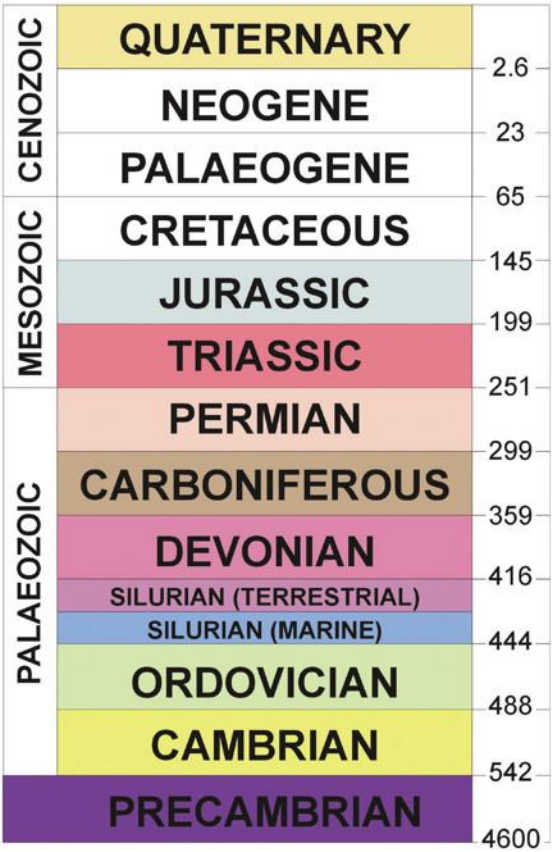
# Lickey Hills

## Barnt Green Road Quarry

Community Earth Heritage
CHAMPIONS
project




# GEOLOGICAL TIMESCALE IN MILLIONS OF YEARS

The coloured boxes show the ages of rocks that are found in Worcestershire

Cover Images:

Main Photograph:
Barnt Green Road Quarry
*Courtesy of John Stocks*

Small Photographs:
*1.* View east from Bilberry Hill
*2.* Professor Charles Lapworth
*3.* Scots Pine with Ladybird

Published by Herefordshire and Worcestershire Earth Heritage Trust
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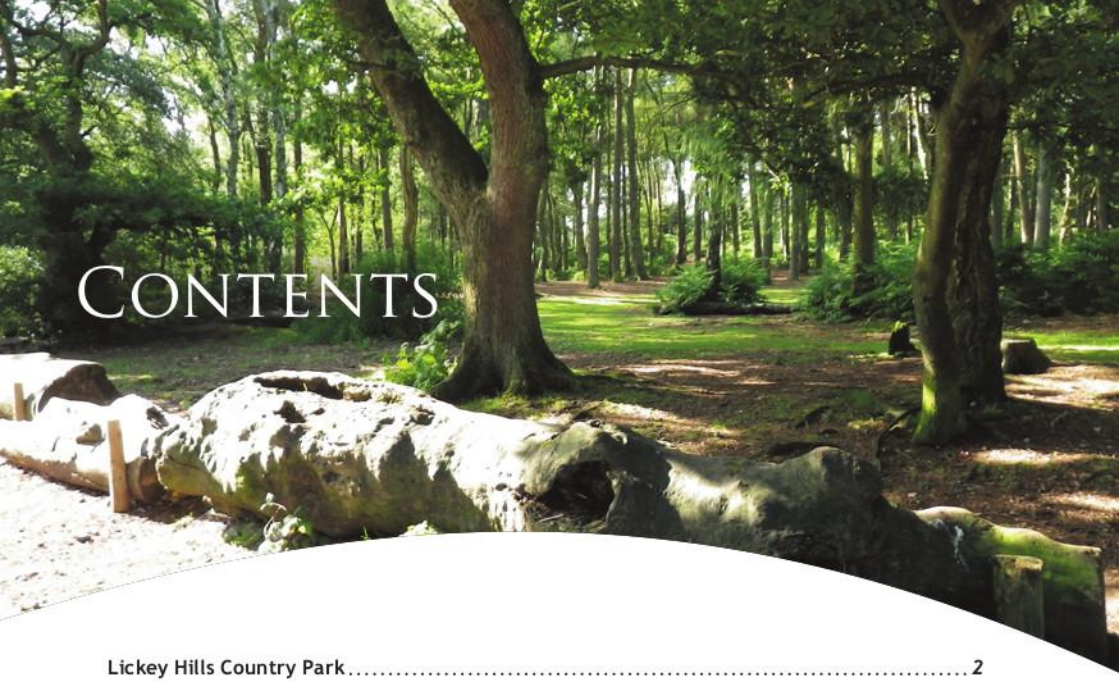


