Geology – How to do it...No. 4 Fossils

Why are fossils important?

Fossils are 'smart' particles and can be used for many different purposes. They can give us vital environmental information as fossils were once living organisms adapted to a particular environment. This involves not just specifics such as water depth, nutrient or oxygen supply, but also climate. Fossils may also provide dating information for the rocks they are found within. Used individually they are important, but together they tell us about ancient ecosystems.

Collecting specimens or data?

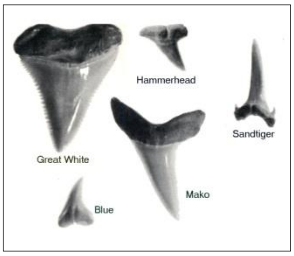
Collecting from working quarries or from wave torn beaches is good and can be considered rescue work. However, often fossils are best left where they are, as they are valuable for others to see and to interpret. If you do collect, then remember – the most valuable piece of information is where you found it – keep a label with the fossil. Only you know this, and *always* label both fossils and bags. Before you collect think – is the site protected by law? Have you the owner's consent to collect? Is it safe to collect? Is collecting really needed to add to your specimens or to aid your understanding?

Identifying fossils

This subject is beyond the capability of a short information sheet. However, pocket guides are useful to find the main groups of fossils, but identification to species level is often very difficult. Local specialist guides to a site can make this process much easier though, as it narrows down the potential species. The key at the end of this sheet shows the sorts of observations you need to make. Identifications are all about recognising patterns, textures and symmetry, plus 'special' features.

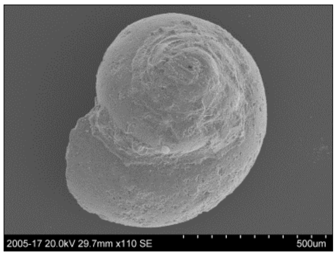
There are three broad groupings of fossils that might be useful to consider:

1. Body fossils – both plant and animals.
2. Trace fossils – the trails and tracks made by animals which show behaviour.
3. Microfossils – requiring a minimum of a x20 hand lens and usually a microscope.



