Chapter 2 The need for Earth heritage conservation

Exceptional Earth heritage sites

Many people are aware of the need for the conservation of the natural world. Reports about pollution, disappearing rain forests and the extinction of species have increased our perception of the need to protect the natural environment. Rocks, minerals, fossils, soils and landforms are an integral part of our natural world. The distribution of habitats, plants and animals depends not only upon climate, but also upon the geology and landscape.

As well as being a fundamental part of the natural world, geology and landscape have had a profound influence on society and civilisation. Our use of the land, for agriculture, forestry, mining, quarrying and for building homes and cities is intimately related to the underlying rocks, soils and landforms. Moreover, economic resources such as coal, oil, gas and metal ores have played an important role in the industrial development of Britain, particularly during the Industrial Revolution.

The heritage value of sites and the importance of conserving them can be summarised under six themes:

- the international significance of Earth heritage sites
- exceptional Earth heritage sites
- Earth science research
- environmental forecasting
- Earth heritage sites in education and training
- Earth heritage as a cultural and ecological resource.

The international significance of earth heritage sites

Much of the early knowledge of the history of the Earth was developed in Britain (*see* Chapter 3), and many British sites have played a part in the development of now universally applied principles of geology. These sites have great historical importance. For example, many of the names of periods of geological time are derived from Britain. Many other sites serve as international reference sections. By reference to these international 'standards' (Figure 2), the relative ages of rocks all over the world can be compared. Other internationally important British reference sites include those where rocks, minerals and fossils were first described. Such sites must be conserved so that they can continue to be used as the standard references.

Exceptional earth heritage sites

There are many sites in Britain which are of international importance because of their exceptional nature. For example, rocks from Charnwood in Leicestershire (Figure 3) have yielded some of the oldest multi-celled animal fossils in the world. Similarly, a site at Rhynie in Scotland (*see* (Figure 46)) contains some of the oldest known fossils of higher plants, insects, arachnids (mites and spiders) and crustaceans. They occur in an exceptionally well-preserved state; so much so, that the microscopic detail and cell structures of the original organisms can be studied. Such sites are rare and are an irreplaceable part of the Earth heritage of the world.

Earth science research

The geology of Britain provides a resource for research (Figure 4). Natural rock outcrops and landforms, and artificial exposures of rock created in the course of mining, quarrying and engineering works, are crucial to our understanding of Britain's Earth heritage. Future research may help to resolve current geological problems, support new theories and develop innovative techniques or ideas only if sites are available for future study.

Environmental forecasting

Understanding how processes have operated in the past — the climate system, soil formation, desertification and the evolution and extinction of plants and animals — contributes to our comprehension of the problems of the present. We may be able to use this knowledge to forecast volcanic activity, earthquakes or changes in climate. For example, by studying the dynamics of natural systems, such as rivers and coasts, it may be possible to predict how land and coastal processes will operate in the future. This will aid flood prediction and management, the mapping of physically hazardous areas and coastal management.

Evidence from the sediments and landforms, particularly over the past 15,000 years, shows that the natural environment is highly sensitive to climatic change. Further study will throw light on possible future changes in the climate system and the faunal, floral and environmental responses to such changes (Figure 5).

As well as recording natural changes, the sediments in lakes and bogs provide records of the effects of human activities on the environment through pollution, vegetation changes (including forest clearance) and soil erosion. These records are important for assessing the effects of current human activity.

