Predators vs. Prey and Parasites vs. Hosts:

A Perpetual Arms Race

Mechanisms Used by Predators

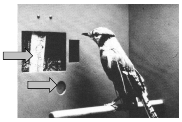
(1.) Learning (i.e., search images)

(2.) Detoxification of prey defensive compounds

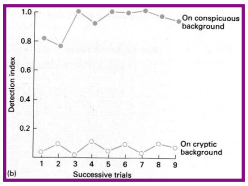
(3.) Exploitation of prey mating signals

Learning in Predators (i.e., search images)

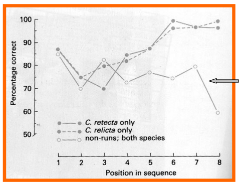
(Pietrewicz & Kamil 1981)



Monomorphic Moth Study



Polymorphic Moth Study



Detoxification of prey defensive compounds

Horned Lizard (Predator)

Harvester Ant (Prey)

TABLE 1. LETHALITIES OF HARVESTER ANT (*Pogonomyrmex maricopa*) VENOM, TO MICE AND TO TWO IGUANID LIZARDS, *Sceloporus jarrovii* AND *Phrynosoma cornutum*.

Venom source	Route injected	Species injected	Animals/dose	LD_{50} (μg/g)	95% CI (μg/g)
P. maricopa	iv	mice	6	0.119	0.072–0.197
P. maricopa	ip	mice	12	0.103	0.067–0.161
P. maricopa	ip	*S. jarrovii*	4	28	10–82
P. maricopa	ip	*Ph. cornutum*	4	162	61–432

(Schmidt et al. 1989)

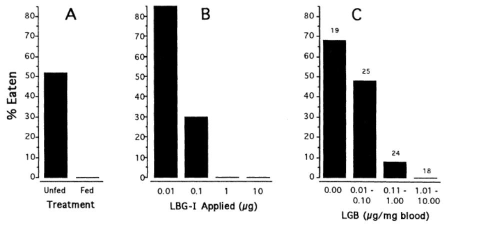
Predators exploiting mating signals (Fireflies)

⇨ **Female *Photuris* lures and eats male *Photinus***

⇨ **Female *Photuris* acquire defensive compounds from prey**

⇨ **Lucibufagin (LBG) = Cardiotonic Steroid**

Predators exploiting mating signals (Fireflies)



A = Lab-fed *Photuris*; B = LBG applied to *Drosophilla*; C = Field-caught *Photuris*
(Eisner et al. 1997)

⇨ **Defensive compound (LBG) at high levels is effective against spider predation**

Mechanisms Used by Prey

(1.) Crypsis & Startling Behavior

(2.) Prey defensive compounds
- --Batesian mimicry
- --Mullerian mimicry

(3.) Defensive hairs

(4.) Surface adhesion and shielding

Crypsis & Startling Behavior (Lepidoptera)

Cryptic Phase

www.morning-earth.org

Startle Phase

Prey defensive compounds

Warning Coloration

www.morning-earth.org

www.morning-earth.org

www.whatsthatbug.com

Prey defensive compounds

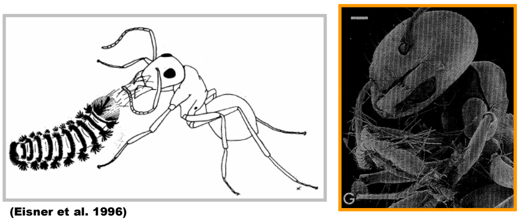
Batesian mimicry = mimic is not poisonous

Left = Viceroy
Right = Monarch

Müllerian mimicry = mimic is *also* poisonous

Queen Butterfly

Defensive hairs of prey (*Polyxenus fasciculatus*)

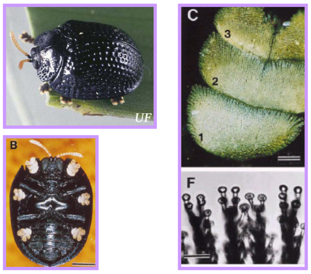


(Eisner et al. 1996)

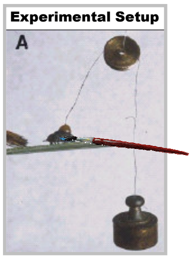
Surface adhesion and shielding (Tortoise Beetles)

***Hemisphaerota cyanea* (Adults)**

(Eisner & Aneshansley 2000)



