Palaeontology

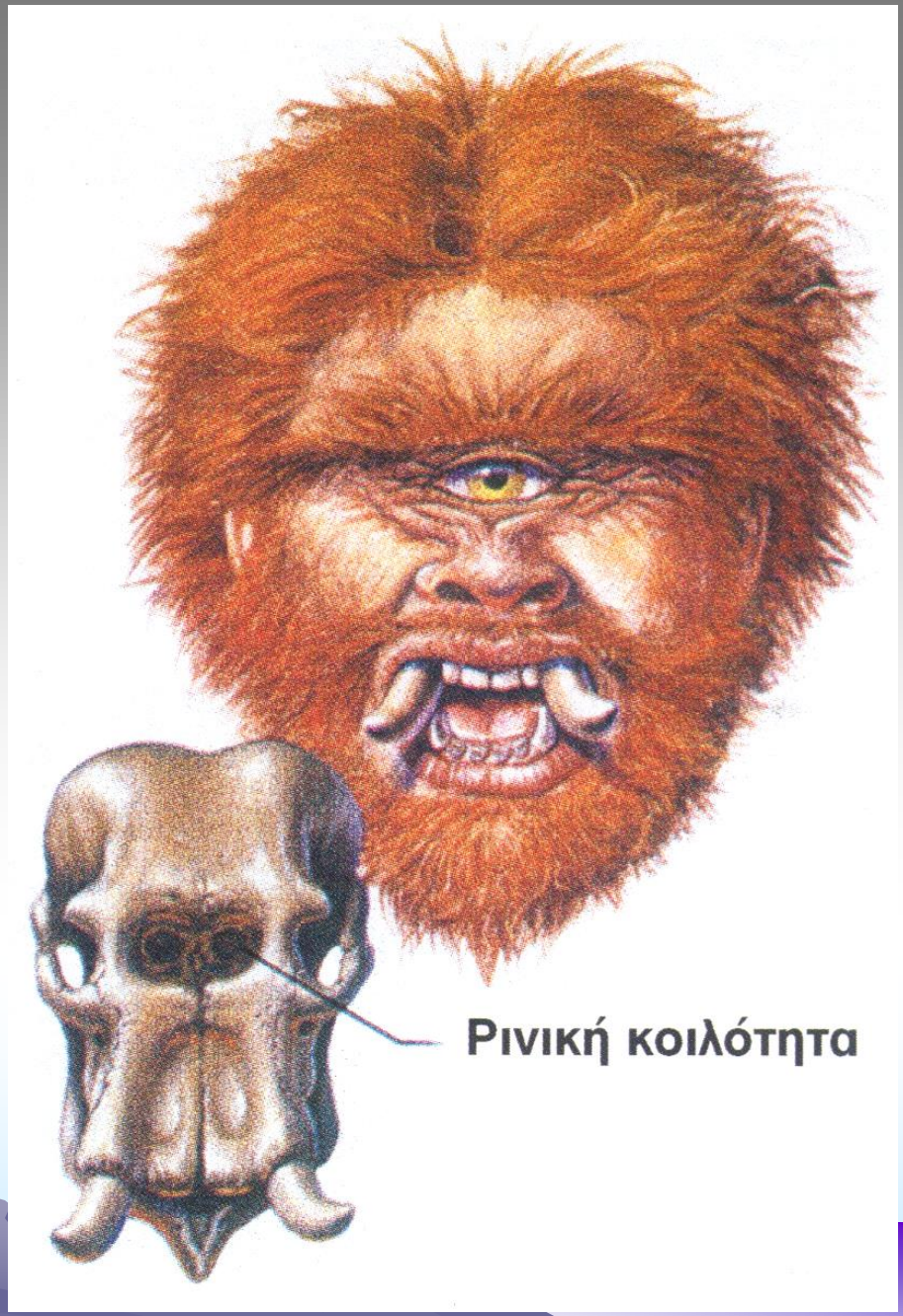
Lecture 2

Classification

When were the first fossils became known to humans?

Giant fossil bones in surface deposits, provided convincing evidence and helped to bolster myths, legends and folklore.

