lease in humans (*10*) have been inconclusive because cardiovascular side effects preclude the use of doses of α-blockers comparable to those used in rhesus monkeys. In addition to its role in pulsatile LH release, increased adrenergic activity has been implicated in the initiation of flushes (*1-4*). The finding of increased finger temperature, as a result of vasodilatation during flushes (*2, 14*), would seem to be inconsistent with increased adrenergic activity, since finger vessels are under the exclusive control of a tonic α-adrenergic vasoconstrictor mechanism (*15*). Further, the present finding that circulating catecholamine concentrations do not change during flush episodes suggests that a peripheral adrenergic mechanism is probably not causally involved in flush initiation. However, central adrenergic activation could occur, resulting in local release of vasoactive substances such as prostaglandin or histamine (*16*), which may explain why vasodilatation outlasts the flush episode. This is consistent with the clinical observation that administration of clonidine, an α-adrenergic agonist that acts centrally to decrease adrenergic activity, provides symptomatic relief of flushes (*17*). Thus, our results do not rule out the involvement of the central catecholaminergic system in the initiation of flushes. On the contrary, they suggest a link between central neuroendocrine mechanisms that initiate episodic LRF neuronal activity and those determining the onset of flush episodes. We anticipate that this finding will provide an important clue for future research into the neuroendocrine mechanism (*7*) involved in menopausal flushes.

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By Dawn's Early Light: Matutinal Mating and Sex Attractants in a Neotropical Mantid

Abstract. *Females of the neotropical mantis* Acanthops falcata *adopt a special posture at dawn which is maintained for about 20 minutes. During the same period, males fly strongly, even in the absence of females. Our studies show that in this posture females are secreting a pheromone that acts as a sex attractant. All sexual activity in this species normally occurs between dawn and sunrise. It can be triggered by any dark-to-light transition, irrespective of real time. This sexual periodicity is probably an antipredator adaptation.*

Tropical praying mantises often have complex defensive adaptations (*1-4*). Several species are highly specialized mimics of leaves, sticks, or flowers (*1, 2*). Such species tend to be rare or widely dispersed; the females are usually larger than the males and have reduced wings. Females of the neotropical dead-leaf mantid *Acanthops falcata* Stal are completely flightless, whereas the smaller males can fly. In order to mate, the males have to find the widely dispersed females. Females strike indiscriminately at moving objects up to the size of males, so the latter run the risk of being treated as prey. Although it has been shown that males of some mantid species can copulate while being eaten (*5-7*), this adaptation has no effect on fitness if the female doing the eating is sexually unreceptive and copulation cannot occur. The male has two major problems, it must find a female of the right species and must find one that is ready to mate. These problems could be solved if females that were ready to mate released a sex attractant pheromone. Our studies show that they do.

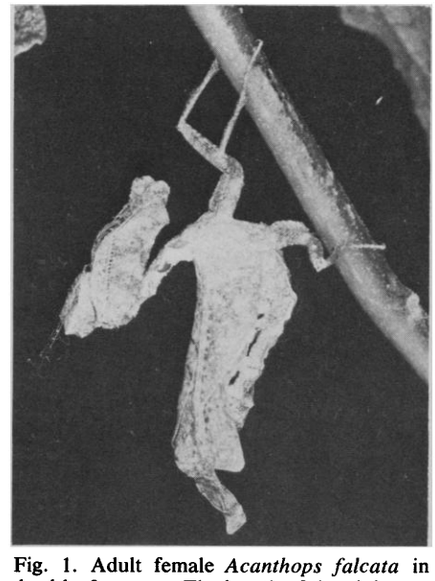

Fig. 1. Adult female *Acanthops falcata* in dead-leaf posture. The length of the abdomen is about 25 to 30 mm. The anterior legs fold around the head and conceal it.

Unmated females release a pheromone for a limited period each day until they have mated. The pheromone release occurs during the short period after dawn during which males fly. We have shown that both the pheromone release and the onset of flight activity are triggered by the dark-to-light transition. Both appear to be independent of any internal clock.

