (USNM); 1 ♂, Chamberlain, Sept. 14, 1946, H. C. Severin (USNM); 1 ♀, Volga, Truman (USNM). NO DATA: 1 ♂, (Bowditch coll., MCZ); 1 ♀, O. Lugger coll. (CNHM).

REMARKS.—Variation in the specimens, here considered to be the subspecies *pseudorpheus*, is not as great as in the other forms. Males range from 5.8 to 9.0 mm. in length and from 3.4 to 5.1 mm. in width; females range from 6.0 to 8.0 mm. in length and from 3.6 to 4.8 mm. in width. The dorsal color varies from green or yellowish green to green with a coppery cast, but the coppery color is never as pronounced as in *canadensis* and is relatively rare, most of the specimens appearing green or yellowish green. There is some variation in the prominence of the tubercles and the size of the punctures. Even though faint, the tubercles are always present and the pronotal punctures generally are large, distinct even basally, and usually separated by no more than 1 to 2 diameters. The dorsal setae vary slightly in length but are always erect and prominent. The clypeal carina in the male majors varies in degree of development, but the carina is always elevated, at least medially. In the females the frontal carina of the vertex is not as constant, usually being slightly lower medially, but with numerous exceptions.

Despite the variation, the subspecies *pseudorpheus* can be separated from the other forms of *orpheus* by its very distinct dorsal setae with usually distinctly tuberculate pronotum and elytra, by the medially elevated clypeal carina of the male majors, and by the medially slightly depressed frontal carina of the females. It can be separated from other species of *Onthophagus* by the specific characters listed under *orpheus orpheus* (p. 47).

Little is known about the subspecies *pseudorpheus*. In general it appears to be a prairie form unlike the other subspecies which are woodland forms. Only two specimens have been associated with any animals and these were taken from the nest of a mouse, *Microtus ochrogaster* (Wagner).

Onthophagus cynomysi Brown

PLATE 5, FIGURES 42 AND 43

Onthophagus cynomysi Brown, 1927, p. 131.—Boucomont, 1932, p. 311.—Leng and Mutchler, 1933, p. 38.—Howden, Cartwright, and Halffter, 1956, p. 11.

MALE MAJORS.—Length 6 to 10 mm., width 3.5 to 4.5 mm. Shining, piceous; head and thorax sometimes vaguely aeneous, legs brownish black, antenna brownish red, the club grayish brown. Head with clypeus strongly reflexed anteriorly, vaguely emarginate, discal surface rugosely punctate, with fine secondary punctures scattered among the coarse ones; vertex and prominent gena with a few scattered, coarse, setigerous punctures and a number of fine secondary punctures. Clypeal carina barely indicated, carina on vertex represented only laterally by a single short tubercle above and behind each eye.

Pronotum margined anteriorly and laterally; convex with anterior process extending over the head almost as far as the anterior edge of the clypeus, this process bifurcating over the vertex, the lateral extensions ending in outwardly flared, hatchet-shaped tips; the process narrowest near its base just behind the pronotal margin, but not flaring noticeably outward until the area of bifurcation, at which point the extensions curve outward and downward; viewed laterally the process curves evenly downward, almost touching the clypeus. Pronotal surface punctate-tuberculate; the pronotum with a tuberculate rather than a punctate appearance because each coarse thoracic puncture bears a pronounced tubercle at its anterior margin; the tubercle-punctures most numerous laterally and on the pronotal process, becoming more sparse and less pronounced medially and posteriorly; a few small secondary punctures, which lack tubercles, scattered over the discal area of the pronotum between the coarse punctures. Pronotum with a smooth, impunctate line more or less traceable forward in some specimens; midline widely, increasingly depressed posteriorly over basal fourth in all specimens. Elytra with well-defined striae; intervals, except for the sutural interval, irregularly, biserially tuberculate, with a minute seta-bearing puncture at the base of each tubercle; surface smooth and shining, not alutaceous.

Pygidium coarsely, setigerously punctate with scattered fine secondary punctures intermingled with the coarse punctures on the lower half. Ventral portions of thorax laterally alutaceous and coarsely setigerously punctate, metasternum medially having only fine secondary punctures and a faint longitudinal sulcus. Abdominal segments coarsely punctate laterally, finely so medially, the last segment emarginate medially. Foreleg with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the thorax; tibia with four large lateral teeth with serrate margin between

and a conical apical tooth above the short inturned tibial spine, femora of mesothoracic and metathoracic legs having on their ventral surfaces scattered coarse setigerous punctures and a few very fine punctures.

MALE MINORS.—Length 7 to 8 mm., width 4.3 to 4.6 mm., usually smaller than male majors or females, differing from the former in the following respects: Clypeus reflexed only slightly more anteriorly than laterally, clypeal carina pronounced, transverse carina of the vertex complete, highest laterally, indicative of the conical tubercles above the eyes in male majors, the pronotal projection greatly reduced, only slightly bifurcate, fore femur and tibia not greatly elongate; tibia lacking the apical conical tooth over the elongate tibial spine which resembles that of a female.

FEMALES.—Length 9 to 10 mm., width 5 to 5.5 mm. Differing from the male major in the following respects: Clypeal margin rather evenly arcuate, slightly emarginate, moderately reflexed anteriorly, only slightly so laterally; surface very coarsely, rugosely punctured, much more so than males; carinae of both clypeus and vertex pronounced, that of vertex being more pronounced and highest medially; vertex before the carina slightly more coarsely punctured than in male and with scattered secondary punctures. Pronotum with the median process evidenced by a broad hump, most pronounced at the lateral angles, not extending beyond the anterior prothoracic margin. Elytra and pygidium similar to those of male. Prothoracic legs not elongate, the apical end of the femur not extending as far as the lateral margin of the thorax; tibia laterally with four large teeth, proportionately shortened and lacking the apical conical tooth; tibial spine long and curved inward at the tip. Mesothoracic and metathoracic femora slightly thicker and shorter than in male majors.

TYPE.—Canadian National Collection 2471.

TYPE LOCALITY.—101 Ranch, Noble Co., Okla.

SPECIMENS EXAMINED.—38.

DISTRIBUTION.—(See fig. 7, p. 59.)

OKLAHOMA: Noble Co., Stillwater, Grady Co., Cleveland. NEW MEXICO: Clouderoft, Roswell.

REMARKS.—This species can be distinguished from *orpheus*, *pseudorpheus*, and other allied species of *Onthophagus* by its large size, piceous color, coarse setigerous punctures of the pronotum with definite tubercles at their anterior margins, presence of secondary pronotal punctures, elytral intervals (except for sutural ones) irregularly biserially tuberculate, and the quite distinctive secondary sexual characteristics of male majors.

O. cynomysi exhibits not only less morphological variability than does *orpheus* or *pseudorpheus*, but it is also quite restricted in its habitat



FIGURE 7. Distribution of species of *Onthophagus*:

- *concinus* Laporte
- *schaefferi*, new species
- × *browni*, new species
- *cynomysi* Brown

preference, being found only in the burrows of the common prairie dog, *Cynomys ludovicianus* (Ord).

***Onthophagus subopacus* Robinson**

PLATE 5, FIGURES 40 AND 41

Onthophagus subopacus Robinson, 1940, p. 142.—Blackwelder and Blackwelder, 1948, p. 30.

Onthophagus lecontei Schaeffer, 1914, p. 298 (not Harold, 1871, p. 115).—Leng, 1920, p. 249.—Boucomont, 1932, p. 327 (in part).—Blackwelder and Blackwelder, 1948, p. 30

MALE MAJORS.—Length 4.4 to 5.7 mm., width 2.6 to 3.3 mm. Black, finely alutaceous, opaque. Clypeus anteriorly sharply reflexed, distinctly emarginate; surface dully shining, very coarsely, rugosely punctate laterally with one or two punctures medially; clypeal carina vague or completely lacking; surface of frons and vertex finely alutaceous with scattered coarse punctures, each bearing a long reddish seta. Gena delimited from the clypeus by a suture extending from distinct marginal notch posteriorly to the lateral base of the transverse carina of the vertex; laterally slightly flared, then parallel-sided, and finally slightly arcuate inward to the eye. Carina of the vertex may or may not be pronounced, but is distinctly evident, of uniform height its entire length, and extends approximately three-fifths of the distance between the eyes. Robinson stated this

carina was only vaguely indicated in his specimens, but in some specimens it is quite pronounced.

Pronotum moderately convex, rather evenly, coarsely punctate; the punctures separated by a distance of 1 to 3 times their own diameter, each puncture bearing a moderately long, reddish seta and overhung anteriorly by a small shining tubercle; the tubercles quite pronounced anteriorly on the pronotal hump; surface otherwise very finely alutaceous. Entire pronotum poorly but distinctly margined; pronotal protuberance in its greatest development extending over the head to a point above the posterior carina, its anterior edge slightly emarginate and with a bilobate appearance, the lateral rounded angles slightly reflexed anteriorly; the protuberance gradually narrowed anteriorly, being widest at its base. Elytral striae shining and vaguely punctate; the intervals (except the sutural) irregularly, biserially tuberculate, the base of each tubercle with a small puncture bearing a moderately long, reddish seta, the surface between finely alutaceous and with an opaque appearance.

Pygidium very coarsely punctate throughout, each puncture bearing a fine reddish seta; basal half of pygidium finely alutaceous, apical half becoming smooth and shiny. Ventral surfaces brownish black to black, antennal club varying from yellowish brown to black. Metasternum, except in the vaguely depressed median line, with large, coarse punctures, each puncture bearing a long, reddish seta; surface alutaceous between the lateral punctures. Abdominal segments, excluding the first, each with a row of long, reddish setae along their basal edge arising from large, rather poorly defined punctures; the remaining surface of abdomen shiny but finely alutaceous; last abdominal segment emarginate, being narrowed near the median line. The long, conspicuous setae of the thorax and abdomen are quite characteristic. Anterior tibiae long, slender, and arcuate anteriorly, the outer margin crenate above and between the four teeth; apex of tibia with a pencil of yellowish hairs. Middle and hind legs not greatly elongate; surface of the femora with a few scattered, coarse punctures, each bearing a long reddish seta.

MALE MINORS.—Length 4.4 mm., width 2.6 mm. Differing from the male majors in the following respects: Clypeal carina vaguely indicated; carina of vertex pronounced, not vague as it often is in male majors; pronotal protuberance small, evenly rounded, without any emargination; foretibiae not greatly elongate but still slender; pencil of hairs scarcely indicated; in other respects similar to male majors.

FEMALES.—Length 4.8 to 5.3 mm., width 3.1 to 3.3 mm. Clypeus with anterior edge poorly reflexed and distinctly emarginate: surface coarsely, densely punctured, somewhat rugose and shining, densely punctured. Clypeal carina distinct, highest medially; carina of vertex

slightly shorter, but well delimited and pronounced. Frons and vertex alutaceous, with a few scattered medium punctures. Pronotum similar to that of male except that the pronotal protuberances are represented by a short arcuate line on each side of midline; elytra similar to those of male. Pygidium a little more shining than in the male. Anterior tibiae thickened and short, nearly straight, crenate above and between the four teeth and lacking the apical pencil of hairs. Last abdominal segment only very slightly narrowed medially, not greatly narrowed as in the male.

TYPE.—USNM 65680.

TYPE LOCALITY.—Prescott, Yavapai Co., Ariz.

SPECIMENS EXAMINED.—29.

DISTRIBUTION.—(See fig. 3, p. 24.)

ARIZONA: Baboquivari Mts., Chiricahua Mts., Payson, Phoenix, Prescott, Sierra Ancha Mts. (Gila Co.), Southwestern Research Station, 5 mi. west of Portal.

REMARKS.—This species is distinguished from the closely allied Mexican species *O. lecontei* Harold by its more shining clypeus and pygidium and by the lack of a definite clypeal carina in the male major. In addition, the range, as far as known, does not overlap, *O. subopacus* being known only from the higher elevations of southeastern Arizona. Howden collected a few specimens by scraping away the ground cover in an area in which cattle and deer had been feeding near Onion Saddle in the Chiricahua Mountains, but none of the specimens taken were associated with animal droppings. L. J. Bottimer trapped some specimens in malt bait cans at the Southwestern Research Station near Portal. This species previously has been incorrectly recorded as *lecontei*, a species known only from Mexico.

Onthophagus subopacus may be separated from other North American species by the finely alutaceous surface; the coarsely punctured pronotum, each puncture overhung anteriorly by a small tubercle with a conspicuous reddish seta at its base; the shining elytral striae; the biserially tuberculate intervals, with the tubercles having reddish setae at their bases; the dorsal opaque black color; the brownish black legs; and the lack of the clypeal carina in the males.

Onthophagus monticolus, new species

PLATE 5, FIGURES 38 AND 39

HOLOTYPE.—Male major, length 6.2 mm., with 3.7 mm. Weakly shining, opaque black. Clypeal margin sharply reflexed anteriorly, feebly so laterally, anterior edge faintly emarginate; clypeal disc with a few coarse punctures scattered completely across its width. Frons with scattered shallow punctures which are much more noticeable

than in males of either *O. alluvius* or *O. knulli*. Clypeal disc and frons almost flat and lacking both clypeal and frontal carinae, the latter being poorly indicated behind eyes; surface between punctures finely alutaceous. Margin of gena noticeably arcuate laterally, anteriorly forming a distinct, obtuse indentation with the clypeal margin; gena sharply, obtusely angulate posteriorly opposite the pronotal angles; surface of gena slightly concave and with scattered coarse punctures.

Pronotum moderately convex, margined anteriorly and laterally; pronotal protuberance a conical median hump, barely projecting over the posterior portion of the head. Surface distinctly alutaceous and with punctures of two sizes: larger punctures annular with margins sharply defined, centrally with an erect reddish-yellow seta, the large punctures usually separated by about two diameters; small secondary punctures half the diameter of large punctures and nearly as numerous, scattered among large punctures; small punctures with sharply delimited margins and lacking central seta. Elytra with feebly shining, vaguely punctate striae; intervals opaquely alutaceous with irregular double rows of small shining tubercles; the base of each tubercle with a fine reddish-yellow seta.

Pygidium with very shallow, coarse, setigerous punctures scattered evenly over surface; entire pygidium except extreme apex opaquely alutaceous; evenly, only slightly convex. All ventral surfaces black except for antennae, tibiae, and tarsi which are tinged with brown. Ventral surfaces of metasternum coarsely punctured, more so laterally; lateral surface between punctures finely alutaceous. Metasternum near midline with a few large punctures and numerous fine ones (metasternum distinctly more punctate near midline than in Texas specimens of *knulli*); midline posteriorly vaguely indented. Ventral segments of abdomen and legs not differing noticeably from those described for holotype of *O. alluvius*, except that the punctures on the femora are larger and more numerous than is usual for *alluvius*.

MALE MINOR.—Paratype, length 4.3 mm., width 2.6 mm. Differing from the holotype male major in the following respects: Clypeus much less sharply reflexed, distinctly emarginate; surface rather evenly, coarsely, rugosely punctate. Clypeal carina lacking; frontal carina low but distinct, slightly indented medially. Gena not greatly produced but still angulate near pronotal angle. Pronotum less convex; pronotal protuberance obsolete, very faintly indicated by a slightly less alutaceous area; pronotal punctures similar but shallower and more widely spaced than in holotype (or other male majors). Elytra and pygidium similar to male majors except that pygidium is alutaceous to apex. Ventral surfaces brownish black, slightly more heavily punctate. Forelegs greatly shortened, the forefemur barely extending to the lateral pronotal margin and the foretibia propor-

tionately shortened and somewhat thickened; both apical conical projection and distinct pencil of hairs lacking.

ALLOTYPE.—Female, length 5.9 mm., width 3.6 mm. Differing from the holotype male major in the following respects: Clypeus slightly reflexed anteriorly, broadly, somewhat angularly emarginate; clypeal disc coarsely, rugosely punctate, the punctures often with brownish-yellow setae; clypeal carina distinct but only slightly, rather evenly, elevated above clypeal-frontal surface. Frons behind carina coarsely punctate; frontal carina low but distinct, generally of uniform height, vaguely indented medially, becoming gradually obsolete laterally; gena scarcely flared, only very obtusely angulate near pronotal angle.

Pronotum less convex, pronotal protuberance indicated by a vague rounded swelling; punctures about the same sizes and density as on the male majors. Elytra and pygidium generally similar to male majors. Ventral surfaces similar to male major except for shortened stubby forelegs; the apex of forefemur barely reaching the lateral pronotal margin; foretibia proportionately shortened; apical projection and pencil of hairs lacking; apical spine as long as the three basal tarsal segments. Last abdominal segment not emarginate, approximately the same width throughout.

TYPE.—Canadian National Collection 7529.

TYPE LOCALITY.—Chipinque Mesa (5400 ft.) near Monterrey, Nuevo León, Mexico.

SPECIMENS EXAMINED.—67.

DISTRIBUTION.—(See fig. 8, p. 64.) Holotype, ♂, and allotype, ♀, Chipinque Mesa (5400 ft.) near Monterrey, Neuvo León, Mexico, Aug. 26–29, 1960, on cow dung, H. F. Howden. And the following paratypes:

MEXICO: NUEVO LEÓN: 24 ♂♂, 24 ♀♀, same data as type (CNC, USNM, Howden). PUEBLA: 7 ♂♂, 8 ♀♀, 6 mi. west of Teziutlán, Aug. 19, 1958, in human dung, H. F. Howden (CNC, USNM).

UNITED STATES: TEXAS: 1 ♂, Boot Springs, Chisos Mts., Big Bend National Pk., 7000 ft, May 18, 1959, in horse dung, H. Howden and E. Becker (CNC).

REMARKS.—As is usual in *Onthophagus*, size range in the species is considerable. Males vary from 4.3 to 6.9 mm. in length and from 2.6 to 3.9 mm. in width. Females vary from 5.2 to 6.5 mm. in length and from 3.2 to 4.0 mm. in width. Specimens are nearly always black, but unworn or teneral specimens have a brownish cast. There is some variation in the size, depth, and spacing of the pronotal punctures. In some specimens the large setigerous punctures are relatively close, being separated by a distance equal to 1 to 2 diameters; in others, from the same locality, the punctures may be separated by a distance equal to 4 to 5 diameters. The margin of the pronotal punctures is usually distinctly depressed, but not infrequently the outer part of the puncture is represented by a shining ring scarcely, if at all, depressed.

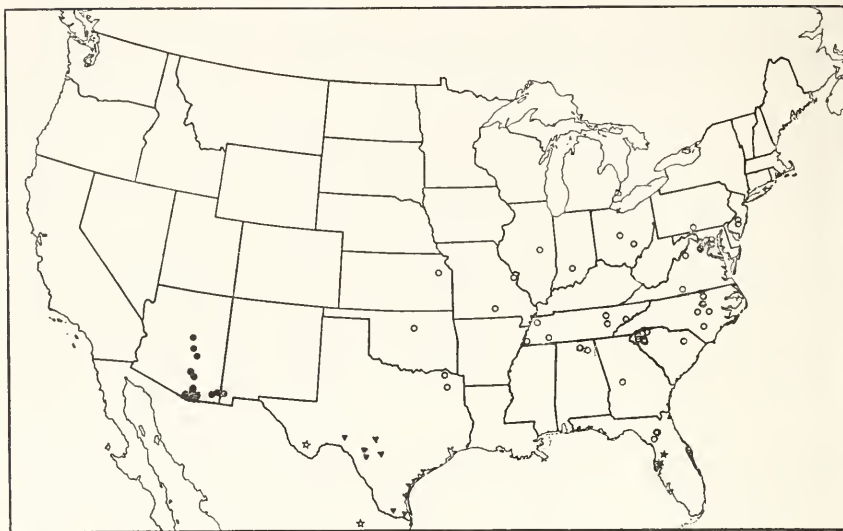


FIGURE 8. Distribution of species of *Onthophagus*:

- | | | | |
|---|---------------------------------|---|--|
| ● | <i>knulli</i> , new species | ○ | <i>subaeneus</i> (Palisot de Beauvois) |
| ▼ | <i>alluvius</i> , new species | ★ | <i>aciculatulus</i> Blatchley |
| ☆ | <i>monticolus</i> , new species | | |

Secondary punctures likewise are occasionally relatively scarce, but this apparent scarcity may be due to abrasion.

Only specimens from the Chisos Mountains of Texas and from the eastern escarpment of the Sierra Madre Oriental in Mexico are included under this species at present. We have examined a Champion specimen, a female, collected at 7800 ft. at Quezaltenango, Guatemala; though very close to *O. monticolus*, the specimen shows some slight differences in the pronotal punctures and the pygidium is quite convex. This Guatemalan form is almost certainly the one called *O. anthracinus* Harold by Bates (1887, p. 77). Even if conspecific with *monticolus* (assuming it is the *anthracinus* of Harold and not referable to *alluvius*), the name *monticolus* will be valid. However, it appears likely that the two forms are not conspecific. More material is needed before the matter can be settled.

O. monticolus can be distinguished by its black color, its well-separated, distinctly margined, often annular setigerous pronotal punctures, small nonsetigerous secondary punctures, pronotal surface dull and alutaceous between punctures, median pronotal protuberance always at least vaguely indicated, and by its tuberculate alutaceous elytra. The pronotal punctures, though quite similar to those of *O. knausi* Brown, are separated by more than 1 diameter; the pronotal surface between the punctures in *knausi* is shining and only minutely

alutaceous, but in *monticolus* is dull. The largely alutaceous, very feebly convex pygidium will separate *monticolus* from *alluvius* or *knulli*.

The adult habits of *monticolus* appear to be nearly identical with those of *alluvius* and *knulli*. All the specimens were taken at elevations over 5000 ft. in mixed deciduous-pine forests. Specimens were taken on cow and horse dung and in human feces. On the Chipinque Mesa near Monterrey, *monticolus* and *alluvius* were taken together in the same pile of dung, this being the only locality where both species were found together. Normally, *O. monticolus* seems to inhabit high elevations with moist cool climate; *alluvius* is largely a lowland form, surviving under hotter, dryer conditions.

Onthophagus alluvius, new species⁴

PLATE 5, FIGURES 36 AND 37

Onthophagus anthracinus Harold, 1873, p. 104 (not Falderman, 1835, p. 247).—Bates, 1887, p. 77.—Schaeffer, 1905, p. 157; 1909, p. 382; 1914, p. 298.—Leng, 1920, p. 249.—Dawson, 1922, p. 179 (misdetermination for *knausi*—fide Brown, in personal communication).—Boucomont and Gillet, 1927, p. 204.—Boucomont, 1932, p. 312.—Lindquist, 1935, p. 7.

HOLOTYPE.—Male major, length 5.8 mm., width 3.4 mm. Weakly shining, opaque black, the elytra with a faint brownish cast. Clypeus sharply reflexed; anteriorly, very feebly, shallowly emarginate. Clypeal disc and frons almost flat and lacking both clypeal and frontal carinae; the frontal carina represented by a small ridge behind each eye; surface very finely alutaceous with scattered fine punctures; scattered coarse punctures present only laterally on clypeus. Edge of gena noticeably arcuate laterally, with its anterior margin forming an obtuse indentation with the clypeal margin, separated from the clypeus by a fine suture; surface of gena with a few scattered coarse punctures. Pronotum moderately convex, margined anteriorly and laterally; pronotal protuberance a slightly flattened cone-shaped median hump, barely projecting over the posterior portion of the head; pronotal surface alutaceous and rather evenly, coarsely punctate; punctures not distinctly annular, separated by approximately 2 to 3 times their diameter, and bearing fine, moderately long setae about half again as long as the distance between punctures; small secondary punctures lacking over most of disc. Elytral striae shining, vaguely punctate; intervals opaquely alutaceous with irregular double rows of small shining tubercles, the base of each tubercle

⁴ *O. alluvius* is described as a new species inasmuch as there is some doubt whether the United States form is conspecific with the form from Guatemala (type locality of *anthracinus* Harold). If the two can be conspecific, *alluvius* will still be the valid name of the species, the name *anthracinus* being preoccupied and no other name being available; the same statement applies if *anthracinus* Harold is conspecific with the closely allied *monticolus*. It seems likely that Bates (1877, p. 77) in his description referred to *monticolus* or a closely allied form.

with a reddish-yellow seta. Pygidium coarsely punctate, the punctures poorly defined basally; basal half altaceous, apical half shining and very convex. Pygidium, abdomen, mesosternum, and metasternum black, prosternum and legs reddish black. Antennal club grayish, tinged with brown. Ventral surfaces of thorax, particularly the metasternum, coarsely punctured, more so laterally than medially, each puncture usually bearing a reddish seta; surface laterally between punctures finely alutaceous; metasternum smoothly shining medially, not indented, posteriorly impunctate except for one or two punctures. Abdominal segments, except first, with a row of setigerous punctures across their base; last segment narrowed medially, emarginate as is typical of genus. Forelegs greatly elongated, the apices of the forefemora extending slightly beyond the pronotal margin; foretibiae proportionately as long, slender, and recurved, with a pronounced projection and a long yellowish pencil of hairs protruding above the apical spine; femora of middle and hind legs with scattered coarse punctures, each puncture bearing a reddish seta.

MALE MINOR.—Paratype, length 5.1 mm., width 2.9 mm. Differing from holotype male major in following respects: Clypeus less sharply reflexed anteriorly, noticeably emarginate, surface coarsely punctate laterally, somewhat rugose; frons with a few coarse punctures and scattered fine ones, somewhat alutaceous; clypeal carina lacking, frontal carina quite pronounced, of rather uniform height, and sharply terminated laterally; gena not as noticeably produced laterally as in male major, but still well-delimited from clypeus.

Pronotum less convex but similar to male major except for pronotal protuberance, which is almost entirely lacking but indicated by a broad, arcuate median line that scarcely protrudes medially over the anterior pronotal margin; reddish-yellow setae present in almost all the pronotal punctures. Elytra and pygidium as described for male major. Ventral surfaces similar to male major. The legs reddish brown with the forelegs greatly shortened, the forefemur barely extending to the lateral pronotal margin and the foretibia proportionately shortened and somewhat thickened; both the conical projection and the yellow pencil of hairs over the apical tibial spine missing.

ALLOTYPE.—Female, length 6.3 mm., width 3.6 mm. Differing from male major in following respects: Clypeus slightly reflexed anteriorly; broadly, somewhat angularly emarginate. Clypeal disc coarsely rugosely punctate, the punctures often with yellowish setae; clypeal carina low, weak but distinct, highest medially; scattered coarse setigerous punctures behind clypeal carina. Frontal carina pronounced, almost twice as high as the clypeal carina, medially of uniform height, laterally becoming gradually obsolete. Gena only slightly flared and broadly arcuate.

