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AN ANNOTATED LIST OF THE ARTHROPODS FOUND IN THE BURROWS OF THE FLORIDA GOPHER TORTOISE, *Gopherus polyphemus* (Daudin)¹

By F. N. YOUNG and C. C. GOFF

The burrows of the Florida gopher tortoise, *Gopherus polyphemus* (Daudin), have preserved, probably since the Ice Age, an interesting association of animals which has been almost entirely neglected by ecological investigators. H. G. Hubbard's original paper (1894), published almost 50 years ago, together with his short additional note (1896) two years later, remain practically the only literature dealing directly with the arthropods² of the biocoenose. The association is in many ways remarkable, and it seems surprising that it should have been so long neglected in view of the abundance and rather wide distribution of the gopher in the southeastern United States. However, when the difficulty of collecting animals from the burrows is considered, this neglect becomes much less amazing. Little is known of the ecological conditions within the burrows, and further investigations will probably show that the fauna itself is still very incompletely recorded.

¹Contribution from the Department of Biology and the Agricultural Experiment Station, University of Florida, Gainesville, Florida.

Note: During the latter part of 1938, I carried on a short correspondence with Mr. Goff concerning the insects found in the burrows of the gopher tortoise. At that time he was engaged in a study of this reptile, and during the course of our correspondence I sent him notes on several burrows which I had excavated around Miami and Gainesville, Florida. Mr. Goff's sudden death a few months later prevented him from completing or correlating the data he had obtained. The present paper is therefore an attempt to record the information obtained by both of us and to summarize the present knowledge of the insects and other arthropods found in the burrows of the tortoise.—F. N. YOUNG.

²Hallinan (1923) has discussed the mammals, reptiles and amphibians associated with the burrows around Jacksonville, Florida. His paper also includes many useful notes on the habits of the tortoise, length of burrows, etc. Although he lists some insects, the species cannot be definitely placed because he failed to give any scientific names.

Recent investigation³ of the burrows of the rodent, *Geomys*, has revealed another biocoenose as remarkable as that discovered by Hubbard in the tortoise burrow. In places the burrows of *Geomys* are to be found side by side with those of *Gopherus*, but so far only two species of insects have been found to be common to both. Each biotope seems to have developed or acquired its own peculiar species and genera, and, as far as we know, the true obligates are strictly limited in distribution by the conditions which have favored their development. Work in the western United States and in Europe has revealed comparable associations in the nests and burrows of several mammals, and there are probably many others of a similar nature yet to be discovered.

It is interesting to note that a distinctive association of commensals has developed in such a simple habitat as the gopher burrow. But when we consider the fact that the gopher is a member of an ancient race which probably reached Florida soon after the elevation of the Pleistocene, and that the burrowing habits of the genus were probably established long before, it would be more noteworthy if no animals had taken advantage of the available protection and food supply. The open mouth of the burrow is a blanket invitation to any animals with cavernicolous tendencies, and the supply of dung at the bottom is an added attraction to coprophages. None of the true obligates as far as we know has been taken outside gopher burrows. Most of them are apparently found throughout the greater part of the range of the tortoise, yet no explanation of how they are transferred from one burrow to another can be offered.

Usually the burrow of the gopher is comparatively simple, varying in size and depth with the size and age of the individual inhabiting it. The young tortoise excavates for itself a burrow just a little larger than the greatest width and depth of its carapace, and from one to three feet deep. As the carapace grows the burrow is gradually enlarged until it may reach a maximum width of a foot or more, and a length varying from ten to 35 feet. There are frequently turns in the course of the descent. These do not seem to be a protective or drainage device, but rather depend on the chance obstruction of the course by rocks, roots, harder material, etc. The vertical distance from the surface to the end of the burrow appears to be determined by the resistance of the underlying material or by the water-

³C. C. Goff and T. H. Hubbell, Manuscript in press.

table. In the Norfolk series of sands it may be as great as the depth to the clay (usually from 4 to 12 feet) while in the Dade sands it is usually the distance to the underlying limestone (from 3 to 8 feet). Where the water-table is near the surface the burrow may be quite shallow and very long (as much as 35 or 40 feet).

