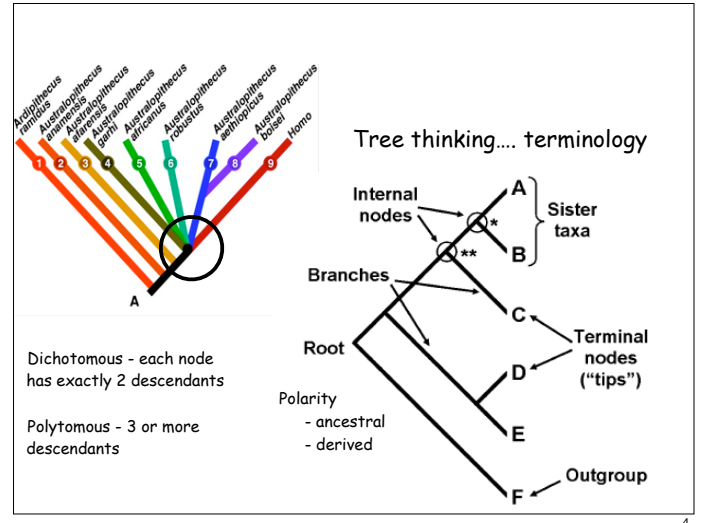


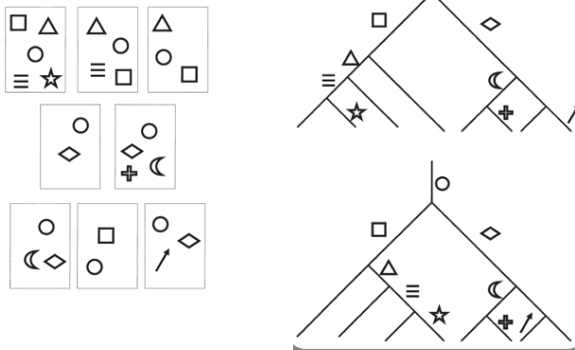
Tracing Phylogeny

1



4

The 'Great Clade Race'



2

Characters: morphology or molecular

Method: discrete (Cladistics) or distance (Phenetics)

"Phylogenetic Systematics"
Willi Hennig 1966

"Principles of Numerical Taxonomy"
Sokal & Sneath 1963

Implementation: Parsimony, Maximum Likelihood, Bayesian Inference

Algorithm: Fitch, Dollo, Wagner, Generalized

Strategy: exhaustive, branch-and-bound, heuristic

$t = 3 \Rightarrow 3$ possible trees

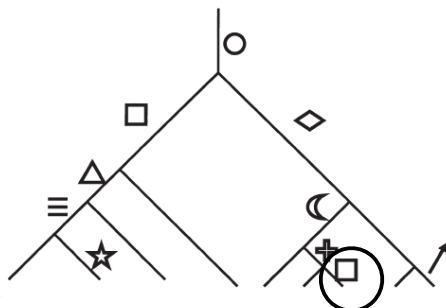
$t = 4 \Rightarrow 15$

$t = 10 \Rightarrow 2$ million

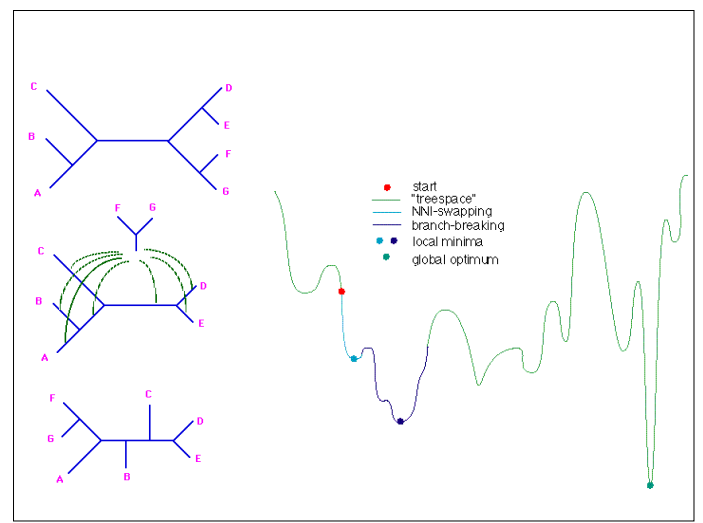
$(2t - 5)! / [2^{t-3} (t-3)!]$ for $t \geq 1$
(Cavalli-Sforza & Edwards 1967)

