The Mesozoic

Mesozoic
Things to think about

• Breakup of Pangea and its relationship to sealevel and climate
• Dominance of reptiles
• Origin of birds
• Origin of mammals
• Origin of flowers (angiosperms)
• Expansion of insects
• Life in the seas assumes an (almost) modern form
FIGURE 3.—Map showing the extent of Tethys (a deep, open sea) bounded by thick dark lines, plotted on a global Cretaceous plate reconstruction (from Kaufman, 1973), and within it, the possible distribution of a warmer, somewhat hyper saline marine climatic zone. Superimposed on it is the possible distribution of a cooler, more marine climatic zone (NT) to north and south, as developed during warm climatic intervals of the Cretaceous during suitable highstand. Tethys is defined on the limits of Cretaceous fossil development. Numbers refer to paleobiogeographic divisions of the Cretaceous in Kaufman (1973). Those pertinent to this paper are: 1) North American Interior Province; 2) Gulf and Atlantic Coast Province; 3) West Central American Subprovince (Central American Province); 4) Anillo Subprovince (Caribbean Province); and 5) Western Mediterranean Subprovince (Mediterranean Province).
The history of diversity of each of the three “evolutionary stages” (Figure 2) in the marine fossil record, with illustrations of major taxa. (From Sepkoski 1984)
Triassic Period

248 to 206 Million Years Ago

Early Triassic  237 Ma
The Connecticut River Valley
Jurassic Period

206 to 144 Million Years Ago
Cretaceous Period

144 to 65 Million Years Ago
Mesozoic Ammonites
Cretaceous Heteromorph Ammonites

*Nipponites mirabilis*
Kamchatka, Russia

*Macroscaphites sp.*

*Baculites sp.*

*Didymoceras stevensoni*

Rudistid Bivalves:
Jurassic-Cretaceous
*Durania cornupastoris* at Abu Roash, Western Desert near Gizah, Egypt

Reef-forming rudist (*Radiolites*) from Sarvak Formation, Cenomanian, south Iran.

Fringing Upper Cretaceous rudist reef reservoirs flanking basement highs, Augila oil field, eastern Libya
Biostrome of hippuritid rudists at Montagne des Cornes; Santonian, Pyrenees, France

Rudistid Buildups
Biostrome of *Vaccinites vesiculosus* (Woodward, 1855); Campanian of Saiwan, Oman

*Monopleura marcida*
Albian, Viotia, Greece
Pterosaurs
Ichthyosaurs
A Dinosaur Family Tree (aka Phylogeny)

Sauropods
Theropods
Dilong paradoxus
Early Cretaceous, China
A feathered tyrannosaurid?

A Dinosaur Family Tree (aka Phylogeny)
Ornithopods
(aka Hadrosaurs)

Thyreophorans
(aka Ankylosaurs, etc)
Margincephalians (aka Ceratopsians)

A Dinosaur Family Tree (aka Phylogeny)
The Liaoning Fauna: An early Cretaceous Lagerstatten

Some highlights:
-- feathered dinosaurs
-- preserved internal organs
-- oldest placental mammal
The Liaoning Fauna

Caudipteryx.

Microraptor gui

MICRORAPTOR zhaoianus.
The origin of birds

- Birds are the descendants of one branch of theropod dinosaurs
- Thus “birds are dinosaurs”
- “Non-avian” dinosaurs may have all had feathers, at least as juveniles or primitively
- Oldest known bird is *Archaeopteryx* from the Late Jurassic (ca. 150 million years old)
The Origin of Mammals

- Mammals and dinosaurs originated at the same time (ca. 220 million years ago – middle Triassic)
- Mammals originated from a group of reptiles called Therapsids (a.k.a. “mammal-like reptiles”)
Distinguishing characteristics of mammals

- Live birth (mostly)
- Fur
- Endothermy
- Mammary glands
- Skeletal characters
The evolution of the mammal ear & jaw from reptiles

Relationships among Therapsids and Mammals

Early Therapsids → Morganucodon → Monotremes → Multituberculates → Marsupials → Placentals

- Develop in pouch
- Develop in uterus with placenta
- Live birth, advanced molar tooth shape
- One bone in lower jaw
- Mammary glands, hair, ear bones on skull
- Articular-quadrato convert to ear bones, jaw joint moves
- Articular-quadrato used for both hoaring and jaw joint
- Increase teeth and occlusal complexity
- Single skull hole behind eye is large
Most Mesozoic mammals were small

⇔ cynodont therapsid

*Diademodon mastacus* juvenile.
Late Triassic, South Africa

The smallest known mammal! ⇒

*Hadrocodium wui*
Early Jurassic
E. Africa

⇔ *Megazostrodon*
Late Triassic- Early Jurassic
Africa, Body length ca 13 cm
The “Giant” Mesozoic mammal that ate a dinosaur:

*Repenomamus giganteus*

Early Cretaceous, China *(Nature, Jan. 12, 2005)*

Ca. 1 meter long
The oldest known placental mammal
Liaoning, China, Early Cretaceous

_Eomaia scansoria_

The Evolutionary Radiation of Placental Mammals
The origin of flowers

- Oldest undisputed angiosperm is Early Cretaceous
- Ancestor unknown
- By the end of the Cretaceous, angiosperms dominate most terrestrial environments
- Today, angiosperms are > 90% of all plant species
Archaefructus
– the oldest undisputed angiosperm
Early Cretaceous, China
Fig. 1. Family-level diversity of fossil insects through geologic time (2C), plotted at the level of stratigraphic stages and compared to the diversity of terrestrial tetrapod vertebrate families. We computed diversity with the range-through method, which assumes that a family was present in all time intervals between its first and last appearance (including the Recent), even if not directly sampled in all intervals. Abbreviations are C, Cenozoic; C, Cretaceous; P, Permian; T, Triassic; J, Jurassic; K, Cretaceous; and T, Tertiary.

Fig. 2. Timeline diagram showing all orders of fossil families within insect orders in stratigraphic stages of the Phanerzoic. A scale bar is shown in the lower right. Abbreviations are Pz, Paleozoic; Mz, Mesozoic; and Cz, Cenozoic. Listed illustrations are not to scale and represent time intervals of the most important orders. Angiosperms often make their first appearance approximately worldwide at the end of the Mesozoic, that is, just before the "K" of the "KT" boundary.