Pronotum almost exactly the same as described for the male minor, the arcuate protuberance being slightly more pronounced, but otherwise similar. Elytra as described for male major. Pygidium similar to holotype but with the apex slightly less convex than in male. Ventral surfaces similar to male minor with following exceptions: Forelegs shortened and stubby; apex of forefemur not extending to lateral pronotal margin; foretibia proportionately shortened and thickened, apical spine slender, as long as $2\frac{1}{2}$ tarsal segments and gradually recurved. Last abdominal segment not emarginate at middle.

TYPE.—Canadian National Collection 7527.

TYPE LOCALITY.—Bentsen-Rio Grande State Pk., near Mission, Tex.

SPECIMENS EXAMINED.—281.

DISTRIBUTION.—(See fig. 8, p. 64.) Holotype, ♂, and allotype, ♀, Bentsen-Rio Grande State Pk., near Mission, Tex., June 4, 1954, in dung. H. F. Howden. And the following paratypes:

TEXAS: 12 ♂♂, 14 ♀♀, same data as type (CNC, AMNH, Howden); 5 ♂♂, 6 ♀♀, reared from pair from type locality (Howden); 8 ♂♂, 7 ♀♀, type locality, Sept. 28, 1951, O. L. Cartwright and A. B. Gurney (USNM); 1 ♂, 2 ♀♀, Brownsville, May 10 (CNC, OSU); 1 ♀, Brownsville, Apr. 12–May 20 (CNC); 2 ♂♂, Brownsville, Nov. 21, 1911, palm jungle, human dung (CNC); 1 ♀, Brownsville, Feb. 7, 1948, L. J. Bottimer (LJB); 4 ♂♂, 6 ♀♀, Brownsville, Esperanza ranch, May 1–29 (USNM, AMNH); 2 ♀♀, Brownsville, June 1901 (Schaeffer coll., USNM); 1 ♀, Brownsville, July 30, 1906, A. B. Wolcott (CNHM); 1 ♂, Cameron Co. (USNM); 7 ♂♂, 3 ♀♀, Camp Stanley, Bexar Co., Apr. 2, 1953, in horse dung, L. J. Bottimer (USNM); 1 ♂, 1 ♀, Devils River, May 5, 1907, F. C. Bishopp (USNM); 8 ♀♀, 25 ♀♀, Garner State Pk., Sept. 22, 1951, in cow dung, O. L. Cartwright and L. J. Bottimer (USNM, LJB); 70 ♂♂, 57 ♀♀, Kerrville, June 25, 1956, cow dung, L. J. Bottimer (USNM, LJB); 9 ♂♂, 15 ♀♀, Kerrville, July 22, 1956, in deer dung, H. and A. Howden (Howden); 5 ♂♂, 7 ♀♀, Kerrville, Apr. 4, 1959, Becker and Howden (CNC); 1 ♂, Kerrville, May 5, 1955, in flight, L. J. Bottimer (LJB); 1 ♂, Kerrville, Apr. 10, 1951, deer droppings, L. J. Bottimer (LJB); 1 ♀, Kerrville, Sept. 20, 1951, horse dung, L. J. Bottimer (LJB); 1 ♀, Kerrville, July 30, 1948, dead on carass, L. J. Bottimer (LJB); 1 ♂, Kerrville, May 23, 1947, L. J. Bottimer (LJB); 1 ♂, Maedona, July 28, H. A. Wenzel (OSU); 2 ♂♂, 4 ♀♀, Mission, Oct. 1, 1951, O. L. Cartwright (USNM); 1 ♀, San Antonio, Sept. 24, 1951, O. L. Cartwright and A. B. Gurney (USNM); 2 ♂♂, 1 ♀, southwest Hidalgo Co., Jan. 26, 1947, at raccoon(?) dung, G. B. Vogt (Vogt); 1 ♂, 1 ♀, Uvalde, June 30, 1936, J. N. Knull (OSU, USNM); 11 ♂♂, 7 ♀♀, Uvalde, Dec. 1920, J. C. Bridwell (USNM); 3 ♂♂, 2 ♀♀, Uvalde, May 29, July 18, 22, 29, August, 1932, A. W. Lindquist (USNM, CNC); 1 ♂, Uvalde Co., May 20, 1938, J. H. Robinson (Howden).

MEXICO: SAN LUIS POTOSÍ: 1 ♀, Valles, Aug. 29, 1936, E. D. Ball (UA). NUEVO LEÓN: 7 ♂♂, 12 ♀♀, Chipinque Mesa (5400 ft.) near Monterrey, Aug. 26–29, 1960, H. F. Howden (CNC); 1 ♂, 7 ♀♀, 2 mi. west of Linares, Nov. 8, 1946, E. S. Ross (CAS); 2 ♂♂, 3 ♀♀, Monterrey, July 24, 1960, cow dung, H. F. Howden (CNC). TAMAULIPAS: 14 ♂♂, 5 ♀♀, crest of first ridge west of Antiquo Morelos, Nov. 18, 1948, H. B. Leech (CAS, Howden); 1 ♀, 47 km. south of Ciudad Victoria, July 5, 1948, W. Nutting (USNM); 1 ♀, 20 mi. north of El Limón, Nov. 10, 1946, Ross (Howden).

REMARKS.—Variation in the series available occurs mainly in size. Males vary from 4.5 to 7.1 mm. in length and from 2.9 to 3.9 mm. in width; females vary from 4.8 to 6.8 mm. in length and from 2.9 to 3.8 mm. in width. Color also shows some variation, for though the majority of specimens are black, a few specimens are distinctly brownish (teneral); rarely specimens have the elytral umbones and apices spotted light brown. Pronotal punctures vary somewhat in density and occasionally appear faintly annulate. However, the margin of the puncture is normally not distinct, and small nonsetigerous secondary punctures are rare.

O. alluvius is closely related to *O. knulli* and *O. monticolus*. It can be distinguished from the allopatric *knulli* by its nearly impunctate posterior median portion of the metasternum and by its more convex pygidium. In addition, *O. alluvius* averages larger in size (about 5 to 6 mm.), is usually a more shining black, and has less obvious dorsal setae than does *knulli*. *O. alluvius* can be distinguished from the partially sympatric *monticolus* by the general lack of small secondary punctures on the pronotum and by the punctate shining, distinctly convex apex of the pygidium. *O. alluvius* can be separated from other species of *Onthophagus* by the dully shining black color, the well-separated pronotal punctures, the median pronotal protuberance which is at least vaguely evident in both males and females, and the elytral intervals with their two irregular rows of small tubercles and alutaceous surface.

For some time during the course of this revision we considered *O. alluvius* and *O. knulli* one species. Small specimens of *alluvius* have the more pronounced dorsal setae that are usual in *knulli* (which is always smaller). The relative rarity of well-developed males in *knulli* perhaps indicates survival under marginal conditions. However, as more and more material was accumulated during the course of this work, a constant morphological difference in the metasternum became apparent; this difference coupled with the lesser differences in the pygidium, the average size-difference, and the allopatric distribution made us conclude that two species are represented. *O. alluvius* is apparently largely limited to the lowland regions of eastern Texas and eastern Mexico, being particularly common in alluvial areas; *knulli* occurs in the mountainous regions of southern Arizona.

The habits of *O. alluvius* seem to be quite similar to those of *O. texanus*. Specimens were most frequently found in cow dung in wooded areas.

Lindquist (1935, p. 7) stated (under the name *anthracinus*) that Texas specimens—

* * * are found in dung from March to December, and a hundred or more have been counted in a single dropping. A burrow is dug vertically into ground

to a depth of 1 to 4 inches and dung is transported into the lower extremity, where it is fashioned into a crude ball in which an egg is laid.

Reared females have deposited from 43 to 67 eggs over periods of 22 to 42 days. Only 1 or 2 eggs are laid daily, and these average 1.56 by 0.74 mm. in diameter. The average developmental period from egg to adult in summer was 38.4 days, with a range of 36 to 52 days. Notes on the number of instars are not complete, but indications are that there are three.

Specimens of *O. alluvius* collected near Brownsville, Tex., brought back to Knoxville, Tenn., and reared in soil-filled flower pots, followed closely the pattern described by Lindquist. The adults made shallow 1- to 8-inch burrows around and under fresh cow droppings. The brood cells averaged 12 mm. in length by 7 mm. in width and contained a cavity in their upper end in which the elongate whitish egg was laid. Each female formed 20 to 40 cells, the number limited perhaps by crowding. Development was very rapid, each of the 3 instars lasting 7 to 9 days with a pupal period of 5 to 7 days. Total developmental time in the flower pots was 35 to 36 days, approximately the developmental time as given by Lindquist.

Onthophagus knulli, new species

PLATE 5, FIGURES 34 AND 35

Onthophagus anthracinus Harold 1873, p. 104 (not Falderman, 1835, p. 247).—Schaeffer, 1905, p. 157; 1914, p. 298 (in part).—Leng 1920, p. 249 (in part).

HOLOTYPE.—Male major, length 5.1 mm., width 3.2 mm. Opaque black, with a slight brownish cast on head and pronotum. Clypeal margin sharply reflexed anteriorly only, edge faintly emarginate; clypeal disc and frons nearly flat, a few coarse punctures near their lateral edges; posterior portion of clypeus and remainder of head distinctly alutaceous, minute secondary punctures present; all carinae absent except for slight ridges behind eyes; genae not greatly expanded, edges arcuate, anteriorly forming a very oblique indentation with clypeal edges.

Pronotum moderately convex; punctures, setae, margins, and protuberance nearly identical to that of male major of *O. alluvius*. The setae slightly more pronounced, punctures very slightly closer, and surface between somewhat more alutaceous; small secondary punctures largely lacking and the large punctures not distinctly annular. Elytra with feebly shining, very vaguely punctate striae; intervals opaquely alutaceous with somewhat irregular, double rows of small shining tubercles, the base of each tubercle with a fine reddish-yellow seta. The rows of tubercles are much more regular and the tubercles are more numerous than in either *alluvius* or *monticolus*.

Pygidium alutaceous basally, shining apically, apical half slightly convex and distinctly, deeply punctate. Ventral surfaces shining

black to brownish black, antennal club grayish brown. Metasternum as coarsely punctured near midline as laterally; narrow band at midline impunctate and faintly indented posteriorly. The metasternal punctures medially larger and twice as numerous as in *alluvius*, and slightly larger and more numerous than in *monticola*. Ventral segments of abdomen and legs not differing noticeably from those described for the holotype of *alluvius*.

MALE MINOR.—Paratype, length 4.1 mm.; width 2.6 mm. Differing from the holotype male major in the following respects: Clypeus shallowly reflexed anteriorly, less so laterally, somewhat more distinctly emarginate; clypeal disc and frons with more numerous, evenly distributed, coarse, setigerous punctures; clypeal carina lacking; frontal carina low but distinct, very slightly indented medially; gena scarcely produced, edge arcuate. Pronotum less convex, pronotal protuberance obsolete, indicated by a faint bulge in the median convexity of the pronotum; punctures somewhat more distinctly margined and more closely spaced. Elytra with rows of tubercles on elytra somewhat more irregular, the tubercles still more numerous than in *alluvius* or *monticolus*. Ventral surfaces similar to type but slightly more heavily punctate on metasternum. Forelegs greatly shortened, the forefemora barely extending to the lateral pronotal margin and the foretibia proportionately shortened and somewhat thickened; both apical conical projection and distinct pencil of hairs lacking.

ALLOTYPE.—Female, length 4.5 mm., width 2.7 mm. Differing from the holotype male major in the following respects: Clypeus shallowly reflexed anteriorly and laterally, somewhat angularly emarginate anteriorly; clypeal disc closely, coarsely, rugosely, setigerously punctate; clypeal carina distinct but only slightly, rather evenly elevated above clypeal-frontal surface; frons behind carina with scattered coarse and fine punctures; frontal carina low but distinct, generally of uniform height, not indented medially, rounded off laterally to surface of vertex; gena scarcely flared, lateral edge arcuate.

Pronotum less convex, pronotal protuberance vaguely indicated by a rounded swelling; size and density of punctures similar to those of the male minor. Elytral intervals with double row of tubercles very irregular; number of tubercles noticeably fewer when compared to either male major or minor. Pygidium and ventral surfaces similar to male major except for shortened, stubby forelegs; the apex of forefemur barely reaching to the lateral pronotal margin; foretibia proportionately shortened, apical projection and pencil of hairs lacking, apical spine as long as the three basal tarsal segments. Last abdominal segment not emarginate at middle.

TYPE.—Canadian National Collection 7528.

TYPE LOCALITY.—5 mi. west of Portal, Ariz. (on the grounds of the Southwestern Research Station of the American Museum).

SPECIMENS EXAMINED.—210.

DISTRIBUTION.—(See fig. 8, p. 64.) Holotype, ♂, Southwestern Research Station, Portal, Ariz., Sept. 1, 1960, on carrion, H. F. Howden. Allotype ♀, same data as type except collected on Sept. 7, 1960 (cnc). And the following paratypes:

ARIZONA: 6 ♂♂, 2 ♀♀, same data as type or allotype (cnc); 1 ♀, Portal, Sept. 13, 1957, W. Rosenberg (WR); 2 ♀♀, 5 mi. from Portal, Sept. 31, 1957, W. Rosenberg (WR); 1 ♀, Southwestern Research Station, Portal, July 7, 1961, B. Benesh (BB); 4 ♀♀, Southwestern Research Station, July 30, 1961, deer droppings, L. J. Bottimer (LJB); 1 ♂, 2 ♀♀, Southwestern Research Station, Aug. 2, 1961, cow dung, L. J. Bottimer (LJB); 3 ♂♂, 5 ♀♀, Southwestern Research Station, Aug. 4, 1961, cow dung, L. J. Bottimer (LJB); 2 ♂♂, base of Pinal Mts., June 19, July 12, 1925, D. K. Duncan (USNM, Duncan); 1 ♂, 1 ♀, Canelo, July 10, 1957, Aug. 3, 1956, G. D. Butler (UA); 3 ♂♂, Chiricahua Mts., D. K. Duncan (CAS, USNM); 5 ♂♂, 6 ♀♀, Chiricahua Mts., July 15, 17, 29, 30, 1959, D. J. and J. N. Knull (OSU); 10 ♂♂, 13 ♀♀, Duquesne, Sept. 27, 1956, L. J. Bottimer (LJB); 1 ♂, 1 ♀, Globe (USNM, cnc); 1 ♂, 3 ♀♀, Huachuca Mts. (Cochise Co.), July 12, August 1905 (cnc, USNM); 1 ♂, 2 ♀♀, Huachuca Mts., July 25, 1905 (Schaeffer coll. USNM); 1 ♂, Huachuca Mts., July 1936, E. S. Ross (CAS); 2 ♀♀, Huachuca Mts., Aug. 19, 1950, D. J. and J. N. Knull (OSU); 3 ♂♂, 3 ♀♀, Huachuca Mts., Sept. 11, 1928, E. R. Leach (Carnegie); 9 ♂♂, 17 ♀♀, Huachuca Mts., Sept. 11, 1928, Nunenmacher (CNHM, Howden); 1 ♀, Huachuca Mts., floor of Carr Canyon (5400 ft.), Aug. 7, 1952, Leech and Green (Howden); 2 ♂♂, Madera Canyon, Santa Rita Mts., Sept. 27, 1952, Norman Lewis (Edwards); 1 ♂, 1 ♀, Nogales, Santa Cruz Co., Aug. 17, 1906, F. W. Nunenmacher (CAS, USNM); 1 ♂, 1 ♀, Nogales (6000 ft.), Mt. Washington, July 11, 16, 1919, J. A. Kusche (CAS); 9 ♂♂, 5 ♀♀, Oracle, July 1, 2, 1936, E. S. Ross (CAS, Howden); 1 ♀, Oracle, June 30, 1936, M. Cazier (AMNH); 1 ♀, 14 mi. east of Oracle, July 25, 1924, J. O. Martin (CAS); 1 ♂, Palmerlee, Miller Canyon, July 21, 1907, H. A. Kaerber (cnc); 6 ♂♂, 10 ♀♀, Palmerlee, July 1, 10, 11, 12, 16, 21, 27, Plains, H. A. Wenzel (OSU, USNM, Howden); 3 ♂♂, 1 ♀, Patagonia, Aug. 21, 1940 (USNM); 1 ♂, Patagonia, Sept. 17, 1952, B. Malkin (Malkin); 1 ♂, Patagonia, July 10, 1936, E. S. Ross (CAS); 1 ♂, Patagonia, Aug. 2, 1924, J. O. Martin (CAS); 3 ♂♂, 2 ♀♀, Patagonia, July 6, 1936, Dazier (AMNH); 4 ♂♂, 4 ♀♀, Patagonia, July 21, 1940, F. W. Nunenmacher (CNHM); 1 ♂, Payson, August 1930 (Saylor coll., CAS); 1 ♂, Pepper Sauce Canyon, Santa Catalina Mts., Aug. 14, 1940, E. S. Ross (CAS); 3 ♂♂, Pepper Sauce Canyon, Santa Catalina Mts., Aug. 17, 1924, J. O. Martin (CAS); 1 ♂, Pinal Mts., Gila Co., July 12, 1925, D. K. Duncan (USNM); 1 ♂, Prescott (Schaeffer coll., USNM); 2 ♂♂, 2 ♀♀, Ramsey Canyon, Huachuca Mts., W. H. Mann (USNM); 9 ♂♂, 5 ♀♀, Sierra Ancha Mts., Gila Co., August–September 1930, Duncan (CAS, cnc, USNM, Duncan, Parker); 2 ♂♂, 1 ♀, Southwestern Research Station, Portal, June 29, July 1, 10, 1956, on carrion, H. and A. Howden (Howden); 1 ♂, Southwestern Research Station, Portal, reared to adult on Aug. 2, 1956, on cow dung, H. and A. Howden (Howden); 1 ♂, Sycamore Canyon, Ruby, Sept. 26, 1953, G. D. Butler (UA); 1 ♂, Yanks Spring, 4 mi. southeast of Ruby, Pajaritos Mts., Santa Cruz Co. (4000 ft.), Sept. 5, 1950, Gertsch and Cazier (AMNH). NEW MEXICO: 1 ♂, 3 ♀♀, Rodeo, Sept. 2, 1957, W. Rosenberg (WR).

REMARKS.—Variation in *O. knulli*, as in *O. alluvius*, occurs mostly in size and color. Males vary from 4.0 to 5.5 mm. in length and from 2.5 to 3.2 mm. in width; females vary from 3.4 to 5.9 mm. in length and from 2.3 to 3.3 mm. in width. Color ranges from a dull black, with an indistinct brownish cast, to a dark brown. Not infrequently the elytral umbone and often the elytral apices are somewhat lighter in color, so that rarely the elytra have a vague spotted appearance. Some variation occurs in the density of punctures and elytral tubercles, but no great variation was noted. Pronotal punctures are usually vaguely ringed, but frequently the outer margin is obscure and the punctures are in these cases identical to those of *alluvius*.

Onthophagus knulli is very closely related to *alluvius* and slightly less so to *monticolus*. The large distinct punctures near the posterior midline of the metasternum readily distinguish *knulli*, and the small size which averages between 4 and 5 mm. is normally less than either of the related species. The lack of nonsetigerous small secondary punctures on the pronotum of *knulli* will separate it from *monticolus*. In addition, the distribution of *knulli* is apparently quite distinct from that of the related forms, *knulli* being known only from the mountains in southern Arizona. *O. knulli* can be distinguished from the other species of *Onthophagus* by its opaquely alutaceous, blackish, dorsal surface, well-separated, setigerous, nonannular pronotal punctures, anterior median pronotal protuberance which is always at least vaguely indicated in both sexes, small size, and western range.

The habits of *knulli* are similar to all the general dung feeders. Specimens occur not only under cow and horse dung, but are common at carrion of various vertebrates. Most of the specimens collected by us were taken in the lower elevations of the Chiricahua Mountains between 5000 and 6000 ft. in areas where oaks or other broad-leaved trees furnished appreciable shade. Some specimens were reared in flower pots at the Southwestern Research Station of the American Museum, and though not closely observed, the general developmental picture did not seem to differ appreciably from that described for *alluvius*.

This species is named in honor of J. N. Knull, who started us on this study by submitting for determination two very small specimens of this species.

Onthophagus subaeneus (Palisot de Beauvois)

PLATE 6, FIGURES 54 AND 55

Copris subaeneus Palisot de Beauvois, 1811, p. 105.

Onthophagus subaeneus (Palisot de Beauvois) Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Crotch, 1874, p. 57. (See *concinus* Laporte, pp. 108 and 112, for discussion of *subaeneus* of other authors.)

Onthophagus cribricollis Horn, 1881, p. 76 (new synonymy).—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 920.—Schaeffer, 1914, p. 297.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 205.—Leonard, 1928, p. 418.—Sim, 1930, p. 141.—Boucomont, 1932, p. 313.—Cartwright, 1934, p. 238.—Brimley, 1938, p. 199.

MALE MAJORS.—Length 4.2 to 4.8 mm., width 2.4 mm. to 2.7 mm. Head and pronotum shining, dark, iridescent cupreous to green; elytra dully shining, black with cupreous or green cast. Clypeus abruptly reflexed anteriorly, margin broadly emarginate anteriorly, sharply angulate on each side of the emargination, often appearing bidentate; lateral margins obtusely arcuate, often forming a nearly straight edge with the margin of the gena, which curves inward rather abruptly near the eyes; disc with scattered, coarse punctures which are larger laterally, central portions of clypeus and frons forming a low convexity, clypeal carina usually obsolete, occasionally indicated by two small, transverse tubercles, one on either side of the median line. Frons coarsely, often setigerously punctate; carina of vertex obsolete, the surface of the vertex nearly impunctate, smooth and shining; a few scattered punctures near the eyes; genae heavily punctate.

Pronotum completely margined, the anterior angles acute and sharply rounded; lateral margins sharply arcuate at the middle, nearly straight before and behind, only moderately convex with a small rounded conical projection basally no wider than the clypeal emargination, scarcely extending over the pronotal margin; disc of pronotum covered with large, conspicuous, setigerous punctures which are seldom separated by more than 2 diameters, those near the anterior angles and pronotal projection having small tubercles overhanging their forward margins. Elytra with shallowly punctate striae; the intervals, except for the sutural one, generally biserially tuberculate; at the base of each tubercle a minute puncture bearing a conspicuous, whitish seta; surface of the intervals between the tubercles shining, very finely alutaceous.

Pygidium with rather evenly distributed, large, shallow punctures bearing long, whitish setae; the impunctate areas smooth, shining, cupreous green. Ventral surfaces smooth and shining with iridescent reflections. Metasternum with coarse, setigerous punctures similar to those on the pygidium; the punctures small medially; the median line either absent or impressed in the posterior half of the metasternum. Abdominal segments with a basal row of setigerous punctures, last segment emarginate to receive the pygidium. Legs with all the femora coarsely punctate and longer than in the females, the fore-femora extending beyond the lateral pronotal margin; foretibia slightly longer than the femur, thin and bent inwardly in the anterior half,

outer margin quadridentate, with the margin above and between the teeth serrate or denticulate, a small pencil of hairs beside the apical spine.

MALE MINORS.—Length 3.3 to 4.2 mm., width 2.0 to 2.4 mm. Differing from the male majors in the following respects: Clypeus not as extended or as reflexed anteriorly, still emarginate and bidentate; disc more coarsely, heavily, setigerously punctate; clypeal carina pronounced, straight, its length usually not more than the width of the anterior clypeal emargination; frons and genae coarsely punctate as on the clypeus; carina of vertex evident, but no higher than clypeal carina, very broadly V- or U-shaped, the terminal portions directed anteriorly and very slightly raised, scattered coarse punctures behind the carina.

Pronotum with anterior angles less acute than in male major, anterior projection obsolete or vaguely indicated; punctures larger, anteriorly lacking the overhanging tubercle, but with long, conspicuous, whitish setae; posterior margins often less distinct than in male majors. Elytra essentially similar but with smaller tubercles on the intervals, the setae slightly longer in the male minors.

Pygidium and ventral surfaces with somewhat more pronounced punctures but generally similar to the male major except for the legs. In the male minor the legs not lengthened, being very similar to those of the females; the forefemur not extending to the pronotal margin and the foretibia reduced similarly, broader, and not bent in apical half.

FEMALES.—Length 3.4 to 5 mm., width 1.9 to 2.6 mm. Differing from the male majors in almost the same respects as the male minors. Clypeus broadly emarginate, bidentate, and scarcely reflexed anteriorly; its surface and that of the frons and genae coarsely, setigerously punctate; clypeal carina as described for male minor but often slightly longer; carina of vertex usually slightly higher than clypeal carina, broadly U- or V-shaped with the lateral terminations slightly raised, vertex behind the carina with scattered coarse punctures.

Pronotum less convex and more heavily punctate than in male majors, each puncture bearing a long, whitish seta and the anterior punctures often having a small tubercle on their forward margins; pronotal projection only faintly indicated by an anterior, scarcely noticeable median swelling adjacent to the margin. Elytra similar to those of males but with the setae and tubercles of the intervals more pronounced. Pygidium convex, coarsely punctate with conspicuous setae. Ventral setae and punctures pronounced, the smooth surfaces with the iridescent color often less than in the males. Last abdominal segment not narrowed medially. Legs not greatly elongated, the forefemora not extending to the lateral pronotal margins; the foretibia

short, stubby, quadridentate, not bent in apical half, and lacking the pencil of hairs often present near the tibial spine in the male majors.

TYPE.—Of *subaeneus*: Unknown to us. Of *cribricollis* Horn: Lectotype, present designation, labelled "Tex," in the Philadelphia Academy of Natural Sciences, Type 3571. The lectotype is an extremely small brownish castaneous specimen with a faint greenish lustre. Length $3\frac{1}{2}$ mm. The USNM collection contains a specimen from Plummers Id., Maryland, which duplicates the size and color of the lectotype.

TYPE LOCALITY.—Of *subaeneus*: United States. Of *cribricollis*: Texas.

SPECIMENS EXAMINED.—261.

DISTRIBUTION.—(See fig. 8, p. 64.)

ALABAMA: De Soto State Pk., Monte Sano State Pk. DISTRICT OF COLUMBIA. FLORIDA: Levy Co., Gainesville. GEORGIA: Barnesville. ILLINOIS: White Heath, St. Claire Co. INDIANA: Lawrence Co. KANSAS: Lawrence. MARYLAND: Beltsville, Bladensburg, Plummers Id. MISSOURI: Mountain Grove, St. Louis. NEW JERSEY: Buddtown, Lakehurst, Mt. Misery, Pemberton, Rancocas Park. NORTH CAROLINA: Franklin Co., Halifax Co., Raleigh, Sampson Co., Wilson Co. OHIO: Hocking Co., Columbus. OKLAHOMA: Payne Co., Stillwater. PENNSYLVANIA: Williamson. SOUTH CAROLINA: Cashiers Valley Rd. (Oconee Co.), Clemson, Florence, Jocassee, Liberty, Rocky Bottom (Pickens Co.), Walhalla. TENNESSEE: Burrville, Chester Co., Great Smoky Mtn. Nat. Pk., Memphis, Roane Co. TEXAS: Jacksonville, Paris. VIRGINIA: Basye, Chatham, Clifton, Falls Church.

