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A New Genus and Species of Mite (Acarina: Podapolipidae) Associated with the Coccinellid *Cycloneda sanguinea*[1]

R. W. HUSBAND
Adrian College, Adrian, Michigan 49221

ABSTRACT

COCCIPOLIPUS, new genus, is erected for ***C. macfarlanei,*** new species, which is associated with *Cycloneda sanguinea* (L.) (Coleoptera: Coccinellidae). All stages are described. Keys to genera of Podapolipidae and species of *Coccipolipus* are provided. New combinations are *C. solanophilae* (Cooreman) and *C. hippodamiae* (McDaniel & Morrill).

The purpose of this study is to (1) remove, from *Tetrapolipus,* some species formerly considered to be in this genus and (2) describe a new genus and species of mite from the coccinellid beetle, *Cycloneda sanguinea* (L.). Mites were examined, measured, and illustrated using a Wild-Heerbrug phase-contrast microscope with a drawing attachment.

When the 1st generic key to Podapolipidae was made (Husband and Sinha 1970), it was difficult to find characteristics which were common to the 5 known species of *Tetrapolipus.* Specimens from *C. sanguinea* keyed to *Tetrapolipus* but have 2 instead of 4 legs in the adult female. Further investigation indicated that the specimens from the coccinellid represent a new species showing affiliation with species presently included in *Tetrapolipus.*

The genus *Tetrapolipus* was erected by Berlese (1911) to accommodate *T. batocerae* (Berlese 1910). Four species were added; *T. blattae* (Oudemans 1911), *T. rhyncophori* Ewing (1924), *T. hippodamiae* McDaniel & Morrill (1969), and *T. solanophilae* (Cooreman 1952). The 1st 3 species mentioned are similar in that a conspicuous solenidion is found on tibia I of the larviform female of each species. These species have either very long chelicerae or 3 conspicuous solenidia on tarsus I. In contrast, larviform females of *T. solanophilae, T. hippodamiae,* and the new species lack tibial solenidia, have only 2 tarsus I solenidia, and chelicerae are relatively short. Adult females of the 1st 3 species either lack a tectum or the tectum is not elongate-ovoid. An elongate-ovoid tectum is present in adult females of *T. solanophilae, T. hippodamiae,* and the new species. The greatest differences between the 2 groups of species occur in males. The male of *T. batocerae* has a very short middorsal aedeagus and has one spine on each of tibiae I, II, and III. The male of *T. blattae* is unknown. The male of *T. rhyncophori* has a very long aedeagus which extends over the gnathosoma. *T. rhyncophori* lacks tibial spines. On the other hand, males of *T. hippodamiae* and the new species have aedeagi which extend over the posterior ¼ of the propodosoma. Each of the 2 last-mentioned species has a combination of one spine on tibia I and 3 spines on tibiae II and III. Thus, it is concluded that the designation of a new genus is appropriate to accommodate *T. solanophilae, T. hippodamiae,* and the new species described here.

Coccipolipus, n. gen.

The genus has the following characteristics: Gnathosoma of larviform female, male, and adult female narrow, no more than ¼ the width of idiosoma. Chelicerae moderately developed in all forms. Pedipalps reduced. Tectum above gnathosoma of adult female. Propodosoma of larviform female with 3 pairs of setae, anterior 2 pairs much reduced, posterior pair normal. Male with 4 pairs of propodo-

[1] Coleoptera: Coccinellidae. Received for publication Apr. 14, 1972.

somal microsetae. Idiosoma of adult female smooth, without setae, 0–4 anterior lobes. Metapodosoma of male and larviform female with 3 pairs of setae; 3rd pair may be situated on a separate plate. Male with aedeagus middorsal, extending anteriorly over the posterior ¼ of propodosoma. Setae sacrales on a separate plate in larviform female, plate and setae lacking in male. Opisthosomal setae of larviform female very long; accessory setae short, inconspicuous. Male and larviform female with 3 pairs of legs, adult female with 1–2 pairs of legs. Male with a single spine on tibia I, tibia II and III each with 3 spines; larviform female without tibial spines. One long and one short solenidion on tarsus I of male and larviform female. Leg I of adult female with a subterminal or terminal hook and dorsal spine, dorsal seta usually present on femur I; leg II, if present, with 2 terminal spines. All species are associated with the beetle family Coccinellidae. Type species: *Coccipolipus macfarlanei,* n. sp.

