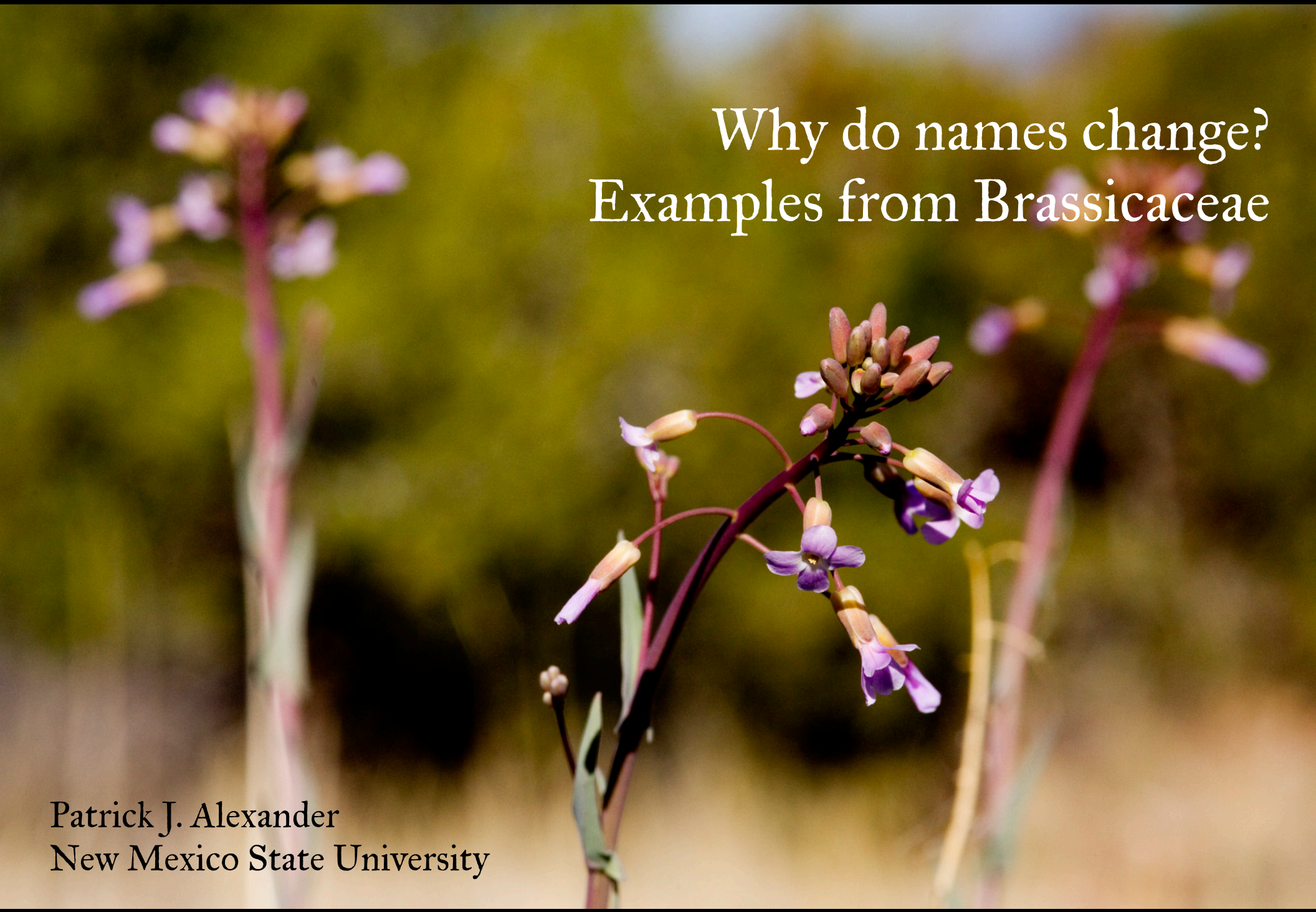

Why do names change? Examples from Brassicaceae

Patrick J. Alexander
New Mexico State University

Why bother?

- most plants have informal names in English, why not just use those?
  - communication across languages
  - precision & ability to track names through time:
    is your "catclaw" the same as my "catclaw"?
  - information about relationships:
    "Syrian rue", "common rue", and "meadow rue" are not closely related!
  - all research in biology is going to depend, to some extent, on the identity of organisms!

How we make names...

Formal botanical names are governed by the International Code of Botanical Nomenclature (ICBN). You can find the current version online: http://ibot.sav.sk/icbn/main.htm

These rules don't tell you *what* to name, but describe *how* you can put names on taxa.

So, how do we name a new species?

We'll limit ourselves to the formal process for the moment & ignore *why* we think something is a new species... the ICBN gives four requirements:

- Give it a binomial!
- Provide a type specimen.
- Provide a Latin diagnosis.
- Get it published.

How do we name a new species?

- Give it a binomial!

Boechera texana Windham & Al-Shehbaz, *sp. nov.* TYPE: U.S.A. Texas: Culberson County, San Antonio Peak, Sierra Tinaja Pinta, 26 April 1961, *R. C. Rollins & D. S. Correll 61142* (Holotype: GH; Isotype: LL).

Herba perennis 2–5 dm alta; caudex lignosus. Caules 1, in centro rosulae exoriens, glaber et glaucus. Folia inferiora oblanceolata vel spathulata, 5–12 mm lata, dentata, petiolis ciliatis, ciliis 1–2 mm longis; pilis 2–4-radiatis 0.4–0.6 mm longis praedita; folia caulina 5–12, inferiora subimbricata, auriculata. Pedicelli fructiferi 10–20 mm longi, divaricati, recurvati, glabri. Flores per anthesin adscendentes; sepala glabra; petala alba vel lavandula, 5–8 × 1.5–2.0 mm; ovula 80–130. Fructus 3.5–5.0 cm × 2.5–3.0 mm, curvati vel subrecti, penduli, nonsecundi, glabri; stylo 0.2–0.7 mm longo. Semina biseriata, 1.1–1.3 × 0.9–1.0 mm.

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How do we name a new species?

- Provide a type specimen.
- The binomial refers to "whatever set of individuals is in the same species as *that plant*".

How do we name a new species?

- Provide a Latin diagnosis.
- This describes features of the taxon that allow it to be distinguished from closely related species.
- When in doubt, the type specimen "wins".

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How do we name a new species?

- Get it published.

Boechera texana Windham & Al-Shehbaz was published in the journal *Harvard Papers in Botany* in 2006.