Although there seems to be no provision for drainage, the burrows are usually rather dry. Hallinan (1923) observes that part of the material from the burrow must be pressed radially into the sides by the tortoise since the volume removed to the outside is not always sufficient to account for the volume of the burrow. If this is true then the tightly packed soil may assist in controlling percolation into the tunnel, and, on the other hand, would prevent rapid drying out and consequent collapse of the roof and sides. In several burrows excavated near Gainesville the sides and floor were found to be quite dry to a depth of 8 or 9 feet while the roof was damp. Beyond this depth, however, the floor and sides also became damp. Under these conditions it is interesting to note that insects were found burrowing into the roof along the upper part of the tunnel.

Goff noted several cases at or near Gillette, Florida, in which part of the burrow was below the water-table. In two of these instances the gopher was found at the end of the burrow completely submerged beneath the water. Normally, however, it seems that the tortoise avoids the lower grounds in which the water-table is subject to fluctuation. In the northern and central region of the State it confines its burrows more or less to the Norfolk sands, while along the east and west coasts the Dade, Palm Beach, St. Lucie and other loose dune and coastal sands offer an excellent burrowing medium. Many of the coastal islands where the soil is suitable have been occupied by the tortoise, but no investigations of the commensal fauna have been made in these isolated situations.

The Florida gopher is confined to the southern coastal plain. According to Stejneger and Barbour (1939) the range is the "coast from southern South Carolina to Florida and the Mississippi River and north into southern Arkansas". But outside of Florida the gopher is not commonly encountered. In the west two other species of the genus are confined to the semi-desert regions where they are said to burrow, but the ranges of the three species do not come in contact with each other at

any point. An investigation of the commensals of the western species ought, on that account, to give some indication of the age of the association, because the present distribution has apparently existed for some time and any resemblances of the faunas would have to antedate the present isolation.

The principal method of investigating the inquilines of the gopher is complete excavation of the burrow. This probably explains the long neglect of the subject, for the task of digging out even a single burrow is not easy. Hubbard (1894) described the size of one of his excavations by saying that a carriage and horses could easily have been placed in it, and both authors of the present paper have made quite large pits in tracing out the course of burrows. In digging, care must be taken not to lose, wholly or in part, the inhabitants, and the chances of introducing animals from the surface are very great.

The following list is far from complete, and future work may even double or triple it. Many of the species listed are obviously only casual visitants to the burrows; others, although they are not obligates, form a normal part of the association. In many cases only further work will indicate whether some species are casual, normal or obligate commensals. We have tried to divide the inhabitants of the burrows into five groups based on food habits or occurrence. One of these groups, *casual*, indicates that the animal is not a normal part of the association. Thus, a *casual* may be either a scavenger, predator, parasite, or coprophage without having any normal effect on the food chains of the association.

Acknowledgments are due to several specialists who have assisted in the determination of material during the preparation of this study, especially Mr. O. L. Cartwright, Dr. T. H. Hubbell, Dr. J. Bequaert, and Dr. H. K. Wallace. Thanks are due many others for assistance in preparation of this paper and for information concerning the distribution, habits and taxonomy of the gopher tortoise.

Arachnida
Pedipalpi
Thelyphonidae

Thelyphonus giganteus Lucas

Predator: Crescent City, * Hubbard (1894: footnote p. 306); De-Funiak Springs and Clearwater, Hubbard (1896: 299-301). Probably enters the burrows to prey on insects; not confined to them.

*All localities unless otherwise indicated are in Florida.

Pseudoscorpionida
Cheliferidae

Chelanops affinis Banks

Predator: Described from gopher burrows at Crescent City, (Banks, in Hubbard, 1894: 314). Recorded by Hubbard from DeFuniak Springs and Clearwater, (1896: 299-301). Confined to the burrows.

