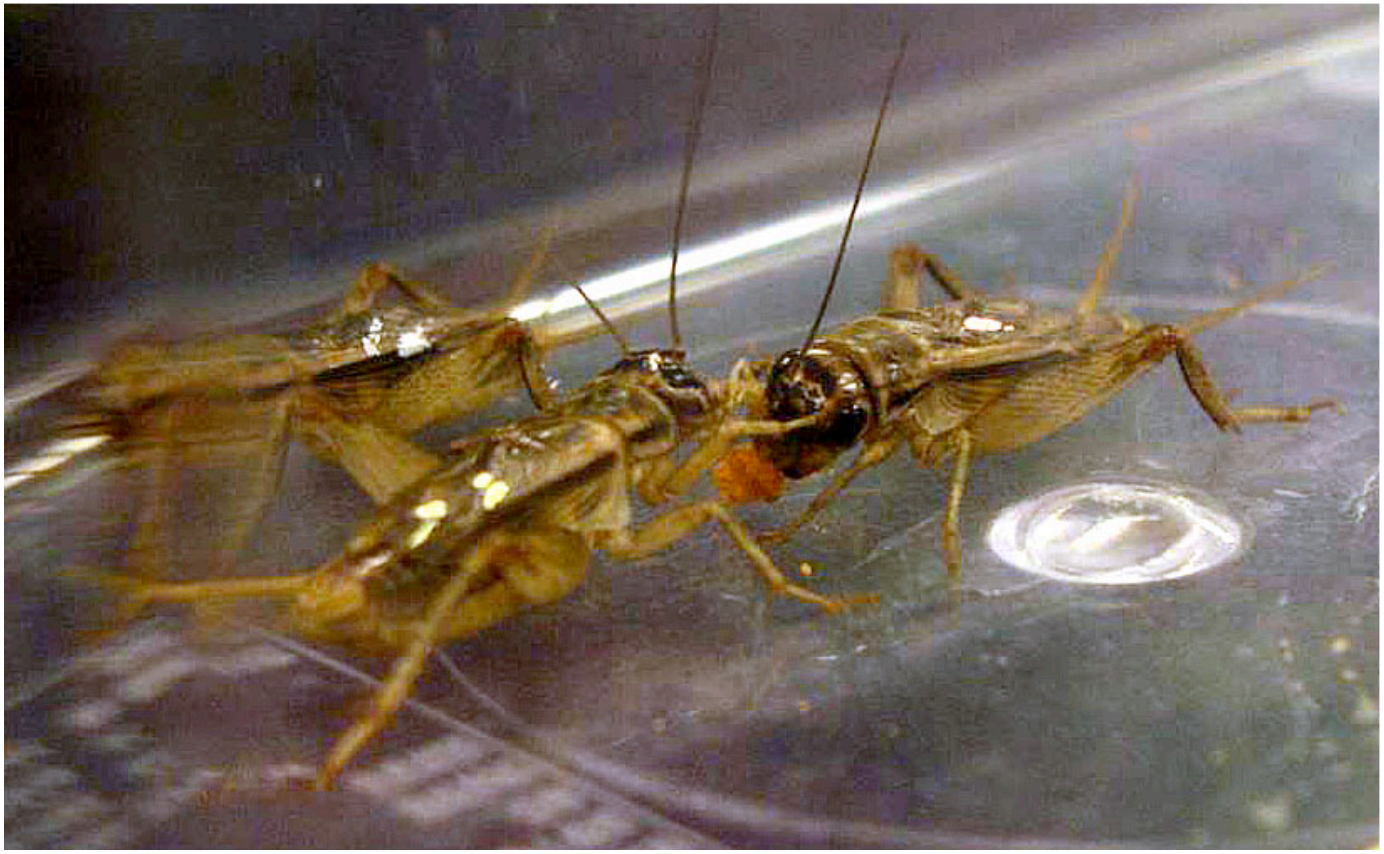
Dominance Behavior of the cricket *Gryllus domesticus*



AGENDA

- Hypothetico-deductive methodology
- Cricket as a representative insect
- Dominance hierarchies & Sexual selection
- Observation of Dominance behavior among crickets

Hypothetico-deductive methodology

- Ask a question.
- Develop an hypothesis by induction.
- Make deductions from the hypothesis.
- Test the deductions.
- Use conclusions from the tests to validate or falsify the hypothesis.

- Inductive: reasoning from observed facts to broader principles.
  - Specific to the general

- Deductive: reasoning from general principles to specifics.
  - General to the specific

Ask the question

- Once you have the question about some observed phenomenon, make a guess at what the answer is. That is your hypothesis.

- The “guess” is a not random thought. It’s an induction based on various observations, hunches, and clues.

Remember!

- Hypothesis must be testable
- Data must be verifiable

Experimentation

- Once the question has been asked and the hypothesis has been formulated, it's time to test the hypothesis by performing experiments based on deduction.
- If the hypothesis is true, then any deductions derived from it must be true.
- If the deduction proves to be true, then we can say the hypothesis may be true.

- Deduction?
- Induction?

A=inductive B=deductive

- In *A Scandal in Bohemia*, Holmes deduces that Watson had gotten very wet lately and that he had "a most clumsy and careless servant girl". When Watson, in amazement, asks how Holmes knows this, Holmes answers:

- It is simplicity itself . . . my eyes tell me that on the inside of your left shoe, just where the firelight strikes it, the leather is scored by six almost parallel cuts. Obviously they have been caused by someone who has very carelessly scraped round the edges of the sole in order to remove crusted mud from it. Hence, you see, my double deduction that you had been out in vile weather, and that you had a particularly malignant boot-slitting specimen of the London slavey.

