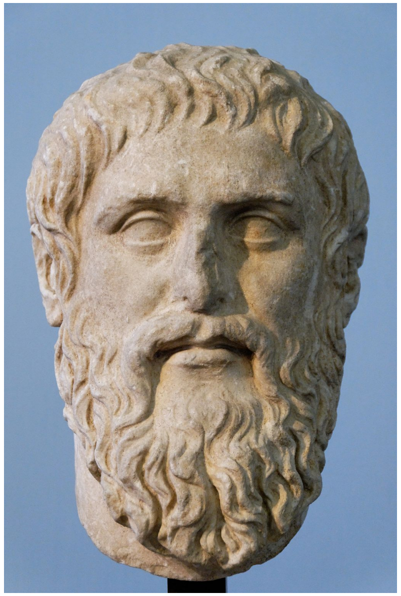
Aristotle’s Ladder

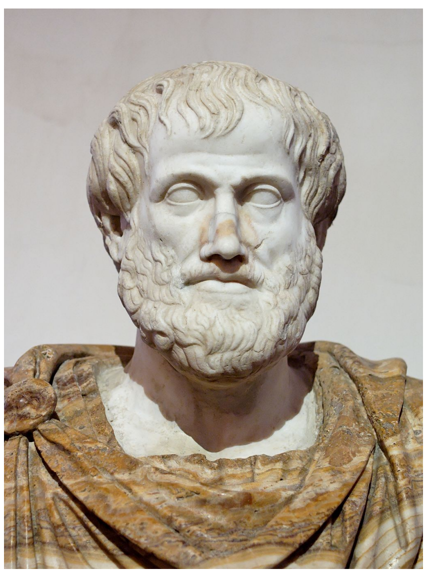
= Special Creation

The Greeks



Plato: **"Typological Thinking"**

1. **Every species = one "type".**
2. **Variations in a species = unimportant.**
3. **Types never change.**



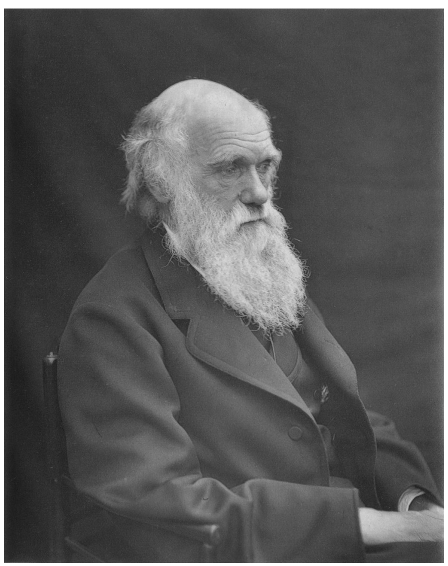
Aristotle agreed with Plato … plus his new idea: **"Chain of Being"**

1. **Species = rankable: simple to complex.**
2. **Humans are at the top of the ladder.**

The “Geeks”

Lamarck: **“Inheritance of Acquired Characters”**

1. **Phenotypes change due to environ.**
2. **Changes get passed on to children.**
3. **Species climb Aristotle’s Ladder.**



Darwin: **“Population Thinking”**

1. **Individuals vary within a population.**
2. **Nature selects “fittest” ones to survive.**
3. **Populations evolve (change over time).**

Misconception	Example
"Evolutionary change occurs in organisms" -- Lamarck CORRECTION: -- Darwin • Natural selection just sorts existing variants in organisms; it doesn't change them • Evolutionary change occurs only in populations • Acclimatization ≠ adaptation Selection does not cause neck length to increase in individual giraffes, only in populations	

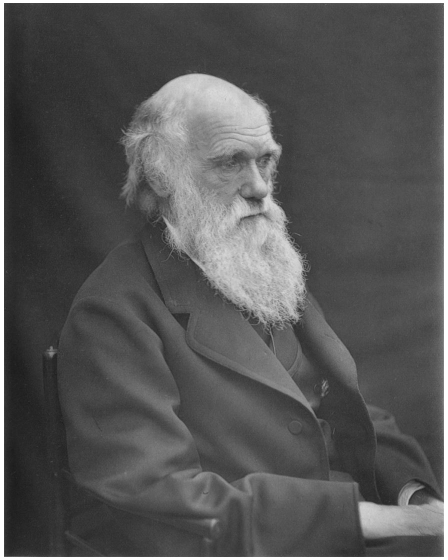
Lamarck: "Inheritance of Acquired Characters"

1. ~~Phenotypes change due to environ.~~
2. ~~Changes get passed on to children.~~
3. ~~Species climb Aristotle's Ladder.~~

Why Lamarck's Theory was flawed:

- Gemmules do not exist, but genes do.
- Genes are not affected by somatic events.

- Suntans are not inherited. **Duh!**
- Children of amputees still have their legs. **Duh!**
- Jewish boys still have to get circumsized. **Duh!**



Darwin: **"Population Thinking"**

1. **Individuals vary within a population.**
2. **Nature selects "fittest" ones to survive.**
3. **Populations evolve (change over time).**

Why Darwin's Theory has stood the test of time:

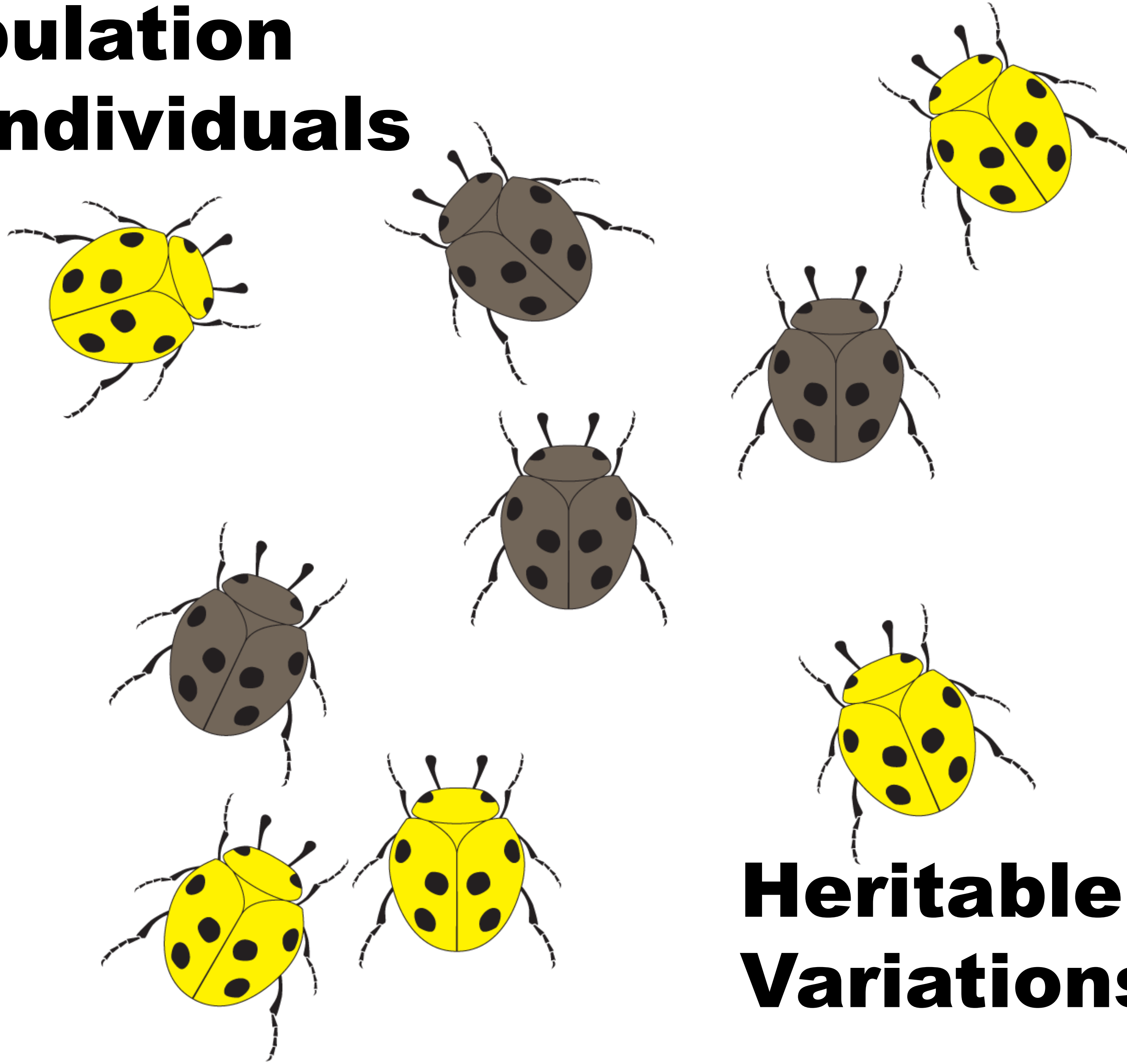
- **Experiments.**
- **Fossils.**
- **Biogeography.**
- **Embryology.**
- **Comparative anatomy.**
- **Vestiges.**
- **Artificial selection.**
- **Embryology.**
- **DNA homology.**
- **Comparative genomics.**


Artificial Selection ≈ Natural Selection



Cocker Spaniel
Basset Hound
Collie
German Shepherd
Chihuahua
Pekingese
Old English Sheepdog
Poodle
Boxer