The following 2 species are reassigned to *Coccipolipus: Tetrapolipus solanophilae* Cooreman and *T. hippodamiae* McDaniel & Morrill.

Key to Genera of Podapolipidae

1. Terminal opisthosomal setae shorter than ⅓ width of idiosoma or absent 2
   Terminal opisthosomal setae at least as long as ½ the width of idiosoma ..... larviform females
2. Aedeagus present, 3–4 pairs of legs ..... males
   No aedeagus, 0–3 pairs of legs ..... adult females

Key to Larviform Females

1. Tibiae I, II, III each with 0–1 spines 2
   Tibiae I, II, III each with 2 or more spines ..... *Ovacarus*
2. Caudal accessory setae conspicuous, elongate, slightly pectinate, or well separated from long opisthosomal setae 3
   Caudal accessory setae inconspicuous, or absent 7
3. One solenidion on tibia I 4
   No solenidion on tibia I ..... *Podapolipoides*
4. Gnathosoma longer than broad; palpi ca. ⅓ the width of gnathosoma 5
   Gnathosoma as broad as long; palpi less than ¼ width of gnathosoma 6
5. Usually one seta on coxa IV; length of accessory setae less than 2 times the distance between accessory setae; proximal solenidion on tarsus I longer than ½ length of distal solenidia ..... *Dorsipes*
   Two setae on coxa IV; length of accessory setae less than 2 times the distance between accessory setae; proximal solenidion on tarsus I less than ½ length of distal solenidia ..... *Eutarsopolipus*
6. Length of tibia I solenidion equal to or greater than width of tibia I ..... *Tetrapolipus*
   Tibia I solenidion equal to or less than ½ width of tibia I ..... *T. rhynchophori*[2]
7. Tarsus I with 2 solenidia 8
   Tarsus I with 3 solenidia 9
8. Solenidia on tarsus I nearly equal in length ..... *Bakerpolipus*
   Posterior solenidion on tarsus I about half as long as anterior solenidion ..... *Coccipolipus*
9. Length of setae scapulares externae (*s.sc.e.*) at least half the width of idiosoma 10
   Length of *s.sc.e.* much less than half the width of idiosoma ..... *Archipolipus*
10. No spines on tibia I, II, III; length of setae humerales externae (*s.h.e.*) less than width of femur III ..... *Podapolipus*
    Spines on tibiae I, II, III or, if spines lacking, *s.h.e.* much longer than width of femur III .... *Locustacarus*

Key to Males

1. Four pairs of legs 2
   Three pairs of legs 4
2. Aedeagus middorsal; no spines on tibiae II, III .. 3
   Aedeagus posterior; spine on each of tibiae II, III ..... *Archipolipus*
3. From Scarabaeidae ..... *Tarsopolipus*
   From Carabidae ..... *Dorsipes*
4. Aedeagus posterior 5
   Aedeagus middorsal or anterior 6
5. Spines on tibiae I, II, and III; *s.sc.e.* inconspicuous or absent ..... *Ovacarus*
   No spines on tibiae; *s.sc.e.* long, conspicuous .... *Eutarsopolipus*
6. Aedeagus opening anterior, near the gnathosoma .. 7
   Aedeagus opening near anterior of metapodosoma or near posterior of propodosoma 9
7. Length of *s.h.e.* less than ¼ width of idiosoma 8
   Length of *s.h.e.* at least ½ width of idiosoma .... *Locustacarus*
8. Aedeagus extends freely over gnathosoma; no spine on tibiae ..... *T. rhynchophori*[2]
   Aedeagus terminates immediately posterior to gnathosoma; at least tibia I with one spine .... *Podapolipus*
9. One or more spines on each of tibiae I, II, and III .10
   Tibiae without spines ..... *Bakerpolipus*
10. Two or more spines on each of tibiae II and III ..... One spine on each of tibiae II and III ..... *Tetrapolipus*
11. Two solenidia on tarsus I, posterior solenidion ca. ½ the length of anterior one ..... *Coccipolipus*
    Three solenidia on tarsus I, distal solenidia nearly equal in length ..... *Podapolipoides*