Experiment: attempt to identify a cause-effect relation

- Independent variable: manipulated variable. Sometimes called the design factor, predictor or experimental intervention.

- Dependent variable: the measured, outcome, observed, or response variable. Usually has some kind of unit attached or measured.

Titles as reports on experiments

- Usually contain information about cause and effect relationships.
- Listing of dependent variables (DV) and independent variables (IV)
- Information about the variables or measurements made under what conditions

Some variations in titles

- **The Effect of IV on DV**
- The effect of insulin on the blood glucose levels in the laboratory rat, *Rattus sp*.
- **The Role of IV on DV**
- The role of insulin in regulating the blood glucose level in the laboratory rat, *Rattus sp*.
- **DV as a result of IV**
- Change in blood glucose levels in *Rattus sp*. as a result of insulin injections
- **IV and DV**
- Insulin and Changes in Blood Glucose Levels in *Rattus sp*.

Post, G, Power, DV & Kloppel, TM (1974). Survival of rainbow trout eggs after receiving physical shocks of known magnitude, *Trans. Am. Fish Soc.*, 103:711-716

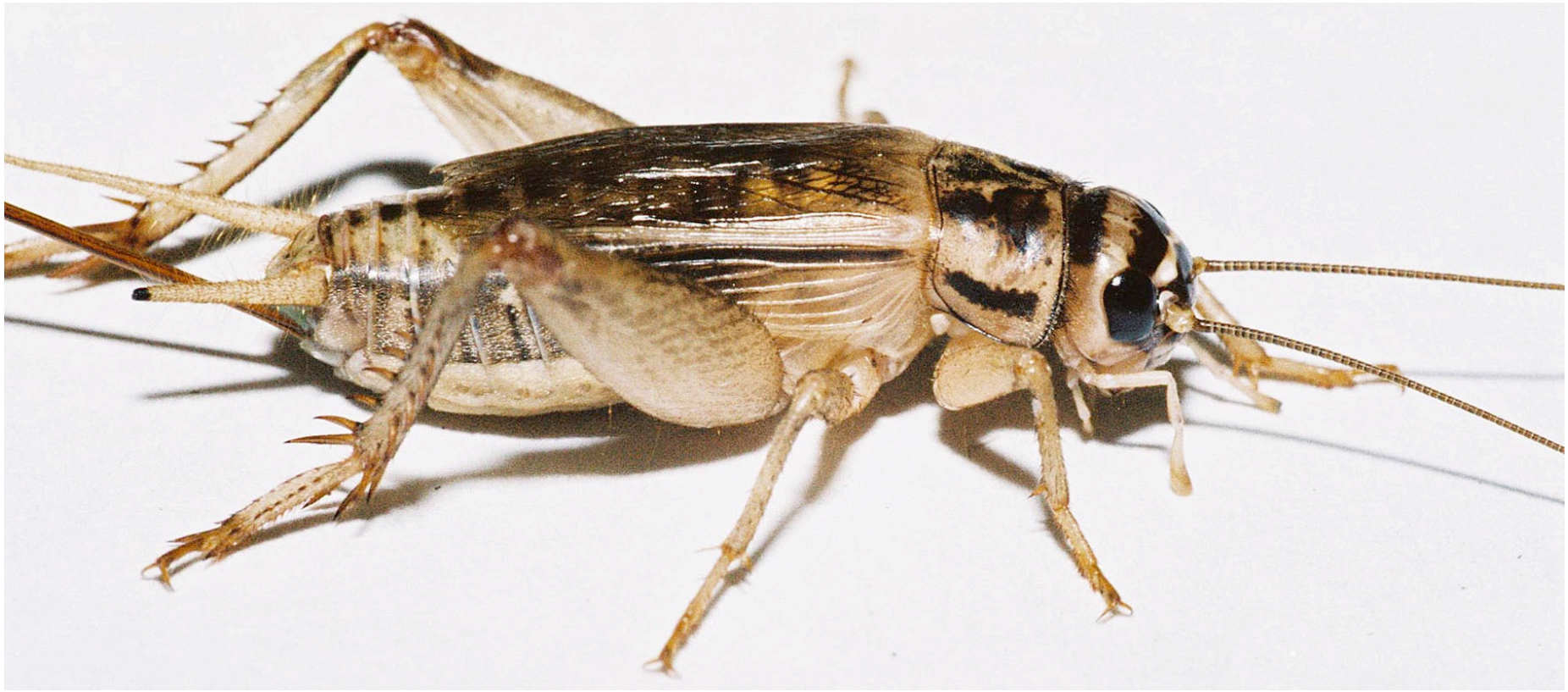
- DV?
- *Survival of Rainbow Trout Eggs*
- IV?
- *After receiving Physical Shocks of Known Magnitude*

- Format: DV after IV

Larimer, J .L. & Gold, A. H. (1961). Responses of the crayfish, *Procambarus simulans*, to respiratory stress. *Physiological Zoology*, 34:167-173.

