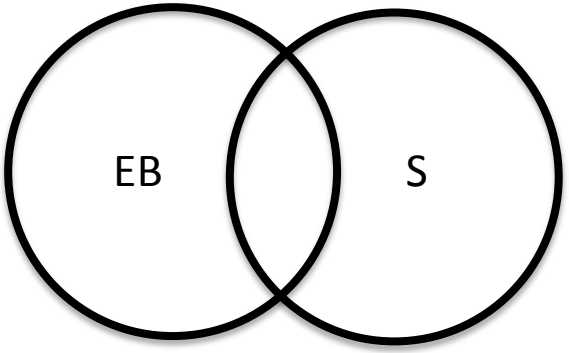
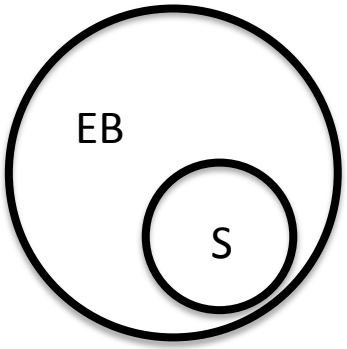
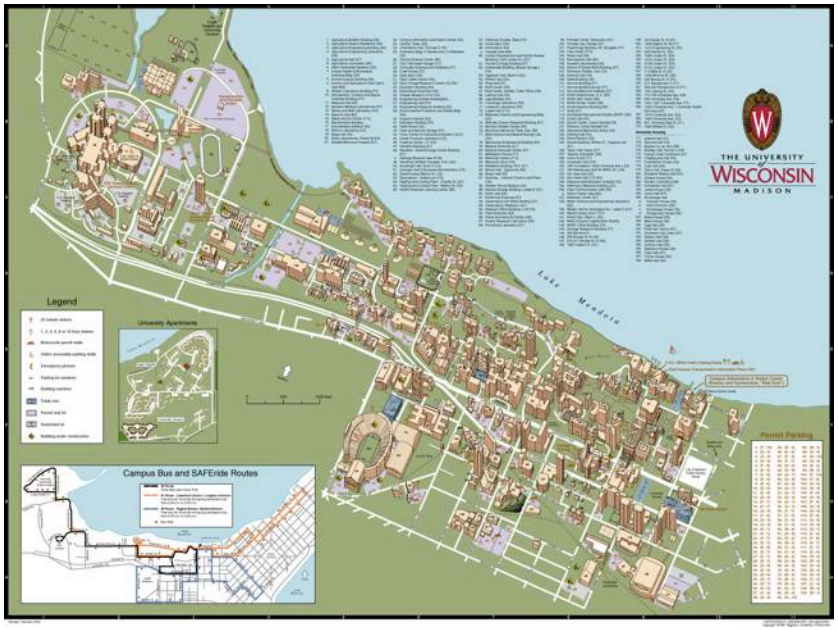
VARIATION AND EVOLUTION IN PLANTS

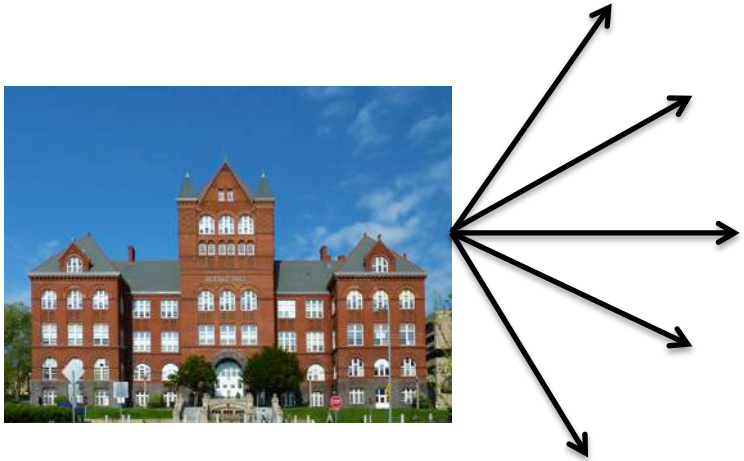
Ch. 3: The Basis of Individual Variation