Key to Adult Females

1. With 1–3 pairs of legs 2
   Without legs ..... *Archipolipus*
2. With 3 pairs of legs 3
   With 1–2 pairs of legs 6
3. Width of gnathosoma less than ½ width of propodosomal plate 4
   Width of gnathosoma greater than ½ width of propodosomal plate ..... *Tarsopolipus*
4. Tibial spines absent 5
   Tibial spines present ..... *Ovacarus*
5. Proximal solenidion on tarsus I at least ½ length of distal solenidia; solenidion on tarsus II nearly equal to spine on tarsus II ..... *Dorsipes*
   Proximal solenidion on tarsus I less than ½ length of distal solenidia; solenidion on tarsus II less than ½ length of spine on tarsus II ..... *Eutarsopolipus*
6. Anterior lobes of idiosoma, if present, not bifurcate 7
   Anterior lobes bifurcate ..... *Podapolipoides*
7. Idiosoma elongate or if nearly spherical, then reticulate tectum usually present 8
   Idiosoma spherical, smooth; gnathosoma without tectum ..... *Locustacarus*
8. With 1 pair of legs; 0–2 anterior lobes 9
   With 2 pairs of legs, or if one pair, then with 4 anterior lobes 10
9. Idiosoma ovoid and reticulate, lobes absent ..... *Bakerpolipus*

[2] *Tetrapolipus rhynchophori* represents a new genus which will be described when more data are collected. Males of this species have been discovered recently in Brazil by Dr. Carlos Flechtmann.

Idiosoma elongate, smooth, if reticulate, then with a pair of anterolateral lobes ..... *Podapolipus*

10. Two pairs of legs; propodosoma ⅓ width of metapodosoma, usually a distinct unit anterior to metapodosoma ..... *T. rhynchophori*[2]
    One pair of legs; if 2 pairs, then prodosoma not a distinct unit anterior to a larger metapodosoma..11
11. Distinct ovoid tectum, usually with a long seta on femur I ..... *Coccipolipus*
    Tectum absent, seta on femur I absent..*Tetrapolipus*

Key to Species of *Coccipolipus*

1. Dorsal aedeagus, tibial spines present, opisthosomal setae absent (males) 2
   Aedeagus and tibial spines absent, with or without long opisthosomal setae (females) 3
2. Coxa III pore contiguous with seta base; setae verticales internae *(s.v.i.)* as near to setae verticales externae *(s.v.e.)* as to each other .... *macfarlanei*
   Coxa III pore separated from coxa III seta by a distance nearly equal to distance between coxae III; distance between *s.v.i.* distinctly less than the distance between *s.v.i.* and *s.v.e.* .... *hippodamiae*
3. Opisthosomal setae present, long; 3 pairs of legs (larviform females) 4
   Opisthosomal setae absent; 1–2 pairs of legs (adult females) 6
4. Two metapodosomal plates; setae dorsales *(s.d.)* very short 5
   Three metapodosomal plates; *s.d.* very long, extending past posterior margin of idiosoma .... *solanophilae*
5. Claws on legs II and III with one tine, well sclerotized; coxa II setae farther removed from the midline than coxae I setae by about the diameter of the circle at the base of setae ....*hippodamiae*
   Claws on legs II and III 2-tined, not well sclerotized; coxae II setae nearly twice as far from the midline as coxae I setae .....*macfarlanei*
6. Two pairs of legs; 0–2 anterior idiosomal lobes lateral to gnathosoma 7
   One pair of legs; 4 anterior lobes lateral to gnathosoma .....*macfarlanei*
7. Terminal sucking disc and hooked spine on leg I; tectum not tongue-like; one conspicuous spine on tarsus II; idiosoma with one pair of bulges ..... *solanophilae*
   No sucking disc on leg I; tectum tongue-like; 2 spines on tarsi II; idiosoma with an anterior and posterior pair of bulges .....*hippodamiae*

