

Palaeontology

Lecture 1

Introduction

Palaeontology

From the Greek words palaeos+on+logos

palaeos= old, ancient

on= living

logos= study

The study of the remains or traces of life of ancient life-forms, found in sedimentary rocks

These remains are described as **fossils**

The word fossil derives from the Latin word fossa= ditch and fossilis= dug up

Fossils represent preserved or replaced parts of once living organisms (**body fossils**), or they have been formed by the behaviour of these organisms (**trace fossils**) e.g. locomotion, burrowing, coprolites, etc.

Palaeontology is related to :

other earth sciences, stratigraphy,
geochronology, geochemistry, sedimentology,
etc.

biosciences, botany, zoology, ecology,
taxonomy, evolution, etc.

Subdivisions of palaeontology

- ***Invertebrate paleontology*** – study of fossil animals without a vertebrate column (backbone)
- ***Vertebrate paleontology*** – study of fossil animals with a vertebrate column
- ***Micropaleontology*** – study of microscopic forms
- ***Paleobotany*** – study of fossil plants
- ***Palynology*** – study of spores and pollen
- ***Ichnology*** – study of trace fossils
- ***Paleoecology*** - ancient organisms and relation to environment
- ***Taphonomy*** – study of the post mortem controls on the preservation of fossils

Fossils;

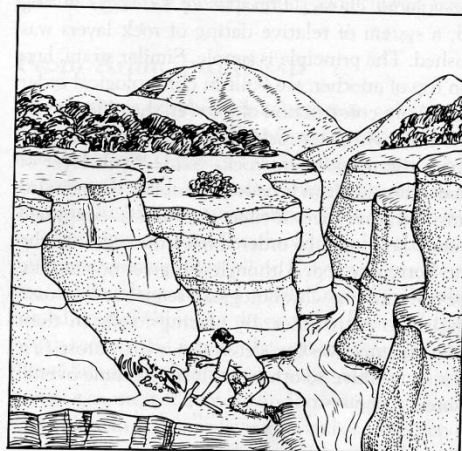
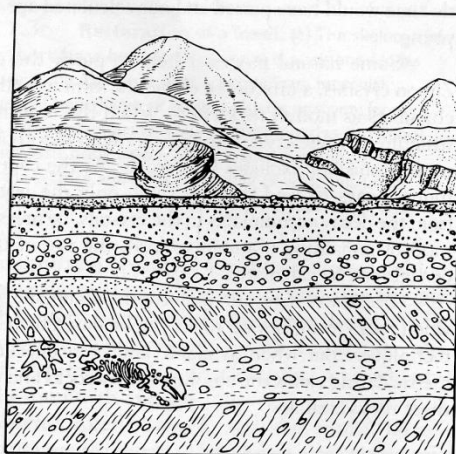
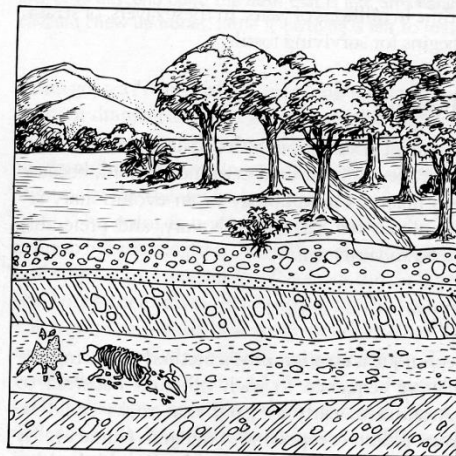
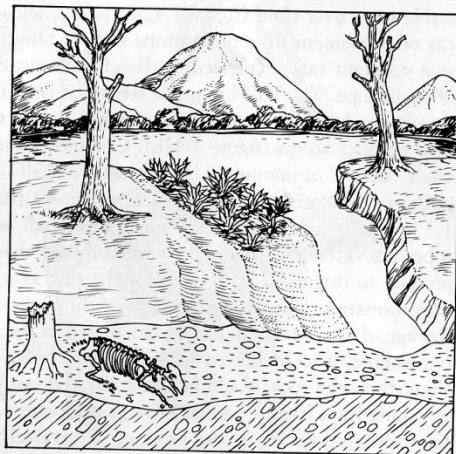
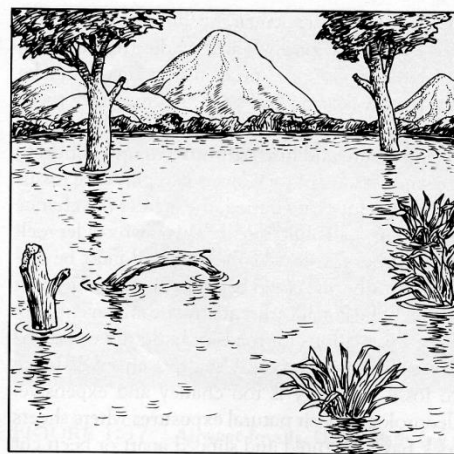
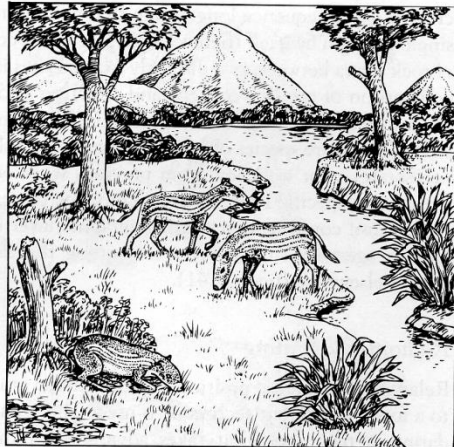
- Paleontology deals with the study of fossils
- "The fossils represent the preserved or replaced remains, or traces of life of prehistoric life forms found in sedimentary rocks"
- Older than 10,000 years

