



Plants and Insects:
The Most Important Relationship of All Time



Outline

A Story for the Ages: Plant-Insect Interactions

- Herbivory and Pollination
- Predation and Parasitism

Tying it all together: Plants, Insects, and the Urban Environment



Plant-Insect Interactions

Aristotle (384-322 B.C.)

- *Historia Animalium* (350 B.C.) was the first comprehensive description and 'natural history' of all animals;

Of animals that live on dry land some take in air and emit it, which phenomena are termed 'inhalation' and 'exhalations'...Others, again, do not inhale air, yet live and find their sustenance on dry land; as, for instance, the wasp, the bee, and all other insects...

-Historia Animalium





Plant-Insect Interactions

Maria Sybilla Merian (1647-1717)

- German-born naturalist and artist
- Published many important works and drawings, including *Metamorphosis insectorum Surinamensium* (1705)
- One of the first naturalists to:
 - Accurately describe and document metamorphosis in insects
 - Observe host plant specificity for larval insects



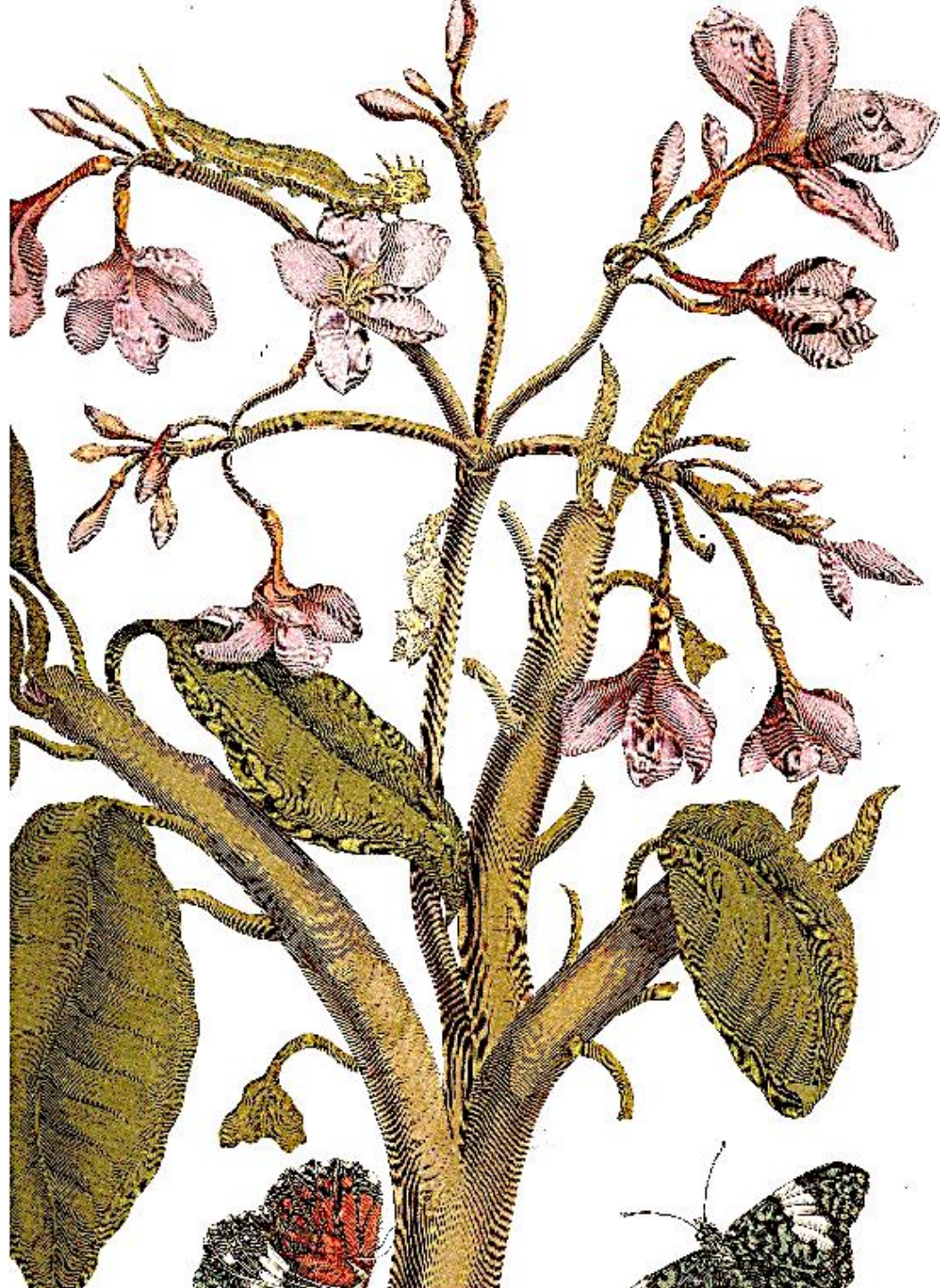
Maria Sibylla Merian,
wikipedia.org



Print from: *Botanicals: Butterflies and Insects*, Overstreet, 2008.



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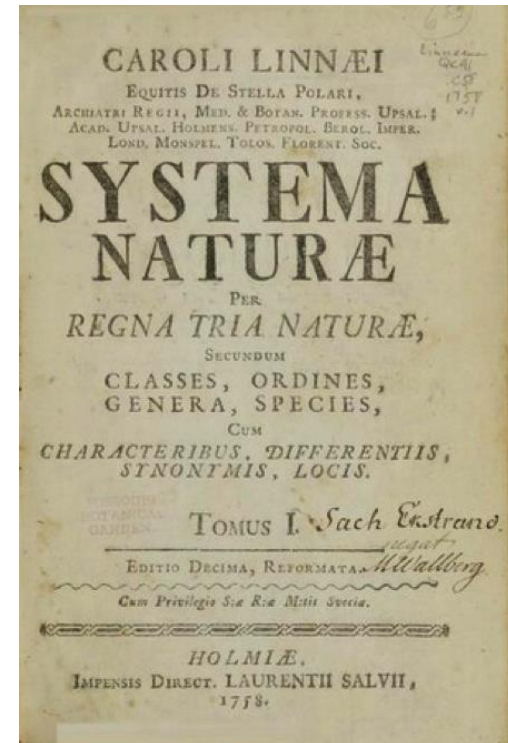
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Plant-Insect Interactions

Karl Linnaeus (1707-1778)

