

Scarabaeus

A NEWSLETTER FOR THOSE INTERESTED IN SCARABAEIDAE

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The first number of this newsletter was sent out to about 75 addressees, comprising a list of individuals known to the editors to be interested in Scarabaeidae, supplemented with names taken from reprint request cards which were sent for papers on Scarabaeidae. For the present time this list was restricted to addresses in the United States and Canada. There were several reasons for this, the most important being the difficulty imposed upon foreign readers in obtaining U.S. postage stamps for return envelopes. Unfortunately, this has apparently been more of a problem than we expected for our Canadian addressees; several have sent money for postage with the self-addressed envelopes. The editors are only too happy to assist those having postage problems.

The initial response to the newsletter has been generally favorable, although a few questions have arisen which merit response. First, this newsletter was to be a stimulus to collectors, be they amateur, semi-professional, or professional entomologists, to fill in gaps in the knowledge of North American Scarabaeidae. To this end, and because we wanted to start slowly, articles on non-nearctic groups were not envisioned for the early numbers. For reasons of postage, foreign exchange and the like, a nearctic mailing was initially undertaken. As this newsletter matures, we expect to include a broader geographical base and an increased mailing list.

Second, the "recent literature" notices are of worldwide literature, primarily taxonomic and ecological-biological, from 1978 to the present (1977 to present on larger works). Some of these are not at hand when these listings are written. For this reason, as well as time and space limitations, it is not possible to summarize the contents of each citation.

Third, there is a real possibility (as has been expressed) of the editors running dry on topics of interest. We are definitely interested in a broad scope of submitted material. We hope to become editors and not writers.

It should be kept in mind that this newsletter is not a formal publication in the sense of the code of Zoological Nomenclature and, thus, can be quite informal.

As mentioned above, the initial mailing was to about 75 addressees. Several of these were returned as undeliverable. To date, 31 people have responded with envelopes. THIS IS THE LAST NEWSLETTER THAT WILL BE SENT OUT FREE!

DUNG BEETLE NESTING BEHAVIOR

The Scarabaeinae provide an excellent opportunity for simple, yet highly productive observation of insect nesting behavior. Very few insect groups are as easily studied in the laboratory, whether it is in a garage or university complex. Using a few simple techniques, professional or amateur alike can contribute much important information about how these beetles nest, their life cycles and immature stages. This is the first of a two-part article on dung beetles. My main purpose is to stimulate interest in observing these beetles, particularly their behavior. This part focuses on the nesting behavior of the subfamily; the second part, which will appear in a future issue, will deal with techniques of observing nesting behavior.

"Dung beetle" is a colloquial reference to any beetle which utilizes excrement as a food source. Coprophagous Scarabaeidae are included in three subfamilies: Scarabaeinae, Geotrupinae and Aphodiinae. There are a few other, very small subfamilies which include coprophagous species, but these are rare and occur outside North America; they will not be dealt with here. By far the highest incidence of coprophagy is among the species of Scarabaeinae; and it is these beetles which are most commonly referred to as dung beetles in the United States. Reference below to "dung beetles" or scarabaeines are equivalent to Scarabaeinae.

The commoner scarabaeines in the United States belong to the genera Copris, Phanaeus, Canthon, (the common "tumblebugs"), Onthophagus and Dichotomius (the correct name for Pinotus). Other genera include Melanocanthon, Pseudocanthon, Ateuchus (= Choeridium) and Deltochilum. Almost all U.S. species of these and the few other rare genera are coprophagous. Yet, in spite of their name, not all scarabaeines are exclusively dung feeders. A few specialize on other food sources, such as carrion and fungi; many normally coprophagous species will occasionally feed from these same substances. Of those which are regularly (or exclusively) coprophagous, very few restrict their feeding to certain kinds or classes of excrement. Therefore, most dung eaters will exploit cowdung, human excrement, swine dung, etc., as available, although human excrement is by far the most attractive and equine and ovidung are the least attractive (probably because they contain less water than other types). Those species which specialize on a particular kind of dung almost always occupy some restricted habitat; for example, there are several Onthophagus inhabiting the nests of burrowing animals which will normally accept only the excrement of their "host" as a food source. Species which are normally not coprophagous usually have specialized feeding habits; that is they feed on fungi, or carrion or rotting fruit, etc.