Fossilisation

- The set of inorganic processes that allow an organism or parts of it to be preserved after its death, and after its immediate burial.

This process is rare and only occurs in sediment deposition areas.

Only a small number of organisms are getting fossilized (about one species every 5000).



Preservation of fossils



Soft parts: proteins, lipids, etc.

Hard parts: bones, teeth, shells, wood

In vertebrates carbonated calcium phosphate and collagen

In invertebrates calcium carbonate (calcite, aragonite), silica and chitin, collagen and conchiolin

In plants cellulose and lignin

Usually these fossilized remains are the hard parts of the organisms, such as bones or shells

Biological and physical agents easily destroy not only soft but hard parts as well

However, very rarely under special conditions the soft parts of the organisms can be also preserved

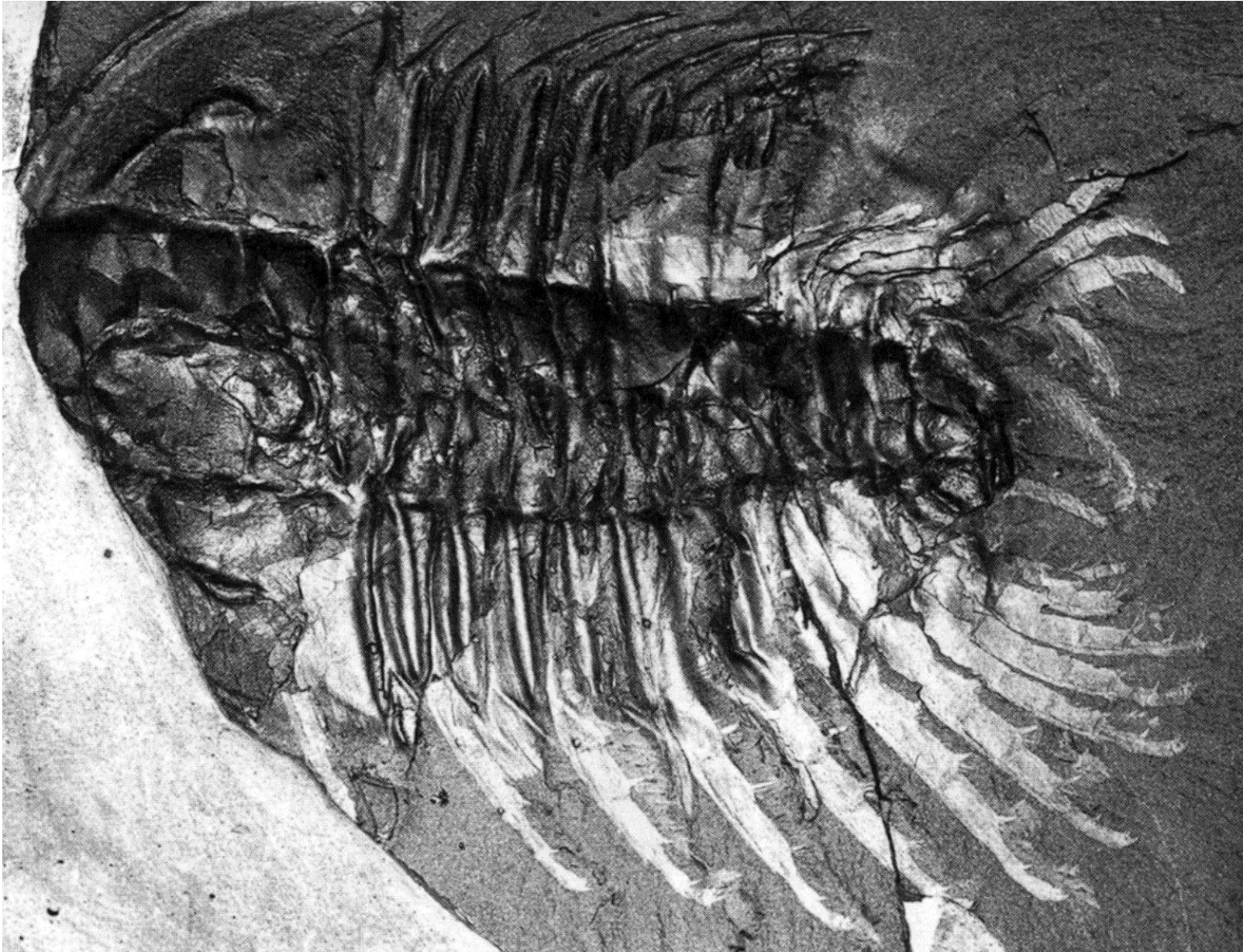


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Preservation of fossils (cont)

- Mostly hard parts are preserved

however

only if rapid burial and favourable diagenetic conditions take place

- Soft parts rarely preserved

Fast decay and decomposition of soft tissues

however

under special conditions soft tissues are preserved
exceptional preservation

→ (Lagerstätten)

Preservation

To maintain an organism as a fossil, it must:

- Have hard parts
- Be buried quickly under sediments
- After burial avoid physical, chemical, biological destruction

Fossils (categories)

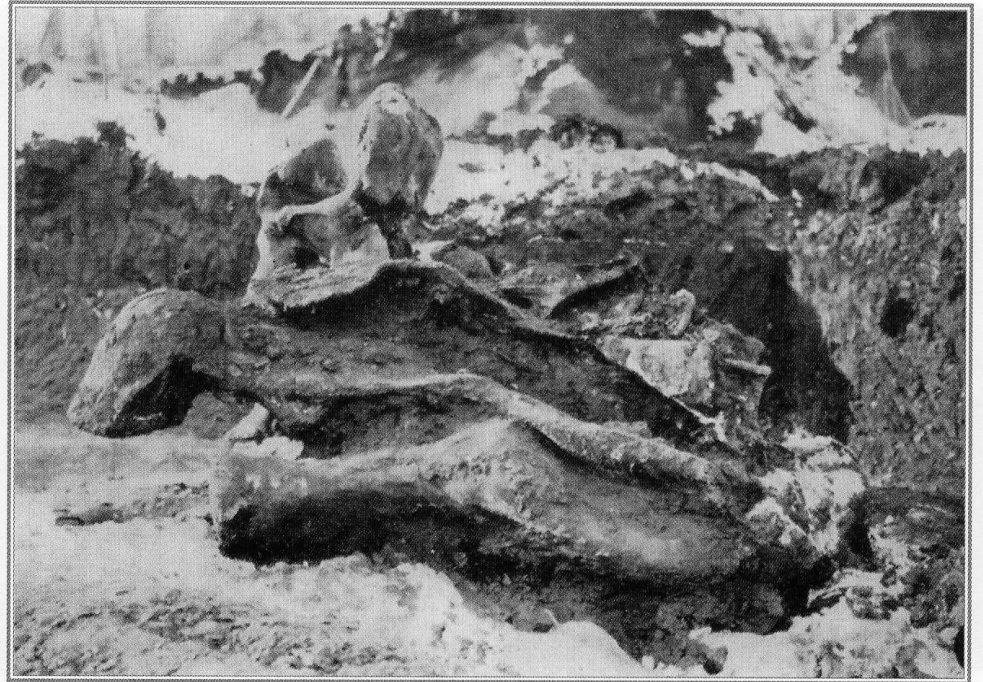
1. Body fossils
 - i. True
 - ii. Imprints
2. Trace fossils
3. Chemical fossils