Our attention was first drawn to this problem when, very early in the morning, we transferred hand-reared virgin females to a large outdoor cage (*8*) and found wild males resting on the outside of the cage and mated pairs within. We later found that at dawn (*9*) all the males within the cage became unusually active. After a brief period of rocking movements, they flew or walked with wings raised, eventually settling close to a female. From this position they jumped the last few centimeters onto her dorsal surface and there grasped the leading edge of the female's wings with their raptatory anterior legs. During the same period the females exposed the dorsal surface of their abdomen by raising the wings and

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curling the abdomen ventrally. This exposed two shiny black protuberances close to the anterior margin of segment 7. Because of the form of this posture and the behavior of the males, we assumed that the female was exposing glands and releasing a sex attractant. We later confirmed this assumption by experiment and call this the "pheromone-release" posture. Copulations last from 20 minutes to more than an hour. About 20 minutes after first light unmated males and females resumed their normal resting postures. Recently mated females were not approached by males nor did they adopt the pheromone-release posture.

In 7 days of observation we saw ten wild males fly onto the cage during the same dawn period when the males inside were flying. The wild males flew in silhouetted against the dawn sky 5 to 10 m above the ground and then circled down to alight. (The species had never been seen or collected in this area previously.) We saw 31 copulations within the cage at first light and none at any other time.

To investigate the presence of a sex attractant, we conducted the following experiments.

All the females were removed from the outdoor cage and kept in individual cages of hardware cloth (*8*) in the laboratory. Just before dawn, 18 unmated caged females were placed on a rack 1 m away from one of the sides of an outdoor cage containing 20 males. A screen of hardware cloth was placed between the females and the cage to ensure that the males were not locating the females visually (*10*). Females were checked during the experimental period to determine whether they adopted the pheromone-release posture and the behavior of the males was noted. We placed the rack successively opposite all four walls of the cage to eliminate any possible effect of the compass bearing of first light on the flight direction of the males. To control for the effect of wind (which was imperceptible at dawn) we used a large electric fan and on two occasions directed it from the female rack onto the male's cage and also directed it from the males onto the females. As a further control we repeated the experiments using mated females that did not adopt the pheromone-release posture.

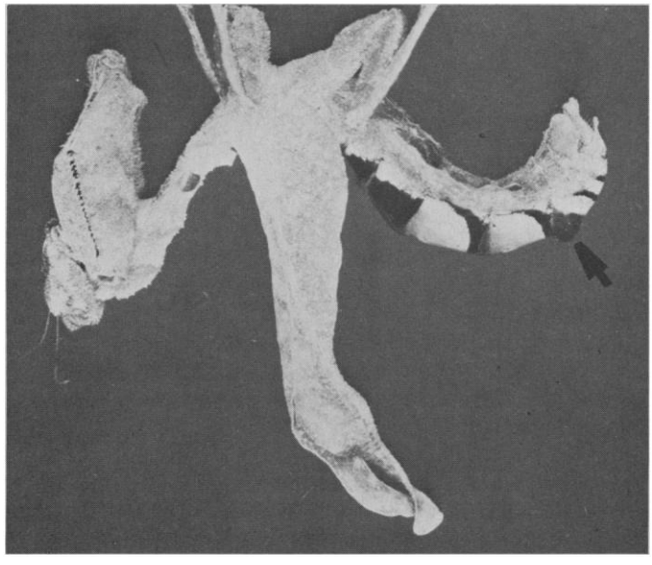

Fig. 2. Adult female *Acanthops falcata* in dawn secretory posture (see text). The abdomen is moved away from the wings, curled, and protuberant glands (arrow) appear on the anterior edge of segment 7.

