Fossils and palaeontology

Fossils are the preserved remains of animals or plants. Most commonly only the hard shells or skeletal parts of an animal, or the most durable parts of plants, are preserved as fossils. In some circumstances the original soft animal or plant tissue may be preserved, but these are very rare indeed.

Trails, tracks, burrows, worm casts and feeding traces of a variety of animals in soft sediments are commonly preserved, and in some environments the imprints of soft-bodied animals may also be preserved. The term trace fossil is applied to such remains.

Palaeontology is the study of ancient life. The recognition of distinctive fossils, and fossil assemblages, is an essential tool in the identification, relative dating and correlation of rock units. Palynology is the study of fossilised plant remains. In common with animal fossils, these remains allow identification and relative dating of the strata, but are also essential for identifying palaeoenvironments that are conducive to the formation of fossil fuels including coal, oil and gas. Palaeoecology is the study of the associations of coexisting fossil species. Like modern ecology, this enables interpretation of contemporary environments and ecosystems. Palaeoecological interpretations can be made from many fossil assemblages, but most valuable are those in which the fossilised organisms are preserved in their life positions as complete fossilised ecosystems.

Palaeontology and palaeoecology together offer important links between geo- and biodiversity. It is worth recalling that the vast majority of biological species are extinct and reside within the fossil record.

Fossils in Great Britain

Fossils of one form or another can be found in virtually all of the sedimentary sequencences throughout the United Kingdom, and some unique igneous and metamorphic successions. Some sequences are relatively barren and may only contain fossils of microscopic size (microfossils), whilst in others fossils clearly visible to the naked eye (macrofossils) and of many different species can be found in abundance.

One method for the subdivision of rocks, biostratigraphy, is based on the identification of key fossils and fossil assemblages, and the recognition of how these change with time through successions of strata. Such biostratigraphical ‘zoning’ by means of fossils assists identification of strata where the sequence is not otherwise clear and acts as an additional check on correlations based on similar rock types. Correlation of strata using this approach allows relative dating of sequences and enables comparisons to be made between areas of the same age, but composed of dissimilar rocks. Many fossil localities throughout the United Kingdom are key to recognising specific worldwide events in the geological history of the Earth and positioning the boundaries between different geological periods and era. These sites, along with similar sites in other countries, are used to correlate geological strata the world over.

Fossils in the district

Detailed lists of the fossils recorded from the district may be found in the scientific literature, including many of the references cited in the bibliography. In addition, many large collections of fossils from the district are held in the collections of BGS and in museums (p. 104).

Fossils of Silurian age are the oldest to have been found in the rocks of the district. Although relatively rare in the district, sufficient graptolites have been found in the Coquet Head Inlier to form an assemblage diagnostic of the top of the *Monograptus riccartonensis* zone of Wenlock age. This has allowed the strata to be correlated with sediments in the nearby Riccarton and Hawick inliers. Other sites where Silurian fossils have been noted include the Lower Ramshope Burn.

Fossils recognised within the Coquet Head Inlier include: *Monograptus priodon*, *Monograptus flemingii*, *Pristiograptus meneghini*, *Monograptus radotinensis*, *Monograptus flumendosae*, *Atrypa* sp., *Orthoceras* sp., *Monograptus* sp. and *Helminthoida* sp. (trace fossil).

The Carboniferous rocks in the district contain finely preserved examples of many of the principal fossil groups, such as algae, sponges, foraminifera, brachiopods, molluscs, gastropods, ammonoids, goniatites, echinoderms, crinoids, corals, bryozoans, ostracods and plants. Whereas such fossils may be widely scattered through many of the rocks, a number of localities within the district are notable for concentrations of one or more fossil species.The following are particularly important:

Tipalt Burn [NY 659 661] – [NY 687 683], in the west of the district, exposes fine sections through a particularly fossiliferous portion of the Lower Bankhouses Limestone. The nature and occurrence of the rich fauna of cephalopod molluscs, echinoderms, bryozoans, corals and brachiopods has invited comparison with the Carboniferous reef limestones of the Craven area of North Yorkshire. The site is today scheduled as an SSSI for its palaeontological importance.

The **Redesdale Ironstone Shale** is renowned for the rich diversity and fine preservation of its fossils. One band in particular within the deposit contains an exceptionally well preserved molluscan fauna. Redesdale Ironstone Quarries SSSI [NY 895 833] is one of the richest faunal localities in Dinantian strata in Britain.

