

'Rivers' are also offered at Bracken Hall. I have taken some groups there where we look at fossil & modern rivers, river features (meanders, spring, confluence, sediment loads)

One could adapt some of it to field work at CC i.e. walk up Black Hill or down to R. Ave & look at other landscape aspects.

lots of work for an "Access" fund person to develop.

Cliffe Castle Museum

Spring Gardens Lane
Keighley
West Yorkshire
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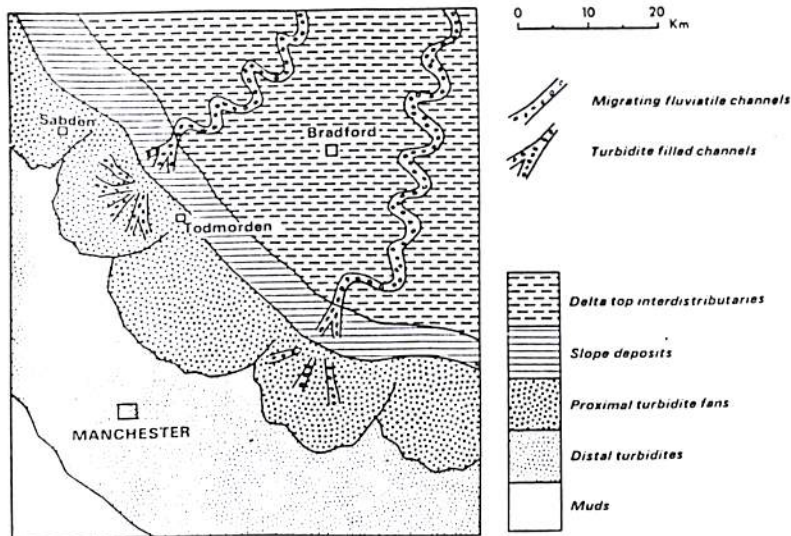
GEOGRAPHY IN THE BRADFORD FRAMEWORK

LOOKING AT RIVERS

Our local rocks of sandstone and shales formed in a huge river delta which flowed over this area 300 million years ago, in upper Carboniferous times.

Rivers of this size and form have never developed again on our planet and there is nothing quite like it today. The Ganges and Mississippi have some of the sedimentary features seen fossilised in the local rocks.

The kinds of sediments and features associated with modern day rivers and river deltas, help earth scientists to reconstruct past river deltas. The same geomorphological and sedimentary features are assumed to have been formed by similar processes of erosion, transportation and deposition. The fossil sands and muds of the ancient river delta in our area are now indurated (hardened) into sandstone and shale. They still preserve features such as graded bedding, varied grain size, grain shape and mineral content, sand ripples and current bedding etc which tell us about the different watery environments of the Carboniferous age river delta.



Redrawn from Collinson

THE FOSSIL
RIVER DELTA -
300 million years
ago

Using The Airedale Gallery at Cliffe Castle

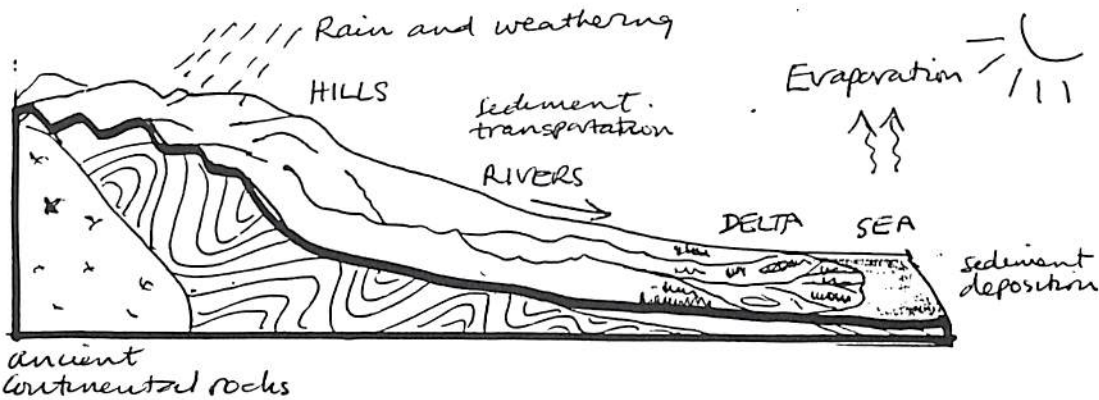
In the RIVER DELTA AND SWAMP display, in the Airedale Gallery, palaeogeographical maps, models and rock specimens show what the Carboniferous river delta environment in Yorkshire was like, and the processes of erosion, transportation and deposition which were involved in its making. It can be compared to modern rivers. The ICE AGE display shows, photographically, other erosional and depositional features in the Aire Valley, and how these forces are still going on. You can touch some local ice-smoothed limestone boulders and compare with the shape of river pebbles.