Body fossils

- Preservation of soft parts
- Preservation of hard parts

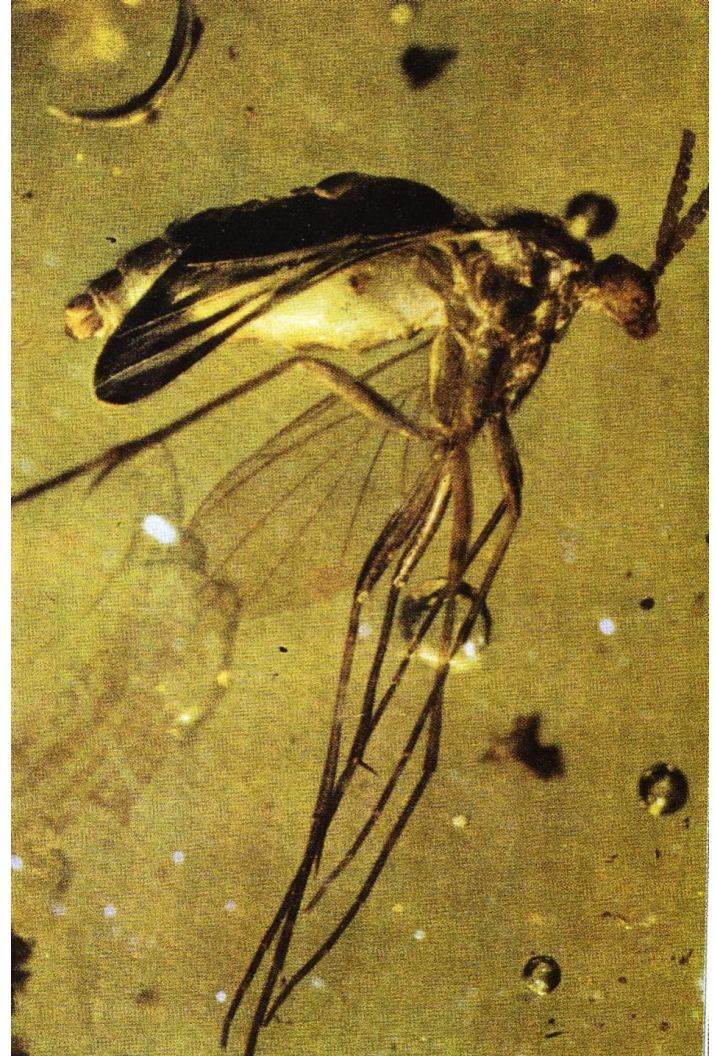
Soft parts

- **Permafrost:** Intact frozen animals in surface sediments



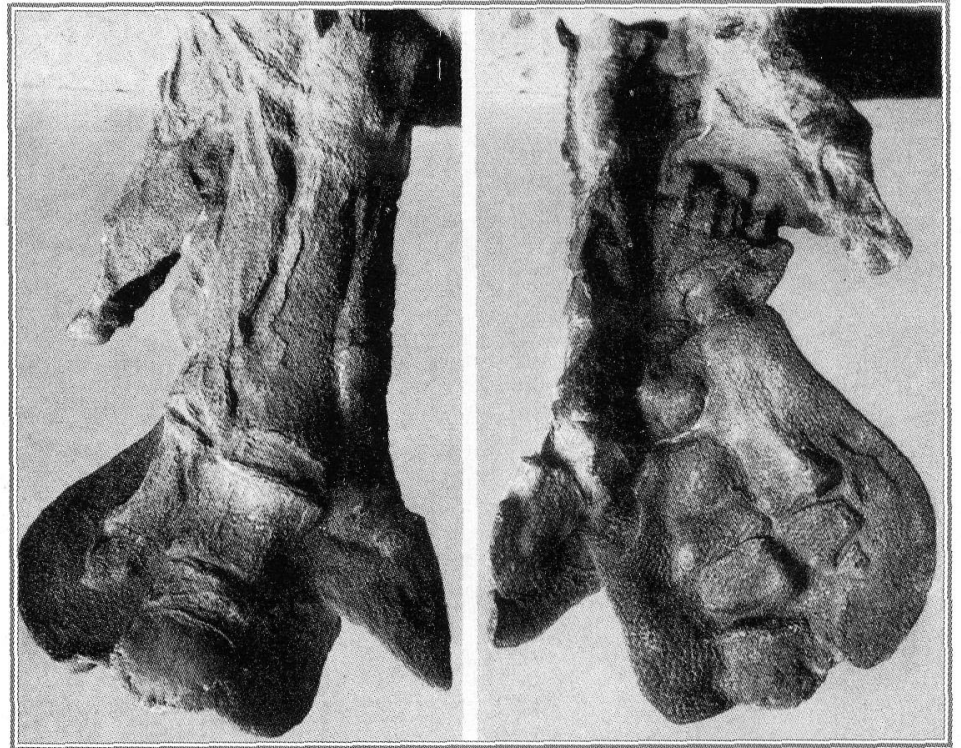
Soft parts

- **Amber:** Trapped and engulfed small creatures, especially insects in fossilised resin oozed from trees



Soft parts

- **Mummification:**
Dehydration of carcasses in hot and dry climates.



