

---

---

RS4-17

ANASTATUS FLORIDANUS (HYMENOPTERA:  
EUELMIDAE) A NEW PARASITE ON  
THE EGGS OF THE COCKROACH  
EURYCOTIS FLORIDANA

BY  
Louis M. Roth  
and  
Edwin R. Willis

---

From the Transactions of The American Entomological Society  
LXXX, 29-41

Issued May 12, 1954

1206.50

---

---

This is a separatum from the TRANSACTIONS and is not a reprint. It bears the original pagination and plate numbers, and library copies were mailed at Philadelphia on the above date of issue.

R54-17

**ANASTATUS FLORIDANUS (HYMENOPTERA:  
EUELMIDAE) A NEW PARASITE ON  
THE EGGS OF THE COCKROACH  
EURYCOTIS FLORIDANA**

BY LOUIS M. ROTH AND EDWIN R. WILLIS

*Pioneering Research Laboratories, U. S. Army Quartermaster  
Corps, Philadelphia 45, Pennsylvania*

(Plates I-III, Text-fig.)

In late December 1952, one of us (L. M. R.) together with Marc Roth collected several adults and oöthecae of *Eurycotis floridana* (Walker) in St. Petersburg, Florida. On February 8, 1953, 65 ♀ and 3 ♂ Hymenoptera emerged from 2 holes made through the side of one of the egg cases. Several of the wasps were submitted for determination to Dr. B. D. Burks of the U. S. National Museum, Washington, D. C. who informed us that the wasp was "... an undescribed species of the eupelmid genus *Anastatus*, near *blattidarum* Ferrière. Mr. Gahan segregated specimens of this species in our collection several years ago as *Anastatus* sp. W. The specimens of this 'sp. W' already in our collection were reared from the egg case of an undetermined roach collected at Indian River, Florida."

*Anastatus blattidarum* Ferr., a parasite in the eggs of *Supella supellectilium* (Serv.) (brown-banded roach), was first recorded from the Anglo-Egyptian Sudan (Ferrière, 1930, 1935) and has since been found in Hawaii (Weber, 1951) and Arizona (Flock, 1941). The U. S. National Museum collection also has specimens from Louisiana, Texas, Virginia, District of Columbia, and Florida as well as Mysore and Coimbatore, India (Burks, 1953). *Anastatus blattidifurax* Girault was reared from an oötheca of an unidentified cockroach in Australia (Girault, 1915).

*Eurycotis floridana* has been recorded from Georgia, Florida, and Mississippi, where it is found in outdoor sheltered areas such as stumps, under signs, bark of dead trees (Hebard, 1917), and

corded wood (Dozier, 1920). Friauf (1953) has collected *Eurycotis floridana* in 5 types of habitat in northern Florida: this species was one of the dominant Orthoptera in xeric hammock vegetational associations, frequent in the mesic hammock habitat, and infrequent in the sandhills habitat; in moister situations it was infrequent in the saw grass marsh habitat, but was one of the dominant Orthoptera in low or hydric hammocks.

Our specimens were collected in a trash dump where the species was very numerous. The Australian cockroach was also present in this dump. Occasionally *Eurycotis* was found to enter houses where their large size and stout appearance cause considerable consternation among the occupants, even though few specimens may be seen indoors.

About 24 adult *Eurycotis* were brought back to our laboratory from Florida, and a colony of this species has been established. The insects have been maintained and reared on Purina Dog Chow Checkers. In the laboratory the formation of the oötheca (Plate I, figs. 1-6) may be completed in about 6 hours, after which it is carried by the female until it is deposited about 18 hours later. The oötheca is formed with its keel directed dorsally and remains in this position as long as it is attached to the female (Plate I, figs. 5, 6). The female may or may not cover the dropped oötheca with debris (e.g., paper, food); when the egg case is covered, the material used is chewed into a paste and spread over the egg case. The oviposition behavior is in general similar to that of the American and oriental cockroaches.

The oötheca of *Eurycotis floridana* is comparatively large, the average size being 13 mm. long and 8 mm. high (Lawson, 1953). Of 100 oöthecae isolated from our culture, the average number of eggs per oötheca was 23 (minimum 15, maximum 25). The average percent hatch from an oötheca was 96 (based on 100 oöthecae from which some or all the eggs hatched). Sometimes abnormally small oöthecae, containing less than 15 eggs, are formed. At about 85° F. the eggs hatch in from 48 to 51 days.