NEW AND NOTEWORTHY SPECIES OF *BOECHERA* (BRASSICACEAE) I: SEXUAL DIPLOIDS

MICHAEL D. WINDHAM[1] AND IHSAN A. AL-SHEHBAZ[2,3]

Abstract. On the basis of a critical examination of the type collections of all taxa described in *Arabis* and *Boechera* from North America, we propose the following nomenclatural adjustments among the sexual diploid taxa. Seven new species of *Boechera* (*B. evadens, B. rollinsiorum, B. serpenticola, B. shevockii, B. texana, B. ultraalsa, B. villosa*) are described and new names are proposed for the taxa originally described as *A. pulchra* var. *munciensis* (*B. lincolnensis*) and *A. breweri* var. *austinae* (*B. breweri* ssp. *shastaensis*). Ten new combinations (*B. arcuata, B. atrorubens, B. fernaldiana* ssp. *vivariensis, B. formosa, B. howellii, B. nevadensis, B. paupercula, B. pendulocarpa, B. polyanthua, B. spatifolia*) are validated. Notes on the delimitation, distribution, and/or typification of *B. davidsonii, B. holboellii, B. johnstonii, B. lignifera, B. lyallii, B. microphylla, B. pallidifolia, B. pendulina, B. retrofracta, B. sparsiflora,* and *B. subpinnatifida* are presented, with the last species reported for the first time from Idaho, Nevada, and Utah. *Arabis davidsonii* var. *parva*, *A. demissa, A. hirshbergiae,* and *A. thompsonii* are reduced to synonymy under *B. davidsonii, B. oxylobula, B. johnstonii,* and *B. pallidifolia*, respectively.

Keywords: *Arabis, Boechera,* Brassicaceae, North America.

The genus *Boechera* Á. Löve & D. Löve has been slow to gain acceptance among North American botanists. The original publication ter to *Draba* (Koch, 2003; Bailey et al., in press), both of which have a base chromosome number of $x = 8$. By contrast, the largely North

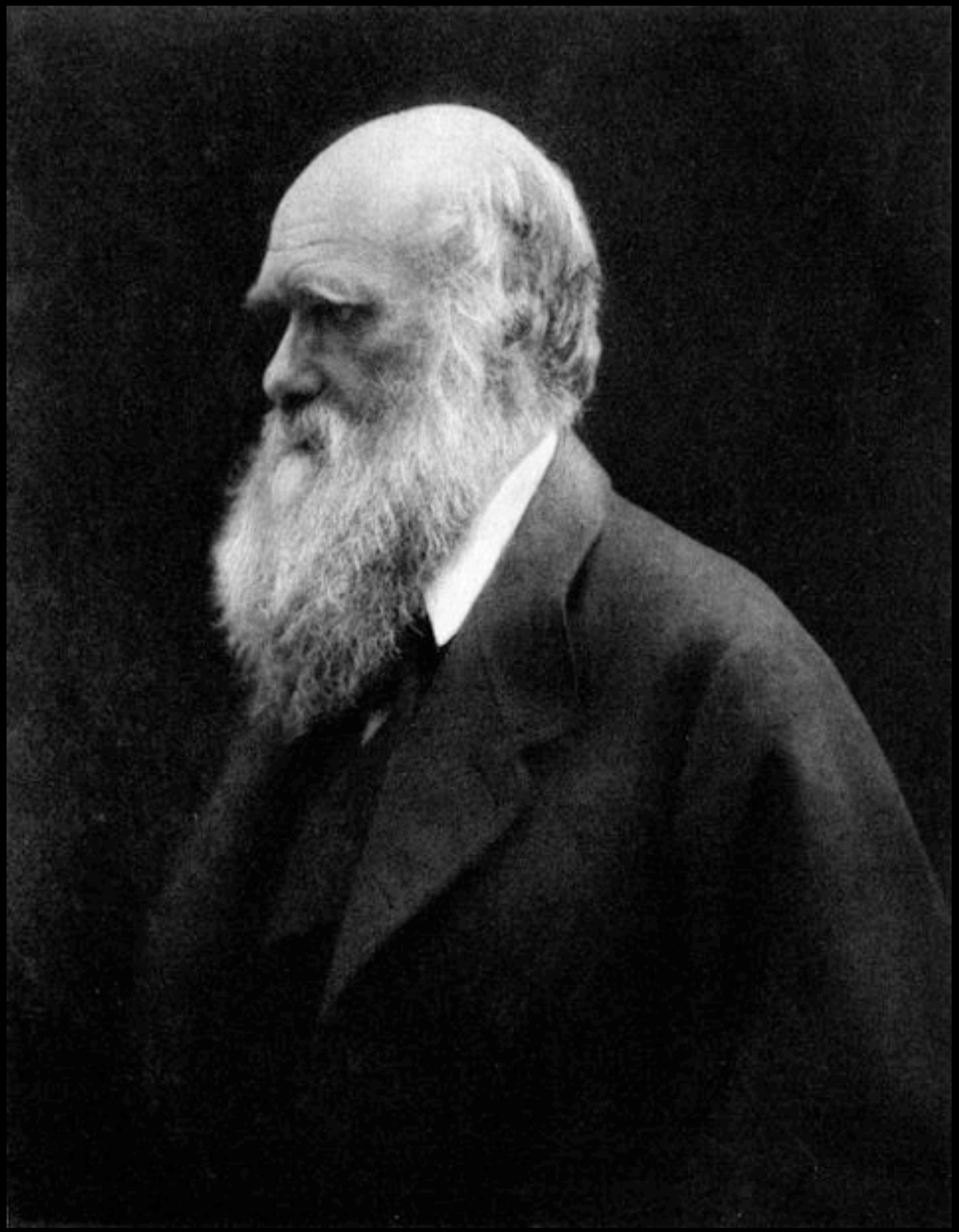
Genera

- The process is basically the same for genera & higher (families, etc.) taxa.
- However, in this case a *species* fills the role of the type.

Why we change names...

This guy (and others) introduced the idea that species are historically related to each other.