The river environment and processes

In the RIVER DELTA AND SWAMP display , a world map shows "Britain" in Upper Carboniferous times, at the southern edge of a large equatorial continent.

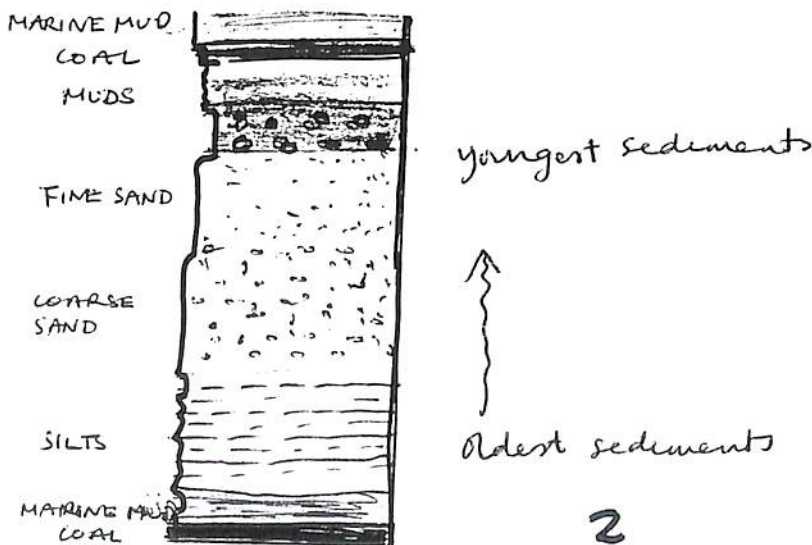
The model nearby shows a " satellite" view of the area with a "ghost "of modern Britain but with a hilly continent to the north and a great, braided river delta spreading over Yorkshire and into a sea basin centred on what is now Manchester.

Another model shows the water/sedimentation cycle , which is still an ongoing process today. In this case, monsoonal rain eroded the hard, granite-like rocks of the Carboniferous continental landmass, (now parts of Scandinavia and Scotland) and deposited sand and mud in river channels, swamps, delta slopes and in the sea.



Yet another model shows a closer view of the different deltaic environments which were found in Yorkshire; spot the braided river channels, lakes, forested islands, delta slope and so on .Different kinds of sediments were deposited in these different environments, and this still happens today.

A diagram shows that cyclic layers of sediments built up in the unstable deltaic environment. In the sinking and silting sea basin, there were alternating advances of river sediments and sea muds. A sea invasion was often followed by deltaic mud, then coarse sand, fine sand, a plant soil and then coal (decayed plants)



Looking at sediments and rocks

Specimens in the case below show examples of the fossil sediments (now hardened into rocks) from the ancient delta environments.