- DV?
- Responses of the crayfish, *Procambarus simulans*
- IV?
- Respiratory stress

- Format: DV after IV



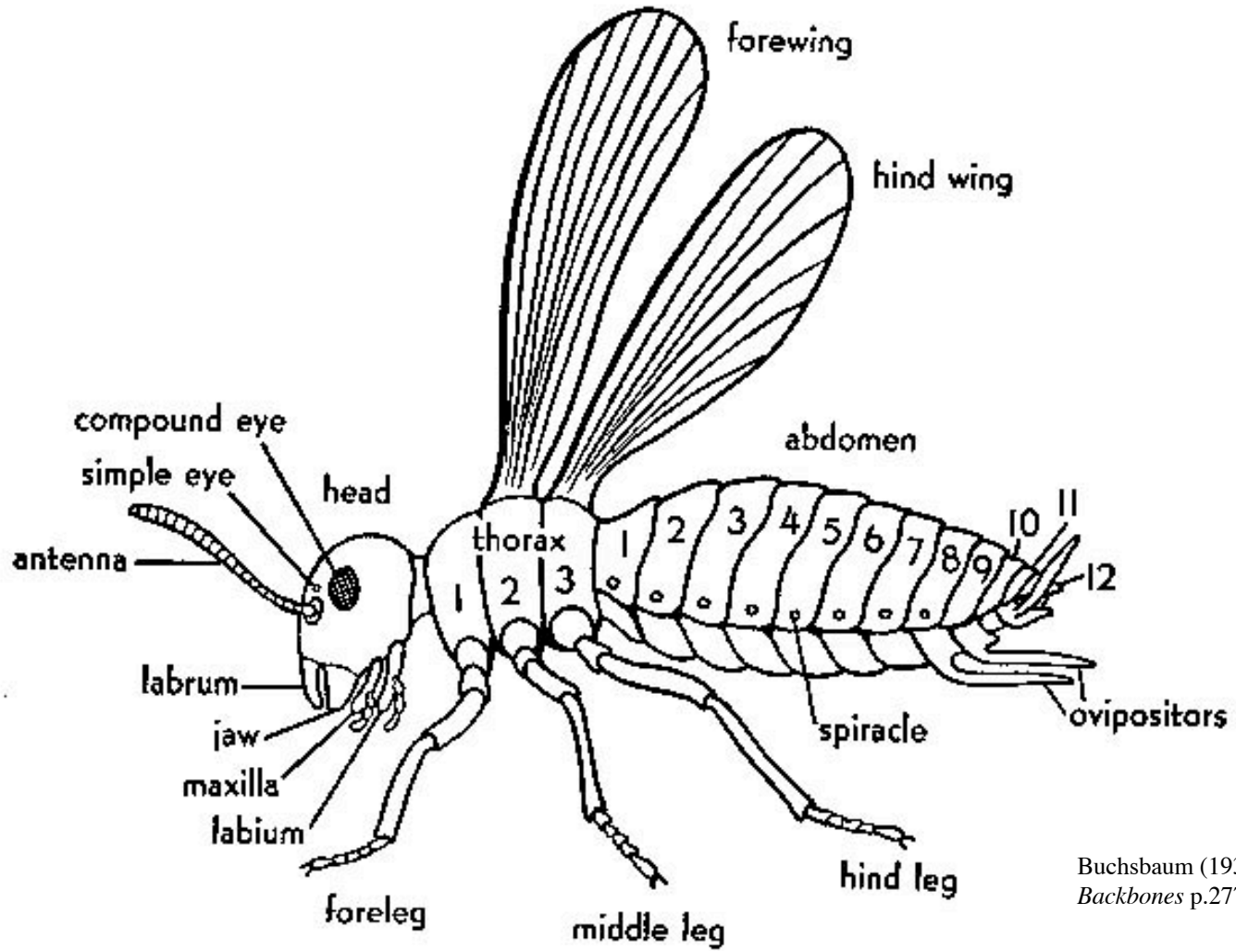
Class: Insecta (Hexapoda)

- Body divided into 3 regions
  - Head
    - Six segments
      - Pair antennae
  - Thorax
    - Three segments
      - 3 pairs of legs
      - 2 pairs of wings
  - Abdomen
    - 9-11 segments