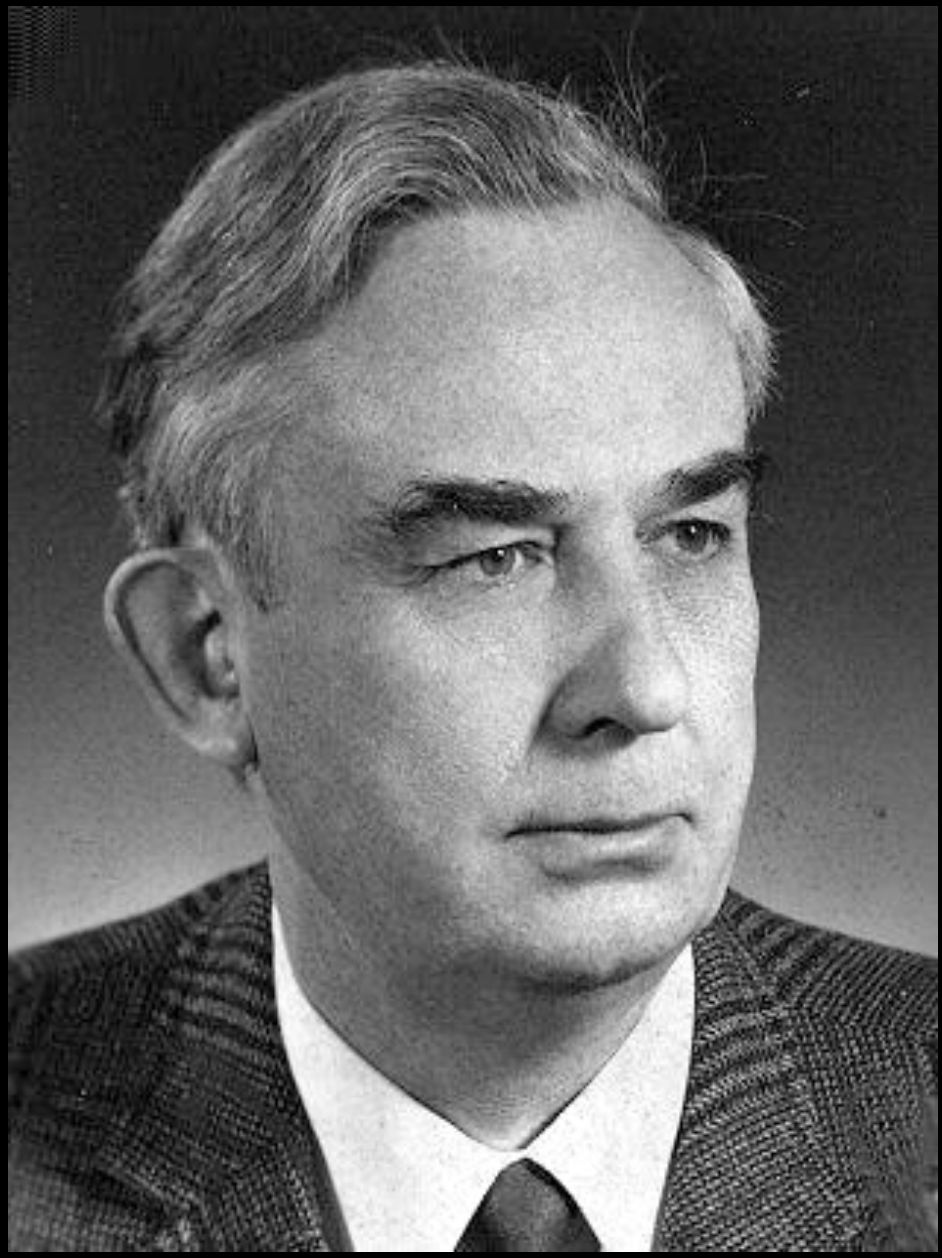
Shouldn't classification be based on those shared relationships?



The "Natural System"

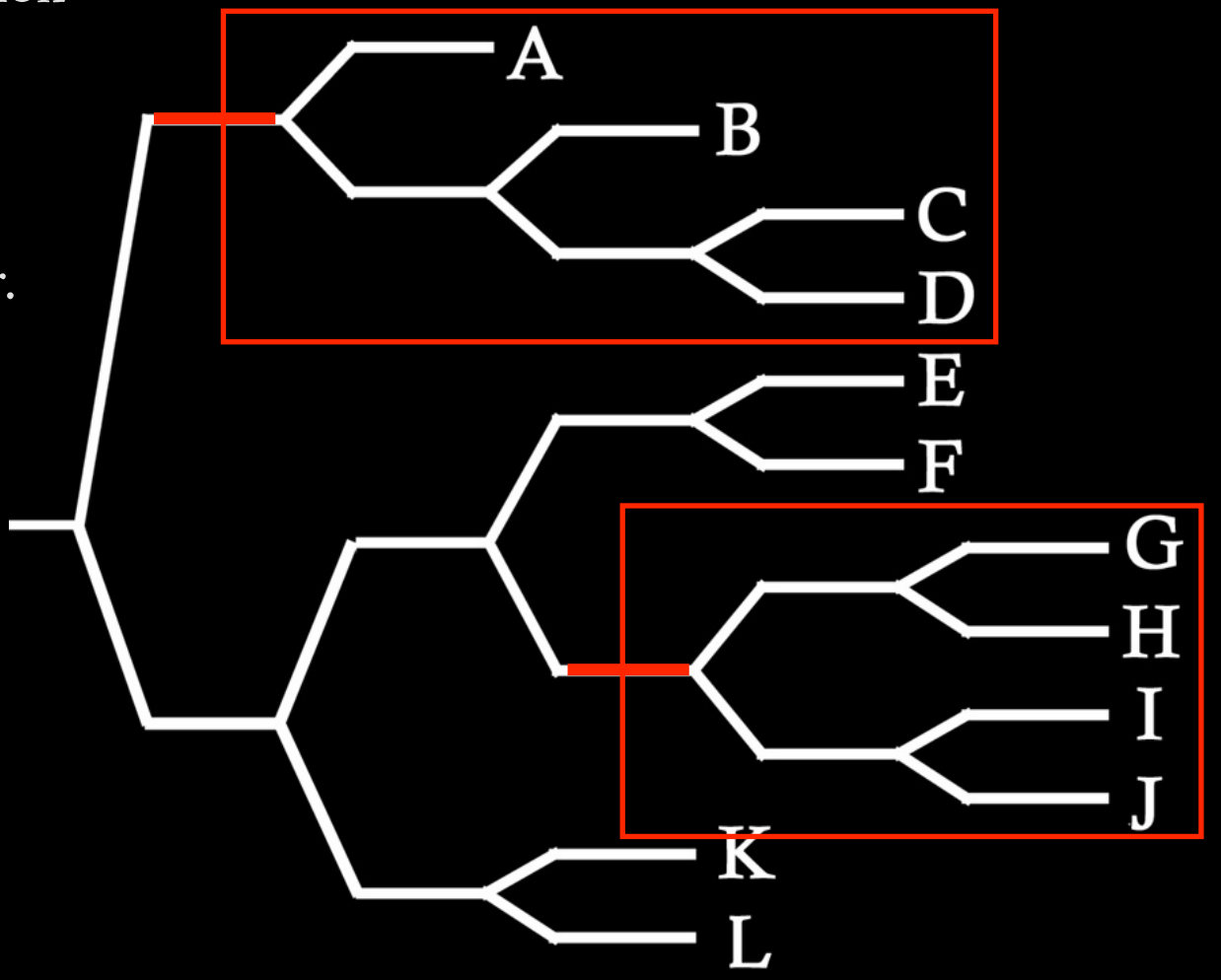
Willi Hennig made this more precise. He argued that our classification should only name monophyletic groups (also called clades).