5

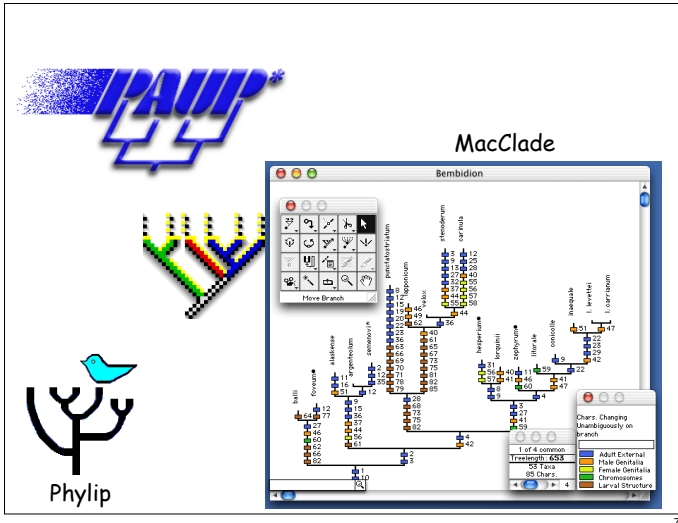
Parsimony principle
(extension of Occam's Razor)



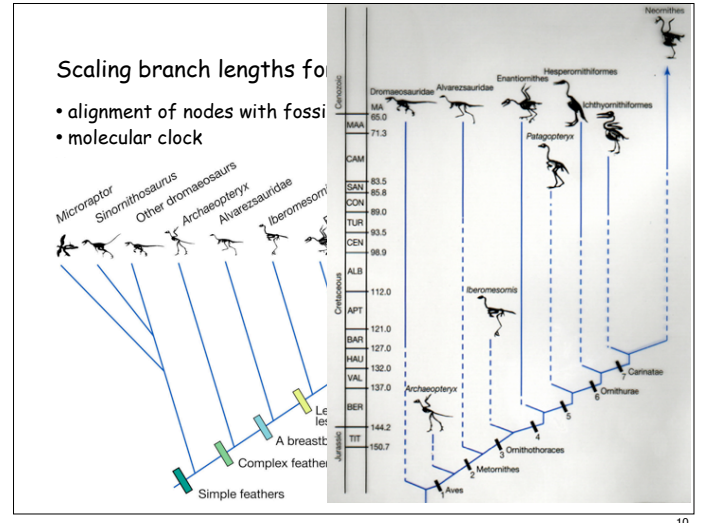
3



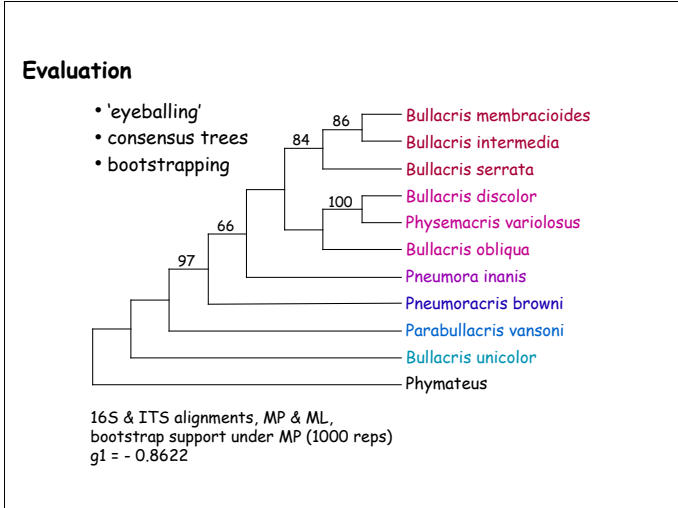
6



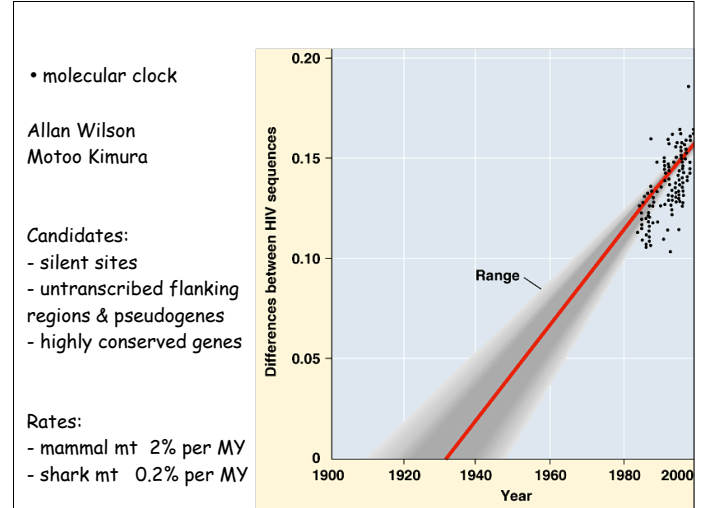
7



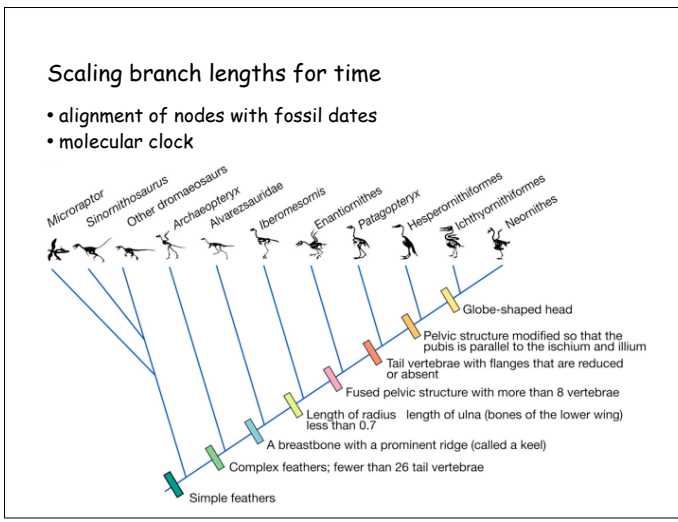
10



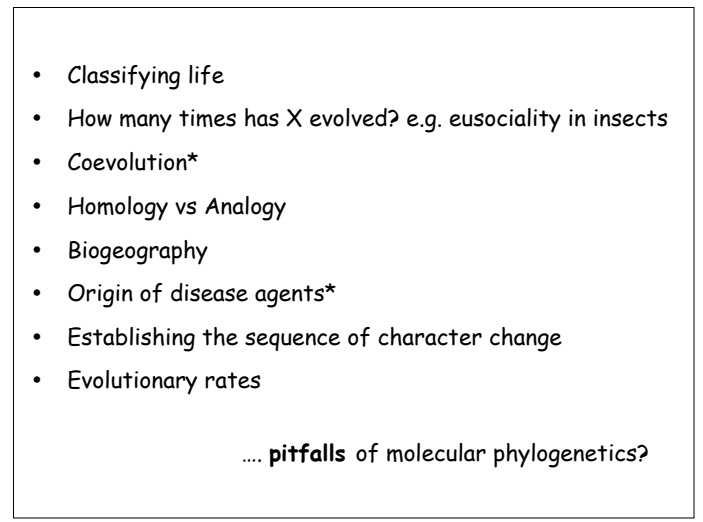
8



11



9



12

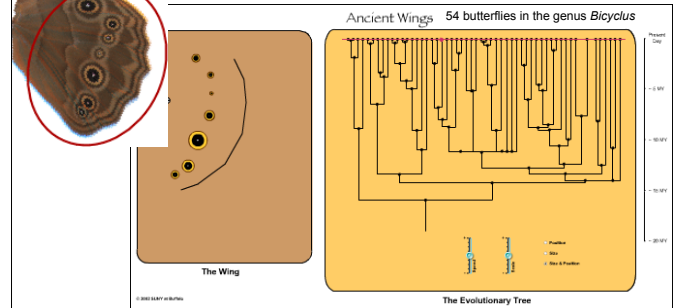
e.g. Coevolution