Order: Orthoptera
house cricket-*Gryllus domestica*

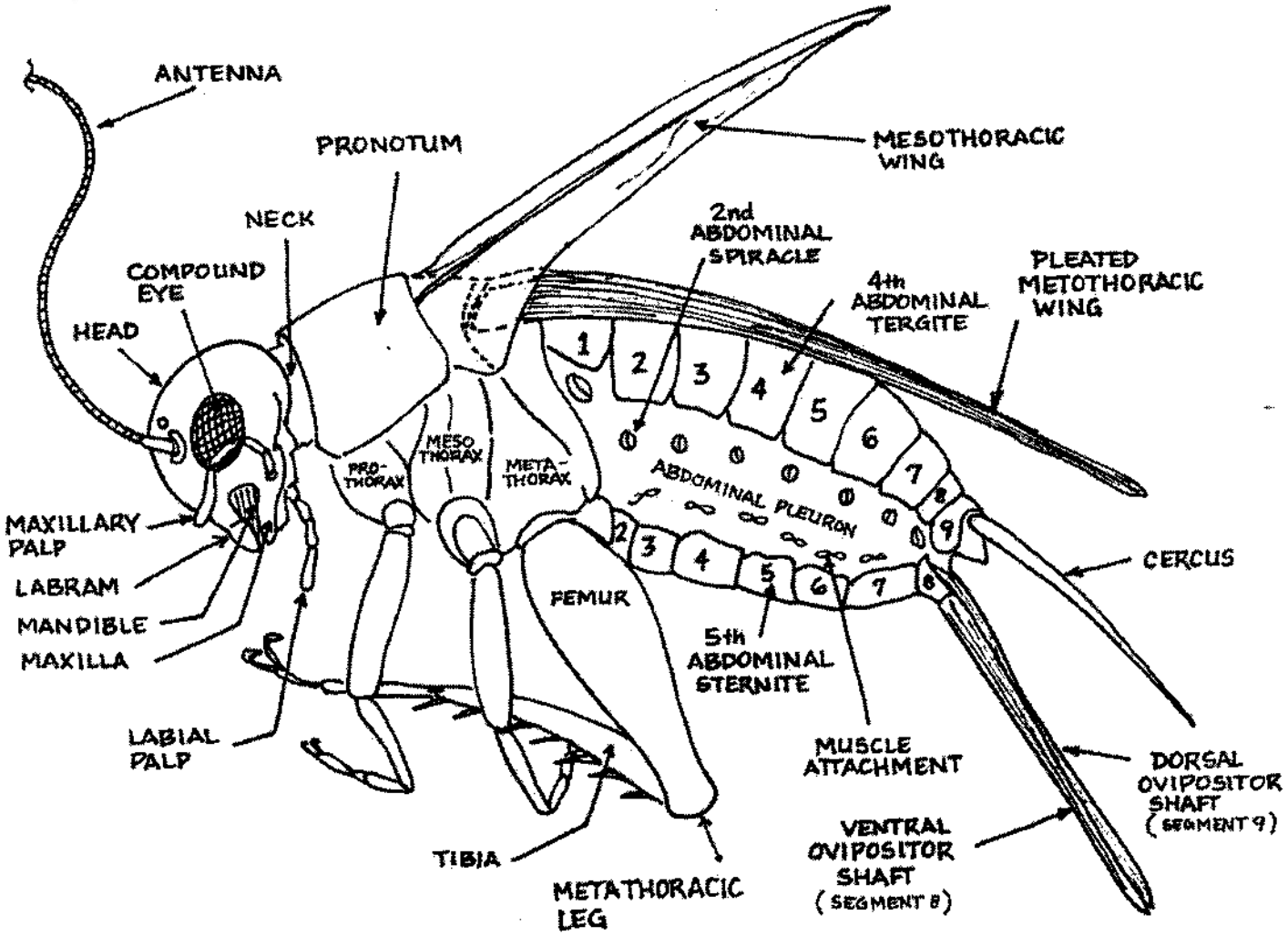
- Large insects with mouth parts of the biting type; posterior legs with enlarged femora for jumping; fore wings as tegmina which overlap each other; cerci unjointed; pronotum with enlarged lobes hiding the pleural wall; ovipositor well developed' specialized stridulatory organs