Scarabaeines locate their food by relying mainly upon olfactory stimuli. After finding a food source (say, a fresh cow pat), these beetles relocate a portion of it for their own feeding or nesting activities. Food relocation behavior is common to both feeding and nesting behavior and is accomplished by one of two primary methods: (a) by packing pieces of food into the blind end of a burrow dug beforehand beneath or near the food source, or (b) by rolling away for some distance and burying intact a ball fashioned from a piece of the food source. Depending upon the method used for food relocation, scarabaeines can be loosely classified behaviorally as either burrowers or ball-rollers. Ball-rollers are confined to the tribe Scarabaeini and are known as "tumblebugs" in the U.S. and "ruedacacas" in Mexico. All other U.S. species are burrowers and belong to the tribes Onthophagini, Coprini, Onitini and Oniticellini. (The other tribe, Eurysternini, is not found in the United States; Onitis alexis, the only U.S. onitine, has been introduced from Africa via Australia into California and Texas.)

A BRIEF INTRODUCTION TO SCARABAEINE NESTING BEHAVIOR

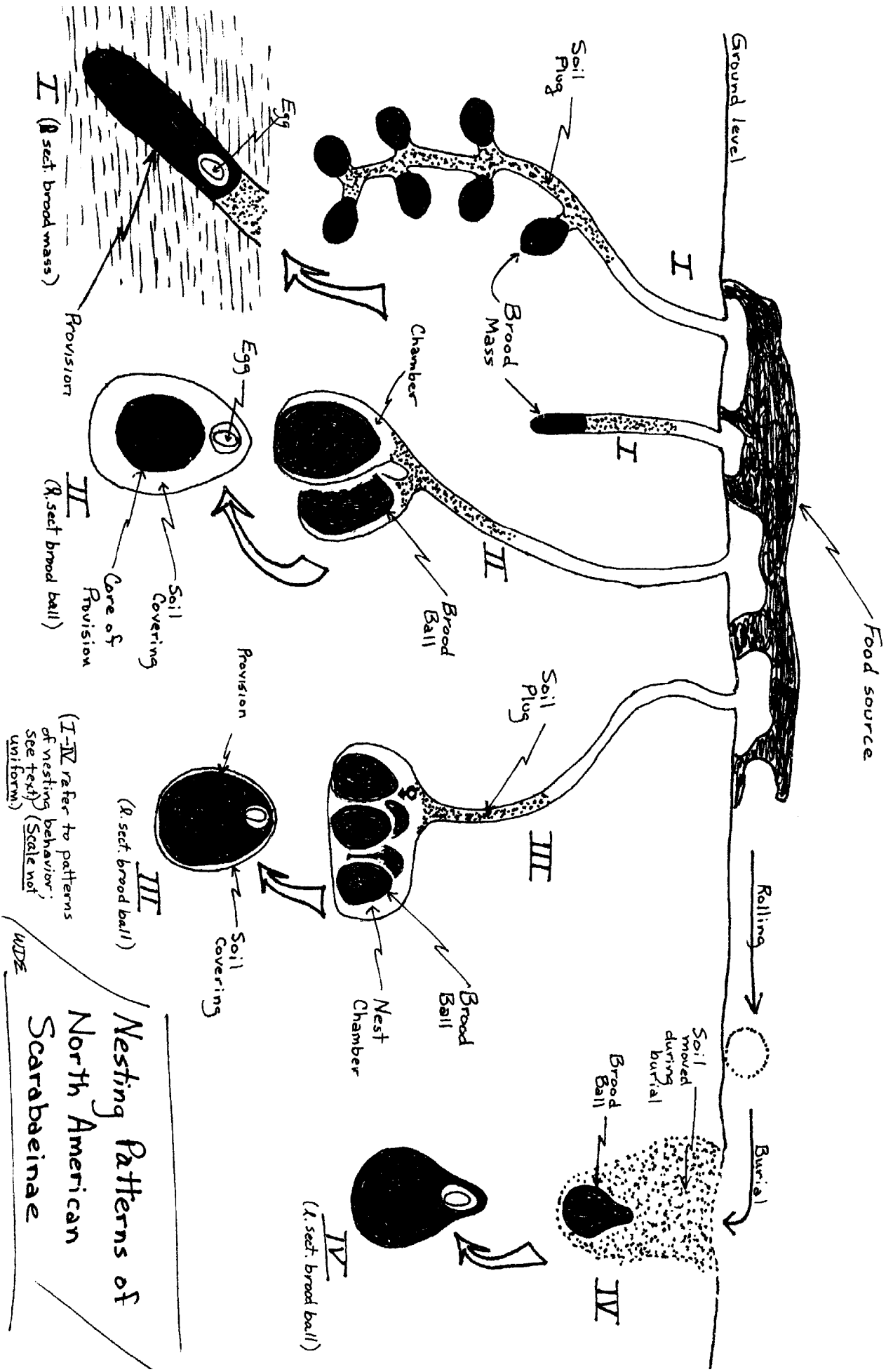
Nesting (nidification) behavior is best considered an extension of feeding behavior in Scarabaeinae. That is, for most groups, the initial phases of nesting behavior are the same as those used to secure food. There is no "normal" nesting behavior for the subfamily. Rather, several criteria provide a convenient basis for defining various patterns of behavior: location of the nest, whether or not a brood mass or brood ball is made, whether or not the female cares for the nest after it is completed, the number of brood balls (or masses) the nest contains, to mention but a few. To date, I and my colleague, Dr. Gonzalo Halffter of Mexico, have recognized seven such patterns (designated Pattern I Nesting Behavior, etc.). The main results of nesting behavior are (a) the adults provide food for progeny, (b) offspring are provided for individually and are limited to this provision as a food source (they cannot forage), (c) each offspring is physically restricted to the confines of its provision, and (d) each developing individual is isolated from siblings by the manner the nest is constructed. These features are shared only with Geotrupinae, from which Scarabaeinae differ only in the much greater extent to which nesting behavior has diversified.