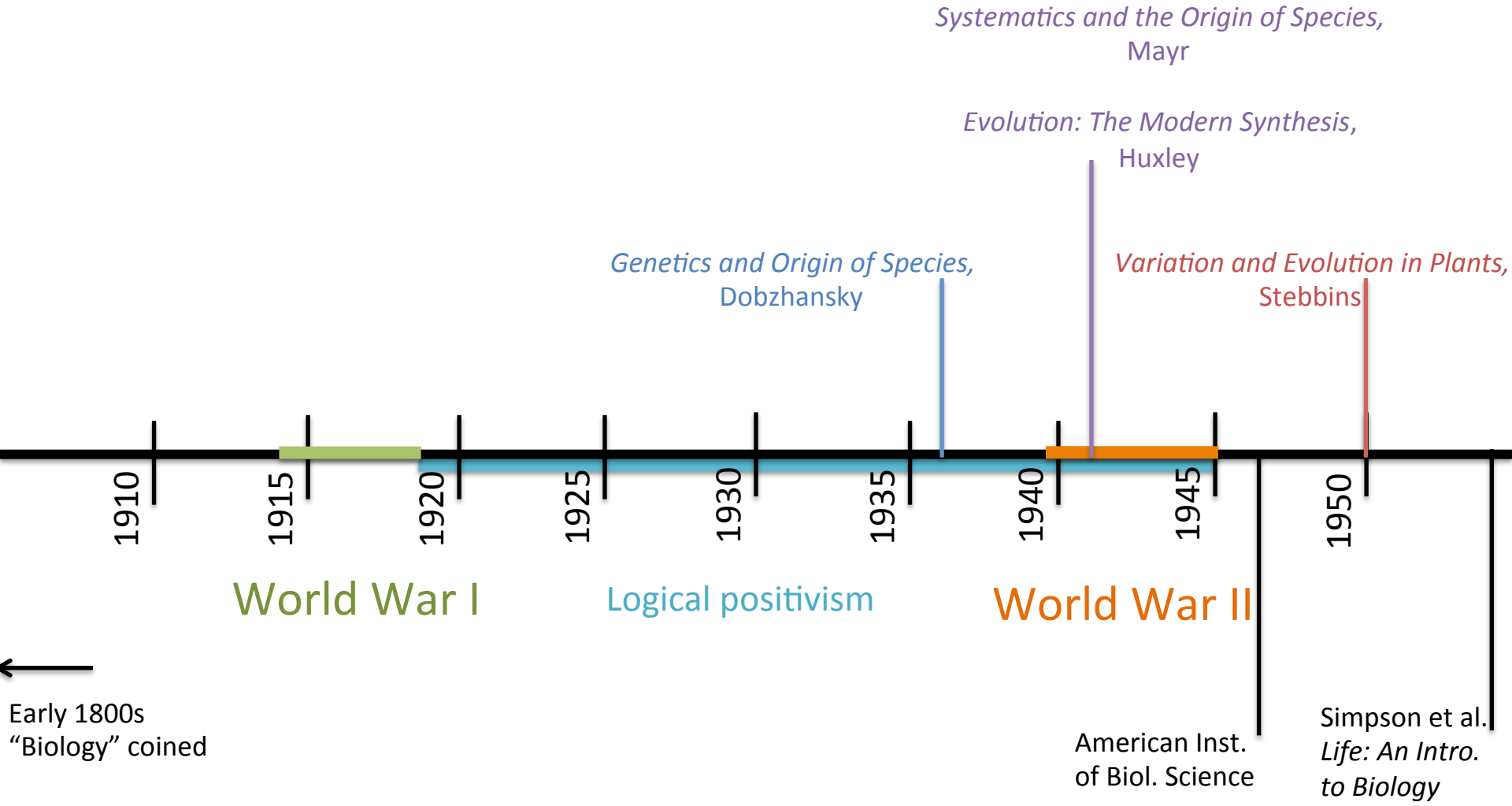
How do you conceptualize the relationship between evolutionary biology and systematics (and other such terms)?









