

Molecular Apomorphy

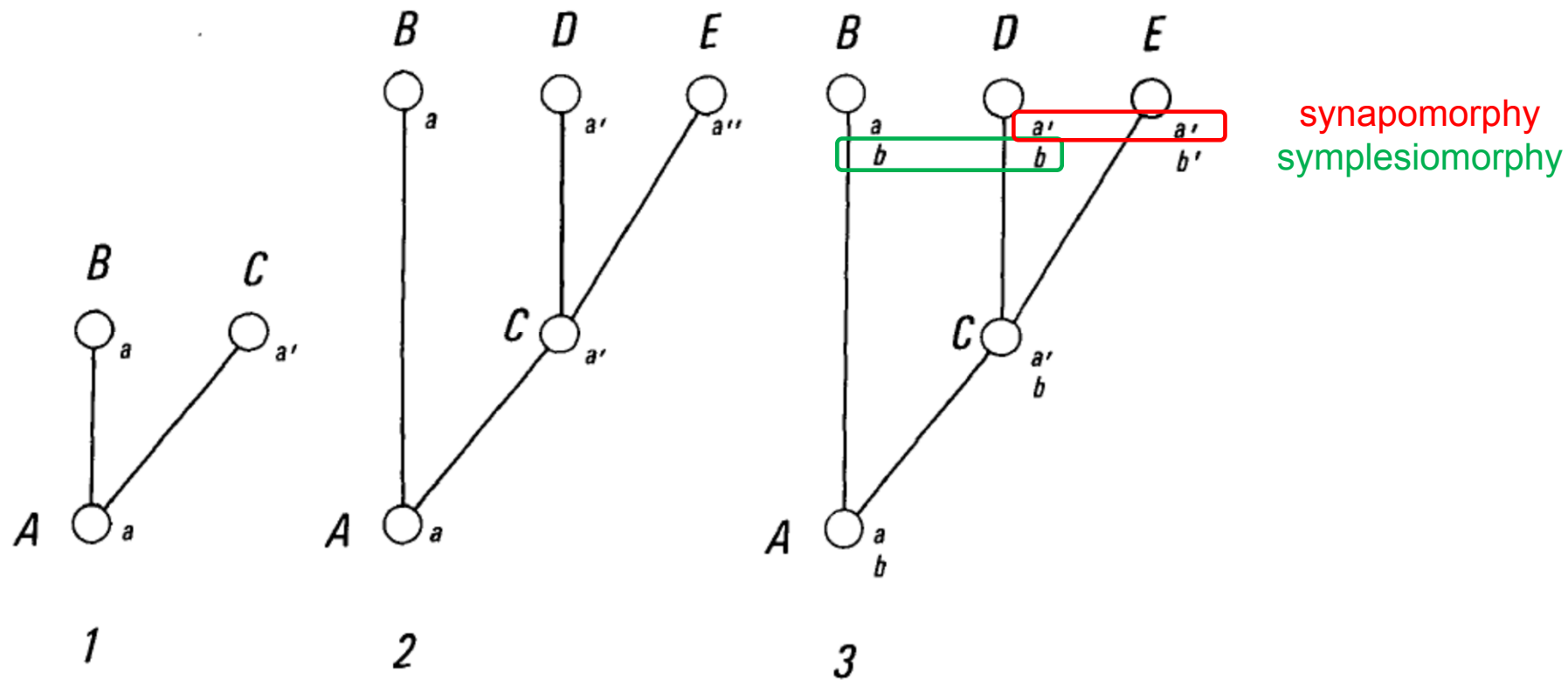
The lost part in molecular phylogenetics

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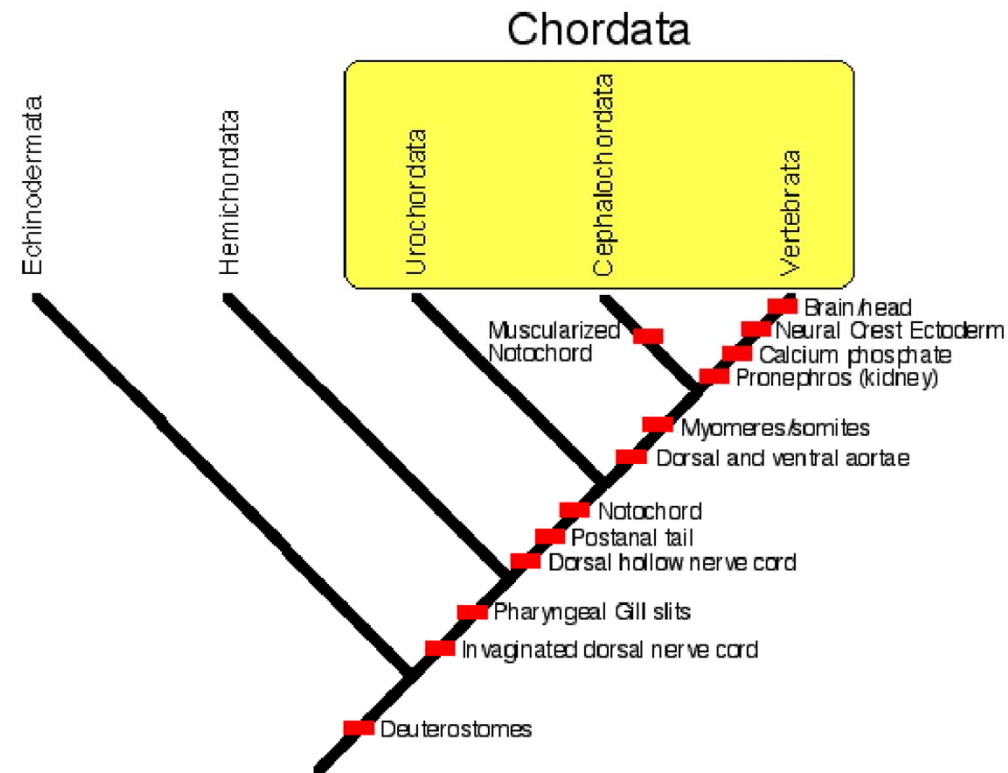
What is apomorphy?