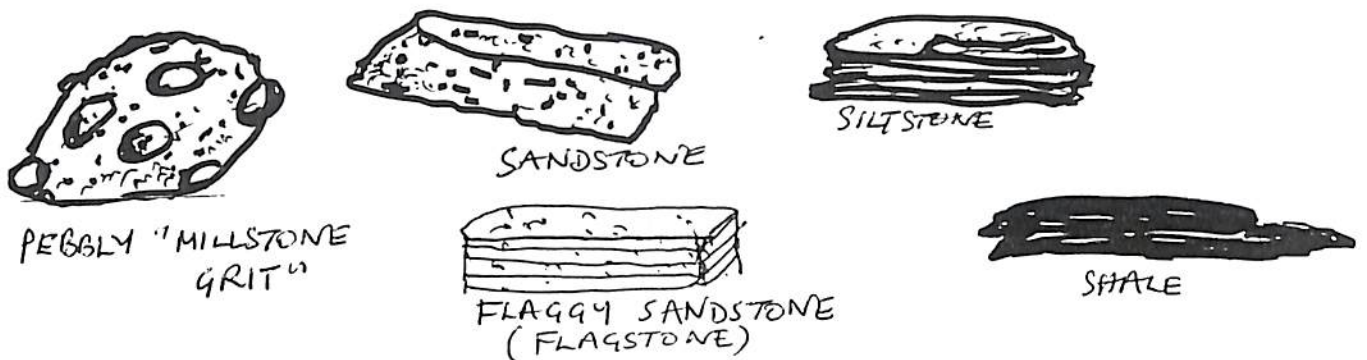
From the sea, dark marine muds (now shale rock) are full of fossil fragments of marine shells

From the delta lakes, dark muds sometimes with coaly plant fragments

From the high-energy braided river channels, are coarse sands (See the examples of pebbly, inequigranular "millstone grit" compared to even-grained "millstone grit".)

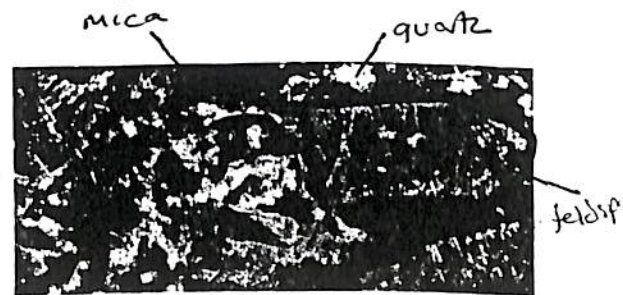
From the abandoned channels and levees, are sandstones to which local quarrymen have given names such as "rag", a ripple marked stone, and "tea leafy", stone full of decayed coaly plant fragments. Siltstones are stripy-looking rocks.

From the swampy islands, leached plant soils are now fireclay (where made of mud-forming minerals) or gannister (a dense white quartz rich rock)



Also shown in the display case are some examples of granites and gneiss which made up the old continent, and which formed the source of the eroded material. This was weathered and recycled into the new sandy and muddy sediments, now hard sedimentary sandstones and shale rocks.

You can see that rocks like granite are made up of the hard minerals quartz (glassy and greyish) and feldspar (pink or whitish and blocky) and soft flaky minerals like mica. The quartz and feldspar became sand. Mica, being soft, light and easily broken up, formed an ingredient of mud. Mica is absent from high-energy environments but could be carried great distances and into the sea



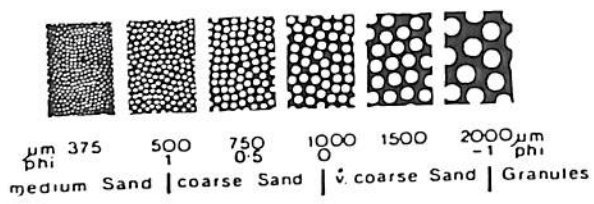
CLOSE UP OF GRANITE



QUARTZ is seen in all sandstones.
FELDSPAR is seen in some of the coarser sandstones.
MICA is seen in flagstones and makes up dark rocks like shale.