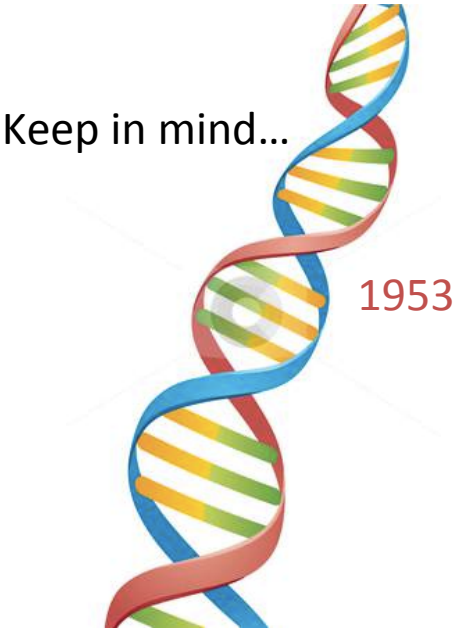


"The evolutionary synthesis signaled the unification of the biological sciences[1]."

[1]Smocovitis. 1992. Unifying biology: the evolutionary synthesis and evolution. *J. Hist. Biol.* 25(1): 1-65.

Ch. 3: The Basis of Individual Variation

1. Environmental modification and its effects
2. The importance of recombination
3. Types of mutation and their significance
4. Genetic effects of mutation
5. Rates of mutation



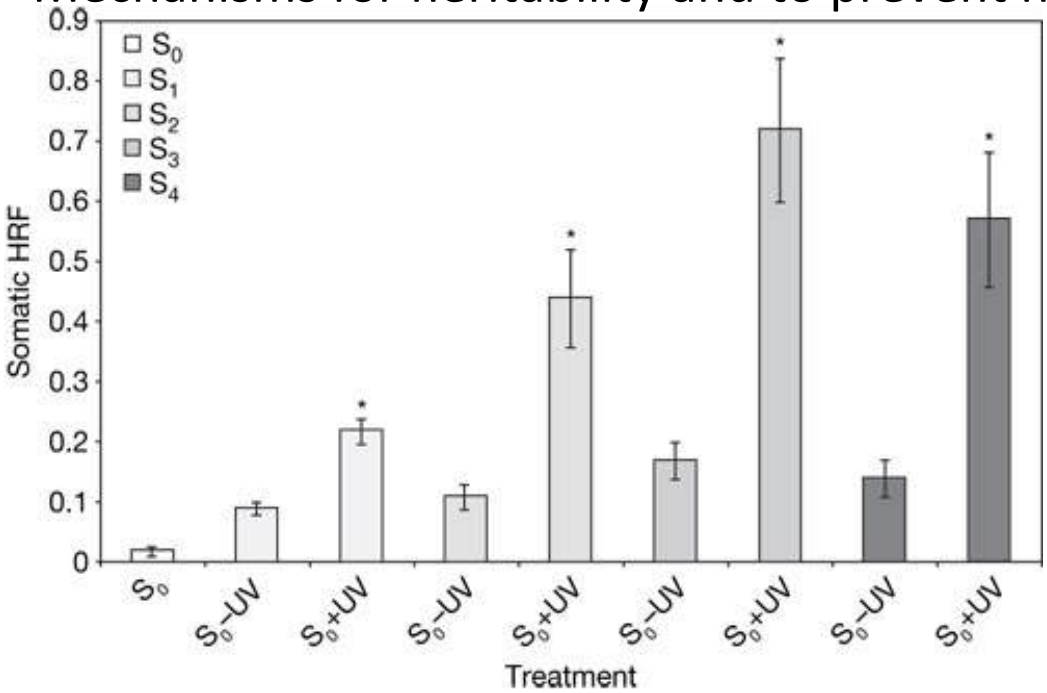
1. Environmental modification and its effects

Stebbins

- Not directly significant factor in evolution
- Differential plasticity within individuals

Contemporary research: epigenetics

- Transgeneration memory of stress in plants[1]
- Adaptive vs. stress memories[2]
- Mechanisms for heritability and to prevent heritability?[2]



[1] Molinier et al. 2006. Transgeneration memory of stress in plants. *Nature*. 442: 1046-1049

[2]Iwaksaki and Paszkowski. 2014. Epigenetic memory in plants. *EMBO.* 33: 1987-1998.