- Swedish botanist who developed our modern classification system, *Linnaean Hierarchy* (*binomial nomenclature*)
- Described some 3,000 species of insects





Plant-Insect Interactions

J.C. Fabricius (1745-1808)

- Student of Karl Linnaeus
- Described ~10,000 species of insects

...those whose nourishment and biology are the same, must then belong to the same genus.

J.C. Fabricius, 1790; from Philosophia Entomologica (1778)



JC Fabrcius. Britannica.com



Plant-Insect Interactions

Pierre Andre Latreille (1762-1833)

- French zoologist;
- Trained as a priest, but never took an official oath;
- Described ~160 species of insects;
- Emphasis on placing arthropods in higher taxa for classification;
- Known for introducing the concept of a 'type'



Pierre Latreille, France National Library



Ham beetle; *Necrobia ruficollis*; coleoptera.org.uk



Plant-Insect Interactions

Two broad categories of interactions:

1. Insect-Plant Interactions

- Pollination and Herbivory
- Plant-Insect Defenses

2. Predation and Parasitism



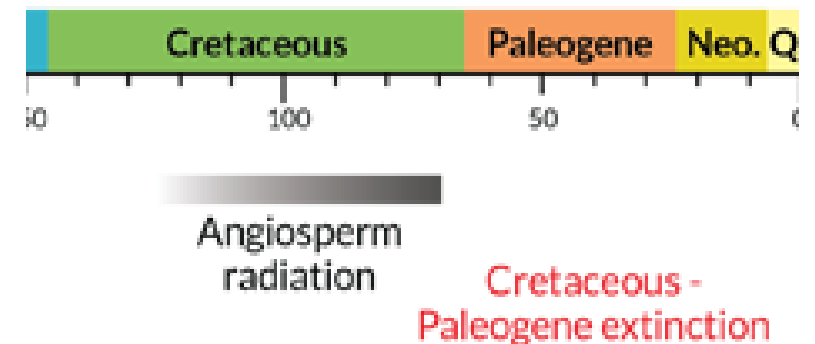
From, *Botanicals: Butterflies and Insects*. Sybilla Merian



Plant-Insect Interactions: Pollination

Flowers Steal the Show: the Cretaceous Period

- ALL biomes defined on the basis of flowering plants
- Insects are most intimately associated with plants:
 - Control gene flow
 - Affect speciation
- How does host plant specialization affect speciation in insects?





