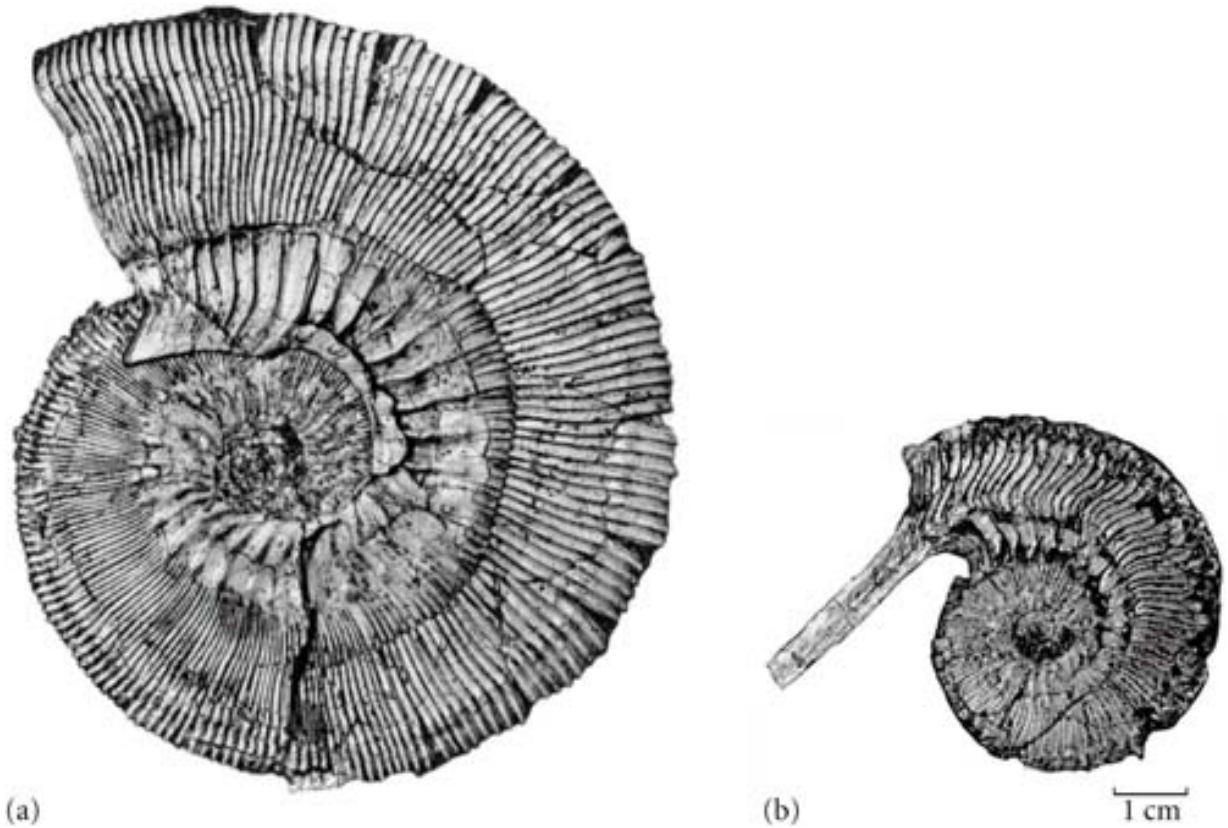
Variation

Variation within populations

- Environmental/ecological pressures:
  - Think of an example of an organism that we already know that looks different in different environments (same species)
- Sexual dimorphism: how would we know?