Sufficient cockroach eggs were obtained to maintain the parasite, and it was carried through several generations. Following the description of this new eupelmid parasite, we present various biological data.

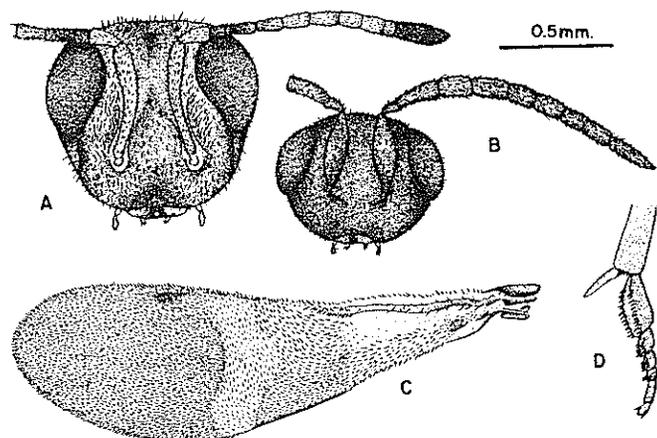
*Anastatus floridanus*, new species (Plate II, figs. 7-9; Text-fig. 1.)

FEMALE.—Length 2.0-4.1 mm. Head and thoracic sclerites rusty yellow-brown with purplish reflections. Abdomen brownish-black with purplish reflections except for the basal two segments which are largely whitish; baso-dorsal and dorso-lateral surfaces of the first abdominal segment brownish, and two small dorso-lateral spots and apical margins on second abdominal segment brownish. About basal half (hidden in abdomen) of the valvae dark-brown followed by a narrow hyaline stripe, the remainder brownish-yellow. First 3 antennal flagellar segments darkened and club (sometimes segment 10 also) blackish, the scape, pedicel, and remaining flagellar segments yellowish-brown. Coloration of forewing (Text fig. 1, C) as follows: small basal portion brown followed by a hyaline area, then a band partly brownish-yellow and partly brown, then an almost median hyaline irregular stripe, finally followed by a broad brown outer region, with iridescent reflections. Except for a small area near the base, the wing is covered by cilia, those in the irregular hyaline stripe being colorless whereas the others are in the main dark. Posterior wing hyaline with iridescent reflections, long cilia on the posterior margin; surface cilia on apical half darker and more dense than those on basal half. Legs brownish, a thick patch of broad pale setae on anterior surface of hind coxa.

Head (Text fig. 1, A) viewed from in front wider than high. Cheeks converging slightly, eyes finely but sparsely pubescent. Scrobe moderately deep, marginate, extending about half the distance between the antennal fossae and median ocellus. Except for the scrobes, head sclerites covered with fine setae. Mesoscutum slightly longer than scutellum. Parapsides and scutellum strongly sculptured. Gaster about one-third longer than thorax. Ovipositor extending slightly beyond gaster.

Antennae 13 segmented, inserted below the level of the ventral margins of the compound eyes. Scape slightly curved, about as long as the pedicel and first 3 flagellar segments combined, reaching the level of the median ocellus. Pedicel about twice as long as broad. First flagellar segment subquadrate, about half as long as second; flagellar segment 8 slightly wider than long. Club almost as long as the 3 preceding segments combined. Ocelli forming an obtuse triangle; postocellar line longer than ocellar line. Forewing (Text fig. 1, C) about 3 times as long as broad. The mid-tarsal segments 1-4 each with 2 rows of short stout spines (Text fig. 1, D). About 3 or 4 short stout spines (similar to those on the tarsal segments) near the calcarium of the mid-tibia.