REMARKS.—This small iridescent species, never commonly collected but having an extended range, can be distinguished from other North American *Onthophagus* by its broadly emarginate bidentate clypeus, its completely margined pronotum which is conspicuously punctate, the long, whitish setae present dorsally and ventrally, the small, median conical protuberance near the anterior pronotal margin in male majors, and by the carinae of the head in male minors and females.

Brown (1926) found *O. subaeneus (cribricollis)* in moist woodlands and postulated that the species might feed on decaying organic matter on the floor of woodlands. It was collected by sifting debris from the ground in a moist woods. It has been taken frequently in early spring (February) at Florence, S. C., in sifting woods trash for hibernating boll weevils. It has also been taken at fungi, at carrion, under the dung of various animals, and even "under chicken manure." Some specimens have been taken in malt or malt and propionic acid traps.

The most comprehensive study of *subaeneus (cribricollis)* was done in New Jersey by Sim (1930, p. 141) who stated:

My own records began with June 25, 1926, when one was found under a rabbit pellet in the small pine Barren at Rancocas Park, five miles from Mount Holly.

Between that date and July 9, seventy specimens were collected under rabbit droppings in the same place; twenty-seven being taken on July 4. In 1927, fifty were collected in the same locality, all within an area one-eighth mile in diameter. The best days were July 20 and 21, on each of which twelve of the beetles were collected. All specimens were taken at rabbit pellets. Thus two seasons' collecting resulted in 120 specimens. The beetles were most active on warm sunny days after showers, and practically all were found between 9 A.M. and noon. None was ever observed on the wing in the afternoon or on a cloudy morning. As in all species of *Onthophagus* whose habits are known to me, *cribricollis* buries its food where found and sinks it vertically to a depth of a few inches, where the subsequent grub lives in a double walled plaster cell of its own manufacture. The entire metamorphosis was found to require about one month. As in other species, this beetle probably overwinters as a hibernating adult buried singly at a depth of several inches.

It seems odd that the name *subaeneus* (Palisot de Beauvois) could ever have been used for the species at times called *O. protensus* Melsheimer and here recognized as *O. concinnus* Laporte. The original description of *subaeneus* (Palisot de Beauvois) details several major differences, and the illustration is completely at variance with *concinnus* Laporte. The latter is a larger, brightly shining, bicolored green and yellow, strongly tuberculate species having in the male a flat, somewhat bifurcate pronotal projection and median upturned clypeal process, whereas *subaeneus* (Palisot de Beauvois) is punctate, unicolorous, moderately shining, black with cupreous or greenish cast, and has in the male a short conical pronotal protuberance and bidentate clypeus. The illustration accompanying the original description of *subaeneus* shows a figure with bidentate clypeus and no evidence of bicolored elytra. The size of the species is indicated and measures 4 mm.

Onthophagus knausi Brown

PLATE 6, FIGURES 56 AND 57

Onthophagus knausi Brown, 1927, p. 130.—Boucumont, 1932, p. 312.—Leng and Mutchler, 1933, p. 38.

Onthophagus anthracinus Dawson, p. 73 (not Harold, 1873, p. 911).

MALE MAJORS.—Length 4.3 to 4.9 mm., width 2.4 to 2.6 mm. Black, moderately shining, sometimes with cupreous reflections on head and pronotum; elytra opaque to weakly shining; ventral surfaces piceous, legs usually slightly lighter in color. Head with clypeus sharply reflexed anteriorly, poorly so laterally, reflexed portion distinctly emarginate, angulate laterally, giving clypeus a bidentate appearance; disc of clypeus flat with scattered coarse setigerous punctures, clypeal carina absent, posterior portion of clypeus and anterior of frons slightly tumid, frons finely alutaceous and coarsely, moderately punctate; vertex lacking carina, alutaceous with scattered

punctures; gena with margin abruptly rounded before the eye, surface alutaceous with a few scattered, setigerous punctures.

Pronotum margined anteriorly, laterally, and indistinctly so basally; anterior angles abruptly rounded; quite strongly convex with small, rounded, cone-shaped anterior, median protuberance overhanging margin, its base usually slightly wider than clypeal emargination. Disc shallowly, densely punctate; the punctures separated by less than 1 diameter, varying in size, annular in appearance, with the larger punctures each bearing a distinct seta in the center; surface between punctures very finely alutaceous, becoming more noticeably so near the median posterior margin. Elytra with shining, very shallow, irregularly punctate striae; intervals irregularly, biserially tuberculate, the second, third, fourth, and fifth often apparently having only single rows; each tubercle with a fine, reddish seta at posterior edge; surface of intervals between the tubercles very noticeably alutaceous.

Pygidium only convex apically, shallowly, setigerously punctate; surface alutaceous basally, becoming smooth and shining at the apex. Ventral surface of thorax and abdomen between setigerous punctures smooth medially, alutaceous laterally. Abdominal segments setigerously punctate along basal margin, punctures sometimes obsolete medially; last segment emarginate medially to receive the pygidium. Forelegs elongate, the femora extending at least as far as the lateral pronotal margins; tibia likewise lengthened, bent in apical third, outer margin quadridentate, serrate or denticulate between and above the teeth, apex with a single or bidentate projection above the apical spur and with a small, yellow pencil of hairs usually present. Femora of all legs moderately, coarsely, setigerously punctate.

MALE MINORS.—Length 3.6 to 4.2 mm., width 2.0 to 2.3 mm. Differing from male majors in the following respects: Head with clypeus shallowly reflexed anteriorly, broadly emarginate, laterally less distinctly angulate; disc of clypeus coarsely, closely punctate; clypeal carina still obsolete; frons and genae similar to those described for male majors. Vertex with a low, poorly delimited carina which is highest laterally, bent posteriorly, and depressed medially; alutaceous and with scattered, coarse punctures behind carina.

Pronotum similar to male majors except that the protuberance is only faintly indicated by a rounded, anterior swelling. Elytra and pygidium not significantly different. Ventral surfaces not noticeably differing from the male majors. Forelegs not greatly lengthened, the femora not reaching the lateral pronotal margins, the foretibiae slender, but not greatly lengthened, the conical projections and pencil of hairs usually reduced or lacking.

FEMALES.—Length 3.5 to 5 mm., width 2.3 to 2.7 mm. Differing from male majors in the following respects: Head with clypeus scarcely reflexed anteriorly, not at all laterally; clypeus anteriorly emarginate with the emargination laterally sharply delimited by abrupt angulations giving clypeus a bidentate appearance; disc coarsely, rugosely punctate; clypeal carina present but not very strong, highest medially. Frons and genae coarsely setigerously punctate; vertex with low, transverse carina complete, depressed, and bent posteriorly at the midline; surface behind carina alutaceous and bearing a few coarse, setigerous punctures.

Pronotum less convex than in male majors, the anterior pronotal protuberance obsolete, otherwise similar. Elytra with tubercles, setae, and alutaceous sculpture usually more pronounced than in the males. Pygidium less convex apically, punctures more pronounced. Ventral surfaces with punctures and setae often more obvious than in males. Last abdominal segment not narrowed medially. Forelegs not lengthened, femora not reaching lateral pronotal margins. Foretibia short, rather stocky, with the four teeth pronounced; outer margin denticulate or serrate between and above the teeth; tibial apex lacking conical projection and pencil of hairs. Legs in other respects similar to those of males.

TYPE.—Canadian National Collection 2461.

TYPE LOCALITY.—Morris Co., Kansas.

SPECIMENS EXAMINED.—60.

DISTRIBUTION.—(See fig. 5, p. 37.)

ILLINOIS: White Heath. KANSAS: Douglas Co., Lawrence, Morris Co., Topeka. NEBRASKA: Bennet, Omaha. TEXAS: Abilene, Austin, Camp Stanley (Bexar Co.), Dallas, Garner State Pk., Kerrville, Kott ranch (Gillespie Co.).

REMARKS.—*Onthophagus knausi* is easily distinguished from species occurring north of Mexico by its small size, emarginate clypeus, densely annularly punctate pronotum, and irregularly biserially tuberculate, opaquely alutaceous elytral intervals. A Central American species, *O. digitifer* Boucomont, is similar to *knausi* but is even smaller and has a more densely punctate pronotum and more conspicuous elytral setae.

Little is known concerning the life history of *O. knausi*, which is a relatively rare species ranging from Illinois and Nebraska to south-central Texas. L. J. Bottimer has taken a number of specimens in the vicinity of Kerrville, Tex., on deer droppings and more rarely on other types of dung. Many of the specimens were taken in April. Nothing is known concerning food utilized by the larvae.

Onthophagus aciculatulus Blatchley

PLATE 9, FIGURES 83 AND 84

Onthophagus aciculatulus Blatchley, 1928, p. 128.—Blackwelder and Blackwelder, 1948, p. 30.

Onthophagus alutaceus Blatchley, 1919, p. 31 (not Wiedemann, 1823, p. 14).—Leng and Mutchler, 1927, p. 38.—Blackwelder and Blackwelder, 1948, p. 30.

Onthophagus aciculatus Leng and Mutchler, 1933, p. 38.—Blackwelder and Blackwelder, 1948, p. 30.

MALES.—Length 3.8 to 4.5 mm., width 2.5 to 2.6 mm. Black, moderately shining; legs dark piceous. Clypeus moderately reflexed anteriorly, edge flat laterally; widely shallowly emarginate anteriorly, weakly dentate or angulate each side of the emargination, lateral margins only slightly arcuate, nearly straight; genae finely, slightly reflexed, widely rounded, not prominent. Entire surface of head very finely alutaceous; clypeus and genae tuberculate-punctate, the small, fine tubercles grouped in short transverse rows and the accompanying punctures bearing short, inconspicuous setae; clypeal carina absent; frons smoother than clypeus but with scattered shallow punctures separated by 2 to 3 or more diameters, their accompanying tubercles inconspicuous; frontal carina represented by two widely separated, elongated, very noticeable tubercles; punctures of vertex as on frons; eyes quite large and wide, twice as long as wide, about 7 facets wide.

Pronotum finely, completely margined; anteriorly with a small, median, conical protuberance. Surface of pronotum rather coarsely, setigerously tuberculate-punctate over anterior third, more noticeably so over declivity, elsewhere with simple shallow setigerous punctures; the punctures evenly distributed, everywhere separated by about 1 diameter. Setae fine, slightly longer than distance between punctures, surface between punctures finely alutaceous. Elytral striae fine, strial punctures shallow, not conspicuous; intervals flat, alutaceous, setigerously punctate-tuberculate, the small, fine tubercles arranged in one or two irregular rows; setae fine and not very conspicuous, about as on pronotum.

Pygidium apically convex, smooth and shining, basally alutaceous; moderately, coarsely punctate, the punctures deeper apically, separated generally by about 1 diameter. Underside more shining; femora and metasternum shining, smooth at middle; metasternum with scattered, moderate punctures; abdominal segments with the usual transverse rows of punctures reduced to minute, inconspicuous, setigerous punctures bearing very fine setae. Anterior legs not unusually long or slender but probably more so than those of the females; the anterior tibia ending in a small tooth above the spur.

FEMALES.—Unknown.

TYPE.—In Blatchley collection, Purdue University, Lafayette, Ind.

TYPE LOCALITY.—Dunedin, Fla.

SPECIMENS EXAMINED.—3 males, including holotype.

DISTRIBUTION.—(See fig. 8, p. 64.)

FLORIDA: Dunedin, Pasco Co.

REMARKS.—Dr. Blatchley's holotype (by monotypy) was collected "on the wing" at Dunedin, Jan. 7, 1918. His second specimen, also from Dunedin, was taken Jan. 22, 1921. The third specimen seen was collected in Pasco County, Fla., 20 to 50 miles northeast of Dunedin, March 20, 1957, by H. V. Weems, Jr. Nothing further is known concerning this species.

O. aciculatulus is perhaps nearest *O. oklahomensis* in size but is also similar to small *O. pennsylvanicus* and *O. tuberculifrons*. However, it is separated from all these by the conical pronotal protuberance of the males, the shallow pronotal punctures, and the larger, wider eyes. It is also quite similar to *O. subaeneus* which, however, is usually very shiny, has a greenish or coppery lustre, lacks tubercles on the clypeus, and is much more hairy.

Onthophagus oklahomensis Brown

PLATE 6, FIGURE 58

Onthophagus oklahomensis Brown, 1927, p. 128.—Boucomont, 1932, p. 319.—Leng and Mutchler, 1933, p. 38.

In this species, no differences in the often sexually dimorphic morphological features of the males were noted; the following description, therefore, omits separate descriptions of "major" and "minor" males.

MALES.—Length 2.8 to 3.9 mm., width 1.8 to 2.4 mm. Dorsal color black, elytra occasionally piceous; head and pronotum shining, elytra dull but less so than in *O. pennsylvanicus*; ventral color piceous to black, legs brown to piceous. Head with clypeus rounded, sometimes slightly truncate apically, margin slightly, rather evenly reflexed; disc finely punctate medially, with scattered, coarse, setigerous punctures laterally; clypeal carina obsolete, but indicated by a broad convexity at the juncture of the clypeus and the frons; frons nearly flat with scattered fine and coarse punctures; genae scarcely produced, depressed, the surfaces with occasional punctures; vertex usually with a vague, transverse ridge indicating the obsolete carina; surface behind the ridge with scattered, coarse, setigerous punctures.

Pronotum completely margined, poorly so posteriorly; anterior angles abruptly rounded; disc weakly convex, lacking any protuberance, heavily punctate with a mixture of large and small punctures. The large punctures shallow, centrally setigerous and separated by more than 1 diameter; smaller punctures, much less numerous, scattered

over the disc, lacking setae, and usually less than a third the diameter of the larger punctures; surface between the punctures shining, smooth or finely alutaceous. Elytra with shallowly punctate striae; intervals with one or two rows of small tubercles, each with a seta at its base; surface dully shining, finely alutaceous.

Pygidium convex, coarsely, setigerously punctate, and alutaceous basally. Ventral surfaces of thorax and abdomen laterally alutaceous, coarsely, setigerously punctate except in the median posterior portion of the metasternum where the punctures lack setae and are often small or obsolete. Abdominal segments with a basal row of setigerous punctures which often become obsolete medially; last segment slightly emarginate medially. Legs similar in the two sexes. Forelegs of males not noticeably lengthened, tibia short, stocky, quadri-dentate, outer margin serrate or denticulate between and above the four teeth; apex lacking any projection or pencil of hairs. Femora of all legs with a few scattered fine and coarse setae on their ventral surfaces. In *O. pennsylvanicus* the punctures are usually larger and more numerous.

FEMALES.—Length 2.7 to 4.1 mm., width 2.0 to 2.7 mm. Differing from the males in the following respects: Head with clypeal disc slightly more heavily punctate, sometimes laterally faintly rugose. Clypeal carina usually slightly developed, evident as a low ridge, highest medially and extending the width of the frons; carina of vertex obsolete, no better developed than in males. In other respects head, pronotum, and elytra similar to males. Pygidium less convex, nearly flat except near apex. Ventral surfaces and legs similar to males except for the last abdominal segment which is not narrowed medially.

TYPE.—Canadian National Collection 2459.

TYPE LOCALITY.—Payne Co., Okla.

SPECIMENS EXAMINED.—2572.

DISTRIBUTION.—(See fig. 3, p. 24.)

ALABAMA: Claiborne. ARKANSAS: Fouke, Lawrence Co. DISTRICT OF COLUMBIA. FLORIDA: Statewide (25 localities). GEORGIA: Banbridge, Billys Id. (Okefenokee Swamp), Fort Valley, McRae, Millen, Newton, Spring Creek (De-catur Co.), Swainsboro, Upson Co., Vidana. KANSAS: Medora. LOUISIANA: State label only. MISSISSIPPI: Gulfport, Perkinston. NORTH CAROLINA: Carthage, Faison, Raleigh, Southern Pines, West End. OKLAHOMA: Grady Co., Lattimer Co. SOUTH CAROLINA: Statewide (21 localities). TENNESSEE: Burrville. TEXAS: Amarillo, Aransas National Wildlife Refuge, Bailey Co., Brazos, Bastrop, Calhoun Co., Canadian, Colorado Co., Fedor, Lee Co., Montague Co., Pleasanton, Victoria. VIRGINIA: Nelson Co.

REMARKS.—*Onthophagus oklahomensis* is one of the smallest of the North American species. It may be distinguished by its small size, black or piceous color, round clypeus slightly truncate anteriorly,

shining, punctate pronotum with punctures of two sizes, tuberculate elytral intervals, lack of secondary sexual characteristics of the pronotum and legs in the males, slightly developed or obsolete carinae of the head of both sexes, and the lack of pronounced rugosity on the clypeus of the females. The species is very closely allied to *O. pennsylvanicus* from which it may be separated by the presence of a more shining pronotum, the mixed pronotal punctures of two sizes, feebly developed carinae of the head, more pronounced posterior pronotal margin, and less punctate femora.

The habitat preference of *O. oklahomensis* differs from *pennsylvanicus*, for though both species are sometimes taken together, the former is restricted almost entirely to sandy areas. It is commonly taken in the sandhill regions of the southeastern coastal plain as well as in sandy areas in Oklahoma and Texas. The species appears to be generally a dung feeder, making shallow 1-to-3-inch burrows under or beside piles of cow dung. Besides being attracted to dung, adults come readily to rotten melon rind, bananas, and malt and propionic acid traps. In the laboratory, cow manure was used by the beetle for construction of small oval cells buried 1 to 2 inches deep in packed sandy clay. Sand grains coating the cells made them difficult to measure, but 11 cells averaged approximately 10 mm. long by 8 mm. wide. In this species as in *pennsylvanicus*, development from egg to adult takes about 3 weeks or slightly longer. Several of the cells were formed about June 25, and on July 17 some contained pupae or teneral adults. The length of the various instars was not ascertained.

Onthophagus pennsylvanicus Harold

PLATE 6, FIGURES 59 AND 60

- Onthophagus ovatus* Melsheimer, 1806, p. 4 (not Linnaeus, 1767, p. 551).—Say, 1835, p. 174.—Dejean, 1836, p. 158.—Sturm, 1843, p. 108.—Haldeman and LeConte, 1853, p. 54.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1034.—Crotch, 1874, p. 57.—Austin, 1880, p. 25.—Leonard, 1928, p. 418.
- Onthophagus moeris* Sturm, 1826, p. 178 (attributed to Melsheimer; nomen nudum).
- Onthophagus pennsylvanicus* Dejean, 1836, p. 158 (nomen nudum).—Sturm 1843, p. 108 (nomen nudum).—Gemminger and Harold, 1869, p. 1034 (nomen nudum).—Harold, 1871, p. 115.—Horn, 1875, p. 141.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 920.—Schaeffer, 1914, p. 297.—Leng, 1920, p. 249.—Dawson, 1922, p. 179.—Boucomont and Gillet, 1927, p. 207.—Boucomont, 1932, p. 318.—Lindquist, 1933, p. 120; 1935, p. 8.—Ritcher, 1945, p. 15.
- Onthophagus falcipes* Harold, 1871, p. 115.

MALE MAJORS.—Length 4.3 to 5.0 mm., width 2.7 to 3.2 mm. Dorsal color piceous or black, usually black and dully shining; ventral surfaces usually black with legs piceous. Head with clypeus moderately reflexed and slightly prolonged anteriorly, the reflexed

portion with margin slightly emarginate, truncate, or broadly rounded; lateral portions scarcely reflexed, obtusely rounded. The disc nearly flat, smooth, and shining, with occasional widely separated coarse or fine punctures; the carina absent; frons nearly flat, alutaceous, and finely punctate; vertex lacking any trace of the transverse carina, more heavily alutaceous and punctate than frons. Genae depressed, shining, and with a few coarse punctures; delimited from clypeus and frons by faint lines; margins of genae scarcely extending beyond clypeal margins.

Pronotum margined anteriorly and laterally, sometimes faintly so posteriorly; anterior angles scarcely obtuse, sharply rounded. Disc moderately convex, lacking any type of pronotal protuberance, although the anterior median portion may be slightly swollen; surface covered with large, shallow, setigerous punctures usually separated by at least 1 diameter, the punctures near the anterior margin sometimes bearing conspicuous tubercles at their anterior edge. Rarely occasional specimens having a few small punctures scattered between the large ones near the posterior midline; even the small punctures, however, often bearing setae; surface between punctures finely alutaceous. Elytra with shining, shallowly punctate striae; intervals with rows of small tubercles bearing setae at their bases, the smooth surfaces dully alutaceous; at least third, fourth, and fifth intervals with tubercles arranged in two irregular rows.

Pygidium convex near apex, coarsely, setigerously punctate; surface smooth and shining between punctures except basally where it is often finely alutaceous. Ventral surfaces of thorax and abdomen alutaceous laterally and with scattered, coarse, shallow, setigerous punctures lacking only near the midline of the metasternum. Ventral abdominal segments, except for first, with a basal row of setigerous punctures often obsolete near the midline, last segment broadly emarginate to receive the pygidium. Forelegs elongated, the apex of the front femora extending to or nearly to the lateral pronotal margin; foretibia likewise elongated (but not to the extent noted for *O. landolti texanus* and others), moderately slender, bent inwardly in apical half, quadridentate, the margin between and above the teeth denticulate or serrate; tibial apex with a conical projection above the spine and usually with a pencil of hairs beside the projection. Femora of all the legs ventrally with scattered coarse and fine punctures, the mesothoracic and metathoracic legs not differing greatly between the sexes.

MALE MINORS.—Length 3.6 to 4.2 mm.; width 2.3 to 2.6 mm. Differing from the male majors in the following respects: Head with clypeus at least slightly reflexed both anteriorly and laterally, the disc more heavily setigerously punctate, the carina obsolete; vertex

with nearly straight carina present but not pronounced, often obsolete or depressed medially; scattered, coarse, setigerous punctures behind it. Pronotum less convex, alutaceous appearance and punctures more pronounced than usual in male majors. More conspicuous punctures or tubercles are often noted on elytral, pygidial, and ventral surfaces of male minors, but in other respects these areas do not differ significantly from the male majors. Forelegs of male minors not greatly elongated but not as robust nor with the four teeth as large as in females, the apical conical projection small or absent, the pencil of hairs lacking, and the tibia only slightly bent in outer half. In other respects the legs do not differ greatly from the male majors.

FEMALES.—Length 3.3 to 4.6 mm.; width 2.1 to 2.8 mm. Differing from male majors in the following respects: Head with clypeal margin shallowly reflexed anteriorly and laterally, usually broadly emarginate anteriorly; disc coarsely, often rugosely, setigerously punctate; clypeal carina present, highest medially; frons alutaceous with scattered, coarse, setigerous punctures; carina of vertex straight, often depressed medially and no more pronounced than clypeal carina, vertex behind carina with an irregular row of setigerous punctures. Pronotum less convex, the punctures and setae often more pronounced than in male majors. Punctures of elytra, pygidium, and ventral surfaces likewise often more pronounced, but not differing greatly in other respects. Last abdominal segment not narrowed medially. Forelegs not lengthened, the apex of the front femora not extending to pronotal margin. Foretibia stocky and nearly straight; the four marginal teeth large, the margin serrate between and above the teeth; apical projection and pencil of hairs lacking. Legs in other respects similar to male.

TYPE.—Unknown to us.

TYPE LOCALITY.—“Pennsylvania, Kentucky.”

SPECIMENS EXAMINED.—1428.

DISTRIBUTION.—(See fig. 2, p. 20.) Colorado, South Dakota, and all States east and south of these except New Mexico, Vermont, and Maine.

REMARKS.—Several early workers confused this species with the common European *O. ovatus* (Linnaeus); this confusion persisted in our literature as late as 1928 when Leonard listed the name in his “Insects of New York.” We have seen no specimens of *ovatus* from North America. Hamilton (1889) and others have pointed out the error in early records.

O. pennsylvanicus is a common, wide-ranging eastern species that may be distinguished from related species by the uniform dull or feebly shining black or piceous color, the unornamented pronotum which is coarsely, rather uniformly punctate; each puncture usually bearing a reddish seta and separated from its neighbor by approximately a

diameter, the tuberculate elytral intervals (third, fourth, and fifth intervals with two irregular rows), the alutaceous upper surface of pronotum and elytra, and by the male majors with cephalic carinae lacking and forelegs lengthened, the tibia usually having an apical pencil of hairs.

The species occurs from southern Ontario south to central Florida and westward to central Texas. Adults are most commonly collected in areas having a clay-type soil, but also occur in fairly sandy localities. Adult food habits are varied. Specimens have been taken at many types of animal dung, horse, cow, dog, deer, and human being the most common, at carrion, both bird and mammal, and at rotting fungi and watermelon rind. Specimens can be taken in large numbers by using sunken cans baited with a mixture of fermenting malt and propionic acid.

It is not known how many types of animal dung may be used for larval food, but adults brought into the laboratory and placed in large clay-filled flower pots readily utilized cow dung in construction of the cells for their larvae. They made numerous winding burrows, 2 to 3 inches deep, beneath and at the margin of a pile of dung, each burrow terminating in a cell averaging 6 mm. wide by 10 mm. long. When the dung wad was completed, a small cavity was left in the upper end of the dung and in this a single elongate egg was glued by one end so that it was upright in the cavity. Larval development was typically rapid, developmental time from egg to adult having a duration of approximately 3 weeks. Adults were placed in flower pots on June 22; pupae and teneral adults of the F₁ generation were found when the pot was excavated on July 17. The developmental time for each stage was not determined. The discussion of the habits of *O. pennsylvanicus* by Lindquist (1933) may refer to *pennsylvanicus* or to *O. oklahomensis* Brown.

Onthophagus tuberculifrons Harold

PLATE 6, FIGURES 52 AND 53

Onthophagus tuberculifrons Sturm, 1843, p. 108 (nomen nudum).—Gemminger and Harold, 1869, p. 1038 (nomen nudum).—Harold, 1871, p. 115.—Horn 1875, p. 140.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 298.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 208.—Boucomont, 1932, p. 319.

Onthophagus tuberculatus (Zimmermann in litt.) Gemminger and Harold, 1869, p. 1038 (nomen nudum).—Harold, 1871, p. 115.

MALE MAJORS.—Length 4.6 to 5.5 mm., width 2.8 to 3.1 mm. Black with brown spotted elytra, at least with spots at humeri and apices; head and pronotum dully shining, sometimes with cupreous cast, elytra opaque. Head with clypeus widely rounded, slightly,

evenly reflexed and anteriorly shallowly emarginate; disc flat, shining, coarsely, setigerously punctate; clypeal carina absent; frons and genae coarsely, setigerously punctate, finely alutaceous; margin of genae not delimited from that of clypeus; frontal carina indicated by two small truncate tubercles, one near each eye, the vertex between and behind the tubercles coarsely punctate and finely alutaceous.