Table 1.—Measurements (in μ) of *C. macfarlanei.*

Character	Range	Mean
Adult female (n = 11)		
Idiosoma length	425–532	478.1
Idiosoma width	291–446	358.8
Gnathosoma length	39–57	48.5
Gnathosoma width	39–57	44.7
Tectum length	38–70	53.5
Tectum width	40–59	48.5
Genital opening	119–182	150.7
Leg length[a]	78–107	92.1
Femoral seta length	18–19	18.3
Chelicera length	14–27	22.5
Anterolateral lobe length	38–81	54.6
Anterolateral lobe width	58–89	74.8
Male (n = 8)		
Idiosoma length	97–145	118.8
Idiosoma width	82–125	103.5
Gnathosoma length	19–22	20.7
Gnathosoma width	19–27	21.2
Chelicera length	8–9	8.9
Anterior solenidion length	9–11	9.8
Posterior solenidion length	5–6	5.4
Tibia I spine length	4–5	4.4
Aedeagus length	12–18	14.0
Aedeagus width	11–15	13.2
Leg I[a]	52–72	60.4
Leg II[a]	56–82	69.5
Leg III[a]	51–77	60.5
Larviform female (n = 12)		
Idiosoma length	109–167	142.3
Idiosoma width	104–135	117.1
Gnathosoma length	32–43	38.2
Gnathosoma width	33–44	39.2
Chelicera length	19–30	25.1
Anterior solenidion length	9–12	10.8
Posterior solenidion length	5–6	5.7
Opisthosomal setae	150–161	155.5
Caudal accessory setae	3–4	3.8
Leg I[a]	70–88	78.5
Leg II[a]	79–92	87.6
Leg III[a]	71–84	79.8
Egg (n = 10)		
Length	179–190	185.2
Width	79–119	97.5

[a] Measured from center of mesal margin of coxa to apex of pulvillus.

Coccipolipus macfarlanei, n. sp.

C. macfarlanei is distinguished from other *Coccipolipus* by characteristics used in the preceding key. Table 1 gives ranges and means of measurements of the adult female, larviform female, male, and egg.

FEMALE. (Fig. 1, 2).—*Gnathosoma.*—Longer than wide, well sclerotized; tectum slightly longer than wide. Chelicerae smooth, ca. ½ width of gnathosoma. Stigmata on slender processes, dorsolateral to gnathosoma.

Idiosoma.—Egg-shaped, smooth; 4 nearly equal anterolateral lobes; conspicuous ventral genital opening.

Legs.—One pair; hooked, mesal, ventral tarsal spine; 2 dorsal tarsal spines; one stout, long, dorsal femoral seta.

MALE. (Fig. 3, 4).—*Gnathosoma.*—Width ca. ⅘ that of idiosoma; nearly as long as wide; dorsal and ventral setae short. Pedipalps reduced, conspicuous seta on basal segment. Length of chelicerae less than ½ width of gnathosoma.

Propodosoma.—Propodosomal plate hemicircular, with 4 pairs of microsetae in a semilunar cluster.

Metapodosoma.—Middorsal aedeagus at anterior margin; aedeagus extending anteriorly over the posterior ¼ of propodosoma. Three pairs of microsetae. Plates I and II completely fused, forming a circular plate.

Opisthosoma.—No plates or setae apparent.

Sternum.—Coxal plates 1 and 2 fused mesially, separated from 3 by an area of nonsclerotized integument. Coxae 3 separated from each other by nonsclerotized integument. Each coxal plate with a short seta, coxae 3 seta adjacent to a pore.

Legs.—Shorter than width of idiosoma; chaetotaxy as in Table 2. Anterior spine on tibia I, 3 spines on each of tibiae II and III. Ventral tibia

Table 2.—Leg chaetotaxy of male and larviform female of *C. macfarlanei*.

Leg	Femur	Genu	Tibia	Tarsus[a]
I	1 1—0 1	1 1—1 0	3 1—1 1	4 s, 2 so 1 sp
II	0 1—0 0	0 1—0 0	1 1—1 1	2 s, 2 sp
III	0	0 1—0 0	1 1—1 1	2 s, 2 sp

[a] Because of difficulty in assignig a position to terminal setae, a different designation is used to indicate tarsal setae. The following abbreviations apply: s = seta, so = solenidion, sp = spine.