MALE.—Length 1.5-2.7 mm. Head, thorax, and abdomen entirely dark, with greenish and purplish reflections. Scape brown except for a pale basal and vertical grooved area. Pedicel and flagellar segments blackish. Front, mid, and hind femora dark except for small pale basal and apical areas, the pale areas on the front femur more extensive than on the other two. Apical halves or less of the front, mid, and hind tibiae brownish, the remaining parts



Text-figure 1.—Parts of *Anastatus floridanus*. A, Head of ♀ (front view); B, Head of ♂ (front view); C, Forewing of ♀; D, Tarsus and apex of tibia of midleg of ♀. (Drawn from alcoholic and slide-mounted specimens.)

of the tibiae and tarsi yellowish: the dark portions of the mid and hind tibiae more distinct and extensive than those of the front tibiae. Wings hyaline, with iridescent reflections, covered with cilia.

Head, thorax, and abdomen setose. Head (Text fig. 1, B) viewed from in front more or less elliptical. Antennae 11 segmented, inserted slightly above the level of the ventral margins of the compound eyes. Scape reaching to about the level of the upper margin of the head. Pedicel subtriangular, about one-half the length of the first funicular segment; one minute ring segment; pedicel and flagellar segments about as long as head and thorax combined.

*Type locality*.—Snell Isle, St. Petersburg, Florida.

*Types*.—U.S.N.M. no. 62211

Described from a series of alcoholic, pinned, and slide-mounted specimens. The original parasites were reared from an oötheca of *Eurycotis floridana* collected December 28, 1952 (L. M. Roth). The specimens used for the descriptions were laboratory-reared offspring from these original wasps. The ♀ holotype, ♂ allotype, and 8 ♀ and 5 ♂ paratypes, have been deposited in the U. S. National Museum; in addition 19 ♂ and 12 ♀ specimens mounted on slides, not included in the type series, are deposited in the U. S.

National Museum collection. Two ♂ and 8 ♀ paratypes deposited in the Academy of Natural Sciences, Philadelphia, Pennsylvania.

Some differences between the females of *Anastatus floridanus* and *A. blattidarum* are listed below:

	<i>Anastatus floridanus</i>	<i>Anastatus blattidarum</i>
Host	<i>Eurycotis floridana</i>	<i>Supella supellectilium</i>
Head	Yellow-brown	Shining green
Antennae	Yellow-brown except for darkened first 3 flagellar segments and black club; scape short (reaching level of anterior ocellus) and expanded toward apex	Brown with scape and pedicel yellow; scape long (much exceeding level of vertex) and narrow throughout
Thorax	Yellow-brown; anterior part of mesonotum almost smooth	Orange-yellow; anterior part of mesonotum rugose
Abdomen	Brownish-black with purplish reflections, first and second segments largely whitish	Aeneous-black, with dark-green shine near apex, first and second segments largely whitish
Valvae of ovipositor	Basal half dark-brown followed by a narrow hyaline stripe, remainder brownish-yellow	White

The abdomen of *A. blattidifurax* is dark metallic blue except for a white band at the base (Girault, 1915).

#### Biology of *Anastatus floridanus*

*Mating*.—The wasps begin to mate immediately after they emerge from the oötheca. If the males emerge first, they show considerable "excitement" around the emergence hole; a male was observed extending his abdomen into the emergence hole prior to the issuance of the females. The females are sexually receptive almost immediately on leaving the cockroach egg case; they raise the tips of their abdomens and extend the triangular basal portions of their ovipositors. This apparently is a "calling" position and may have to do with the emission of a sex odor. The male mounts the female and clings to the end of her abdomen while he bends

his abdomen anteroventrally and impregnates the female. Mating takes 3 to 4 seconds. The males mate repeatedly and may fertilize several females; females may also assume the calling position after mating and may copulate more than once.

*Oviposition.*—The female initially "probes" the oötheca with the tip of her sheathed ovipositor. On finding an acceptable spot she unsheathes the ovipositor (Plate II, fig. 7) and drills a hole through the wall of the oötheca. After penetrating the oötheca she inserts the sting up to its base (Plate II, fig. 8). While the wasp is ovipositing, her antennae are directed forward and downward and vibrate repeatedly. One female was seen ovipositing for about 5 hours, but briefer periods of oviposition were also observed. One female was seen to feed on the material which oozed from the puncture made by her ovipositor. Insertion of the ovipositor into the oötheca gives no assurance that the eggs will be parasitized; in a few instances female wasps were seen to pierce the oötheca, but the cockroach eggs were not parasitized.