When species move between genera or genera move between families, this is usually based on new analyses indicating that the old classification recognized paraphyletic groups.



Monophyly vs. paraphyly

- a monophyletic group is one that includes all descendants of a common ancestor;
- a paraphyletic group is one that includes some, but not all, descendants of a common ancestor.



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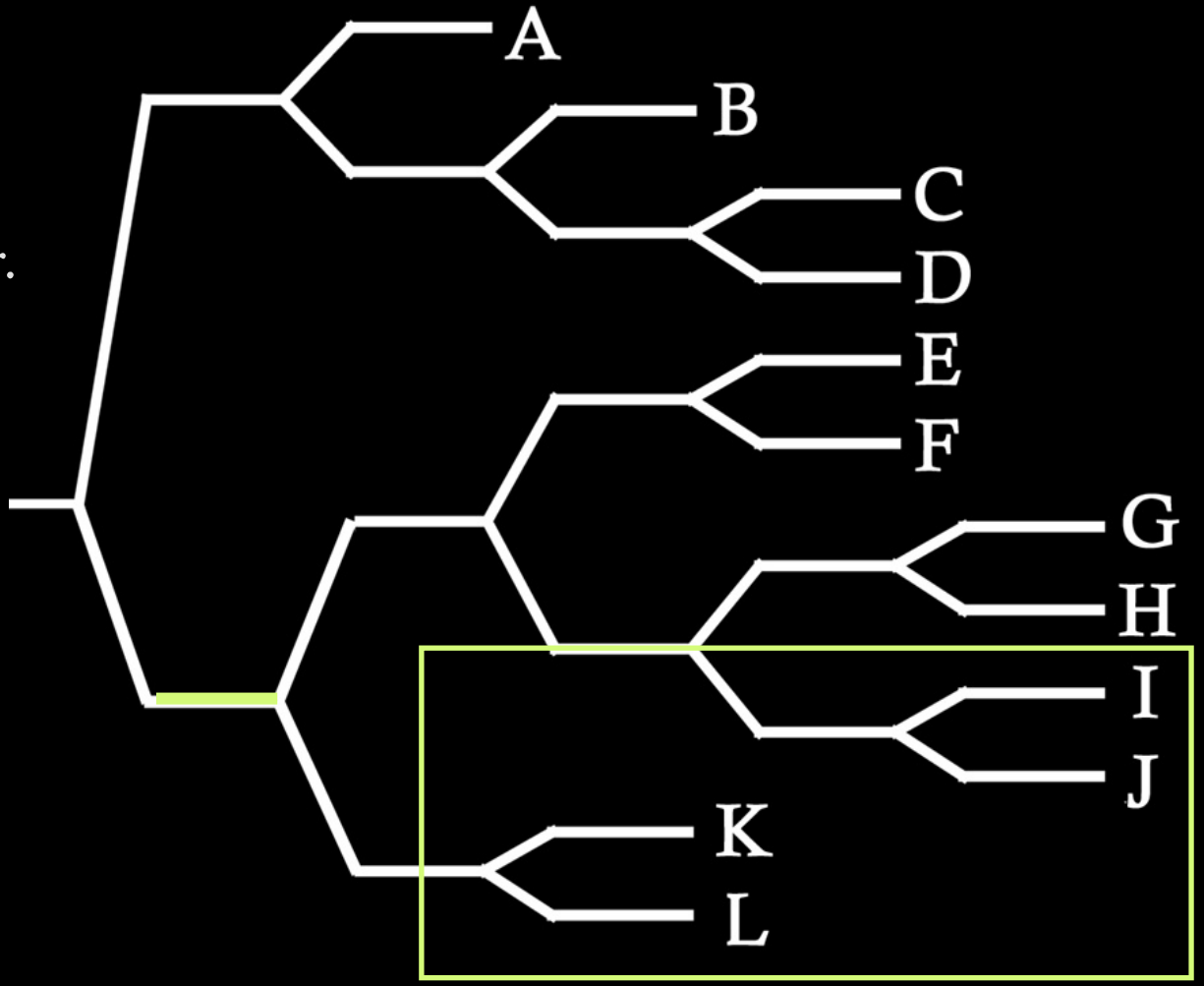