III spine with 1, 2, or 3 tines. Most tibial and tarsal setae shorter than in larviform female.

LARVIFORM FEMALE (Fig. 5, 6).—*Gnathosoma.*—About ¼ width of idosoma; ventral and dorsal setae very short. Pedipalps 2-segmented, one short seta on each segment. Chelicerae smooth, more than ½ width of gnathosoma.

Propodosoma.—Propodosomal plate semilunar; 2 pairs of setae; length of *s.sc.e.* nearly equal to width of idiosoma.

Metapodosoma.—Plates I and II fused; 3 pairs of microsetae.

Opisthosoma.—Plate I oval, bearing one pair of short setae. Terminal plate triangular, bearing one pair of short caudal accessory setae and one pair of opisthosomal setae longer than length of idiosoma.

Sternum.—Coxal plates 1 and 2 fused mesially, separated from plate 3 by nonsclerotized integument. Coxae 3 separated by nonsclerotized integument. Each coxal plate with a short seta, pores well separated from setae.

Legs.—Shorter than width of idiosoma; chaetotaxy as in Table 2. No spines on tibiae. Most tibial and tarsal setae longer than in male. Lightly sclerotized opposable claws on legs II and III each with 2 tines.

EGG.—One to 5 oval eggs in various stages of development observed within the body of the adult female.

Type Data.—Holotype, ♂; 26 ♀, 16 ♂ and 31 larviform female paratypes, Glasshouse Crops Research Institute, Littlehampton, England, April 1968; collector B. Gurney; from a laboratory culture of the coccinellid beetle *C. sanguinea*. The holotype is deposited in the British Museum (Natural History).

Paratypes are to be distributed to each of the following: Adrian College, Adrian, Mich.; Bernice P. Bishop Museum, Honolulu,Hawaii; British Museum (Natural History), London, England; Canadian National Collection, Entomology Research Institute, Ottawa; University of Georgia, Athens; Acarology Laboratory of the Ohio State University, Columbus; L'Institute Royal des Sciences Naturelles, Bruxelles, Belgium; Hebrew University, Jerusalem, Israel; Le Museum National d'Histoire Naturelle, Paris, France; Institute of Zoological Research, Potchefstroom, South Africa; Research Station, Canada Department of Agriculture, Winnipeg; Snow Entomological Museum, Lawrence, Kansas; South Australian Museum, Adelaide, Australia; National Museum, Adelaide, Australia; National Museum of Natural History, Washington, D. C.; Universtetes Zoologiske Museum, Copenhagen, Denmark; Zoological Institute of the Academy of Sciences, Leningrad, USSR; Zoologisches Institute der Universitat Freiburg, Germany; Instituto Sperimentale per la Zoologia Agraria, Firenze, Italy.

Remarks.—Specimens of the host species of *C. macfarlanei,* the coccinellid beetle *C. sanguinea,* were collected from eggplants at Curepe, Trinidad, West Indies. Many specimens of *C. marfarlanei* were found under the elytra by Miss Gurney. Adult females were most common. Female mites outnumbered male mites by a ratio of more than 10 to 1. *C. macfarlanei* appears to be specific to *C. sanguinea.* An abundance of the fungus *Laboulbeniales* sp., was also found on the host beetles. Other species of Coccinellidae from the West Indies observed by Miss Gurney lacked both the fungus and mites. She obtained the original stock of beetles from F. J. Simmonds of the Commonwealth Institute of Biological Control.

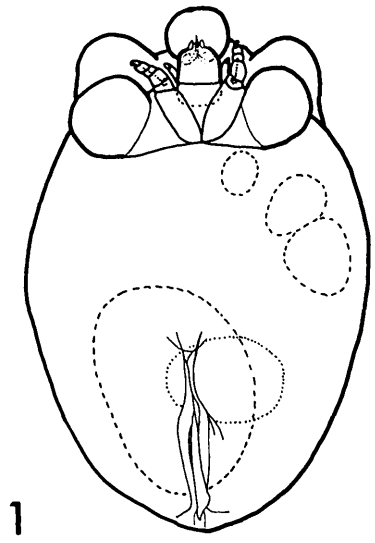
The species is named in honor of Donald Macfarlane in recognition of his contributions to the field of acarology.

