Mammal Evolution

Geology 331
Paleontology
Triassic synapsid reptiles: Therapsids or mammal-like reptiles. Note the sprawling posture.
Mammal with Upright Posture
From Synapsids to Mammals, a well documented transition series

Carl Buell

Prothero, 2007
Synapsid Teeth, less specialized

Mammal Teeth, more specialized
Figure 13.5. The gradual transformation of the jaw bones within the synapsids, as all the nondentary jaw bones (shaded bones: angular, surangular, articular, coronoid, splenials, and so on) are gradually reduced to tiny splints in the inside back part of the jaw, and the dentary bone (unshaded bone) takes over as the principal jaw bone. Eventually, all the nondentary jaw elements are lost in mammals, except for the articular bone, which becomes the “hammer” (malleus) bone of the middle ear. (Drawing by Carl Buell).
Yanoconodon, Lower Cretaceous of China
Yanoconodon, Lower Cretaceous of China, retains ear bones attached to the inside lower jaw.
We can trace bones from gill arches to our ears, first during the transition from fish to amphibian (right), and later during the shift from reptile to mammal (left).
Of the three parts of our ear - the outer, middle, and inner - the inner ear is the most ancient and the part that controls the nerve impulses sent to the brain.
Human Ear Bones, or Auditory Ossicles

Cochlea

- articular of lower reptile jaw
- quadrate of upper reptile jaw

malleus
- handle of malleus
- long process of incus

incus
- stapes
Mammals have a bony secondary palate

Reptiles have a soft secondary palate
Hand and Foot of Permian Synapsid *Seymouria*

Reduction of digit bones from 2-3-4-5-3 in synapsid ancestors to 2-3-3-3-3 in mammals

Human Hand and Foot
Class Mammalia - Late Triassic to Recent
Superorder Tricodonta - Late Triassic to Late Cretaceous
Superorder Multituberculata - Late Jurassic to Early Oligocene
Superorder **Monotremata** - Early Cretaceous to Recent
Superorder **Metatheria** (Marsupials) - Late Cretaceous to Recent
Superorder **Eutheria** (Placentalts) - Late Cretaceous to Recent
Evolution of Mammalian Superorders

- Tricodons
- Multituberculates
- Monotremes
- Metatheria (Marsupials)
- Eutheria (Placentals)

Extinct:

Live Birth

Mammary Glands?
Teeth, breasts, feathers, and hair all develop from the interactions between layers of skin.
Mammals in the Age of Dinosaurs – a nocturnal life style
Hadrocodium, a lower Jurassic mammal with a “large” brain (6 mm brain case in an 8 mm skull)
Were larger brains adaptive for a greater sense of smell?

Big Brains and Early Mammals

July 14, 2011

The Academic Minute

http://www.insidehighered.com/audio/academic_pulse/big_brains_and_early_mammals
Lower Cretaceous mammal from China
Jawbones of a Cretaceous marsupial from Mongolia
Mammal fossil from the Cretaceous of Mongolia
Reconstructed Cretaceous Mammal
Early Cretaceous mammal ate small dinosaurs

*Repenomamus robustus* fed on psittacosaurs.

*Image: Xu Xiaping, 2005*
Repenomamus robustus
Repenomamus robustus with small dinosaur in the gut
Modern Elephant Shrew – what is the long nose for?
Weasel hunting at night
Bats, such as this vampire bat, hunt at night.
Monotremes: Platypus
The Platypus

adult

baby

egg
Monotremes: Echidna
The Echidna
Typical Marsupial, a Kangaroo
Poorly developed newborn kangaroo attached to a nipple in the pouch.
Australian Marsupials

Koala  Numbat  Pademelon
Wallaby – Victoria State, Australia, March 2014
Australian Marsupials

Quokka

Sugar Glider
Tasmanian Devil
The extinct Tasmanian “Wolf”
Convergent Evolution between Marsupials and Placentals
An extinct marsupial sabertooth “cat” from South America
North American record of mammal orders

Alroy, 1999
Figure 13.9. The evolutionary radiation of placental mammals, modified from Novacek (1994). (Drawing by Carl Buell)
Figure 1. Mammalian phylogeny for living taxa based on (A) morphological evidence (after Shoshani and McKenna, 1998) and (B) nuclear and mitochondrial DNA sequence data (after Springer and Murphy, 2007). For each tree, colors distinguish major placental clades recognized. Lightly shaded dashed lines indicate the orders that have been moved in the left-hand tree to correspond with the right-hand tree. This was done for the sake of readability.