Earth heritage sites in education and training

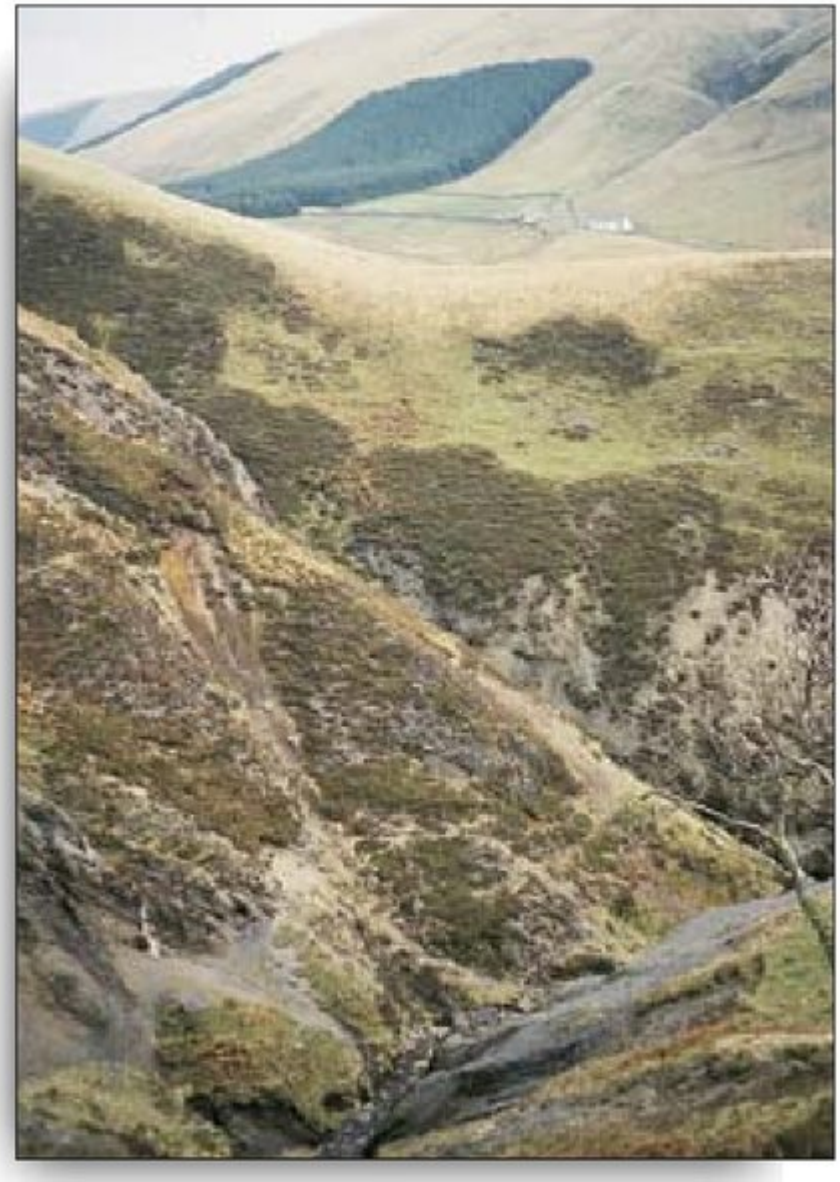
Earth heritage sites are essential for training and education. Students and teachers need sites for practical demonstration of the principles of geology and to illustrate the processes of landscape evolution (Figure 6)a.

The use of rocks and minerals, water and the energy derived from fossil and nuclear fuels, are at the centre of modern society and are essential to its economic well-being. Trained geologists are needed to locate and extract oil and gas (Figure 6)b, metal ores and the raw materials for the construction industry, such as clays for brickmaking, stone for building and aggregates for concrete. Geologists also discover aquifers, and locate reservoirs and sites for major engineering projects.

