

NEW HYMENOPTEROUS PARASITES OF ANTS (CHALCIDOIDEA: EUCHARIDAE)

GEORGE C. WHEELER AND ESTHER W. WHEELER,
University of North Dakota
Grand Forks, North Dakota

Orasema sixaolae new species.

FEMALE. (Fig. 15.) Length 1.7 mm. Head (Fig. 16) in front view subtriangular about as wide as long; in dorsal view, one and one-third times the width of the thorax. Antennae ten-segmented; scape one-fifth the entire length and extending two-thirds the distance to the top of the head; inserted in a wide longitudinal furrow. Flagellum somewhat clavate; segments very short, except the terminal, which is three times as long as the average. Right mandible with two rather stout teeth on the medial border, the left with only one; apices slender, curved, acute. Eyes oval, their length one-third the length of the head and one and one-third the malar space. Ocelli in a triangle; posterior pair about the same distance from the eyes as from the front ocellus but twice as far from each other. Thorax one-third the total length; width five-eighths and height two-thirds its own length. Mesoscutum trilobed, the lobes convex. Scutellum simple. Mesepisterna shallowly punctate in the middle. Metepisterna smooth. Legs very slender. Propodeum steeply sloping. Wings with a submarginal vein; forewings also with a post-marginal and a stump of a stigmal vein. Stigma very feebly developed. Abdomen one-half the total length. Petiole very slender, subcylindrical, five and one-half times as long as wide, and at its attachment to the gaster abruptly enlarged ventrally. Gaster slightly compressed, sub-circular in side view, its width three-fourths its length. Six dorsal and five ventral segments visible. Ovipositor (Fig. 19) short, thick, acute, with a dorsal row of eight transverse, blunt ridges towards the apex; sheaths thickened in the middle, curved, very acute. Head with punctations which are deeper on the vertex. Region in front of eyes smooth except along the shallow median furrow. Genae and clypeus smooth. Pronotum unsculptured. Praescutum deeply and coarsely punctate; lateral lobes of the mesoscutum glabrous except for some erratic lines near the mid-dorsal suture. Scutellum with the apex subglabrous, the remainder irregularly striated; bounded posteriorly by a ridge. Metanotum very short. Propodeum with a coarsely punctate, mid-dorsal, longitudinal ridge and lateral smooth areas. Petiole irregularly roughened. Gaster shiny. Coxae faintly striated. Mesepisterna variously punctate; metepisterna smooth. Hairs absent, with the following exceptions: four long hairs on the anterior margin of the clypeus; a few minute hairs on the genitalia; pubescence on the flagellum (except the first joint), the tarsi, and the wings. Head, thorax, and petiole fusco-piceous to piceous with a reddish metallic lustre; gaster uniformly ferruginous; mandibles, antennae, and femora fuscous; eyes, ocelli, tarsi, tibiae, and genitalia fulvous.

Description based on two females from a nest of *Solenopsis* (*Diplorhoptum*) *tenuis* Mayr, in dead twig, Sixaola River, Province of Limón, Costa Rica, VII-29-1924. Collected by G. C. Wheeler. Host identified by Dr. W. S. Creighton. Types in the authors' collection.

YOUNG LARVA. (Figs. 1, 2.) The very young larva or planidium (length 0.12 mm.) has ten to twelve closely applied segments visible. The body is subellipsoidal, the posterior fourth being somewhat narrowed and more acute than the anterior. On the ventral surface the posterior margin of each segment from the fourth to the eighth inclusive, bears a pair of short, obtuse, tooth-like projections. Each thoracic segment has a pair of dorsal hairs, and the terminal segment two stout bristles. The head (Fig. 7) is ovoidal, its length one and one-fourth times the width. The short metopic suture impresses the center of the occipital border. There is a pair of papillae on the frontal region, a more lateral pair on the temporal region, and four smaller structures, probably also papillae, at the attachment of the labrum. The mandibles are simple, curved, and acute. The distal border of the labrum has a row of nine papillae; when the mouth is distended, this row becomes projected forward beyond the other mouth parts. The center of the anterior (?) labial surface bears four papillae on a square area which is connected with the distal border by a furrow. On each side of this furrow, two pairs of relatively large papillae lie along the distal border.