DISCUSSION

So few of the existing mites of the family Podapolipodidae have been described that it is difficult to determine relationships. In addition, the grouping of related species based upon characteristics found in the adult female often gives a different grouping than one based upon characteristics found in either males or larviform females. In my opinion, the adult female, which is most degenerate, is the least helpful in determining generic position. The male has the most useful set of characteristics. Of course, all stages should be considered when proposing generic relationships.

Coccipolipus is most closely related to *Bakerpolipus, Tetrapolipus,* and *Podapolipoides.* In *Tetrapolipus,* the mesal solenidion of tarsus I is reduced. Both *Bakerpolipus* and *Coccipolipus* lack a mesal solenidion on tarsus I. This solenidion is well developed in *Podapolipoides* and is present in most other Podapolipodidae. Male *Coccipolipus* have 3 spines on tibia II

FIG. 1–6.—*C. macfarlanei.* 1, Venter of adult female. 2, Adult female; A, leg I, ventral view; B, same, dorsal view. 3, Dorsum of male: S.V.I., setae verticales internae; S.V.E., setae verticales externae; S.SC.I., setae scapulares internae; S.SC.E., setae scapulares externae. 4, Venter of male. 5, Dorsum of larviform female: S.H.E., setae humerales externae; S.D., setae dorsales; C.A.S., caudal accessory setae; OPS., opisthosomal setae. 6, Venter of larviform female.



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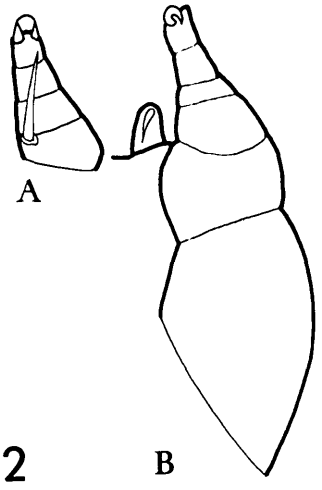

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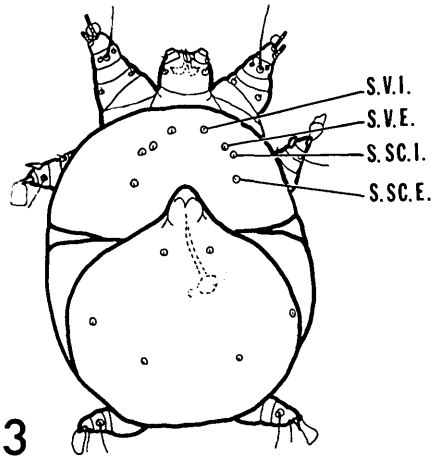

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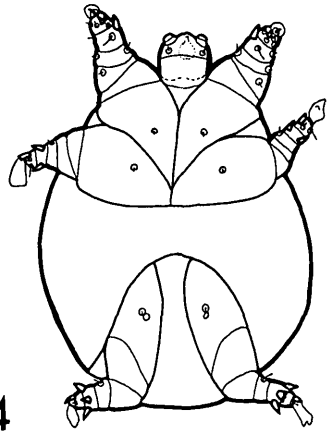

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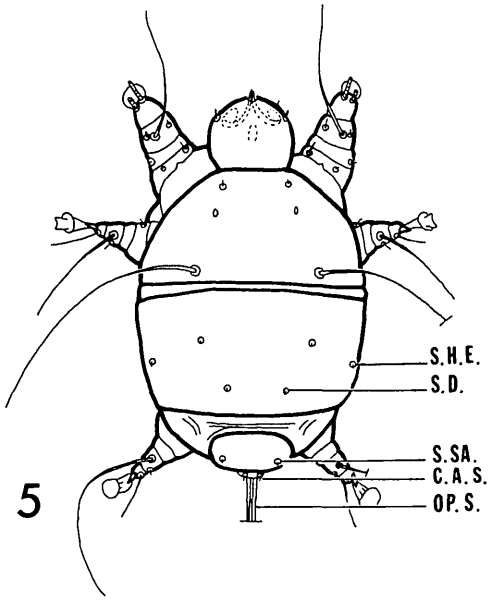