The female wasp will oviposit not only in oöthecae that have been dropped by the cockroach (eggs as old as 36 days were successfully parasitized), but also in egg cases that are being formed and are still attached to the female *Eurycotis* (Plate II, fig. 9). When oötheca-bearing cockroaches are exposed to the adult female parasites, the wasps orient with heads toward the blattids and approach them with rapidly vibrating antennae. The wasps hop up on the oötheca, or if they climb on to the body of the cockroach, they may crawl to the oötheca. Once the wasps touch or crawl on the cockroach, the blattid makes repeated efforts to brush them off with her hind legs. The cockroach may also keep her antennae in contact with the substrate and sweep them back and forth; she attempts to catch the wasps, and if successful eats them. On several occasions we observed a female cockroach catch and eat wasps when confined with them in a glass chamber 10 cm. in diameter. Once the wasp inserts her ovipositor into the attached oötheca, the cockroach usually remains quiescent and makes no attempt to dislodge her. The wasps will also orient toward male and non-oötheca-bearing female *Eurycotis*. Cros (1942) observed that *Blattia orientalis* L. will pursue the females of *Prosevania punctata* (Brullé), a wasp which parasitizes the eggs of the oriental and American cockroaches.

*Developmental period.*—At about 85° F. the wasps complete their development in from 34 to 46 days after the eggs are deposited; this is somewhat less time than is required for development of the cockroach eggs. Some of this variation may be caused by differences in the numbers of wasps developing within the oöthecae (Table 1.) When fewer wasps develop within an oötheca, they take a longer period of time to consume the greater amount of available food.

TABLE 1  
Relation Between Duration of Developmental Period and  
Size of Broods of *Anastatus floridanus* in Oöthecae  
of *Eurycotis floridana*

Number of Wasps Per Oötheca			Duration <sup>1</sup> (Days) of Developmental Period			Number of Oöthecae
Min.	Max.	Mean	Min.	Max.	Mean	
23	57	45	39	46	41.5	10
64	306	189	34	39	36.4	36

<sup>1</sup> From day of exposure of the oötheca to the female wasps till emergence of the offspring.

*Number of wasps developing in an oötheca and effect on host.*—Table 2 shows the number of wasps which may develop in the eggs of *Eurycotis* after the oöthecae have been exposed to either a single or many female parasites. A single female wasp may produce an average of 50 offspring, which is considerably less than the large number of large eggs, in the oötheca of *Eurycotis*, can actually support. After exposure to numerous female wasps, more than 300 parasites may develop on the eggs contained in a single oötheca. It is probable that at times either the first-hatched wasp larvae eat unhatched wasp eggs or the larvae eat one another. For example, 4 oöthecae were each exposed to 50 female wasps and then dissected one week later. These oöthecae contained from 388 to 709 (average of 601) wasp larvae, considerably more than the maximum number (306; see Table 2) of wasps reared to maturity from oöthecae exposed to many females. Two oöthecae, each exposed to 50 female wasps and kept until the parasites emerged, produced only 176 and 167 wasps respectively. These data indicate that cannibalism may occur among the developing wasp larvae

if too many wasp eggs (for the available food) are deposited into one oötheca.

TABLE 2

Size of Broods of *Anastatus floridanus* from *Eurycotis floridana* Oöthecae Exposed to Single and Many Wasps

Note: The oöthecae were exposed for the entire life of the wasps

Oöthecae Exposed to	Total Number <sup>1</sup> Wasps Per Oötheca		Mean Numbers $\pm$ S.E. <sup>2</sup> of		Ratio ♀:♂	Number of Parasitized Oöthecae	
	Min.	Max.	Mean $\pm$ S.E.	♀♀			♂♂
Single wasps	23	81	50 $\pm$ 6.4	38 $\pm$ 6.8	9 $\pm$ 0.4	4.2:1	8
Many wasps	93	306	198 $\pm$ 8.0	126 $\pm$ 4.6	65 $\pm$ 8.0	1.9:1	34

<sup>1</sup> Includes the small number of larvae or pupae which failed to complete their development and remained in the oötheca.

<sup>2</sup> Standard Error.

