on the other hand, proposes that *Helicopis, Sarota, Anteros,* and *Ourocnemis* Baker form a closely related group of genera. The behavioral evidence reported here supports Harvey's classification. Further, we can predict that specimens of *Ourocnemis* will be found to also move their hindwings.

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INTERACTIONS OF PARASITOIDS WITH AN *OPSIPHANES* (BRASSOLIDAE) CATERPILLAR IN COSTA RICA

Both hymenopteran and dipteran parasitoids are known to kill the caterpillars of *Opsiphanes* species (Brassolidae) in Central America (Harrison, 1963, Ann. Entomol. Soc. Amer. 56:87–94; Young & Muyshondt, 1975, Stud. Neotrop. Fauna 10:19–56). In these studies, wild-caught caterpillars on their monocot food plants (Musaceae and Palmae) are checked individually for emergence of parasitoids, with little or no direct observations on the ways in which these organisms interact with their host. In this note I describe some behavioral observations on both adult Tachinidae (Diptera) and Chalcidae (Hymenoptera) attempting to parasitize a single *Opsiphanes* caterpillar at the same time. Field observations on the interaction of hymenopteran and dipteran parasitoids on the same host are almost entirely absent in the entomological literature. Given the well-documented and studied roles of individual parasitoid species in the regulation of plant-associated insect populations in both the temperate and tropical zones (e.g., Jumalon, 1964, J. Lepid. Soc. 18:101–104; Herrebout, 1966, Z. Angw. Entomol. 58:340–355; Etchegaray & Nishida, 1975a, Proc. Hawaiian Entomol. Soc. 22:33–39; 1975b, Proc. Hawaiian Entomol. Soc. 22:41–49; Link, 1977, Dusenia 10:201–204; Zaucki, 1981, Aust. Entomol. Mag. 8:3–8; Olaifa & Akingbohungbe, Insect Sci. Appl. 3:73–77; Roth et al., 1982; Environ. Entomol. 11:273–277; Stamp, 1982, Environ. Entomol. 11:100–104; Courtney & Duggan, 1983, Ecol. Entomol. 8:271–278; Elzen et al., 1983, Environ. Entomol. 12:1872–1876; Grant & Shepard, 1983, Environ. Entomol. 12:1673–1677; Messina, 1983, Environ. Entomol. 12:807–809; Oatman et al., 1983, J. Econ. Entomol. 76:52–53; Thompson et al., 1983, Environ. Entomol. 12:1312–1314; Maier, 1984, Can. Entomol. 116:443–449; Marston et al., 1984, Ann. Entomol. Soc. Amer. 77:21–28), the field study of the ways in which different parasitoids "interact" at the same host may clarify certain aspects of how these organisms regulate populations of phytophagous species (e.g., Van Driesche, 1983, Environ. Entomol. 12:1611–1622).

A fifth instar caterpillar of *Opsiphanes* sp. was found partly concealed within a silken sleeve on a single pinna of a coconut palm (*Cocos nucifera* "dwarf" variety) on 7 March 1984 at "Finca Experimental La Lola," about 15 km east of Siquirres (10°06'N, 83°30'W), Limon Province, Costa Rica. From 7 to 16 March, I made daily observations at various hours on the presence of tachinids and hymenopterans with this caterpillar. These observations were initiated when, at 1745 h on 7 March, I observed a tachinid (described as "red eyes with gray and white striped body and wings held at about 45° angle to the body") "buzzing" around the caterpillar as the latter crawled towards the silken sleeve from an apparent feeding site elsewhere on the tree (about 2.0 m tall). On 16 March the

caterpillar was collected and kept alive for rearing to adulthood, placing it in a clear plastic bag with a fresh cutting of the coconut palm leaf pinnae.

Between 7 and 12 March, the *Opsiphanes* caterpillar was found re-entering its "nest" on the same pinna, usually between 1600 and 1800 h; morning observations (0800–1100 h) on the same days indicated no activity; the caterpillar could clearly be seen resting motionless inside the nest. The nest was located on the distal-most third of the pinna, and the caterpillar either crawled directly into it, head-first (Fig. 1) or sometimes backed into it.

A single adult tachinid was observed attempting to land on the caterpillar on two dates: 7 March (1745 h) and 12 March (1500 h). Based upon the general appearance of the fly, it appeared to be the same species on both dates and it was collected on 12 March, following observations, and kept for a voucher determination. On 7 March, the fly made several attempts to alight directly on the caterpillar's body, usually in the proximal-most third region. Every time the fly made such an attempt (N = 18 instances) to land, the caterpillar jerked its head violently in broad swings through an imaginary circular axis, effectively chasing the fly away for a few moments. Between attempts, the tachinid often alighted on an adjacent pinna. For a total of 11 times, the fly intermittently perched alongside the caterpillar as it crawled towards the nest (Fig. 1), periodically trying to alight on the host again but always failing to do so. Once inside the nest, the tachinid walked over the silken surface (Fig. 1) of it, before flying off (by 1755 h). On 12 March at 1500 h, a tachinid was found walking on top of the silken nest again, when the caterpillar was motionless inside. At one point, the fly sat motionless immediately above the thoracic area of the caterpillar's body but on the outside of the thin silken layer between it and the host insect. The caterpillar was clearly visible through the fine lacework of silken mesh (Fig. 1). Periodically, the fly moved a bit and curled its abdomen under itself, as if attempting to oviposit either on the silk or through it and onto the body of the host. At 1700 h, I gently placed a dry glass vial over the tachinid as it perched above the caterpillar, and it did not move at all. The fly was collected in this manner a few minutes later.