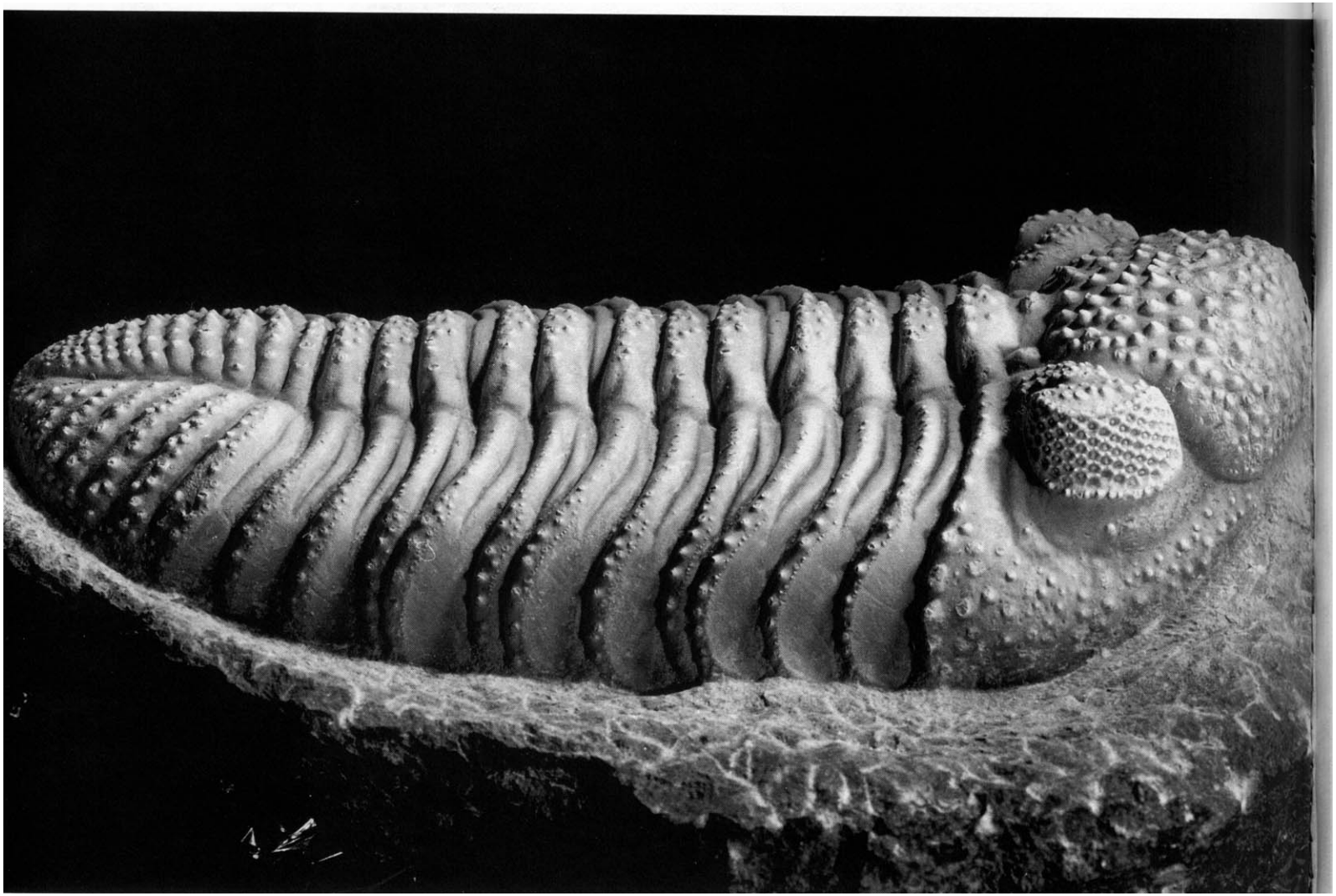


http://www.blackwellpublishing.com/paleobiology/jpg/300_96dpi/c06f002.jpg

Variation within populations

- Environmental/ecological pressures:
- Sexual dimorphism
- Individual genetic variability:
  - Are we more likely to see variability in advantageous or neutral traits?

What characters are the most likely to exhibit individual variation?