Pronotum margined anteriorly and laterally, poorly so posteriorly, anterior angles abruptly rounded; disc weakly convex, without pronotal protuberance; coarsely, shallowly, setigerously punctate; pronotal punctures separated by 1 to 2 diameters, each puncture usually bearing a very small tubercle at its anterior margin; tubercles becoming pronounced near the anterior margins, surface between them alutaceous. Florida specimens with punctures larger and tubercles often lacking, but in other respects they do not differ from the main population. Elytra with shallow, poorly to moderately punctate striae; intervals, except for sutural one, biserially tuberculate, each tubercle bearing a short seta at its base, surface alutaceous between tubercles.

Pygidium setigerously punctate, the punctures indistinct, surface alutaceous, sometimes becoming smooth near the apex. Ventral surfaces of thorax and abdomen alutaceous laterally and coarsely, setigerously punctate except at midline of the metasternum and abdomen where the punctures often are obsolete. Abdominal segments with a basal row of setigerous punctures, the last segment emarginate to receive the pygidium. Legs not differing noticeably from those of female. Foreleg not greatly elongated, tibia short and stocky, the four teeth large, with outer margin denticulate-serrate between and above the teeth; tibia lacking sexual modification such as an apical projection or pencil of hairs.

MALE MINORS.—Length 3.8 to 4.4 mm., width 2.4 to 2.8 mm. Differing from male majors in the following respects: Clypeus not so widely rounded nor as deeply reflexed, disc slightly more heavily punctate; clypeal carina faintly indicated by a short raised ridge near the midline. In other respects, except for slightly more pronounced punctures and setae, the male minors do not differ significantly from the male majors.

FEMALES.—Length 3.9 to 5.7 mm., width 2.4 to 3.3 mm. Differing from male majors in the following respects: Clypeus abruptly moderately reflexed anteriorly, the reflexed portion sharply emarginate and laterally angulate, the clypeus therefore appearing bidentate; disc of clypeus more tuberculate than punctate, the tubercles often appearing as short, irregular, transverse ridges; clypeal carina low, most distinct medially, usually not reaching the juncture of clypeus and genae; surface of genae indistinctly ridged or very coarsely, setigerously punctate; surface of frons and vertex not differing greatly

from that of males; carina of vertex as in males but reduced, sometimes only faintly visible.

Pronotum and elytra as noted for male minors. Pygidium less convex and more conspicuously setigerously punctate than is usual in male majors. Ventral surfaces and legs generally similar to male minors except that the last abdominal segment is not narrowed medially.

TYPE.—Location unknown to us.

TYPE LOCALITY.—“Carolina.”

DISTRIBUTION.—(See fig. 9.)

ALABAMA: Hartford, Mobile, Seale. ARKANSAS: Washington Co. CONNECTICUT: State label only. DISTRICT OF COLUMBIA. FLORIDA: 50 localities throughout the State. GEORGIA: 10 mi. west of Fort Valley, Rabun Bald Mtn. (Rabun Co.), Satoloh. INDIANA: Lake Station, Pine. ILLINOIS: Kankakee Co. (Hopkins Pk.), LaFayette. KANSAS: Corbin, Medora. MARYLAND: State label only. MICHIGAN: Livingston Co. (George Reserve). NORTH CAROLINA: Asheville, Balsam, Black Mts., Faison, Southern Pines, Sunburst, Victoria. NEW JERSEY: Bayhead, Burlington Co., Cassville, Clementon, DaCosta, Jericho, Lakehurst, Lucaston, Millville, Rancocas Park, Warren Grove. OKLAHOMA: Payne Co. SOUTH CAROLINA: Beaufort, Cashiers Valley Rd., Clemson, Chappells, Columbia, Denmark, Florence, Hartsville, Meredith, Rocky Bottom, Ware Shoals, White Pond, Venus (Pickens Co.). TENNESSEE: Burrville, Chilhowee Mtn., Knoxville. TEXAS: Anderson Co., Bastrop State Pk., Goliad. VIRGINIA: Norfolk.

REMARKS.—*Onthophagus tuberculifrons* is characterized by its dull black or faintly cupreous color with brown spotted elytra; clypeus emarginate, seemingly bidentate; carina of vertex bituberculate with

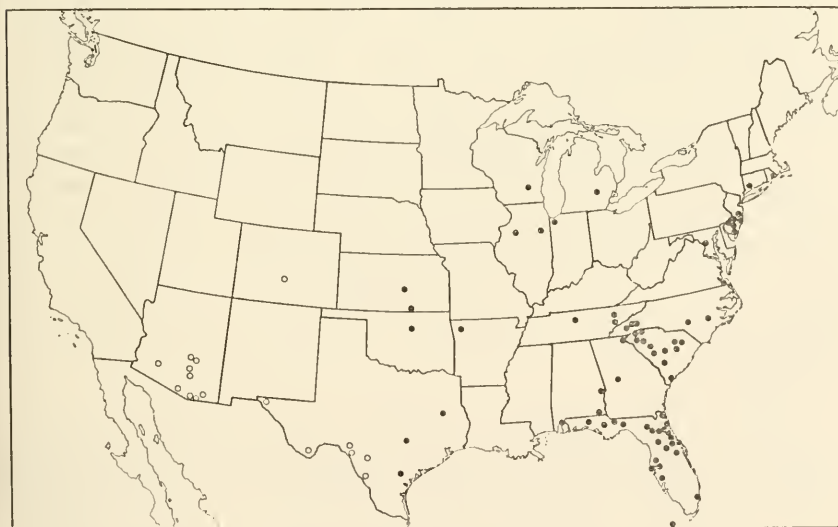


FIGURE 9. Distribution of species of *Onthophagus*:

○ *velutinus* Horn

● *tuberculifrons* Harold

central portion obsolete; pronotum punctate; elytral intervals bi-seriately tuberculate and dorsal surface largely alutaceous. Males of this species can be differentiated from the females by the emargination of the last abdominal segment, the pronotum and legs being similar in both sexes.

O. tuberculifrons is found most commonly in sandy localities from Connecticut to Florida and west to Texas, Oklahoma, and Kansas. Specimens are readily collected by the use of sunken cans baited with fermenting malt and propionic acid. Adults are attracted to human, cow, and other types of animal dung as well as fermenting fungi or other vegetable material. Depth of the adult burrows ranges from 2 to 3 inches in moist localities such as the Chilhowee Mountains of Tennessee and from 6 to 7 inches in more xeric habitats such as Southern Pines, N.C.

Brown (1926) stated that "*tuberculifrons* is an eastern species occurring in pine woods along the Atlantic coast from New Jersey to Florida." However, he also found it in a small wood of blackjack oak near Ripley, Okla.

Onthophagus schaefferi, new species

PLATE 6, FIGURES 49-51

Onthophagus landolti Schaeffer, 1905, p. 158; 1909, p. 382; 1914, p. 299 (not Harold 1880, p. 34).—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.—Boucomont, 1932, p. 314.—Robinson, 1948, p. 176.

HOLOTYPE.—Male major, length 5.5 mm., width 3.1 mm. Head dull greenish black, pronotum shining dark green, elytra feebly shining black with scattered brown spots. Clypeus broadly, sharply, strongly reflexed anteriorly, upturned edge broadly, shallowly emarginate; angles on each side almost dentate; sides finely reflexed, almost straight, slightly sinuate from anterior angle or tooth to external angle of the genae; clypeal carina absent, a slight general swelling in its place; frontal carina reduced to two widely separated, very short but elongated tubercles behind the eyes; head surface alutaceous with a few moderate setigerous punctures laterally on clypeus, genae, and above the eyes; scattered, very fine, scarcely noticeable punctures on clypeus and more noticeable, fine punctures scattered over front.

Pronotum finely, completely margined, anterior angles not acutely rounded; disc moderately convex with a small, blunt, cone-shaped, medial protuberance extending forward slightly beyond anterior edge, its tip red-cupreous. Surface of discal area smooth and shining between moderately coarse punctures; alutaceous in anterior angles, narrowly so across base and forward, slightly so along the widely,

shallowly, basally depressed midline. Moderately coarse punctures, setigerous laterally and across anterior declivity, where each seta is preceded by a noticeable tubercle; coarse pronotal punctures everywhere quite evenly dispersed, separated by 1 to 2 diameters, a few smaller punctures intermixed on disc. First three elytral striae slightly wider than next four, with very distinct punctures crenating the sides of the intervals; punctures of next four striae wider than the striae, a little like widely spaced beads on a string; intervals flat, alutaceous except outside humeri. Elytra black except for a moderately large yellowish-brown humeral spot at base of intervals 6 and 7; two smaller discal spots on 5th interval roughly one-third and two-thirds distance from base; similar coalescing spots at top of apical declivity from 2nd to 6th intervals.

Pygidium shining and smooth over convex apex, finely alutaceous basally; everywhere with moderately deep, moderately coarse setigerous punctures separated by 1 diameter or less. Underside, including femora, with moderately coarse setigerous punctures throughout, even at middle of metasternum; punctures of the abdominal segments arranged in transverse basal rows. Legs dark brown, anterior pair elongated, the femora extending beyond the thoracic margins; tibiae thin and narrow, longer than femora, arcuately bent at outer third, and terminating with a tuft of long, yellowish hairs and tooth above the spur. Stem of antenna red-brown, club fuscous.

MALE MINORS.—Minor males gradually approach the appearance of females, the pronotal protuberance becoming smaller and smaller almost to complete absence; the tubercles representing the frontal carina becoming more prominent and closer together until they approach the female carina in appearance, and the legs becoming shorter until similar to those of the female; the clypeal carina, however, not showing in any of the male minors available for study.

ALLOTYPE.—Female, length 5.25 mm., width 3.0 mm. Similar to holotype in color except that the yellowish-brown spots of the elytra are less developed. The shoulder spot is about the same, but interval 5 has a small spot slightly posterior to the middle and another near the top of the apical declivity, and interval 6 has a similar small spot apically; no others are visible. The head is similar in outline but the clypeal emargination is deeper and therefore has a more dentate appearance; both carinae are strong and well developed, the clypeal carina rather evenly elevated, only slightly higher medially, the frontal carina shorter than the clypeal carina and notched at middle; surface of clypeus coarsely punctate, slightly rugose transversely, more finely so anteriorly; moderately coarse punctures extending over genae and between and behind the carinae. Forelegs shorter, with heavier tibiae, the tuft of hair and tooth above the spur lacking.

Pygidium more extensively alutaceous; terminal abdominal segment not narrowed apically as in male.

VARIATION.—Greatest variation is in the size, intensity, and number of spots on the elytra of both sexes. The larger humeral spots are nearly all distinct, but conceivably some individuals may show none at all. In some, the spots are all quite bright and distinct; in others, they are dim and indistinct. In greatest development, the humeral spots extend completely across intervals 6 and 7, basally a large spot appears on intervals 3 and 4, and smaller discal spots are found on all except the sutural interval. Forty distinct spots were counted on the elytra of one specimen.

TYPE.—USNM 65685.

TYPE LOCALITY.—Brownsville, Tex.

SPECIMENS EXAMINED.—57.

DISTRIBUTION.—(See fig. 7, p. 59.) Holotype and allotype, Brownsville, Tex., May 24, 1941, W. Goodpaster (Cartwright coll., USNM). And the following paratypes:

UNITED STATES: TEXAS: Brownsville, 2♂♂, 3♀♀, May 24, 1941, W. Goodpaster (USNM); 1♀, Apr. 2 (USNM); 4♂♂, June 1901 (Schaeffer coll., USNM); 2♂♂, May 25, 1939, June 8, 1934, D. J. and J. N. Knull (USNM); 1♀, June 8, 1934, D. J. and J. N. Knull (osu); 1♂ (USNM); 1♂, 1♀, May 10, Dury (H. W. Wenzel coll., osu); 1♀, Oct. 9, 1960, cow dung, L. J. Bottimer (LJB); 4♂♂, 2♀♀, Wickham (USNM, CNC); 2♂♂, 4♀♀, Apr. 15, 1903 (USNM, CNC); 2♂♂, 4♀♀, Apr. 12–May 20 (USNM, CNC); 1♂, 1♀, Nov. 21, 1911, palm jungle in human dung (USNM); 1♂, 2♀♀, palm jungle, June 1, 1954, H. F. Howden (Howden). 3♀♀, St. Tomas, Brownsville, Brooklyn Museum Cat. 828 (USNM); 1♂, St. Tomas, Brownsville, Howden coll. (CNC); 3♀♀, Los Borregos, Brownsville, May 24, 1904, H. S. Barber (USNM); 1♂, 2♀♀, Esperanza ranch, Brownsville, Apr. 4, 1903, June 21, July 30, Brooklyn Museum Cat. 820 and 829 (USNM); 4♂♂, 4♀♀, Lake Corpus Christi State Pk., June 8, 1954, H. F. Howden (Howden); 1♀, southwest Hildalgo Co., May 30, 1947, George B. Vogt (Vogt); 1♂, 2♀♀, Cameron Co., Nov. 2, 1946, George B. Vogt, dung of opossum or raccoon composed of fruit of *Condalia obovata* Hook (Vogt); 1♀, Bentsen-Rio Grande State Pk., June 4, 1954, H. F. Howden, horse dung (Howden); 1♂, no data (USNM).

MEXICO: 1♀, Jalapa, W. Schauss (Robinson coll., USNM).

REMARKS.—*Onthophagus schaefferi*, *O. landolti texanus*, and *O. höpfneri* occur together and are frequently confused. They are quite distinct however, and may be separated as follows: In *O. schaefferi* the small round reddish or brownish discal spots first show up on the 5th elytral interval and the spots never form stripes; the elytral apices rarely show solid yellow, but if so, even then the small discal spots remain well separated; the 8th interval is never solid yellow posteriorly. In *landolti texanus* the 5th elytral interval never shows yellow except rarely at base and apex; yellow stripes frequently develop, the yellow color developing as stripes and not as coalescing round spots; the 8th elytral interval is always solid yellow posteriorly.

In *höpfneri* (usually labeled *arizonensis*), the yellow is usually a brighter yellow compared to the reddish yellow or brownish yellow of *schaefferi*; the yellow is always much more extensive, the base and apices of the elytra usually solid yellow with numerous small, round, yellow spots in between; the 8th elytral interval is solid yellow posteriorly.

Dr. A. Villiers kindly checked a specimen of *schaefferi* with Harold's specimens of allied species in the Muséum National d'Histoire Naturelle and reported no similar specimens were represented.

The writers' observations indicate that *O. schaefferi* is less abundant than *I. texanus*, though the two are often taken together in shaded habitats in the lower Rio Grande Valley. They are attracted to excrement of many different animals.

The species is named after Charles Schaeffer whose 1914 revision of *Onthophagus* has served American entomologists for over fifty years

***Onthophagus landolti texanus* Schaeffer**

PLATE 6, FIGURES 46-48

Onthophagus texanus Schaeffer, 1914, p. 299.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 208.—Robinson, 1948, p. 176.

Onthophagus landolti var. *texanus* (Schaeffer), Boucomont, 1932, p. 314, 326.

MALE MAJORS.—Length 4.6 to 5.3 mm., width 2.8 to 3.1 mm. Head and pronotum shining, piceous to black, rarely with faint greenish cast, usually with anterior angles and anterior lateral margins of pronotum narrowly brown. Elytra variable, frequently black with humeral spots and apical portion yellowish brown, occasionally largely brown, with only sutural interval and parts of intervals behind the humeri black; quite often with alternate black and brown intervals, giving a striped appearance, the sutural and alternate following intervals black, always with a marginal black spot beyond 4th and 5th intervals. Pygidium bicolored, centrally piceous or black, marginally brown; ventral surfaces piceous to black with lateral margins of abdomen and legs brown to dark brown. Head with clypeus extended and abruptly reflexed anteriorly, scarcely reflexed and obtusely arcuate laterally; a bidentate appearance resulting from broadly emarginate and laterally abruptly angulate reflexed portion. Clypeal disc flat and smooth, very finely punctate medially, with a few scattered, moderate, setigerous punctures laterally; clypeal carina absent; frons finely punctate, smooth, shining, and almost flat; genae scarcely flared, surface smooth to finely alutaceous with scattered, moderate, setigerous punctures; vertex slightly elevated but with carina obsolete, surface smooth to alutaceous and nearly impunctate.

Pronotum finely margined anteriorly, laterally and basally very finely at middle; anterior angles sharply rounded; pronotum wider

near the middle, moderately convex with a small median, somewhat flattened, conical projection extending over the anterior margin; the projection basally being scarcely as wide as the reflexed portion of the clypeus; pronotum coarsely punctate except for tip of the projection and for a narrow band just behind the anterior margin; the punctures separated by 1 to 3 diameters and bearing fine, brownish, inconspicuous setae; surface between the punctures smooth and shining to minutely alutaceous except near the median portion of the posterior margin where it may be finely alutaceous. Elytra with faintly punctate, shallow, shining striae; intervals except for sutural interval irregularly biserially tuberculate, the tubercles bearing small setae at their posterior margins; surface between the tubercles very finely alutaceous. Pygidium coarsely, setigerously punctate, surface between the punctures largely smooth and shining, particularly on and near the convex apex. Ventral surfaces of thorax coarsely, setigerously punctate, laterally with surfaces finely alutaceous; median line of metasternum often slightly indented and impunctate. Abdominal segments each with a basal row of setigerous punctures, often obsolete medially, last segment emarginate medially to receive the pygidium. Forelegs elongated, the apex of the femora extending beyond the lateral margins of the pronotum. Foretibia similarly lengthened, quadridentate; outer margin dentate or serrate between and above the teeth, bent inwardly in apical half, the tip extended over the apical spine and usually bearing a pencil of hairs. Middle and hind legs not greatly elongated, the femora with a few scattered setigerous punctures.

MALE MINORS.—Length 3.1 to 4.1 mm., width 1.8 to 2.8 mm. Differing from the male majors in the following respects: Fully as variable in color, but usually lacking greenish cast on the head and pronotum. Head with clypeus emarginate anteriorly but not greatly reflexed; disc of clypeus, frons, and gena as described for male majors. Clypeal carina absent, the area of the carina sometimes slightly tumid; vertex with a small to moderate, nearly straight carina extending about two-thirds of the distance between the eyes. Pronotum less convex than in male majors with pronotal projection only vaguely indicated, rarely completely absent, punctures extending to anterior margin; pronotum in other respects similar to male majors. Elytra exhibiting all the variations in color mentioned for male majors. Pygidium and ventral surfaces generally similar to those of male majors, but with setae and punctures often more pronounced. Forelegs not greatly extended, femora not extending to lateral margins of pronotum, foretibia short, scarcely bent, lacking apical conical projection over spine and pencil of hair, tibial teeth often slightly larger than in male majors; similar in other respects.

FEMALES.—Length 3.8 to 5.2 mm., width 2.5 to 3.0 mm. Differing from the male majors in the following respects: Color exhibiting all the variations noted including the shining greenish cast. Head with clypeus more sharply emarginate, moderately reflexed anteriorly and laterally; clypeal disc flat, coarsely, almost rugosely punctate; a low clypeal carina present, highest medially; frons and genae with scattered, moderate, setigerous punctures; vertex with a moderate carina extending approximately two-thirds the distance between the eyes, nearly straight and level, occasionally indented medially or bent posteriorly at the ends; vertex behind the carina with scattered coarse punctures.

Pronotum as described for male minors with the pronotal projection either absent or barely indicated, setae often more pronounced than in male majors. Elytra similar except for slightly more pronounced tubercles and setae. Pygidium more evenly convex, otherwise similar; ventral surfaces with more pronounced punctures and setae; last abdominal segment not narrowed medially to receive the pygidium. Forelegs not extended, the femora not reaching the lateral pronotal margins; tibiae stocky, the four teeth larger than in males, margin between and above teeth usually denticulate or serrate; apical projection and pencil of hairs lacking; in other respects not noticeably different from males.

TYPE.—Of *texanus* Schaeffer: Lectotype, present designation, ♀, USNM 42592, Brooklyn Museum Collection, 1929. Cotypes, 2 ♀ ♀, were collected on the Esperanza ranch, Brownsville, Tex., May 29, 1903. Of *landolti* Harold: Muséum National d'Histoire Naturelle, Paris, France.

TYPE LOCALITY.—Of *texanus* Schaeffer: Brownsville, Tex. Of *landolti* Harold: Ocaña, Colombia, and La Guayra, Venezuela.

SPECIMENS EXAMINED.—424.

DISTRIBUTION.—(See fig. 1, p. 17.)

OKLAHOMA: Marietta. TEXAS: Bentsen-Rio Grande State Pk. (near Mission), Brownsville, Lake Corpus Christi State Pk., west Cameron Co., Garner State Pk., southwest Hidalgo Co.

BIOLOGY.—Some specimens were brought back alive to the University of Tennessee, placed in large earth-filled flower pots, and furnished with fresh cow dung. Under these conditions the beetles reproduced readily. The female beetles made winding 3-to-7-inch burrows with a cell of dung at the bottom of each burrow. Twenty cells were measured, the longest being 16 mm., the shortest 10 mm.; in width they ranged from 7 to 11 mm. The average cell was 12 to 14 mm. long and 8 to 9 mm. wide.

The female made the cell by packing the dung into the end of the burrow and making a small cavity in the upper end of the dung. A single elongate oval egg 0.8 to 0.9 mm. long and 0.3 to 0.4 mm. wide was fastened by one end to the side of the cavity. Each female produced from 3 to 30 eggs. Two females placed in a flower pot with a single male produced 55 cells. Development was rapid, the eggs hatching in 2 to 4 days, the first two instars lasting from 7 to 10 days and the third instar 12 to 14 days. (A discussion of the length of development, pictures of the larva and adult, and the effects of gamma radiation on development have been published elsewhere. See Howden, 1957). Larvae that were observed hatching August 2 became pupae on August 31. Before pupation, the larva forms a hard spherical pupal cell of its own feces inside the dung wad. The pupal period lasts only 5 to 7 days but the teneral adult may remain in the pupal cell for several weeks. Once the adult emerges, mating, though not observed, apparently is not long delayed, for females start cell formation shortly after their appearance. It is interesting to note that isolated virgin females do little burrowing in comparison with mated females. Active beetles lived for 2 to 3 weeks under laboratory conditions. At least six generations were reared, starting with the two females fertilized by a single male.

At almost any point in the above cycle, adverse conditions may change the length of time required for development. Either too moist or too dry conditions in the flower pots caused considerable mortality. Moisture favored the appearance of fungi in the cells. However, mites were the most difficult problem to contend with in the flower pots; frequent changes were necessary, because if the adults were left in pots where the mite population was large, the mites would actually kill the beetles. Occasional specimens in the field have been noted infested with mites, but how serious a pest they are to the coprophagous beetles remains an interesting problem.

REMARKS.—Boucomont (1932) placed *O. texanus* as a variety of *O. landolti*, and unquestionably it is very close. We prefer at present to give *texanus* subspecies status. It differs from typical *landolti* in that it is less shining and more noticeably alutaceous. The pronotum is usually black or brown, only rarely with a greenish cast, whereas in *landolti* it is frequently bright green or coppery. The pygidium is always bicolored, often being yellow over more than half its surface, but in *landolti* the pygidium is black or only the edges are narrowly yellow. The apical black spot of the elytral declivity is more rounded higher up, and is opposite the 4th and 5th intervals; in *landolti* the spot is elongate, nearer the edge, and opposite intervals 3, 4, and 5; the males of *texanus* never have the anterior arcuate pronotal carina which is sometimes evident in *landolti*.

There are less noticeable differences in the width and punctures of the elytral striae and in the emargination and teeth of the clypeus. Typical *landolti* is distributed at least as far north as Sonora, Mexico.

O. texanus is frequently confused with *O. höpfneri* Harold and *O. schaefferi*, new species; however, in *texanus* the yellow-brown color of the elytra tends to form longitudinal stripes and never forms round spots on the disc of the elytra.

In southern Texas, *O. texanus* is not uncommon in low shaded areas. The writers took it in numbers in the lower Rio Grande Valley, particularly in the palm jungle at Southmost below Brownsville and in the Bentsen-Rio Grande State Park. Most of the specimens were taken under fresh horse droppings, but some were found at Lake Corpus Christi State Park on watermelon rind and under cow dung.

Onthophagus höpfneri Harold

Plate 6, FIGURES 44 AND 45

Onthophagus höpfneri Harold 1869, p. 512.—Boucomont and Gillet, 1927, p. 206.—Boucomont, 1932, p. 326—Robinson, 1948, p. 176.

Onthophagus arizonensis Schaeffer, 1909, p. 382; 1914, p. 296.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 204.—Boucomont, 1932, p. 314.—Robinson, 1948, p. 176.

Onthophagus landolti Robinson, 1948, p. 176 (not Harold, 1880, p. 34).

Onthophagus texanus (Schaeffer), Robinson, 1948, p. 176.

MALE MAJORS.—Length 4.7 to 5.1 mm., width 2.7 to 3.0 mm. Head and pronotum shining green to dark green, often with cupreous or violaceous reflections; elytra usually largely brownish yellow with black arcuate median band mottled with small, round yellowish spots, occasionally mostly black with scattered yellow spots; sutural intervals black; legs reddish brown to piceous. Head with clypeus sharply reflexed anteriorly, scarcely so laterally, reflexed portion broadly shallowly emarginate medially and more or less angulate on each side; disc smooth, nearly flat, with only an occasional coarse puncture and a few fine ones; both clypeal carina and the carina of the vertex absent; surface of frons and vertex similar to that of clypeus, only slightly convex; gena delimited from clypeus by a fine line, its surface finely alutaceous and coarsely punctate, margins of genae abruptly rounded near eyes.

Pronotum completely margined, poorly so posteriorly, anterior angles acutely rounded, lateral margins arcuate. Disc of pronotum moderately convex with a somewhat flattened conical median projection extending forward over the head, the protuberance abruptly rounded anteriorly and curved slightly upward; disc coarsely punctate, the punctures separated by a distance equal to 1 to 2 diameters,

the punctures often bearing whitish setae and having a small tubercle at their anterior margins; surface between punctures smooth and shining with scattered fine punctures evident on unabraded specimens, except for a narrow, nearly impunctate, very finely alutaceous area extending across just behind the anterior margin. Elytra with narrow punctate striae; intervals with two or three irregular rows of small tubercles, each with a setigerous puncture at the base, smooth surfaces of intervals finely alutaceous.