On 11 March at 1545 h, I noticed a small black wasp securely fastened to the dorsal area of the thorax of the caterpillar. In spite of violent, head-thrashing movements identical to those exhibited in an apparent response to the presence of the tachinid, the caterpillar was unsuccessful in dislodging this wasp. At the time the caterpillar was about three cm from the entrance of the silken nest. It moved into the nest with the wasp still firmly attached. Once inside the nest, the wasp began crawling over the thoracic area of the *Opsiphanes* caterpillar. A few moments later, the big caterpillar backed out of the nest with the wasp still attached. At this time, in the good daylight, I noticed a few blackened spots on the caterpillar's thoracic area, easily spotted against the light green background color of the insect. The caterpillar, however, was not successful in removing the wasp. I collected the wasp a few moments later (using a glass vial).

The *Opsiphanes* caterpillar was collected at 1800 h on 12 March for rearing. Two days later, three tachinid pupae were found in the bottom of the rearing bag and caterpillar was dead. About a week later the tachinids eclosed and they matched the general appearance of the adult observed interacting with the caterpillar in the wild. No parasitic hymenopterans emerged.

The four tachinids were examined a few weeks later by Dr. Norman E. Woodley, Research Entomologist, Systematic Entomology Laboratory of the U.S. Department of Agriculture (Washington, D.C.), who told me that they were from a very poorly known group, making generic determination exceedingly difficult. The wasp was determined to be *Brachymeria* sp. (Hymenoptera: Chalcidae) by Dr. E. E. Grissell of the U.S. National Museum of Natural History. Species determination of the *Opsiphanes* was not confirmed since the adult was not reared.

These qualitative observations suggest that *Opsiphanes* caterpillars exhibit two types of defensive behavior against parasitoids and do so in the following order: (1) violent head-thrashings chase away tachinids some times, followed by (2) rapid movement into a silken nest. If a caterpillar is approached by a parasitoid some distance away from the nest, the second line of defense cannot be utilized. Given the fact that the caterpillar

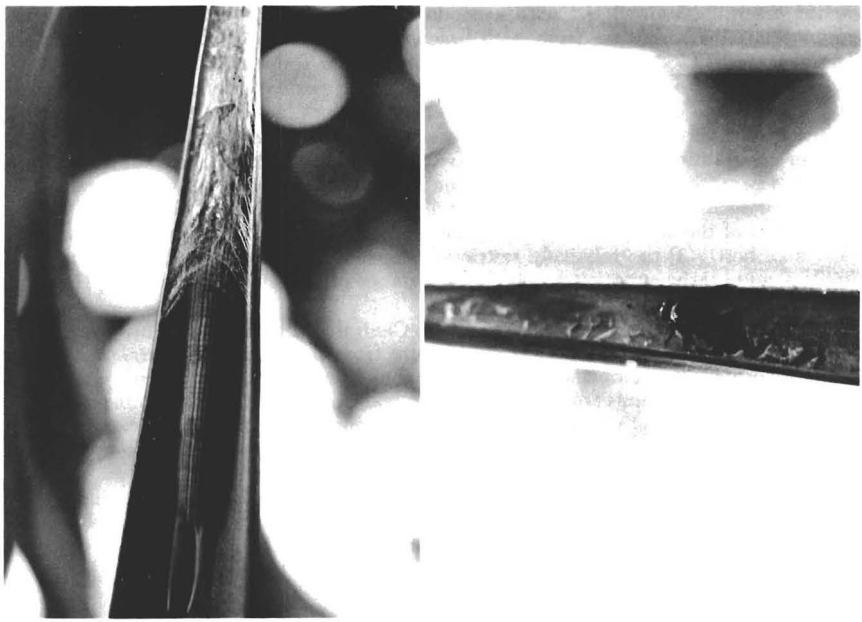

FIG. 1. **Left:** *Opsiphanes* caterpillar entering silken nest on leaf pinna of the food plant, *Cocos nucifera* (Palmae) at Finca Experimental La Lola, Siquirres, Limon Province, Costa Rica (12 March 1984 at 1600 hr); **right:** adult tachinid perched on the silken "roof" of the caterpillar nest and directly over the thoracic region of the host's body (12 March 1984 at 1550 h).