A somewhat older larva (length 0.2 mm.) might also be called a planidium (Fig. 4), but its twelve segments are distended so that the length is one and two-thirds that of the young planidium. The first and second dorsal sclerites are in contact as are also the eighth to twelfth inclusive. The intermediate sclerites are more or less widely separated and the body is considerably swollen ventrally. The first three dorsal plates bear each a pair of hairs. The first one also has a disc-like structure visible laterally, which may be a hair-base. The anal bristles have probably been broken off, since structures were seen which might be their stumps. The ventral pairs of tooth-like projections on the fourth to eighth segments, the hairs, and the characters of the head are like those of the undistended planidium.

Orasema costaricensis new species

FEMALE. (Fig. 20.) Length 2.7 mm. Head (Fig. 17) in front subtriangular, about as wide as long. Scape extending four-fifths the distance to the top of the head. Eyes about one-half the length of the head and one and one-third the malar space. Ocelli in a triangle; distance between the posterior pair about three-fourths that from the eyes, but twice that from the anterior ocellus. Maxillary palpi three-, labial two-jointed (Fig. 21). Head one and one-fourth the width of the thorax above. Thorax about one-third the entire length, height and width each two-thirds its own length. Forewings with submarginal, short postmarginal, and stump of stigmal veins. Abdomen one-half the total length. Petiole six times as long as wide, not enlarged at the posterior end. Gaster slightly compressed, almost as high as long; dorsal

width five-eighths the length; height one and one-third times the width. Ovipositor (Fig. 18) slender with a dorsal row of nine transverse blunt ridges; sheaths slender, tips curved, acute, with six ventral teeth near apex. Head (including genae) very coarsely punctate; striated behind, the striations following the contours. Scutum and scutellum roughly punctate dorsally. The rows of dorsal pits on the lateral lobes of the mesoscutum run in two directions separated by a fine transverse ridge; the anterior rows are transverse, the posterior longitudinal. Mesepisterna punctate all over, and metepisterna faintly punctate. Four hairs on the anterior margin of the clypeus; a few small hairs on the genitalia. Flagella (except the first joint), apex of hind tibiae, tarsi and wings pubescent. Head and thorax piceous with a greenish lustre. Abdomen ferruginous, darker above. Flagella, coxae, and front femora fuscous; rest of legs, scapes, ocelli, eyes, and mandibles (except brown tips of teeth) fulvous. Wings iridescent.

Description based on one female and four mature pupae from a nest of *Pheidole flavens* Roger var. in rotten log, Zent, Costa Rica, VI-24-1924. Collected by G. C. Wheeler. Host identified by Dr. W. M. Wheeler. Types in the authors' collection.

YOUNG LARVA. (Fig. 3.) The smallest planidium (length 0.17 mm.) in our material is already somewhat inflated. Sclerites one to two and five to twelve are still in contact and the body back to the seventh segment is distended below. A much larger larva (length 0.48 mm.), almost three times as long and as wide as the former (Figs. 5, 6), has all segments up to the eighth so widely separated that the sclerites are scarcely recognizable as such. These sclerites and the head are of the same size as those on the less distended planidium; this would suggest that the growth of the planidium is made possible by the spreading of the softer membranes rather than by ecdysis. Both larvae have the same integumental characters. Pro-, meso-, and metathoracic segments bearing each a pair of single, slender hairs on the dorsal surface; the anal segment also bearing a single pair, usually broken off in the much distended form. One or two pairs of discs (sensory?) on the anterior margin of the mesothoracic plate. Pairs of tooth-like projections present on the ventral surface of the fourth to eighth segments. Head (Fig. 8) somewhat elongate, oval, its length one and one-fourth times its breadth, with a very short metopic suture; posterior angles of the head rounded. Four pairs of sensory discs on the front, the two lateral pairs larger, each with a distinct peg-like protuberance. The heavily chitinized plate of the head widely separated mid-ventrally. Mandibles slender, falcate, acute, concealed under the labrum and attached to thickly chitinized triangles. In the center of the labium a short, transverse, arcuate line (opening of sericteries?); the ends of this line connected by fainter lines with a elliptical elevation at the apex of the labium; two paired structures, probably papillae (the dorsal one bearing a minute spinule), at either end of this elevation.