Plant-Insect Interactions: Pollination

Amborella and ANITA

- 3 basal groups of angiosperms:
 - *Amborella* spp.
 - Nymphaeales (65 spp.; aquatic)
 - Illiciales (90 spp.)



Amborella spp. is the basal-most (living) angiosperm; pollination mechanism is still unknown.

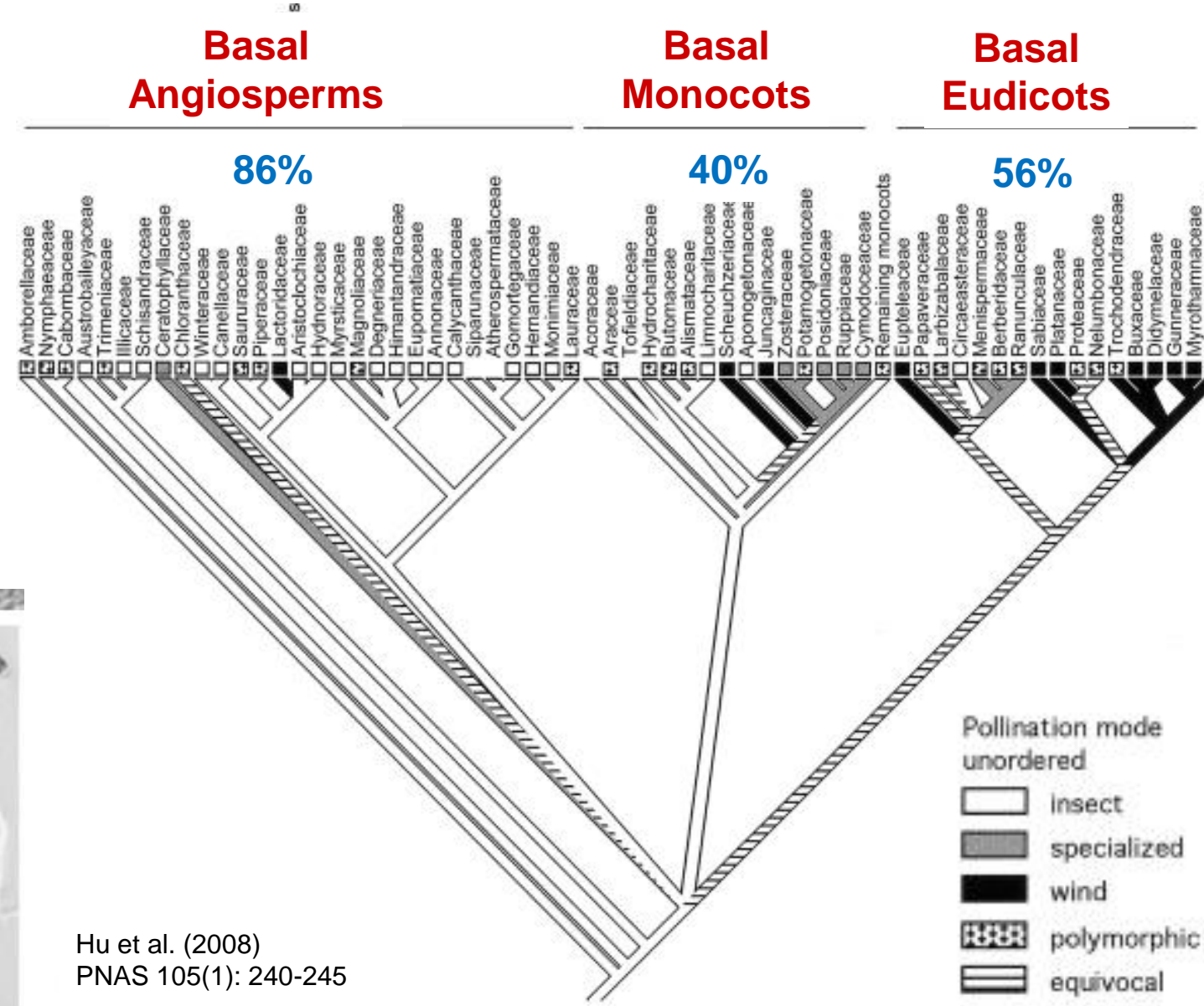
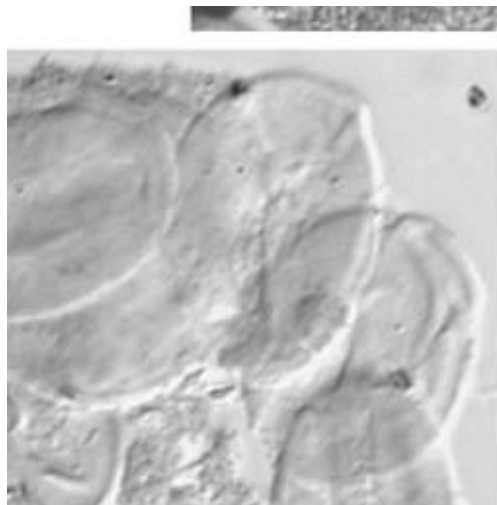
Image credit: Scott Zona