died from tachinid attack, it is clear that the defensive behavior is not always successful. The close association of both kinds of parasitoids with the caterpillar at its nest site further suggests that chemical attractants associated with the nest itself might be involved in the host-searching behavior of the parasitoids. Volatiles are known to play important roles as chemical signals in attracting parasitoids to their hosts (e.g., Weseloh, 1980, Ann. Entomol. Soc. Amer. 73:593–601; Elzen et al., op. cit.; Kamm & Buttery, 1983, Entomol. Exp. Appl. 33:129–134; Thompson et al., op. cit.), although physical (structural) stimulants may also be involved in some instances (e.g., Cole, 1959, J. Lepid. Soc. 13:1–10; Tautz & Markl, 1978, Behav. Ecol. Sociobiol. 4:101–110). The possible role of lepidopteran silken nests as deterrents to parasitoids has not been studied in great detail, although Stamp (op. cit.) observed parasitoids attacking the gregarious caterpillars of the Baltimore checkerspot on the outside of their nests. The nesting habit of *Opsiphanes* has been known for some time (Jones, 1882, Proc. Liter. and Philosoph. Soc. Liverpool 36:327–377), but the functional role of this habit remains largely unstudied.

Young and Muyshondt (op. cit.) noted that *O. tamarindi* Fruhstorfer is parasitized by two different species of Tachinidae in El Salvador and Costa Rica, and it was assumed in that paper that adult parasitoids deposited their eggs on the food plants rather than on the host caterpillar. But one caterpillar of *O. tamarindi* in El Salvador was found with two eggs attached to the integument near the distal end of the trunk, and these might have been Tachinidae. Young and Muyshondt (op. cit.) found considerable parasitism of *O. tamarindi* by the braconid *Meteorus* sp. in El Salvador and by the chalcid *Spilochalcis nigrifrons* (Cam.) in Costa Rica. Ten of 11 pupae reared from wild-caught fourth and fifth instar caterpillars from Puntarenas, Puntarenas Province, Costa Rica eclosed as *S. nigrifrons* instead of adult *O. tamarindi* in that study. Tortricid and geo-

metrid caterpillars associated with avocado foliage in southern California frequently exhibit "mixed" parasitism from both braconids (*Apanteles*) and chalcids (*Meteorus*) (Oatman et al., 1983, op. cit.). Young and Muyshondt (op. cit.) suggest that tachinids associated with *Opsiphanes* populations in Central America are most likely generalists on a broad range of lepidopterous hosts. Whether or not hymenopterous and dipterous parasitoids converging ecologically on the same individual host caterpillar actually engage in competition for the host remains to be studied quantitatively. And the *Opsiphanes* × Musaceae and Palmae interaction in Central America might be a good model system for such studies, given (1) the large body-size of the host caterpillars, (2) the exploitation of the caterpillars by braconids, chalcids, and tachinids (including the same individual host), (3) the relatively restricted monocot food plant association of the caterpillars, and (4) the apparent economic importance of some *Opsiphanes* (e.g., Harrison, op. cit.).

Other brassolids associated with Palmae in Central American forests may not be experiencing the same forms of selection pressure from parasitoids as *Opsiphanes*. Communally nesting aggregations of the caterpillars of *Brassolis isthmia* (Bates), which construct leaf and silken nests from adjacent palm leaf pinnae and which exhibit a strongly crepuscular feeding activity outside the nest, do not, for example, experience attacks from parasitoids such as Tachinidae and Chalcidae (A. M. Young, unpubl. observ. and field data).

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ON A PREVIOUS REPORT OF DIURNAL ROOSTING OF THE PIPEVINE SWALLOWTAIL, *BATTUS PHILENOR* (L.)

Gillaspy and Lara (1984, J. Lepid. Soc. 38:142–143) recently recounted their observations concerning a short-lived aggregation of *Battus philenor* (L.) in apparent response to an approaching rainstorm. They reported six butterflies flew to a branch of a mesquite, *Prosopis glandulosa* Torr., on 12 June 1981 near Laredo, Texas. Gillaspy and Lara (op. cit.) wondered if these butterflies would later return for a nocturnal roost, but they were unable to provide further observations. They also suggest that further, admittedly fortuitous, observations would be required to understand fully such temporary behavior.

Interestingly, observations by H. B. Parks (1935, Bull. Brooklyn Entomol. Soc. 30:196) on a similar occurrence provided some answers to questions raised by Gillaspy and Lara (op. cit.). On 7 June 1935, near Santa Rita in southern Brooks Co. (approximately 150 km southeast of Laredo), he observed 40 *B. philenor* (prior to commencement of rain) fly toward and hang underneath the limbs of a huisache, *Acacia smallii* Isely, with, "The thick leaves and branches thus giving complete protection." Of particular significance to one query presented by Gillaspy and Lara (op. cit.) is the report of a "Ranchman [who] stated that these butterflies came to this one tree . . . also to roost during the night."

Field workers in the southern Texas area should be aware of the need for observations on these nocturnal roosts, if they exist. Obviously, each butterfly rests at night at some