MATURE LARVA. (Figs. 11, 12.) This stage (length 1.77-2.15 mm.) is composed of eleven segments in addition to the head. The body is

elongate, moderately stout and subcylindrical with the ends rounded; the head and anal segment are ventral. There are two dorso-lateral rows of nine pustulate protuberances (suggesting in shape immature mushrooms), one row immediately dorsal to each row of spiracles. In addition, the meso- and metathorax bear each a pustule below the spiracle on either side. The first abdominal segment is slightly depressed and somewhat expanded ventrally. A mid-dorsal furrow divides the anterior half of the prothorax into two lateral lobes. On the side of each lobe projects a simple, low, rounded excrescence. The small head (Fig. 9) is very short, the height being three times the length; the width is one and one-third the height. On the front there is a median longitudinal depression separating a pair of subcircular convexities. A pair of minute sensory discs are located near the center of the depression; between this pair and the mouth parts are five more. Labrum short and broad; mandibles small, acute, curved outwards, too short to meet; labium transversely elliptical, with a small notch in the center of the distal border. A few minute discs (sensillae?) on each lateral surface of meso- and metathorax. Integument of prothorax, intersegmental regions, and anal segment furnished with small obtuse spinules, varying in size. Nine pairs of spiracles, each on a small elevation.

At this stage, the parasite has become separated from its host. Whether it was still feeding could not be ascertained. If it eats at all, it is probably ectoparasitic in contrast with the pianidium which is endoparasitic.¹

SEMI-PUPA. (Fig. 13.) The semipupa (length 1.8 mm.) is similar to the mature larva except that segments three to five (inclusive) are enlarged so as to form a mid-ventral swelling, which is corrugated by the impressed intersegmental furrows; the corrugations terminate abruptly in the ventrolateral region.

PUPA. (Fig. 14.) The pupa (length 2.4 mm.) has a mid-dorsal longitudinal row of three pustulate tubercles, formed from the pupal membrane, on the posterior thoracic and petiolar regions. They are globular in shape and abruptly constricted at their attachment. The intersegmental folds are prominent on the gastric dorsum and sides. The anterior fold is much the largest, its lateral termini are strongly produced, and its mid-dorsum forms a subglobular knob. The other folds become progressively smaller and lack the lateral dilations. Other smaller and simpler protuberances are present: one in the clypeal region, another above the antennal insertions, three over the ocelli, one on the pronotum, and several near the genitalia.

DISCUSSION

ADULTS. *Orasema sixaolae* is smaller and more finely punctate than *O. costaricensis*. The subclavate flagellum has shorter

¹Wheeler (1907, p. 9) says of *O. viridis*, "As soon as the full grown *Orasema* has been separated from its prey, it begins to pupate." Perhaps in our species also it starts to change immediately without further feeding.

segments (except the apical). The genae are smooth instead of punctate; the clypeal hairs longer. The propodeum is sculptured into a mid-dorsal, longitudinal, coarsely punctate ridge with lateral smooth areas while *O. costaricensis* is finely punctate. The apex of the petiole of *O. sixaolae* is enlarged ventrally. Although the abdomen is ferrugineous in both, the thorax is differently colored: *O. costaricensis* is piceous with a greenish lustre; *O. sixaolae* is more fusco-piceous with a reddish lustre. In both species the thorax is one-third the entire length, the abdomen one-half; antennae ten-segmented; maxillary palpi three-jointed, labial two; mesoscutum trilobed; scutellum without projections; propodeum steeply sloping; petioles slender, gaster shiny, sub-circular and slightly compressed; fore wings with submarginal, short post marginal and feeble stigmal veins.

Some of the above characters may be generic, but it is impossible to decide until Girault's unpublished monograph is available or until more complete descriptions are published. Moreover, the paucity of specimens makes it difficult to generalize about specific characters.

PLANIDIA. All the known first-stage eucharid larvae are planidia and may be characterized as follows: obovoid; head and dorsal plates heavily sclerotized, the latter often meeting below; hairs or short teeth or both on some segments; anal segment often with a pair of bristles; mouth usually distensible; mandibles simple, comma-shaped, with the apex slender and acute. In addition to *Orasema sixaolae* and *O. costaricensis* (*vide supra*), planidia of the following species have been reported in the literature: *Orasema viridis* Ashmead (Wheeler, 1907, p. 7, and Smith, 1912, p. 59), *Psilogaster fasciventris* Brues (1919, p. 15), *Schizaspidia tenuicornis* Ashmead (Clausen, 1923, p. 199), *S. manipurensis* Clausen (1928, p. 84), and *Stilbula cynipiformis* Rossi (Parker and Thompson, 1925, p. 393).