Pygidium black, yellow, or bicolored; setigerously punctate; the basal portion alutaceous, the apex smooth and shining. Ventral surfaces of thorax piceous to black with traces of iridescence; alutaceous laterally, smooth and shining medially on the metasternum. Sterna coarsely setigerously punctate except near the finely punctate median line of metasternum; abdominal segments with a basal row of small setigerous punctures, surfaces otherwise finely alutaceous, last abdominal segment emarginate. Forelegs greatly elongated, apex of forefemur extending beyond lateral margin of pronotum; tibia as long as or longer than femur, thin, slightly curved near the apex, laterally quadridentate, with the margin between and above the teeth serrate or denticulate; apex extended slightly over the tibial spine and bearing a small pencil of hairs. Middle and hind legs not greatly elongated; the femora bearing a few coarse punctures in apical half.

MALE MINORS.—Length 3.6 to 3.9, width 2.3 to 2.5 mm. Differing from male majors in the following respects: Head with clypeus not extended nor sharply reflexed anteriorly; the margin vaguely emarginate or truncate medially and broadly arcuate laterally, clypeal disc coarsely punctate, rugosely so laterally, frons and genae with scattered coarse punctures; clypeal carina barely indicated medially; carina of vertex pronounced, nearly straight, slightly depressed at the midline and terminating some distance from the eyes; surface behind the carina with a few coarse setigerous punctures.

Pronotum evenly moderately convex with only a trace of the anterior median pronotal hump; surface coarsely, evenly, setigerously punctate. Elytra similar to those of the male majors except that the tubercles on the intervals sometimes more pronounced. Pygidium quite convex with only basal third alutaceous. Ventral surface with more conspicuous setae, but otherwise similar. Forelegs not elongated, similar to those of females; the foretibiae short, with the four teeth smaller than in females; apical conical projection and adjacent pencil of hairs both lacking.

FEMALES.—Length 3.7 to 5.0 mm., width 2.2 to 3.0 mm. Differing from male majors in the following respects: Head with clypeus not noticeably prolonged anteriorly; clypeal margin slightly reflexed, broadly emarginate anteriorly, moderately angulate on either side

of the emargination; clypeal disc transversely rugosely punctate, clypeal carina evident, only slightly higher medially, terminating at the genae. Frons and genae with scattered, coarse, setigerous punctures; carina of vertex pronounced, nearly straight, depressed medially and abruptly terminated laterally near the eyes; surface behind the eyes with scattered, coarse, setigerous punctures.

Pronotum differing only slightly from that described for male minors, often showing no indication of the anterior median pronotal projection, the pronotum being evenly rounded anteriorly. Elytra not differing from those of male majors except by having slightly more pronounced tubercles and setae. Pygidium convex apically, surface coarsely punctate, each puncture bearing a conspicuous whitish seta. Ventral surfaces similar to males except for the slightly more evident punctures and setae. Last abdominal segment not narrowed medially. Forelegs not lengthened, the apex of the femora not extending beyond the pronotal margin; foretibia short, stocky, with four large teeth, with the margin denticulate or serrate between and above; apex lacking conical projection and pencil of hairs noted in male majors.

TYPE.—Of *höpfneri*: Muséum National d'Histoire Naturelle, Paris, France. Of *arizonensis*: Lectotype, present designation, USNM 42590, ♀, Brooklyn Museum Cat. 824.

TYPE LOCALITY.—Of *höpfneri*: Veracruz, Mexico. Of *arizonensis*: Nogales, Santa Cruz Co., Ariz.

SPECIMENS EXAMINED.—247.

DISTRIBUTION.—(See fig. 5, p. 37.)

UNITED STATES: ARIZONA: Atascosa Mtn., Baboquivari Mts., Douglas, Nogales, Patagonia, Portal (Southwestern Research Station), near San Fernando, Santa Rita Mts., Tucson.

MEXICO: NAYARIT: Jesús María, Navarrete. MORELOS: 7 km. south of Alpuéca.

REMARKS.—At our request, Dr. A. Villiers very graciously compared three specimens with the Harold types in the Muséum National d'Histoire Naturelle. He stated that our small Mexican specimen with wide black band and no spots agreed well in size, punctuation, form of the clypeus, and frontal carina but that the type had yellow spots. Our larger, many-spotted specimens were reported to be identical in elytral coloration. Because of the poor condition of Harold's types, Dr. Villiers could not be sure of the sex but he indicated he would not be surprised if both Harold specimens were females. Neither has a pronotal projection. Inasmuch as the type male (supposedly!) has a frontal carina and the allotype has both clypeal and frontal carinae, the holotype very likely is a male minor. Because

the many yellowish spots are so typical of *O. arizonensis*, we have concluded that *arizonensis* must be a synonym of *höpfneri*. *Onthophagus höpfneri* males vary from very small (3.1 mm.) specimens lacking any trace of the pronotal protuberance but with a very distinct frontal carina, a mere suspicion of an anterior clypeal carina, and few or no round spots in elytral black band, to much larger specimens (6 mm.) with a well-developed conical pronotal protuberance, no head carinae, and numerous round spots on the elytra.

Mexican and more southern specimens seem to be smaller, the yellow part of the elytra is wider anteriorly, the humeral umbone is yellow, there are fewer yellow spots on the median band, the pygidium is black, the pronotal punctures are not quite so deep and clear cut, and each seta is near the anterior of the puncture and at its base has a more evident tubercle. Arizona specimens are usually larger, the yellow base of elytra narrower, the humeral umbone and fifth sutural near base black, the pygidium bicolored.

O. höpfneri is separated from allied and other United States species by its size and by the color of the elytra, particularly the usually numerous, small, round yellowish spots on the black background across the middle of the elytra. Males usually have a small conical pronotal protuberance, and the elongated foretibiae terminate with a pencil of long hairs and a tooth above the apical spur.

This species has been taken only in south central Arizona. Series of specimens have been examined from Tucson, Patagonia, and the Baboquivari Mountains (particularly Browns Canyon). It seems to be a general dung feeder; the majority of specimens were collected in July and August. Nothing has been recorded on its life history.

Onthophagus arnetti, new species

PLATES 7, FIGURES 68 AND 69; 8, FIGURE 76

HOLOTYPE.—Male major, length 8.6 mm., width 4.8 mm. Head, except clypeus, and pronotum dark green, clypeus and elytra black; finely alutaceous, feebly shining. Clypeus abruptly reflexed anteriorly only, the reflexed portion widely arcuate; disc of clypeus slightly concave, with mixed coarse and fine punctures, slightly rugose laterally; clypeal carina a fine raised line extending from margin to margin; frons slightly convex, moderately punctate, some punctures with erect setae; surface between punctures very finely alutaceous; gena with margin extended laterally further than lateral clypeal margin, obtusely angulate with clypeus; surface of gena coarsely setigerously punctate; eye noticeably convex and nearly twice as wide as eye of either *velutinus* or *browni*; frontal carina obsolete medially; laterally the sharp carina highest at abrupt terminations behind the eyes; surface behind carina with a few coarse setigerous punctures.

Pronotum moderately convex and margined anteriorly and laterally; dorsal surface with distinct tubercles 2 to 3 diameters apart, overhanging minute posterior punctures which bear short fine setae; surface between tubercles alutaceous. Pronotal protuberance forming a wide, shelflike projection over head, the sides of the projection parallel, anterior margin terminating over eyes; broadly emarginate and somewhat depressed medially. When viewed laterally, projection turned slightly upward at apices, with a deep smooth circular fovea under margin on each side, and resembling that of *medorensis*, except that the adjacent fossa is circular instead of elongate; anterior pronotal angles very broadly rounded, much more so than in *O. browni* or *O. velutinus* and not excavated as in *O. medorensis*; posterior angles more abruptly rounded than *browni*.

Elytra with shallow striae, both striae and intervals dull and alutaceous; intervals with two or three irregular rows of small tubercles, small punctures at the base of each tubercle bearing an erect reddish seta. Pygidium feebly convex, completely alutaceous, shallowly, indistinctly punctate, the punctures bearing erect reddish setae.

Ventral surfaces brownish black to black with a faint greenish cast on the legs; antennal club brown to brownish gray. Metasternum with scattered coarse punctures most numerous laterally, each puncture bearing a very long erect seta; midline at center of metasternum largely lacking coarse setigerous punctures but with scattered fine secondary punctures; surface between punctures finely alutaceous laterally. Abdominal segments alutaceous and, except for first segment, with a row of setigerous punctures across their bases. Last abdominal segment emarginate as is typical for the genus in North America. Forelegs not much more elongate than in female, tibia with conical projection over apical spur and with spur sharply bent inwardly near apex. Middle and hind femora with scattered, widely separated, coarse, setigerous punctures and very fine secondary punctures.

MALE MINOR.—Unknown.

ALLOTYPE.—Female, length 6.75, width 4.0 mm. Differing from male holotype in the following respects: Head longer with clypeus not so arcuate laterally or distinctly angulate between clypeus and genae; clypeal margin only narrowly reflexed and weakly emarginate anteriorly; surface of clypeus coarsely, transversely, rugose-punctate throughout; clypeal carina similar but not as fine; frons and genae more coarsely punctate; frontal carina evenly elevated from side to side, curving slightly posteriorly above the eyes. Pronotum convex; pronotal prominence low, rounded, and inconspicuous, slightly arcuate forward over middle third of total width. Forelegs noticeably shorter, the tibia lacking the tooth above the spur. Terminal abdominal segment not narrowed apically to receive the pygidium.

TYPE.—Canadian National Collection 7530.

TYPE LOCALITY.—Pena Blanca Canyon (3800 ft.), Santa Cruz Co., Ariz.

SPECIMENS EXAMINED.—Holotype, allotype, and one paratype.

DISTRIBUTION.—(See fig. 10.)

ARIZONA: Pena Blanca Canyon, Santa Cruz Co. The holotype was collected at black light, July 24, 1960, by Killian Roever, and the allotype by Ross H. Arnett, Jr., July 23, 1959. Paratype, ♂, Patagonia, (E. R. Leach coll., CAS).

REMARKS.—This species is easily separated from other North American *Onthophagus* by the following combination of characters: Dark green head and pronotum with dull black elytra; large convex eyes; small circular pronotal tubercles separated by two or more diameters; short reddish setae at the base of the tubercles on both pronotum and elytra; very broadly rounded anterior angles of the pronotum; the moderately large size, 6.6 to 8.6 mm. in length.

O. velutinus, *O. browni*, and *O. arnetti* are all about the same size, alutaceous and feebly shining, with rather evenly distributed, well-separated tubercles; however, *arnetti* is green and black, *velutinus* dark brown, and *browni* black; the anterior angles are much more broadly rounded in *arnetti*. Viewed laterally, the posterior angles are sharper in *arnetti*, measuring 130° in *arnetti*, 140° in *browni*, and 145° in *velutinus*, and the margin between the anterior and posterior pronotal angles is nearly straight in *arnetti* and noticeably sinuate in the other two; the pronotal protuberance of the female *arnetti* is intermediate in development compared to the others. In *arnetti* the eyes are much

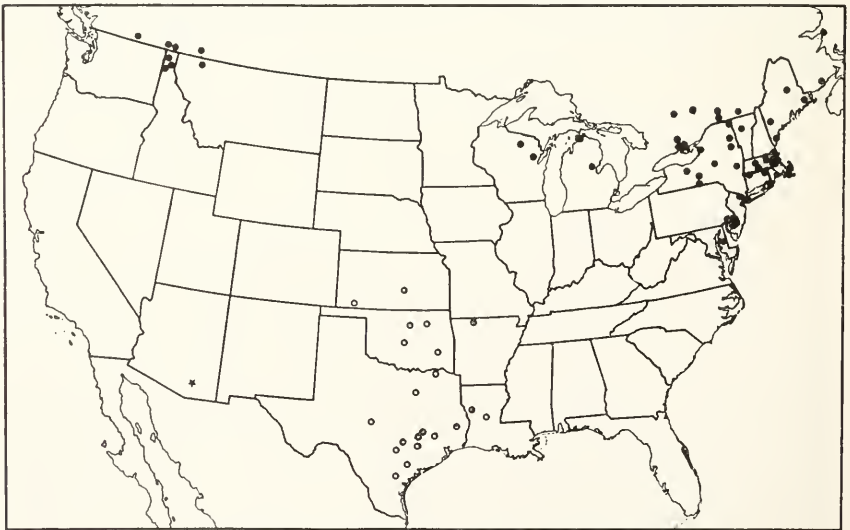


FIGURE 10. Distribution of species of *Onthophagus*:

● *nuchicornis* (Linnaeus) ○ *medorensis* Brown ★ *arnetti*, new species

wider and more convex, being 10 facets wide with a ratio of width to length 7 to 10; in *velutinus* the ratio is 5 to 11, the width 7 facets; in *browni* 4 to 10 ratio, 6 to 7 facets width.

The male major pronotal protuberance is rather similar to that of *O. medorensis*.

Nothing is known about the habits of *arnetti*, the three specimens having been taken at light. However, one might do well to look for *arnetti* in wood rat nests, inasmuch as it is similar to *browni* and *velutinus*, both of which occur in *Neotoma* nests.

We take pleasure in naming this species after its first collector, Dr. Ross H. Arnett, Jr., founder and for many years publisher of the Coleopterists' Bulletin.

Onthophagus browni, new species

PLATE 7, FIGURES 66 AND 67

HOLOTYPE.—Male major, length 6.6 mm., width 3.7 mm. Dorsal surfaces dull black, finely alutaceous between the pronotal tubercles and elytral striae, in these respects being similar to *O. velutinus*. Clypeus reflexed anteriorly and broadly, very shallowly emarginate; disc coarsely, rugosely punctate, delimited posteriorly by a small but distinct, slightly sinuate carina running from margin to margin. Frons, vertex, and gena alutaceous and having scattered coarse punctures which often bear minute reddish setae; carina on vertex indistinct medially, forming a pronounced ridge behind each eye but without any indication of a horn; gena flared laterally by the front of the eye, more noticeably arcuate than in *velutinus*.

Pronotum margined anteriorly and laterally, dorsal surface moderately tuberculate, each tubercle overhanging a small puncture bearing a minute reddish seta, tubercles separated by a distance equal to three or more times their diameter, more crowded anteriorly on the pronotal protuberance; pronotal protuberance flattened, projecting forward as an inverted triangle one-third wider anteriorly than at its base, the strongly sinuate anterior margin broadly shallowly emarginate at middle and curving laterally more sharply posteriorly to the outer angles. A large, deep, smooth, impunctate fossa beneath the protuberance on each side; anterior angles abruptly rounded, lateral margins arcuate, slightly sinuate anteriorly, with a small knob above each margin near the middle. The elytra with smooth, shining, narrow striae; all except sutural interval irregularly, biserially tuberculate; behind each tubercle a minute puncture bearing a short reddish-yellow seta; surface between tubercles alutaceous. Except for the deeper striae punctures, the elytra almost identical to those of *velutinus*.

Pygidium coarsely punctate, dull and noticeably alutaceous basally, becoming shiny and smooth apically. Ventral surfaces brownish black

with mouth parts, antennal scape, and legs reddish brown to piceous; antennal club grayish black except the apical segment which is tan; ventral parts of the thorax with scattered coarse punctures, each bearing a reddish seta; surface finely alutaceous between punctures except medially on the metasternum where it is smooth and finely punctate; abdominal segments alutaceous and, except for the first segment, with a row of punctures across their bases, most of the punctures bearing short reddish setae; last abdominal segment apically reddish brown, broadly emarginate to receive the pygidium. Forelegs not noticeably larger than those of females, similar to male major of *velutinus* except that they are not as obviously alutaceous on the outer surface. Middle and hind femora with scattered coarse and fine punctures, the coarse ones often bearing setae.

MALE MINOR.—Paratype, length 6.0 mm., width 3.6 mm. Differing from the type in the following respects: Dorsal color reddish black; head similar except that the clypeus is scarcely reflexed anteriorly and the carina of the vertex is higher. Pronotum similar in outline, but less convex and with the pronotal protuberance reduced to a flat shelf barely extending over the back of the head, the protuberance with parallel sides and a truncate anterior margin, the deep fossae on each side of the protuberance in the male major here reduced to shallow indentations with a few tubercles and punctures (in one damaged male minor the thoracic protuberance is so reduced that the pronotum is similar to that described for the female). Elytra, pygidium, and ventral surfaces, except for a lighter color and few more tubercles on the elytral intervals, identical with the male major.

ALLOTYPE.—Female, length 7.0 mm., width 4.2 mm. Differing from the male major in the following respects: Surface of head heavily, rugosely punctate; clypeus scarcely reflexed, more sharply, narrowly emarginate anteriorly; clypeal carina evident and entire from side to side; frontal carina at least twice as high as in male major, bowed posteriorly near the middle. Pronotum differing mainly in the shape of the pronotal protuberance which is reduced to a large median tumosity rising almost vertically above the anterior pronotal margin; a smooth groove on either side of the tumosity representing the fossae of the male major, the anterior edge of the tumosity broadly arcuate and approximately the same width as the carina of the vertex; tubercles of pronotum more pronounced than in male, with the basal setae slightly longer. Elytra similar, except that the tubercles of the intervals appear slightly larger. Pygidium more convex and apically less alutaceous than in male major; ventral surfaces with the setae and punctures more conspicuous; last abdominal segment lighter in color along its posterior margin, not emarginate to receive the pygidium. Foretibia of the same length as in the

male major but broader, with the basal portion of the four outer teeth larger.

VARIATION.—Length ranges from 5.0 to 7.1 mm. and the width from 2.9 to 4.2 mm. Color of individuals varies from reddish brown to completely black. The alutaceous sculpture, tubercles, and setae show little variation except the slight sexual one noted above. The greatest variation other than sexual differences is in size and shape of the pronotal protuberance of the male which ranges from a rounded hump in some male minors to the extensive projection described for the male major.

TYPE.—Canadian National Collection 7531.

TYPE LOCALITY.—1 mile east of Portal, Ariz.

SPECIMENS EXAMINED.—151.

DISTRIBUTION.—(See fig. 7, p. 59.) Holotype and allotype, 1 mi. east of Portal, Ariz., June 26, 1956, H. and A. Howden, in wood rat nest (*Neotoma* sp.). And the following paratypes:

UNITED STATES: ARIZONA: 26 ♂♂, 26 ♀♀, 1 mi. east of Portal, June 26–29, 1956, H. and A. Howden, O. L. Cartwright, F. N. Young (CNC, USNM, Howden, FNY); 1 ♂, 1 ♀, Sept. 14, 1960, H. F. Howden, in *Neotoma* nest (CNC); 10 ♂♂, 15 ♀♀, July 31, 1961, 4 ♀♀, Aug. 1, 1961, in *Neotoma* nest, L. J. Bottimer (LJB); 1 ♀, Southwestern Research Station laboratory, 5 mi. west of Portal, at light, June 28, 1956, H. and A. Howden (Howden); 1 ♂, 1 ♀, Southwestern Research Station, July 12, 1956, R. J. Frederick (RJF); 1 ♀, Southwestern Research Station, Aug. 28, 1958, elevation 5000–6000 ft., H. V. Weems, Jr. (REW); 1 ♀, Southwestern Research Station, July 15, 1961, B. Benesh (BB); 1 ♂, 1 ♀, 1 mi. south of Portal, July 11, 1956, R. J. Frederick (RJF); 1 ♂, 1 ♀, Mt. Graham, July 28, 1954, at light, F. G. Werner (UA); 1 ♀, Mayer, July 1937, E. R. Leach (CAS); 1 ♂, Patagonia, Santa Cruz Co., July 15, 1955, at light, F. G. Werner and G. D. Butler (UA); 1 ♂, Prescott, July 9, 1936, E. R. Leach (CAS); 1 ♀, Mt. Graham, near Safford, July 14, 1956, Vincent D. Roth (REW); 1 ♂, 1 ♀, Chiricahua Mts., July 8, 1952, R. H. Beamer (UKA); 2 ♀♀, July 12, 22, 1953, D. J. and J. N. Knull (OSU); 1 ♀, Ramsey Canyon, July 10–15, 1941, A. Klots (AMNH). NEW MEXICO: 1 ♂, State label only, (H. W. Wenzel coll., OSU). TEXAS: 10 ♂♂, 14 ♀♀, Chisos basin, Big Bend National Pk., May 5, 19, 29, 1959, Howden and Becker, at black light and on carrion (CNC).

MEXICO: CHIHUAHUA: 8 ♂♂, 5 ♀♀, Majalea Rd. (5500 ft.), 30 mi. northwest of Chihuahua, April 17, 1961, wood rat nest, Howden and Martin (CNC, Howden).

REMARKS.—This species can be readily separated from all other United States *Onthophagus* except *velutinus* by the tuberculate pronotum and elytra and the dull black alutaceous surface between the tubercles. The male majors are easily distinguished from *velutinus* by the lack of horns on the head and the odd heart-shaped pronotal projection. Male minors and females of *browni* are sometimes very difficult to separate from females of *velutinus*, being separable only by the shape of the carinae on the head and the larger pronotal hump as noted in the descriptions and in the key. It gives the authors considerable pleasure to name this distinctive species in honor of W. J.

Brown, Entomology Research Institute, Canada Department of Agriculture, Ottawa, who has contributed so much to the study of the genus and who has been of considerable help with the present work.

It seems odd that this species so long escaped discovery. When the present study was started, the only specimen found in any collection was a male in the Canadian National Collection simply labelled "Prescott, Ariz." and determined as undescribed by Mr. Brown. Three other specimens subsequently were collected at light in Arizona by Drs. Werner and Butler, University of Arizona. Then in late June of 1956, when the authors were collecting with Dr. Frank Young near Portal, Ariz., Dr. Young found a dead specimen under a rock at the edge of a wood rat nest. This discovery led to the investigation of several nests in the area, 1 mile east of Portal, and the finding of additional specimens.

Most of the wood rat nests examined were built in the centers of small clumps of mesquite which grew among fair-sized rocks. The rats (*Neotoma* probably *mexicana*) constructed their nests of any material that was handy. In this particular locality the nests consisted largely of mesquite and *Acacia* twigs and bits of cactus. In several nests, dried cow chips were added to the heap, as well as paper, cloth, small rocks, and pieces of broken glass. The nests were 4 to 5 feet in diameter and several feet thick. The rats usually had several entrances to the nest, with the central chamber often under a large rock. It was near the end of an extremely long dry season when the nests were investigated, and the ground crumbled to fine dust when disturbed.

After Dr. Young's initial discovery, the writers chose a large nest and with the aid of an ax and crowbar pulled it apart. The bottom of the nest yielded some fragments and dead specimens of *Onthophagus* and *Euphoria*, but was largely unproductive. It was not until excavation was started beneath the nest that the *Onthophagus* came to light. More than thirty specimens were taken from the one nest in 3 days of digging. Many of the specimens were dead, evidently killed by the prolonged drought. The dusty rocky soil made it very difficult to find the beetles and almost impossible to locate the burrows, for as soon as a rock was removed the soil crumbled to dust. However, one live beetle was found at a depth of 5 inches in what appeared to be a pupal cell beneath the underside of a rock. There was no indication of any dung or other food material.

During the excavating, a few specimens of *O. brevifrons* were also taken, as well as a *Euphoria* near *devulsa* Horn and several species of *Aphodius* and *Ataenius*. Other insects were also numerous.

Several live *O. browni* were taken back to the Southwestern Research Station; one male and three females were placed in a large battery

jar half filled with moist earth and supplied with fresh horse droppings, no fresh wood-rat droppings being available. The beetles were left undisturbed for 12 days before the jar was examined. Four loosely formed cells, 12 mm. long and 6 mm. wide, were found. Two contained eggs; two contained first stage larvae. The two larvae were preserved and the two cells containing eggs were placed in soil-filled 4-oz. metal salve boxes. The eggs hatched in 2 days. The larvae were full grown in 20 to 22 days. One third-stage larva was preserved; the other reached the adult stage on August 5, approximately 30 days after hatching.

The development of *O. browni* seems to conform to the usual pattern for the North American species, but even though the larva seems able to survive on horse dung, unknown factors apparently restrict *O. browni* to pack rat nests.

In September 1960, Howden revisited the Portal locality and excavated additional nests. Only one live pair of *O. browni* was found, but over forty *brevifrons* were taken; these species evidently have different times of activity.

Onthophagus velutinus Horn

PLATE 7, FIGURES 64 AND 65

Onthophagus velutinus Horn, 1875, p. 140.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Schaeffer, 1914, p. 294.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 208.—Boucomont, 1932, p. 306.—Howden, 1960, p. 460.

MALE MAJORS.—Length 6.2 to 7.0 mm., width 3.5 to 3.8 mm. Dorsal surface dark brownish black to black. Clypeus slightly reflexed anteriorly and broadly shallowly emarginate, each side weakly angulate; disc coarsely, almost rugosely punctate, the surface shining; clypeal carina semi-obsolete, sometimes barely indicated by an impunctate area which is slightly raised medially; frons and vertex with scattered coarse punctures which occasionally bear fine yellowish setae; frontal carina incomplete, represented by two long, nearly straight, usually slightly diverging horns, the horns separated basally by a distance equal to one-third the distance between the eyes; genae extending laterally slightly beyond the arcuate sides of the clypeus, anteriorly delimited from the clypeus by a vague suture which extends posteriorly around the eyes to the base of each horn.

Pronotum moderately convex, margined anteriorly and laterally, the dorsal surface moderately tuberculate, each tubercle overhanging a very small puncture which bears a short yellowish seta; tubercles separated by a distance 2 to 3 times greater than their diameter, becoming smaller and more widely separated posteriorly; surface between tubercles very finely alutaceous and dully shining; pronotum

anteriorly slightly tumid, vaguely concave, and nearly impunctate behind each horn, with the upper median part of the prominence angularly bent forward between the horns; anterior angles rounded, not sharply angulate. Elytral striae shining, the strial punctures barely indicated; intervals, excluding the sutural interval, irregularly biseriately tuberculate, behind each tubercle a minute puncture bearing a small yellow seta; surface between the tubercles finely alutaceous.

Pygidium with scattered, poorly delimited punctures, each bearing a short yellowish seta; surface alutaceous, more so basally, becoming smoother and dully shining apically. Ventral surfaces brownish black to black with mouth parts, antennae, and legs usually reddish brown. Antennal club usually grayish brown, the apical segment largely brown. Ventral portions of the thorax with scattered coarse punctures each bearing a slender, reddish seta; surface between finely alutaceous except medially on the metasternum where it is smooth and impunctate. Abdominal segments alutaceous and, except for the first segment, with a row of vague punctures across their bases, the punctures usually bearing short reddish setae; last abdominal segment reddish brown in color, broadly emarginate to receive the pygidium. Forelegs not noticeably longer than those of the female, the tibia being slightly more slender but not elongated, its flattened outer surface with finely alutaceous sculpture and scattered coarse punctures. Middle and hind femora with scattered coarse punctures bearing short reddish setae.