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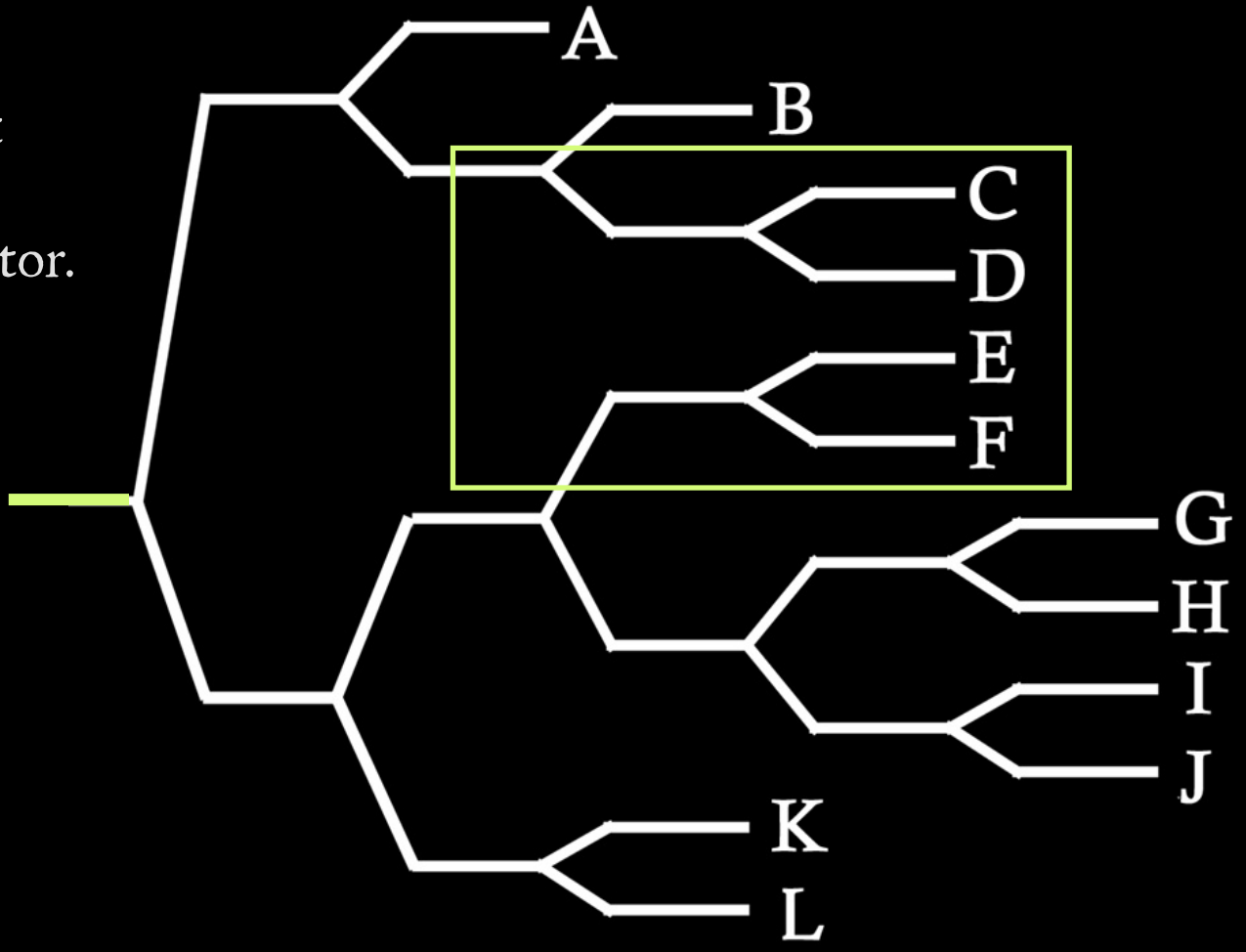
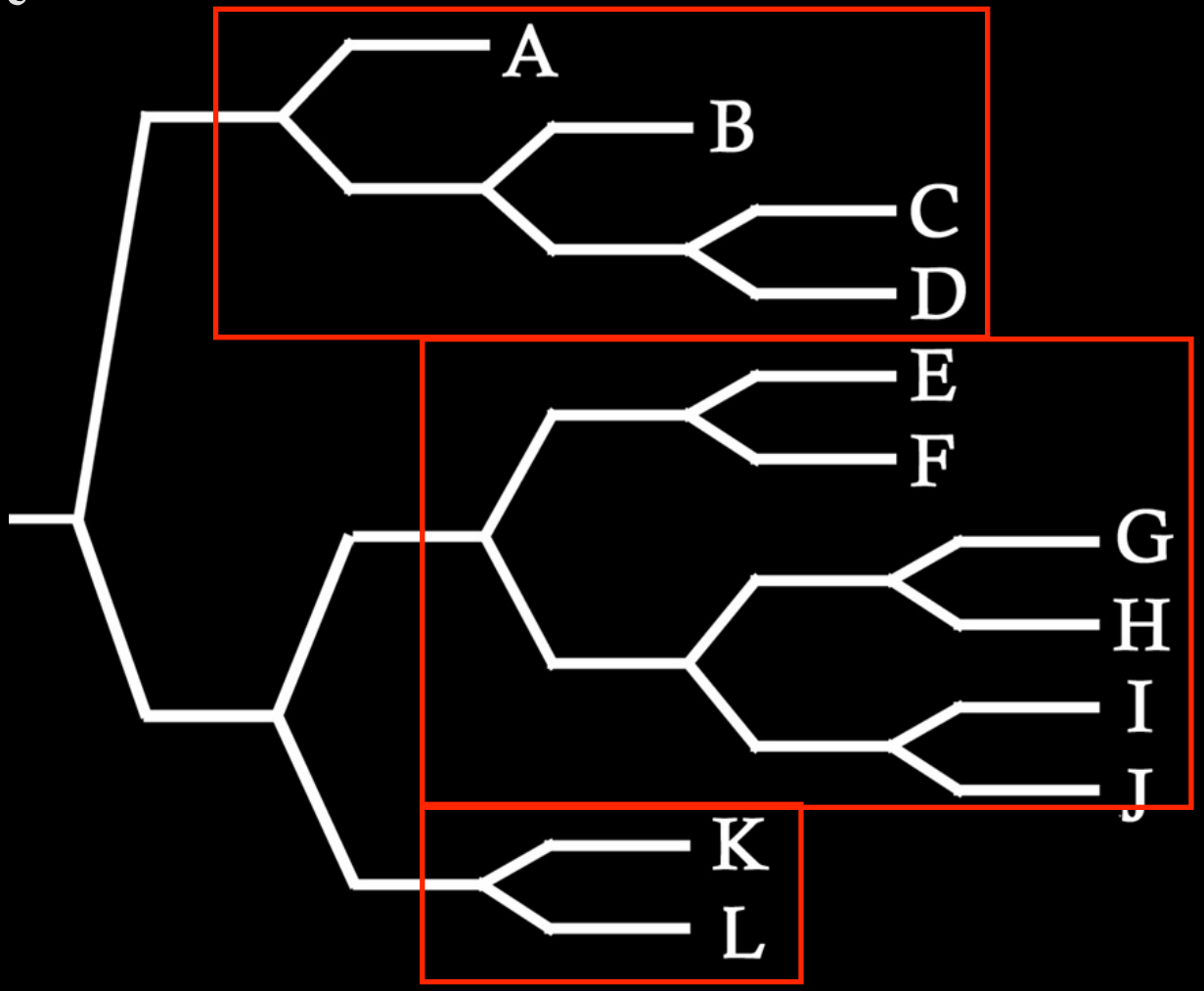


Monophyly vs. paraphyly

So, if we're cladists, we have a couple of different options if we're grouping species into genera...