OLDER PLANIDIA. Since the enlarged planidium of *O. sixaolae* differs from its early stage only in length and distention, we should expect the same to be true of *O. costaricensis*, although no unswollen planidia were found. The similarly distended planidia of these two species are comparable in shape, ventral teeth and hairs but the head and mouth parts are different.

Since we have been unable to find any fundamental external differences between planidia of various sizes nor any change in the size of the head and dorsal plates, we consider it highly probable that no ecdysis occurs during the swelling of the

planidium. Wheeler (1907, p. 8) found distended planidia of *Orasema viridis*; Brues (1919, p. 16) of *Psilogaster fasciventris*; Clausen (1923, p. 216) of *Schizaspidia tenuicornis*; and Parker and Thompson (1925, p. 393) of *Stilbula cynipiformis*. No one has witnessed a molt, but Brues (p. 15) found a cast skin of an engorged planidium attached to the "mature larva" of *P. fasciventris*, indicating that in his case there were no other stages in between. Wheeler figured (Pl. II, Fig. 16) an older larva without the dorsal bands so characteristic of the enlarged planidium. He thought (p. 8) that the fact that all traces of the dark bands had disappeared was probably due to "the intervention of an ecdysis." Clausen (1923, p. 200) also found a second stage larva without dorsal bands in *Schizaspidia tenuicornis*. His third stage larva is quite extraordinary; there is a unique suctorial mouth but no mandibles.

MATURE LARVA. Wheeler (1907, p. 9) says that the larva of *O. viridis* (without dorsal bands) referred to above molts to "a short thick-set semipupa, slightly constricted just in front of the middle of its body. Another ecdysis seems to follow almost at once leaving the semipupa covered with a peculiar envelope studded with large blisters, or pustules." The pustules are "arranged segmentally in regular rows along each side of the body but are absent in the middorsal and midventral lines." Judging from Wheeler's figures (Pl. II, Figs. 18, 19), these pustules are more numerous than those of *O. costaricensis*. He is unable to assign them any function. Reichensperger (1913, p. 12) considers them "eine Art von Exsudatknospen" because the host workers lick and protect the parasitic larvae. But host ants often lick other parasites which apparently have no special exudate organs as if they were their own brood. The full-grown larva of *Psilogaster fasciventris* has a large vesicular swelling at the anterior end (Brues, 1919, p. 16) which may be comparable to the above mentioned pustules.

PUPA. The pupae of Eucharidae also have various swellings which are sometimes very similar in appearance to the larval pustules. In 1890 (p. IX) Forel mentions the "curieuses nymphes . . . couvertes d'aspérités et de boursoufflures" of *Eucharis myrmeciae* Cameron. Reichensperger (1913, Pl. 6, Fig. 12) figures a pupa of *Psilogaster fraudulentus* Reich. with dorsal tubercles like those of the pupa of *O. costaricensis*, with pronounced abdominal folds, and with smaller subglobular projections on the head and sides of the thorax. He says (p. 213),

"Der Hinterleib ist mit einer Anzahl wallförmiger Erhebungen umgürtet, die seitlich und oben in der Mittellinie Verdickungen aufweisen. Ferner liegen drei kuglige stark vortretende Knötchen zwischen Metathorax und Abdomen über dem Pedicellus; endlich besitzt die Vorderseite des Kopfes oben mehrere kuglige Vorsprünge . . ." Wheeler (1907, p. 9) describes the pupa of *O. viridis* as "enclosed in a thick membrane (Pl. II, Fig. 22) which, in the intersegmental regions of the abdomen, is thrown into prominent transverse welts," but it lacks the tubercles or pustules, which he found on the mature pupa of *O. coloradensis* Ashmead (p. 13, Pl. IV, Figs. 53, 54). On the latter they are even more abundant than on *O. costaricensis*. *Psilogaster fasciventris* (Brues, 1919, p. 17) has the whole body beset "with vesicular swellings. The mesonotum bears a small rounded tubercle at each side of the anterior edge, an acute one near each tegula and a widely separated pair of sub-acute ones on the disc before the scutellum. . . There are no tubercles above the propodeum and petiole." In a recent paper (1934, p. 205) on Australian eucharids, Brues finds that the pupa of *Tricoryna chalcoponeræ* Brues "shows no striking characteristics except that the margins of the abdominal tergites are distinctly raised and carinate, the edge of the second tergite projecting as a distinct, sharp tooth on each side not far from the median line." There is therefore considerable difference in these tubercles both between and within genera.