Attine ants

13

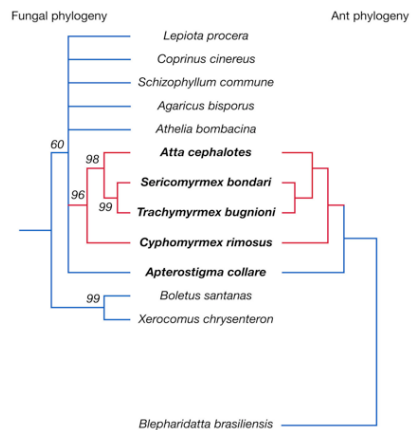
Ancient Wings



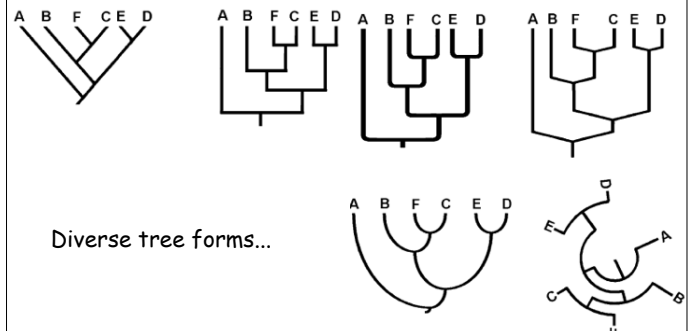
<http://www.arachnology.org/monteiro/flash/>

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Prediction:
congruent phylogenies



14

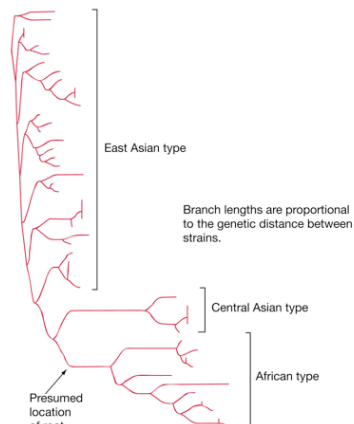


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Origin of disease agents

Yersinia pestis