The earth heritage as a cultural and ecological resource

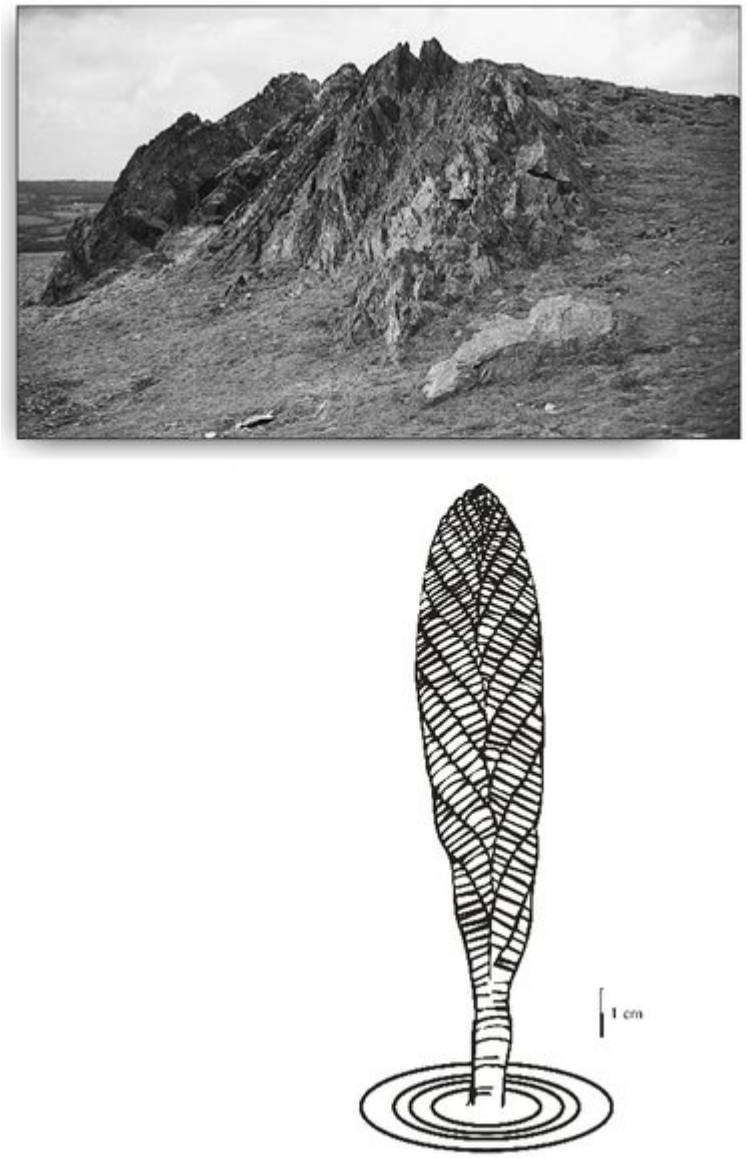
Geological features contribute to the aesthetic and ecological quality of landscape as part of the cultural heritage of Britain (Figure 7).

Geology trails, visitor centres, museums, show caves and mines open to the public, enhance and deepen our appreciation of the Earth heritage. Some places attract hundreds of thousands of visitors each year.