In general all of the cockroach eggs are eaten by the wasp larvae, but even if some of the eggs are uneaten (Plate III, fig. 11), they usually fail to hatch, and the fully matured cockroach embryos die in the oötheca after the wasps have emerged. In one instance 5 cockroach nymphs hatched from a parasitized oötheca which had been exposed to wasps 27 days after the egg case had been dropped by the *Eurycotis*; 23 wasps developed and 5 cockroach embryos were uneaten but failed to hatch. One oötheca in which we saw a wasp insert her ovipositor yielded only 2 wasps (1 adult ♀ and 1 larva); ten cockroaches hatched out, and on opening the oötheca we found each of the 2 wasps in the space formerly occupied by a single cockroach egg; 1 well-developed embryo and 11 undeveloped cockroach eggs remained in this oötheca. Apparently the one adult wasp had matured on one or possibly one and part of a second *Eurycotis* egg. Uneaten cockroach eggs are usually found in oöthecae containing few wasp larvae.

The wasps make from 1 to 6 (Plate III, fig. 10) emergence holes in the oötheca; of 42 parasitized egg cases the average number of emergence holes was 2. Frequently more than one wasp may begin chewing an emergence hole, but when one hole is com-

pleted the other wasps stop chewing and leave through the finished opening. When the wasps emerge from the cockroach oötheca, their antennae are still covered by the pupal skins; they shed these skins just after emergence. The pupal skin other than that covering the antennae remains in the oötheca.

*Sex ratio and parthenogenesis.*—The wasps issuing from cockroach eggs exposed to one mated female are preponderantly female, averaging about 4 females to 1 male (Table 2). Undoubtedly the larger proportion of males emerged from oöthecae exposed to many wasps because some of the ovipositing females had not mated and the eggs from these individuals produced only males.

Two *Eurycotis* oöthecae were exposed to 13 unmated *Anastatus* females which we removed, prior to emergence, from an oötheca. Only one of these oöthecae yielded parasites: 42 males and 7 larvae. In another experiment 35 female wasps emerged from an oötheca which did not contain any male parasites. Three *Eurycotis* oöthecae were exposed to these females, and two of them later yielded parasites: a total of 591 adult males and 10 immatures; no adult females developed. *Anastatus floridanus* can reproduce parthenogenetically, the offspring apparently being all males (arrhenotoky); this is also true for *Anastatus blattidarum* (Flock, 1941).

*Size of adults.*—The size of the adult wasps varies, and depends on the amount of available food; thus when very few individuals develop within an oötheca, the adults are comparatively large on emergence. This is shown in Table 3 where antennal and tibial measurements are given for random samples from 2 groups of wasps in which the numbers of wasps that developed within two oöthecae differed by a factor of 6.8; the size differences between the 2 groups are highly significant.

TABLE 3

Effect of Parasite Density Within the *Eurycotis* Oötheca on the Size of Adult Females of *Anastatus floridanus*

Number of Wasps in Oötheca	Mean Length (mm.) $\pm$ S.E. <sup>1</sup> of		Number of Wasps Measured
	Antenna <sup>2</sup>	Hind Tibia	
35	1.34 $\pm$ 0.009	1.08 $\pm$ 0.005	15
238	1.12 $\pm$ 0.011	0.83 $\pm$ 0.009	15

<sup>1</sup> Standard Error.

<sup>2</sup> Includes only the combined length of the pedicel and flagellar segments.

*Longevity.*—The adult wasp is short-lived. At about 80° F., females lived from 2 to 4 days and males only 1 day (these wasps were supplied with moist raisins).

*Host specificity.*—The oöthecae of three other species of cockroaches were exposed to large numbers of female *Anastatus floridanus*. None of 40 oöthecae of *Supella supellectilium* was parasitized. Nine (6%) out of 152 oöthecae of *Periplaneta americana* (L.) were parasitized. One out of 111 oöthecae of *Blatta orientalis* L. was parasitized; 44 female and 4 male adult wasps were obtained from this egg case and these were given 10 oriental oöthecae. None of the eggs in these latter oöthecae was parasitized. Apparently *Anastatus floridanus* is specific for *Eurycotis floridana*, and only rarely, under experimental conditions, will it parasitize the eggs of the American or the oriental cockroach, even though the wasp is capable of developing on the eggs of these blattids. *Anastatus blattidarum* seems to be specific for the eggs of *Supella supellectilium* and will not oviposit in the eggs of *Latiblattella lucifrons* Heb., *Periplaneta americana*, *Blattella germanica* (L.) and *Blattella vaga* Heb. (Flock, 1941). However, there are specimens of *A. blattidarum* from India in the National Museum collection which are said to have come from *P. americana* (Burks, 1953).