Basal Angiosperms are Entomophilous



Clumpy Fossil Pollen





Plant-Insect Interactions: Pollination

Why Plants, Why Insects?

- Reproductive Advantage (for the plants)
 - Direct transfer of gametes
 - Greater efficiency
 - Greater genetic diversity
 - Pollination and reproduction allowed from physically distant individuals



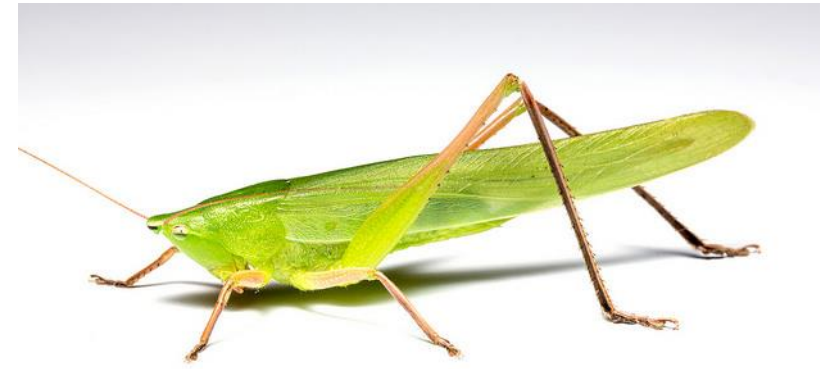
Cherokee coral bean



Plant-Insect Interactions: Pollination

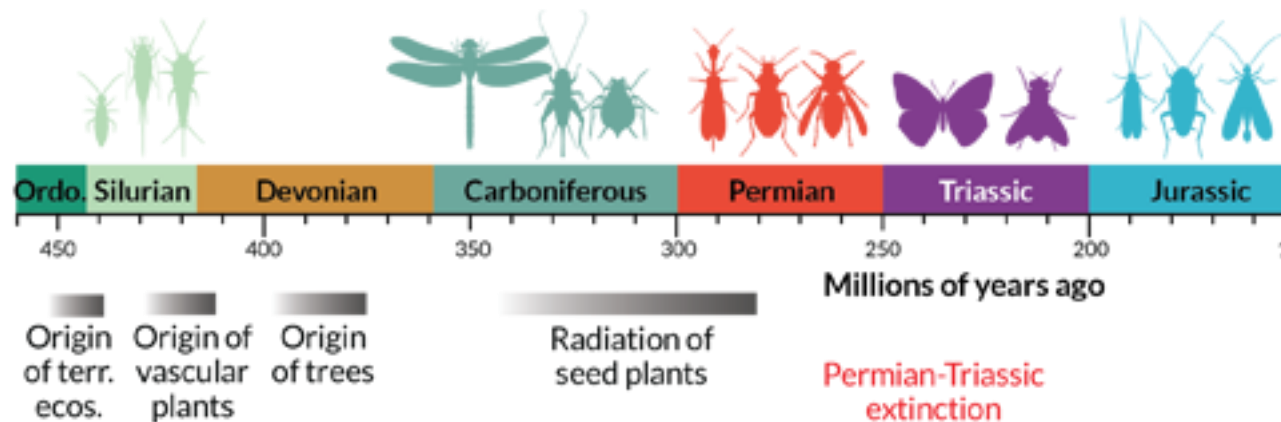
Why Plants, Why Insects?