The long-disused **Brunton Quarry**, near Chollerford [NY 929 700], which displays a section in the basal Namurian Great Limestone, is scheduled as an SSSI for its palaeontological importance. The Chaetetes Band, in the lowest 1.5 metres of the limestone, contains superbly preserved reef-like encrusting mats of the sponge *Chaetetes depressus*, accompanied by colonial corals and a variety of brachiopods and bivalves preserved in life position. It is a superb example of a Carboniferous tropical sea floor community – or complete ecosystem – fossilised in situ. The quarry is additionally noteworthy as the type locality for the alga *Calcifolium bruntonense*, a species restricted to the Great Limestone, in a bed known as the Brunton Band.

The **Greenleighton Quarry** SSSI [NZ 034 920] is of importance for the rich marine shell faunas contained in the Great Limestone and the overlying shales, including the type material *Pleuropugnoides greenleightonensis*. Nodules occurring just above the Great Limestone have yielded specimens of the goniatite *Cravenoceras leion*, thus proving the Great Limestone to be at or very close to the base of the Namurian, and ending the controversy over its precise stratigraphical position.

In **Black Pasture Quarry** [NY 932 699], sandstones A above the Great Limestone locally contain abundant specimens of the brachiopods Schellwienella crenistria. The abandoned sections of the quarry also expose beautifully ripple-marked surfaces of sandstone on which well-preserved worm casts are locally conspicuous.

At **Mootlaw Quarry**, near Ryal [NZ 024 750], the shales that overlie the Great Limestone are notable for a rich and varied fauna of brachiopods, molluscs, gastropods, crinoids and goniatites. Of particular interest is the presence of the goniatite *Cravenoceras* cf. *lineolatum*, an important marker fossil in the Namurian rocks of northern England. The shales have also yielded an almost complete, fully articulated, crinoid: such fossils are almost invariably found in a fragmentary condition.

Conservation issues

Like all surface exposures, well-exposed sections of highly fossiliferous rock are vulnerable to deterioration through weathering and the growth of vegetation. Whereas the collecting of fossils, especially from in situ exposures, is a real threat in many parts of Great Britain, there is little or no evidence for such activities damaging fossil-bearing sites in this district.

The recovery, by collectors and research workers, of fossil specimens from active quarry workings can make a valuable contribution to the preservation and conservation of important material, providing specimens and accompanying documentation are deposited in an appropriate museum or in national collections.

Wider significance

The fossils within the district's rocks give invaluable evidence of contemporary environments and ecosystems across northern England and Europe, and enable correlations and comparisons to be made with rocks of similar age and type elsewhere in Britain and across the world.

The palaeontologically distinctive Chaetetes and Brunton bands, within the Great Limestone, are of considerable importance in enabling detailed the correlation of parts of the Carboniferous sequence across a wide area of northern England. The fossils within the Great Limestone and overlying mudstone have been significant in determing the position of the base of the Namurian stage in Europe.

Figures

(Figure 65) Trace fossils in sandstone at Hindleysteel Quarry, Henshaw Common.

(Figure 66) Sketches of some characteristic graptolites from the Coquet Head Inlier. 1 *Monograptus priodon*, 2 *Monograptus riccartonensis*, 3 *Monograptus flemingii*.

(Figure 67) A — Crinoid, *Woodocrinus* sp. B — Goniatite C — Brachiopod, *Spirifer bisulcatus* group.