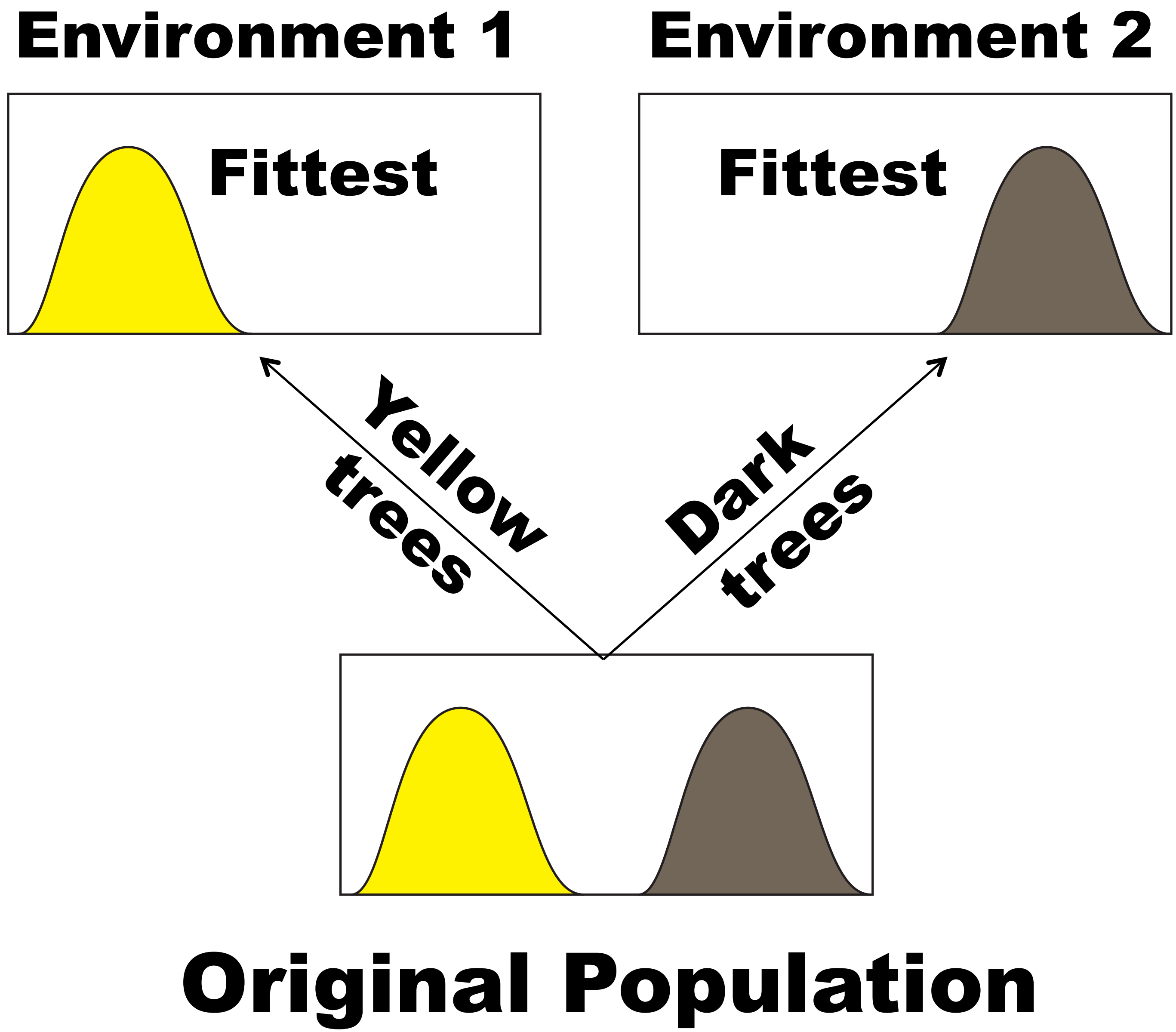
Population of individuals

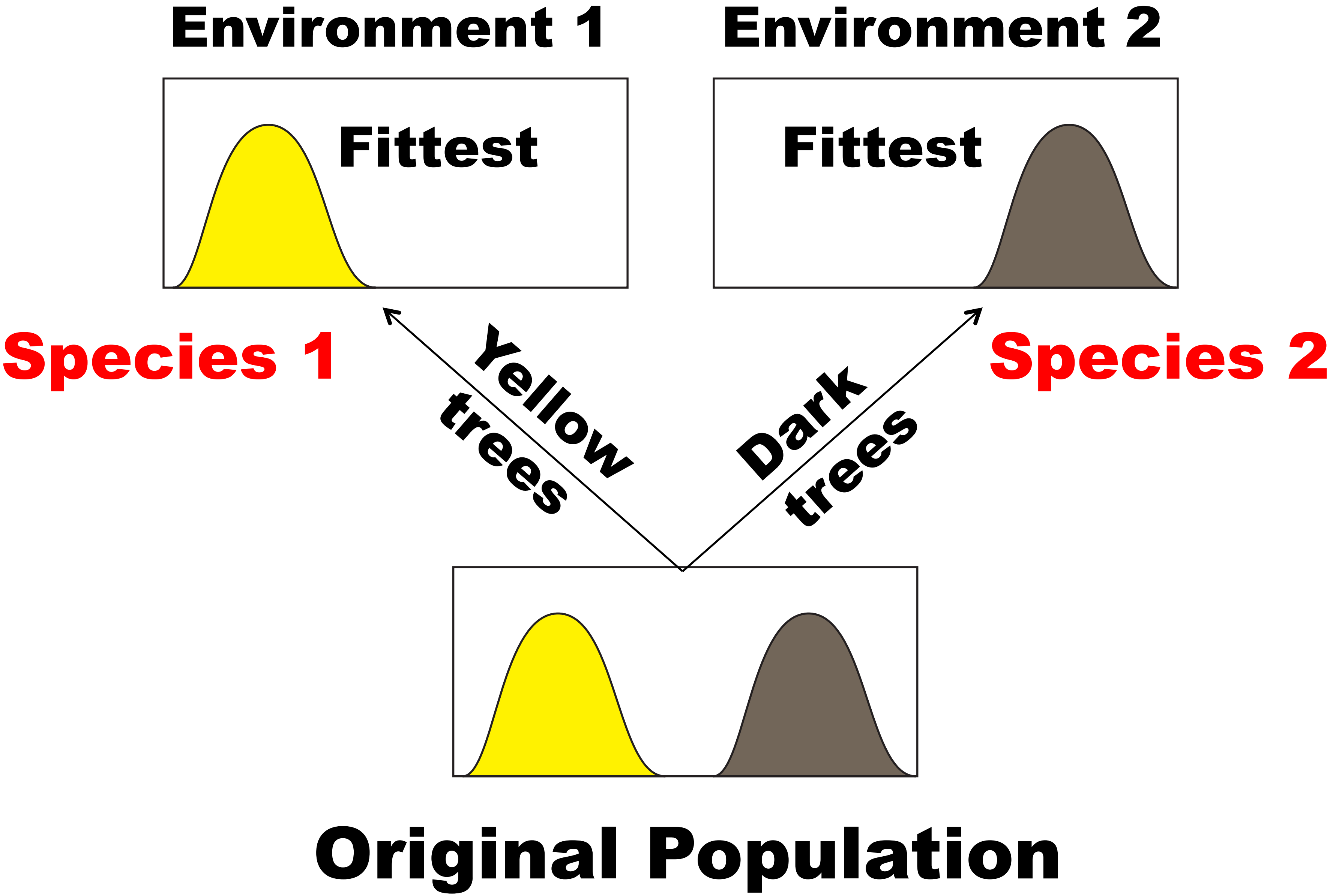


Heritable Variations

Natural Selection

Natural Selection


Environment 1
Environment 2
Fittest
Fittest
Yellow trees
Dark trees
Original Population


Environment 1
Environment 2
Fittest
Fittest
Species 1
Species 2
Yellow trees
Dark trees
Original Population

Heredity (2005) 94, 217–228

www.nature.com/hdy

Local adaptation in the rock pocket mouse (*Chaetodipus intermedius*): natural selection and phylogenetic history of populations

HE Hoekstra, JG Krenz[1] and MW Nachman
Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721, USA

Elucidating the causes of population divergence is a central goal of evolutionary biology. Rock pocket mice, *Chaeotdipus intermedius*, are an ideal system in which to study intraspecific phenotypic divergence because of the extensive color variation observed within this species. Here, we investigate whether phenotypic variation in color is correlated with local environmental conditions or with phylogenetic history. First, we quantified variation in pelage color ($n = 107$ mice) and habitat color ($n = 51$ rocks) using a spectrophotometer, and showed that there was a correlation between pelage color and habitat color across 14 sampled populations ($R^2 = 0.43$). Analyses of mtDNA sequences from these same individuals revealed strong population structure in this species across its range, where most variation (63%) was partitioned between five geographic regions. Using Mantel tests, we show that there is no correlation between color variation and mtDNA phylogeny, suggesting that pelage coloration has evolved rapidly. At a finer geographical scale, high levels of gene flow between neighboring melanic and light populations suggest the selection acting on color must be quite strong to maintain habitat-specific phenotypic distributions. Finally, we raise the possibility that, in some cases, migration between populations of pocket mice inhabiting different lava flows may be responsible for similar melanic phenotypes in different populations. Together, the results suggest that color variation can evolve very rapidly over small geographic scales and that gene flow can both hinder and promote local adaptation.
Heredity (2005) **94,** 217–228. doi:10.1038/sj.hdy.6800600
Published online 3 November 2004

Keywords: adaptation; *Chaetodipus*; color; gene flow; phenotypic variation; phylogeography

Before Charlie became famous …

He failed as pre-med student.