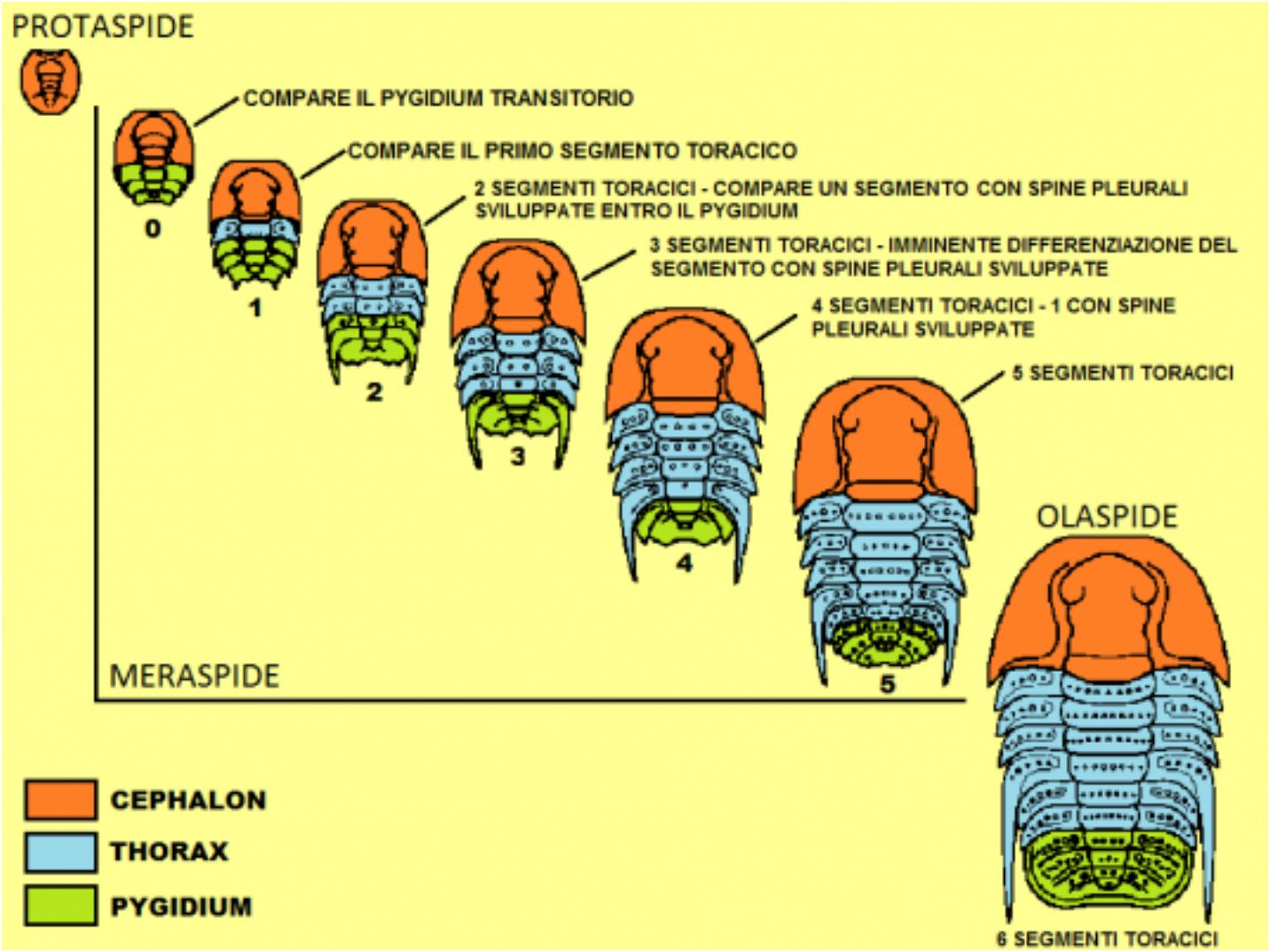


http://www.ps-19.org/Crea08Evolution/index_files/devonianphacops.jpg

Variation within populations

- Environmental/ecological pressures:
- Sexual dimorphism
- Individual genetic variability
- Ontogeny: How are adults and juveniles likely to be different?

How would you know they are the same species?