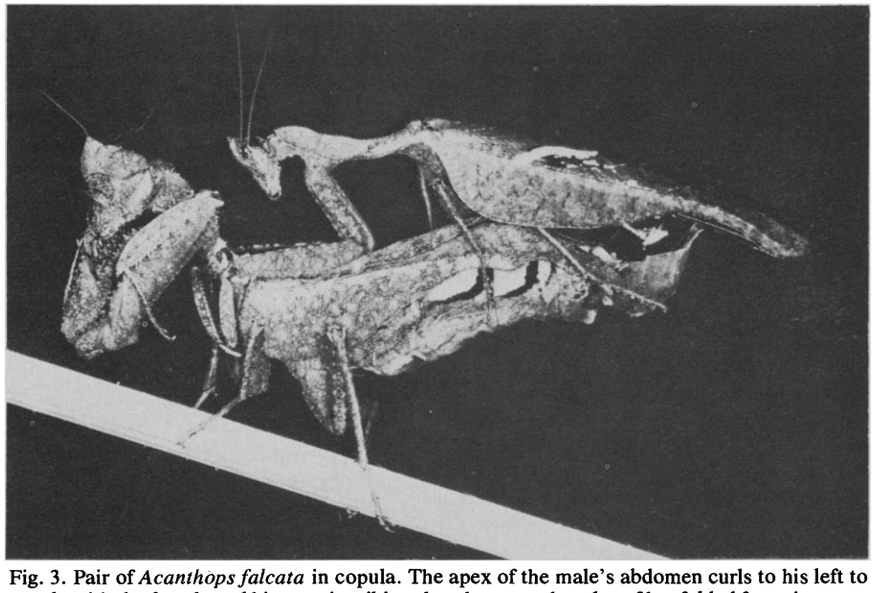

Fig. 3. Pair of *Acanthops falcata* in copula. The apex of the male's abdomen curls to his left to couple with the female and his anterior tibiae clasp her over the edge of her folded forewings.

When there was no apparent wind 100 percent of the males flew toward the virgin females, irrespective of the position of the rack to the dawn sun (below the horizon). Most of the males came to rest on the wall of the cage directly opposite the females, the others alighted on the walls and roof of the quadrant closest to the females. Each day one or two of the males closest to the females made copulatory insertion movements against the cage wall. When the fan was used from behind virgin females, males flew toward the females and flight was sustained against the cage wall for several minutes. When the fan was used from behind mated females, flight was random but sustained. With the fan at the opposite end of the cage to the females, male flight appeared to be random; at the end of the flight period, 47 percent of the males rested in the half nearest the fan and 53 percent in the half nearest the females. No orientation toward mated females was detectable. More than 95 percent of the virgin females assumed pheromone-release postures in all the experiments; no previously mated females assumed the posture. We conclude that females in the pheromone-release posture are, in fact, releasing a sex attractant, and that the flight of the male is directed primarily by this factor.

To investigate the physiological basis of the sexual periodicity we kept mantids in an environmental chamber with a 12-hour-dark and 12-hour-light cycle giving a reversed day-night regime (*11*). We were able to bring individual mantids out of the chamber and place them in light during their subjective night. Within 3 days the mantids had adjusted their sexual activity to coincide with subjective dawn. By removing mantids from the dark, during all the hours of subjective night, we were able to test the effect of the dark-light transition on sexual activity.

All unmated females over 8 days old adopted the pheromone-release posture when subjected to the dark-light transition irrespective of the hour of subjective night. All the males responded to the dark-light transition by flying and fluttering. We obtained effective copulations from animals brought into light at all hours of their subjective night.

Mated females do not adopt the pheromone-release posture at any time during the period from first copulation to the production of the first ootheca. After the first ootheca has been produced, a percentage of females start secreting again, and a further number secrete again after the production of the second ootheca (*12*).

Dawn mating may well be the result of a compromise between conflicting selection pressures. Mating mantids are almost certainly particularly vulnerable to predation. They cannot maximize their primary defense by adopting the species-specific cryptic posture nor can they make startle displays for secondary defense. Males fly weakly and must be particularly vulnerable when flying to females. Mating at dawn may reduce the risks from predation because it occurs at a time when visually hunting predators are not active. In Panama, although the birds are stirring at this time they are not foraging. Insectivorous primates start feeding even later than birds (*13*). Nocturnal mating might be even safer than dawn mating, but could be impossible in this case because the final movement of the male onto the female appears to be mediated by visual cues.