Stories about giants and dragons, in Greek mythology cyclops, titans, etc., the Celtic Finn, the Scandinavian Ymir, the Anglo-Saxon Gog and Magog


Ρινική κοιλότητα

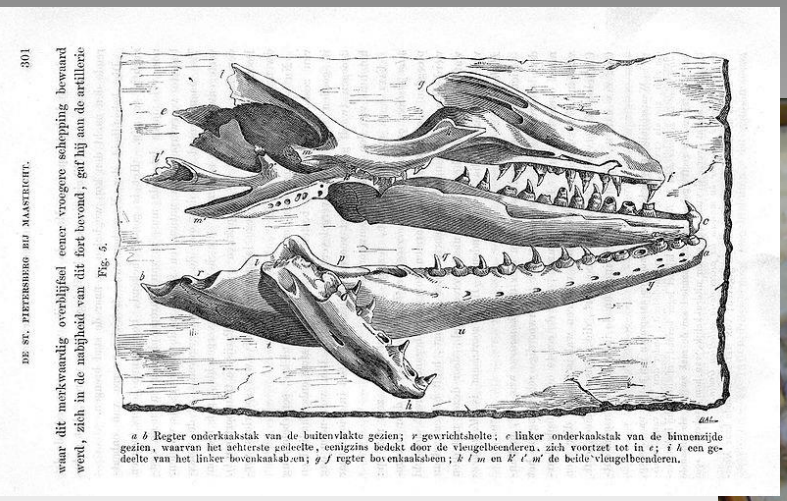
The classical literature from Herodotus (5th century BC) to Augustinus (4th century AD) is full of references of scattered bones

Some provide rather accurate determinations, like Euphorion (200BC) and Plutarch (100AD) who mention in their works the Neades legend from the island of Samos (Greece). Euphorion mentions that the bones found on the island belong to gigantic and dangerous animals that once occupied the island and Plutarch states that some of the bones belong to the remains of war elephants used by Dionisus to defeat the Amazons on Samos.

The first person to illustrate a genuine fossil is Conrad Gesner in 1558, a fossil crab.

Niels Stensen or better known as Steno (1638-86), who is commonly acclaimed as the “founder” of palaeontology, stratigraphy and crystallography, helped to resolve the nature of fossils and determined their organic origin

Maastricht monster (1780)



Mosasaurus hoffmannii

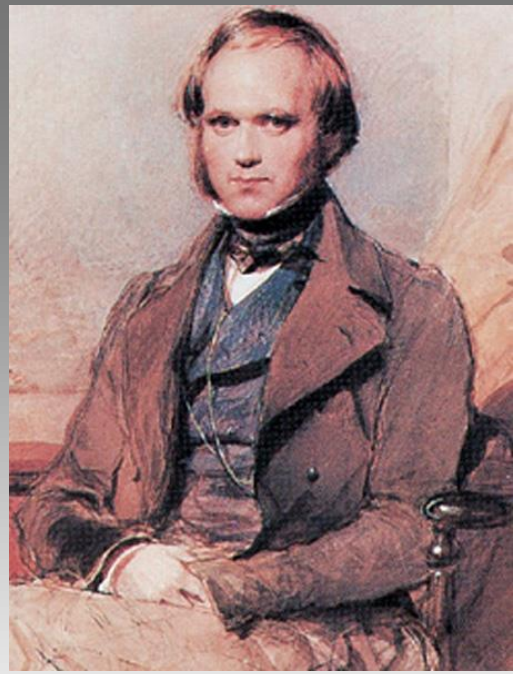
Fossil Succession (William Smith, 1769-1839)

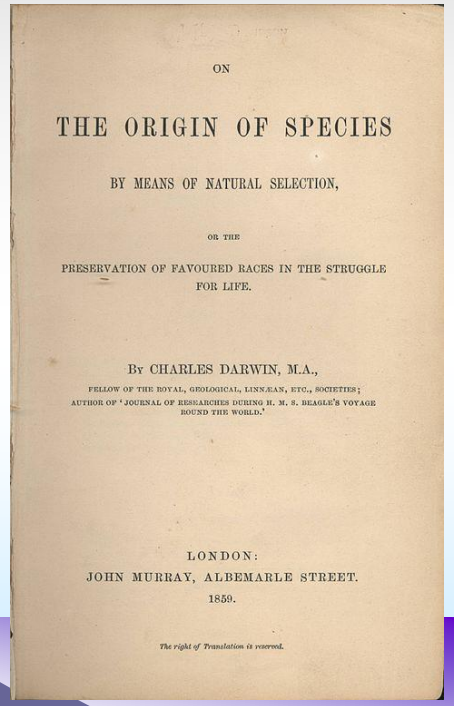
In 1816 the British engineer **William Smith** discovered that in thick sequences of sedimentary rock the fossils they contain change in a systematic fashion. This pattern is repeated throughout the world, and thus by finding distinctive fossils geologists can correlate rocks in widely separated areas and determine that they have the same relative age.