- Reproductive Advantage (for the plants)
- Pollen
 - Earliest records of pollen-feeding comes from the Permian



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Katydids: one of the first pollen-feeding groups





Plant-Insect Interactions: Pollination

Why Plants, Why Insects?

- Reproductive Advantage (for the plants)
- Pollen
- Development of specialized structures:
 - Petals and sepals (~120 mya)
 - Filamentous stamens/corolla tubes
 - Clawed petals
 - Development of “viscin” on pollen
 - Floral nectaries (~90 mya)



Hammer Orchid, Mark Brundrett



Plant-Insect Interactions: Pollination

Why Plants, Why Insects?

- Reproductive Advantage (for the plants)
- Pollen
- Development of specialized structures
- Insects develop adaptive strategies as well:
 - Forming mouthparts with a long proboscis
 - Combs or setae on mandibles



Bombylius sp.; Long-tongued fly; one of the earliest adopters of feeding on nectar from flowers.



Plant-Insect Interactions: Pollination

Why Plants, Why Insects?

- Reproductive Advantage (for the plants)
- Pollen
- Development of specialized structures
- Insects develop new strategies as well:
 - Pollen-carrying structures (scopa and pollen baskets)
 - Hovering





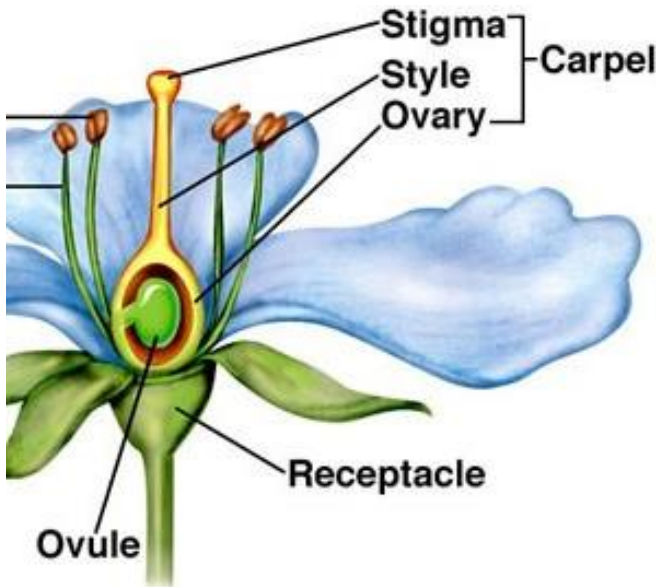
Plant-Insect Interactions: Pollination

Early Adopters of Pollination

- Insects were there first;
- Beetles? (Kevan and Baker, 1983)
- Early flowers were structurally generalized
 - Gnetales and other gymnosperms secrete 'pollination droplets'



Thrips, Univ. of Florida



Primitive water lilies were
pollinated by tiny flower beetles.

Credit: borderglider, Flckr





Plant-Insect Interactions: Pollination

Queen Bees are King

- Many species are *oligolectic*
- Highly social species (i.e. *Apis* spp.) are *polylectic*
- Of 84 major crops in the U.S:
 - Bees pollinate 75% (64) crops
 - Nearly \$34 billion annually

Oligolectic: foraging on a particular family or genus of plants

Polylectic: visiting (and foraging) on many species





Plant-Insect Interactions: Pollination

Obligate versus facultative mutualisms

- **Obligate:** one species relies completely on the other species



Yucca Moth (*Tegeticula* sp.)





Plant-Insect Interactions: Pollination

Obligate versus facultative mutualisms

- Obligate: one species relies completely on the other species
- **Facultative:** one species does not necessarily rely on the other