# Contents

# THE LICKEY HILLS COUNTRY PARK

Forming a natural boundary between south-west Birmingham and the county of Worcestershire, the Lickey Hills Country Park offers a quiet haven away from the bustle of the big city, and is home to a wide variety of wildlife and flora. The hills and valleys, woods and open spaces within the 524 acres of parkland offer plenty of places to explore, and the hills provide stunning views across the surrounding cityscapes and countryside.

The Park began back in 1888 when Rednal Hill was handed to the City of Birmingham by the philanthropic *Birmingham Association for the Preservation of Open Spaces*. By 1933 the Park had grown to its current size through land-purchase by the City, plus gifted land from the Cadbury family and others. The Park became popular as a recreation area and attendance numbers exploded between 1924 and 1953 when a tram service connected the park with the terminus at Rednal. It was considered 'the' bank holiday destination for the people of Birmingham and the Black Country until, that is, the closure of the tramway. The park was formally designated a Country Park by the Countryside Commission in 1971.

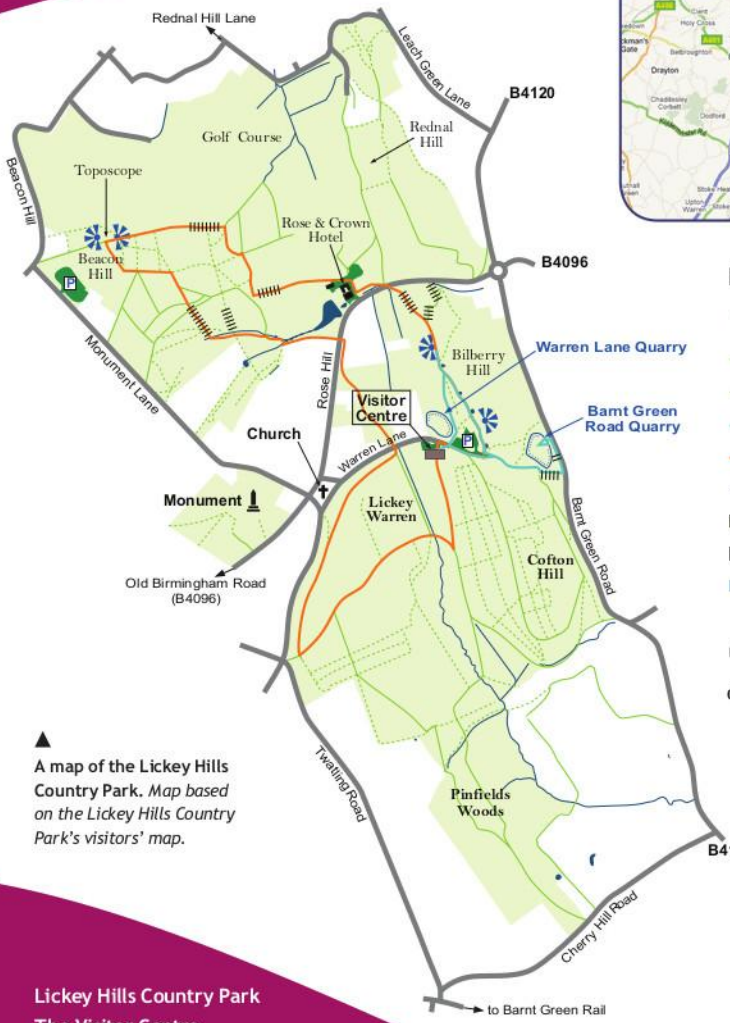
At 987ft Beacon Hill is the highest point in the park. It is said that you could travel due east for 3000 miles to the Urals in Russia before reaching higher ground! Beacon Hill is just one of numerous points of historical interest within the park, its brazier probably being lit in 1558 when the Spanish Armada was sighted in the English Channel. A Roman Road also dissects the park and a 3000 year old flint tool found on Rednal Hill shows that Stone Age man roamed about on the Lickey Hills. Local place names reveal royal connections - with the park once sporting a royal hunting ground (forest) and a warren. The Lickey Hills military history encompasses both WW1 and WW2, together with the formation of the Worcestershire Regiment of Yeomanry Cavalry by Other Archer in the 1830s. Established as part of a national response to the threat of a Napoleonic invasion, the Cavalry also took on the role of policing the area which had a reputation for highway robbery and was then also experiencing ever increasing levels of civil unrest.

