# Genetics I

History & Basic Concepts

March 17, 2008

## History continued …

"Ideals" inherited through ♂,♀ flowers

Theophrastus (370-285 BC)

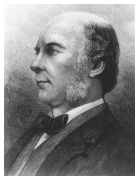
Hybrids intermediate "blending inheritance"

Linnaeus (1707-1778)

"blending inheritance" "pangenes in blood" "soft inheritance"

Darwin (1809 –1882)

## Francis Dalton (1822-1911), a cousin of Darwin



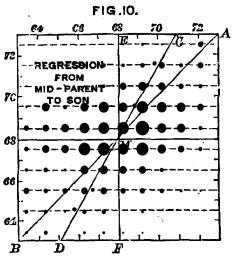
Disproved "pangenesis" through blood transfusion experiments with rabbits.

(The terms "blood relative", "full-blooded", and "royal blood" are relicts of pangenesis)

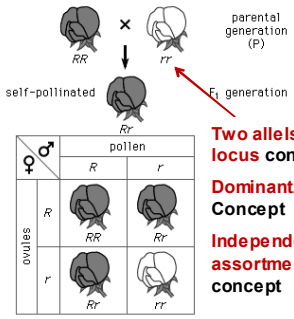
Disproved "blending inheritance" We see regression toward the mean, yet genetic variation is not destroyed over several generations – a paradox!

(That's where the term "regression analysis" comes from)

He understood "hardin heritance", i.e. no acquired traits are inherited.




## Gregor Mendel (1822-1884), a contemporary of Darwin & Dalton




Two alleles at one locus concept

Dominant/recessive Concept

Independent assortment concept

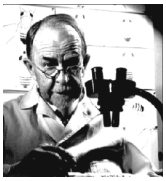
Described inheritance of discontinuous traits, but it was too odd and apparently not applicable to most traits to make an impact

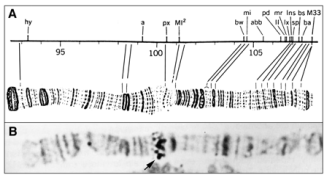
## Ronald A. Fisher (1890-1962)

- Mendelian genetics works for continuous (quantitative) traits too: R. A. Fisher. 1918. The correlation between relatives on the supposition of Mendelian inheritance.
- Developed a comprehensive mathematical theory of natural selections and evolution
- Invented statistics, and coined the terms variance & standard deviation along the way. (F in F test stands for Fisher)

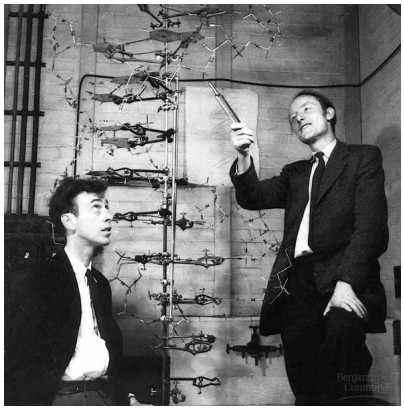
## Thomas H. Morgan (1866–1945)

- Thomas Hunt Morgan won the Nobel Prize in Medicine in 1933 for his chromosome theory of heredity.
- Actually, he was infamous for fighting the original idea by Theodor Boveri & Walter Sutton
- To disprove it, he and his students collected hundreds of mutants of the fruit fly (Drosophila), and discovered not only inheritance but also crossover & linkage on chromosomes
- They even came up with a genetic map of traits visible on giant polytene chromosomes






## Watson & Crick (1953)



- Nobel price in 1962 for discovery of DNA structure and function.
- They never did any hands-on research, just talked to a lot of people and put the pieces together!

## Powerful explanation for inheritance and evolution, but not everyone liked it …

- Lack of inheritance of acquired characteristics did not fit well with communist view of human nature.
- Trofim Lysenko (1898-1976), protégé of Stalin, and supported by Khrushchev ran the Soviet Union's plant breeding program into the ground with false theories of environmentally acquired inheritance.