Brues (1919, p. 19) believes that these pustules "were originally either secretory or excretory organs, or those assisting in some way in the process of ecydysis." He also mentions (p. 20) Dr. W. M. Wheeler's suggestion that they might be of assistance in eliminating large amounts of water during growth.

NUMBER OF MOLTS. It is impossible at present to state the number of molts in the Eucharidae. For *Orasema viridis*, Wheeler (1907) records two larval stages, two semi-pupal, and one pupal. For *Schizaspidia tenuicornis*, Clausen (1923) reports three larval stages and one pupal. In *O. costaricensis*, there are probably three larval stages, a semi-pupal and a pupal. These available data would suggest four or five stages between egg and adult.

RELATIONS TO HOSTS

ENTRANCE HOLES. The first stage larva of *O. sixaolæ* penetrates the host by way of a simple, unthickened, rounded open-

ing cut through the integument. From this opening a few (usually four) posterior segments of the planidium protrude. As the parasite distends, the periphery of this hole becomes thickened and forms an indistinct collar, projecting inward; the opening, however, maintains the original diameter (about 0.045 mm.). The depth of the collar varies slightly, the larger the parasite, the deeper the collar. *O. costaricensis* (Fig. 10) causes the formation of a similar aperture.

POSITION OF PARASITES ON HOSTS. Twelve host larvae of *Solenopsis tenuis*, ranging in length from 0.7 to 1.6 mm., i. e., from very young to mature, were infested with eighteen small endoparasitic planidia of *O. sixaolae*. Eight had one parasite each, two had two each, and two had three each. Of the single infestations four were on the anterior half of the host larva and dorsal in position; four were near the middle, three of these anterior and ventral, while one was posterior and dorsal. Of the double infestations: in one case both parasites were dorsal and on the posterior half; in the second case one was anterior and dorsal and the other posterior and ventral. Of the triple infestations: in one case all were dorsal, two near the middle and one on the posterior half; in the other case, of the two near the middle, one was lateral, the other was dorsal, and the third was anterior and dorsal.

Seven host larvae of *Pheidole flavens* var., ranging in length from 1.9 to 2.2 mm., were infested with eight more or less distended planidia of *O. costaricensis*. Four infestations (including a double one) were anterior and dorsal, two posterior and ventral, and one in the extreme posterior end.²

None of our mature *Orasema* larvae was attached to a host larva and no parasite at any stage was found on a host pupa.

The actual process of parasitization by Eucharidae was discovered by Clausen. He found that the female of *Schizaspidia tenuicornis* (1923, p. 195) and also *S. manipurensis* (1928, p. 85) laid their eggs in buds of trees or shrubs; the newly hatched planidia attached themselves to passing workers of *Camponotus herculeanus japonicus* Mayr, and were thus carried to the nest where they transferred themselves to the brood.

²Dodd (1906, p. 123) states that *Rhipipallus affinis* Bingham may produce "several sometimes from one cocoon" of *Odontomachus ruficeps* subsp. *coriaria* Mayr.

HOST RECORDS OF EUCHARIDAE³

Chalcura sp. Host: *Formica rufa* L. Wasmann, (1894) p. 168. "Prag (Polak)."

Chalcuroides versicolor Girault. Host: *Myrmecia* sp. Girault, (1915) p. 236. Townsville, Queensland, Australia.

Epimetagea purpurea Girault. Host: "reared from ants." Girault, (1915) p. 226. Townsville, Queensland, Australia.

Eucharis adscendens Fabr. Host: *Messor barbarus* L. Fahringer and Tölg, (1912) p. 249. Fahringer, (1922) p. 42. Ruschka, (1924) p. 84. Southern Europe, warmer regions of middle and western Europe.