Body: a variety of sharks teeth

Trace: burrows in soft sand



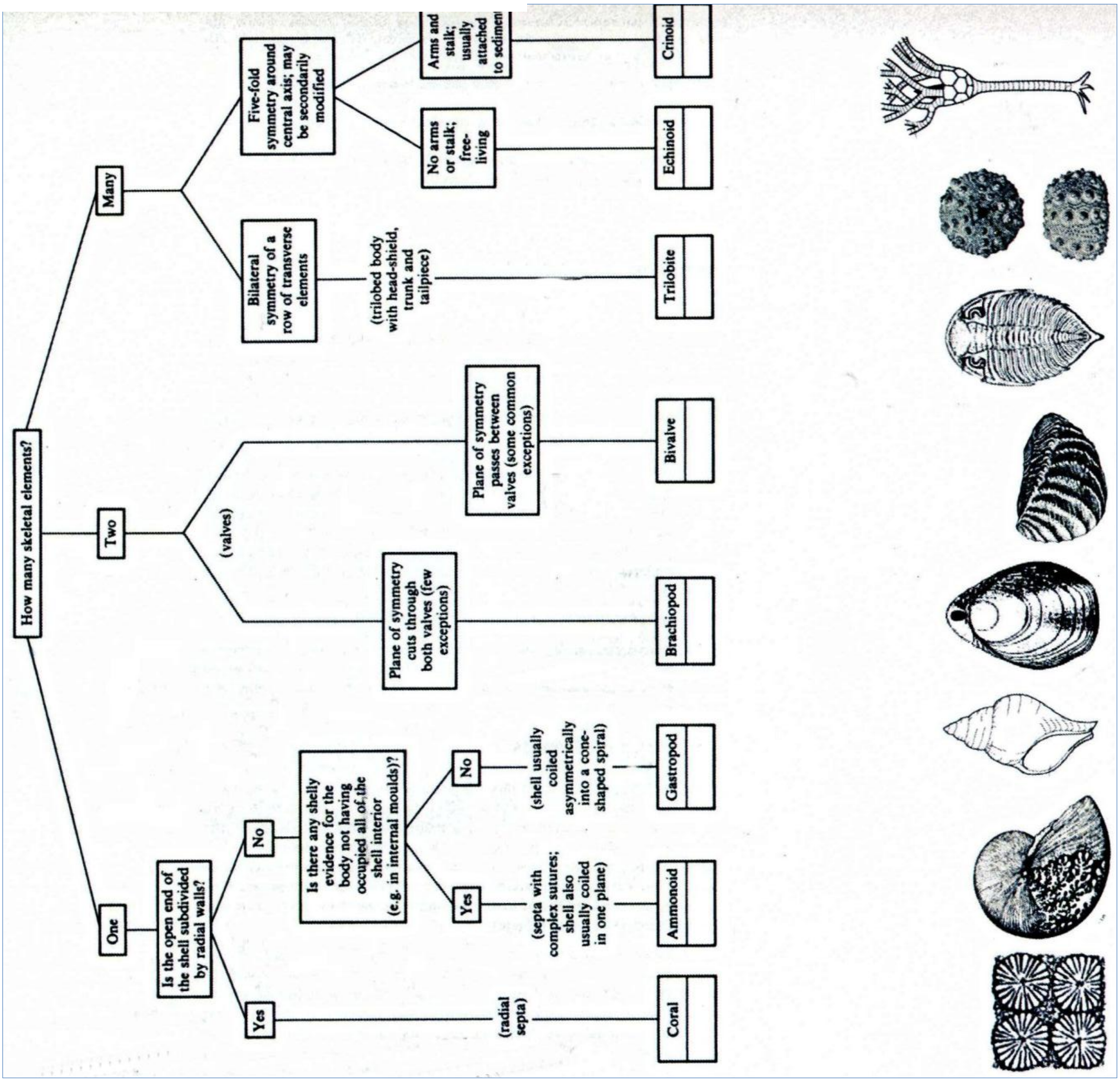
Microfossil: micro-gastropod

Fossil preservation

Recognising how the fossil is preserved is important to determine what has happened before, during and after burial. Fossils not in life position, and especially broken fossils, have been moved from the place they lived. Whole fossils in life position tell you a lot about the environment as does the sediment they are entombed within. Fossils may be preserved as original material (e.g. bone or shell) or they may be permineralised (replaced by a mineral such as silica, iron oxide or calcite). Fossils may also be preserved as a mould – the original body having been dissolved away after the rock had formed, leaving a cavity where it had been. You will find an internal and an external mould.

Prepared as part of the 'Rocks and You' programme funded by HLF

After Open University teaching materials from Geology S276



This key can be used to show the process of identification, but it will only assist with the 8 main types of invertebrate. Although these are very common in the fossil record, there are a lot more fossils to find – including many more invertebrates, plants, and all the invertebrate groups such as fish, amphibians, reptiles, birds and mammals!

Dating your rocks

Discovering your fossil group, and being sure it belongs in the rock you found it (that is, it has not been reworked from elsewhere), means you may be able to date your rocks:
Palaeozoic (540 to 250 Ma*): trilobites, brachiopods, graptolites, rugose & tabulate corals.
Mesozoic (250 to 65 Ma): ammonites, fish, belemnites, bivalves, reptiles including dinosaurs.
Cenozoic (65 Ma to present): mammals, scleractinian corals, bivalves.
Of course, if you can identify your fossil to a family or a species the date can be confined to a much smaller interval. *(*Ma = millions of years)*

Fossils common in Buckinghamshire

The rocks and sediments of Jurassic and Cretaceous age in Bucks hold a range of different fossils which show a variety of preservation styles. These fossils can often be *in situ* and tell us about the environment represented in that rock (such as the Oxford Clay or the Chalk). The Quaternary (Ice Age) sediments also show a variety of fossils, but these have all been eroded from older rocks and transported by ice or water to the Buckinghamshire localities. However, they are still lovely specimens (Jurassic *Gryphaea* also known as the 'Devil's toenail', or coral, sea urchins and belemnites from the Chalk, even fragments from Carboniferous (350 million year old) tree fern trunks have been found in our quarries (e.g. Stowe). Here is a little information on the main fossils:

Sponges

Sponges have been around from the Cambrian period 500 million years ago to the present day. Modern sponges have a protein skeleton, ancient forms were made from silica (quartz) or sometimes calcite. Sponges are common in the chalk (left image) and often are preserved in the centre of flint nodules (right). They are identifiable in these nodules by their porous texture – lots of tiny holes will be visible. **Marine**.

Sea urchins

Sea urchins (or echinoids) have been around since the Ordovician period about 480 million years ago. However they change their form over this time. Round urchins with long spines live on the sediment surface and are grazers; streamlined and heart-shaped urchins with small or no spines are burrowing animals and ingest sediment to extract organic matter. **Marine.**

Belemnites

Belemnites were present during the Jurassic to Cretaceous periods between 200 and 65 million years ago. The squid-like animal was very numerous in the warm seas of this period. Their internal skeleton is the bullet shaped fossil commonly found as it is a very robust form of calcite. It is so strong it survives being eroded and occurs commonly in glacial sediments. **Marine**.

Brachiopods

Brachiopods have been around from the Cambrian period more than 500 million years ago. They have two valves which are not the same size and the plane of symmetry runs through the shell. It is important to use this to distinguish them from bivalves as brachiopods are a good environmental indicator as they are always **marine**.

Bivalves

Bivalves, similar to brachiopods, have also been around since the Cambrian period *c*. 500 million years ago, and their shell also has two valves. However, the symmetry is different – the plane of symmetry runs *between* the valves. Each valve is similar in shape and a mirror image of each other. An exception to this rule are the oysters. **Marine, brackish or freshwater**.

Left – a hole in a bivalve caused by drilling by a predatory gastropod.

Gastropods

Gastropods (the slugs and snails) have been around since the Cambrian period 500 million years ago, but they only really became very abundant during the last 60 million years. They are usually recognised by an upwardly coiled shell, but there are flat coiled varieties. The inside of the shell is open and is occupied throughout by the animal. This is an identifying criterion to distinguish flat coiling types from ammonites below.
Marine, brackish, fresh water and land.