6th century - Africa
14th - Central Asia
17th - China

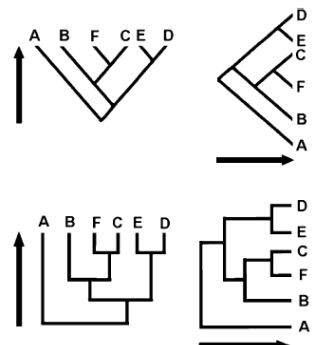


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How not to read evolutionary trees

Misconception #1:
Higher and Lower

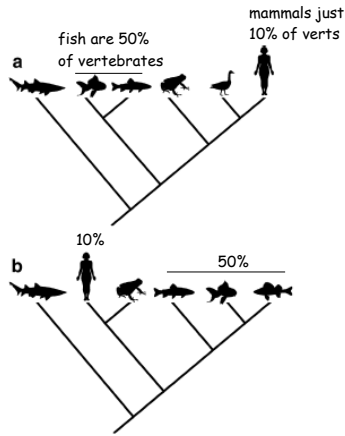
modern species
Direction of time
earliest ancestor



18

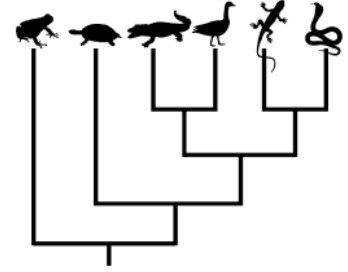
Misconception #2: Main Line & Side Tracks

