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John L. Capinera
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## Cycloalexy

Pierre Jolivet<sup>2</sup>

(2) Paris, France

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### Without Abstract

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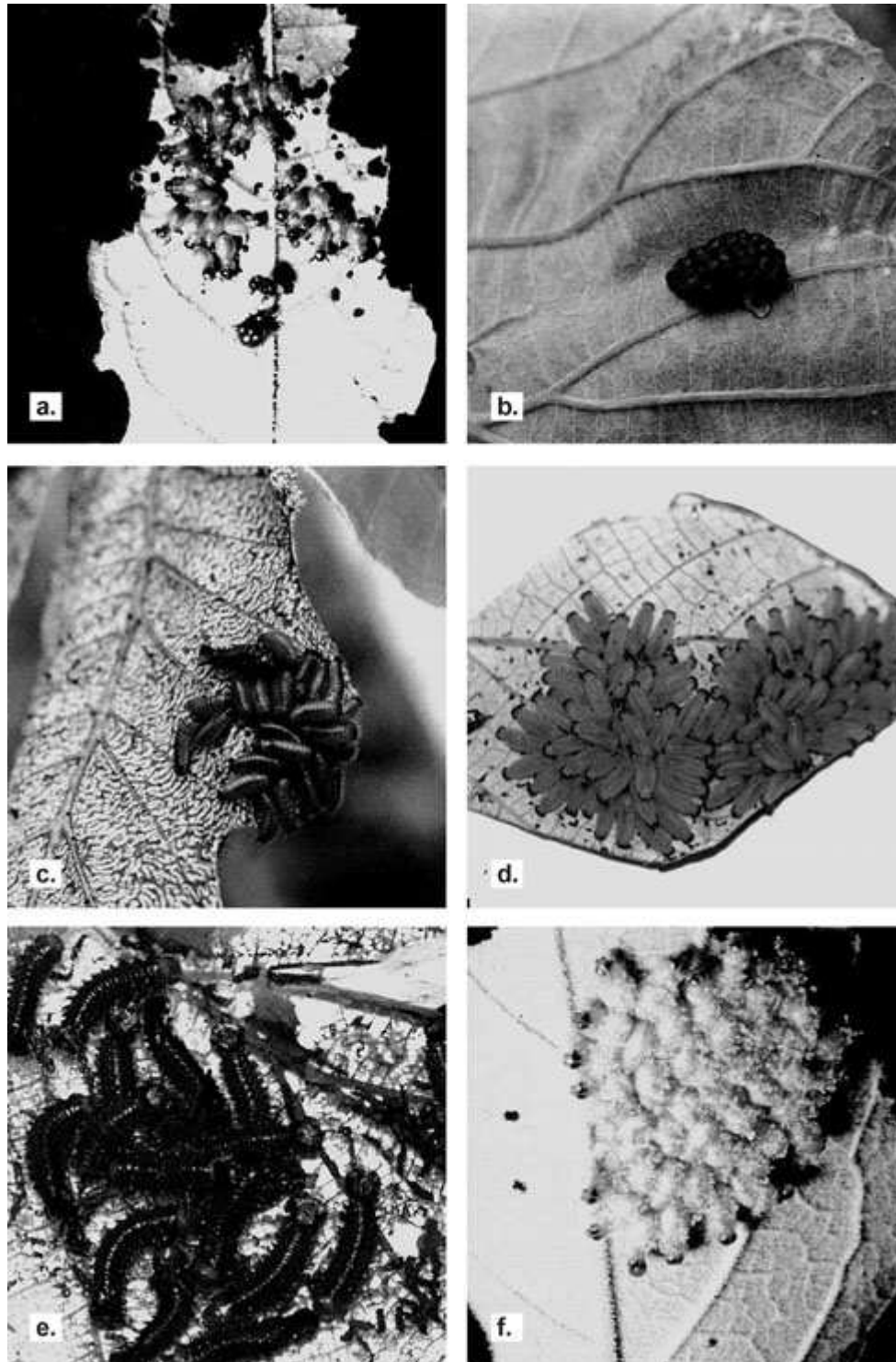
Cycloalexy is a form of gregarism, and involves group reactions. The name is derived from the Greek “kuklos” = circle and “alexo” = I defend, I protect. It is the attitude adopted at rest by some insect larvae, both diurnal and nocturnal, in a tight circle when either the heads or ends of the abdomen are juxtaposed at the periphery, with the remaining larvae at the center of the circle. It can also be named the ring defense behavior. Coordinated movements such as the adoption of threatening attitudes, regurgitation, reflex bleeding and biting are used to repel predators or parasitoids. If for any reason, the circle is broken, ants or pentatomids can easily catch some larvae. The system is more efficient against predators than against parasitoids that have all found a way to turn the defense. Cycloalexy has analogy in vertebrates, penguins and muskoxen, for instance, living in familial groups and sometimes adopting a circular formation of males protecting the young and females from potential predators. Cycloalexy is mainly known among Coleoptera: Chrysomelidae, (Cassidinae, Chrysomelinae, Criocerinae), Coleoptera: Curculionidae, sawflies, and several other insect orders (Diptera, Ceratopogonidae, Neuroptera, Lepidoptera, etc.).