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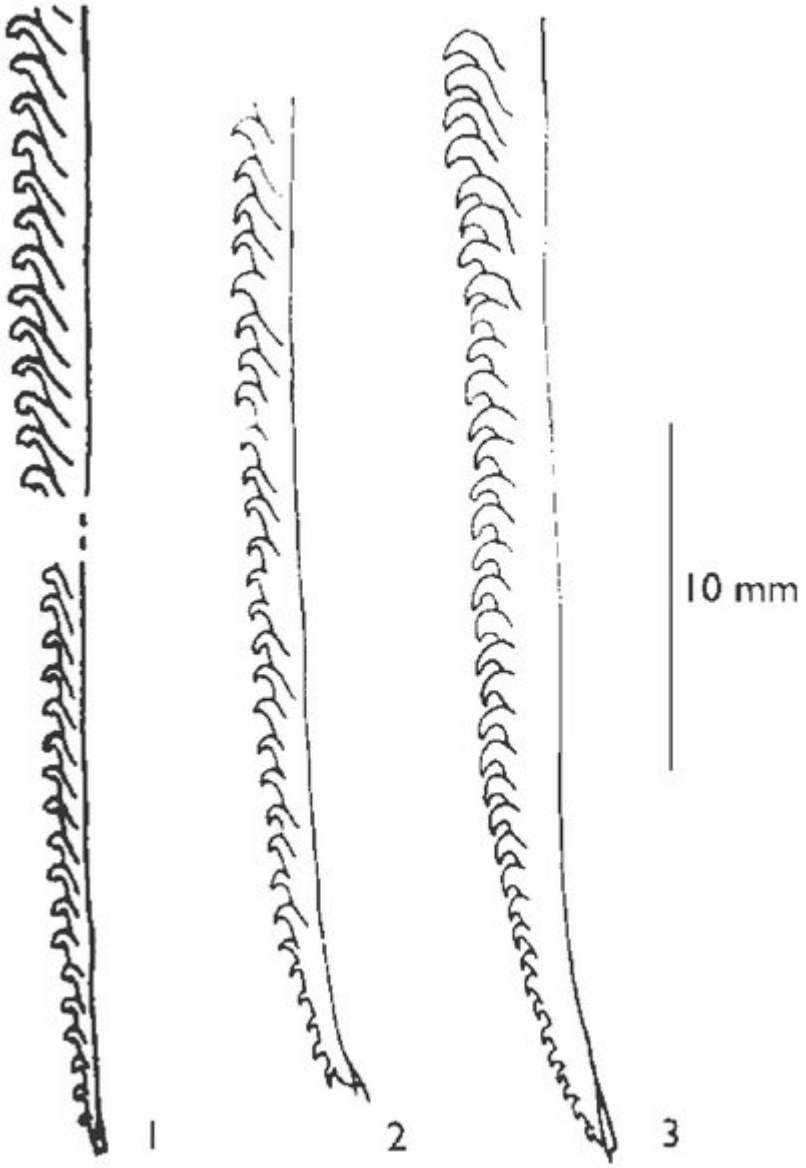

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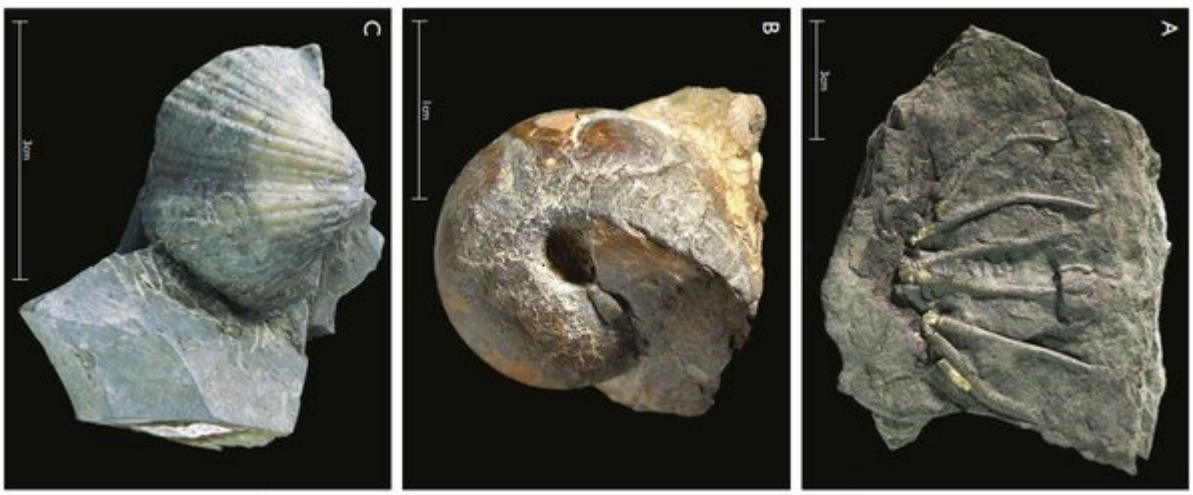

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