## But we do know something about plants …

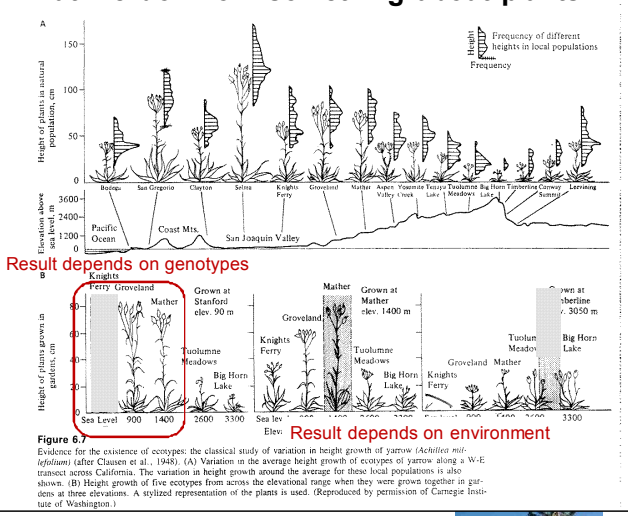



Figure 6.7
Evidence for the existence of ecotypes: the classical study of variation in height growth of yarrow (*Achillea millefolium*) (after Clausen et al., 1948). (A) Variation in the average height growth of ecotypes of yarrow along a W-E transect across California. The variation in height growth around the average for these local populations is also shown. (B) Height growth of five ecotypes from across the elevational range when they were grown together in gardens at three elevations. A stylized representation of the plants is used. (Reproduced by permission of Carnegie Institute of Washington.)

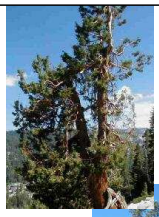
## Macroevolution - Microevolution

Domains
Kingdoms
Phyla
Classes
Orders
Families
Species
Subspecies
Races
Varieties
Ecotypes
Clines

**Evolution & Taxonomy**

**Population Genetics & Plant Breeding**

## Subspecies



- Usually used for geographically isolated populations of a species
- Visibly different
- Still capable of interbreeding

(i.e. an evolutionary speciation process not quite complete)


Lodgepole pine

## Race

- Synonymous (in a biological sense). Subspecies implies "formal recognition" by the taxonomic community

## Varieties


Bred: Flower color

- Naturally occuring (or bred)
- Visibly different in a minor trait
- Still capable of interbreeding
- Usually not geographically isolated

(i.e. simply an easily recognizable instance of genetic variation within a population)

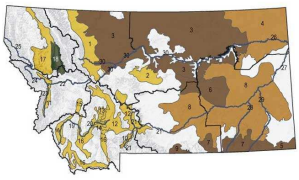


Natural: *Alnus rubra* var. *pinnatisecta*

## Ecotype

- Usually used for at least somewhat geographically isolated populations of a species
- Physiologically different (e.g. adapted to different environments)
- Limited geneflow among disjunct populations

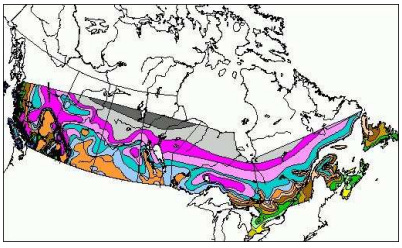
(i.e. early stages of an evolutionary speciation process)



## Clines

- Individuals adapted to conditions along an environmental gradient within the range of a species
- Not geographically isolated (geneflow along the environmental gradient)

(i.e. not on the path to speciation)



## Review Questions

- What are the contributions of Dalton, Mendel, Fisher, Morgan, and Watson & Crick to genetics?
- What is a plant *subspecies, variety, ecotype,* and *cline*.
- How is a plant population defined?
- Explain the terms *genotype* and *phenotype*
- Explain the terms *mendelian trait* and *quantitative trait*
- How can you measure genetic variation?
- What is a *provenance trial* or *common garden study*?
- What are the limitations of such genetic trials?
- If someone tells you that they "discovered a gene" that controls a complex trait (e.g. yield in a crop species or height in a tree), what questions would you ask to find out if that is really a relevant discovery?

## Self Study (Chapter 13)

- If you are not familiar what exactly is meant and is the difference between: *DNA & RNA, chromosome & genome, diploid & polyploid, genes & alleles, dominant & recessive, homozygous & heterozygous*, do review pages 226-242 of Chapter 13 (10th Edition) - basically high school level genetics. Otherwise, start with "Quantitative Traits" on page 243.