He failed at Divinity School.

He felt like running away.

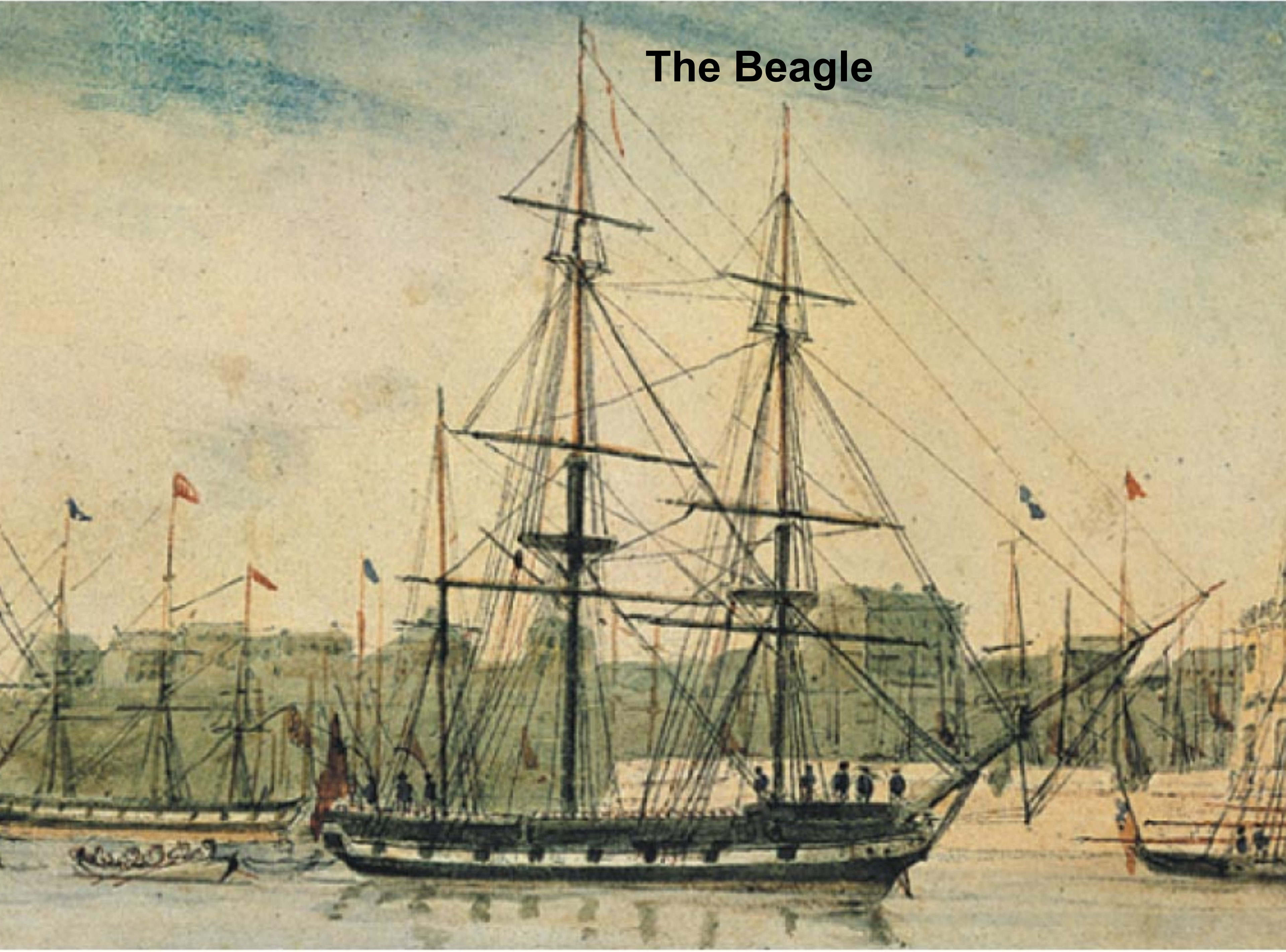
So he took a “road trip”.

Voyage of the Beagle 1831-36.

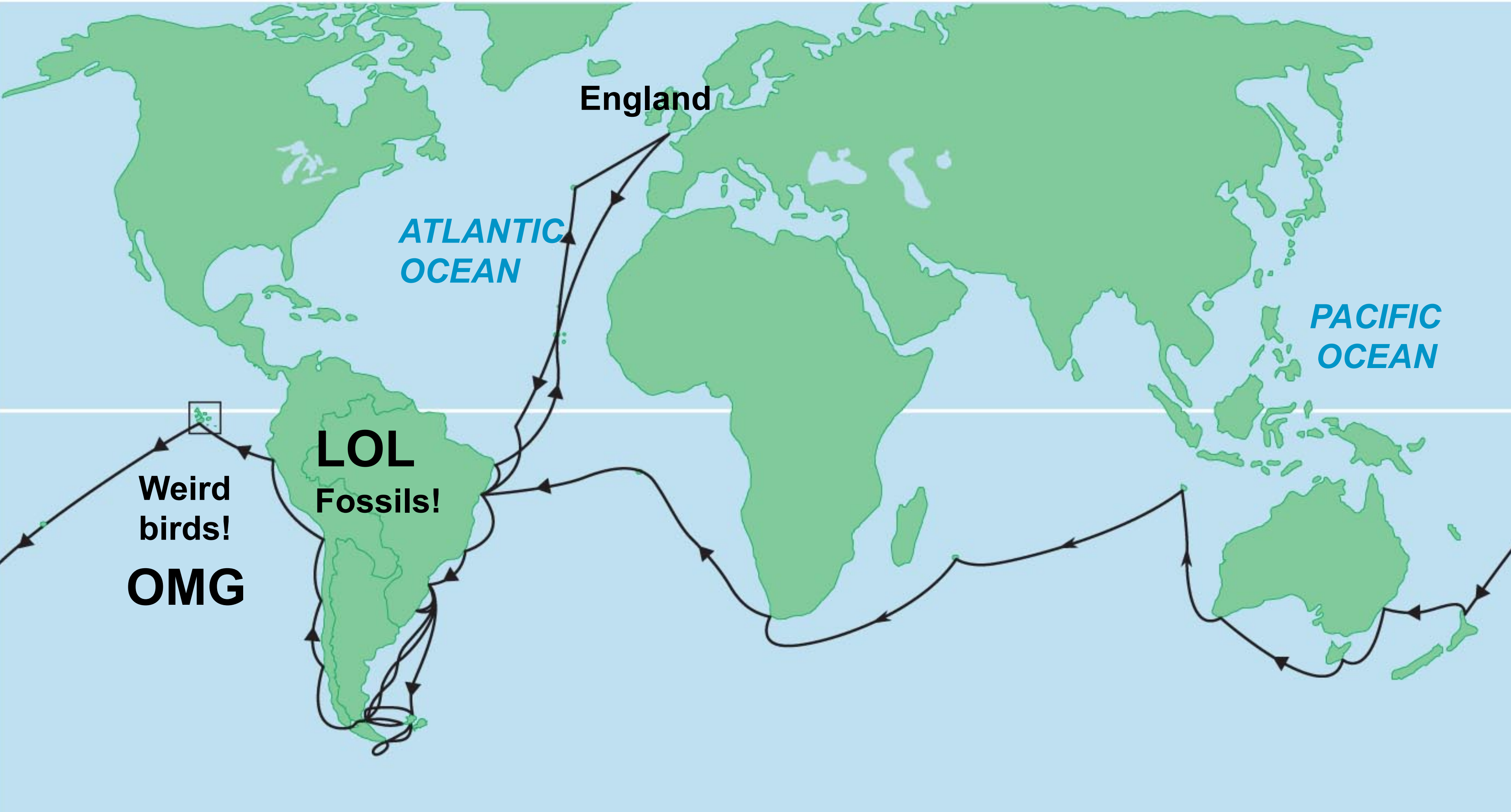
It changed his life … & ours.