Geologists interpret this succession as the result of evolution

Evolution

- Geologist, botanist and then zoologist, Charles Darwin (1809-1882) provided a hypothesis to explain this succession of fossils.
- Being a student of Lyell, and affected by the ideas of Lamarck, and Malthus (evolution of economy) and after his long trip with H.M.S. Beagle (1831-1836) as a naturalist, in November 1859, he published his book "*On the Origin of Species by Means of Natural Selection, or The Preservation of Favoured Races in the Struggle for Life",* and it is this book which is now generally referred to as "*The Origin of Species* ", in which he set out his ideas in full





ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNÆAN, ETC., SOCIETIES;
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

The right of Translation is reserved.

1861

Taxonomy (or Systematics)

The science of classification of organisms, which explores the relationships and similarities between organisms.

Classification

- Archiving system
- Storage and retrieval of data, related to the relationships of organisms
- Fundamental unit: “species”
- Carolus Linnaeus (Linne), 1758, Systema Naturae

Biological species concept

All the members of different populations that naturally interbreed, and produce a viable offspring.

Morphological species concept

An assemblage of forms that have very similar appearance to be identifiable as one of a kind, and which differ from all others by clear characters.

Palaeontological species concept

An assemblage of forms of similar geological age that have very similar appearance to be identifiable as one of a kind, and which differ from all others by clear characters.

(used in palaeontology)

The cell

- The basic unit of living organisms
- All earth life is organised into cells (except viruses and virons)
- The cell structure provides a boundary (membrane) to separate the external from the internal environment where biochemical reactions occur and house DNA and RNA