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Discussion

- How have changes in our understanding of the evolutionary role of environmental modification influenced the field of evolutionary biology?

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2. The importance of recombination

Stebbins

- Major *immediate* source of variability for evolution

Will be discussed in depth in Chapter 5…

3. Types of mutation and their significance

Stebbins

- *Ultimate* source of variability for evolution
- Four types: multiplication of entire set, +/- few chromosomes, gross structural changes, *submicroscopic changes
- No reason to believe correlation between size of mutation (structural or submicroscopic) and its genetic effect

Contemporary research: genome size

- Plant DNA C-values Database[1]
- Primary method: flow cytometry[2]

[1]http://data.kew.org/cvalues/

[2]Bennett and Leitch. 2011. Nuclear DNA amounts in angiosperms: target, trends and tomorrow. *Annals of Botany*. 107: 467-590.

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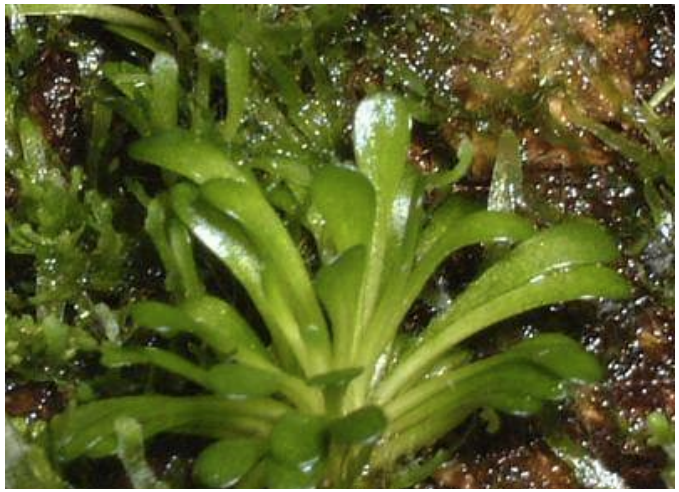

Genlisea margaretae (Lamiales)

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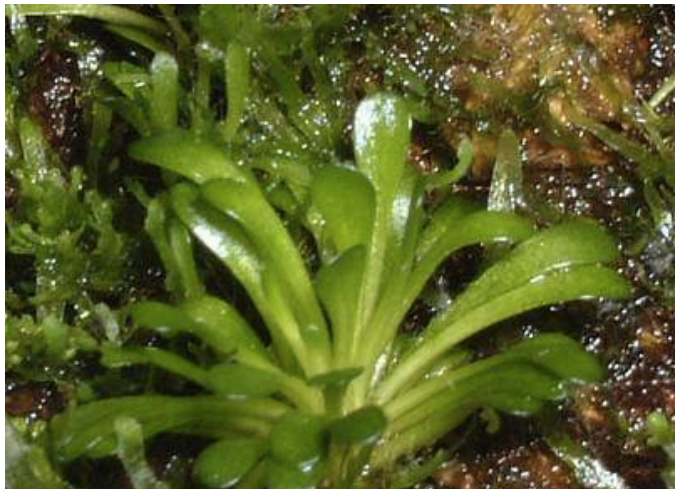

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Paris japonica (Liliales)

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Discussion

- "The majority of the morphological and physiological differences important in evolution come about, not through alterations of the number and gross structure of the chromosomes, but through… 'point mutations'" (84).

- "The evolutionist may not have very long to wait for the vital information he needs in order to understand the ultimate source of evolutionary change" (85).

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[2]Bennett and Leitch. 2011. Nuclear DNA amounts in angiosperms: target, trends and tomorrow. *Annals of Botany*. 107: 467-590.