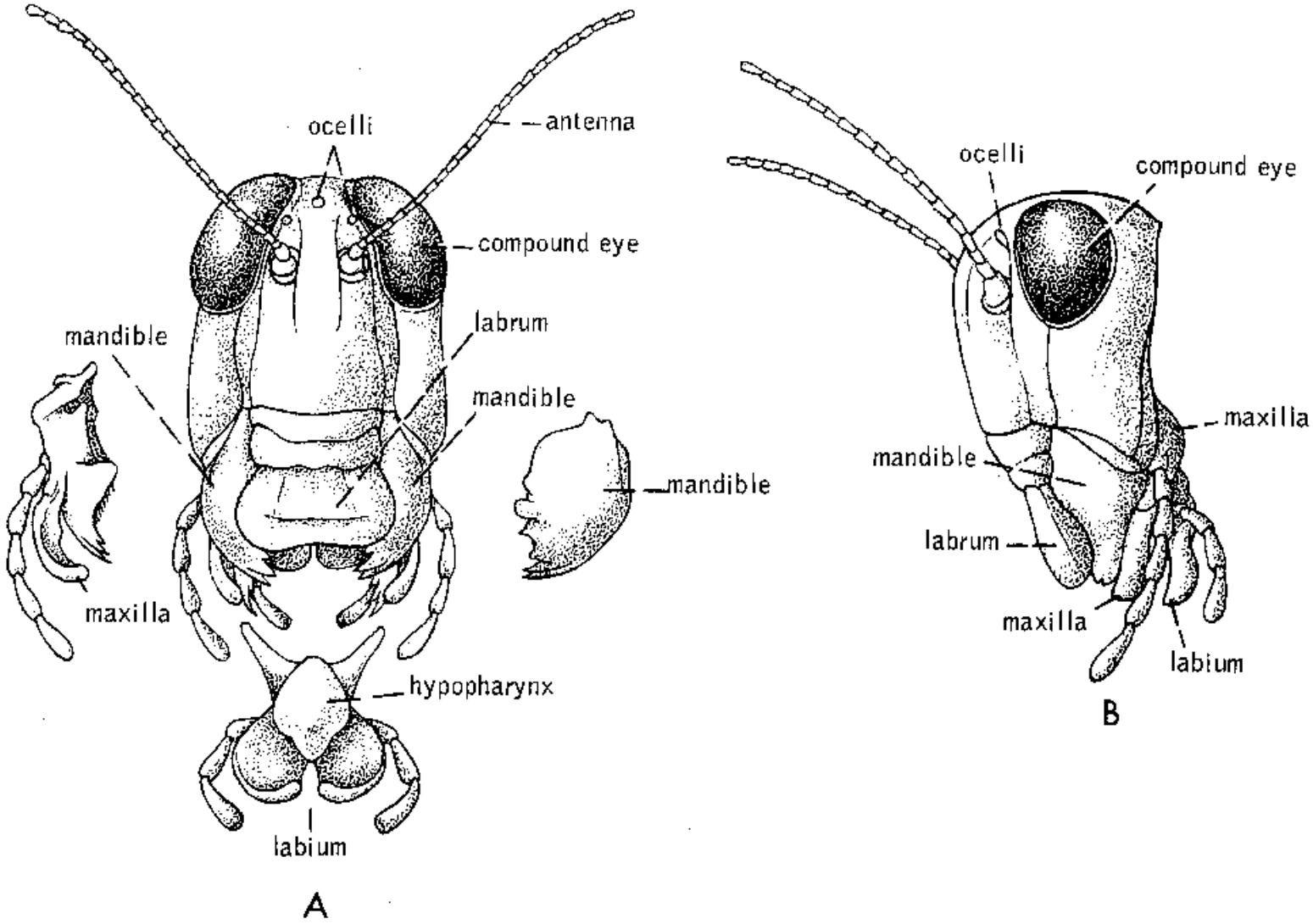
Generalized body plan



Buchsbaum (1938) *Animals Without Backbones* p.277

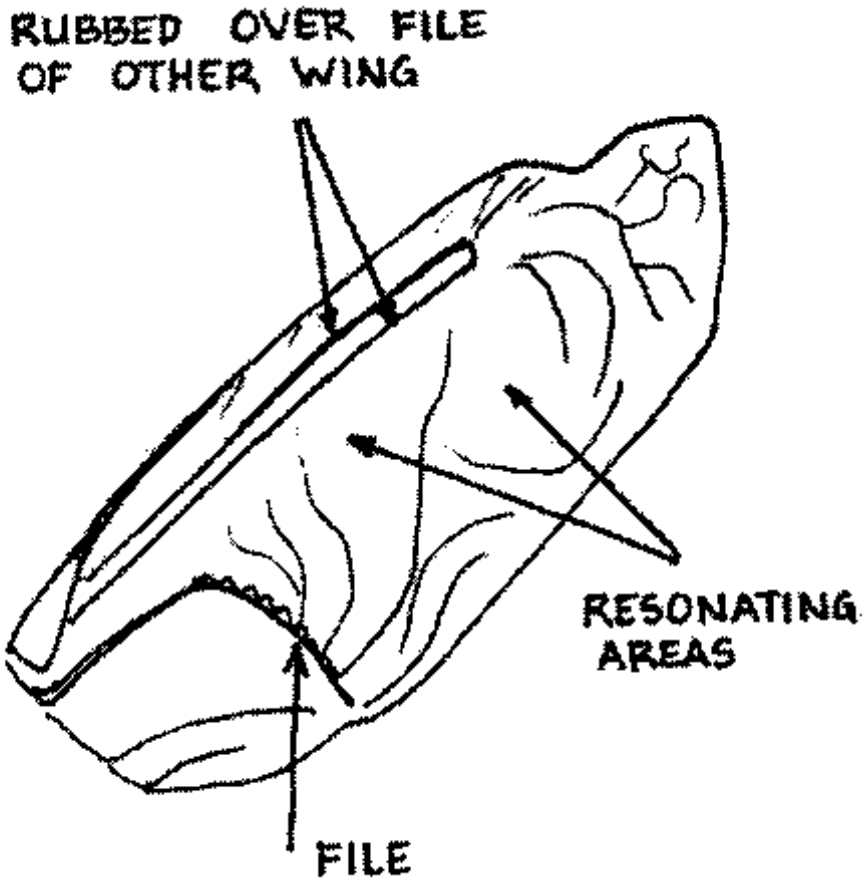
Cricket morphology





Barnes, .D. (1974). *Invertebrate Zoology*,3rd ed., Philadelphia: W.B. Saunders Co., 621.