Phalangiida
Phalangiidae

Phalangodes n. sp.

Predator: Hubbard indicates this as a new species in his second paper (1896: 300), but he apparently did not describe it later. Crescent City, DeFuniak Springs and Clearwater, Hubbard (1896: 299-301). Apparently confined to the burrows of the gopher.

Araneae
Lycosidae

Lycosa rabida Walck.

Casual: Apparently only a casual visitor confined to hiding in the mouth of burrows during the day. Gainesville, xi.8.39, about six feet down the burrow, F. N. Young.

Lycosa carolinensis Walck.

Casual: Hides under or in any sort of protected place during the day. Gainesville, xi.4.39, in mouths of several burrows, F. N. Young.

Attidae

Casual: A single specimen from Gainesville, xi. 8.39, taken about 7 feet down the burrow was too immature to determine.

(?)Casuals: Hubbard (1896: 299-301) records two species of spiders from burrows at Crescent City, DeFuniak Springs and Clearwater, but gives no hint as to family or genus. Many spiders probably stray into the burrows by chance or use them for hiding places. None of the species so far recorded seem to be true obligates, but the Lycosid *Sosilaus spiniger* is common in the burrows of *Geomys* and may occur in those of the gopher as well.

Acarina
Ixodidae

Ornithodoros turicata Duges

Parasite(?): Crescent City (as *americanus* Marx), Hubbard (1894: 306); DeFuniak Springs and Clearwater, Hubbard, (1896: 299-301); Keene, Kissimmee, and Crescent City, Banks, (1908: 18). The published records indicate that the species is not a parasite on the gopher but merely inhabits the burrows. In Texas, New Mexico, Arizona, and California the species is found on cattle (Banks, 1908: 18). E. T. Boardman (unpublished thesis, University of Florida, 1929) records the species as occurring on the Gopher Frog, *Rana capito*.

Amblyomma tuberculatum Marx

Parasite: Described from a specimen taken by Hubbard from a gopher at Crescent City and a specimen from Florida without definite locality

(Marx, in Hubbard, 1894: 315). Banks (1908: 38) gives its range as "various parts of Florida, and—associated with the gopher tortoise". Our records: Miami, v.20.33, F. N. Young; Leesburg, v.4.38, C. C. Goff, and Gainesville, xi.28.36, F. N. Young. All taken on gophers. The species is the largest North American tick, and its allies are South American.

Parasites: In addition to the above some orobatid mites are said to occur on the beetle, *Copris gopheri*, which inhabits the burrows (Hubbard, 1896: 301).

Insecta

Orthoptera

Gryllacrididae

Ceuthophilus latibuli Scudder

Scavenger: Described (in part) from specimens taken by Hubbard in gopher burrows at Crescent City, (Scudder, in Hubbard, 1894: 313-4). Frequently cited as an inquiline of the gopher burrow, but not confined to this situation. It will even dig its own burrow if no better cover offers. For a detailed discussion of the habits and distribution see Hubbell, 1936: 324-3. Our records: Leesburg, iii.16.38, trapped in mouth of burrow, C. C. Goff; Gainesville, xi.4.39, trapped in burrow and xi.8.39, observed in burrow, F. N. Young.

Ceuthophilus walkeri Hubbell

Scavenger: Frequents occupied and unoccupied burrows of the gopher, but uses cover of other sorts. For habits and distribution see Hubbell, 1936: 394-6. Our records: Gainesville, xi.28.36, in burrows excavated near town, F. N. Young.