There is an important distinction in the form of the provision as supplied to each offspring. A brood mass is a quantity of food packed into a gallery; each such packing receives a single egg in a distinct chamber. A brood mass takes the shape of the space into which provision was packed and may be spheroid to cylindrical. A brood ball is a quantity of provision modeled by the adult into a spheroid, to which an outer layer of soil may be added; each brood ball contains a single egg in a special chamber. Except in the case of ball rollers, the brood ball of which is made at the food source and later buried, brood balls are either constructed and remain on the surface (superficial nesting) or are constructed underground in a distinct chamber (subterranean nesting).

Following is a brief description of each of the four nidification patterns known for United States Scarabaeinae. The accompanying diagram depicts examples of finished nests for each group and of a longitudinal section view of the brood mass/ball before the egg has hatched. The larva gradually hollows the provision as it feeds, creating a cavity within which pupation occurs.

Pattern I: The adult (usually only the female nests) constructs brood masses in an underground tunnel or tunnel system; each receives an egg in a specially made chamber. The provision used can be brought down directly from the food source, or can be first stored in a blind side branch of the nest tunnel. A nest can contain a single brood mass; or from two to many arranged linearly in a single tunnel, in a branching system or in a combination of both. No brood balls are made and the female abandons the completed nest to construct more. All Pattern I species are burrowers; in the U.S. they belong to the genera Onthophagus, Dichotomius, Ateuchus and Oniticellus. After completing development, the larva uses its own feces to construct a spherical or cylindrical pupation chamber within the hollowed remains of the brood mass.

Pattern II: Provision is usually first stored in a side branch of the main nest gallery by the female, who may be aided by the male. From this supply, the female constructs usually two brood balls one at a time, each in a separate chamber. A quantity of provision is first compressed into a ball; a thick layer of compacted soil is added to the outer surface of the provision, which becomes a food core. The egg chamber is formed in the upper pole of the soil covering of the brood ball such that the egg is isolated from the provision. The nest is abandoned after completion. The larva does not construct a pupation within the brood ball. Pattern II nesting behavior is known only for Phanaeus among U.S. species.