We think that the problem experienced by other workers in obtaining mantid matings (*7*) could be due to undetected narrow periodicities of sexual activity such as those described herein. Postures similar to the pheromone-release posture that we have described have been described for other species (*7*). We think that the whole system deserves further research.

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10. The males were separated from the females by three layers of screening: (i) fiberglass insect screening on the cage wall, (ii) a hardware-cloth screen between the rack and the cage, and (iii) the hardware-cloth walls of the individual mantis cages. The rack was placed 1 m from the wall of the experimental cage.
11. In a room approximately 3 m square, illuminated by one 48-inch daylight fluorescent tube and two small shaded windows. Incident light [measured as described in (*9*)] was 12 foot-candles.
12. After mating, all females stopped secreting; but 36.6 percent started again after producing the first ootheca, 16.6 percent after producing the second, and 26.6 percent after producing the third; 20.2 percent were still not secreting after producing the third ootheca ($N = 30$).
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α-Melanocyte-Stimulating Hormone: Reduction in Adult Rat Brain After Monosodium Glutamate Treatment of Neonates

Abstract. *Intraperitoneal injection of monosodium glutamate in neonatal rats resulted in a 90 percent loss of α-melanocyte-stimulating hormone in hypothalamic and extrahypothalamic areas of the brain, whereas the amount of hormone in the pituitary gland did not change. The dramatic reduction of α-melanocyte-stimulating hormone in the brain suggests that its primary source there is the neuronal perikarya of the arcuate nucleus.*

Certain acidic amino acids, such as glutamic, aspartic, cysteic, cysteine sulfinic, and homocysteic acids, are both neuroexcitatory (*1*) and neurotoxic (*2*). Glutamate, the most widely studied of these amino acids, is routinely used in electrophysiological studies to artificially induce neuronal firing, whereas the monosodium salt of glutamate (MSG) is commonly used as a dietary additive. Neuronal degeneration induced by MSG or glutamate has been demonstrated in primates (*3*), hamsters (*4*), guinea pigs (*5*), rats (*6*), and mice (*7*). Neuronal destruction in the brain after systemic administration of MSG is apparent in areas where the blood-brain barrier is leaky—the circumventricular organs (CVO) and contiguous structures (*8*).

The arcuate nucleus of the mediobasal hypothalamus, a region contiguous with the median eminence (a CVO) and one that accumulates subcutaneously administered MSG (*9*), is particularly vulnerable to the toxic effects of MSG. Since the integrity of the mediobasal hypothalamus is essential to normal endocrine function, mature animals treated neonatally with MSG manifest a variety of neuroendocrine deficiencies (*4, 10, 11*).

In the mediobasal hypothalamus, systems containing monoamines (*11*), acetylcholine (*11, 12*), and γ-aminobutyric acid (*12*) have been implicated in the etiology of the MSG-induced endocrine deficits. However, systemic administration of MSG has no effect on hypothalamic regulatory peptides, such as luteinizing hormone-releasing hormone (LHRH), thyrotropin-releasing hormone (TRH), and somatostatin (*11, 13*), in the region of the arcuate nucleus and median eminence. Since MSG is taken up by dendritic and somal membranes but not by axons passing through a region (*14*), the lack of effect of MSG on levels of TRH, LHRH, and somatostatin in the arcuate region suggests that these peptides originate in neuronal perikarya outside of the arcuate-median eminence region. Appropriate doses of MSG destroy 80 to 90 percent of the neuronal cell bodies in the arcuate region. Inasmuch as an important source of α-melanocyte-stimulating hormone (α-MSH), one of several melanotropic peptides in the brain (*15*), is neuronal perikarya of the arcuate nucleus (*16*), we measured by radioimmunoassay the effect of neonatally administered MSG on hypothalamic and extrahypothalamic levels of α-MSH in adult rats.

Neonatal rats of the Zivic-Miller strain received an intraperitoneal injection of MSG (4 mg per gram of body weight) on alternate days throughout the first 10 days of life (*17*). An equal volume of 0.9 percent NaCl was injected in control animals. At 60 days of age, animals were decapitated and their brains were rapidly excised. Brains were sliced with the aid of an ice-chilled Plexiglas holder and

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