Mesothoracic wing



male

female

Nervous and Circulatory system

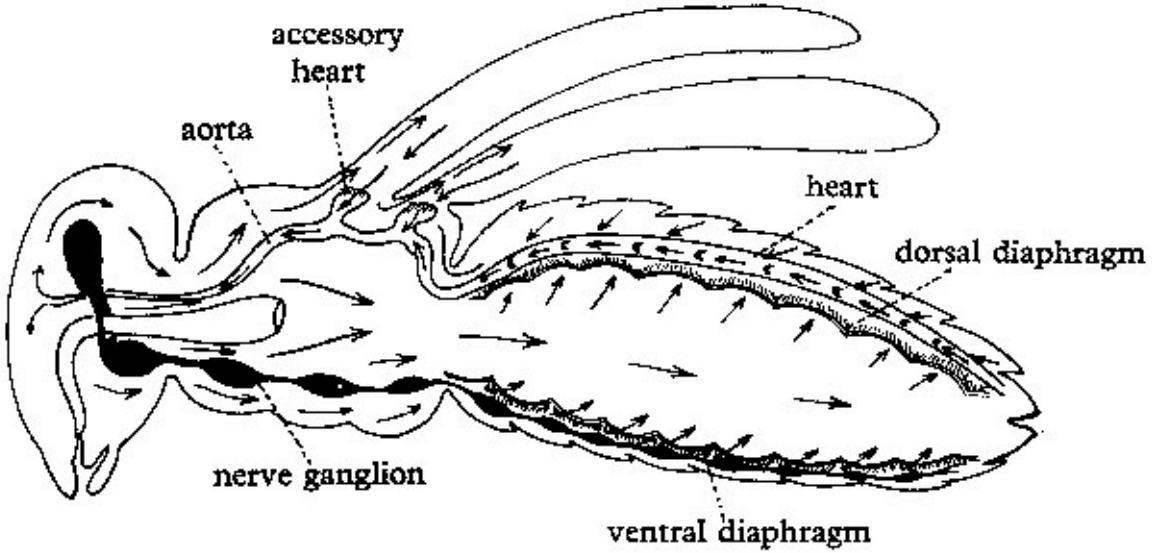
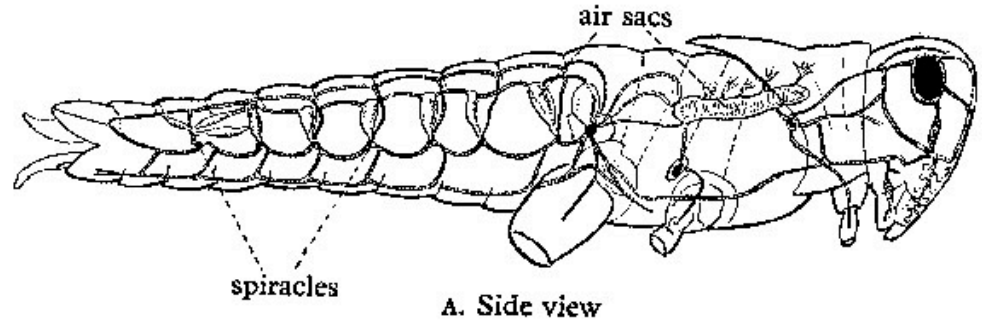
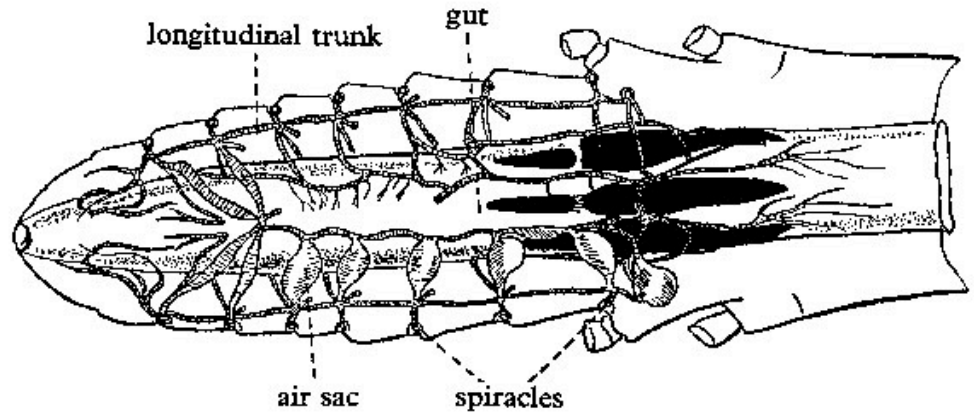


Fig. 304. Diagram to illustrate the general circulation of the blood in an insect.

Respiratory system



A. Side view



B. Dorsal view

Fig. 305. Tracheal system of the locust, *Dissosteira carolina*. A, side view. B, dorsal view, the lower half to show air sacs, the upper half to show the tracheal supply to the alimentary canal. (Modified from Vinal.)