MALE MINORS.—Length 5.5 mm., width 3 mm. Differing from the male majors in the following respects: Clypeus only slightly reflexed, anteriorly distinctly emarginate with the disc rugosely punctate; punctures more crowded and smaller than in the male major, clypeal carina still vague, but slightly elevated medially; carina of vertex discernible between the lateral horns which are reduced in length and farther apart. Pronotum less convex, the tubercles more widely separated, the anterior tumosity small, indicated by a small arcuate ridge with anterior face tuberculate-punctate and only slightly or not at all concave behind the reduced horns; pronotum anteriorly not extended forward between the horns, anterior angles more angulate. Elytra and pygidium mostly as described for male majors; ventrally the major differences are in the color and the setal length, the ventral color of the male minor being reddish brown, the legs and mouth parts being only slightly lighter, and the ventral setae appearing to be reduced in length. General aspects of the legs appear similar to those of the male major.

FEMALES.—Length 5.4 to 6.1 mm., width 3.4 to 3.9 mm. Differing from the male majors in the following respects: Clypeus scarcely

reflexed anteriorly, shallowly emarginate, with disc rugosely punctate; clypeal carina weak but distinct; frons coarsely punctate; carina of vertex pronounced and fairly uniform in height, nearly straight when viewed from above, not noticeably bent posteriorly at the midline. Pronotum similar to that of male minor except that the pronotal tumosity is less evident, lower, broad, and slightly arcuate. Elytra similar to those of male major. Pygidium differing only in being less convex apically. Ventrally the color of the females ranges from reddish brown to black, with setae shorter than in the male major; punctures of the thorax and abdomen slightly less pronounced, and the last abdominal segment not emarginate or lighter in color; the foretibiae slightly thicker but not shorter than in male majors, and their flattened outer surfaces, while still punctate, only barely alutaceous.

TYPE.—Lectotype, male, present designation, in the Henry Ulke collection, Carnegie Museum, Pittsburgh, Pa. Dr. Horn in his original description stated that *O. velutinus* occurs in Baja California and Arizona. Neither of these localities is represented among *velutinus* specimens in the Horn collection at the Philadelphia Academy of Natural Sciences or in the LeConte collection at Harvard College. Banks, Schwarz, and Viereck (1910) stated that some types of LeConte, Horn, and Dietz are in the Henry Ulke collection. In the Ulke collection are two male specimens of the *velutinus* series bearing only the labels "Ariz." and "Cal." These are presumably from the type series; the Arizona specimen is here designated lectotype. Because the fauna of Baja California is different and distinct from that of Arizona, it seems odd that *velutinus* would occur there. Examination shows the "Cal." specimen to be an undescribed species having similar cephalic horns and surface sculpture. It will be described in a subsequent paper.

TYPE LOCALITY.—"Arizona."

SPECIMENS EXAMINED.—89.

DISTRIBUTION.—(See fig. 9, p. 87.)

TEXAS: Big Bend National Pk., Del Rio, Dimmit Co., El Paso, Lake Walk, Sabinal, "S.W. Tex." COLORADO: Canon City. ARIZONA: Base of Pinal Mts., Tucson, Sabino Canyon (Pima Co.), Baboquivari Mts., Florence (Pinal Co.), Globe, San Bernardino Ranch (Cochise Co.), Nogales, Ramsey Canyon (Huachuca Mts.), 36 mi. east of Gila Bend, 10 mi. east of Nogales, 2 mi. east of Lochiel, Carr Canyon.

REMARKS.—Except for three related species, two of which are described in this revision, *O. velutinus* is quite distinct from the other North American *Onthophagus*. The dull black alutaceous dorsal surface and the small scattered tubercles on the pronotum and elytra usually distinguish this southwestern species. The long, erect, slightly diverging, straight horns placed rather close together on the vertex are

unique among our species. These characters will usually separate *velutinus* from the other closely related southwestern species (see p. 100).

O. velutinus ranges from central Texas through Arizona but it is quite rare in collections. Most of the specimens bearing collecting data simply state "collected at light." It apparently has a restricted habitat, probably only in *Neotoma albigula* Hartley nests, a habitat in which it was first collected by L. J. Bottimer. It was taken at black light and in wood rat nests on the lower slopes of the Chisos Mountains (Howden, 1960, p. 460).

Onthophagus concinnus Laporte ⁵

PLATE 7, FIGURES 61-63

Onthophagus concinnus Dejean, 1836, p. 157 (nomen nudum).

Onthophagus concinnus Laporte, 1840, p. 87. (This curious misspelling of "*Onthophagus*" is repeated for 39 species, yet the page headings are spelled correctly.)

Onthophagus concinnus (Laporte), Lacordaire, 1856, p. 109.—Gemminger and Harold, 1869, p. 1027.

Onthophagus viridicollis Sturm, 1843, p. 108 (nomen nudum).

Onthophagus protensus Melsheimer, 1845, p. 134 (new synonymy).—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1027.—Crotch, 1874, p. 57.—Boucomont, 1932, p. 329.—Brimley, 1938, p. 200.

Onthophagus subaeneus Horn, 1875, p. 139 (not Palisot de Beauvois, 1811, p. 105).—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 294.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 208.—Löding, 1945, p. 99.

MALE MAJORS.—Length 6.8 to 8.1 mm, width 4.0 to 4.4 mm. Head and pronotum usually bright shining green, occasionally becoming violaceous; elytra usually with brownish-yellow basal band and apical spots, medially greenish black, extreme base of elytra and sutural interval blackish. The black area may almost completely cover the elytra, leaving, in extreme cases, only three or four small brownish spots near the basal edge of the elytra, the apical spots being entirely absent. Pygidium usually brownish yellow basally, black apically, but varying from almost completely brownish to entirely black. Clypeus anteriorly sharply reflexed, the anterior margin forming a median flattened perpendicular horn, laterally abruptly rounded, the sides almost parallel and giving the clypeus a rectangular appearance. Disc of clypeus smooth and shining, with a few coarse scattered punctures; laterally becoming rugosely punctate; clypeal carina sometimes semiobsolete, but more often appearing as a fine, sharp, transverse ridge running completely across the posterior clypeal margin; behind the clypeal carina the head medially slightly convex, with scattered coarse setigerous punctures;

⁵ *O. concinnus* has been incorrectly credited to the author Castelnau because, as pointed out by Grensted (1952), "Laporte" was the author's name and "Comte de Castelnau" merely his title. In his own writings, Laporte used the abbreviation "Lap." (See Laporte, 1840, 149, "*Trochilus* Lap.")

frontal carina indicated only laterally by a sharp erect horn directed outwardly over each eye; between the horns a median smooth non-tuberculate, often finely alutaceous and slightly concave area; genae moderately prominent, their laterally arcuate margins extending slightly beyond the lateral clypeal margins.

Pronotum moderately convex, margined anteriorly and laterally; anterior angles smooth, shining, deeply concave, the fossae extending upward each side to the base of pronotal protuberance which is very similar to that of *O. medorensis* and *O. blatchelyi* and to a moderately developed pronotal process in *O. hecate*; pronotal process broad, slightly wider than the distance between the eyes and extending forward slightly beyond the eyes, its anterior end flared, acutely angled, and deeply emarginated between the hornlike angulations, median edge unarmed. Viewed laterally the dorsal surface of the pronotal protuberance appears almost flat with the tips of the angulations thickened; disc of pronotum evenly tuberculate, the tubercles separated by a distance 2 to 3 times their own diameter, posterior edge of each tubercle with a long reddish-yellow seta, the pronotum therefore having a noticeably hairy appearance. Elytral striae shallowly but distinctly punctate, intervals flat and alutaceous between small shiny tubercles; except on the sutural interval, the tubercles usually arranged in very irregular rows, the interval adjacent to the sutural interval having three or four rows, the next interval two or three, and subsequent intervals usually three rows, each tubercle with a long yellowish seta posteriorly at its base.

Pygidium flat basally, slightly convex over apical half, vaguely alutaceous over basal third, smooth and shiny apically, with coarse punctures most pronounced on apical half, all punctures bearing long yellowish setae. Ventral surfaces generally black with traces of greenish or bluish iridescence, stem of antennal club reddish brown, the club grayish black. Anterior coxae rounded, similarly to *medorensis*, not as transverse as *hecate*, their anterior surface appearing finely rugose. Mesothorax and metathorax coarsely punctate, except along median line of metathorax, each puncture bearing a long, reddish-yellow seta; surface shiny between the punctures, usually not alutaceous as in *medorensis*; metasternum forming a slight ridge between the middle coxae as in *medorensis*; abdomen with a regular line of very small, setigerous punctures running completely across the base of each abdominal segment except the first, last segment slightly emarginate as is typical in the males of the genus. Forelegs elongate, the apical end of the forefemur extending slightly beyond the lateral edge of the thorax; foretibia very long and slightly curved, with an apical conical projection over the tibial spine, the spine thickened and

abruptly recurved at apex. Middle and hind femora with scattered coarse punctures each bearing a long seta.

MALE MINORS.—Length 5.2 to 7.1 mm., width 3.2 to 4.1 mm. Differing from male majors in the following respects: Clypeus rather evenly rounded, reflexed upward only slightly more anteriorly than laterally; disc evenly, rugosely punctate, the punctures bearing short setae; clypeal carina more pronounced than in male majors, but of uniform height and extending completely across the posterior margin of the clypeus. Surface between the clypeal carina and frontal carina as described for the male major; frontal carina evident throughout its length, highest laterally where it forms a small knob at each end; a few scattered, coarse punctures behind the carina; gena scarcely produced.

Pronotum with tubercles and setae as in male major, tubercles almost to the anterior margin; disc generally less convex than in male majors and lacking the indentations in the anterior angles; protuberance usually indicated by a slight anterior median swelling. General aspect of elytra and pygidium similar to male major. Except for a slight difference in punctures, the ventral surfaces resemble those described for male majors. Forelegs are shortened, the apices of the anterior femora extending no further than the lateral margins of the thorax, the foretibia proportionately shortened, but still slender and inwardly curved, the apical conical projection lacking. The middle and hind legs slightly more stocky than in male majors, but otherwise similar.

FEMALES.—Length 5.6 to 7.6 mm., width 3.2 to 4.5 mm. Differing from the male majors in the following respects: Clypeus rather evenly rounded, slightly more reflexed anteriorly than laterally with disc very coarsely, rugosely punctate, at least some of the punctures bearing reddish setae; clypeal carina extending completely across the posterior margin of the clypeus, evenly elevated across middle; surface behind the carina coarsely, setigerously punctate, many of the punctures with small indistinct tubercles at basal edges. Frontal carina pronounced, slightly indented medially, and abruptly terminated laterally near the eyes; behind it an irregular double row of setigerous punctures bearing rather pronounced tubercles at their posterior margins.

Pronotum less convex than male majors with tubercles distributed rather evenly over the entire surface, the tubercles usually larger and more pronounced than in males, separated generally by only 1 to 2 diameters; pronotal setae often less conspicuous than in males, somewhat finer; protuberance indicated by a vague hump which is often delimited laterally by a small shiny swelling, the distance between these lateral swellings approximately the same as the length of the frontal carina of the head. Elytra generally similar to those of

male, but with the tubercles slightly larger and fewer in number, and the setae generally shorter.

Pygidium less convex than in male, otherwise quite similar. Ventral surfaces in general similar to those of male, the coarse setae more scattered; the last abdominal segment of approximately equal length throughout and lacking the characteristic emargination of the male. Legs generally stockier than in male with apex of forefemora not extending to lateral prothoracic margins; foretibiae short and rather stocky without conical projection over the tibial spine, the tibial spine fairly slender and curved inwardly in apical half.

TYPE.—Muséum National d'Histoire Naturelle, Paris.

TYPE LOCALITY.—"Amerique Boreale."

SPECIMENS EXAMINED.—295.

DISTRIBUTION.—(See fig. 7, p. 59.)

ALABAMA: Mobile. FLORIDA: Miami, Monticello, Mossyhead, Newmans Lake (Alachua Co.), Wacissa. GEORGIA: Atlanta, Baker Co., Boston, Fort Valley. LOUISIANA: Covington. MISSISSIPPI: (State label). NEW JERSEY: Blount Springs, Browns Mills, Chatsworth, Hadden Heights, Lakehurst, Malaga, Mt. Misery, Rancocas Park, Riverside, Riverton, Westville. NORTH CAROLINA: Carthage, Southern Pines, West End. PENNSYLVANIA: Broomall. SOUTH CAROLINA: Beaufort, Belton, Coshiers Valley Road (Oconee Co.), CCC Camp 2 (Oconee Co.), Clinton, Columbia, Florence, Fish Hatchery (Oconee Co.), Jocassee, Meredith, Pinnacle Mt., Seabrooks Island, Venus (Pickens Co.), Walhalla, White Pond. TENNESSEE: Black Mts. (Cumberland Co.), Burrville.

REMARKS.—*Oonthophagus concinnus* can be separated from closely related species by the shining bright green, rarely purplish, head and pronotum, dark greenish-black elytra with yellowish-brown base and apex, and pronotum with almost circular tubercles separated by more than their own diameters. A few specimens are very hard to distinguish from *O. medorensis* in color and sexual characteristics, but in these specimens the three or more irregular rows of tubercles on the elytral intervals will usually distinguish this species. It can be separated from *O. hecate* and *O. blatchleyi* by the dorsal coloration and the pronotal protuberance of the male major, which lacks downward-projecting median teeth.

Biologically, *O. concinnus* is still somewhat of an enigma. It is a widely distributed species, occurring in the spring and fall from New Jersey to Florida and westward to Mississippi. Nowhere does it seem common. A possible explanation of its seeming rarity may stem from the fact that the adults are usually taken on the droppings of small mammals, skunks, foxes, and possibly others, only occasionally being taken on human feces or cow dung. It has been taken under fungi, under chicken manure, and a few specimens have been collected in fermenting malt traps. Several live females were placed in flower pots and supplied with fresh cow droppings, but none of the specimens

evinced any interest in the dung, dying without attempting to construct brood cells.

As indicated in the synonymy, this species was known for many years under the name *O. subaeneus*, as applied incorrectly by Dr. G. H. Horn, a misidentification mentioned in the remarks concerning that species (p. 76). Melsheimer's name *O. protensus* was resurrected in 1932 by Boucomont who apparently overlooked the earlier name by Laporte. Gemminger and Harold (1869) correctly placed *protensus* as a synonym of *concinus*. Casey seems to be the only American specialist who correctly identified his specimens as *O. concinns*.

Onthophagus medorensis Brown

PLATE 8, FIGURES 77 AND 78

Onthophagus medorensis Brown, 1929, p. 204.—Boucomont, 1932, p. 309.—Leng and Mutchler, 1933, p. 38.—Howden, 1955, p. 65.
Onthophagus guatemalensis Schaeffer, 1914, p. 295 (not Bates, 1887, p. 73).—Leng, 1920, p. 249.—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 6.8 to 8 mm., width 3.9 mm. Purplish black to rather shiny purplish blue to moderately shiny green, the color more pronounced on the head and pronotum. Clypeus anteriorly sharply reflexed, the margin forming a flattened median perpendicular horn; laterally the clypeus sharply rounded, presenting an almost rectangular appearance when viewed from above; disc smooth and shiny with only a few scattered punctures, laterally becoming rugosely punctate; clypeal carina fine but distinct, the fine ridge running completely across from edge to edge; frons slightly convex behind the clypeal carina, the surface finely tuberculate, with a long yellowish seta at the anterior edge of each tubercle. Frontal carina indicated only laterally by a sharp semi-erect, posteriorly directed horn overhanging each eye; medially smooth, nontuberculate, often finely alutaceous between the horns. Genae moderately prominent, their lateral margins extending slightly beyond those of the clypeus.

Pronotum moderately convex, margined anteriorly and laterally; anterior angles shining, smooth, almost impunctate, minutely alutaceous, deeply concave, the fossa extending upward to base of pronotal protuberance. Pronotal protuberance similar to that of *O. concinns* and male minors of *O. hecate*; the process broad, usually slightly wider than the distance between the eyes, and extending to a position approximately over the eyes, its anterior end slightly flared, acutely angled and strongly emarginate between the hornlike angulations, without a median downward protrusion as in *hecate*; when viewed laterally the protuberance flaring upwards slightly at its anterior tips; pronotal disc evenly tuberculate, the tubercles separated by a distance of approximately twice their diameter, the pronotum with a noticeably

hairy appearance, from the long yellowish seta at posterior edge of each tubercle. Elytral striae black, usually shining, distinctly but not deeply punctate; intervals flat and alutaceous between small, shiny tubercles which are usually arranged in very irregular double rows, except on sutural interval; posteriorly each tubercle with a long, yellowish seta at its base, coloration uniform, no spots being evident in any of the specimens examined.

Pygidium alutaceous and finely punctate over basal half, shiny over slightly convex apical half with rather coarse punctures, all the punctures, both basally and apically, bearing long, yellow setae. Ventral surfaces usually brownish black with only a trace of the dorsal blue or green; stem of antenna dark reddish brown with club grayish brown. Anterior coxae more rounded and not as transverse as in *hecate*, their anterior surface appearing finely rugose. Metathorax laterally coarsely punctate, each puncture bearing a long, reddish-yellow seta, the surface between the punctures finely alutaceous; midline smooth, impunctate, anteriorly forming a vague ridge. Abdomen, excluding the first segment, with a regular line of very small, setigerous punctures running completely across the base of each segment, the last segment emarginate as is typical in males of the genus. Forelegs elongate, the apical end of the forefemur extending slightly beyond the lateral margin of the thorax; foretibia very long and slightly curved with an apical conical projection over the tibial spine, the spine thickened and abruptly recurved at apex. Middle and hind femora with scattered, coarse punctures, each bearing a long seta.

MALE MINORS.—Length 5.5 to 7 mm., width 3.3 to 4 mm. Differing from male majors in the following respects: Clypeus rather evenly rounded, reflexed upward anteriorly only slightly more than laterally; disc evenly, rugosely punctate, with punctures bearing short setae; clypeal carina more pronounced than in male major but of more uniform height and extending completely across the posterior margin of the clypeus; area between the clypeal carina and the frontal carina similar to that described for the male major; frontal carina evident throughout its length, but highest laterally, where it forms a small horn at each end, a few scattered setigerous tubercles behind the carina; genae only very slightly produced laterally, the margins protruding only a short distance beyond the clypeal margin.

Pronotum less convex but with tubercles and setae similar to male major, margin generally similar in outline but without smooth concave area in the anterior angles, the protuberance often indicated by only a slight anterior median swelling, the swelling sometimes delimited laterally by smooth anteriorly directed humps.

Elytra and pygidium similar to those of male major. Ventrally the metathorax shows fewer coarse punctures; otherwise ventral surfaces resemble those described for male majors. Forelegs shortened, the apices of anterior femora not extending quite as far as lateral margins of thorax; foretibia proportionately shortened but still slender, inwardly curved, and lacking the apical conical projection above the tibial spine. Middle and hind legs slightly more stocky than in male majors but otherwise similar.

FEMALES.—Length 4.9 to 7.7 mm., width 3 to 4 mm. Differing from the male majors in the following respects: Dorsal color of greener blue, often less noticeable; clypeus rather evenly rounded, slightly more reflexed anteriorly than laterally, with disc coarsely rugosely punctate, each puncture bearing a long, thin seta; clypeal carina similar but more pronounced medially, the frons between clypeal and frontal carinae moderately tuberculate, with long, yellowish setae arising from punctures at the anterior base of each tubercle; frontal carina pronounced and at least as high as median portion of clypeal carina, often slightly indented near midline but without any indication of lateral horns, a few setigerous tubercles behind.

Pronotum less convex than in male majors, with shining tubercles distributed quite evenly over the entire surface, the base of each tubercle with a slender, reddish-yellow seta; tubercles slightly larger than those of the male, separated by approximately their own diameter; setae shorter and finer, less conspicuous than in male; pronotal protuberance in some specimens indicated by only a vague hump, in others the lateral edges delimited by a shiny round swelling, the distance between these swellings approximately the same as the length of the frontal carina of the head. Elytra generally similar to those of male, but with the tubercles slightly larger and the setae slightly shorter.

Pygidium slightly less convex than in male but otherwise quite similar. Ventral surfaces generally similar to those in male with the exception of the last abdominal segment which is not emarginate. Legs generally stockier with apex of forefemora not extending to the lateral thoracic margins. Foretibiae not at all elongate, being short and rather stocky with no conical projection over the tibial spine, the tibial spine fairly slender and inwardly curved in apical half.

TYPE.—Canadian National Collection 2971.

TYPE LOCALITY.—Payne County, Okla.

SPECIMENS EXAMINED.—250.

DISTRIBUTION.—(See fig. 10, p. 100.)

ARKANSAS: Boone Co. KANSAS: Liberal, Medora. LOUISIANA: Alexandria, Vowells Mill. OKLAHOMA: Cleveland Co., Latimer Co., Payne Co., Ripley, Stillwater, Tulsa. TEXAS: Bastrop State Pk., Brady, Brazos Co., College Sta-

tion, Colorado Co., Columbus, Lake Corpus Christi State Pk., Dallas, Doncette, Goliad, New Braunfels, Paris, Somerset, Willis.

REMARKS.—This species can be separated from closely related species by the uniform purplish blue or green color and by the hairy tuberculate pronotum with almost circular tubercles separated by a distance usually greater than their diameter. The pronotal protuberance in the male major is also quite distinctive because the apical median portion lacks the downwardly protruding teeth usually characteristic of the male majors of *O. hecate* and *O. blatchleyi*. Also characteristic are the irregular double rows of small tubercles on the elytral intervals and the lack of spots on the elytra. *O. concinnus* is very close but has a bright green head and pronotum and bicolored elytra.

Onthophagus medorensis has been found in some numbers in Oklahoma and eastern Texas. Numerous adults were found in mid-June at Bastrop State Park, Tex., feeding on rotten watermelon rind and on human feces. Most of the specimens were taken in low, well-shaded sandy areas. Several pairs were kept alive, placed in a soil filled 12-inch flower pot on June 16, and supplied with fresh cow dung. On June 26 the flower pot was examined; it yielded a single brood cell 16 mm. long by 10 mm. wide. Near the upper end of the cell was a cavity, 5 mm. in diameter, containing a single yellowish-white egg, 1.8 mm. long, which was attached at one end to the side of the cavity. Subsequent examination on July 5 yielded four more cells at depths ranging from 2 to 5 inches. The cells all contained eggs, one of which hatched on July 9, the first instar exhibiting the prominent conical dorsal wart on the third abdominal segment typical of *Onthophagus* larvae. Unfortunately, in some way eggs of *Aphodius lividus* (Olivier) were included in each of the brood cells and the resulting *Aphodius* larvae destroyed the *Onthophagus* egg or larva in all five cells. This parasitism of the *Onthophagus* brood cells by the *Aphodius* was described in a 1955 paper by Howden. No additional information was obtained concerning the life cycle of *O. medorensis* because all the adults died without having constructed additional broods cells.

Brown (1926; 1928) stated that *O. medorensis* (*guatemalensis*) is abundant during the spring months in Payne County, Okla., beneath excrement in very sandy localities. "It does not occur where there is little or no sand."

Onthophagus hecate hecate (Panzer)

PLATE 8, FIGURES 70-72

Scarabaeus hecate Panzer, 1794, p. 5.—Melsheimer, 1806, p. 3.

Onthophagus hecate (Panzer) Sturm, 1843, p. 107.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemminger and

- Harold, 1869, p. 1030.—Horn, 1875, p. 138.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 918.—Schaeffer, 1914, p. 294.—Leng, 1920, p. 248.—Dawson, 1922, p. 178.—Boucomont and Gillet, 1927, p. 205.—Boucomont, 1932, p. 309.—Lindquist, 1933, p. 120.—Ritche, 1945, p. 14.—Miller, 1954, p. 380.
- Copris hastator* Fabricius, 1798, p. 28; 1801, p. 31.
- Onthophagus hastator* (Fabricius) Lacordaire, 1856, p. 108.—Haldeman and LeConte, 1853, p. 54.—LeConte, 1863, p. 36.—Gemming and Harold, 1869, p. 1030.—Leng, 1920, p. 248. Boucomont and Gillet, 1927, p. 205.
- Copris latebrosus* Fabricius, 1801, p. 34.—Palisot de Beauvois, 1809, p. 93.
- Onthophagus latebrosus* (Fabricius) Sturm, 1826, p. 178; 1843, p. 107.—Dejean, 1836, p. 157.—Kirby, 1837, p. 125.—Melsheimer, 1844, p. 135.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemming and Harold, 1869, p. 1030.—Crotch, 1874, p. 57.—Austin, 1880, p. 25.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 206.
- Copris oblectus* Palisot de Beauvois, 1805, p. 25.
- Onthophagus oblectus* (Palisot de Beauvois) Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemming and Harold, 1869, p. 1030.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 206.
- Onthophagus scabricollis* Kirby, 1837, p. 126.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Crotch, 1874, p. 57.
- Onthophagus sayi* Laporte, 1840, p. 87.—Lacordaire, 1856, p. 109.—Gemming and Harold, 1869, p. 1030.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 206.
- Onthophagus furcicollis* Dejean, 1836, p. 157.—Gemming and Harold, 1869, p. 1030.
- Onthophagus lama* Dejean, 1836, p. 157.—Gemming and Harold, 1869, p. 1030.

MALE MAJORS.—Length 7.5 to 9.5 mm., width 4.2 to 4.9 mm. Black, with occasional aeneous reflections dorsally; appendages brownish black; dorsal surfaces tuberculate, surface between the tubercles opaque, finely alutaceous. Head with median anterior part of clypeus reflexed sharply upward, forming a pronounced, transversely flattened rounded perpendicular horn, surface laterally rugosely punctate, centrally smooth with scattered, fine punctures; clypeal carina indistinct; frontal carina weak, fine, slightly more pronounced laterally; surface of gena and vertex punctate before the carina, impunctate behind the carina. Antenna brownish black with club grayish black.

Pronotum convex, with anterior process usually less than half the width of head, extending forward as far as the posterior margin of the clypeus, narrowest over the posterior carina of head, flaring suddenly, and terminating laterally in two knobs; the anterior margin between the two knobs turning downward and dividing into two small pointed teeth. In many males these central teeth not distinct, but broadly merged with the lateral knobs. When viewed laterally, the dorsal portion of the process forming a straight or slightly concave line with the dorsal curvature of the thorax. Pronotum margined anteriorly

and laterally; dorsal surfaces with pronounced oblong tubercles, usually separated by a distance no greater than their greatest length; behind each tubercle a minute, setigerous puncture; the long, yellowish setae most pronounced laterally and anteriorly, becoming shorter and less obvious medially and posteriorly, almost lacking near the posterior median depression of the pronotal disc. Summits of the tubercles shining, the surface between opaque, finely alutaceous; occasionally a few scattered minute tubercles near the midline; anteriorly on the pronotal process the tubercles irregular, being replaced by punctures at the tip of the process. Elytral striae usually shining, shallowly punctate; elytral intervals, except the sutural, very irregularly tri-seriately tuberculate; basally each tubercle with a fine, yellowish seta of approximately the same length as those of the thoracic disc; surface between the tubercles finely alutaceous.