## Fact File:

11 miles south-west of Birmingham / 4 miles north-east of Bromsgrove.
**Grid reference:** (Visitor Centre) SO998753. Ample free parking.
**Nearest train station:** Barnt Green railway station (2 miles).
**Buses serving the local area:** West Midlands no. 62 Birmingham to Rednal
Diamond Bus no. 202 Bromsgrove to Halesowen

# Location of The Lickey Hills

The Lickey Hills Country Park can be found on the border of Worcestershire county and the City of Birmingham. The two main B roads around the park are the B4120 and the B4096.


## Key

- Car Park
- Track
- Path
- Champions Trail
- Lickey Hills Explore Trail
- North Worcestershire Path
- Lickey Hills Country Park
- Private Land
- Water
- Viewpoint
- Steps

0 Scale (Metres) 500

▲ **A map of the Lickey Hills Country Park.** *Map based on the Lickey Hills Country Park's visitors' map.*


**Lickey Hills Country Park**
**The Visitor Centre**
Warren Lane, Rednal
Birmingham. B45 8ER
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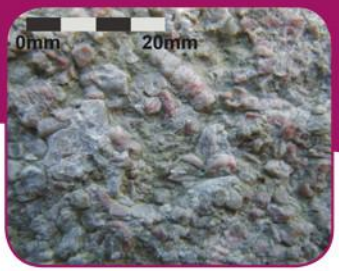
**E-mail:** lickey.hub@birmingham.gov.uk
**www.Birmingham.gov.uk/lickeyhills**

# WHAT IS GEOLOGY?




◀ Fossil rich Limestone

Geology is the study of rocks, minerals and fossils; how they were formed; and how they have influenced landscapes over millions of years. Planet Earth is some 4600 million years old, and trapped within each and every rock there is a geological story just waiting to be read: how and where they came into existence and how they end up where they are today. By closely looking at what a rock is made up of, together with its relationship to the surrounding landscape, then, bit by bit a story begins to reveal itself; and it's a long story covering millions of years of geological history!

Geology underpins the natural world in which we all live. It shapes our landscapes, influences soil types, and consequently affects biodiversity and land-use.

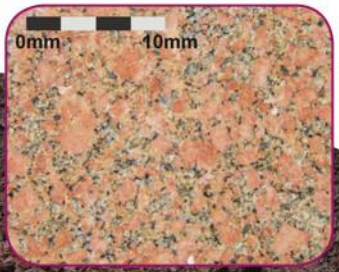
## An introduction to rocks

Rocks can be divided into three main groups:

**Igneous rocks** are formed when magma (molten rock) cools and solidifies. They can either be intrusive: formed beneath the Earth's surface, or extrusive: when the molten material comes to the surface and forms a volcano for example. Examples of igneous rocks are granite, rhyolite and basalt.