Group Specific Conservativeness



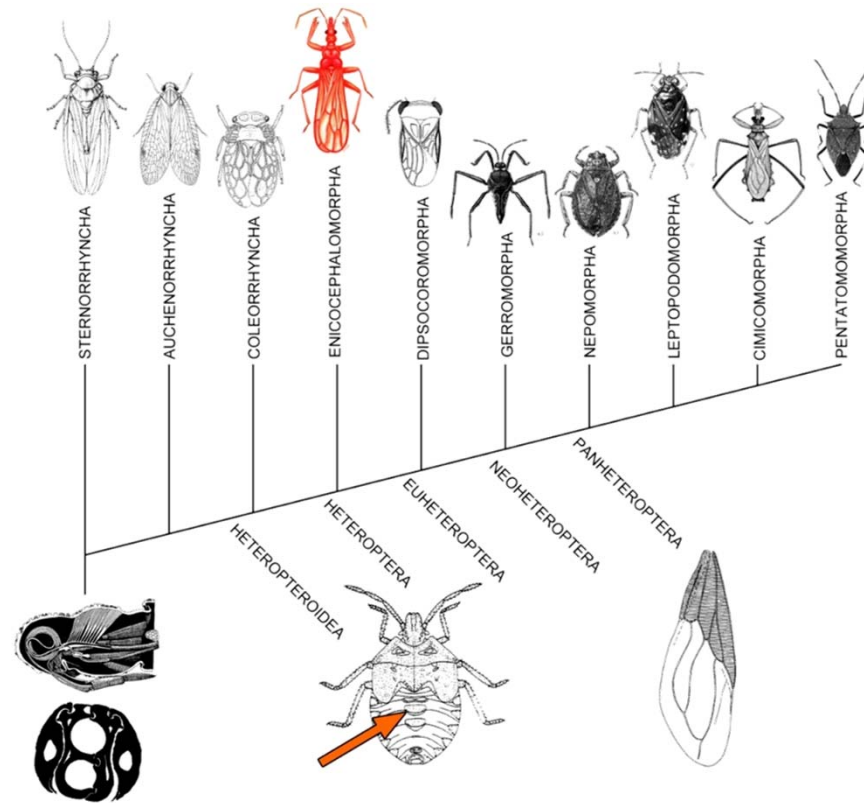
Speciation and character transformation

Apomorphy: Example of Chordata



Chordata: notochord, postanal tail, dorsal hollow nerve cord

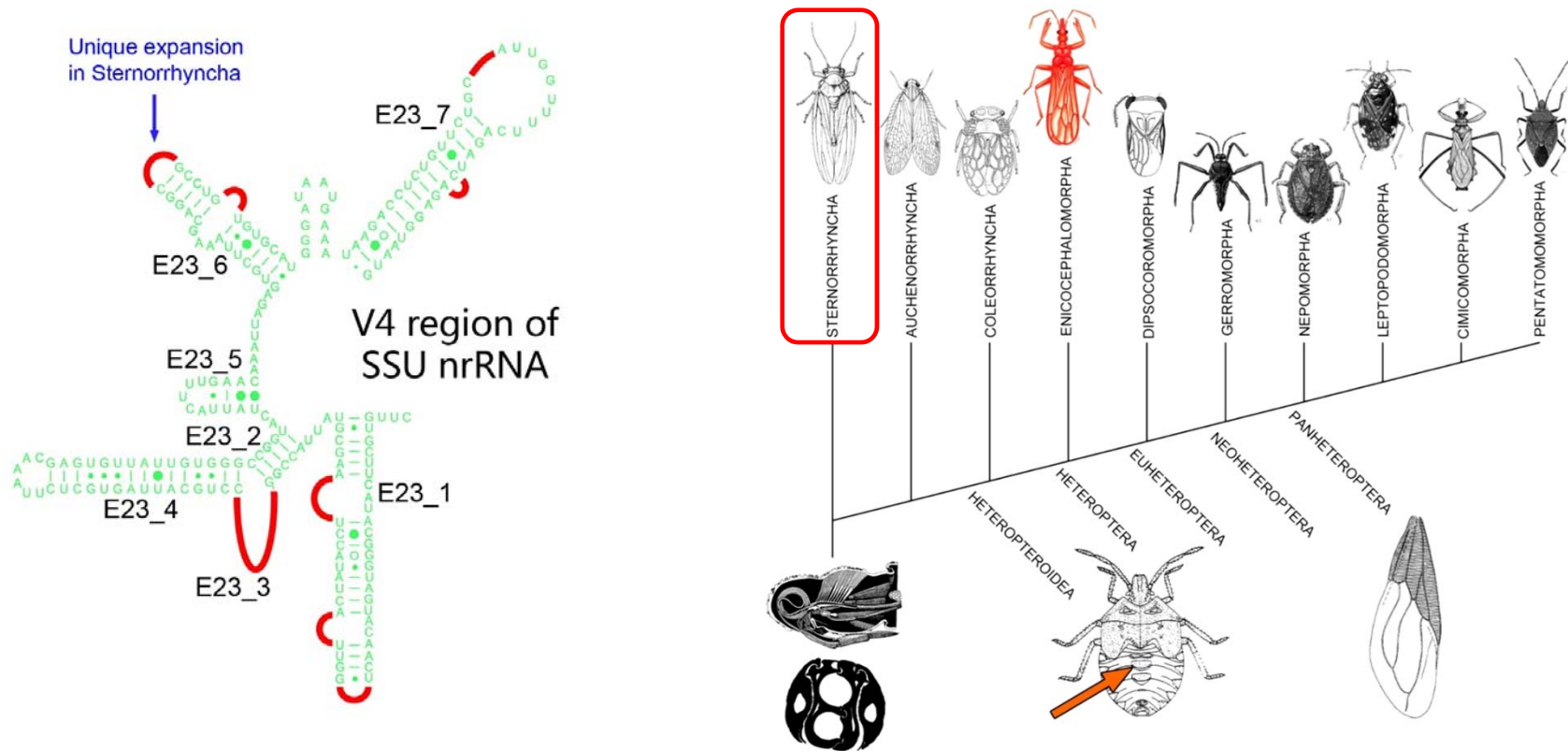
Apomorphy: Example of Hemiptera-Heteroptera



Hemiptera: piercing-sucking rostrum

Heteroptera: nymphal dorsal scent gland on tergite three

Molecular apomorphy: Length expansion



Sternorrhyncha: 28-41 nt, the other Hexapoda: 4-11 nt

Xie Q, et al. 2008. Mol. Phylogenet. Evol. 47: 463-471.
Xie Q, et al. 2009. Mol. Phylogenet. Evol. 50: 310-316.