Pygidium finely alutaceous over dorsal half, shining and coarsely punctate over lower half. Ventral surfaces of thorax behind the transverse carina shallowly punctate to coxal cavities, the surface between punctures shining and finely ridged. Metasternum medially with a smooth, shining, faint, longitudinal ridge, devoid of punctures and highest anteriorly, laterally setigerously punctate and very finely alutaceous. Each abdominal segment anteriorly with a transverse row of coarse punctures which become more numerous laterally, surface between punctures very finely alutaceous. Legs brownish black; foreleg with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the pronotum; tibia with four large lateral teeth with serrate margin between and a conical tooth above the inturned tibial spine; femora of mesothoracic and metathoracic legs with a moderate number of coarse setigerous punctures on their ventral surfaces.

MALE MINORS.—Length 5.2 to 7.9 mm., width 3.0 to 4.5 mm. Usually smaller than male majors or females; differing from the former in the following respects: Clypeus broadly rounded and rather evenly reflexed, only slightly more so anteriorly; clypeal carina pronounced, highest medially; carina of vertex highest laterally, sometimes terminating in a small sharp tubercle; clypeus rugosely punctate, but not as greatly so as in the females. Pronotal protuberance often reduced to a mere hump, similar to that of female; when slightly more pronounced, protuberance as broad as the frontal carina and only slightly emarginate. Two median teeth of the pronotal process becoming apparent only after the process extends well over the head. Fore-tibia greatly reduced in length, usually not quite as heavy as the fore-tibia of the female, and lacking the apical conical tooth over the tibial spine. In other respects the male minors are similar to the male majors.

FEMALES.—Length 6.6 to 8.3 mm., width 3.7 to 4.7 mm. The females differ from the male majors in the following respects: Clypeus broadly rounded, only very weakly reflexed, slightly more so anteriorly than laterally; surface strongly rugosely punctate, sparsely setigerous; clypeal carina strong, quite evenly elevated, only slightly higher medially than laterally; setigerously punctate behind the carina, rarely some of the punctures with an accompanying small tubercle; carina of vertex slightly arcuate anteriorly, slightly higher medially with no indication of lateral horn; behind the carina several rows of setigerous punctures followed by an impunctate area; gena not prominent, the margin almost evenly continuous with the clypeal margin. Pronotum less convex than in male major; pronotal protuberance only vaguely indicated by a broad, anterior, median swelling; punctures similar to male, but the setae arising at the base of the punctures often more pronounced, particularly on the disc. Elytra as in male but often with slightly longer setae. Pygidium similar to that of male but not as convex. Legs slightly stockier than those of male, forelegs considerably shorter than in male major, femur not reaching lateral thoracic margin; the tibial spur elongate, gently recurved, not thickened as in male; legs of female otherwise quite similar to those of the male. Last abdominal segment not medially emarginate.

TYPE.—Present location unknown to us.

TYPE LOCALITY.—“America Borealis.”

SPECIMENS EXAMINED.—2111.

DISTRIBUTION.—(See fig. 11.)

Taken in Alberta, British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Nova Scotia in Canada, and in every State in the United States except the far western States of Washington, Oregon, California, and Nevada.

REMARKS.—This species may be distinguished from allied species by the sexual characters of the male majors and by the pronounced elongate pronotal tubercles usually separated by a distance less than their own length. The lateral pronotal setae are usually yellowish, and the elytral tubercles, though not as pronounced as those of the pronotum, are still large, each usually with a yellowish basal seta. Dorsal color is ordinarily distinctive, being entirely black with an occasional aeneous glint.

Southward there is a gradual change from typical *O. hecate* to the subspecies described by Brown as *O. blatchleyi*. The pronotal protuberance becomes broader and shorter with less crowded tubercles, the median projection of the protuberance, which in northern specimens terminates in two well-developed separate teeth, develops into a longer binodose process in the specimens from the Carolinas and Florida, and the apical brown spots of the elytra become larger and

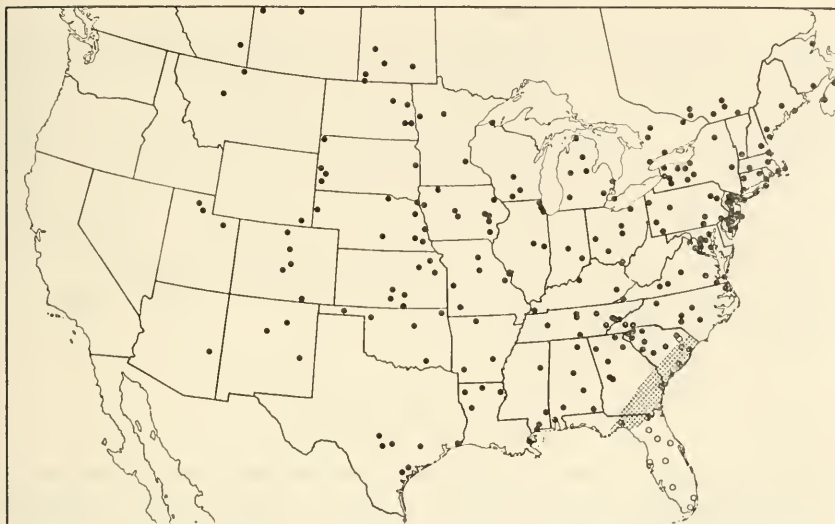


FIGURE 11. Distribution of species of *Onthophagus*:

● *hecate hecate* (Panzer)

○ *hecate blatchleyi* Brown

more numerous in the Florida specimens. Very rarely two or four brown spots occur in northern specimens. Such specimens have been noted from Wisconsin, Michigan, Arkansas, Iowa, Texas, and New Mexico, as well as the southeastern States.

Onthophagus hecate is the most widely distributed and one of the most common of the North American species. As an adult it has been taken under many types of dung, rotting fungi and fruit, at carrion, in bait traps, and at light. Cow droppings seem to be preferred but many specimens have been found on human feces and on droppings from dogs, rabbits, and horses; a few fragments of adults were found also in wood rat nests in the Great Smoky Mountain National Park in Tennessee.

Ritcher (1945, p. 14-15) stated that "at Lexington, Kentucky, adults of *O. hecate* are abundant in fresh cow dung during May, June, and July. They dig tunnels beneath the droppings to a depth of 2 to 9 inches and pack the lower end of each with a wad of dung. Tunnels are nearly vertical for most of their length but each turns near its lower end so that the manure pellet lies nearly horizontally. The farther end of the pellet, at the end of the burrow, is bulbous; the egg is laid in a small cell in the other, neck-like end. When full grown, the larva constructs an elliptical pupal cell within the remains of the old dung pellet." In South Carolina, adults have been taken in every month of the year except January.

Lindquist (1933) found larval cells of *O. hecate* in Kansas in June under dried cow dung in burrows up to 17 cm. deep; the brood cells averaged 17 mm. in length by 8.5 mm. in diameter. The adult emerged from the "round black pupal cells" between August 25 and September 5. Lindquist stated (p. 120-121) that "a considerable portion of dung remained after the insects transformed from the larval to the pupal stage and would no doubt be of value to the soil." He found the average weight of each cell to be 0.26 gm. Information on developmental time for each stage has not been published.

An excellent description of the third stage larva of *O. hecate* has been given by Ritcher (1945, p. 14).

Onthophagus hecate blatchleyi Brown

PLATE 8, FIGURES 73-75

Onthophagus blatchleyi Brown, 1929, p. 86.—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 7.5 to 8.5 mm., width 4.3 to 4.8 mm. Dorsal surface with shining tubercles, surface between opaque, finely alutaceous. Color grayish black with a number of brownish spots near elytral apices. Head with anterior portion of clypeus reflexed sharply upwards, forming a horn similar to that described for *hecate*; clypeus rugosely punctate laterally and becoming smooth medially, clypeal carina moderately pronounced; frons noticeably finely alutaceous between the scattered punctures behind the carina, laterally near the eyes the alutaceous sculpture less pronounced; carina of vertex only vaguely indicated, becoming more pronounced laterally but without any indication of lateral horns; gena pronounced as in *O. hecate*.

Pronotum margined anteriorly and laterally, convex. Anterior process extending over the head almost as far as the clypeal carina; the process broad, approximately a third the width of the pronotum, the sides flaring slightly, near the apex forming acute apical angles, with the anterior edge between them directed downward in broad, flattened, apically emarginate horn. Pronotal surface densely tuberculate except for the anterior angles and an area immediately behind and parallel to the anterior pronotal margin. The tubercles ovate, shining, and separated by a distance usually slightly greater than their length; generally less pronounced and separated by a much greater distance than are the tubercles in *O. hecate*. A very short, yellowish seta, much shorter than is usual in *hecate*, at the base of most of the tubercles. Elytral striae shining, intervals with very small, shining tubercles, the surface between finely alutaceous. The tubercles fewer and noticeably smaller than in *hecate* with the setae at their posterior margin almost invisible, those in the interspace between the second

and third striae arranged in a very irregular double row. Two small reddish-brown spots near the elytral apices; an indistinct brownish spot laterally near the middle may be present on each elytron. In some specimens the two apical spots may almost fuse. Pygidium similar to that of *hecate*, but with setae generally shorter. Ventral surfaces and legs similar to those of *hecate*, except for coarse punctures of the thorax and abdomen which are more scattered and bear shorter setae than is usual in *hecate*.

MALE MINORS.—Length 6.2 to 7.8, width 3.8 to 4.3 mm. Similar to male majors in the pronotal tubercles, length of setae, characters of elytra, and position of the brown spots. Variation is most noticeable in the rounded clypeus which is only slightly more reflexed anteriorly than laterally; often the rugose punctures extend entirely across the clypeus with the clypeal carina pronounced. Area between the clypeal carina and the frontal carina similar to that in male major; frontal carina medially weak but pronounced laterally, forming a small denticle at each side. Pronotal protuberance usually merely a broad rounded hump with its anterior lateral edges smooth and shiny. The only other noticeable difference is in the shortened forelegs, the apical end of the femur not extending to the lateral thoracic margin; tibia still slender, but only a little longer than that of the female; tibial spur rather thick and abruptly incurved near its end.

FEMALES.—Length 7 to 8.2 mm., width 4.2 to 5 mm. Differing from male majors in the following respects: Margin of clypeus evenly rounded, slightly reflexed upward, surface coarsely rugosely punctate, many of the punctures bearing short setae; clypeal carina pronounced, slightly higher medially, area between the clypeal carina and frontal carina similar to that described for male; frontal carina somewhat higher than clypeal carina, longer, only slightly higher medially, and lacking lateral denticles noted in the male minors; gena not prominent, its margin almost continuous with that of the clypeus. Pronotal tubercles of females separated by a distance greater than their length, slightly larger than the tubercles in the males and appearing slightly denser; setae arising at the base of the tubercles slightly more evident than in male majors but still very short, particularly on the disc; pronotal protuberance indicated by a vague anterior swelling delimited on each side by a small, rounded shiny hump, the humps separated by a distance approximately equal to the length of the transverse carina of the head.

Pronotum less convex than in the male major, but with outline and margin similar. Elytra in female very similar to those in male, but with tubercles slightly larger, the apical brown spots somewhat smaller and the median, lateral, brown spots often absent. Pygidium

in dorsal half rather flattened and finely alutaceous, the alutaceous sculpture becoming less evident towards the apex which is coarsely, setigerously punctate and quite convex slightly below the median line; not quite as elongate as in the male. Ventrally the female is similar to the male except that the last abdominal segment is not emarginate and the legs are slightly stockier than in the male. The forefemur and tibia considerably shortened compared to the male major, but little shorter than in the male minor; the foretibiae stockier than in either the male major or minor, with the tibial spines rather slender and curved inwardly on outer half.

TYPE.—Canadian National Collection 2870.

TYPE LOCALITY.—Royal Palm Park, Fla.

SPECIMENS EXAMINED.—861.

DISTRIBUTION.—(See fig. 11, p. 119.)

FLORIDA: Capron, Collier Co., Crescent Beach, Donnelton, Dunedin, Enterprise, Estero, Gainesville, Highlands Hammock State Pk., Homestead, Kissimmee River, La Belle, Lake Alfred, Lakeland, Lake Merion, Lake Okeechobee, Levy Co., Lutz, Marineland, Miami, Miami Beach, Ocala, Osceola Co., Orange Co., Paradise Key, Royal Palm Park, Starke, Stemper, Tampa. SOUTH CAROLINA: Beaufort, Charleston, Florence, Hartsville, Yauhannah.

REMARKS.—*O. blatchleyi* has been treated as a subspecies not because it is lacking in distinguishing characteristics, but because all the characteristics in specimens from north of peninsular Florida appear to blend with the true *hecate*. It is interesting that the characters separating *O. blatchleyi* from *O. hecate*, the widely spaced pronotal tubercles, the small elytral tubercles, the brown spots on the elytra, and the broad pronotal horn, all seem to intergrade at approximately the same time and in the same areas. Some investigators have stated that subspecies are often based on only one character and that, if based on more than one, these characters do not show simultaneous intergradation. Here at least is one subspecies that seems to disprove this point. In peninsular Florida south of Gainesville, the populations of *blatchleyi* are uniform and easily distinguishable from the more northern *hecate*. Intergradation begins to occur in a curving line between DeFuniak Springs, Fla., and coastal South Carolina, the areas of intergradation being more diffuse along the coast and more distinct inland. The brown elytral spots are present in some of the specimens taken near Clarksville, Fla., but are entirely absent in any specimens the writers have seen from Mobile, Ala. Likewise, specimens from Savannah, Ga., though having rather small pronotal tubercles, usually lack the brown spots. Hundreds of specimens of *hecate* have been examined, but only relatively rarely have the brown spots been noted in more northern specimens exhibiting the other characters of the true *hecate*.

The subspecies *O. h. blatchleyi* can be separated from other closely related species in the same way as *O. h. hecate* is separated; it is separated from *O. hecate* by the characters discussed above.

No difference has been noted in the habits of *O. h. blatchleyi* and typical *hecate*. The Florida subspecies was collected at cow dung, small animal droppings, decaying fruits, and the fermenting malt-propionic acid mixture. Specimens were taken both in the sandhill areas and in the low hammock areas of south Florida. Some specimens were taken at Paradise Key on raccoon dung.

Despite numerous adult records, the immature stages have not been found.

Onthophagus nuchicornis (Linnaeus)

PLATE 9, FIGURES 81 AND 82

Scarabaeus nuchicornis Linnaeus, 1758, p. 347.—Melsheimer, 1806, p. 3.

Onthophagus nuchicornis (Linnaeus) Curtis, 1825, No. 52.—Henshaw, 1885, p. 87.—Schaeffer, 1914, p. 297.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 207.—Burmeister, 1930, p. 562.—Boucomont, 1932, p. 318.—Brown 1940, p. 72; 1950, p. 200.—V. Lengerken, 1954, p. 207.—Landin, 1956, p. 7.

Onthophagus rhinoceros Melsheimer, 1846, p. 134.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36 (footnote).—Horn, 1875, p. 141.

Onthophagus rhinocerus [sic] (Melsheimer), Haldeman and LeConte 1853, p. 54.
Onthophagus Xiphias? LeConte, 1863, p. 36 (footnote).

MALE MAJORS.—Length 7.3 to 8.1 mm., width 4.4 to 4.7 mm. Head and pronotum black, elytra tan mottled with black, with suture and base black; pygidium, ventral surfaces and appendages black. Head with clypeus slightly reflexed anteriorly, vaguely emarginate; otherwise the outline of clypeus and genae evenly arcuate and nearly semicircular. Disc of clypeus shining, very finely punctate anteriorly, becoming moderately punctate laterally and posteriorly; laterally, the punctures elevated anteriorly to form a more or less distinct tubercle, and each bearing short, tan seta; genae similarly punctate. Clypeus and frons separated by a difference in elevation, the frons slightly higher; frons strongly arcuate forward and narrowly smooth along anterior edge, moderately punctate, the punctures more widely separated posteriorly. Vertex armed with a single, very distinctive cylindrical median horn; the horn equal in height to the anterior convexity of the pronotum and broadly flared or transversely flattened basally with an angulation or denticle on each side near basal third of its height.

Pronotum weakly shining, completely margined, poorly so posteriorly, anterior angles rounded; disc moderately convex, slightly tumid anteriorly with a vague shallow, rather broad concavity medially behind the cephalic horn; surface coarsely, shallowly punctate; posteriorly the punctures nearly circular, separated by a distance

approximately equal to their diameter, and with an extremely short seta in the center of each puncture; laterally the setae becoming longer, usually quite evident near the anterior angles; anteriorly the punctures becoming more crowded and raised along their anterior edges, a tuberculate appearance produced; surface between the punctures very finely alutaceous. Elytral striae shallowly punctate; intervals, except for the sutural one, generally irregularly biserially tuberculate, with a short, tan seta at the base of each tubercle; elytral surfaces weakly shining, finely alutaceous between the striae and tubercles. (Although the amount of black and tan mottling on specimens ranges from largely tan elytra to black elytra with occasional tan spots, there is usually more tan than black.)

Pygidium coarsely, shallowly punctate; each puncture bearing a short, tan setae; surface between the punctures finely alutaceous. Ventral surfaces of thorax coarsely punctate except at impunctate midline of metathorax; most of the punctures bearing long, reddish setae. Abdomen largely impunctate except for a few scattered basal punctures on the last three segments, last segment emarginate to receive the pygidium. Forelegs not elongate, similar to those of female except that the four tibial teeth are more slender; outer surface of foretibia coarsely punctate. Mesothoracic and metathoracic femora with scattered coarse and fine punctures, the coarse ones usually bearing setae.

MALE MINORS.—Length 6.3 mm. to 6.8 mm., width 3.6 to 3.8 mm. Differing from the male majors in the following respects: Clypeus less extended, disc and frons more heavily punctate, the punctures often bearing reddish setae; clypeal carina barely evident as in male major; carina and horn of vertex greatly reduced in height. The carina with a truncated low triangular shape when viewed frontally, the median cylindrical horn barely indicated. Pronotum less convex, barely tumid anteriorly, the tumosity with few punctures and flat but not concave to receive the horn; setae more evident in male minor, being longer on the disc than in the male major. Elytra, pygidium, and ventral surfaces similar to those of male majors.

FEMALES.—Length 6.3 to 8.0 mm., width 3.4 to 4.5 mm. Differing from the male majors as follow: Clypeus less elongate, shallowly emarginate, rather closely punctate, often finely rugose posteriorly; clypeal carina pronounced, arcuate, evenly elevated, and extending the width of the frons; gena delimited from the clypeus by a faint suture, frons behind clypeal carina with scattered, coarse, setigerous punctures; frontal carina very strong, evenly elevated, extending to posterior margin of the eyes; posterior surface of carina with scattered, coarse, setigerous punctures.

Outline of pronotum generally similar to that of male major, but less convex and with a median conical protuberance projecting slightly beyond the anterior margin, occasionally reduced to a poorly defined arcuate ridge but usually well developed and quite similar to the male major pronotal hump in such species as *O. texanus*, *O. subaeneus*, and *O. knausi*; punctures of disc similar to those of male but with the setae occasionally longer and more noticeable. Elytra with tubercles slightly larger but otherwise similar to those of male major. Pygidium less convex than in male, coarsely punctate, smooth surfaces finely alutaceous. Ventral surfaces not differing significantly. Teeth of the prothoracic tibia basally thicker than in the male, in other respects alike in the two sexes. Last abdominal segment not narrowed medially to receive the pygidium.

TYPE.—Collection of the Linnean Society, London (Landin, 1956, p. 7).

TYPE LOCALITY.—Europe.

SPECIMENS EXAMINED.—358.

DISTRIBUTION.—(See fig. 10, p. 100.)

CANADA: ALBERTA: Christina Lake. BRITISH COLUMBIA: Creston, Elko, Marysville, Osoyoos. NEW BRUNSWICK: Grand Manon, Miscow Harbor [sic], St. John. NEWFOUNDLAND: Harmon Field. NOVA SCOTIA: Windsor, Halifax. ONTARIO: Chalk River, Honey Harbor, Irondale, Marmora. QUEBEC: Duparquet, Joliette, Kazabazua, Knowlton, Montreal.

UNITED STATES: CONNECTICUT: Canaan, Pomfret. IDAHO: Granite, Priest Lake (Boumer Co.), Sagle. MAINE: East Machias, Millnocket, Old Orchard, West Bethel. MARYLAND: Ridgely. MASSACHUSETTS: Amherst, Barnstable (Cape Cod), Blue Hill, Boston, Clinton, Forest Hills, Framingham, Ipswich, Milton, Hyannis, North Saugus, Salisbury Beach, Sherborn, Wilbraham, Woods Hole. MICHIGAN: Cheboygan, Douglas Lake, Molasses River, Wilson State Pk. MONTANA: Glacier National Pk. NEW HAMPSHIRE: (State label). NEW JERSEY: Berlin, Camden, Dumont, Gloucester, Reed Beach (Cape May Co.), Riverton. NEW YORK: Albany, Brooklyn, Flatbush, Ithaca, Mt. Hurricane (Essex Co.), Mt. Whiteface, Orient, Plattsburg, Port Gibson, Schroon River, Utica, Waverly, Woodville. PENNSYLVANIA: Broomall. RHODE ISLAND: Providence. VERMONT: Stowe. VIRGINIA: (State label; this seems doubtful). WISCONSIN: Oconto Co., Oneida Co.

REMARKS.—This European species, which has become widely established in North America, may be distinguished from the American species by its moderately large size (6 to 8 mm.), black head and thorax, and brown elytra mottled with black. Dorsally the pronotum is coarsely punctate and finely alutaceous between the punctures. The males can be easily recognized by the presence of a single median horn arising from the vertex.

While little has been recorded on the habits of the species in North America, the life cycle in Europe has been described in detail by Burmeister (1930) and by von Lengerken (1954, pp. 207-235).

In Canada and the United States, the species has been taken at cow and horse dung. It is now established on both the east and west coasts of Canada and the United States, probably by separate introductions. The history of its spread in North America has been discussed by Brown (1940; 1950).

Onthophagus depressus Harold

PLATE 9, FIGURES 79 AND 80

Onthophagus depressus Harold, 1871, p. 116.—Boucomont and Gillet, 1927, p. 165.—Cartwright, 1938, p. 114.—Blackwelder, 1939, p. 50.—Robinson, 1948, p. 177.

This southeast African species has become established in Georgia and Florida. It is quite different from the endemic *Onthophagus* of the United States and, unlike the native species, lacks obvious secondary sexual characters. The external differences distinguishing the male are the emarginate narrowed last abdominal segment and a tibial tooth directed inwards beside the apical spine. Because the secondary sexual characters are few and inconspicuous, the following description includes both sexes.

MALES AND FEMALES.—Length 6.0 to 7.7 mm., width 3.7 to 5.0 mm. Brownish black to black with antennal clubs brown, legs dark reddish brown. Clypeus slightly reflexed anteriorly, sharply, narrowly emarginate, bidentate; disc with elongate transverse tubercles, punctures lacking, surface between tubercles smooth and shining; disc posteriorly delimited from the frons by a vague arcuate carina; genae scarcely flared, surface rough, tubercles irregular; frons nearly flat, tubercles smaller and less elongate than on clypeus, occasional punctures present. Carina of vertex low, often hidden by the anterior pronotal margin; when visible, the carina vaguely depressed and bowed forward medially; area behind the carina smooth and shining. Pronotum completely margined, poorly so posteriorly; anterior angles produced, forming an acute angle bent outward at the tip.

Pronotum convex, more so in large males than in females and diminutive males; surface very closely punctate, the punctures unusual in that they have an elongate flattened tubercle which projects toward their center from the anterior margin and gives the large shallow punctures a crescent shape; anteriorly the pronotum often appearing more tuberculate than punctate, with a short flat stubby seta projecting from each puncture. Superficially the pronotum appears exceedingly rough and granular. Elytra heavily punctate-tuberculate as described for the pronotum, the punctures nearly circular and not as crowded as on the pronotum; elytral striae barely indicated; each interval with two to three rows of flat yellow setae.

Pygidium coarsely, shallowly punctate; each puncture bearing a short, flat, yellow seta, tubercles lacking. Ventral portions of the thorax with scattered coarse punctures, each bearing a long, reddish seta; surface between punctures smooth and shining. Abdominal segments, except for apical one, having across their bases a regular row of coarse punctures; laterally many of the punctures bearing reddish setae. Last segment in male emarginate (narrowed) medially, approximately twice as wide as adjacent segment; last segment in females not narrowed medially, and longer than the combined length of the preceding three segments. Legs similar for both sexes, except for the foretibia of the male which has its inner apical surface prolonged into a spine approximately the length of the first tarsal segment; this projection when seen beside the usual tibial spine, which is present in both sexes, giving the apex of the male tibia an unusual bispinate appearance.

TYPE.—Present location unknown to us.

TYPE LOCALITY.—Caffraria, southeast Africa.

SPECIMENS EXAMINED.—315.

DISTRIBUTION.—(See fig. 4, p. 29.)

GEORGIA: Lyons, Vidalia, Wenona. FLORIDA: Lake Placid, Sebring.

REMARKS.—This species can be separated from other North American *Onthophagus* by the sharply emarginate, bidentate, transversely tuberculate clypeus. The rough appearance of the pronotum, the crescent-shaped punctures with the flat anterior tubercle, and the short, stubby, yellow setae all serve to distinguish the species. Also characteristic is the bispinous apical end of the male foretibia and extremely wide last abdominal segment of the female.

The species is a dung feeder. An extensive series of specimens was collected in the vicinity of Lyons, Ga., on cow dung and at light by the late P. W. Fattig.