Diptera

Anthomyidae

Pegomya gopheri Johnson

Coprophage (in larval stage): Described (in part) from specimens bred from larvae found feeding on excrement in gopher burrows by Hubbard, (Johnson, 1913: 77-8). Types from DeFuniak Springs, iv.7 (including the holotype), Crescent City, iii.23, Clearwater vi.27.1894 and Keene, Fla. (Coquillett). Hubbard (1896: 299-301, as *Hylema* n. sp.) This or a very similar species occurs in the burrows of *Geomys* as well as in those of the tortoise. This seems to indicate a partial interchange of faunas between the two associations, but the species from the two situations are not positively identical. The larvae may not be coprophagous. Malloch (Bull. Brooklyn Ent. Soc., 15: 124, 1920) expresses doubts that they are true dung feeders, and David G. Hall of the U.S.D.A. (in letter to T. H. Hubbell concerning the determination of the species found in *Geomys* burrows) is uncertain of their food habits. Dipterous larvae and adults which might be this species were found in burrows at Miami, v.20.33 and i.31.34, F. N. Young.

Borboridae

Leptocera sp.

Coprophage (in larval stage): Hubbard records this (1896: 299-301) from the larvae found in dung at the end of burrows as *Limosina* sp. (Borboridae). Crescent City, DeFuniak Springs and Clearwater (Hubbard, 1896: 299-301). For genus see Johnson, 1913: 79. As far as known confined to gopher burrows.

Lepidoptera
Noctuidae

Epizeuxis gopheri Smith

Coprophage (in larval stage): Described from specimens taken at Crescent City by Hubbard, (J. B. Smith, 1899, Can. Ent., xxxi: 94. DeFuniak Springs and Clearwater, Hubbard (1896: 301, as *Epizeuxis* n. sp.), and Crescent City, Hubbard (1894: 305, as Deltoid (?) Moth). Whether or not the larvae are true coprophages is not definitely known. Our records: Adults possibly referable to this species, Gainesville, xi.28.36, and larvae xi.8.39, F. N. Young.

Coleoptera
Leiodidae

Ptomophagus ulkei Horn

Casual (?): DeFuniak Springs, Hubbard (1896: 302) as a "visitant".

Ptomophagus consobrinus (Lec.)

Casual (?): Crescent City, Hubbard (1896: 302) as a "visitant". This species or a close ally of LeConte's species also occurs in the burrows of *Geomys* at Gainesville.

Staphylinidae

Paederus sp.

Predator: A series of this brightly colored species from Gainesville, xi.28.36, and a single specimen xi.8.39, F. N. Young. Most of the specimens were taken in small side burrows along about the first eight feet of the gopher burrow. The species resembles *floridanus* Austin but is large and differs in several characters from specimens determined as that species by W. S. Blatchley (Agr. Exp. Sta. Collection, Gainesville, Florida.) Probably not confined to the burrows of the gopher.

Linolathra dimidiata (Say)

Casual: Gainesville, xi.8.39, in lower part of burrow, F. N. Young. Common elsewhere as in gopher burrows.

Acrostilicus hospes Hubbard

Predator: Hubbard (1896: 299-301) defines the genus and species by a comparison with the genus *Stilicopsis*, but gives no description nor did he apparently describe it before his death in 1899. Since none of the rules of nomenclature has been broken the species must remain on our lists although it is practically unknown. Crescent City, DeFuniak Springs, and Clearwater, Hubbard (1896: 299-301).

Philonthus cautus Er.

Casual: Hubbard (1896: 302) records it as a "visitant", from Crescent City, DeFuniak Springs, and Clearwater. Not confined to the burrows.

Philonthus gopheri Hubbard

Predator: Described by Hubbard (1894: 308-9) from gopher burrows excavated at Crescent City, and recorded by him (1896: 299-301) from DeFuniak Springs and Clearwater. Notman (1920) records, "Three specimens marked 'Fla.' and three Enterprise, October 15, one of these labeled

'Gophers Hole.'" Our records: Gainesville, xi.28.36, in dung at end of burrow, and xi.8.39, larvae and adults at end of burrow, F. N. Young. Apparently an obligate of the gopher burrow.