The stimuli involved in finding and ovipositing into cockroach eggs by wasp parasites are unknown. Edmunds (1952) noted that the evaniid *Prosevania punctata* paid more attention to oöthecae which the American cockroach cemented to the walls of the cage than to egg cases that were merely dropped and left uncovered. Cros (1942) observed this same species of parasite dig deep excavations with the front legs to bare oöthecae which were buried in sand; this behavior would indicate that an olfactory stimulus was involved in locating the host oötheca. In one experiment we covered *Eurycotis* oöthecae with a layer of sand, and in another experiment with sawdust, then placed about 100 *Anastatus* in each of the dishes. None of the eggs was parasitized; however, one of the oöthecae in the sawdust was partly uncovered, apparently by the wasps.

Ten American cockroach oöthecae were smeared with a "paste" made of wet sand and ground up empty (the cockroaches had

hatched) *Eurycotis* oöthecae and exposed to many female wasps; none of these eggs was parasitized. Ten American oöthecae were smeared with saliva and chewed filter paper taken from a female *Eurycotis* in the act of covering her deposited egg case. After exposure to the wasps, 3 (30%) of the oöthecae contained parasites; 33 female wasps (plus several males) reared from these American oöthecae were exposed to 30 untreated American oöthecae; none of these eggs was parasitized. Although the number of oöthecae used in the saliva experiment was small, the results may indicate the presence of a substance in the saliva of *Eurycotis* females which may induce *Anastatus* to oviposit. It should be noted that the wasps reared from the eggs of the American and oriental cockroaches later failed to parasitize oöthecae of these 2 species. Evidently host specificity cannot be reduced in one generation by rearing this parasite on unnatural hosts.

#### SUMMARY

A new wasp *Anastatus floridanus*, which is parasitic on the eggs of *Eurycotis floridana*, is described. The wasp can reproduce parthenogenetically and apparently is arrhenotokous. The sex ratio of offspring from mated females is about 4 females to 1 male. The female may oviposit through the still-soft walls of an oötheca that is being formed and carried by the cockroach or through the hardened oötheca containing eggs more than a month old. Wasp development takes 34 to 46 days, the developmental time being determined to some extent by the number of parasites in the oötheca. The female wasp produces an average of about 50 offspring, but more than 300 wasps can develop on the eggs contained in a single oötheca of *Eurycotis*. All of the cockroach eggs are usually eaten by the wasp larvae, but if too few parasites are present, some of the eggs may not be eaten and may complete their development; however, these generally fail to hatch. The size of the wasps is variable being largely determined by the amount of available food; there is some evidence that the larvae are cannibalistic. The adult wasps are short-lived, the males living about 1 day and the females about 2 to 4 days. *Anastatus floridanus* can develop on the eggs of the American and oriental cockroaches but will not oviposit into these eggs readily; the wasp will not oviposit into the eggs of *Supella supellectilium*.

*Acknowledgement*

The writers thank Dr. B. D. Burks, U. S. National Museum, for his interest and helpful suggestions.