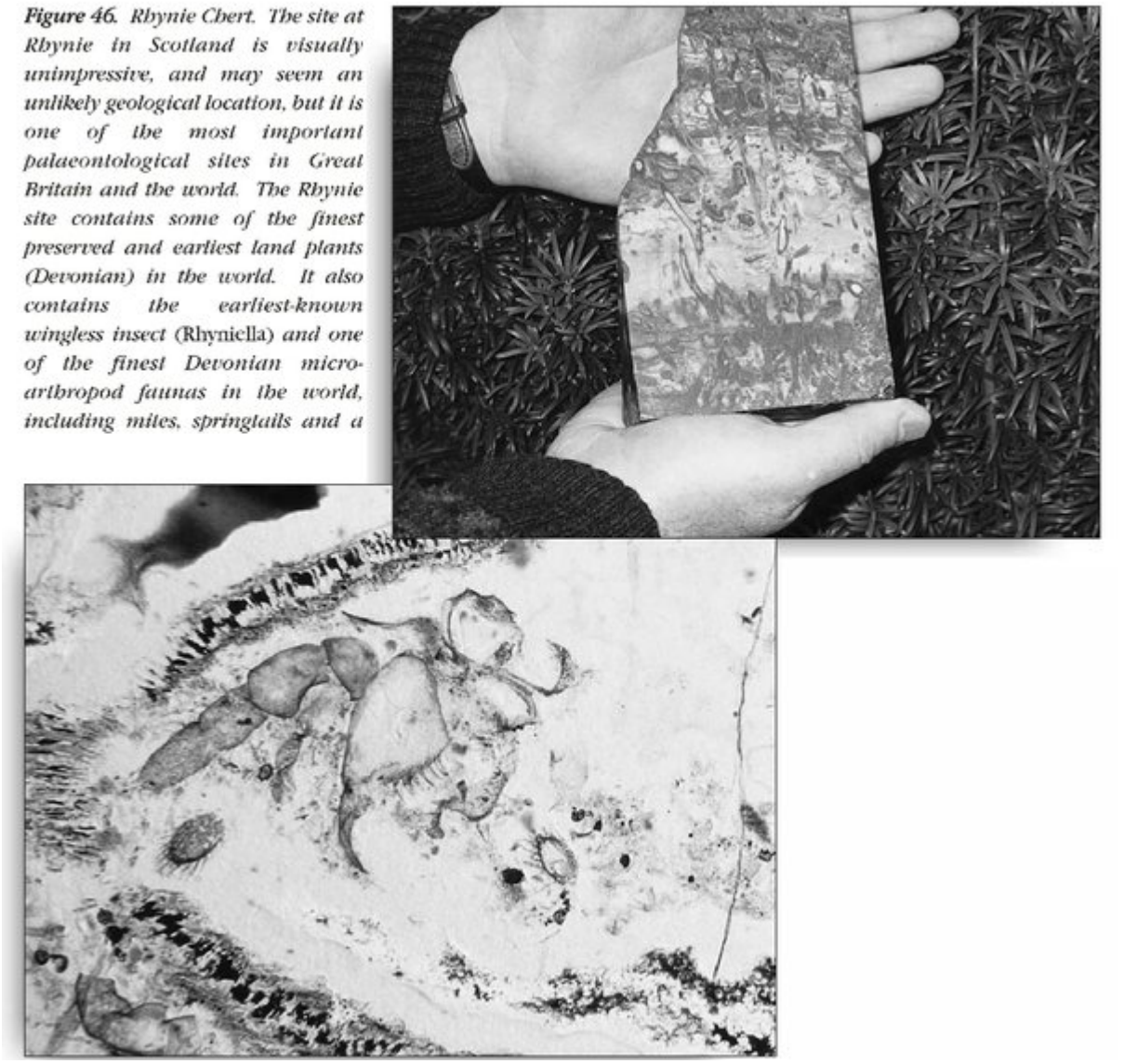


References and further reading

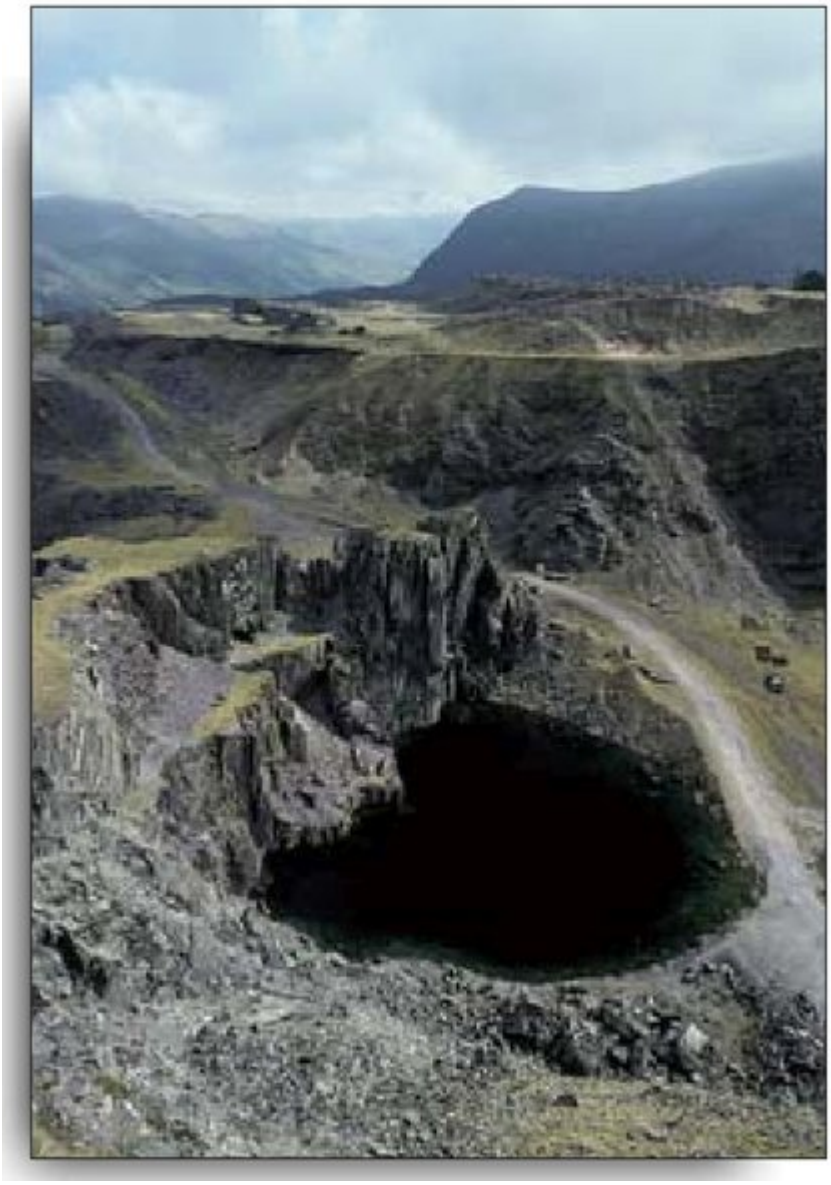
(Figure 2) Dob's Linn, south-west Scotland. This internationally important site is officially recognised by the International Union of Geological Sciences (IUGS) as the reference section for the boundary between the Ordovician and Silurian Periods (see (Figure 13)). This boundary is used as the global standard for comparative purposes. For example, fossils and other rock attributes that occur at Dob's Linn can be compared with those in rocks elsewhere. Photo: C.C.J. MacFadyen.