Soft parts

- **Tar:** remains enclosed in the residue left on evaporation of oil seapages



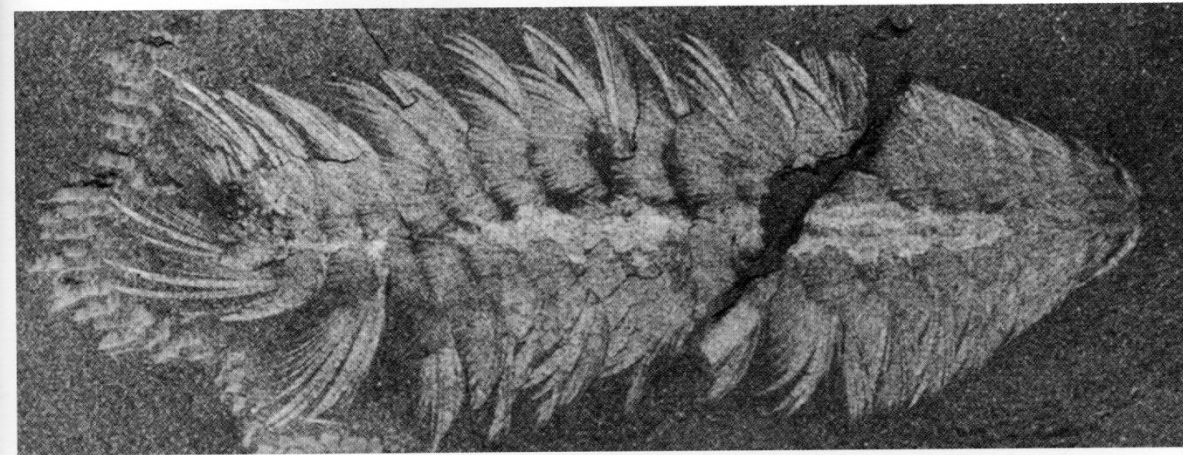
Soft parts

- **Peat:** Soft parts of animals are preserved in partly decomposed plant matter in water logged conditions, where bacteria and oxygen are excluded.



Soft parts

- **Impressions:** Traces of soft bodied organisms in fine-grained sediments



Soft parts

- **Carbonisation:** Organic materials of plants and animals (scleroproteins, chitin, cellulose, lignin) are easily carbonised and preserved.