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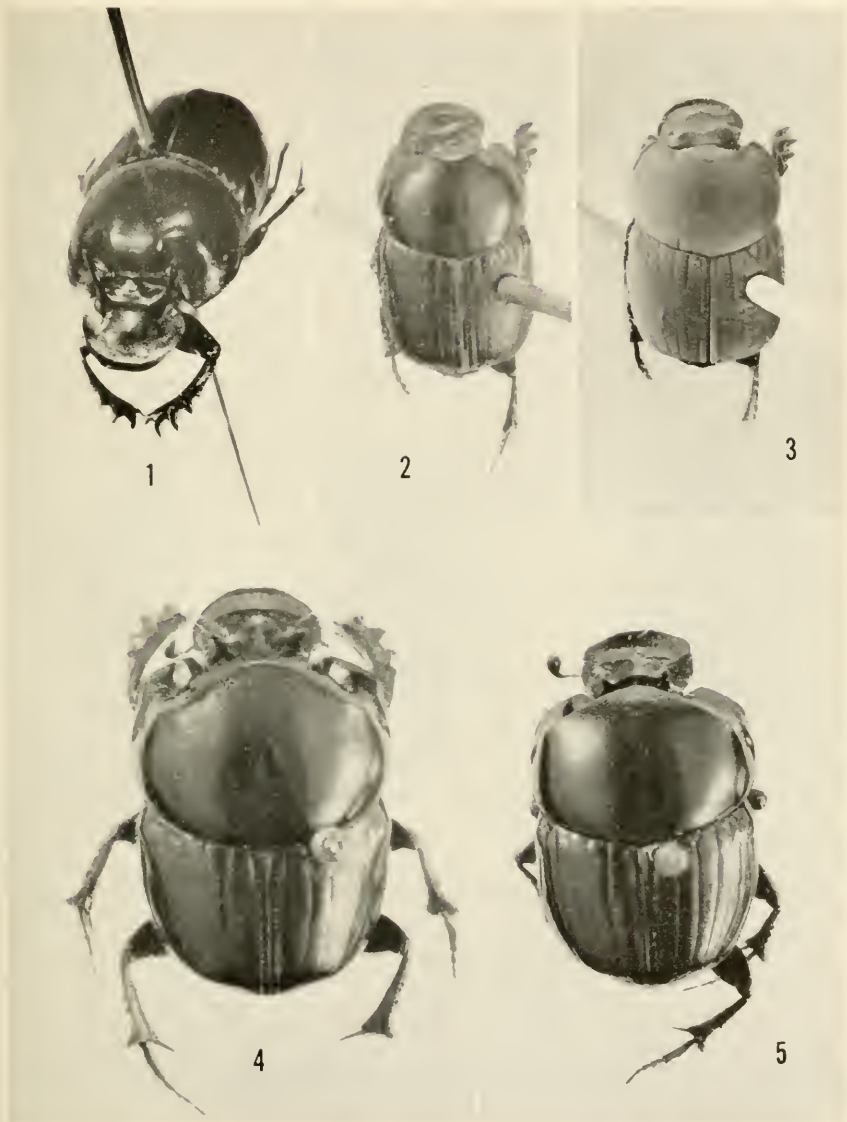
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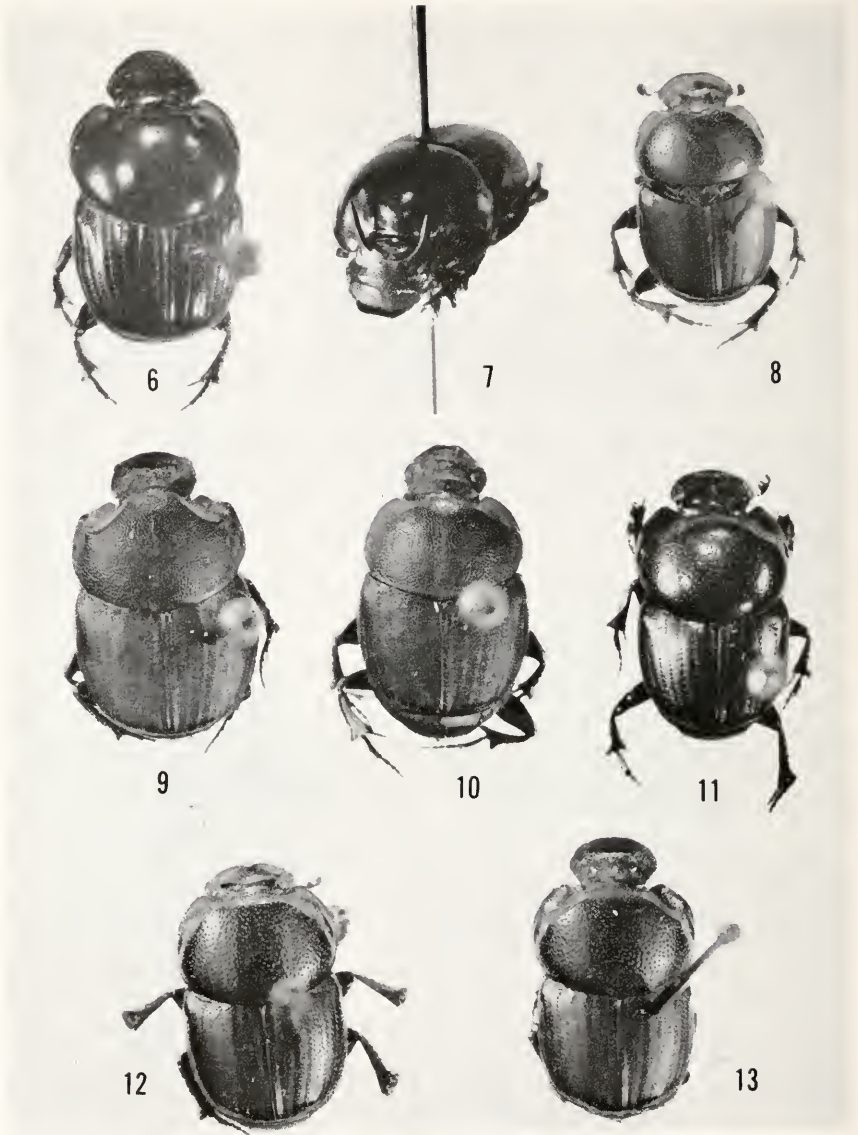
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Plates

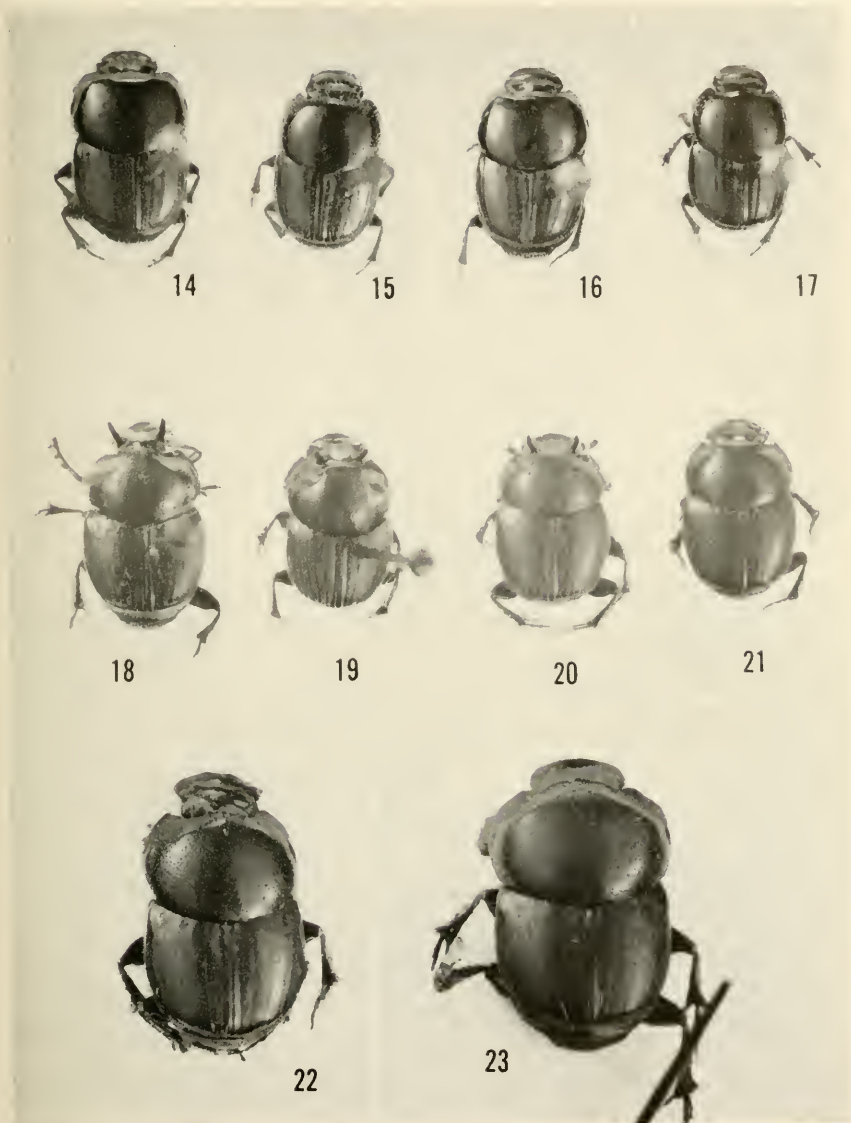
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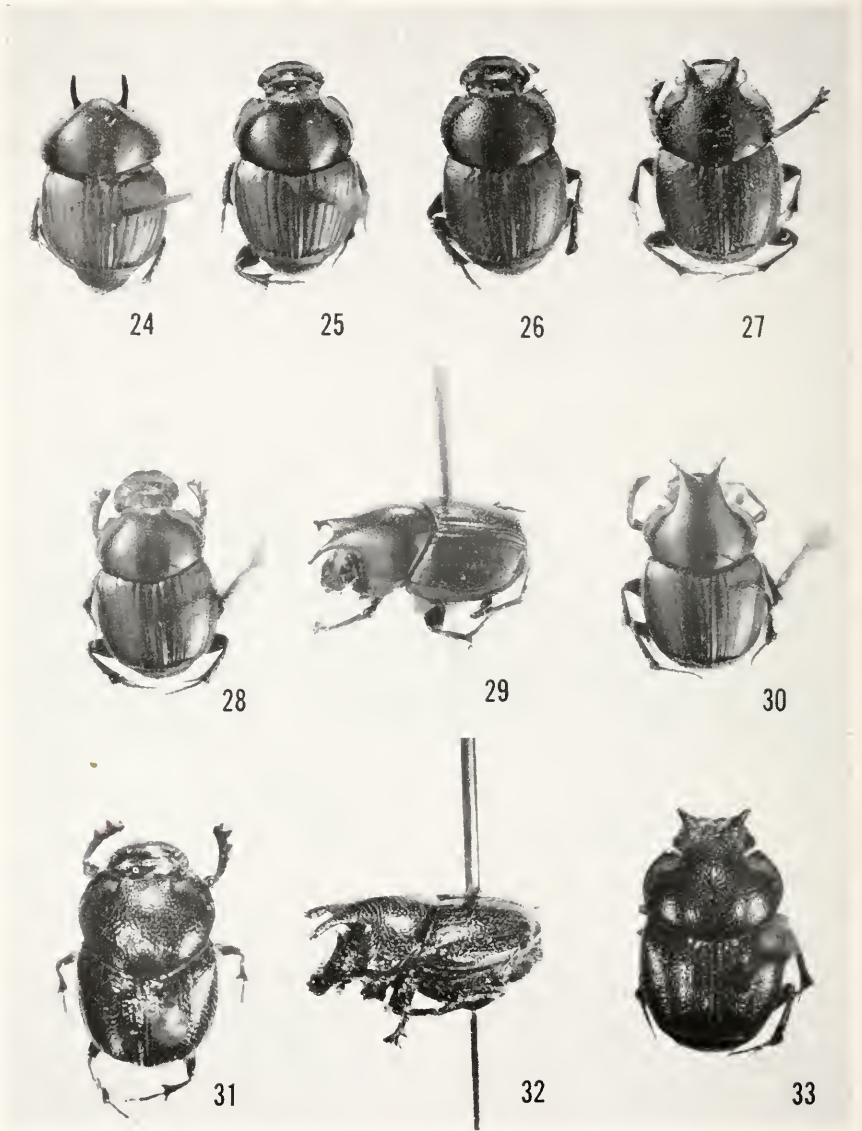
1-3, *Onthophagus incensus* Say: 1, ♂; 2, ♀ (holotype); 3, ♀ (holotype smoked to show cephalic carinae). 4, 5, *O. coproides* Horn: 4, ♀; 5, ♂.



6, 7, *Onthophagus batesi*, new species: 6, ♀; 7, ♂. 8, *O. subtropicus*, new species: ♀. 9, 10, *O. cochisis* Brown: 9, ♂; 10, ♀. 11, *O. subtropicus*, new species: ♂ (holotype). 12, 13, *O. brevifrons* Horn: 12, ♀; 13, ♂.



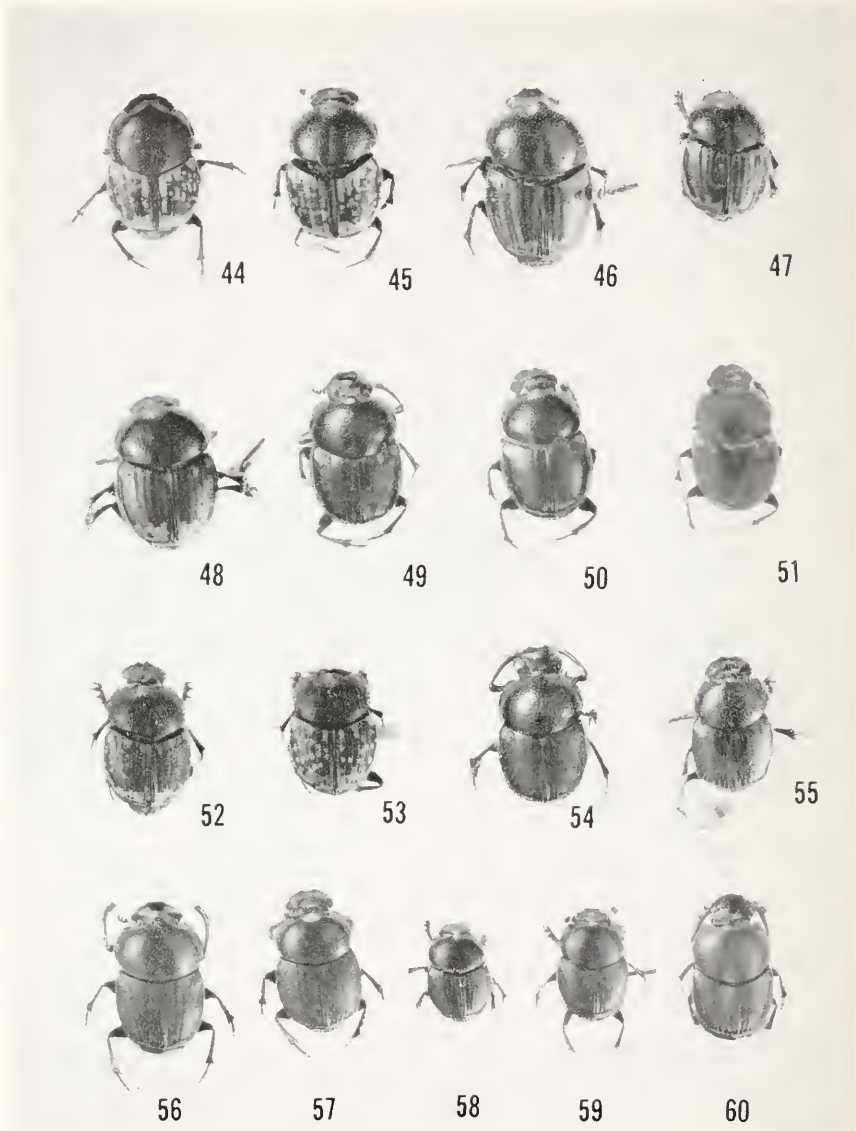
14, 15, *Onthophagus polyphemi polyphemi* Hubbard: 14, ♂; 15, ♀. 16, 17, *O. polyphemi sparsisetosus*, new subspecies: 16, ♂; 17, ♀. 18-21, *O. striatulus striatulus* (Palisot de Beauvois): 18, ♂; 19, ♂; 20, ♂; 21, ♀. 22, 23, *O. cavernicollis*, new species: 22, ♀; 23, ♂.



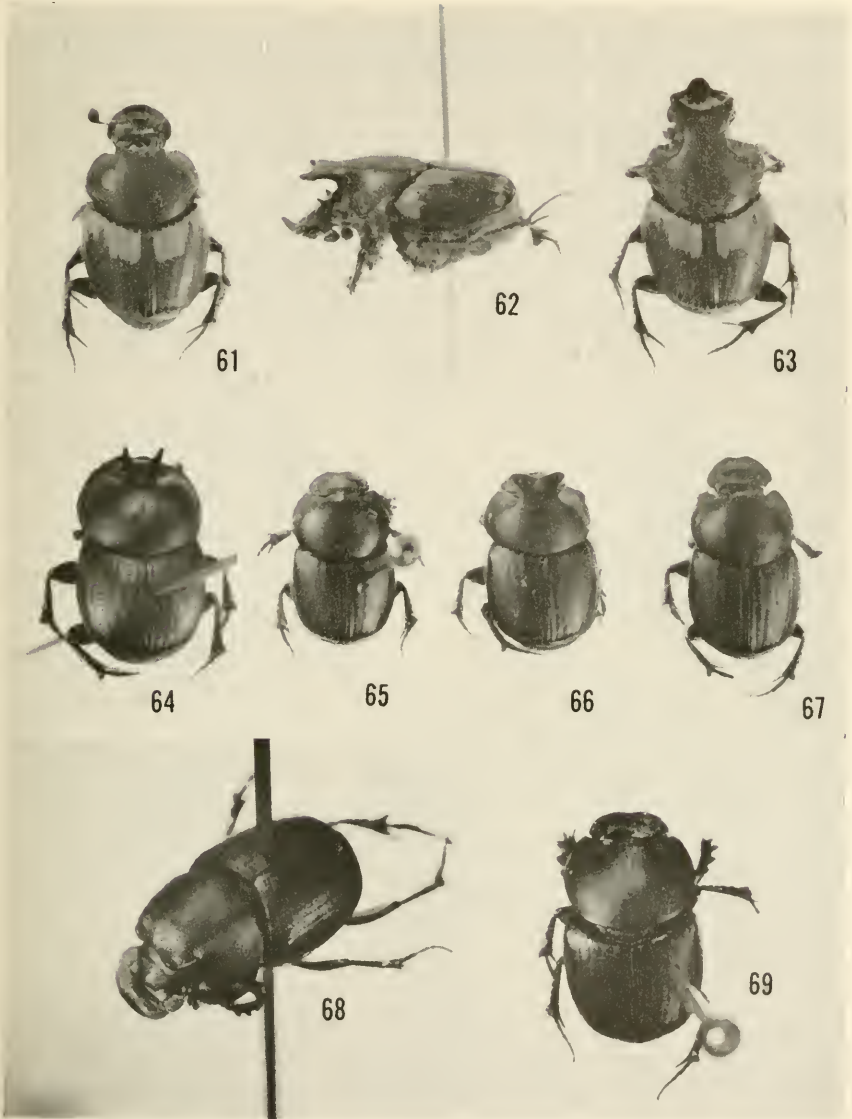
24, 25, *Onthophagus striatulus floridanus* Blatchley: 24, ♂; 25, ♀. 26, 27, *O. orpheus orpheus* (Panzer): 26, ♀; 27, ♂. 28-30, *O. orpheus canadensis* (Fabricius): 28, ♀; 29, ♂; 30, ♂. 31-33, *O. orpheus pseudorpheus*, new subspecies: 31, ♀; 32, ♂; 33, ♂.



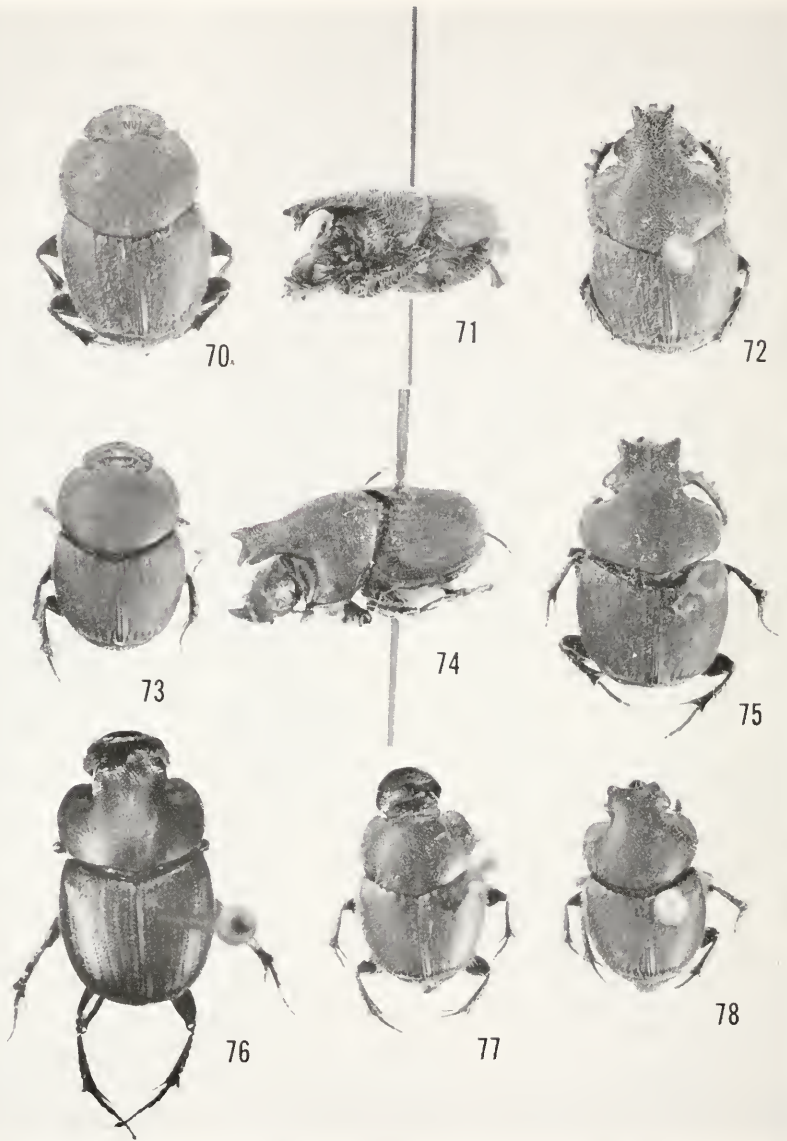
34, 35, *Onthophagus knulli*, new species: 34, ♂; 35, ♀. 36, 37, *O. alluvius*, new species: 36, ♀; 37, ♂. 38, 39, *O. monticolus*, new species: 38, ♀; 39, ♂. 40, 41, *O. subopacus* Robinson: 40, ♀; 41, ♂. 42, 43, *O. cynomysi* Brown: 42, ♀; 43, ♂.



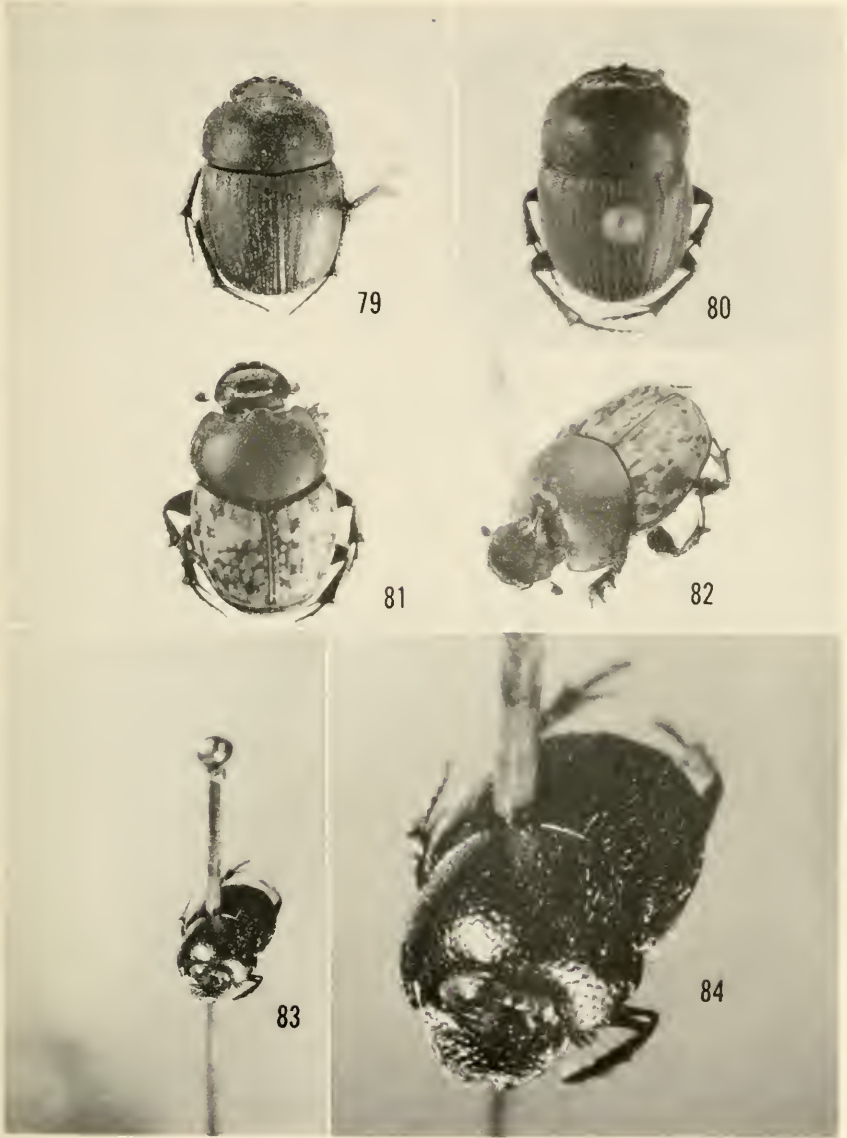
44, 45, *Onthophagus höpfneri* Harold: 44, ♂; 45, ♀. 46-48, *O. landolti texanus* Schaeffer: 46, ♂; 47, ♀; 48, ♀. 49-51, *O. schaefferi*, new species: 49, ♂; 50, ♀; 51, ♀. 52, 53, *O. tuberculifrons* Harold: 52, ♀; 53, ♂. 54, 55, *O. subaeneus* (Palisot de Beauvois): 54, ♂; 55, ♀. 56, 57, *O. knausi* Brown: 56, ♂; 57, ♀. 58, *O. oklahomensis* Brown, ♀. 59, 60, *O. pennsylvanicus* Harold: 59, ♀; 60, ♂.



61-63, *Onthophagus concinnus* Laporte: 61, ♀; 62, ♂; 63, ♂. 64, 65, *O. velutinus* Horn: 64, ♂; 65, ♀. 66, 67, *O. browni*, new species: 66, ♂; 67, ♀. 68, 69, *O. arnetti*, new species: 68, ♂; 69, ♀.



70-72, *Onthophagus hecate hecate* (Panzer): 70, ♀; 71, ♂; 72, ♂. 73-75, *O. hecate blatchleyi* Brown: 73, ♀; 74, ♂; 75, ♂. 76, *O. arnetti*, new species: ♂. 77, 78, *O. medorensis* Brown: 77, ♀; 78, ♂.



79, 80, *Onthophagus depressus* Harold: 79, ♀; 80, ♂. 81, 82, *O. nuchicornis* (Linnaeus): 81, ♀; 82, ♂. 83, 84, *O. aciculatus* Blatchley: 83, ♂; 84, ♂ (enlarged to show cephalic tubercles).