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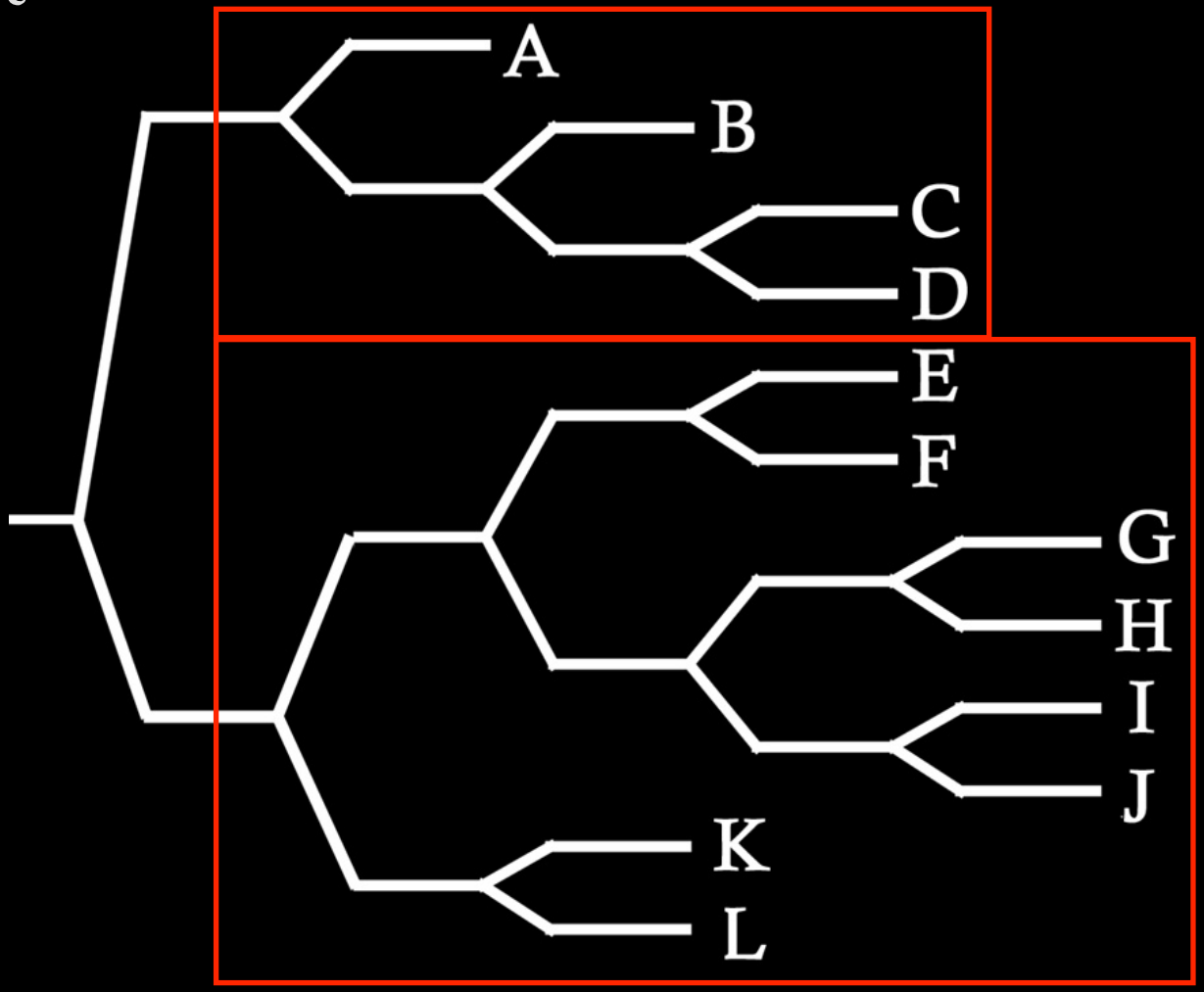
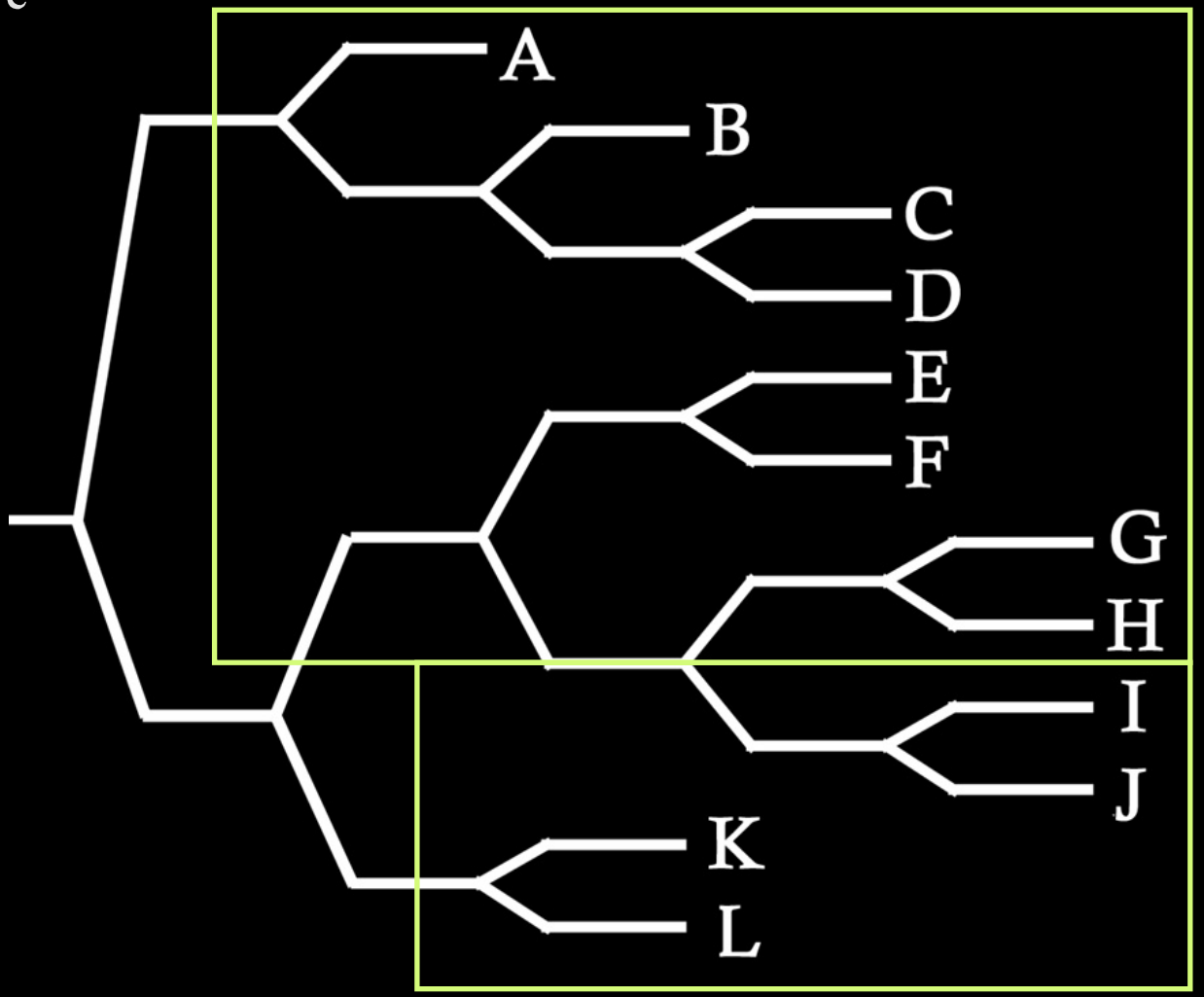


Monophyly vs. paraphyly

So, if we're cladists, we have a couple of different options if we're grouping species into genera...

but some options aren't available.

