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Evolution lecture #8 **-- Fossils: Precambrian and Paleozoic --** Nov. 19th, 2008
required reading: 656-658 (ch. 32) 8th; 628-630 (ch. 32) in 7th
optional, for background: 698-735 (ch. 34) 8th; 671-707 (ch. 34) 7th

• Summary of topics for today

- Review and overview of the history of life
- Mass extinctions
- Summary of the geological time tale: eras, periods, and epochs
- Continental drift (plate tectonics)
- Precambrian period
- Paleozoic era

(see notes from last time)

• Major features of the early fossil record

mass extinctions: times during which rates of extinction were very much higher than during intervening times; a possible link to impacts of extraterrestrial bodies.

stromatolites: banded layers of sediments (limestone) containing bacterial mats.

cyanobacteria: photosynthetic, oxygen producing bacteria -- caused a turnover in the atmosphere to oxygen ~ 2 BYA

See Table 25. 1 (8th); Table 26. 1 (7th)

PRECAMBRIAN - 4.6 billion to 542 MYA

In billion years (BYA)

~15 Big Bang, formation of the universe

4.6 earth forms

3.8 origin of life?

3.5 oldest known definitive evidence of life on earth (prokaryotes)

~2 oldest known definitive fossils of eukaryotes (well defined nucleus)

1.5 eukaryotes proliferate

endosymbiotic theory: in addition to the nuclear genome, mitochondria have a genome, as do the chloroplasts of cells. The organization and expression of mitochondria and chloroplast genomes show considerable similarities to that of some prokaryote cells, suggesting that the evolution of eukaryote cells involved a process in which a precursor to the eukaryote cell (protoeukaryote)

engulfed (endocytosed) a prokaryote cell (the symbiont) (see Fig. 28.2 (8th); Fig. 26.13 (7th)). Such a process is termed endosymbiosis, and this is thought to have conferred a selective advantage to the resulting new cell. The genomes of the engulfed prokaryote cell and the host cell are envisaged to have given rise to the present day mitochondrial and nuclear genes respectively.

700 Myr origin of first animals, soft bodied marine invertebrates.

Doushantuo fossils (Southern China) – sponges, animal embryos, cyanobacteria, multi-cellular algae (shallow water marine invertebrate habitat, dominated by photosynthetic organisms, scattered among them are tiny animals who filtered organic debris from the water)

Ediacaran fossils (South Australia) – large sponges, jellyfish, many burrows, tracks, and other trace fossils from animals, no animals with shells were present (shallow water marine habitats, containing a diversity of animal species, none have limbs or mouths or feeding appendages, suggests animals burrowed in the sediment, sat immobile on the sea floor, or floated in the water and did actively hunt and capture food, but simply filtered organic materials from their surroundings) (fig. 32.4 8th; fig. 32.5 (7th)).

542 Myr (Paleozoic era)

(Cambrian, Ordovician, **Silurian**, **Devonian**, **Carboniferous, Permian)**

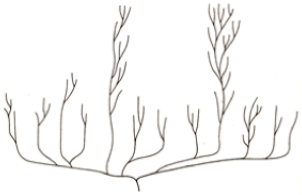
Beginning of an abundant fossil record

Cambrian "explosion" (adaptive radiation) – this was a time of great innovation, the appearance of hard shells and exoskeletons, all the phyla existing today originated early in the Cambrian, and there were many diverse algae (see fig. 32.5 8th; Fig. 32.6 (7th)).

There was a tremendous increase in the size and morphological complexity of animals, accompanied by diversification in how they made a living. The Cambrian seas were filled with animals that had eyes, mouths, limbs, and shells. They were predators, scavengers, filter feeders, and grazers.

Burgess Shale (British Columbia, Canada) and Chengjiang (China) fossils – few if any species of the Ediacara are seen, new species of sponges and jellyfish are seen, and entirely new groups present as well, especially the arthropods and mollusks, and even a chordate.

- Hallucigenia
- Opabinia



"Cone of increasing diversity" or "Decimation and diversification"?

Marine Animals:

• invertebrates with shells, exoskeletons

e.g., **trilobites:** marine arthropods that were extremely abundant in the Paleozoic

• primitive vertebrates (jawless fish)

• jawed fish (Fig. 34.2, 34.13, and 34.14 (8th)); (Fig. 34.13, and 34.20 (7th))

Transition to Land - what are the major problems land organisms had to deal with?

- reproduction
- UV radiation
- water relationships

• animals on dry land (arthropods) - millipedes, scorpions, spiders

• amphibians (Fig. 34.19 (8th & 7th) and insects (wingless) on dry land, cockroaches, mites, crabs

• mammal-like reptiles (synapsids)

• land plants -- early species were *poikilohydric* (i.e., their water content matched that of the surrounding environment) and *desiccation-tolerant*

• gymnosperms Fig. 30.5 (8th); Fig. 29.7 (7th) - evolution of the *seed*

• "reptiles" (Fig. 34.24 (8th); Fig. 34.23 (7th))

• extensive forests of vascular plants with giant club-mosses, horsetails and ferns in the Carboniferous, and insects with wings (Fig. 29.16 (8th); Fig. 29.15 (7th))

Mass extinction at end of Permian, primarily marine (trilobites extinct): Pangaea forms, sea levels reduced, volcanic activity

Questions relating to lectures on the fossil record

1. Do self quiz questions 2&3 on page 735 of the 8th edition, or do self quiz question 2 on page 637 of the 7th edition.