Homalota sp.

Casual: Crescent City, Hubbard (1894: 304); DeFuniak Springs and Clearwater, Hubbard (1896: 299-301). Members of this genus are mostly inconspicuous insects associated with dung and probably occur in the gopher burrow only by chance. A small *Homalota*, probably not the same as the one recorded by Hubbard, was taken at Gainesville, xi.8.39, in dung at end of burrow, F. N. Young.

Ptillidae

(Trichopterygidae)

Trichopteryx n. sp.

Coprophage: Crescent City, Hubbard (1894: 304); DeFuniak Springs and Clearwater, Hubbard (1896: 299-301) as *Trichopteryx* sp. indet. Noted as abundant in the accumulation of dung at the end of burrows.

Nossidium sp.

Coprophage: Gainesville, xi.8.39, in dung at end of burrow, F. N. Young. May be same as above, but keys to *Nossidium*. The small size of the members of this family makes the study of their habits and taxonomy difficult.

Histeridae

Chelyoxenus xerobatis Hubbard

Coprophage (?) and Predator (as larva): Described from burrows at Crescent City by Hubbard (1894: 309-10), and recorded by him (1896: 299-301) from Lake Worth (Hamilton), DeFuniak Springs and Clearwater. Our records: Gainesville, xi.28.39 and xi.8.39, in dung at end of burrow, F. N. Young; Miami, v.20.33, xii.30.33, i.29.33, in dung at end of burrows, F. N. Young. The species is especially interesting because it apparently represents a relict genus which has no close allies in the United States.

Saprinus ferrugineus Marseul

Casual: Crescent City, Hubbard (1894: 305) and DeFuniak Springs and Clearwater, Hubbard (1896: 299-302) as a "visitant". Common throughout the State.

Scarabaeidae

Choeridium lecontei Harold

Casual: Leesburg, vii.9.38, trapped in mouth of burrows, C. C. Goff. Common at dung throughout the northern part of the State and the surrounding region.

Phanaeus floridanus D'Ols.

Casual: Leesburg, vii.14.38, trapped at mouth of burrow, C. C. Goff. Not normally associated with the gopher.

Copris gopheri Hubbard

Coprophage: Described from burrows at Crescent City by Hubbard (1894: 310-11) and recorded by him (1896: 299-301) from DeFuniak Springs and Clearwater. Blatchley (1928: 10) records the species from gopher burrows at, Lake Worth, Enterprise, Sanford, Lake Mary, and Clearwater, based on work of E. A. Schwarz (Manuscript list of Florida

Coleoptera in Smithsonian). This species is closely allied to *Copris minutus* Drury, but it is a true obligate and shows adaptations for a subterranean life.

Onthophagus tuberculifrons Harold

Casual: Leesburg, vii.9.38, vii.14.38, trapped at mouth of burrows, C. C. Goff. A common species which probably wandered into the traps by chance.

Onthophagus polyphemi Hubbard¹

Coprophage: Described by Hubbard from gopher burrows at Crescent City (1894: 311-12), and recorded by him from DeFuniak Springs and Clearwater (1896: 299-301). Blatchley (1928: 12) records it further from Lake Worth (Hamilton), Enterprise (Castle and Laurent), Sanford and Lake Mary (Schwarz Manuscript), and LaGrange (Davis). Our records: Leesburg, vii.2.38, vii.7.38, and vii.14.38, trapped at mouth of burrows, C. C. Goff; Gainesville, xi.28.36 from dung at end of burrow, and xi.8.39, from burrows in roof of gopher burrow, F. N. Young. Known only from gopher burrows and without any close allies in North America. It probably represents a now otherwise extinct group of the genus.

Ataenius abditus Hald.

Casual: Gainesville, xi.8.39, about 6 feet down in burrow, F. N. Young. Probably fell in during the digging.

