



Creating the Nation's first BioPark

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Letter From the Desk Of David Challinor
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This letter will be about the social life of colonial dwelling caterpillars and some of the advantages and disadvantages they gain from living closely together. Much new information on the subject comes from an excellent article on caterpillars as social insects by James T. Costa (1997, American Scientist, 85:150-159).

This spring the pin cherry (Prunus pensylvanica) on our street corner had only two tent caterpillar (Malacosoma americanum) tents. The tree, about 15 years old, rapidly increased in size when the adjacent large sycamore (Platanus acerfolia) was cut down about five years ago. The number of tents on the cherry's crown has varied annually; some springs there were 7 or 8 nests, whose caterpillars defoliated a good portion of the crown. Do not worry, though, because cherries and their relatives have always been subject to leaf-eating caterpillars. When these larvae reach their last instar (that is, shed their skin for the last time), they stop feeding, pupate by preparing a cocoon, and eventually metamorphose into a brown moth. The moth lays its eggs in the fall in a sticky case around a small twig. The case hardens to protect the eggs inside and if winter conditions are favorable for survival, the eggs hatch as the first cherry leaves emerge in the spring. The tiny hatchlings (about 2mm long) crawl to the buds and feed on emerging leaves not much larger than themselves, but still small enough to be digestible. After either total or partial defoliation, the cherry tree grows replacement leaves in a few weeks as do other deciduous trees. It is unusual for a tree to be heavily defoliated two successive springs and this May, I had to look closely even to find the two tents.

When searching for examples of social insects, we generally think of bees, ants or termites; the work of the colony is often performed by individuals which have modified appearances according to their work. Such colonies have queens, drones, workers, warriors, et al., each specially equipped to carry out their separate tasks. In some cases the insects are organized in ways remarkably similar to human societies. Just as humans exchange information generally by talking or writing, social insects pass on information by dances (honey bees) or by releasing pheromones (bees, ants, wasps and termites).

Caterpillars, until the last few decades, were considered less evolved (an increasingly unacceptable term because there are no degrees of evolution) in their social relations within a colony than bees, ants and termites. Ethologists (scientists who study



animal behavior) have strived to define the term social insects. Within a species, two or more animals always interact at some time to exhibit social behavior. Insect groups, however, exhibit different degrees of social behavior. For example, true social insects (1) live together with overlapping generations, (2) care for their young, and (3) have reproductive castes. The last criterion is crucial because outside of ants, bees/wasps, and termites, it has only been found in naked mole rats and aphids. There is also evidence that some spiders may qualify as being "social."

Caterpillar colonies clearly do not have any of these characteristics and thus by definition are only quasisocial. All larvae in a tent, as far as known, hatched from the same band of eggs. They are thus siblings that live together for only one season. Furthermore, unlike traditional social insects, caterpillars do not bring food back to their tent. Eat they must because they have to grow fast to pupate before being eaten. Only a few bird species will eat tent caterpillars whose bodies are covered with bristly hairs. In eastern North America cuckoos (Coccyzus spp) are a well-known predator of them and gypsy moth larvae both in their last instar. Cuckoos actually tear tents apart to feast on the occupants. Forbush, a famous ornithologist at the turn of the century, explained how cuckoos could consume such great quantities of seemingly unpalatable larvae. He wrote

"Cuckoos take their (tent caterpillars) at all stages and seem to enjoy it. When, in time, the inside of the bird's stomach becomes so felted with a mass of hairs and spines that it obstructs digestion, the bird can shed the entire stomach-lining, meanwhile growing a new one."

Sadly the two cuckoo species are not as common today as they once were and natural control of tent caterpillars is more dependent on the weather and how it affects diseases and parasites of larvae than on bird predation.

Tent caterpillar larvae have developed an elaborate communications system and work well together. For example, when they first hatch a small percentage (5-8%) leave their swarming mass of siblings and head for the ends of twigs where the leaf buds are beginning to open. When these pioneers find a good food source, they return to their colony, but they must make a judgement call in determining whether the food source is adequate enough for the finder to recruit its siblings to share the resource. The better the food found, the stronger the pheromone trail left on its return to lure tent mates to the food source. Larvae unsuccessful in finding a good food source must return to base camp to decide where they should hunt next for food.

After feeding, tent caterpillars return to their tent and spin a new outer covering, enlarging it for themselves; a caterpillar can grow as fast as a cm/week. The tent also serves as a platform for the caterpillars to bask in the sun when it is cool. By so doing they can raise their temperature a remarkable 30°C (about 60°F), which in turn speeds up their metabolism and thus their growth. When the sunshine is too hot, they gather in the shade of the tent, or in extreme cases they will all hang individually by one or two pairs of their abdominal legs from a twig to cool off.

Colonial life can be an advantage to individual caterpillars, which help each other find food and cooperate in enlarging and strengthening their tent home against predators. There are offsetting disadvantages, however, such as being vulnerable to a marauding cuckoo, which could eat all the occupants of the tent. The tent itself has to be carefully maintained. If it is too constricted, the accumulated frass (excretions) of the colony can make it so dark that a series of hot sunny days would raise the internal temperature to a lethal level. A large, rapidly growing colony is also vulnerable to attacks from various pathogens and parasites. Despite such hazards, tent caterpillars are a fascinating example of complex insect interaction. Their ability to mark a trail by attaching a pheromone to the silk strand as it leaves the caterpillar's mouth is an elegant way to communicate with siblings. The development of cooperative behavior in such small, wriggly insects indicates that we humans are by no means alone in having to get along with our "siblings" to survive.

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NOTE: Corrections to my June 1997 letter:
Page 3, last paragraph, 2nd line, and
Page 4, 2nd paragraph, 2nd line
Change "Triassic" to "Tertiary"