Eucharis bedeli Cameron. Hosts: *Cataglyphis bicolor* Fabr. and *Formica rufa* L. Bedel, (1895) p. XXXV. Djebel Edough, Algeria.

Eucharis myrmeciae Forel. Host: *Myrmecia forficata* Fabr. Forel, (1890) p. IX. Janet, (1897) p. 52. South Australia, East India.

Eucharis punctata Förster. Host: *Messor barbarus semirufus* var. *concolor* Emery. Fahringer, (1922) p. 42. Southern Europe.

Eucharomorpha wheeleri Brues. Host: *Pheidole proxima* Mayr. Brues, (1934) p. 203. Wentworth Falls (alt. 2800 ft.), New South Wales.

Isomeria coronata Westwood. Host: *Ectatomma tuberculatum* Olivier. Cook, (1905) p. 15, footnote. Wheeler, W. M., (1907) p. 17, Pl. IV, Fig. 58, 59. Brazil, Bahia and Amazons, South America.

Kapala cuprea Cameron. Host: *Pachycondyla crassinoda* Latr. Myers, (1921) p. 276. Trinidad.

Kapala floridana Ashmead. Host: *Pogonomyrmex badius* Latr. Wheeler, W. M., (1907) p. 17, Pl. IV, Figs. 56-57. Florida.

Orasema coloradensis Ashmead. Hosts: *Pheidole vinelandica* Forel and *Solenopsis molesta* var. *validiuscula* Emery. Wheeler, W. M., (1907) p. 12, Pl. I, Fig. 12; Pl. IV, Fig. 53; Pl. V, Fig. 68. Colorado.

Orasema costaricensis G. and E. Wheeler. Host: *Pheidole flavens* Roger. Wheeler, G. and E., (in this paper). Zent, Costa Rica.

Orasema minutissima Howard. Host: *Wasmannia auropunctata* Roger. Mann, (1918) p. 106. St. Vincent and Cuba.

Orasema pheidolophaga Girault. Host: *Pheidole* sp. Girault, (1915) p. 230. Geelong, Victoria, Australia.

Orasema sixaolae Wheeler, G. and E. Host: *Solenopsis (Diplorhoptum) tenuis* Mayr. Wheeler, G. and E., (in this paper). Sixaolae River, Province of Limón, Costa Rica.

Orasema tolteca Mann. Host: *Pheidole vasliti* var. *acolhua* Wheeler. Mann, (1914) p. 184. State of Hidalgo, Mexico.

Orasema viridis Ashmead. Hosts: *Pheidole kingi* subsp. *instabilis* Emery. Wheeler, W. M., (1907) p. 2, Pl. I, Figs. 10, 11; Pl. II, Figs. 13-23, 30-35. *Pheidole sciophila* Wheeler, W. M., *ibid.*: p. 12. Texas.

Orasema wheeleri Ashmead. Host: *Pheidole ceres* Wheeler, W. M., (1907) p. 14. Fort Davis, Texas.

Pseudochalcura gibbosa Provancher. Host: *Camponotus herculeanus* var. *noveboracensis* Fitch. Wheeler, W. M., (1907) p. 16, Pl. II, Fig. 29; Pl. IV, Fig. 55. Michigan.

³All known hosts of the Eucharidae are ants.

Pseudometagea schwarzi Ashmead. Host: "taken in an ant's nest." Wheeler, W. M., (1907) p. 17. Washington, D. C., and Maryland.

Psilogaster fasciventris Brues. Host: *Myrmecia gulosa* Fabr. Brues, (1919) p. 14, Pl. I, Fig. 2. Hornsby, New South Wales.

Psilogaster fraudulentus Reichensperger. Host: *Pheidole megacephala* Fabr. Reichensperger, (1913) p. 211, 2 Figs. Abyssinia.

Rhipipallus affinis Bingham. Host: *Odontomachus ruficeps* subsp. *coriaria* Mayr. Dodd, (1906) p. 123. Townsville, Queensland, Australia.

Schizaspidia calomyrmecis Brues. Host: *Calomyrmex purpureus* Mayr. Brues, (1934) p. 207. Meekatharra, West Australia.