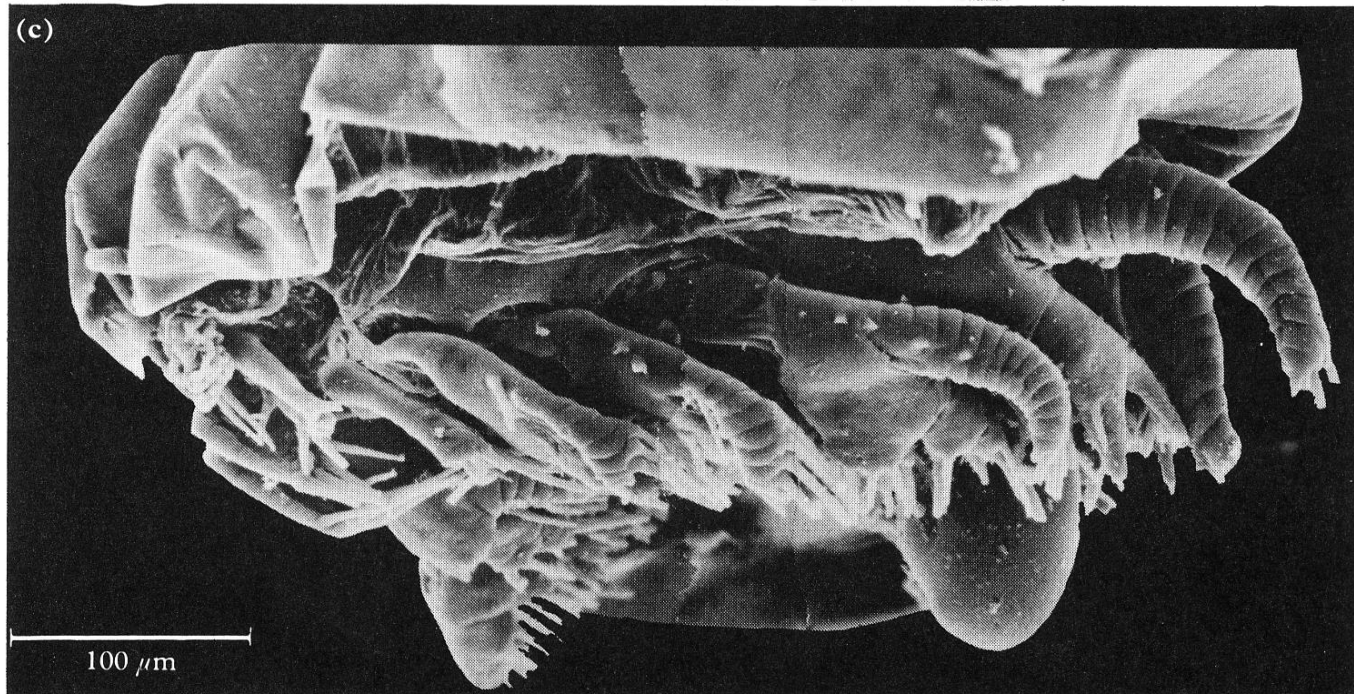
Soft parts

- **Pyritisation:** After burial in mud and under reducing conditions soft parts can be replaced by pyrite.



Soft parts

- **Phosphatisation:** Soft parts of organisms can be replaced by phosphate.



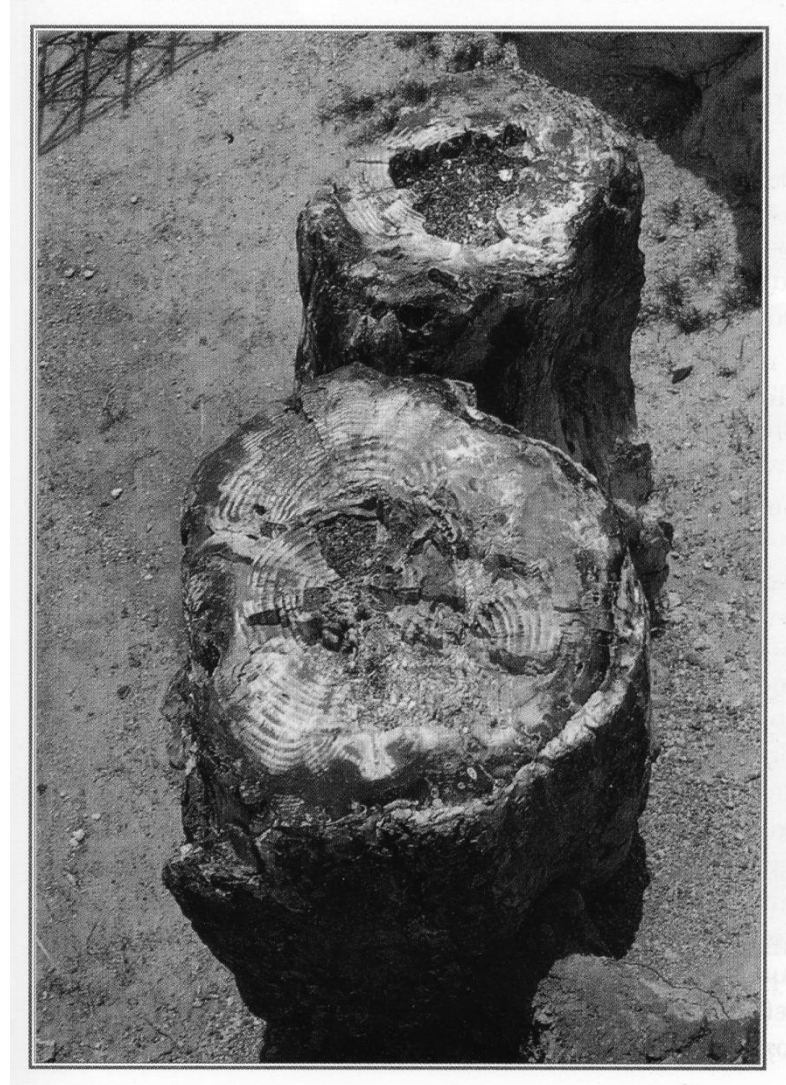
Hard parts

- **Aragonite to calcite:** The unstable mineral aragonite eventually converts to calcite