There are no "main lines" or
"side tracks" in evolution



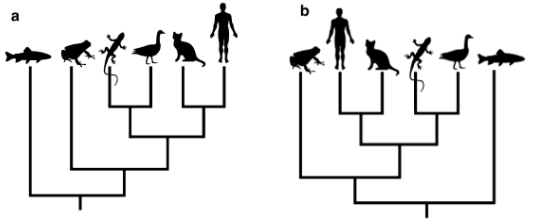
19

Misconception #4: Similarity versus Relatedness



22

Misconception #3: Reading across the Tips

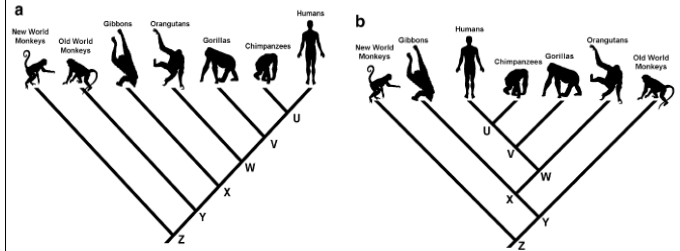


Is the frog more closely
related to the fish or the
human?

The order of terminal nodes
is meaningless!

20

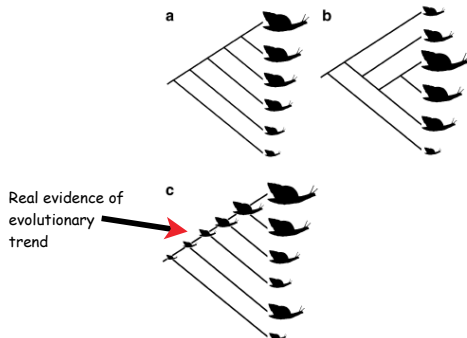
Misconception #5: Sibling versus Ancestor



unbalanced, rightladderized tree

23

Evolutionary trends **cannot** be identified by reading across the tips.

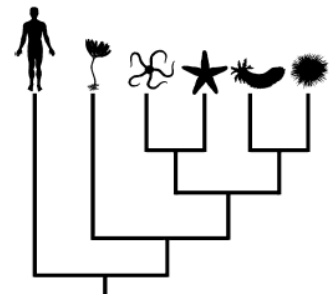


Real evidence of
evolutionary
trend

21

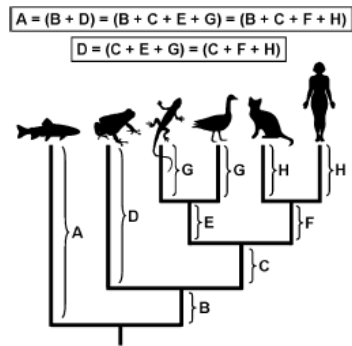
Misconception #6: Long Branch Implies no Change (or "Less Diverse Equals Basal Equals Ancestral")

Out-group is not
"more primitive"



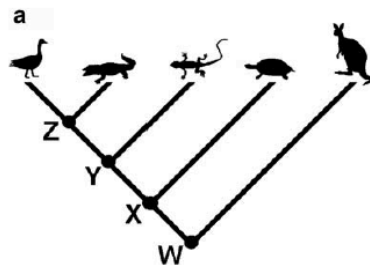
24

Misconception #7:
Different Lineage
Ages for Modern
Species



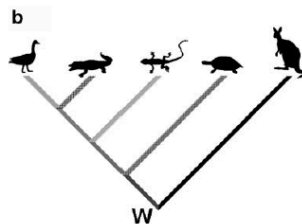
25

Misconception #8:
Backwards Time Axes

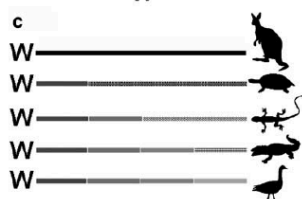


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Misconception #9:
More Intervening
Nodes Equals More
Distantly Related



Misconception #10:
Change Only at
Nodes



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