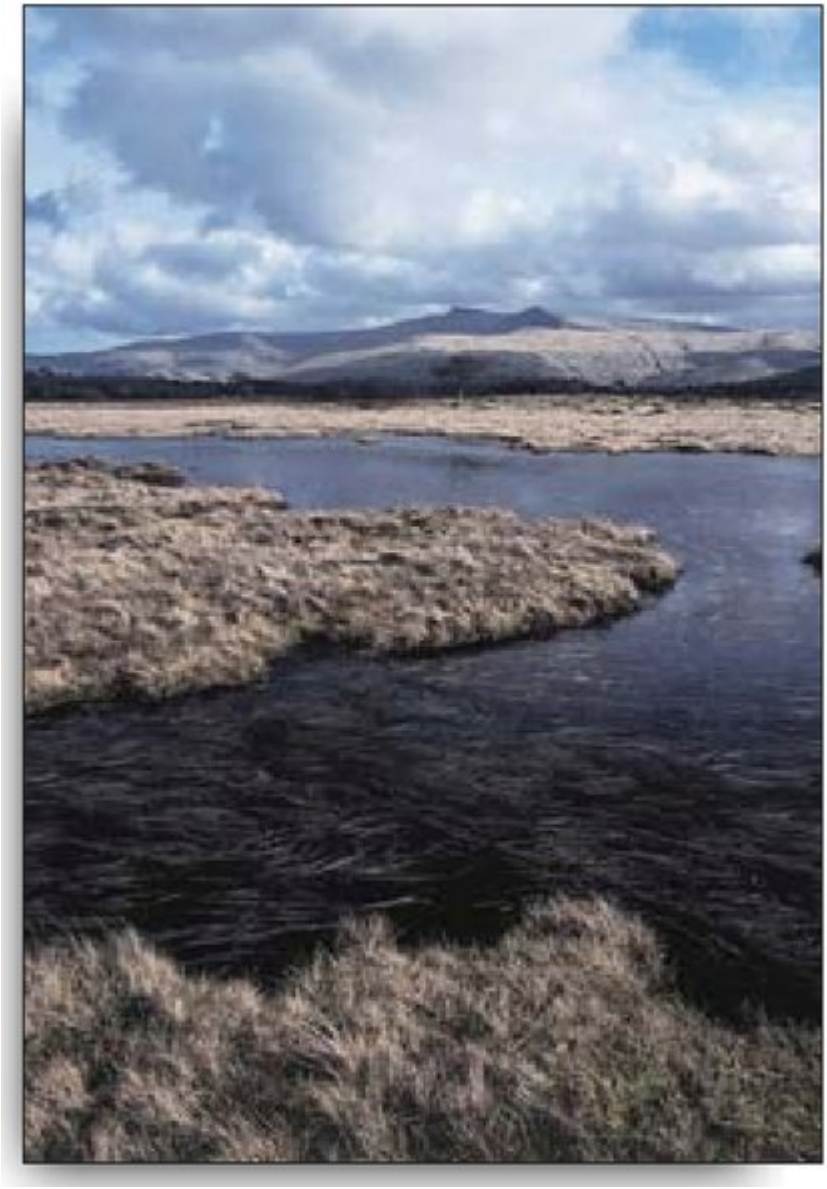
(Figure 3) The rocks of the Memorial Crags at Bradgate Park, Charnwood Forest, Leicestershire and reconstruction of Charnia masoni, a primitive life-form. The rocks exposed in the crags are probably 650–700 million years old. Occasionally, the rock surfaces show impressions of some of the first forms of life — imprints of soft bodies of some of the earliest large multi-celled organisms. These include the remains of jellyfish and sea-pen-like animals, including Charnia masoni. The preservation of soft-bodied animals is rare because they usually decay very soon after death or are eaten by scavengers. In this case, the animals were probably engulfed by a catastrophic event, perhaps the mass slumping of sediment, which trapped the fauna. The animals became preserved in the sediment, which eventually became rock. Because of the worldwide rarity of the preservation of these early life-forms, Bradgate Park is of great importance to the study of early life. Photo Leicestershire Museums.