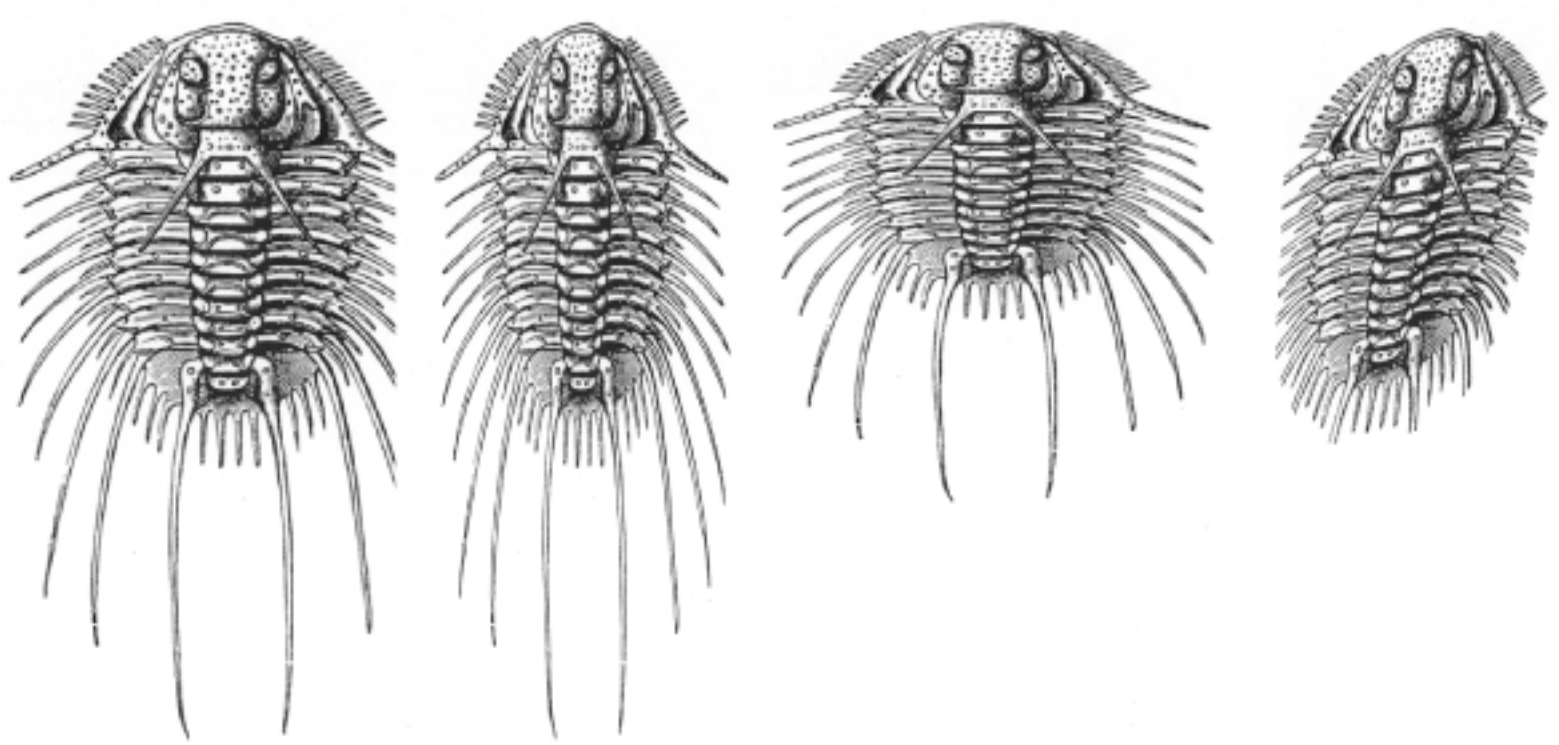


http://www.metropolismag.com/pov/wp-content/uploads/2011/09/Trilobite_ontogeny-535x401.png

Variation within populations

- Environmental/ecological pressures:
- Sexual dimorphism
- Individual genetic variability
- Ontogeny
- Taphonomic variability: What happens between death and fossil discovery to introduce variability?

Can this distortion be useful?



http://www.geol.umd.edu/~tholtz/G331/lectures/331varia.html

Looking closer at ontogeny

- What's the life cycle of invertebrates?

- Egg – not preserved as fossil
- Larvae – may be preserved if it has a shell
- Adult

Growth Patterns

- Accretion: add new stuff incrementally
- Addition: add new elements
- Modification: modify old skeleton
- Molting: throw old skeleton away, grow new skeleton

- For the growth pattern that you are assigned, think about:
  - What groups grow that way
  - How this growth pattern affects the information we can get from the fossils