**Sedimentary rocks** are made up of particles deposited in layers. They usually form on the sea floor, in lakes and rivers, or in deserts. The layers of sediment are compacted and consolidated by the weight of overlying material. The particles within the layers can also be cemented together by minerals (e.g. iron compounds) carried by water percolating through the sediments. Eventually, over millions of years, the compressed sediments become rock. Sedimentary rocks today are being formed over much of the Earth's surface. Examples of sedimentary rocks are sandstone, limestone and mudstone.

**Metamorphic rocks** are rocks that have been altered (metamorphosed) by heat and/or pressure. The original rocks can either be sedimentary or igneous rocks, squeezed deep within the Earth due to the movement of tectonic plates, or heated due to the presence of molten rock (magma). Examples of metamorphic rocks are slate, schist and marble.




◀ Granite



▼ Studying the geology of the Lickey Hills

Trilobite fossil

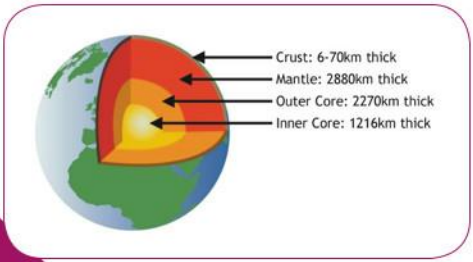
Trace fossil; dinosaur footprint

## Fossils

Fossils are the remains of plants and animals. Fossils usually represent the harder parts of organisms, since these are the most resistant to erosion e.g. shells, bones, exoskeletons and wood. The majority of fossils are aquatic animals or plants because conditions for preservation are usually better in water than on land. Other types of fossils include trace fossils such as burrow holes, walking tracks and fossilised animal droppings (coprolites). To be a fossil you need to be at least 10,000 years old. This is not very old in geological terms when you consider that the oldest fossil ever found is a 3500 million year old pond-slime like bacteria.

## Structure of the Earth and its powerful forces

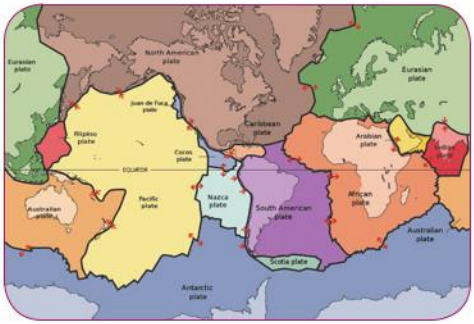
Planet Earth has a diameter of 12,735km. As you move from the surface of the Earth to its centre you pass through four distinct layers; the **Crust**, the **Mantle**, the **Outer Core** and the **Inner Core**. Scientific calculations indicate that the temperature at the centre of the Earth is over 3000 celsius and is composed of a high-density (13.5g.cm$^{-3}$) solid iron-nickel alloy.




Structure of Planet Earth

From the moment the surface of the Earth began to cool, solid rock coalesced to form a continuous crust. This crust has always been subject to immense forces operating beneath it in the mantle, where slow, ongoing movements have caused the fracturing of the crust above. This has resulted in the creation of large portions of the crust known as plates, which are constantly moving against or away from each other at an average rate that varies between 2 and 7 centimeters a year. Mountains, volcanoes, earthquakes, ocean trenches and mid-ocean ridges are all results of this plate movement, as is the migration, over millions of years, of these plates over the Earth's surface.

Travelling back 700 million years ago, what we know now as England was positioned 60° south near the South Pole. Since then we have slowly crept our way northwards on an epic journey to our current day latitude of 52° north.