Molecular apomorphy: Sequence pattern

Zoraptera

Dictyoptera

Orthoptera

Embiodea

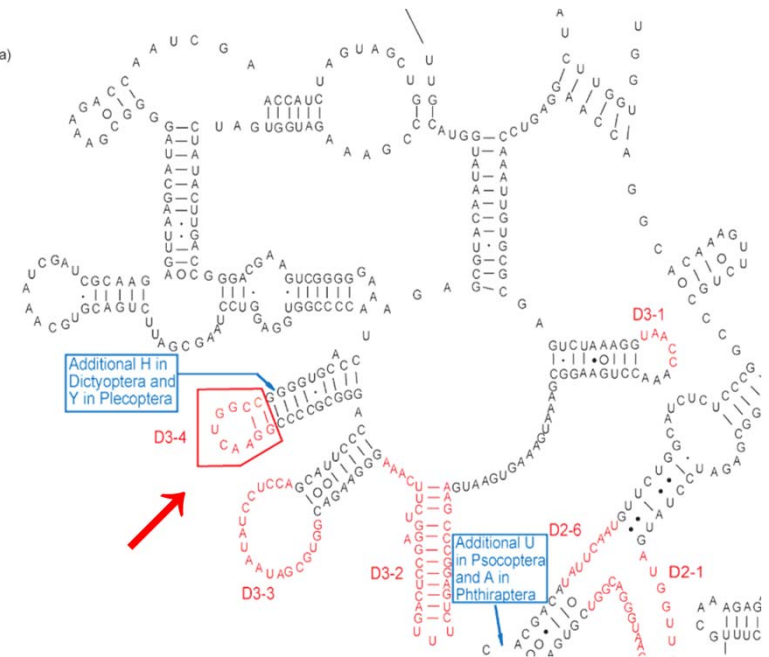
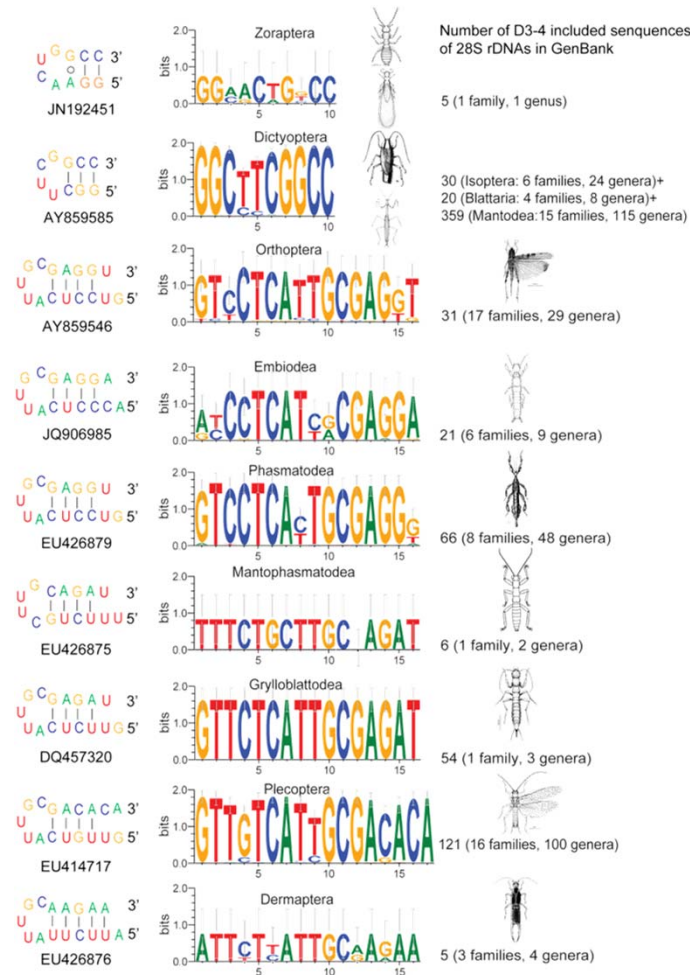
Phasmatodea

Mantophasmatodea

Grylloblattodea

Plecoptera

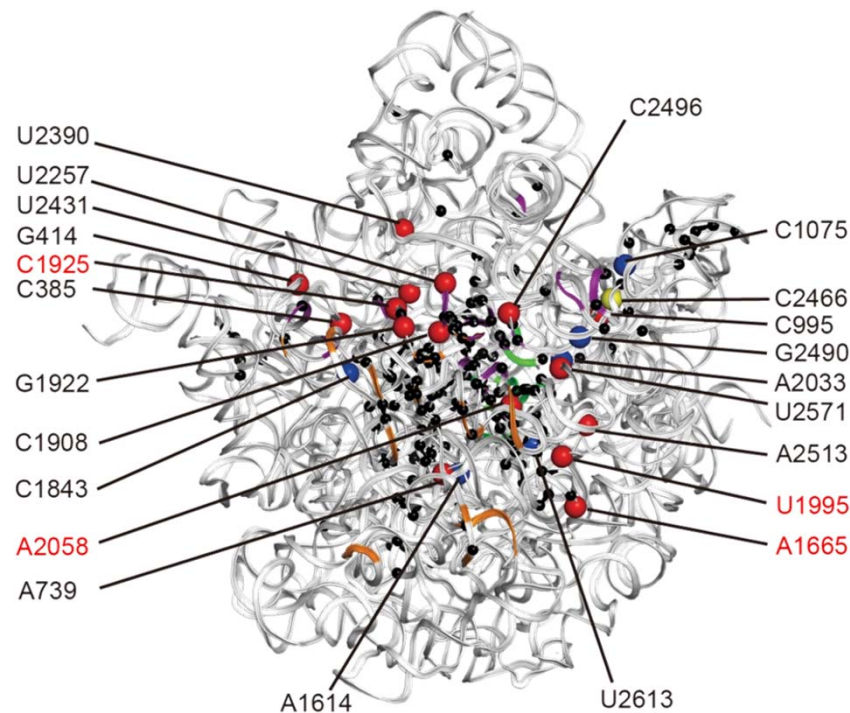
Dermaptera



D3 region of LSU nrRNA

Zoraptera+Dictyoptera: 10nt, the other Polyneoptera: 16 ± 1 nt

Molecular apomorphy: Single nucleotide



LSU nrRNA of *E. coli*

Bacteria	Archaea	Eukaryota
<i>E. coli</i>	<i>H. marismortui</i>	<i>S. cerevisiae</i>