(I-IV refer to patterns of nesting behavior; see text) (Scale not uniform)

WDE
 Nesting Patterns of
 North American
 Scarabaeinae

IV
 (1 sect. brood ball)

Pattern III: A pair of beetles first constructs a gallery terminating in a spacious chamber. A large quantity of food is packed into the chamber and later compressed into a loaf-like mass (the dung "cake"). The access burrow is then plugged. From the "cake" the female (presumably unaided by the male, who may have abandoned the nest before plugging) fabricates from three to seven brood balls, each of which receives an egg in a special chamber within the provision. Each brood ball is covered by a thin layer of soil. The female remains in the nest caring for the brood balls until emergence of her progeny or until she dies. As she broods, she frequently changes the positions of the brood balls and retouches their outer surfaces. Larvae do not construct a pupation cell; each pupates within its hollowed brood ball after lining the inner surface with feces. Of U.S. genera, only Copris exhibits Pattern III nesting behavior.

Pattern IV: A pair of beetles jointly constructs a ball from a portion of the food source. Together, usually with the male pushing and the female pulling or balancing topside, they roll the ball some distance away. It becomes buried as the beetles remove soil from beneath it. After burial, the female reshapes the ball, which becomes pear-shaped, and a single egg is laid in the smaller, upper end in a special chamber and the nest is abandoned. The larva does not construct a pupation cell; it pupates within the hollowed brood ball after lining it with feces. Species of the U.S. genera Canthon, Melanocanthon, and Pseudocanthon are Pattern IV nesters.

The above descriptions are purposefully brief and do not include details or variations known for non-U.S. species. Moreover, the accompanying diagram illustrates only the general aspects of nest architecture. (to be continued)--W.D.E.

A QUESTION ON POLYPHYLLA COMES

Lester Lampert (17 Hillview Circle, Asheville, North Carolina 28805) writes that "Over the years [he has] taken literally hundreds of them [P. comes] at light. Yet, based on antennal structure, [he has] never taken a female." He has been told by collectors that they have specimens, but could not... "produce one. Another good collector has told [him] that the female was not known." Any answers to this will be published in the next newsletter if sent to the editors.

NOTICES

- Arthur Evans (12551 Lorna, Apt. B, Garden Grove, California 92641) has an exchange list and would like trades.
- WANTED - Melolonthinae from anywhere in the world except United States and Western Europe. Identified or not. Will purchase or exchange. Contact A. R. Hardy, Insect Taxonomy Laboratory, Room 340, 1220 "N" Street, Sacramento, California 95814.
- WANTED ON LOAN - Scarabaeidae from Baja California. Will identify. A. R. Hardy, Insect Taxonomy Laboratory, Room 340, 1220 "N" Street, Sacramento, California 95814.
- WANTED - Any information on Micraegialia for future newsletter inclusion.

U. S. CERATOCANTHUS

The scarab genus Acanthocerus MacLeay, was preoccupied at the time of description and, in 1842, White proposed Ceratocanthus as a replacement name. This was largely overlooked, and workers continued to use Acanthocerus and Acanthocerinae. Martinez (1968 and later) rediscovered Ceratocanthus, and proposed Ceratocanthini for the higher category. Cartwright and Gordon (1971) followed suit. Woodruff's "The Scarab Beetles of Florida" (1973) was already set in type using Acanthocerus, but the change to Ceratocanthus was noted as a footnote.

At the present, there are three species of Ceratocanthinae known from the U.S., 2 Cloeotus and Ceratocanthus aeneus (MacLeay). C. aeneus has proved to be a very rare scarabaeid. In the hope that further light can be thrown upon the habits, distribution, etc. of this species, we have reprinted below the relevant and, we feel, interesting information compiled by Dr. Woodruff from "The Scarab Beetles of Florida" (Vol. 8, Arthropods of Florida... Florida Department of Agriculture, 1973).