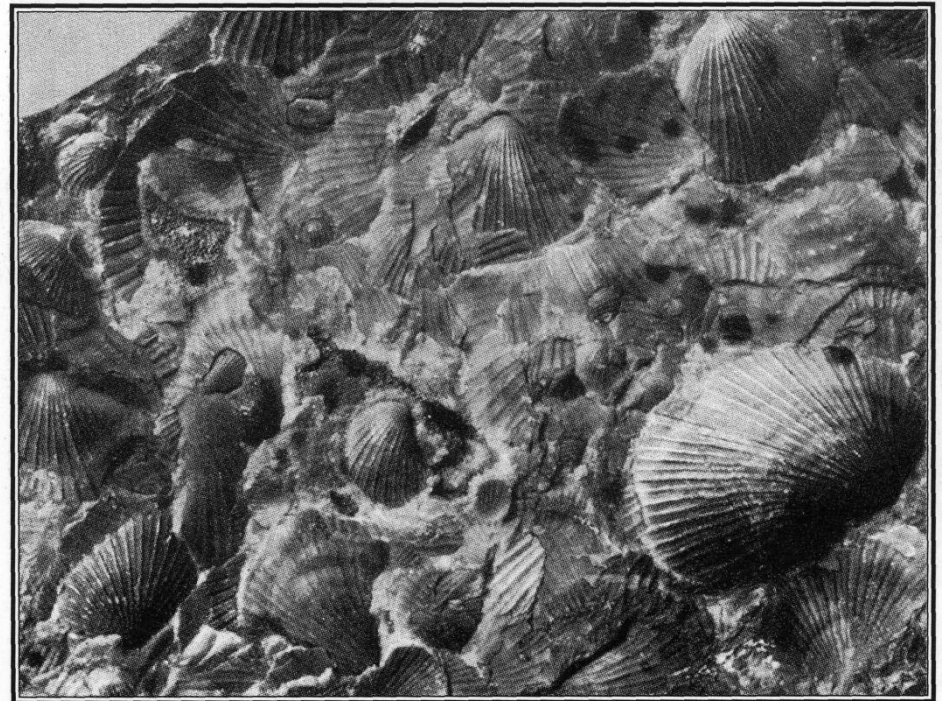
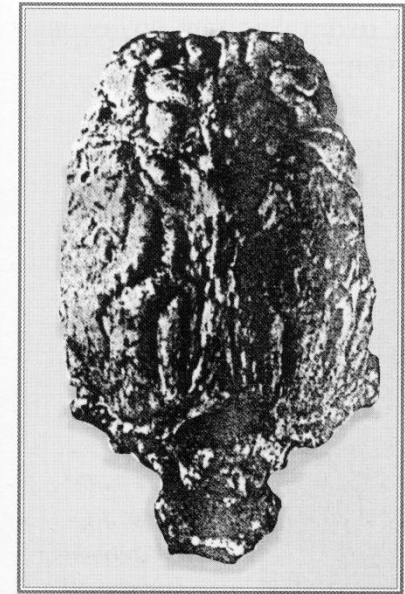
Hard parts

- **Petrification:** Hard parts are impregnated or replaced by minerals from solution in water through porous media



Hard parts

- **Solution of hard parts:**
Acidic waters can dissolve the hard parts of organisms. What is left is an external mould. If internal cavities filled with matrix, then an internal mould is formed.







- **Encrustation:** Usually, calcium carbonate or silica dioxide is deposited upon organic remains which will leave its impression.



Trace fossils

- Traces on or in the sediments formed by the activity of organisms

Trace fossil types

- Footprints
- Traces
- Burrows - in a soft sediment
- Borings - on hard materials
- Traces of roots
- Nests
- Eggs
- Coprolites
- Bite marks