SSU nrRNA

A1110	G	G1330
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LSU nrRNA

A1665	G	G1897
C1925	U	U2268
U1995	C	C2338
A2058	G	G2400

Significance of Molecular Apomorphy: Standalone evidence for phylogenetics



Aphylidae



Canopidae



Lestoniidae



Megaricidae



Corimelaenidae



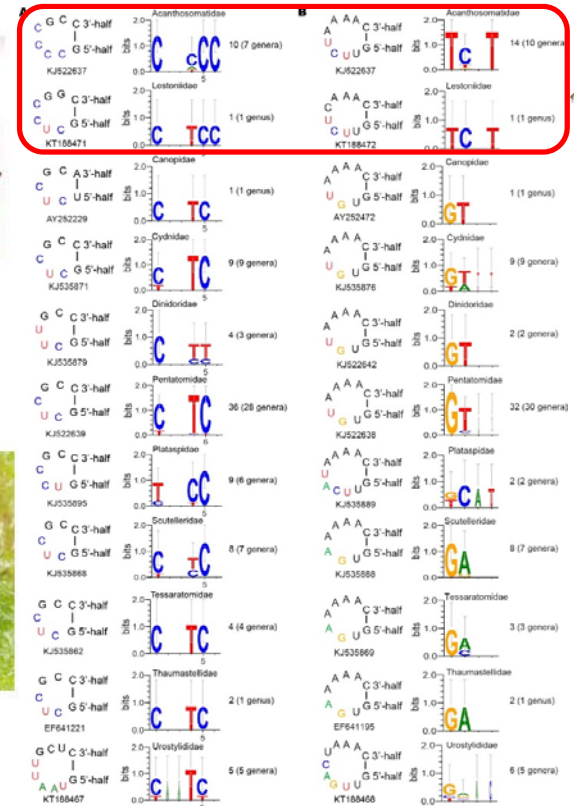
Plataspidae



Scutelleridae

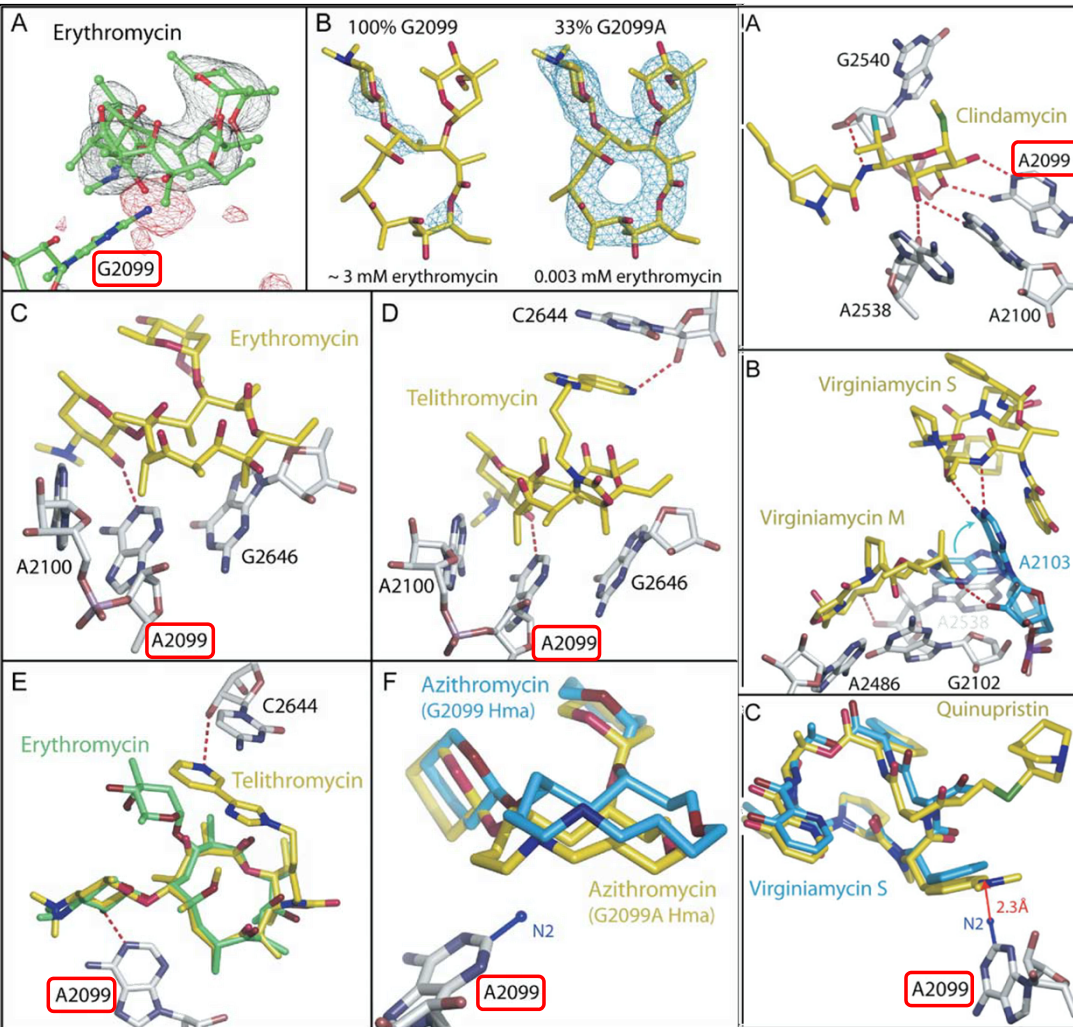


Thyreocoridae



Competitive hypotheses for the position of Lestoniidae (Hemiptera)