## REFERENCES

- BURKS, B. D., 1953. Personal communication.  
 CROS, A., 1942. *Blatta orientalis* et ses parasites. I. *Evania punctata* Brullé; II. *Eulophus* sp. Étude biologique. Eos, Madrid. 18:45-67.  
 DOZIER, H. L., 1920. An ecological study of hammock and piney woods insects in Florida. Ann. Entom. Soc. Amer. 13:325-380.  
 EDMUNDS, L. R., 1952. A study of the biology and life history of *Prosevania punctata* (Brullé) with notes on additional species (Hymenoptera: Evaniidae). Ph.D. dissertation; The Ohio State University. pp. 1-84. (Typewritten).  
 FERRIÈRE, C., 1930. On some egg-parasites from Africa. Bull. Entom. Res., 21:33-44.  
 ———, 1935. Notes on some bred exotic Eupelmidae (Hym. Chalc.). Stylops 4:145-153.  
 FLOCK, R. A., 1941. Biological control of the brown-banded roach. Bull. Brooklyn Entom. Soc. 36:178-181.  
 FRIAUF, J. J., 1953. An ecological study of the Dermaptera and Orthoptera of the Welaka area in northern Florida. Ecol. Mono. 23:79-126.  
 GIRAULT, A. A., 1915. Australian Hymenoptera Chalcidoidea-VII. The family Encyrtidae with descriptions of new genera and species. Mem. Queensland Museum. 4:1-184.  
 HEBARD, M., 1917. The Blattidae of North America north of the Mexican boundary. Mem. Amer. Entom. Soc. 2:284 pp.  
 LAWSON, F. A., 1953. Structural features of cockroach egg capsules. III. The ootheca of *Eurycotis floridana* (Orthoptera:Blattidae). Jour. Tennessee Acad. Sci. 28:28-33.  
 WEBER, P. W., 1951. Notes and exhibitions. Proc. Hawaiian Entom. Soc. 14:223.

## EXPLANATION OF PLATES

## PLATE I

A female *Eurycotis floridana* in the process of forming an oötheca. Time in hours (hrs.) and minutes (min.) taken from the time the oötheca was first visible.

Fig. 1, 1 hr. 30 min.; fig. 2, 2 hrs. 20 min.; fig. 3, 3 hrs. 40 min.; fig. 4, 4 hrs. 10 min.; fig. 5, 20 hrs. 22 min.; fig. 6, 21 hrs. 5 min.; (Figs. 1-5, dorsal views; fig. 6, lateral view; all about natural size.)

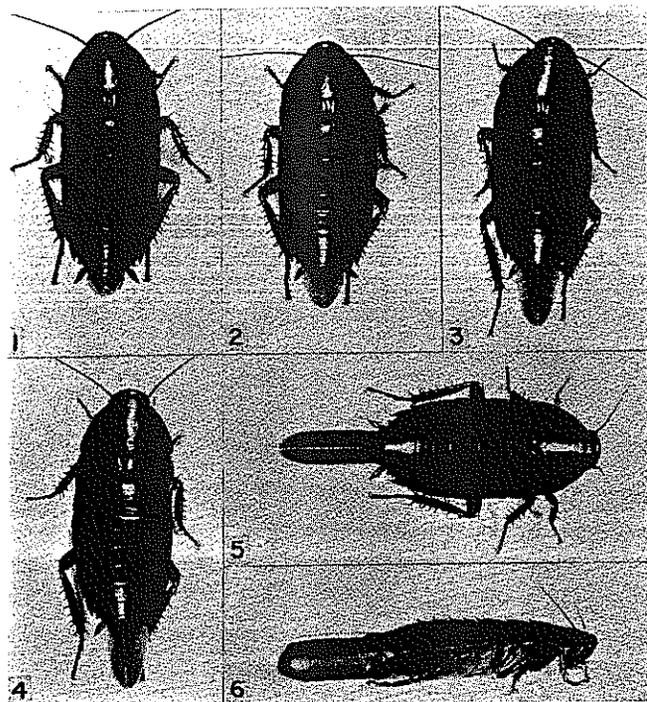
## PLATE II

*Anastatus floridanus* ovipositing into the eggs of *Eurycotis floridana*.

Fig. 7, Wasp beginning to pierce a dropped oötheca with her unsheathed ovipositor. X 13.3; fig. 8, Wasp with her ovipositor inserted through the wall of the oötheca. X 13.3; fig. 9, Wasp ovipositing into an oötheca which is being formed and is still attached to the female cockroach. X 3.

## PLATE III

Oöthecae that contained eggs of *Eurycotis* that were parasitized by *Anastatus floridanus*. X 5.8. Fig. 10, four of 6 emergence holes visible in oötheca; fig. 11, Oötheca opened to show destruction of all but 4 cockroach eggs; 4 well-developed cockroach embryos were still alive in the oötheca after the adult wasps had emerged.



ROTH AND WILLIS—NEW COCKROACH PARASITE