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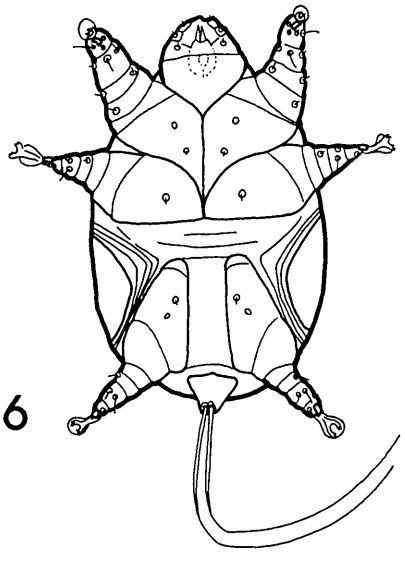

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and III, a characteristic found in only one other genus, *Ovacarus*.

Larviform female *Coccipolipus* resemble larviform female *Bakerpolipus* in that each lacks tibial spines, has inconspicuous caudal accessory setae, and has only 2 solenidia on tarsus I. In addition, the only long setae on the idiosoma of the 2 genera are setae scapulares externae and terminal opisthosomal setae. However, the solenidia on tarsi I are unequal and the chelicerae are much shorter in *Coccipolipus* than *Bakerpolipus*.

All 7 genera of Podapolipodidae which have adult females with one or 2 pairs of legs have tarsus I with a terminal or subterminal hooklike spine. Tarsus I of *Coccipolipus* most closely resembles tarsus I of *Bakerpolipus, Podapolipoides,* and *Tetrapolipus*. *Coccipolipus* differs from *Podapolipoides* in lacking bifurcate anterior idiosomal lobes. Differences between *Coccipolipus* and *Tetrapolipus* were discussed earlier.

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Biology of *Agathis gibbosa* (Hymenoptera: Braconidae), A Primary Parasite of the Potato Tuberworm[1,2]

JOHNSON A. ODEBIYI AND EARL R. OATMAN[3]
Department of Entomology, Division of Biological Control, University of California, Riverside 92502

ABSTRACT

Agathis gibbosa (Say), a primary, solitary, larval endoparasite of *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae), was studied under laboratory conditions of 26.7 ± 1°C and 50 ± 2% RH. The egg is deposited in any of the ganglia along the ventral nerve cord of the host larva. The parasite larva develops in the body cavity, emerging after the host larva has spun its cocoon, and then feeds externally on the host larva for 1 to 2 days before spinning its own cocoon inside that of its host. There are 3 instars, the first being mandibulate and the other two hymenopteriform. Total developmental time from egg to adult ranged from 16 to 22 days; average, 18 days. The duration of each developmental stage was: egg 3.5 days, 1st stage 3.5 days, 2nd stage 1 day, 3rd stage 3 days, prepupa 2 days, and pupa 3 days. Adult emergence was stimulated by light, and copulation occurred within a few minutes to several hours later. Males mated several times, females only once. Unmated females produced only males, mated females both males and females. There is essentially no pre-oviposition period. Without food and water, adults died within 2.6 days; with both honey and water, males lived an average of 12.6 days and females 18 days. The highest average daily production of progeny among 10 mated females was 40.5. The females had an average ovipositional period of 9 days and produced an average of 288.5 adult progeny. Longevity of the mated females averaged 10.8 days and the sex ratio (♂:♀) of their progeny averaged 1.9:1.

Agathis gibbosa (Say), a parasite of *Phthorimaea operculella* (Zeller), is native to North America. It was described originally by Say in 1836 as *Bassus gibbosus*. All the known hosts are larvae of Lepidoptera. Most of them belong to the genera *Phthorimea* and *Mompha*, including *P. operculella*, *P. glochinella* (Zeller), *Mompha stellella* (Busck), and *Mompha* sp. Other hosts are *Coleophora* sp., *Papaipema nebris* var. *nitela* (Guenée), and *Strobisia iridipennella* (Clements) (Muesebeck et al. 1951, Krombein 1958).

The present study was concerned with basic

[1] *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae).
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[3] Graduate Student and Associate Entomologist, respectively, Division of Biological Control, University of California, Riverside 92502.