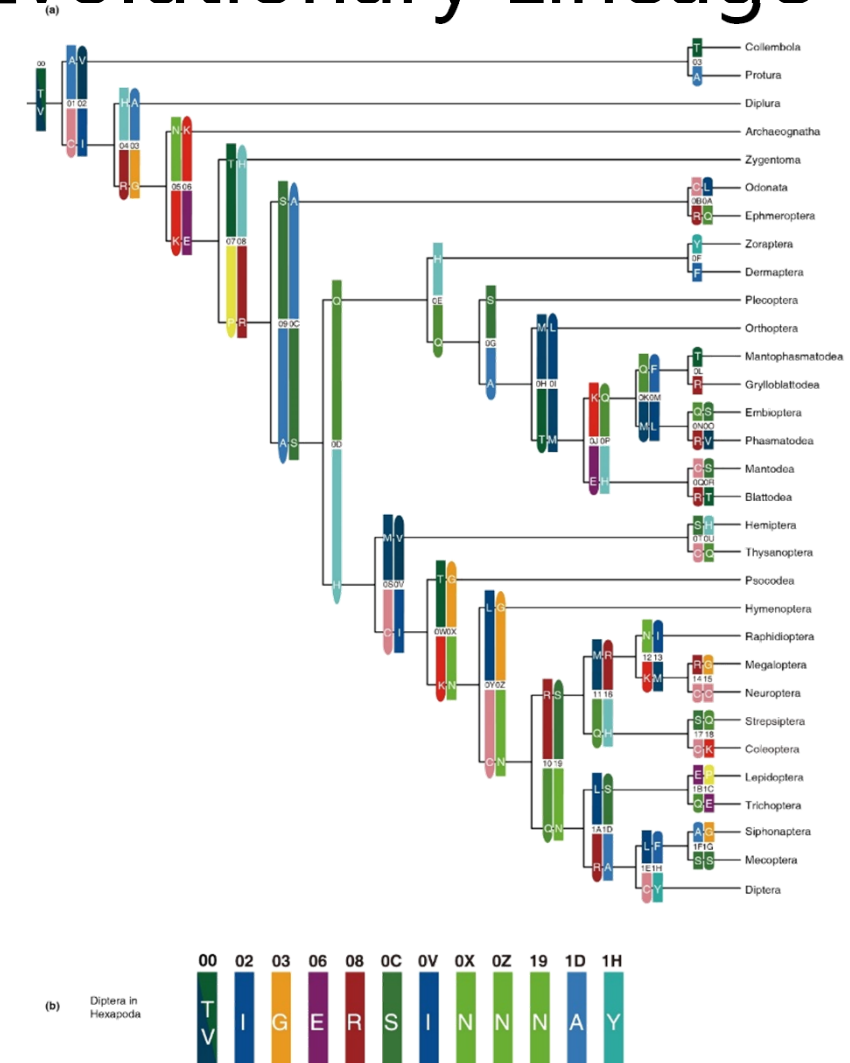
Significance of Molecular Apomorphy: Prediction of Functional Site



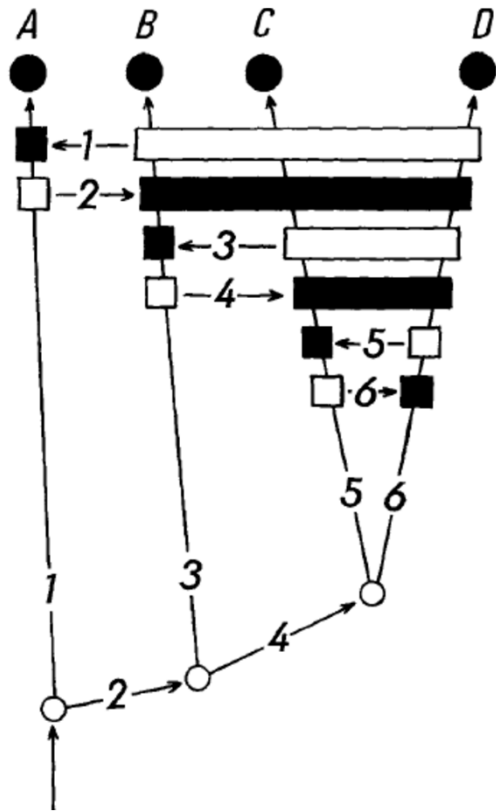
- ▶ Nobel Prize 2009 Chemistry
 - ▶ Bacteria
Escherichia coli A2058
 - ▶ Archaea
Haloarcula marismortui G2099
 - ▶ Eukaryota
Saccharomyces cerevisiae G2400
- Kingdom Specific Spectra of
Antibiotic Susceptibility