Generally, the individuals in a colony disperse to feed upon foliage by night (or by day when they rest during the night), one behind the other, to reaggregate before dawn. In Pergidae, to reaggregate the larvae communicate by means of low frequency vibrations created by tapping the uropod upon the substrate. Paropsine (Coleoptera: Chrysomelidae) larvae in Australia also tap the substrate with the abdomen to reunite the dispersed colony. All the insects demonstrating cycloalexy are subsocial in the larval stage and also often exhibit maternal care of eggs and larvae. Some cycloalexic leaf beetles like *Platyphora* in Brazil are viviparous. When dropped one by one by the mother, the larvae congregate immediately.

Cycloalexy, like maternal care, can only be the result of a long evolutionary history. The behavior efficiently protects the larvae during their most vulnerable periods (at rest, during molting). However, the defense is not always perfect. Trigonalid parasitoids have succeeded in having their eggs swallowed by the sawfly larvae, thus obviating the need to confront the defensive ring.

Younger larvae sometimes seem to be protected inside the circle, and this could be interpreted as altruism on the part of the larvae at the periphery (Fig. 145). Also, reciprocal altruism may take place when the inner and outer larvae exchange positions. However, this interpretation has been challenged. In Australian sawflies in the genus *Perga* (*Perga dorsalis*

Leach), some 20% of the larvae preferentially occupy the outer positions in the resting colony and appear to lead the foraging expeditions. Leaders are quick to regain outer positions if removed and placed in the center of the colony. So there seem to be differences in the dispersal behavior of larvae in time and space.



**Cycloaexy, Figure 145** Cycloaexy: (a) Third instar of *Platyphora conviva* Stål, 1858 (Coleoptera: Chrysomelinae). Rupture of the cycloaexic ring and predation by a bug of one larva. (photo J. Vasconcellos-Neto, 1986.) Itatiaia National Park, RJ, Brazil. (b) Eggs of *Coelomera lanio* Dalman (Coleoptera: Galerucinae), laid on the underside of the folioles of *Cecropia adenopus* (Cecropiaceae).

The newly hatched larvae will aggregate. (photo Jolivet, 1990.) Viçosa, MG, Brazil. (c) First instar larvae of *Coelomera lanio* Dalman (Coleoptera: Galerucina). Cycloalexix ring. (photo Jolivet, 1990.) Viçosa, MG, Brazil. (d) Second instar larvae of *Coelomera lanio* Dalman (Coleoptera: Galerucinae), on a leaf of *Cecropia adenopus*. The ring has been doubled. (photo Jolivet, 1990.) Viçosa, MG, Brazil. (e) Third instar of *Coelomera lanio* Dalman (Coleoptera: Galerucinae), on a leaf of *Cecropia adenopus*. The cycloalexix ring is near to be broken and the larvae to go feeding (Coleoptera: Galerucinae). (photo Jolivet, 1990.) Viçosa, MG, Brazil. (f) Cycloalexix ring of *Platyphora conviva* Stål (Coleoptera: Chrysomelinae). First instar. The larvae have covered themselves with the hair of the underside of the leaves for extra protection. (photo J. Vasconcellos-Neto, 1986.) Itatiaia National Park, RJ, Brazil.

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Small colonies of larvae sometimes show non-viability (e.g., pergids). However, when larvae of *Coelomera* spp. (Coleoptera: Chrysomelidae) on a leaf of a *Cecropia* tree are divided into two or three subgroups, those groups seem as efficient as big ones in repelling predators.

### Gregarious Behavior in Insects

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