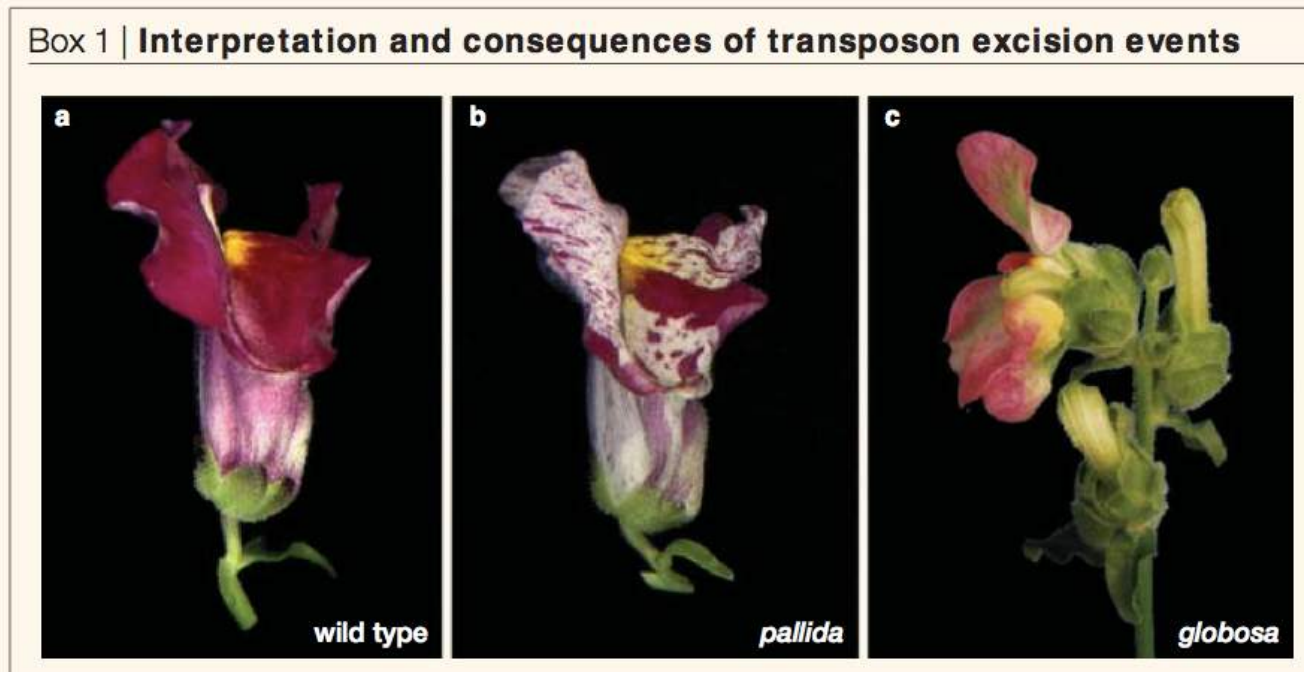
4. Genetic effects of mutations

Stebbins

- Mutations directly affect processes; indirectly affect characters
- Most mutations are neutral or harmful
- Mutations occur randomly

Contemporary research: *Antirrhinum*[1]

- Continues as angiosperm model for research about genetics and development
- Transposons, homeotic genes, MA**D**S-box genes, QTL, …



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Discussion

- How does the current understanding of Stebbins' "switch genes" ,"polygenes", and other genetic effects influence the way you think about evolution and carry out your research?

[1]Schwarz-Sommer et al. 2003. An everlasting pioneer: the story of *Antirrhinum* research. *Nature Reviews: Genetics*. 4: 655-664.

5. Rates of mutation

Stebbins

- Rates vary among taxa, genes
- Rates subject to same laws of evolutionary change as other characters
- Usually caused by internal factors
- Selection favors lower mutation rates

Contemporary research: modeling and simulations

- Entirely new scale of research and understanding

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Discussion

- "Selection will through the ages tend to lower the mutation rate in the genes of a species by establishing mutant genes which act as mutation suppressors" (99).

- Stebbins cites mustard gas research by Auerbach, Robson, and Carr (1947). Can you think of examples of contemporary research fueled by current events, the findings of which have broader implications for science in general?