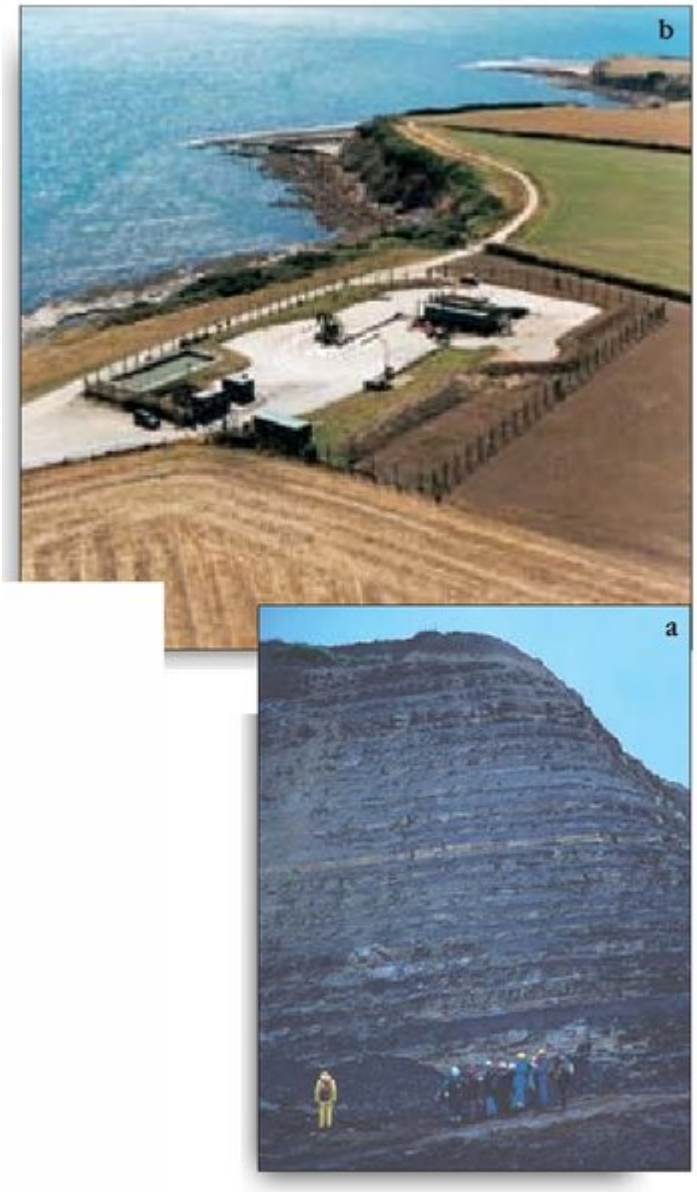
(Figure 46) Rhynie Chert. The site at Rhynie in Scotland is visually unimpressive, and may seem an unlikely geological location, but it is one of the most important palaeontological sites in Great Britain and the world. The Rhynie site contains some of the finest preserved and earliest land plants (Devonian) in the world. It also contains the earliest-known wingless insect (Rhyniella) and one of the finest Devonian micro-arthropod faunas in the world, including mites, springtails and a small aquatic shrimp-like organism, Lepidocaris. The fossils are preserved in chert. The deposit is an excellent example of the freak preservation of life resulting from the flooding of a marsh surface on which these plants were growing, by silica-rich water originating from a hot spring. The hot water killed and preserved the plants and animals before their tissues decayed, and so preserved a complete ecosystem. The arthropods found in the deposit are all primitive forms, and show an early association between plants and their parasites. Preservation is so good that microscopic damage to the plants by these arthropods is seen, as are invading fungal hyphae. The plants are preserved so well that thin sections of rock can be sliced, and examined under a microscope, to reveal the cell structure, including the minute detail of spores as well as cell xylem and stomata. The photographs show a sample and thin section of the chert. The thin section shows the mouthparts of a palaeocharinid (a spider-like arthropod). Photos: C.C.J. MacFadyen (chert sample) and N.H. Trewin (thin section).