Trace fossils

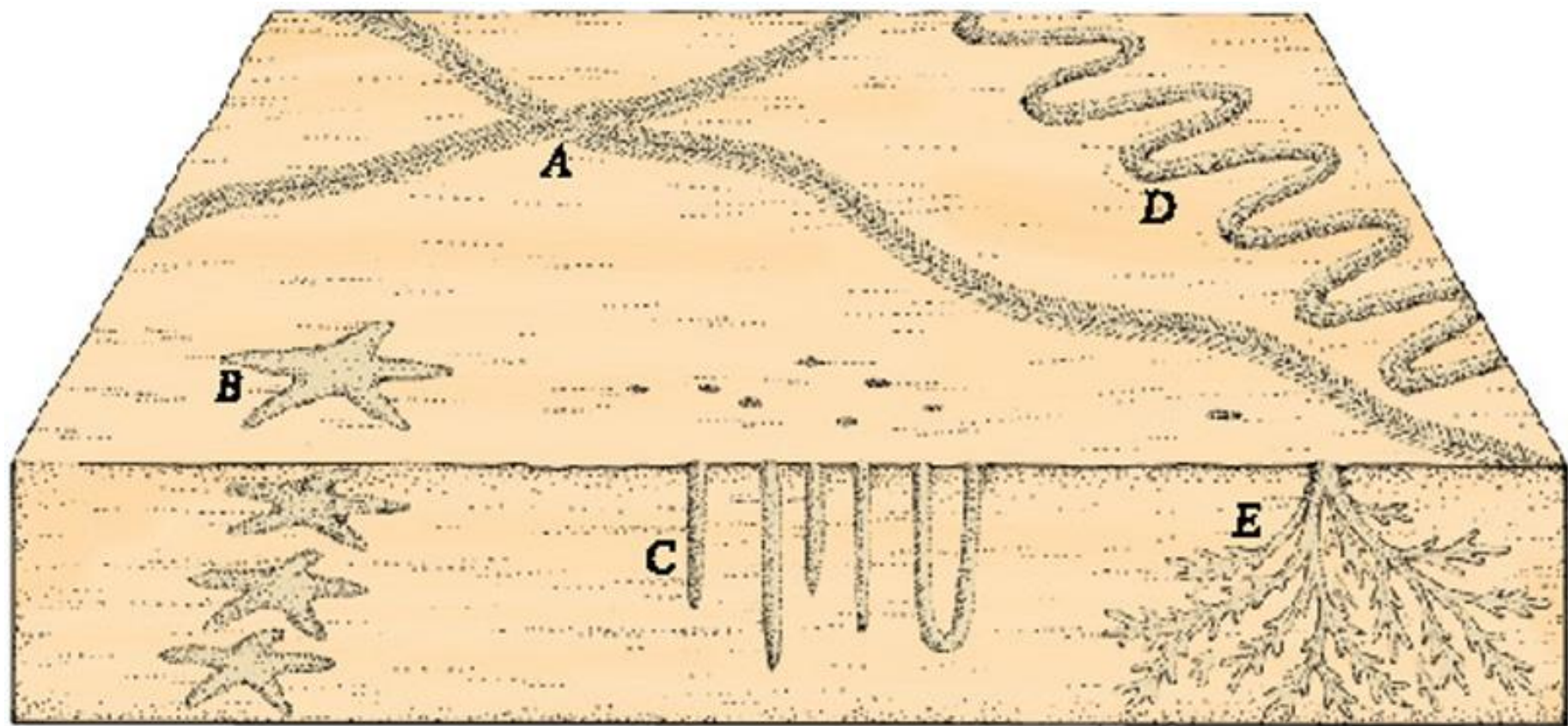
Trace fossils provide information on water depths, palaeocurrents, available food, and sedimentation rates.

Footprints provide information on the structure of the foot, the number of feet, the length of the foot, speed, behavior of organisms living in groups and the reactions among them.

Trace fossil categories

1. Resting traces
2. Traces of creeping
3. Traces of grazing
4. Traces of feeding
5. Traces of residence
6. Traces of traps
7. Traces of rapture
8. Traces of escape
9. Traces of balance
10. Traces of burial







chemical fossils

Sometimes also, although the actual body parts of organisms are absent from the rocks, relics of biogenic organic compounds may be detected geochemically

Pseudofossils

Structures or forms of inorganic origin that present similarities with organic remains (dendrites, loess etc.).



Ψευδοαπολίθωμα
Pseudofossil



- Plant and animal remains that went extinct and got fossilised during the Holocene epoch are called subfossils.
- Organisms that live today are called extant.

Fossil Types

1. Index fossils

Short stratigraphic range and wide geographical expansion

2. Preservative fossils

They are preserved without significant changes for large parts of the geological time

3. Facies fossils

They provide information about the palaeoenvironment in which the organisms lived

4. Transitional fossils

They present a combination of morphological features of two different main relative taxa and thus provide information concerning evolution

5. Frequency fossils

Taxa that present significant abundance in layers of specific geological age in a particular geological area