Types of cells

a. Prokaryotic (Pro=before and karyon=nut, seed or nucleus) cells

b. Eukaryotic (Eu=well, hence true and karyon=nucleus) cells

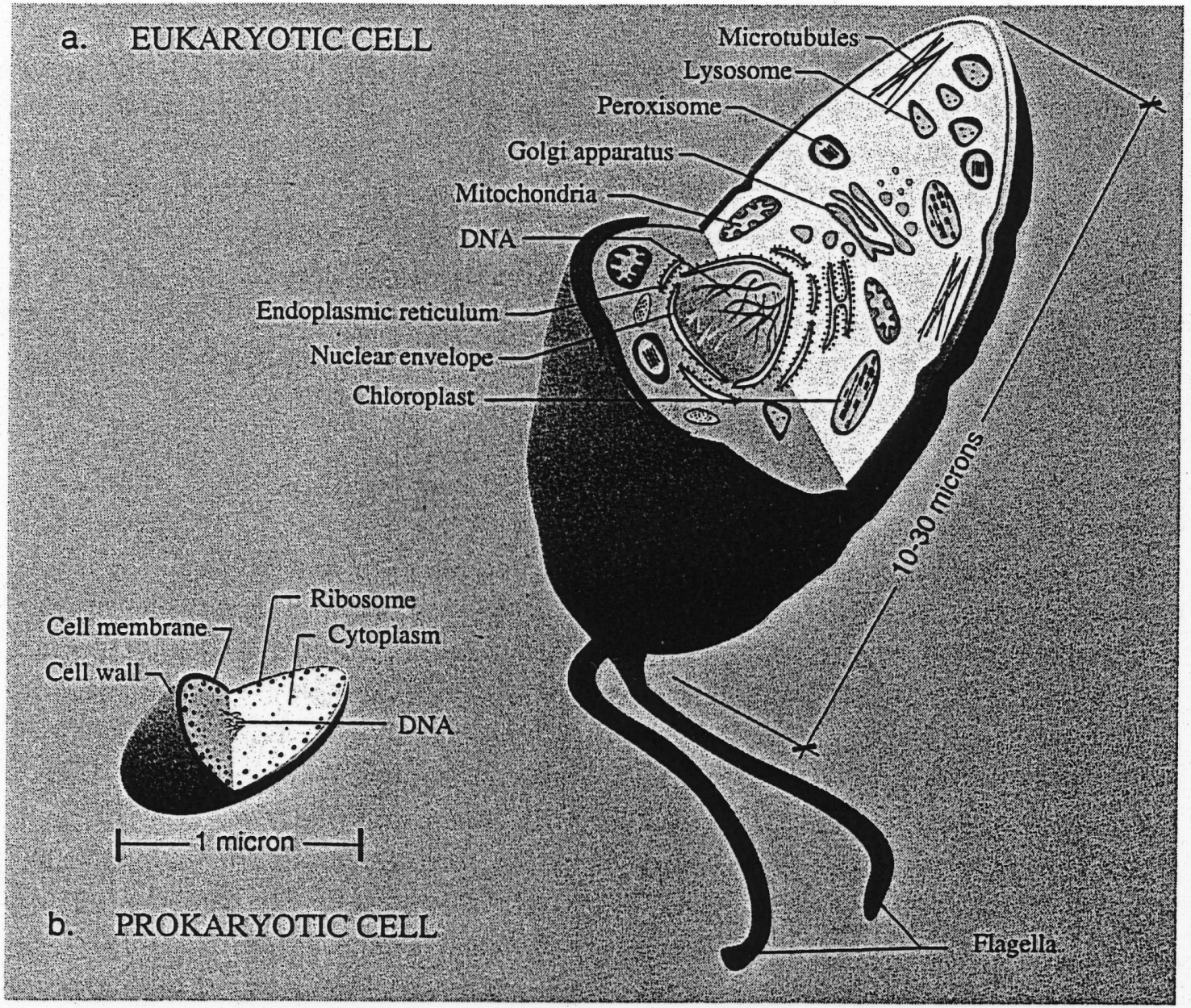


Figure 12.4. (a) Generalized eukaryotic cell, with structures and organelles shown. (b) Prokaryotic cell (a bacterium).

Prokaryotic cells

- Mostly small (0.2-10μm)
- Exemplified cells (bags of cytoplasm)
- A loop of DNA in cytoplasm
- No organelles
- Ribosomes in cytoplasm
- Aerobic and anaerobic
- Divide by simple splitting process
- Non motile or with simple flagellum
- Primitive, bacteria and cyanobacteria

Eukaryotic cells

- Mostly large (10-100μm)
- More complex cells
- DNA housed in nucleus
- Organelles in cytoplasm (plastids and mitochondria) and ribosomes
- Endoplasmic reticulum
- Most eukaryotes utilise O (aerobic)
- Reproduce by more complex processes (mitosis or meiosis)
- Usually motile with more complex flagella
- Later arrivals in the history of life, protists, fungi, plants and animals (advanced)

Linnaean classification

- Binomial name: generic name + specific name
- Generic name, first letter capitalised
- specific name, lower case letters

Canis familliaris

Canis familliaris

Linnaean classification

Canis familliaris (dog)

Canis lupus (wolf)

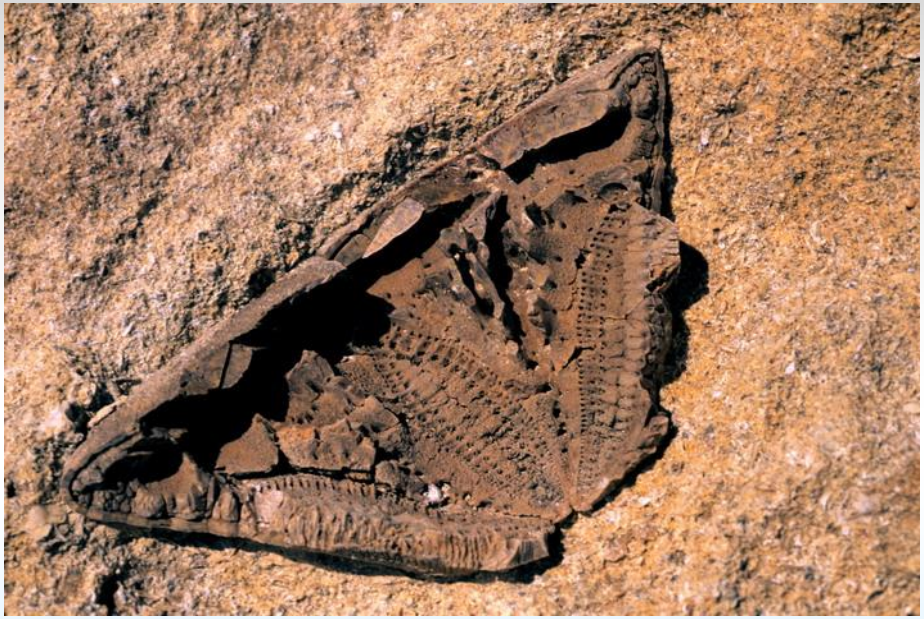
Canis latrans (coyote)