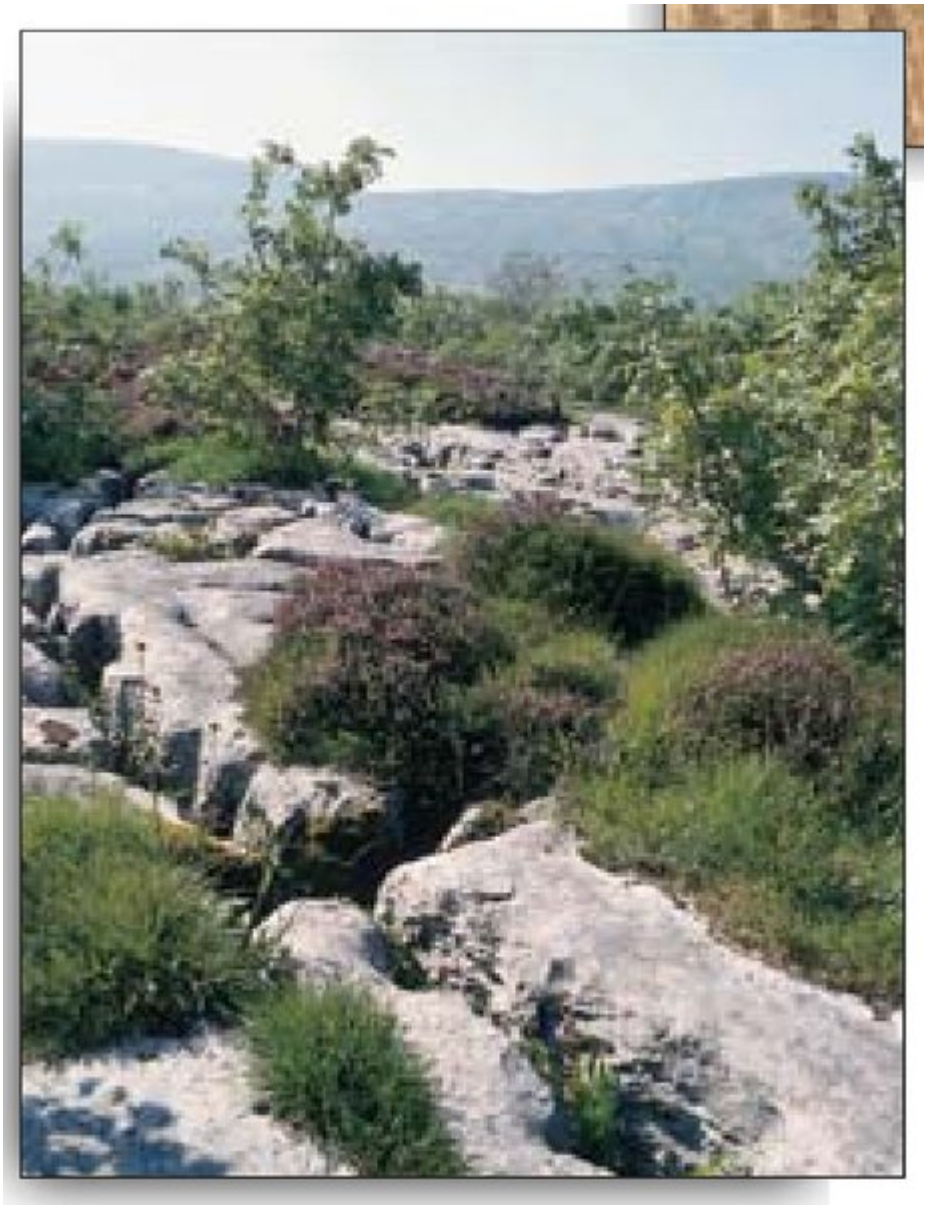
(Figure 4) Moel Tryfan, Gwynedd. This is a historically important site, 400 metres above sea level, that consists of sand and gravel containing fossils of sea-shells. It was cited as evidence for the biblical flood by the Diluvialists. Subsequently it was interpreted as a glacial deposit carried from the sea bed by an Irish Sea ice sheet during the last ice age, about 23,000 years ago. This has a bearing on the dimensions of the last Irish Sea ice sheet, the extent to which it may have depressed the Earth's crust, and the degree of crustal 'rebound' after glaciation (see also (Figure 10)). It is a subject of ongoing research. Photo: S. Campbell.



(Figure 5) Traeth Mawr, Brecon Beacons. This site has a sequence of peat and clay deposits which contain a pollen record reflecting marked fluctuations in climate from 14,000 years ago to the present. It provides information about the nature and rate of climatic and environmental changes. The photograph shows a general view of the site. Photo: S. Campbell.



(Figure 6) Kimmeridge Bay, Dorset. (a) The site is an important location for training courses, universities, schools and geological societies. The photograph shows members of the Dorset Geologists' Association Group visiting the site which displays organic-rich rocks similar to those that have generated oil and gas under the North Sea. Photo: R. Hannock, Dorset Geologists' Association Group. (b) Oil was discovered at Kimmeridge in 1956. Since then, the wellsite has continued to produce 100 barrels of oil a day. Photograph copyright Sillson Photography/BP Exploration Ltd. Reproduced with kind permission.



(Figure 7) Geology is an inseparable part of the natural world. The photograph shows an area of limestone pavement at Scar Close National Nature Reserve in North Yorkshire. Water has percolated through joints in the exposed limestone and produced deep clefts (grykes). In the sheltered grykes, unusual plant life, including many rare ferns and orchids, has developed. The micro-climate in the grykes is more like that of woodland than exposed hillside. Photo: P. Wakely.