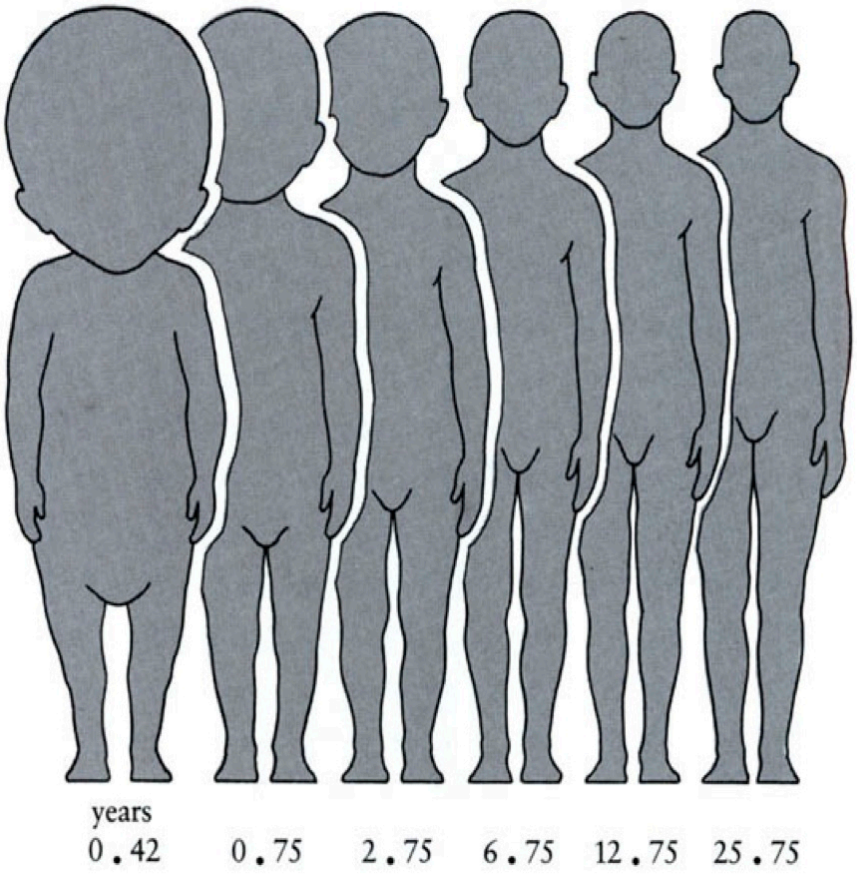
Pattern	Who does it	How it affects evidence left behind
Accretion	Mollusks, coralline algae, corals, brachiopod, bryozoans, echinoderms, archeocyathids	Whole life cycle (except tiny larvae) is recorded in skeleton Each fossil represents an individual.
Addition	Sponges, corals, bryozoans, arthropods, echinoderms, archeocyathids	Separate elements do not tell you about the whole organism. Form of organism may change as it adds new pieces. Need multiple specimens to see life history.
Modification	vertebrates	Little record of previous life history in adult. Need multiple fossils to get whole life history – confusion over what is a new species
Molting	arthropods	Change shape dramatically between molts – hard to link up the molts into a single life history. Too many fossils per individual.

Growth rates

- Isometric: linear change. Retains the same shape
  - $y=mx+b$
- Anisometric: non-linear change – shape changes
  - Allometric: exponential growth – dimensions change at related rates
  - $y = a^x$

Why anisometric?

- Surface area/volume issues
  - E.g., bone strength
  - Other systems: respiration, digestion
- Changing demands in ontogeny



http://vertpaleo.org/PDFS/ad/add1f853-6783-4231-933f-41fb5be566dd.jpg

How does the human shape change over ontogeny?

Why does it change over ontogeny? What's the primary (biological) job of a baby? What's the primary (biological) job of an adult?

Why are the baby starfish (left) and
the adult starfish (right) different shapes?

http://australianmuseum.net.au/image/Starfish-Larva/

http://marine.gov/Images/Tegula/Inverts/pisaster3.jpg

Why anisometric?

- Surface area/volume issues
  - E.g., bone strength
  - Other systems: respiration, digestion
- Changing demands in ontogeny
  - E.g., baby humans don't need optimal legs, but they need big cranial capacity, functional lungs, etc
  - So they are short-legged, big-headed, barrel-shaped creatures
  - Larval v. reproductive demands

Effects of taphonomy

- What's a population:
  - Array of individuals sharing a genepool
- What's an assemblage:
  - A group of fossils found together

- Why would those two things be different?

What info is lost in transition from population to assemblage?

- Life-to-death:
  - Population structure and mortality patterns
  - Who is missing? Who is overrepresented?
  - Is the population structure of the cemetery the same as the population structure of the mall? Is the mall a true picture of population structure?
  - Pompei v. the cemetery
  - Differential mortality across age structure

What info is lost in transition from population to assemblage?

- Death-to-fossil:
  - Missing ontogenetic stages (juveniles may be elsewhere)
  - Differential transport
  - Bias in preservation