ROCK FORMING MINERALS:
The ingredients of sand and mud.

In fossil sediments, as in modern ones, grain size, shape and composition tell you about the sediment.
 Particle size; large particles are carried by strong currents in high energy conditions. Finer material is carried further. Grading upwards in a sediment tells of reducing energy.
 Particle shape; the further a particle is carried the more rounded it becomes. Those in the "millstone grit" are sub angular showing the sediment had not travelled far before burial.
 Composition; muds are made of fine particles of flaky minerals like mica. Sands are made up of coarse, pale-coloured minerals like quartz. The presence of feldspar in "millstone grit" is unusual, as this mineral today weathers to china clay. A warm climate and quick burial is suggested for the Carboniferous delta.



- Sand 0.2 - 2.00 mm
- pebbles 2 - 20 m.m.
- cobbles 20 - 200 mm.
- blocks 200 mm +

SIZE



SHAPE

Looking at structures

Another display case uses specimens and photographs to show some of the fossil sediment structures from the delta.

Sand ripples form on sand bars or lake edges. Prod marks from drifting debris are seen in the specimen here.

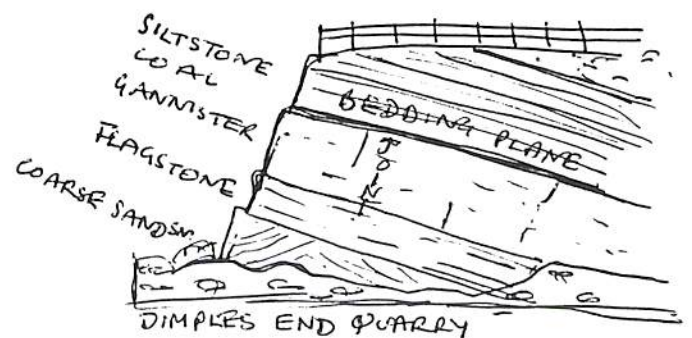
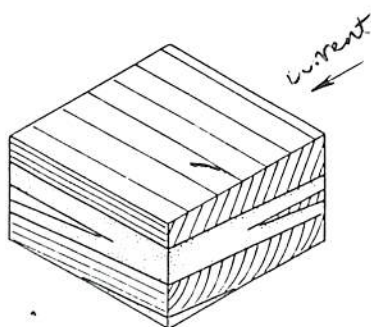
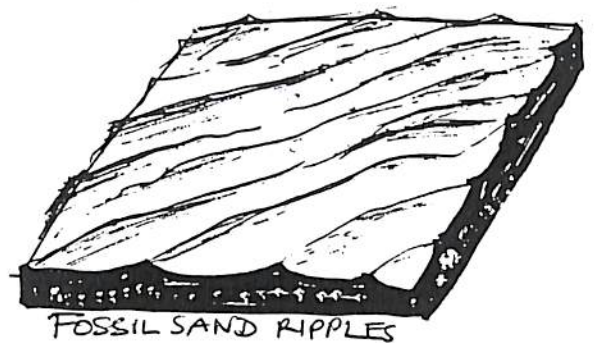
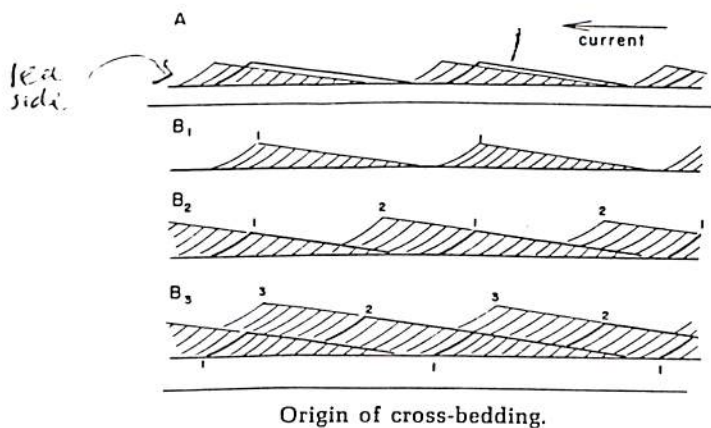
Huge sand dunes or bars in high-energy, shallow-water channels, form the large scale "cross-bedding" seen in the local sandstones. Photographs are shown in the display but you can study the real rocks at Bracken Hall, for example. The bar sand also becomes graded into fine and coarse layers. Fossil tree stems sometimes became lodged on the lea side of a channel dune.