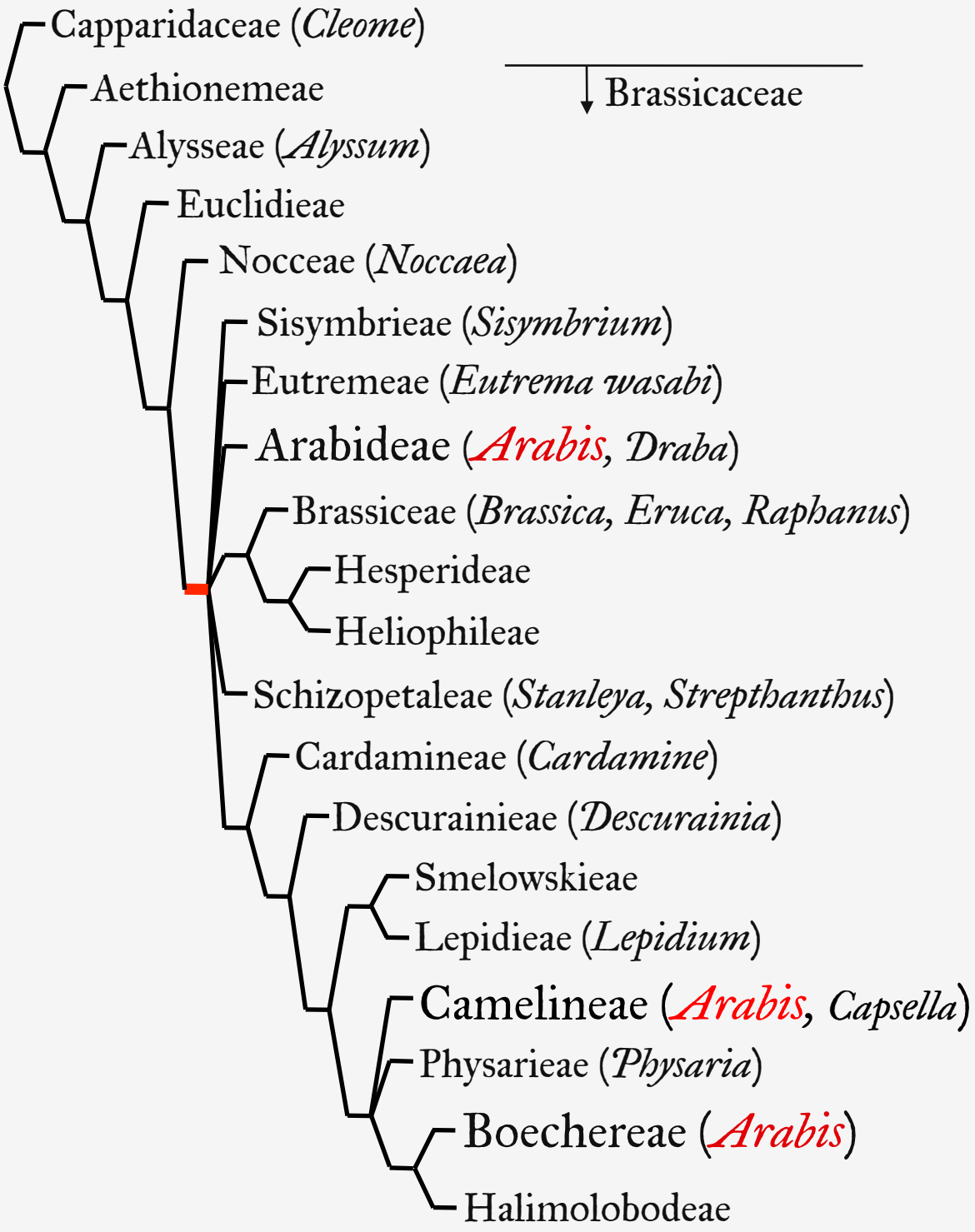


How do we get those trees?

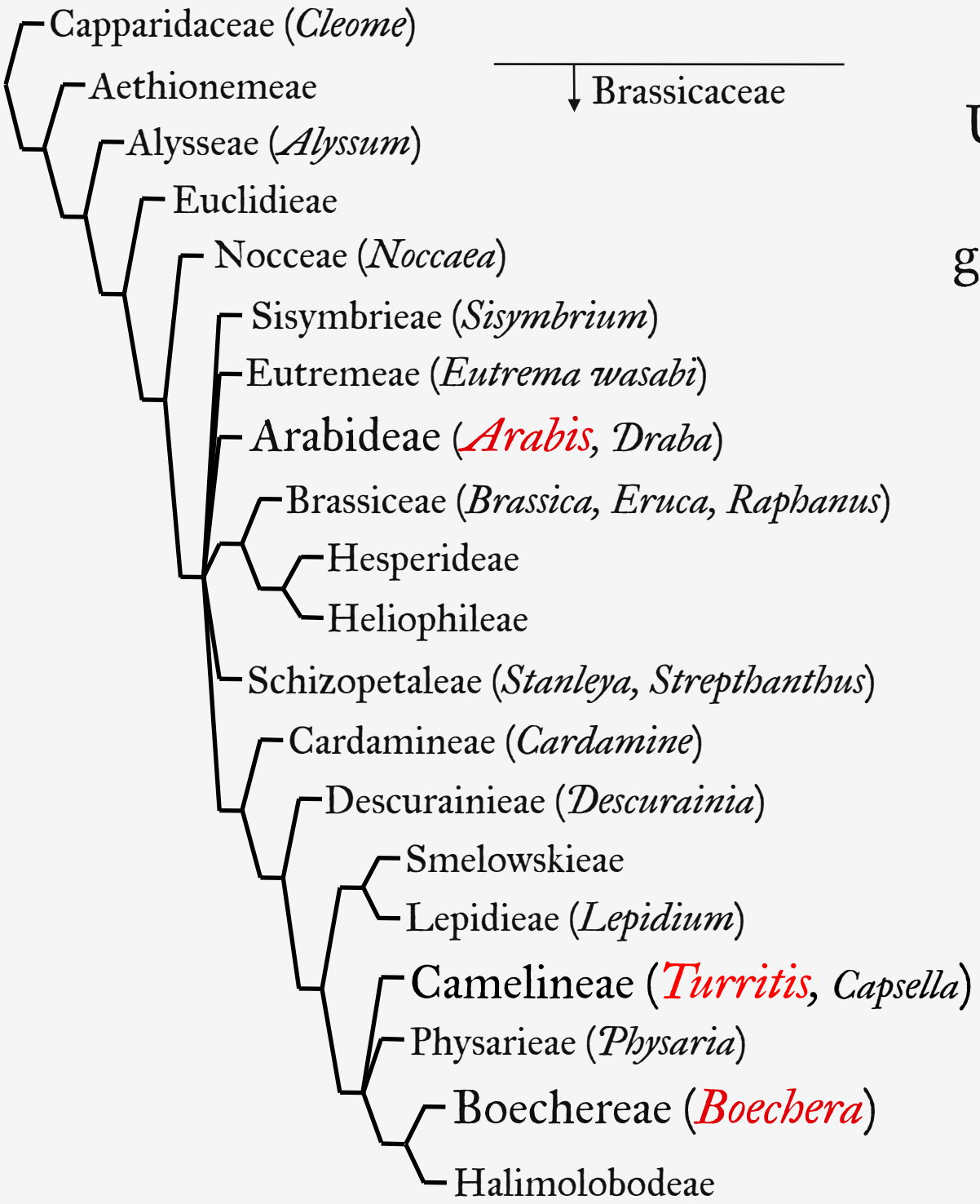
Usually with genetic sequence data. The very short version:

- start with a bunch of individual plant specimens;
- extract DNA from them;
- choose a particular portion of DNA to look at;
- get sequences of that gene (ACGTTGATC, etc.) for each plant;
- use one of several methods of analysis to infer a set of relationships between those plants;

for instance, parsimony is a method that looks among the various *possible* trees and chooses the tree that requires the fewest evolutionary changes in our sequence data.