Schizaspidia doddi Bingham. Host: *Camponotus* sp. Dodd, (1906) p. 123. Townsville, Queensland, Australia.

Schizaspidia polyrhachicida G. and E. Wheeler. Host: *Polyrhachis (Myrmhople) dives* F. Smith. Wheeler, G. and E., (1924) p. 51. Philippine Islands.

Schizaspidia tenuicornis Ashmead. Host: *Camponotus herculeanus* subsp. *japonicus* Mayr. Clausen, (1923) p. 195. Japan.

Stibula cynipiformis Rossi. Hosts: *Camponotus*⁴ sp. Parker and Thompson, (1925) p. 393. *Camponotus marginatus* Latr. Fahringer and Tölg, (1912) p. 250. *Camponotus maculatus sanctus* Forel. Fahringer, (1922) p. 42. *Camponotus aethiops* (Latr.) Parker, (1932) p. 3, 3 Figs. Warmer regions of central and southern Europe, Asia Minor, northern Africa.

Tricoryna chalcoponerae Brues. Host: *Chalcoponera metallica* F. Smith. Brues, (1934) p. 204. Mt. Kosciusko (alt. 3000 ft.), New South Wales.

Tricoryna ectatommae Girault. Host: *Ectatomma* sp. Girault, (1915) p. 228. Melbourne, Victoria, Australia.

LITERATURE CITED

- ✓ **Bedel, M. L.** 1895. Une note sur un hyménoptère parasite des fourmis. Bull. Soc. Ent. France, p. XXXV-XXXVI.
- Brues, C. T.** 1919. A new chalcid-fly parasitic on the Australian bull-dog ant. Ann. Ent. Soc. America 12: 13-21, 2 pl.
- Brues, C. T.** 1934. Some new Eucharid parasites of Australian ants. Bull. Brooklyn Ent. Soc. 29: 201-207, figs. 1-3.
- Clausen, C. P.** 1923. The biology of *Schizaspidia tenuicornis* Ashm., a eucharid parasite of *Camponotus*. Ann. Ent. Soc. Amer. 16: 195-217, pls. 14-15.
- Clausen, C. P.** 1928. The manner of oviposition and the planidium of *Schizaspidia manipurensis* n.sp. Proc. Ent. Soc. Wash. 30: 80-86, 1 fig.
- Cook, O. F.** 1905. The social organization and breeding habits of the cotton-protecting Kelep of Guatemala. U. S. Dept. Agr. Bur. Ent. Tech. Bull. No. 10; 55 pp.
- ✓ **Dodd, F. P.** 1906. Notes on some remarkable parasitic insects from North Queensland. Trans. Ent. Soc. London, p. 119-132, 2 figs.
- Emery, C.** 1925. Genera Insectorum, Formicidae, Formicinae, p. 1-302, pls. 1-4.
- Fahringer, J. and Tölg, F.** 1912. Beiträge zur Kenntnis der Lebensweise und Entwicklungsgeschichte einiger Hautflügler. Verh. natur. Ver. in Brünn, 50: 242-269, 2 pls.

⁴The classification of these *Camponoti* are still in an unsettled state, and there may be some synonymy here. According to Emery (1925, p. 77, footnote 1) the forms of *Camponotus* "sous le nom d'ensemble collectif de *C. maculatus* . . . de sorte que cet ensemble est devenue peu à peu un véritable chaos." He considers *C. marginatus* Mayr a synonym of *C. aethiops* var. *marginatus* (Latr.) and *C. maculatus sanctus* Forel of *C. compressus* subsp. *sanctus* Forel.