In the field, you can tell which direction the river channel was from by looking at the curved, lea-side bedding of the dunes. The underside of sands may be uneven where it has sunk into the scoured sand on the delta slope below. Load casts are the fossil form of this feature, shown in the display.

Nodular formations such as clay ironstones in shales or "mares" in sandstones also form in modern sediments.

The photo of Dimples End Quarry at Haworth (easily accessible for fieldwork for groups) shows part of a cyclic sequence of rocks with coarse, cross-bedded sands, fining upwards into a fossil plant soil. Here there is a thin coal seam indicating decayed plant material above the ground, and a fossil tree root in the gannister below this. Above the coal, are stripy siltstones full of trace fossils, where invertebrates have burrowed and crawled in the silt.

Other display cases have examples of the fossil plants and animals which lived in this ancient river delta environment.



LOOKING AT MODERN RIVERS

Fieldwork:

Visit Bracken Hall to see the "millstone grit" sandstone called the Rough Rock, which was a river delta channel sand in Carboniferous times. It is cross-bedded and has some fossil plant stems in it. The rock has also been smoothed on the top by Ice Age glaciers in the last one million years and eroded into stacks of rock in the last 10,000 years. Examine the beck, a modern youthful stream, which has cut down to form a V shaped valley. As a young stream, it contains fine material, like sand and mud, as well as large angular blocks in its faster-flowing mid stream. In some exposures, you can also look at soils which result from the weathering of different parent material.

Near Salts Mill at Saltaire, the river can be followed westward where it has a terrace feature of gravelly moraine on the north bank and mounds of boulder clay on the south and a narrow alluvial flood plain between.

By contrast, visit the River Aire on the public footpath near the Golf Course, just below Utley Cemetery and Cliffe Castle. Over much of its course, the river Aire meanders through its alluvial floodplain washlands or ings, which flood in the winter. Flood defences are now built higher up to retain flood water and release it slowly. (The ings were improved and drained in the 19th C. The river Aire was also straightened half a mile away downstream, and the great abandoned meander loop at Beechcliffe, well seen from the new A 629, now forms the lake of water called Beechcliffe Ings.) The river seems small in its valley. This is because the valley has been widened and deepened by Ice Age glaciers (forming a rather U shaped profile) and the solid rock is 200 feet below the flood plain. The river by the Golf Course bridge, however, has no flood plain, and is restricted in a narrow channel, where it cuts through an Ice Age retreat moraine.

At East Riddlesden Hall further down the valley you can walk to the river across the flood plain to where it has pebbly banks. The land opposite has been made up and raised.

Further afield, at Bolton Abbey, you can see erosion and deposition in action as the river Wharfe meanders. A cliff of soft shale is exposed by a geological fault and the river cuts into it. Tilted (or dipping) sandstones and limestones are exposed in the river bed. The river pebbles are of limestone washed from the glacial gravels and also sandstone.

On the river Wharfe are a number of access points to the riverside, such as in Ilkley from Nell Bank to Riverside Gardens. Here you can examine the sands and pebbles of fossiliferous limestone which have weathered out of the gravel terraces along the banks.

Dimples End Quarry at Haworth shows different types of sedimentary rocks which made up the cycles of sand and mud in the Upper Carboniferous river delta which covered Yorkshire.

Cliffe Castle Museum
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(TNRIVER)

Arts, Museums & Libraries Division