Ammonites

Although ammonites evolved in the Triassic they became common during the Jurassic and Cretaceous periods between 200 to 65 million years ago. They were so numerous and evolved so rapidly that they are very useful for precisely dating rocks. Sometimes a species was only in existence for a million years or so. Although there are many types of ammonite they can be recognised by a single shell which is

closed internally into little compartments. The compartments represent previous dwelling cavities of the squid-like animal – the animal making a new larger compartment as it grows. The compartments can be seen if the fossil is cut in half or from the outside if the outer shell is a little worn, the edges of these can be seen as complex sutures with the outer wall.

Image top left – *Schloenbachia* from Pitstone (©Bucks County Museum)
Image lower left showing internal compartments; right –showing sutures. **Marine**.

Coral

Corals have been around since the Ordovician period 480 million years ago, but there are 3 main groups which evolved at different times. The rugose corals (like *Lithostrotion* left) and the tabulate corals are the most ancient (480 to 250 Ma); the Scleractinian corals (as lower left image) are around today and originated from about 250 million years ago.

Modern corals (left) are the only types in geological history to form reefs. They build an aragonite skeleton to protect the animal. This is an unstable form of calcite which is easily dissolved away or becomes recrystallised to stronger calcite. Few people realise that they are actually predators – catching tiny prey with a barbed stinging tentacle. **Marine**.

Vertebrates – shark and fish

There are five major groups of vertebrates in existence today: fish, amphibians, reptiles, birds and mammals. The earliest vertebrates were fish swimming in the Cambrian seas from around 540 million years ago, but they only became numerous in the Devonian period about 400 Ma. Teeth and vertebrae are the most common vertebrate finds. **Marine, freshwater, land**.

Prepared as part of the 'Rocks and You' programme funded by HLF

Supported by The National Lottery® through the Heritage Lottery Fund | heritage lottery fund

Trace fossils – traces of animal behaviour

Trace fossils are known as 'ichnofossils' and you can find them everywhere!

1. <u>Resting traces</u> (*repichnia*)

Traces made by moving animals which stop and rest for moments producing a variety of shapes and trails. Examples: *Lockeia & Rusophycus* (right).

2. <u>Crawling traces</u> (*pascichia*)

These traces reflect direct locomotion, rather than any other form of activity. Usually follow bedding planes, but can be made on top of the sediment or within it. Examples: *Diplichnites* and *Cruziana*.

3. <u>Grazing traces</u> (*fodinichnia*)

The trace of an animal exploiting an area for food. It is most obvious as a meandering or spiral pattern. Some can be very elaborate patterns, which reflect the organisms need to exploit all the available sediment without re-working an area already exploited. Examples: *Cosmorhaphe, Phycosiphon, Nereites*, *Helminthopsis* and *Dibunophyllum* (right).

4. <u>Feeding traces</u> (*fodinichnia*)

This trace is a result of a combined function of deposit feeding and dwelling. The structure has a degree of permanence, yet its morphology reflects the exploitation of the sediment for food. Examples: *Thalassinoides*, *Rhizocorallium*, *Chondrites* and *Zoophycos*.

5. <u>Dwelling traces</u> (*domichnia*)

Semi-permanent places for living. There a variety of lifestyles within this category: sessile suspension feeders, detrital feeding worms, etc. The trace fossil represents the stationary dwelling and not the trophic group. Examples: *Skolithos*, *Ophiomorpha* and *Arenicolites*.

6. <u>Traps and gardening traces</u> (*agrichnia*)

These are regular patterned structures, often placed within and difficult to distinguish sometimes from grazing traces. They are usually a very complicated structure. The complex, branching form is available for multiple visits by the occupant. Some simple ones were probably traps, other more complicated forms were most likely gardening systems for microbes (need good irrigation). Examples: *Palaeodictyon* (a gardener, left), *Spirorhaphe* and *Cosmorhaphe* (both trappers of microprey).

7. <u>Predation traces</u> (*praedichnia*)

Mostly restricted to hard substrates. A typical example is *Oichnus simplex* - a neat circular drill hole in mollusc shells by predators (as in bivalve image above).

8. <u>Equilibrium traces</u> (*equilibrichnia*)

Seen beneath seafloors which have either been building up sediment rapidly or have been under erosion. Depths at which animals live beneath the sediment surface is often critical and this structure represents the rapid upward or downward movement of the burrow to maintain this position. Particularly obvious as the spreiten below or within the U-tube. Examples: *Diplocraterion* and *Rhizocorallium* (right)

9. <u>Escape traces</u> (*fugichnia*)

A few species that live within the sediment can tolerate a sudden burial by a mass of mud or sand. Their adaptations to such events result in a panic escape reaction. This may be sudden upward movement to reach the new sediment surface following burial, or a rapid sideways movement to avoid predation. Examples: numerous bivalves (including *Mya*, *Macoma* and *Cerianthus*).

Prepared as part of the 'Rocks and You' programme funded by HLF

Supported by The National Lottery through the Heritage Lottery Fund | heritage lottery fund