- Fahringer, J. 1922. Beiträge zur Kenntnis der Lebensweise einiger Chalcididen. Zeitschr. wiss. Insektenbiol. 17: 41-47, 2 figs.
- Forel, A. 1890. Un parasite de la *Myrmecia forficata* Fabr. Ann. Ent. Soc. France, Fev. 1, p. VIII-X.
- Girault, A. A. 1915. Australian Hymenoptera. Chalcidoidea X. The family Eucharidae, with descriptions of new genera and species. Mem. Queensland Mus. 4: 225-237.
- Janet, C. 1897. Études sur les fourmis, les guêpes, et les abeilles, note 14. Rapport des animaux myrmecophiles avec les fourmis, 99 pp.
- Mann, W. M. 1914. Some myrmecophilous insects from Mexico. Psyche 21: 171-184, figs. 1-4.
- Mann, W. M. 1918. Myrmecophilous insects from Cuba. Psyche 25: 104-106.
- Myers, J. G. 1931. Descriptions and records of parasitic Hymenoptera from British Guiana and the West Indies. Bull. Ent. Res. (London) 22: 267-276.
- Parker, H. L. 1932. Notes on a collecting spot in France and a Chalcid larva (*Stilbula cynipiformis* Rossi). Ent. News 43: 1-6, 3 figs.
- Parker, H. L., and Thompson, W. R. 1925. Notes on the larvae of the Chalcidoidea. Ann. Ent. Soc. Amer. 18: 384-395, 3 pls.
- Ruschka, F. 1924. Die Europäisch-Mediterranean Eucharidinae und Perilampidae. Deutsch. Ent. Zeitschr., p. 82-83, figs. 1-12.
- Reichensperger, A. 1913. Zur Kenntnis von Myrmecophilen aus Abessinien. Zool. Jahrb., Abth. A. 35: 185-218, 2 pls., 15 text figs.
- Smith, H. S. 1912. The chalcidoid genus *Perilampus* and its relations to the problem of parasite introduction. U. S. Dept. Agr. Bur. Ent. Tech. Bull. no. 19: 33-69, figs. 24-31.
- Wasmann, E. 1894. Kritisches Verzeichniss der myrmecophilen und termitophilen Arthropoda, Berlin, I-XVI and 1-231.
- Wheeler, G. and E. 1924. A new species of Schizaspidia (Eucharidae), with notes on a eulophid ant parasite. Psyche 31: 49-56, figs. 1-2.
- Wheeler, W. M. 1907. The polymorphism of ants, with an account of some singular abnormalities due to parasitism. Bull. Amer. Mus. Nat. Hist. 23: 1-93, pls. I-VI, 69 figs.

EXPLANATION OF PLATES

PLATE I

- Fig. 1. Planidium of *Oreasema sixaolae*, dorsal view. $\times 185$.
- Fig. 2. Planidium of *O. sixaolae*, ventral view. $\times 185$.
- Fig. 3. Distended planidium of *Oreasema costaricensis*, side view. $\times 185$.
- Fig. 4. Distended planidium of *O. sixaolae*, side view. $\times 185$.
- Fig. 5. Much distended planidium of *O. costaricensis* inside the prothorax of the host larva, and its entrance hole. $\times 45$.
- Fig. 6. Host larva in anterior view showing the much distended planidium of *O. costaricensis* (posterior-dorsal aspect), and its entrance hole. $\times 45$.
- Fig. 7. Head of young planidium of *O. sixaolae*, antero-ventral view with the mouth retracted. $\times 185$.
- Fig. 8. Head of younger planidium of *O. costaricensis*, anterior view. $\times 185$.
- Fig. 9. Head of mature larva of *O. costaricensis*, anterior view. $\times 93$.
- Fig. 10. Entrance hole in host's integument with posterior end of planidium of *O. costaricensis* in situ. $\times 185$.
- Fig. 11. Mature larva of *O. costaricensis* in dorso-lateral view. $\times 22$.
- Fig. 12. Same mature larva in side view. $\times 22$.

PLATE II

- Fig. 13. Semipupa of *Oreasema costaricensis* in side view (spinules not shown). $\times 22$.
- Fig. 14. Pupa of *O. costaricensis* in side view. $\times 22$.
- Fig. 15. Adult of *O. sixaolae*, ♀, side view. $\times 22$.
- Fig. 16. Head of *O. sixaolae* in anterior view. $\times 22$.
- Fig. 17. Head of *O. costaricensis* in anterior view. $\times 22$.
- Fig. 18. Ovipositor of *O. costaricensis* in side view. $\times 48$.
- Fig. 19. Ovipositor of *O. sixaolae* in side view. $\times 48$.
- Fig. 20. Adult of *O. costaricensis*, ♀, in side view. $\times 22$.
- Fig. 21. Adult mouth parts of *O. costaricensis* in ventral view. $\times 48$.

Parasites of Ants
George C. and Esther W. Wheeler

PLATE I