Aphodius troglodytes Hubbard

Coprophage: Described from Crescent City from gopher burrows by Hubbard (1894: 312-13) and recorded by him from DeFuniak Springs and Clearwater (1896: 299-301). Blatchley (1928: 23) further records the species from Enterprise (Castle and Laurent), and Lake Mary (Fall). Our records: North Miami, v.20.33, xii.30.33, xii.31.33, i.29.34, from sand floor and dung at end of burrows, F. N. Young; Gainesville, xi.28.36 and xi.8.39, from dung at end of burrows, F. N. Young. The species is confined to the gopher burrow, but a closely allied species, *Aphodius geomysi* Cartwright, occurs in the burrows of *Geomys*.

Anthicidae

Anthicus ictericus Laf.

Casual: Crescent City, Hubbard (1894, footnote p. 305). Probably fell in in the course of the excavation.

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¹Mr. O. L. Cartwright, of the South Carolina Experiment Station, Clemson, S. C., tells us that he has recorded this species and *Aphodius troglodytes* from gopher burrows in southeastern South Carolina.

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**A REPORT ON THE DISPOSITION OF THE COLLECTIONS
AND LIBRARY OF MR. C. C. GOFF**

When a worker with the wide interests and the activity of the late C. C. Goff passes away, he often leaves behind him a mass of accumulated data which he has not had time to prepare for publication. The untimely death of Mr. Goff cut short his work, but his notes were so orderly and complete and his records so accurate that his associates have been able to finish some of his papers and additional papers based on his collections and notes have been prepared by other specialists. In order that the members of the Florida Entomological Society may know of these papers and of the disposition of his collections and library, it seems desirable to present a summary of this work.

About two hundred vials of arthropods which had been taken from the burrows of *Geomys*, *Peromyscus*, and *Gopherus* and a number of notes concerning these specimens were turned over to Prof. T. H. Hubbell of the Department of Biology of the University of Florida. Prof. Hubbell assorted these specimens and forwarded parts of the collection to other specialists for study and identification. Among those who have studied and determined Goff's specimens are: O. L. Cartwright of Clemson College, E. S. Ross of the California Academy of Sciences, Dr. J. Bequaert of the Harvard School of Tropical Medicine, C. H. Frost and the late H. C. Fall of Massachusetts, Dr. R. V. Chamberlin of the University of Utah, Dr. H. B. Mills of Montana State College, and numerous specialists in the Department of Agriculture at Washington, particularly in the Division of Insect Identification of the Bureau of Entomology and Plant

Quarantine. Some of the insects collected by Mr. Goff are in the Agricultural Experiment Station at Gainesville, and representatives of each species described from his specimens will be deposited there.

About three hundred specimens of reptiles which Mr. Goff had collected in recent years were presented to the Department of Biology of the University of Florida, and have been incorporated into the Reptile Collection of that institution. The notes on reptiles made by him have been turned over to Dr. A. F. Carr and Coleman J. Goin of the same department.

Mr. Goff had been closely associated with Prof. H. B. Sherman of the Department of Biology in the study of certain Florida mammals. He had collected over two hundred specimens of mammals, mostly of the genera *Geomys* and *Peromyscus*, some of which had been loaned to Prof. Sherman for study and since his death the remaining specimens and notes have been given to Prof. Sherman.

The Goff library and personal reprints were turned over to Coleman J. Goin for handling. The undistributed separates were mailed to specialists in Goff's own field who had not yet received them and his reprint library was put up for sale. It was felt that more money could be obtained by selling different portions of the library to reliable persons than could be had by selling it intact to a commercial dealer. At present all but a few books and about three hundred reprints have been sold for a total of \$119.60. It is expected that additional sums can be obtained for those as yet unsold. As rapidly as this money is collected it is forwarded to Miss Frances Shultz, 1909 McElderry Street, Baltimore, Md., who is the guardian of Mr. Goff's young daughter, Eva.