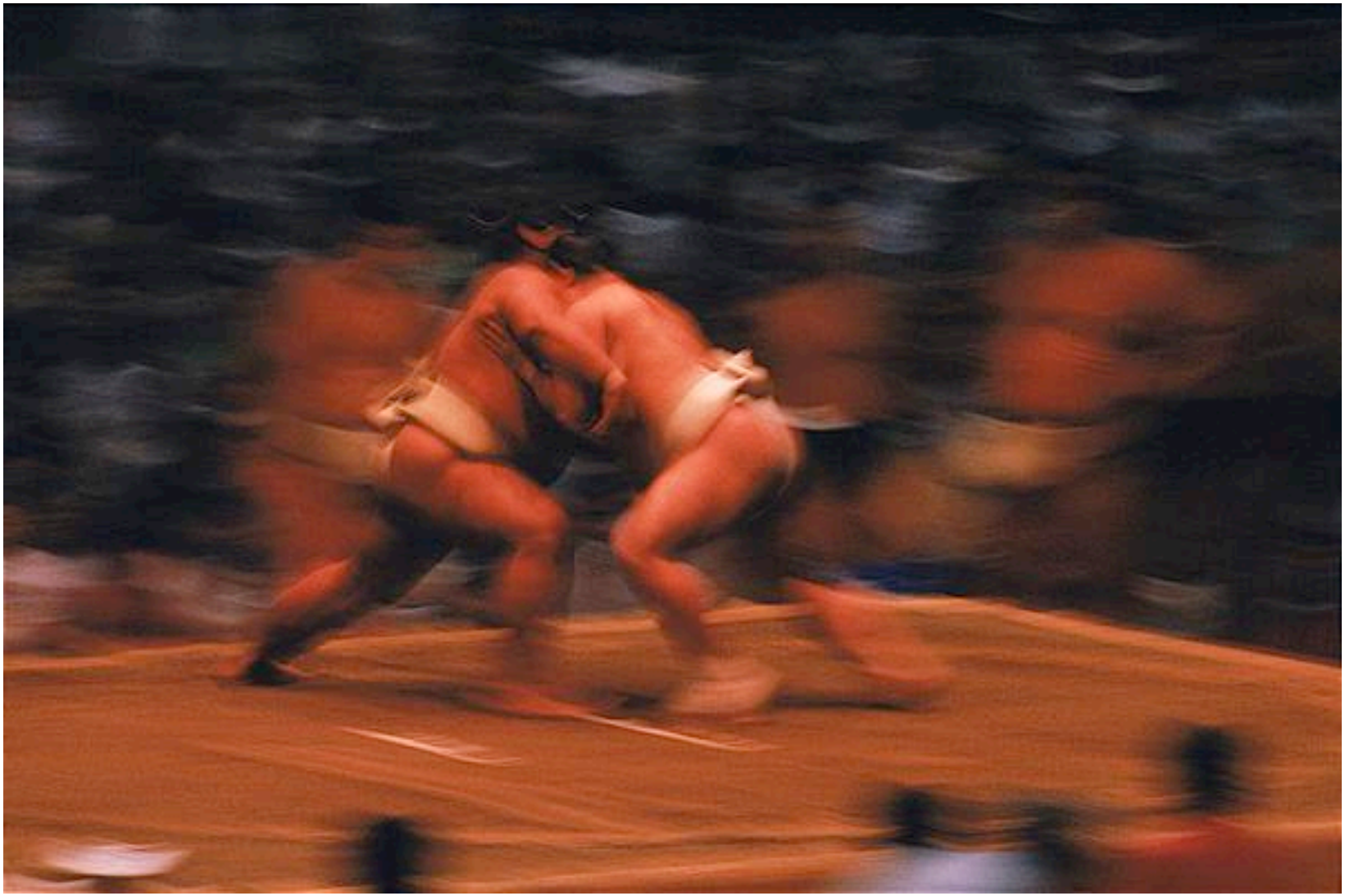
Mating

- No true copulation.
- Male packages semen in a packet, spermatophore that is manipulated by cerci.
- Female mounts male and spermatophore is passed dorsally to female genital opening.
- Spermatophore insert into reproductive tract.
- Female dismounts and moves away.
- Male stands guard to prevent female or other males from removing and eating spermatophore.

Dominance Hierarchy

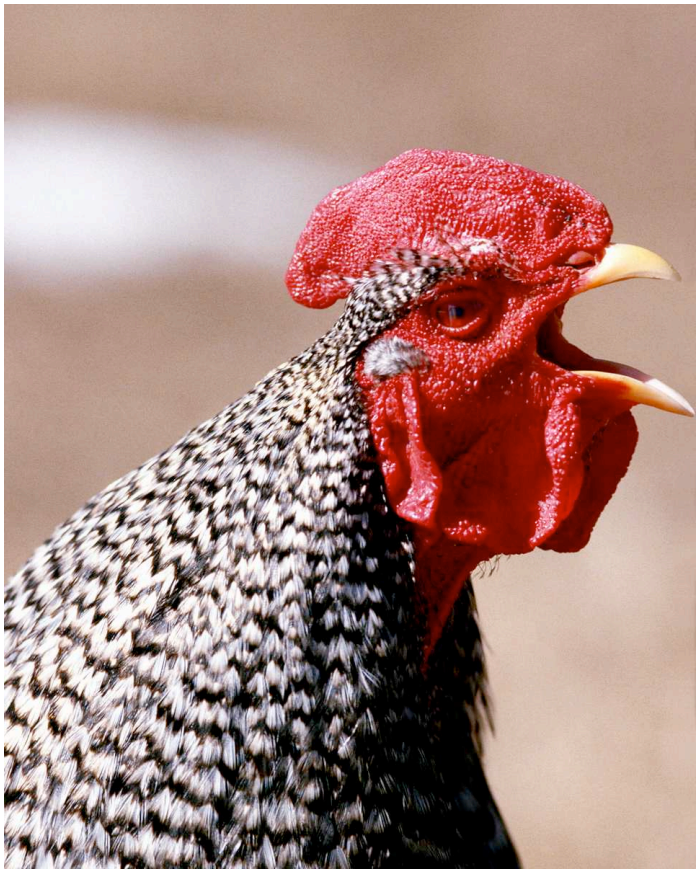
- Many social animals develop and maintain dominance hierarchies.
- It's a social ranking in a population or group of individual's of the same species.
- Hierarchy based and maintained on his/her strength and influence over other individuals.

- Hierarchies are maintained through frequent assessments of the competitors.



ROBB KENDRICK: AURORA

Competitor's strength evaluated through ritualized behaviors and displays that flaunt their size, songs, endurance, strength, and displays of color.