Experimental Setup

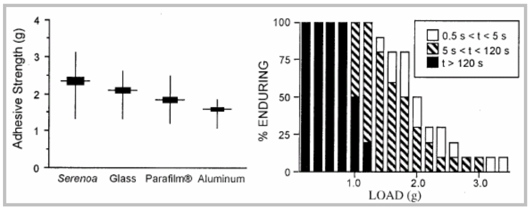


⇨ **Most likely using oily liquid for adhesion**

Surface adhesion and shielding (Tortoise Beetles)

Hemisphaerota cyanea **(Adults)** **(Eisner & Aneshansley 2000)**

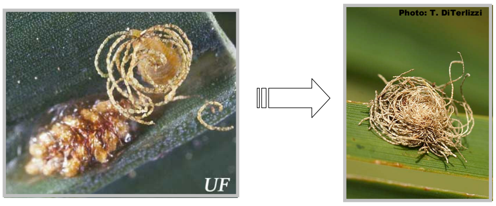
Results



⇨ **Adult beetles weigh *only* about *0.01gr* !!**

Protective shielding (Tortoise Beetles)

Hemisphaerota cyanea **(Larvae)**



⇨ **Makes shield out of frass!!**

Mechanisms Used by Parasites Against Hosts

(1.) Manipulation of host locomotion/neural systems

(2.) Visual mimicry

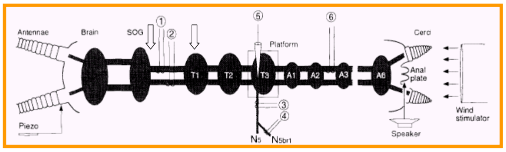
(3.) Chemical Camouflage

(4.) Locomotion mimicry

Manipulation of host locomotion/neural systems

Hymenoptera: *Ampulex compressa*

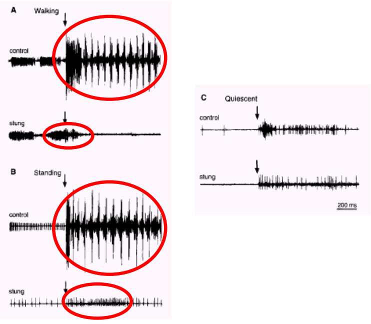
- ⇨ **First sting is at prothoracic region**
- ⇨ **Second sting is near the subesophageal ganglion region**
- ⇨ **Then, roach becomes the wasp's puppet zombie**



(Fouad et al. 1996)

Manipulation of host locomotion/neural systems

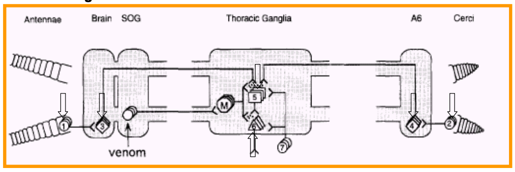
Hymenoptera: *Ampulex compressa* **(Fouad et al. 1996)**



Manipulation of host locomotion/neural systems

Hymenoptera: *Ampulex compressa* **(Fouad et al. 1996)**

Possible target areas of venom



(A.) Antennae and cerci mechanoreceptors (1 & 2)

(B.) Descending mechanoreceptive interneurons & Giant interneurons (3 & 4)

(C.) Thoracic interneurons (5)

(D.) Leg motorneurons (6)

Parasites of ants that use visual/tactile mimicry

Pselaphinae (Coleoptera: Staphylinidae)

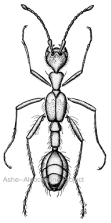
(Hölldobler & Wilson 1990)

Parasites of ants that use visual/tactile mimicry

Coleoptera: Staphylinidae

Mimeciton zikani

Crematoxenus aenigma



Mimanomma spectram

(Hölldobler & Wilson 1990)

Parasites of ants that use chemical camouflage

Cremastocheilus lengi **(Coleoptera: Scarabaeidae)**

(Hölldobler & Wilson 1990)

Parasites of ants that mimic colony movement

Myrmecophila **sp. (Orthoptera: Gryllidae)**

(Hölldobler & Wilson 1990)

Discussion Questions:

(1.) Did parasitism evolve from predation or vice versa? Or did they evolve independently?

(2.) Is co-evolution more difficult in parasite-host systems versus predator-prey systems? Why or why not?

(3.) Did mutualistic endosymbiotic systems evolve from detrimental parasitic systems? If so, what are the possible processes involved in the transition?