1840 (age 31)

The Beagle



The Voyage of the Beagle (1831-36)




The Galápagos Islands
PACIFIC OCEAN
Pinta
Genovesa
Marchena
Equator
Santiago
Daphne Islands
Fernandina
Pinzón
Isabela
Santa Cruz
Santa Fe
San Cristobal
0
40 km
0
40 miles
Florenza
Española

Fig. 13-11a-2

Speciation

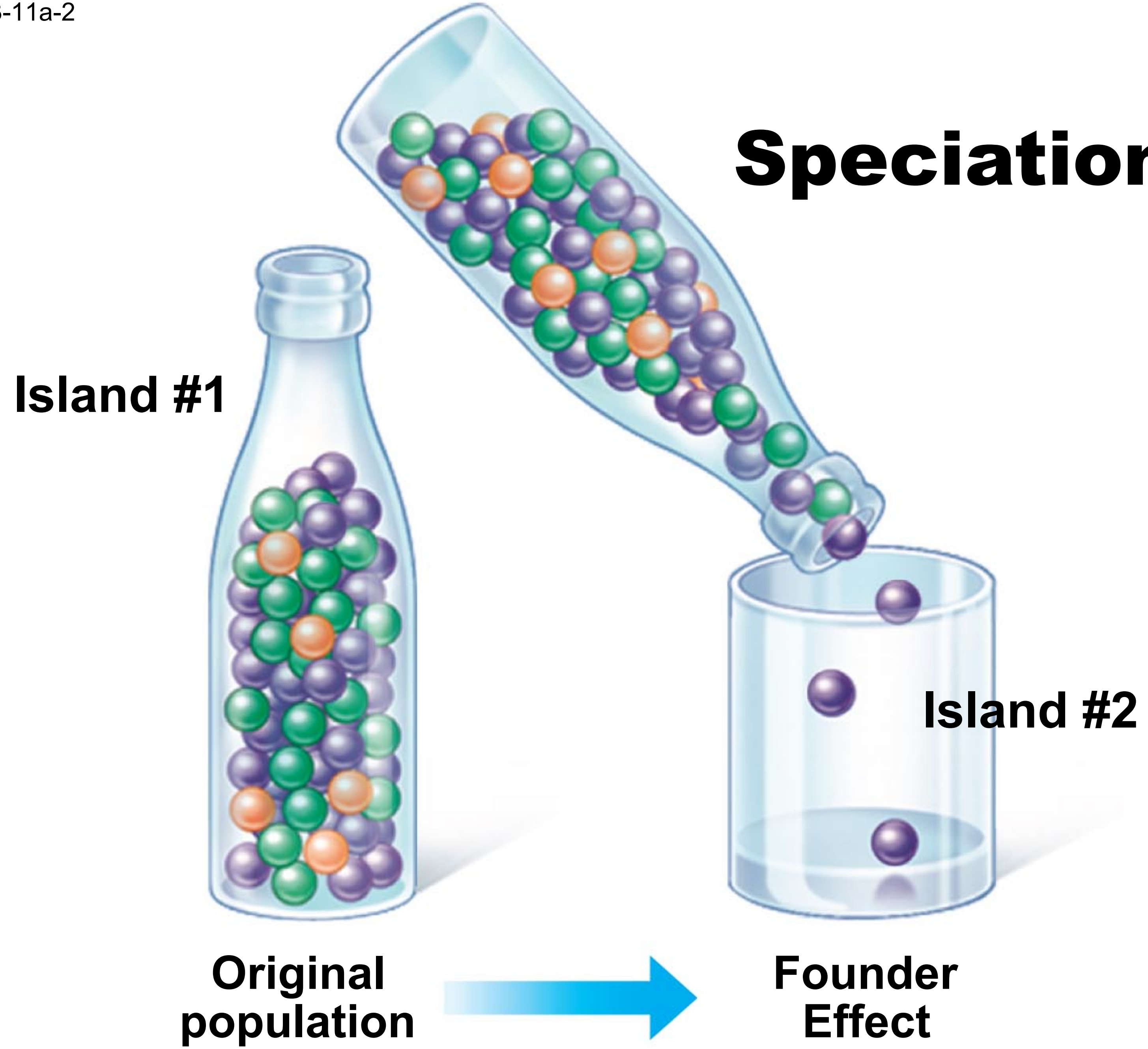
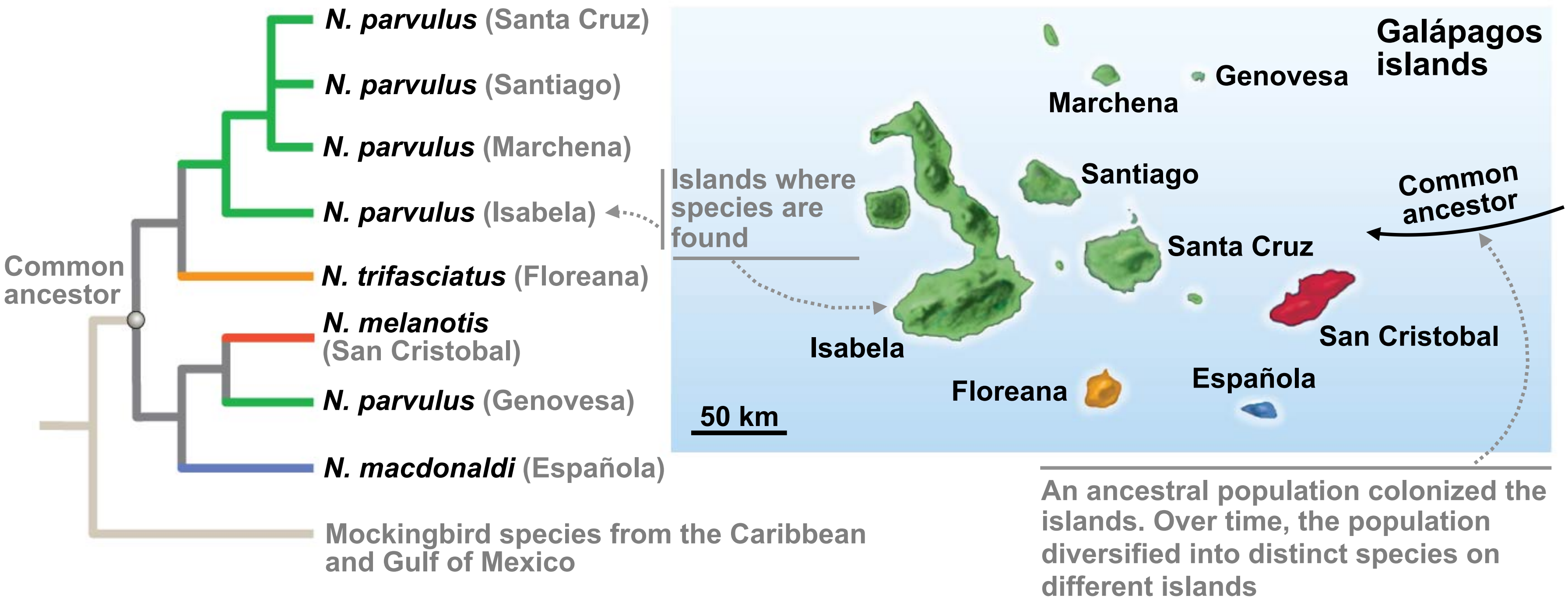


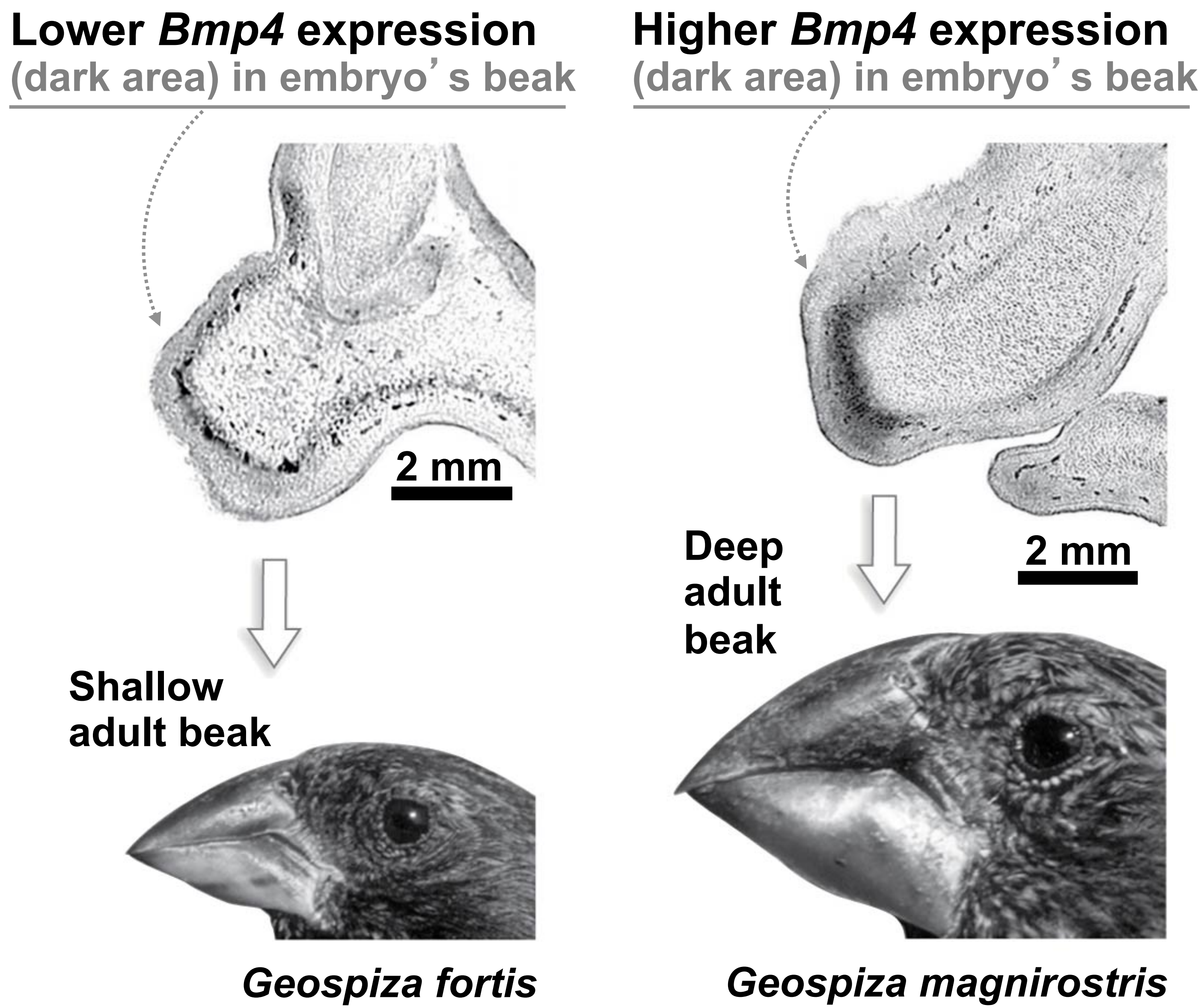
Figure 25.6

(a) **Pattern:** Although the Galápagos mockingbirds are extremely similar, distinct species are found on different islands.