The following papers, based on Mr. Goff's specimens and notes, have been written:

(1) A paper describing new species of beetles, including three new species of Scarabaeidae from *Geomys* burrows, by O. L. Cartwright, published in the Annals of the Entomological Society of America, June, 1939.

(2) A paper describing a new genus of blind "camel-cricket" from *Geomys* burrows, by T. H. Hubbell, to be published in the Annals of the Entomological Society of America.

(3) A paper describing one new genus and four new species of Histerid beetles from *Geomys* burrows, by E. S. Ross, to be published in the Annals of the Entomological Society of America.

(4) A paper describing one new genus and two new species of centipedes from *Geomys* burrows, by R. V. Chamberlin, not yet submitted for publication.

(5) A paper on the insects and other arthropods from the burrows of *Gopherus polyphemus*, by Frank N. Young and C. C. Goff, published in this number of the FLORIDA ENTOMOLOGIST.

(6) A paper on the Arthropod fauna of *Geomys* burrows, by C. C. Goff and T. H. Hubbell, to be published in the Proceedings of the Florida Academy of Sciences.

Additional papers, based at least in part on Mr. Goff's material, may be expected in the future from other specialists who have not as yet completed their manuscripts for publication.

COLEMAN J. GOIN
Department of Biology
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NOTES ON *Chaetanaphothrips orchidii* (Moulton) FOUND ATTACKING CITRUS FRUIT IN FLORIDA

By W. L. THOMPSON, Associate Entomologist
Citrus Experiment Station
Lake Alfred, Florida

In 1937 some mature grapefruit with rather unusual surface markings were sent to the Citrus Experiment Station at Lake Alfred from a grove on Merritt Island, near Cocoa, Brevard County. The writer visited the grove and observed nymphs of some species of thrips on the marked fruit. In December, 1937, the writer, accompanied by J. R. Watson¹, visited the grove and collected an adult thrips on a marked fruit. Watson has identified the thrips as *Chaetanaphothrips orchidii* (Moulton). A. M. Boyce² had recently described a similar injury on oranges in California that was caused by the greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouche). During February, 1938, the writer visited groves in La Ceiba, Honduras, and observed markings on grapefruit similar to those described by Boyce on oranges in California and also much like the markings on the grapefruit in Florida. The thrips collected on the fruit in Honduras were identified by J. R. Watson as greenhouse thrips. One particular difference between the marked fruit in Honduras and that in Florida was the visible excrement deposited by the greenhouse thrips, as described by Boyce, while on the fruit in Florida no excrement was visible. During 1938 periodical visits were made to two infested groves in the vicinity of Cocoa, Florida. The

¹J. R. Watson, Entomologist, Florida Agricultural Experiment Station.

²The California Citrograph, Vol. 23, No. 1, November, 1937.

(5) A paper on the insects and other arthropods from the burrows of *Gopherus polyphemus*, by Frank N. Young and C. C. Goff, published in this number of the FLORIDA ENTOMOLOGIST.

(6) A paper on the Arthropod fauna of *Geomys* burrows, by C. C. Goff and T. H. Hubbell, to be published in the Proceedings of the Florida Academy of Sciences.

Additional papers, based at least in part on Mr. Goff's material, may be expected in the future from other specialists who have not as yet completed their manuscripts for publication.

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NOTES ON *Chaetanaphothrips orchidii* (Moulton) FOUND ATTACKING CITRUS FRUIT IN FLORIDA