The habits are not well known, and most specimens have been collected under bark or by beating dead limbs. At least some species are termitophilous (Boucomont, 1936). Philarmostes is associated with termites in Madagascar and Costa Rica, and two species of Acanthocerus are associated with termites in Brazil (Ritcher, 1958:325). Ohaus (1909) stated that both

adults and larvae appear to feed on rotten wood. Although Ritcher (1966) mentioned, under Acanthocerinae, that the Asiatic Haroldius is myrmecophilous, this genus is a member of the subfamily Scarabaeinae. I have reared two specimens of Cloeotus globosus from the frass in burrows of Popilius disjunctus (Ill.) (Psalidae). Although Edwards (1949a:52) indicated that: "Acanthocerus aeneus MacL. is said to occur on flowers of several species . . .", I have not been able to verify this reference, and I doubt its validity. Cloeotus aphodioides stridulates loudly (Alexander, Moore, and Woodruff, 1963:113), but the significance of these sounds has not been determined. The morphology of the stridulatory organs is also unknown. It is possible that the numerous incised lines of the venter and legs play some role in sound production. Some species of Cloeotus are found in early spring congregated under loose bark (in hibernation?), and others have been collected at lights.

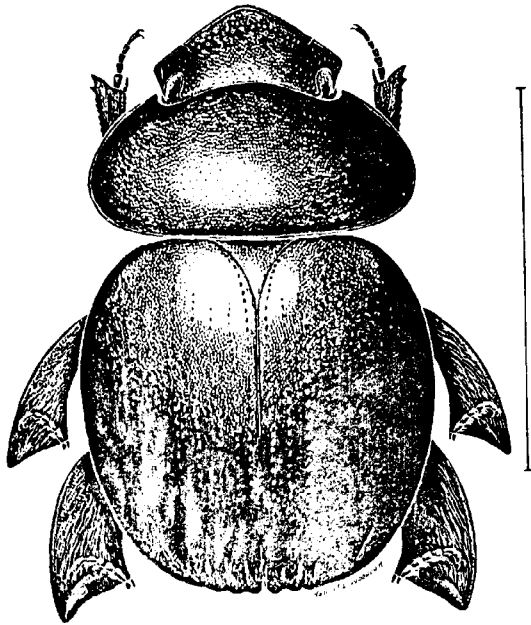


Fig. 371. Acanthocerus aeneus MacL., line = 5mm.

Since this was set in type, Cartwright and Gordon (1971, Scarabaeidae of Micronesia) pointed out some neglected literature involving an old homonym of Acanthocerus. They state that the correct name for the type genus should be Ceratocanthus, and therefore the subfamily should be Ceratocanthinae.

Genus ACANTHOCERUS MacLeay

(Fig. 371, 383, 388, 392-93)

Acanthocerus MacLeay 1819:136.

Sphaeromorphus Germar 1843:111.

TYPE SPECIES: A. aeneus MacLeay 1819:137 (by monotypy).

DIAGNOSIS: This genus can be distinguished readily by the characters given in the key. In addition, specimens are usually larger, shinier, and more metallic than Cloeotus.

TAXONOMIC NOTES: The genus is in need of revision. The last general treatise was that of Harold (1874b). Several of the genera of Acanthocerinae were confused by Germar (1843), and the name Sphaeromorphus is a synonym which resulted. The species are difficult to study because the contractile form does not permit ready access to ventral structures.

DISTRIBUTION & ZOOGEOGRAPHY: The genus is exclusively American with about 33 described species. Sixteen species are recorded from Brazil, five from the West Indies, and a single species (*A. aeneus* MacL.) from the U. S. However, Blackwelder (1944: 218) also listed *A. volvox* Er. from "U.S.A." without specific locality.

BIOLOGY: Nothing is known of the food habits of the adults, and the immature stages are unknown. Adults are usually rare, and their behavior has not been studied. There is no published report of stridulation in the genus, but since it is known in most other members of the subfamily, it is also likely in *Acanthocerus*. Specimens have been collected by beating dead vegetation, and at light.

SELECTED REFERENCES: Arnett, 1962:417; Arrow 1912:48-49; Blackwelder, 1944:218; de Borre, 1886:64; Gemminger and Harold, 1869:1091-1092; Harold, 1874b:23-41; Lacordaire, 1856:155-159.

***Acanthocerus aeneus* MacLeay**

(Fig. 371, 383, 388, 392-93)

Acanthocerus aeneus MacLeay 1819:137.