(b) Recent data support Darwin's hypothesis that the Galápagos mockingbirds share a common ancestor.



Genetics explains Development, which explains Evolution



Powerful Principles of Evolution

1. Descent with modification → homology.

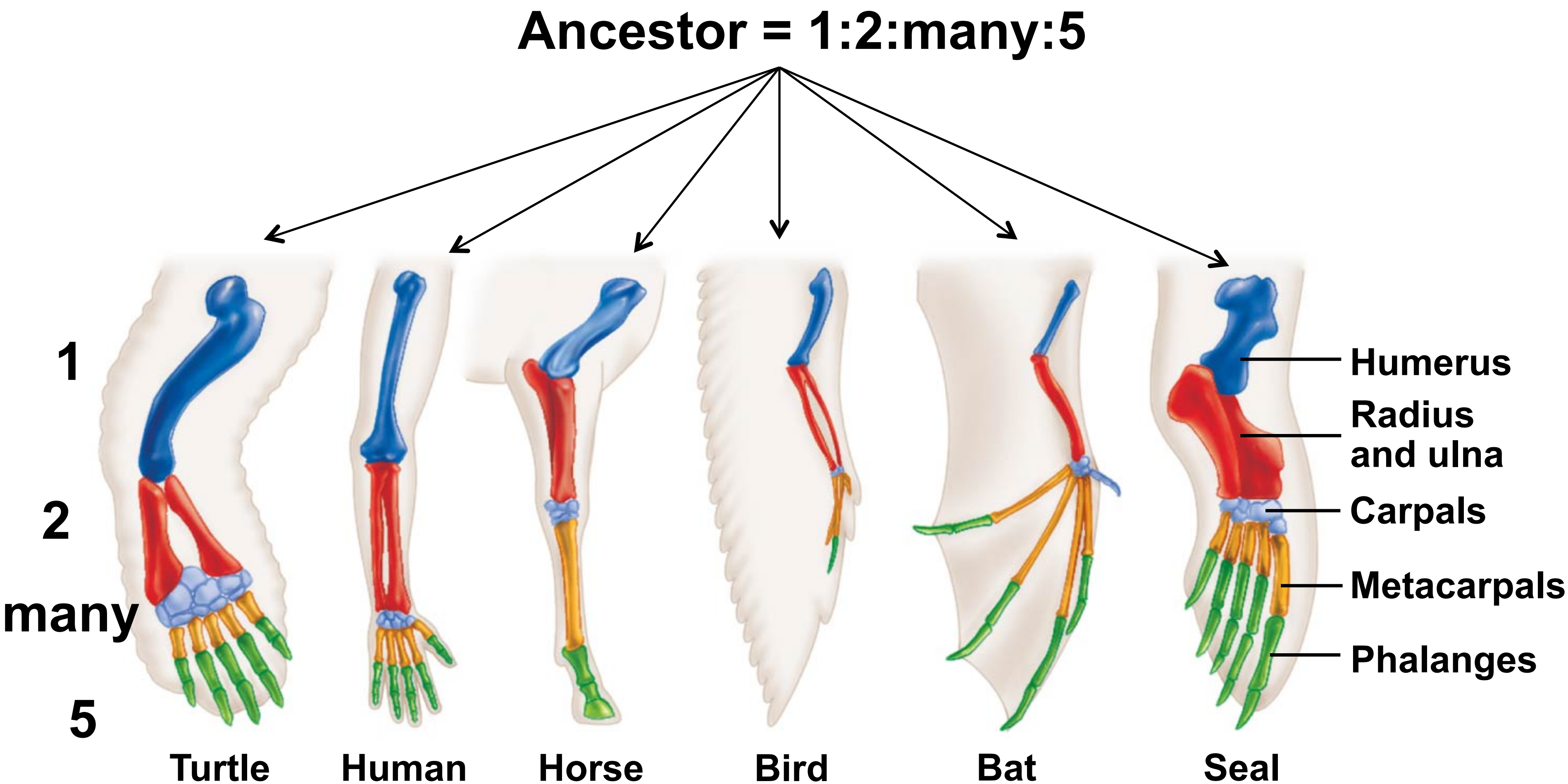
2. Old structures can adopt new functions.

3. Ontogeny recapitulates phylogeny.

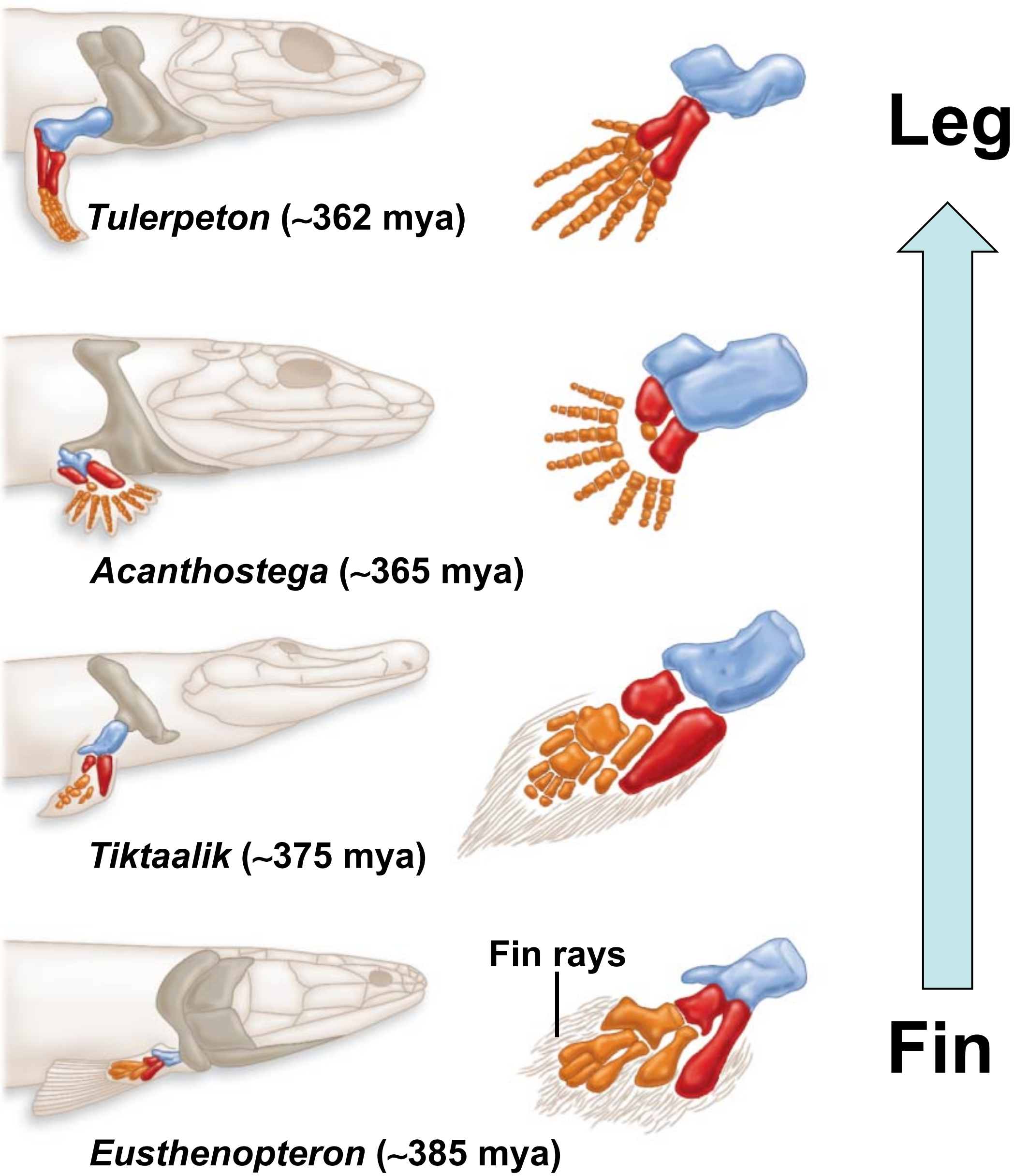
4. Evolution tinkers. It is not an Engineer.