Full taxonomic nomenclature includes author's name and date of first publication

e.g. Felis domesticus (Linnaeus 1778)

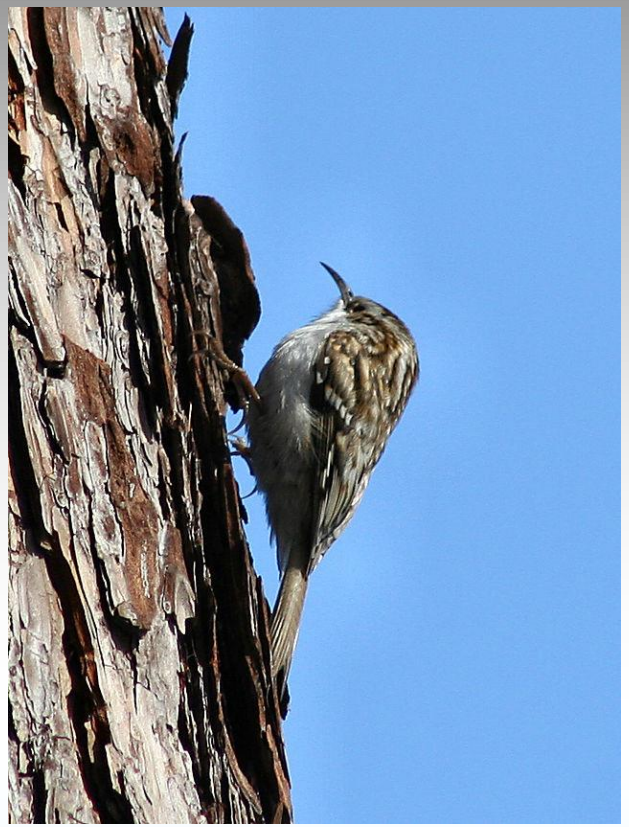
- In palaeontology species definition based on morphological criteria
- Mainly on morphology of preserved hard parts

Difficulties of palaeontological species



Intraspecific variation

Tween species



Certhia familiaris

Certhia brachydactyla

Hybrids (interspecific reproduction)

Canis familliaris

Canis lupus

Canis latrans

Coydog

Based on all these how easy if the determination of palaeontological species?

- In Paleontology the definition of the species is based on purely morphological criteria
  Mainly in the morphological features of the retained hard parts
  So most of the time the determinations will not necessarily be complete and completely accurate due to the lack of all the necessary data.

Determinations with DNA

- Lately techniques (amplification) that allow the extraction of DNA from fossils, but there are many limitations
- Preservation of DNA depends on the burial process. Maximum likelihood of fossils preserved in permafrost.
- Eventually a very small the number of fossils in which intact DNA fragments are retained, older fossils successfully extracted DNA 800000-1000000 years
- Infinite quantities are preserved- not easily detectable from special machinery

New species definition

- Description of all morphological features
- Comparisons with other similar species
- Identification of unique characters that distinguish it from the others
- The description is based on type specimens which after publication must be kept in museum collections
- Type specimens accessible for study
- The best preserved is selected to be the reference specimen, the holotype
- Specimens that may add additional information are called paratypes

Classification

- Grouping in taxonomic categories artificial and subjective, but it should reflect ideally evolutionary relationships

Species grouped in genera (singular genus)
Genera grouped in families
Families grouped in orders
Orders grouped in classes
Classes grouped in phyla (singular phylum)
Phyla are the largest division of kingdoms

Classification

Superkingdom	Eukaryota
Kingdom	Animalia
Superphylum	Deuterostomia
Phylum	Chordata
Subphylum	Vertebrata
Class	Mammalia
Order	Primates
Family	Hominidae
Genus	*Homo*
Species	*Homo sapiens*

According to their cell type organisms are separated into Three superkingdoms

1. Archaea
2. Bacteria
3. Eukaryota

6 Kingdoms of organisms

1. Archaea

Archaebacteria

2. Bacteria

Eubacteria

3. Eukaryotes
    a. protista (or protoctista)
    b. fungi
    c. plantae
    d. animalia

Specific names

1. Descriptive *(Deinotherium giganteum)*
2. Geographic (*Lutrogale cretensis*)
3. Geological (*Globorotalia miocenica*)
4. Names or mythological (*Mene psarianosi*)
5. Mixed