Significance of Molecular Apomorphy: Standardizing the Description of Evolutionary Lineage

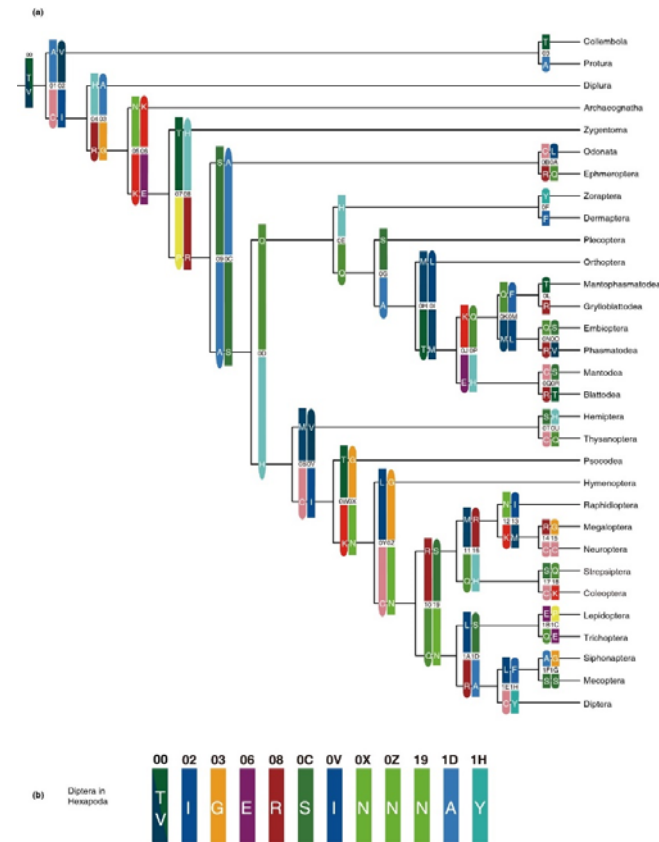
- Phylogenetic Species Concept
- Standardizing the definition of species
- Molecular Barcode
- Standardizing the identification of species
- PhyloCode
- Standardizing the nomenclature of species
- From “Tree of Life” to “Key to Life”



The thinking of apomorphy: 1950 → 2016



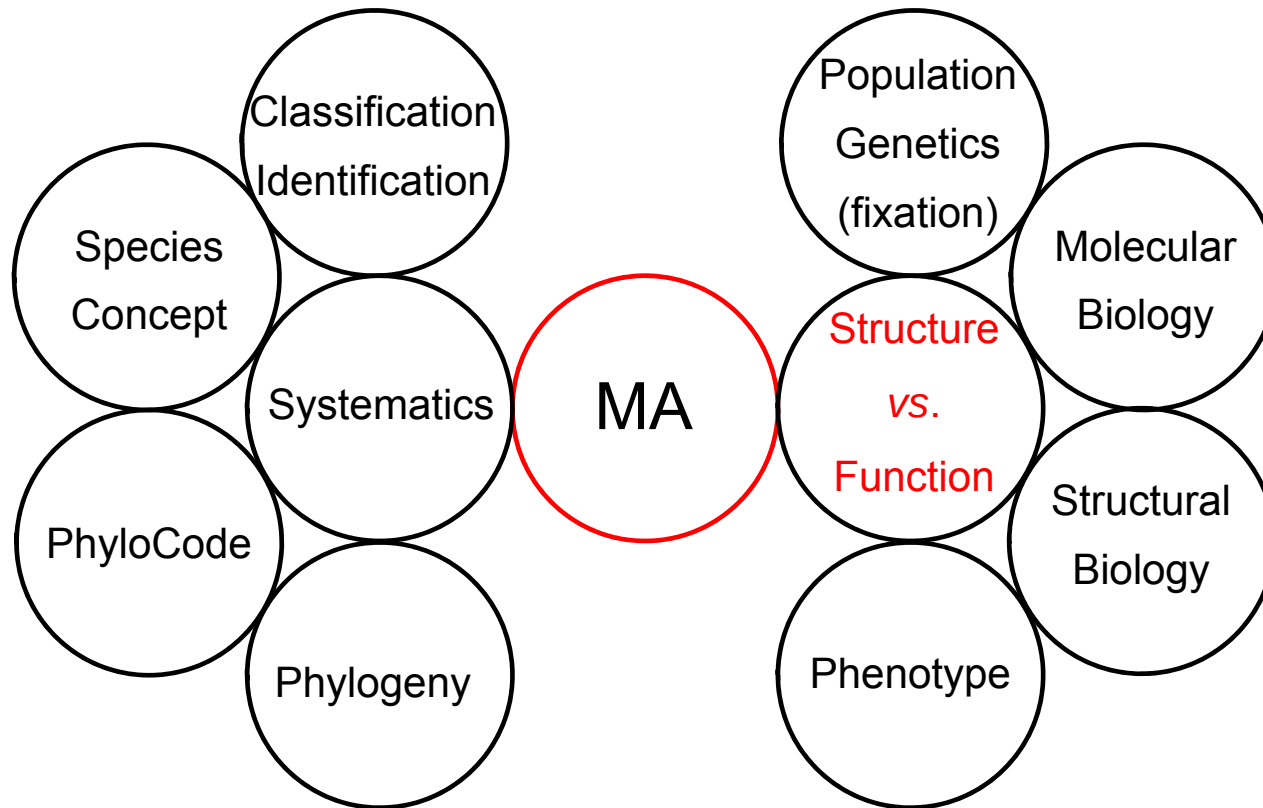
Scheme of argumentation of
phylogenetic systematics
(Hennig 1966)