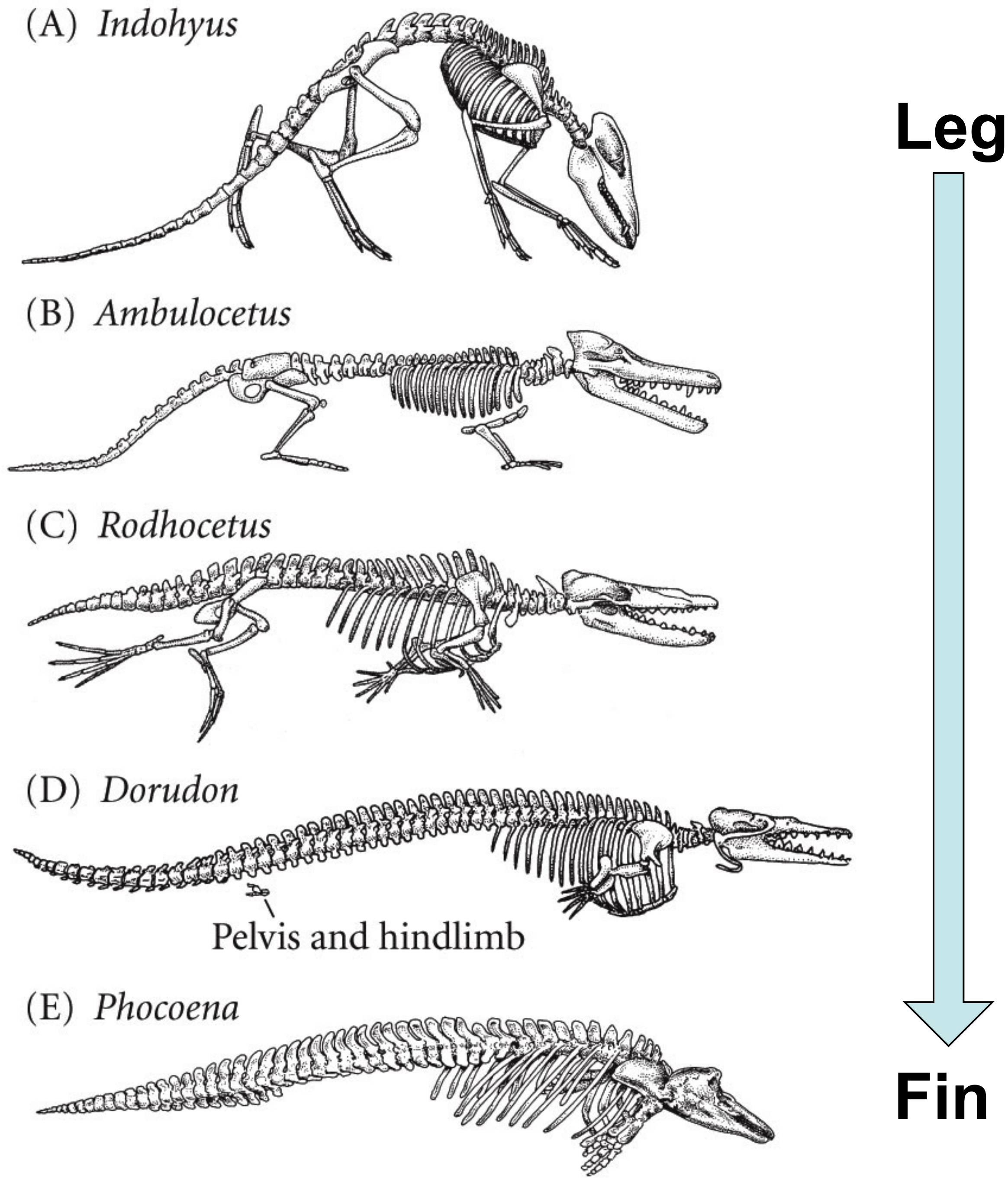
5. Heterochrony explains human evolution.