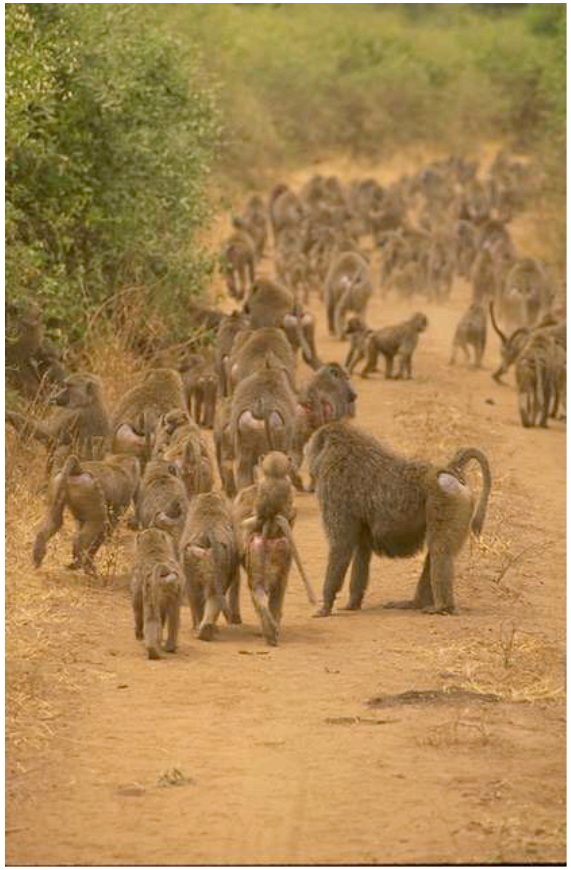
Example of a dominance hierarchy: Chicken pecking order

- Determines who can eat first and who can peck who.
- Order determined quickly and seldom changes.
- Usually, the rooster is the strongest member of the group and maintains the highest rank in the group.

What are the costs and benefits of dominance behavior?

- Reduce chances of injury over fights for resources.
- Cost to the submissive members is less access to resources.

Access to females



- If males are assessing each other's rank in a dominance hierarchy, they may be determining who has access to a resource, they may be determining who has access to a female, and they may be trying to influence a female's mate choice."
- Preszler, R.W. (2004)

Sexual Selection

Presented by Charles Darwin to explain exaggerated traits among the males of species.

Sexual Selection

- Darwin suggested males compete for access to females:
  - Intrasexual selection (dominance struggle between males)
  - Intersexual selection (competition to attract females)

Patterns of male success

- Dominant males enjoy mating advantage

Other possible patterns of male success

- Male mating success unrelated to dominance
- Subordinate males enjoy a mating advantage

Male mating success unrelated to dominance

- Red pigmented associated with a male house finch's diet.
- Brighter finches live longer & have fewer parasites.
- Brighter finches are preferred by females.
- Brighter birds have access to food and females, so no need to establish dominance over other males.

http://sdakotabirds.com/species_photos/house_finch_4.htm

Female cricket choices

- Female prefers dominant males
- Female prefers certain traits of dominate males
- No preference for particular males
- Female prefers traits unrelated to dominance
- Female preference for traits negatively

Some aggressive behaviors to be looking for:

- Chirping
- Wing flaring
- Avoidance
- Biting
- Pushing
- Wrestling
- guarding

Courting behavior

- Antenna stroking
- Chirping
- Following
- Guarding

Why choose crickets for dominance studies?

- Cricket are easy to breed and maintain in the laboratory.
- Crickets known to be aggressive and territorial insects.
- Earliest publication for cricket training for fighting China (Song Dynasty 1213-1275)

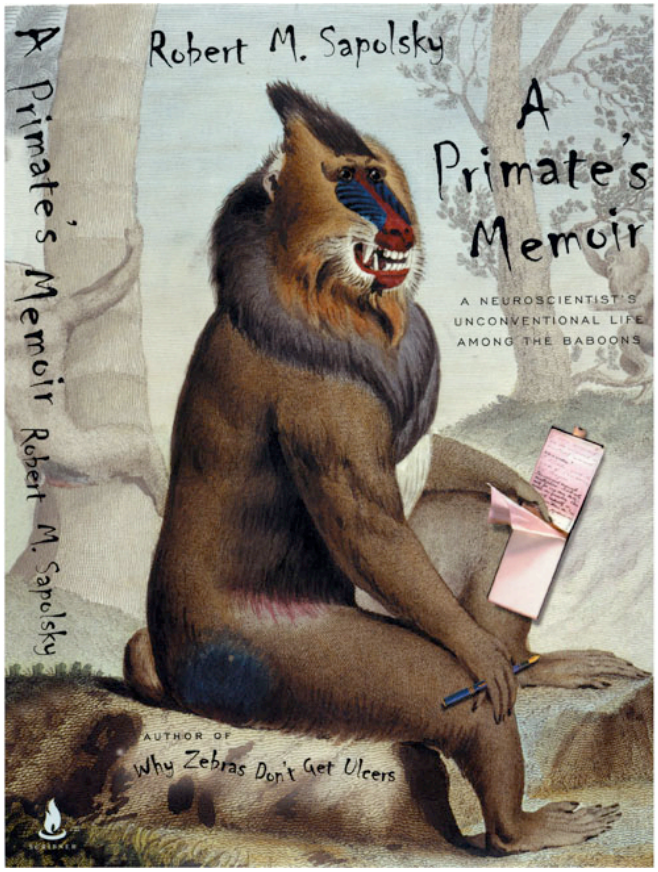
http://www.insects.org/ced3/er_ya.html

A=inductive B=deductive

- Holmes again:

- "From a drop of water"—Holmes wrote in an essay described in *A Study in Scarlet*—"a logician could infer the possibility of an Atlantic or a Niagara without having seen or heard of one or the other."

Laid-back Joshua



- "Everyone from back then…is gone, except one last survivor from the beginning…[H]e avoided the fights and canine slashes and the piling up of injuries that ultimately do in a male baboon…He is far from decrepit, and his lifelong tendency towards calmness has deepened with the years." page 303

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