Molecular descriptions of clades in Hexapoda
based on apomorphic amino acids (2016)

Wu H-Y, et al. 2016. *Scientific Reports* 6: 28308.

Molecular Apomorphy: A Linking Point for Multidiscipline



The only hypothesis accepted by all biologists: correlation between structure and function

Do you still remember ?

那些年，我们一起学的分子生物学

- Variation of single nucleotide
↓
- Variation of single amino acid
↓
- Change of the chemical state of hemoglobin
- Similar cases seldom reported after that ...

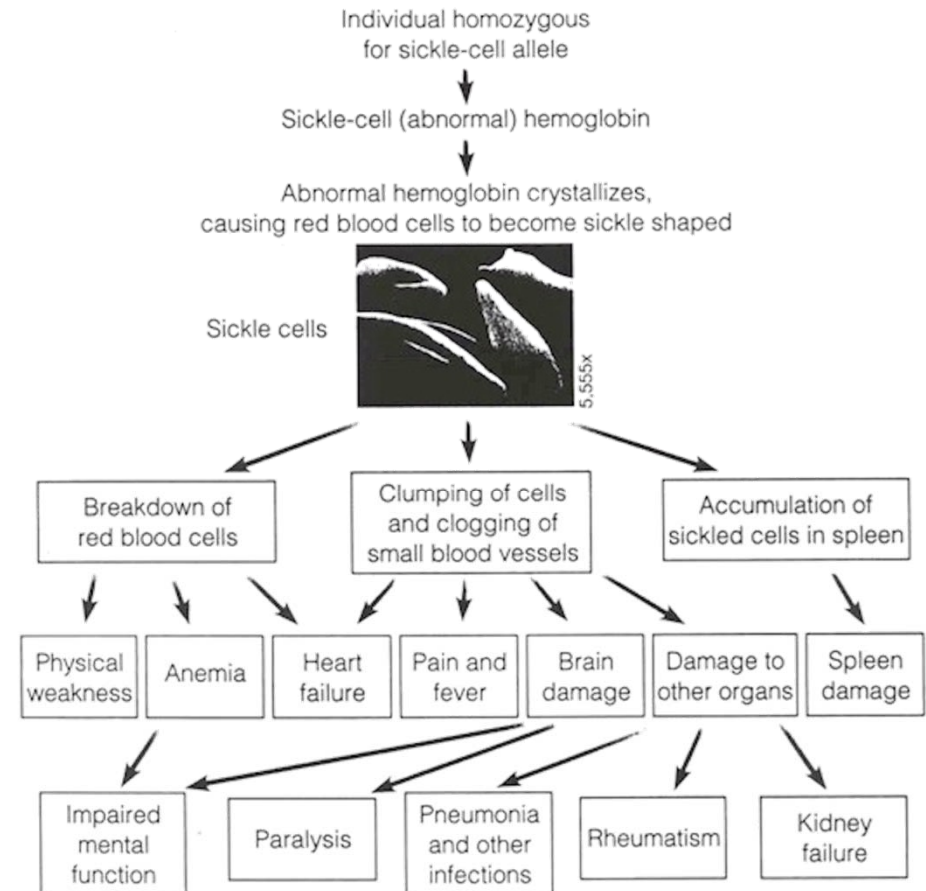


Figure 9.14 Sickle-cell disease, multiple effects of a single human gene

Why only a few molecular apomorphies have been discovered?

- Phylogeny dependent
- Different attributes of morphology traits and molecular ones
- Much attention paid to methodology rather than theory
- Treating gene but not nucleotide/amino acid as operational unit
- Limitation of data quantity and quality

Reminding: The Role of Taxonomy

- Charles Darwin
 - Barnacles
- Ernst Mayr
 - Birds
- Willi Hennig
 - Flies

Thank You for Your Attention

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