1. Descent with modification → homology.



2. Old structures can adopt new functions.



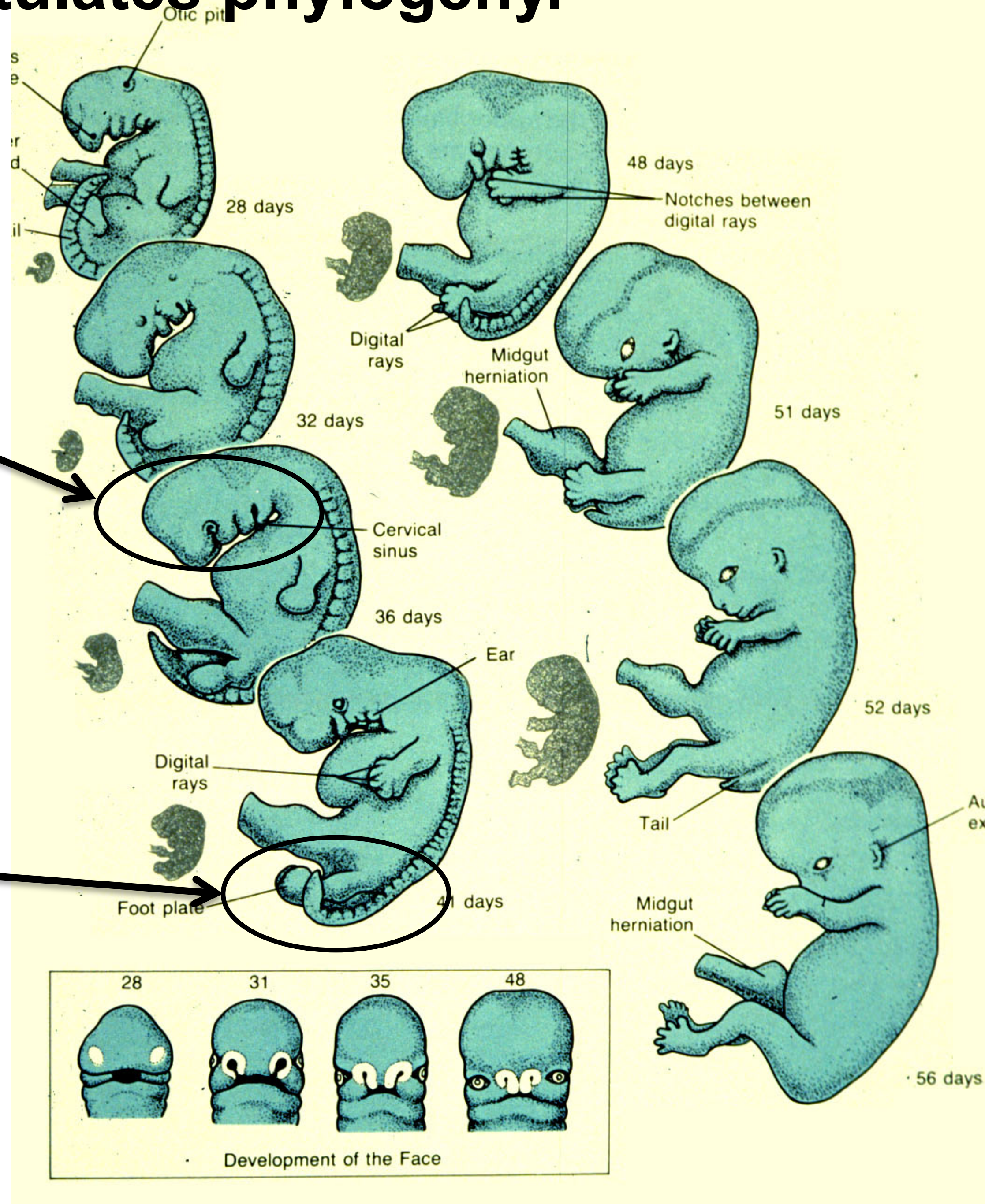


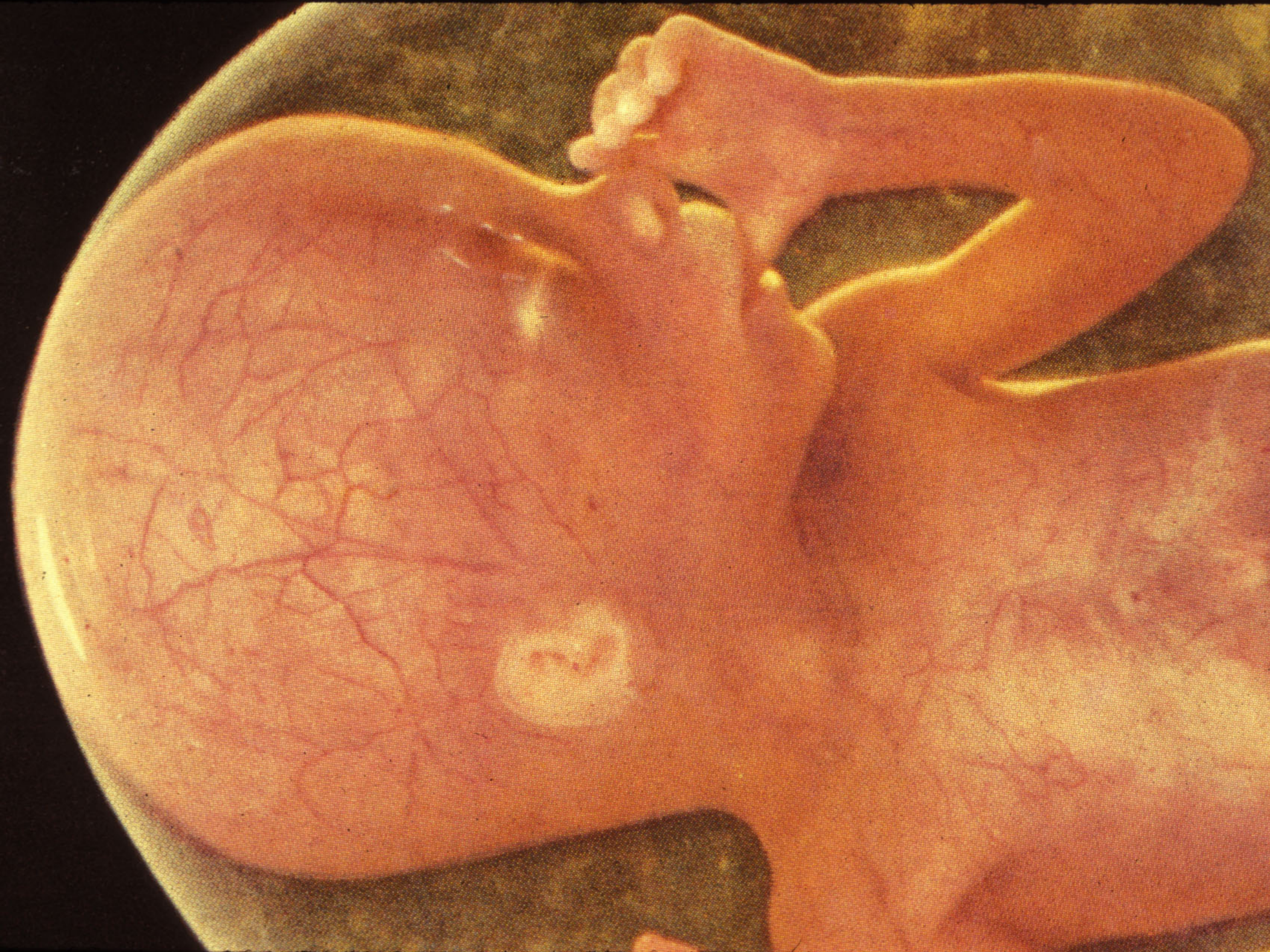
EVOLUTION 2e, **Figure 4.11**

3. Ontogeny recapitulates phylogeny.

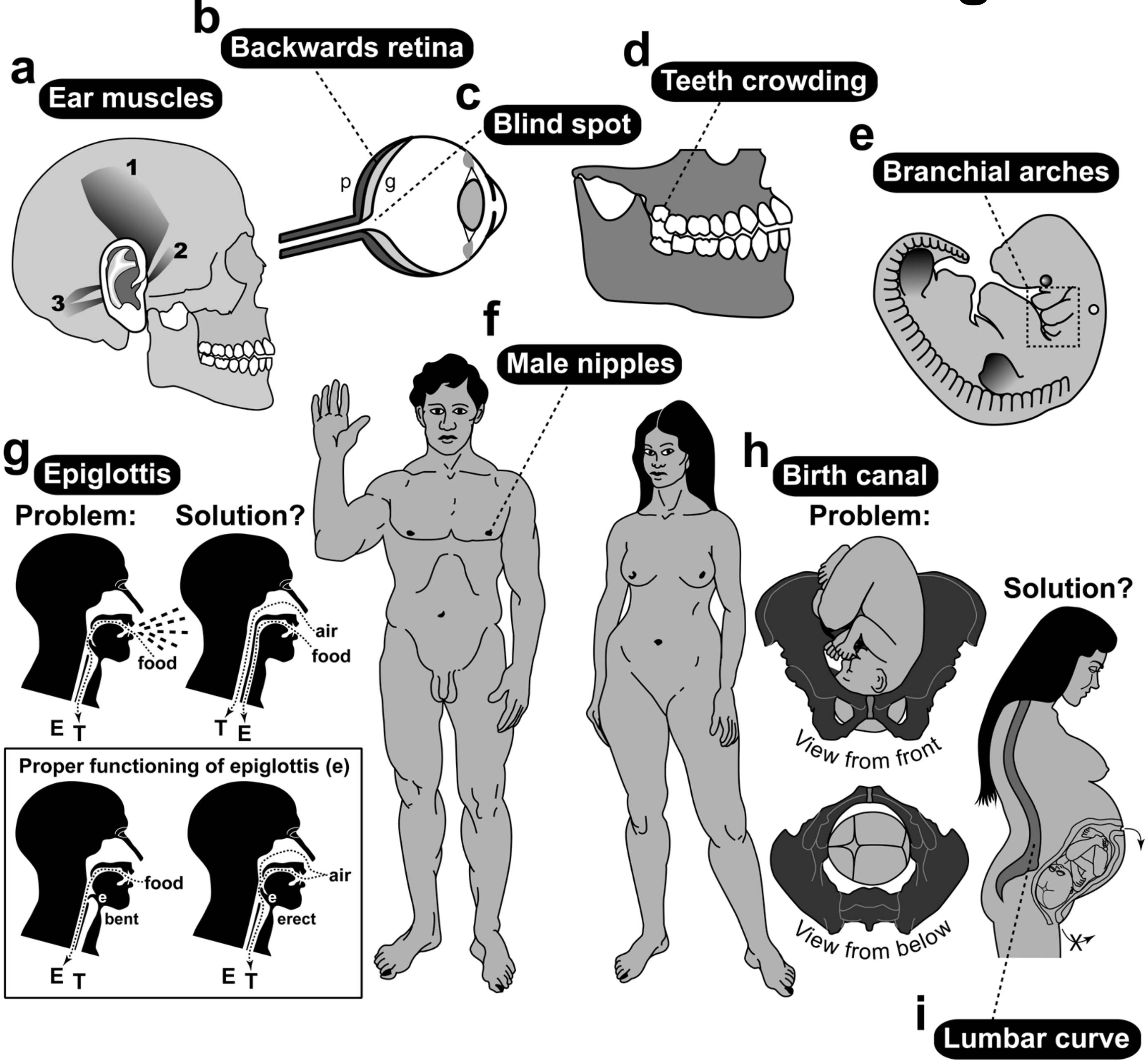
Gill slits (like a fish)

Tail (like a monkey)