An example; *Arabis*...
at left is a phylogenetic tree
of tribes in Brassicaceae



Unless we want to lump most of Brassicaceae into a single genus, we have to split *Arabis*.

Former *Arabis* in New Mexico: *Arabis hirsuta*

Former *Arabis* in New Mexico: *Turritis glabra*

User “Dandelion & Burdock”, Flickr

User “AnnaKika”, Flickr

User “Dandelion & Burdock”, Flickr

Former *Arabis* in New Mexico:
Boechera (the rest, ca. 20 species)

Why names change: species

The basic idea is that species are distinct groups of individuals:

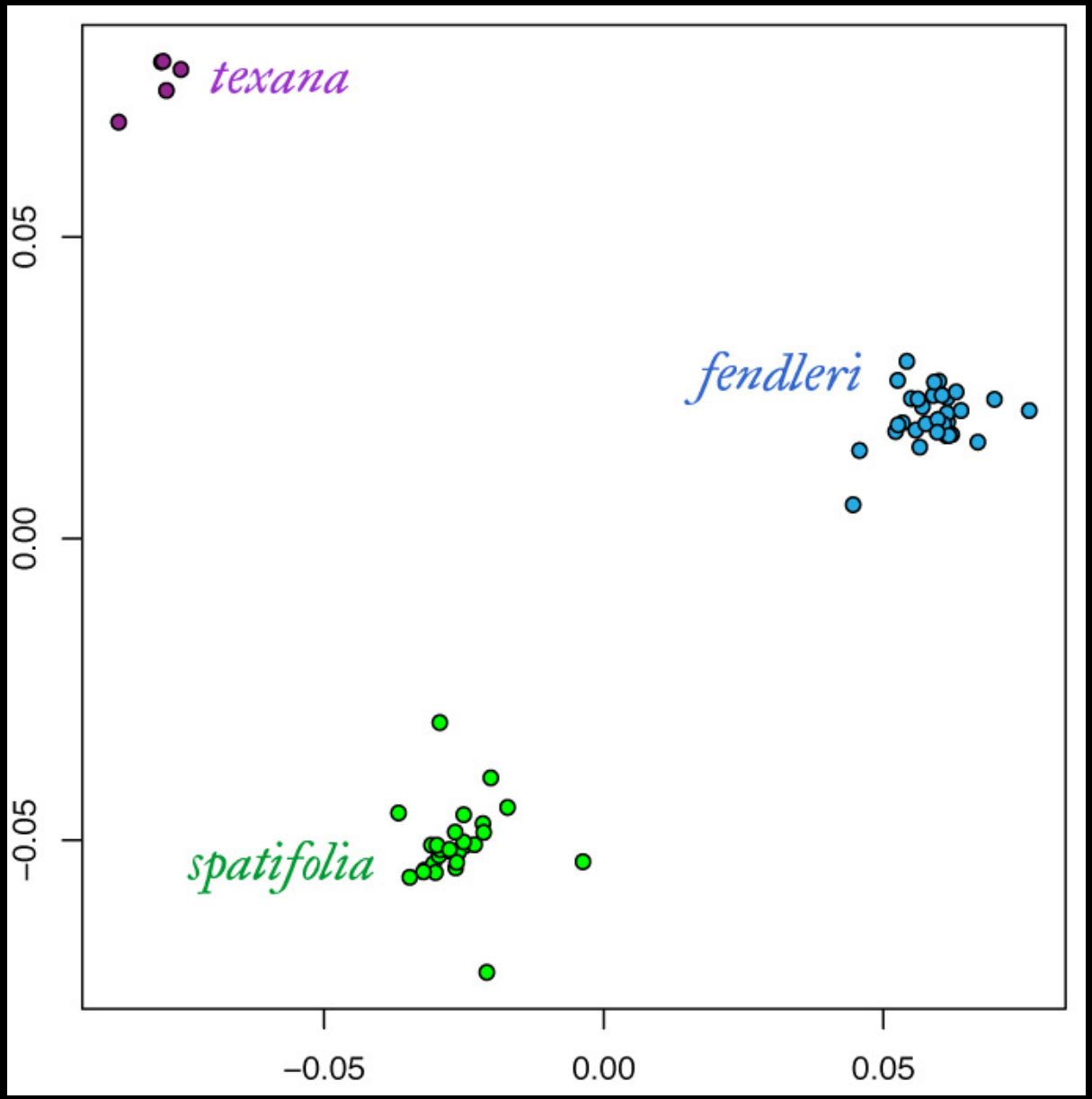
- they differ from each other in some characteristic;
- there aren't (many) intermediates.

In recent research this typically involves genetic data of various kinds...

- sequence data
- microsatellites
- etc.
- single-nucleotide polymorphisms
- amplified length fragment polymorphisms

Why names change: species

An example in *Boechera*... 10 years ago we would have called all these *Arabis fendleri*; now we have *Boechera fendleri*, *Boechera spatifolia*, and *Boechera texana*.



Why genetic data?

There are two main reasons:

1 More data!

- For *Boechera* and related genera, I have a phylogenetic data set that includes ca. 6000 characters across 95 species;
- it would probably not be possible (never mind feasible!) to generate
- that much data from morphology.

2 Less biased data:

- e.g., flower color, shape, & odor are under strong selection from pollinators;
- flower morphology is a record of selection *and* ancestry.

But that doesn't look right...

Sometimes new changes in genera or species don't look "right" to the rest of us, and taxonomists *do* make mistakes like everyone else, but:

- most of us aren't running rigorous computational analyses of the data when we look at plants;
- unfortunately, we can't see all that much.

Do I have to?

Well... no.

The names that reflect our best current knowledge are out there, but taxonomists can't force you to use them.

(No matter how much we might want to!)

Where do I find the "right" names?

- The right name is the one that best depicts reality.
- There really isn't a good substitute for looking through the primary literature, but there's a steep learning curve & who has the time?

- There is no official, correct, list.

- There are lots of lists compiled for convenience.
  - These can serve as a useful standard of common reference, but they do not determine what the "right" name is.
  - Kelly Allred's *Flora Neomexicana I* is the best list for New Mexico.