By W. L. THOMPSON, Associate Entomologist
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In 1937 some mature grapefruit with rather unusual surface markings were sent to the Citrus Experiment Station at Lake Alfred from a grove on Merritt Island, near Cocoa, Brevard County. The writer visited the grove and observed nymphs of some species of thrips on the marked fruit. In December, 1937, the writer, accompanied by J. R. Watson¹, visited the grove and collected an adult thrips on a marked fruit. Watson has identified the thrips as *Chaetanaphothrips orchidii* (Moulton). A. M. Boyce² had recently described a similar injury on oranges in California that was caused by the greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouche). During February, 1938, the writer visited groves in La Ceiba, Honduras, and observed markings on grapefruit similar to those described by Boyce on oranges in California and also much like the markings on the grapefruit in Florida. The thrips collected on the fruit in Honduras were identified by J. R. Watson as greenhouse thrips. One particular difference between the marked fruit in Honduras and that in Florida was the visible excrement deposited by the greenhouse thrips, as described by Boyce, while on the fruit in Florida no excrement was visible. During 1938 periodical visits were made to two infested groves in the vicinity of Cocoa, Florida. The

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C. orchidii were more abundant in a neglected grove than in one that received the regular spray program for disease and insect control. All sprays except an oil spray contained sulfur. During 1939 the thrips were observed in groves in the following counties: Brevard, Indian River, St. Lucie, Hardee, Manatee, Polk and Orange (marked fruit only). The *C. orchidii* have been collected on oranges and tangelos in addition to grapefruit. It is interesting to note also that a few greenhouse thrips were collected in groves in Brevard and Indian River Counties.

The adults of the *C. orchidii* are a light yellowish color. The wing shoulders are dark with a light area right back of the shoulders and the remainder of the wing is dark in color, giving the appearance of two black stripes down the back when the wings are folded. There are three small scarlet-colored dots between the eyes (ocellar crescents) that can barely be seen through the hand lens (10X). The adults are very lively when disturbed or when in direct sunlight. The young nymphs are colorless, seemingly almost transparent but the older nymphs are a very light yellowish color and, as they become more mature, the abdomen has a pinkish tinge of color. The nymphs, like the adults, become quite active when exposed to direct sunlight.

The life history has not been studied but young nymphs were observed 10 days after adults had been placed on the fruit and in 33 days (September 30 to November 2) adults were observed. On the average there were only four to six nymphs per infested fruit but 16 nymphs and four adults have been found on a single fruit.

The *C. orchidii* feed in sheltered areas on the fruit much as do the greenhouse thrips and are found chiefly at the point of contact between fruit in clusters although they are also found where a leaf is in close contact with the fruit. An occasional nymph has been found on the under surface of a leaf where the leaf was directly over an infested fruit. The thrips appear to prefer green, immature fruit. Where both green fruit and mature fruit were on the same tree there was a higher percentage on infested green fruit than mature fruit.

The appearance of the injury caused by *C. orchidii* differs according to the age of the fruit at the time it is attacked. When young fruit are attacked the injury appears as a solid area due to the fact that the contact between the fruit is practically a point contact. After the fruit has matured the early injury

has the appearance of a silvery to dark brown-colored blotch, sometimes two to three inches wide. The injury produced on the more matured fruit usually takes the form of a dark brown ring since the mature fruit have flattened to form an area of contact into which the thrips are unable to penetrate so that the injury takes place around the area of contact.

The *C. orchidii* is probably not a very new species in Florida since the ringed injury on grapefruit has been observed for some years and was thought by many to have been the result of an oil burn from the rind of the fruit caused by the oil being pressed out of the rind by the weight and rubbing of large fruits hanging in clusters.

Commercial damage has been observed in only a limited number of groves and in each case no sulfur or only a minimum number of sulfur sprays had been applied during the spring and summer. In one portion of a commercial grove an unsprayed check plot had thrips injury on 57 percent of the fruit hanging singly and 70 percent of the fruit hanging in clusters. Sulfur sprays applied for rust mite control are apparently a factor in keeping the thrips population at a minimum. In various experimental plots receiving sulfur sprays there was less marked fruit than in the unsprayed checks although none of the sprays were applied for thrips control. In one preliminary experiment for thrips control on grapefruit the thrips population was decreased 84 percent with 1.5 percent lime-sulfur solution supplemented with 6 pounds of wettable sulfur per 100 gallons.

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