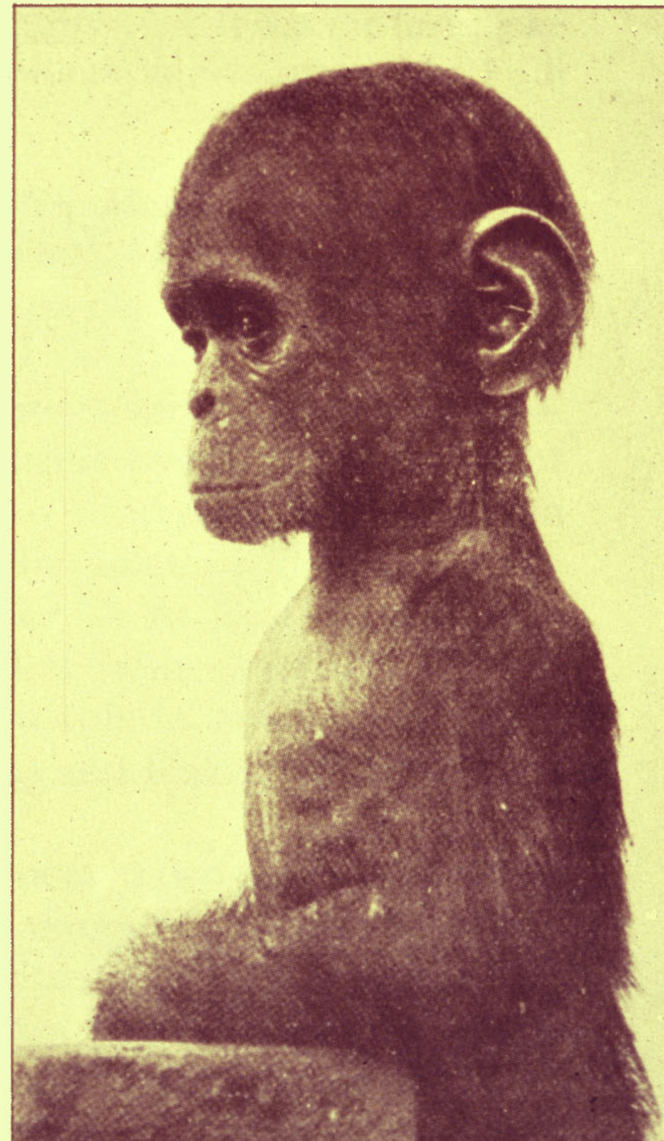


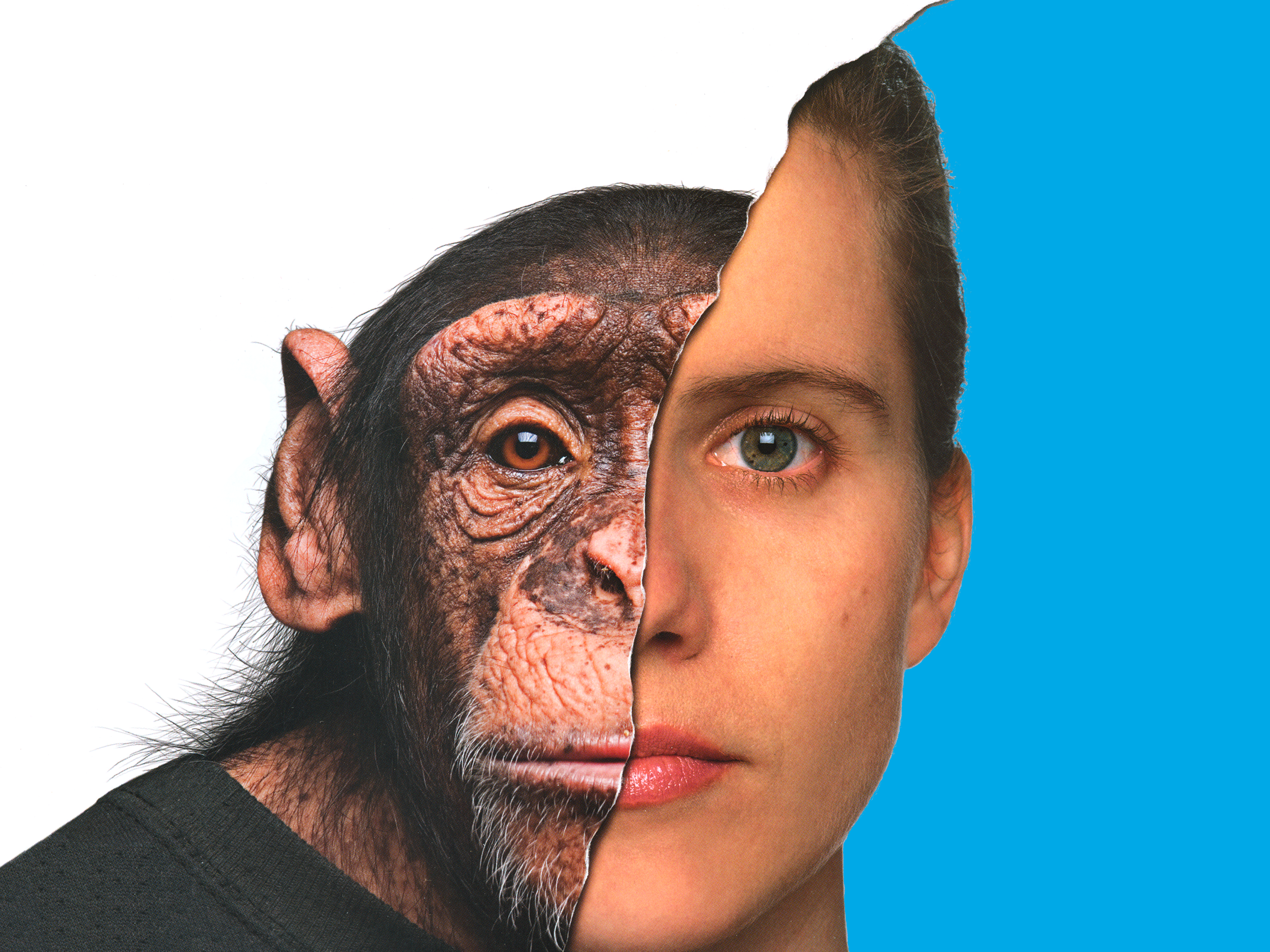


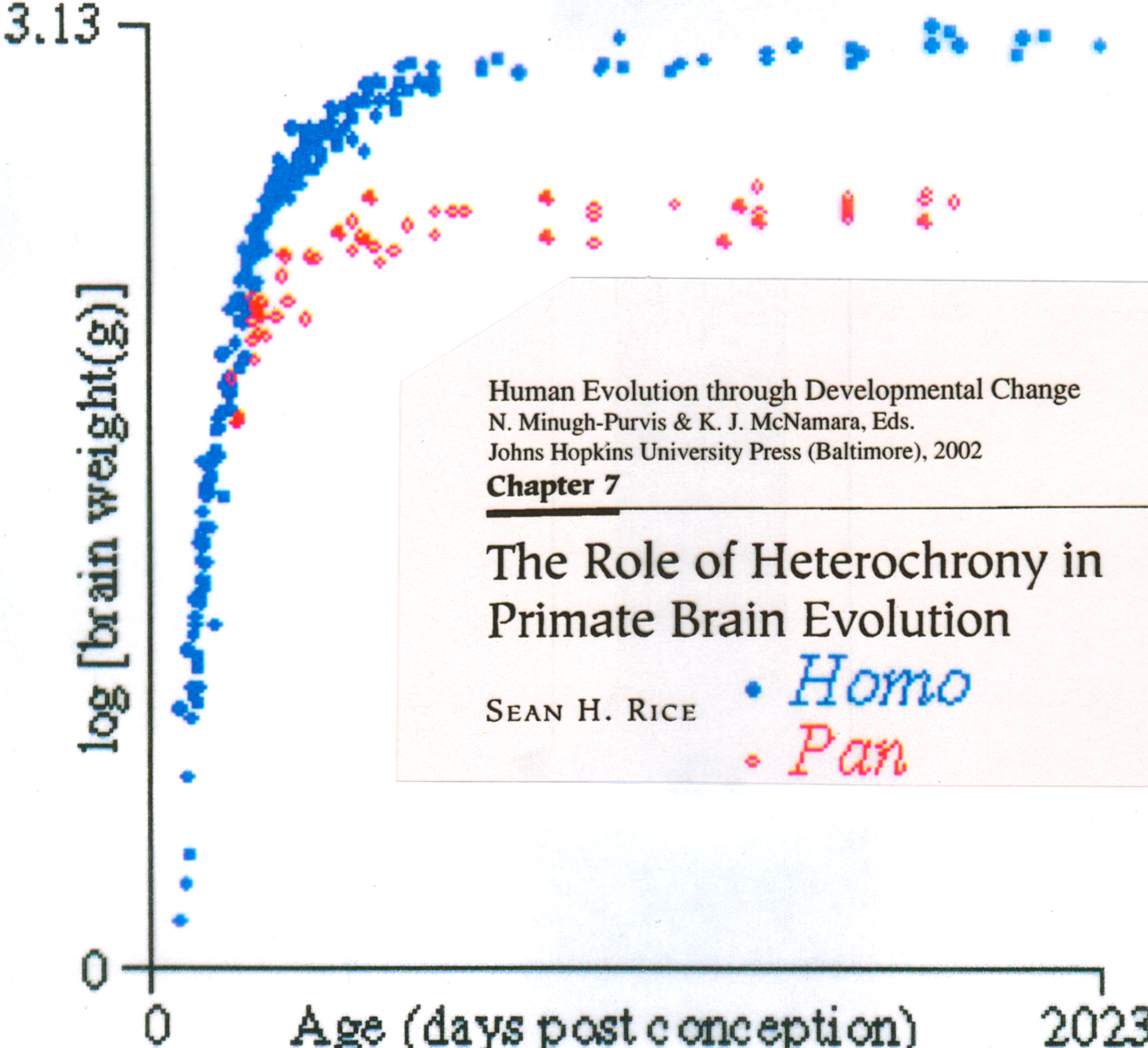
4. Evolution tinkers. It is not an Engineer.



5. Heterochrony explains human evolution.





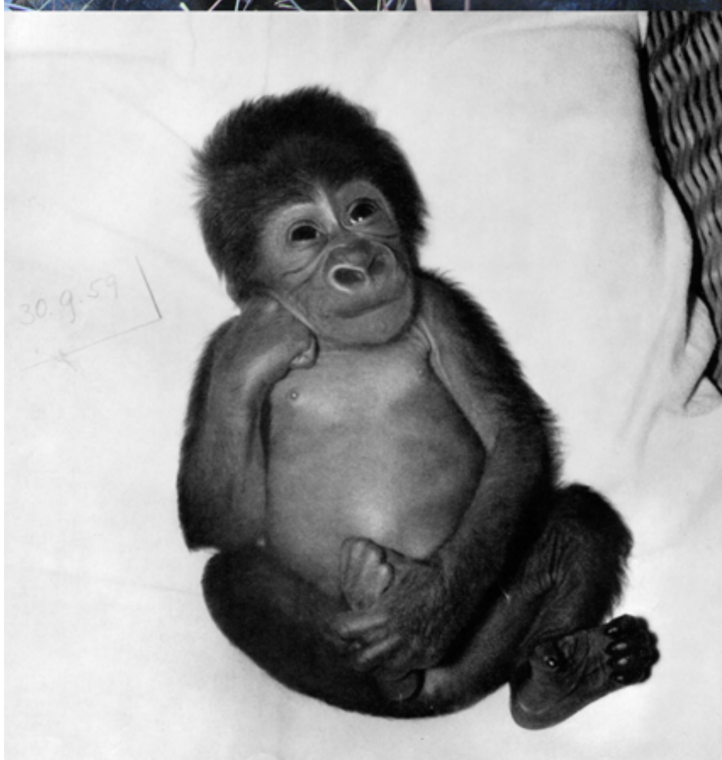


Human Evolution through Developmental Change
N. Minugh-Purvis & K. J. McNamara, Eds.
Johns Hopkins University Press (Baltimore), 2002

Chapter 7

The Role of Heterochrony in Primate Brain Evolution

SEAN H. RICE


30.9.59

The history of evolution is written in our genomes!