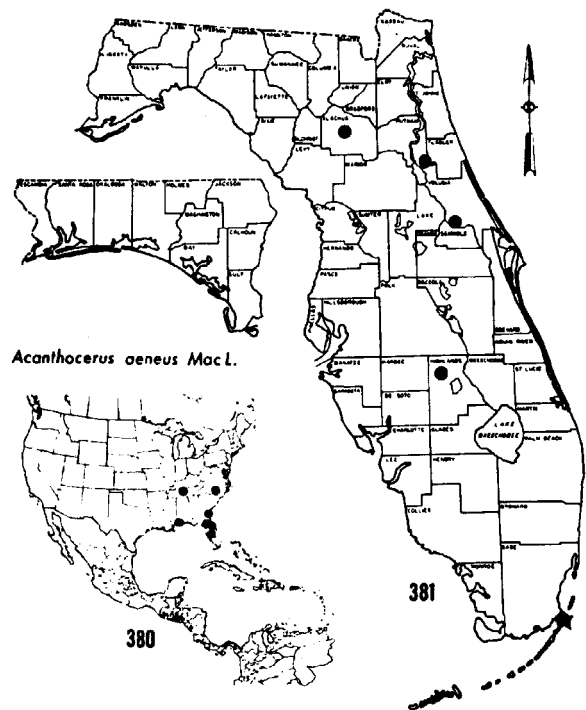
Sphaeromorphus aeneus (MacLeay), Henshaw 1885a: 89.

Acanthocerus volvox Erichson 1843:123 (synonymy?).

DIAGNOSIS: Easily distinguished from the other Florida members of the subfamily by the characters in the key. Their form is more globular than the species of *Cloeotus*, and they are capable of forming a more compact ball during the death feint. Posterior pronotal angles obliterated; anterior pronotal line incomplete and without deep depression in anterior angles; less punctate throughout; elytral punctures not reaching the base and much less impressed; clypeus flat, not raised at anterior margin. Length 7 mm (distended); width 4 mm.

TAXONOMIC NOTES: The species is so rare in collections that little information is available on variability. The single specimen from Key Largo, Florida, probably represents a distinct species, but I am inclined to postpone its description until additional material is available. The *A. volvox* Erichson has been listed numerous times (Gemminger and Harold, 1869; Arrow, 1912; Leng, 1920) as a synonym of *A. aeneus* MacL. However, it is listed as a valid species by Blackwelder (1944:253) and recorded from "U.S.A." Further study will be necessary to clarify the position of the name *volvox*.

DISTRIBUTION & ZOOGEOGRAPHY: (Fig. 380-31). This species has been recorded from Alabama



(Loding, 1933; 1945), Florida (Blatchley, 1928), Georgia (Kissinger, 1955), North Carolina (Brimley, 1938), and South Carolina (Kirk, 1969). I have also seen a specimen from Nashville, Tennessee (new state record). (For Florida records, see section on specimens examined.)

BIOLOGY: Very little is known about this rare species, there probably being less than 15 specimens in all the museums of the world. It has been collected by beating dead vines (Schwarz, 1878), and the only specimen I have collected was under similar circumstances. Kissinger (1955:14 and in litt.) collected two specimens under these conditions. Loding (1945:101) recorded two specimens from under bark. The only other reference to its habits is by Edwards (1949a:52), who stated that it "... is said to occur on flowers of several species or in rotten logs or stumps." I have been unable to determine the source of this information, and I question its validity.

SPECIMENS EXAMINED: 7 specimens from 5 Florida localities as follows: (1) Haw Creek, 10-VII, Hubbard and Schwarz (USNM); (1) Enterprise, 13-VI, Hubbard and Schwarz (USNM); (1) Enterprise, V-87, W. Beutenmuller (USNM); (1) Gainesville, Hatchet Creek, III-35, J. Kilby, stomach of *Rana sphenoccephala* (UMMZ); (1) Gainesville, 1-IX-61, W. J. Platt, III (REW); (1) Highlands Hammock State Park, 8-VII-63, D. G. Kissinger, beating trees (REW); Monroe Co., Key Largo Key, 7-XII-66, R. E. Woodruff and J. H. Knowles, beating grapevine at night (REW) [possible new species].

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