**Current day position of tectonic plates.**
*Courtesy of the US Geological Survey*

# GEOLOGICAL HISTORY OF WORCESTERSHIRE

▲
Abberley Hills

Natural breaks in the geological record allow for the vastness of geological time to be divided into smaller units. The last 542 million years are split into twelve geological periods (as illustrated by the geological timescale on the inside front cover). Time before 542 million years ago is referred to as the Precambrian.

In addition to the Precambrian, nine geological periods are represented in the rock units of Worcestershire:

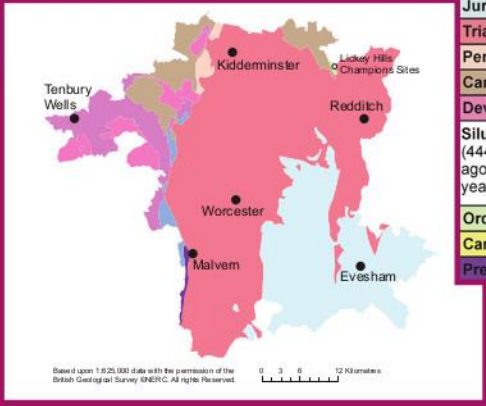
Precambrian (4600 million years ago to 542 million years ago)

- Igneous and metamorphic rocks making up the Malvern Hills and three small areas to the north. Here they are approximately 680 million years old, and amongst the oldest in England.

1. Cambrian (542 million years ago to 488 million years ago)
   - Quartzite, sandstone and shale formed as the sea level began to rise – as found in small areas adjacent to the Malvern Hills and in Martley.

2. Ordovician (488 million years ago to 444 million years ago)
   - Volcanic material was erupted and then deposited in water during this time. At a later stage, sand deposited in a warm, shallow sea formed quartzites. Rocks of this age are found in the Lickey Hills.

## Geological Map of Worcestershire




## Key to Geological Map of Worcestershire

| | |
|---|---|
| **Quaternary** (2.6 million years ago to recent) | |
| **Neogene** (23 million years ago to 2.6 million years ago) | |
| **Palaeogene** (66 million years ago to 23 million years ago) | |
| **Cretaceous** (145 million years ago to 66 million years ago) | |
| **Jurassic** (199 million years ago to 145 million years ago) | |
| **Triassic** (251 million years ago to 199 million years ago) | |
| **Permian** (299 million years ago to 251 million years ago) | |
| **Carboniferous** (359 million years ago to 299 million years ago) | |
| **Devonian** (416 million years ago to 359 million years ago) | |
| **Silurian** (444 million years ago to 416 million years ago) | **Pridoli stage** (419 million years ago to 416 million years ago) |
| | **Llandovery, Wenlock and Ludlow stages** (444 million years ago to 419 million years ago) |
| **Ordovician** (488 million years ago to 444 million years ago) | |
| **Cambrian** (542 million years ago to 488 million years ago) | |
| **Precambrian** (4600 million years ago to 542 million years ago) | |

3. Silurian (444 million years ago to 416 million years ago)
   *a*. Llandovery, Wenlock and Ludlow stages (between 444 million years ago and 419 million years ago) - At the start of the period, sandstones and conglomerates (sediments containing rounded pebbles) formed from the material brought down into a shallow sea during flash flood events. Then limestones and shales formed as the sea level rose.

   *b*. Pridoli stage (between 419 million years ago and 416 million years ago) - Mudstones, sandstones and calcretes (calcium-rich fossilised soil) deposited within a flat, arid landscape near the coast, and crossed by seasonal streams.

4. Devonian (416 million years ago to 359 million years ago)
   - Sandstones, deposited by streams in an otherwise flat and arid landscape. These rocks are found in the west of the county around Tenbury Wells.

5. Carboniferous (359 million years ago to 299 million years ago)
   - Clays, coals, shales and sandstones formed in a flat, swampy delta, which experienced frequent flooding as the sea level rose and fell. These rocks are found around the Wyre Forest Coalfield area and in the north-east of the county. There are also igneous intrusions of this same age found in the Teme Valley and also near Kidderminster.

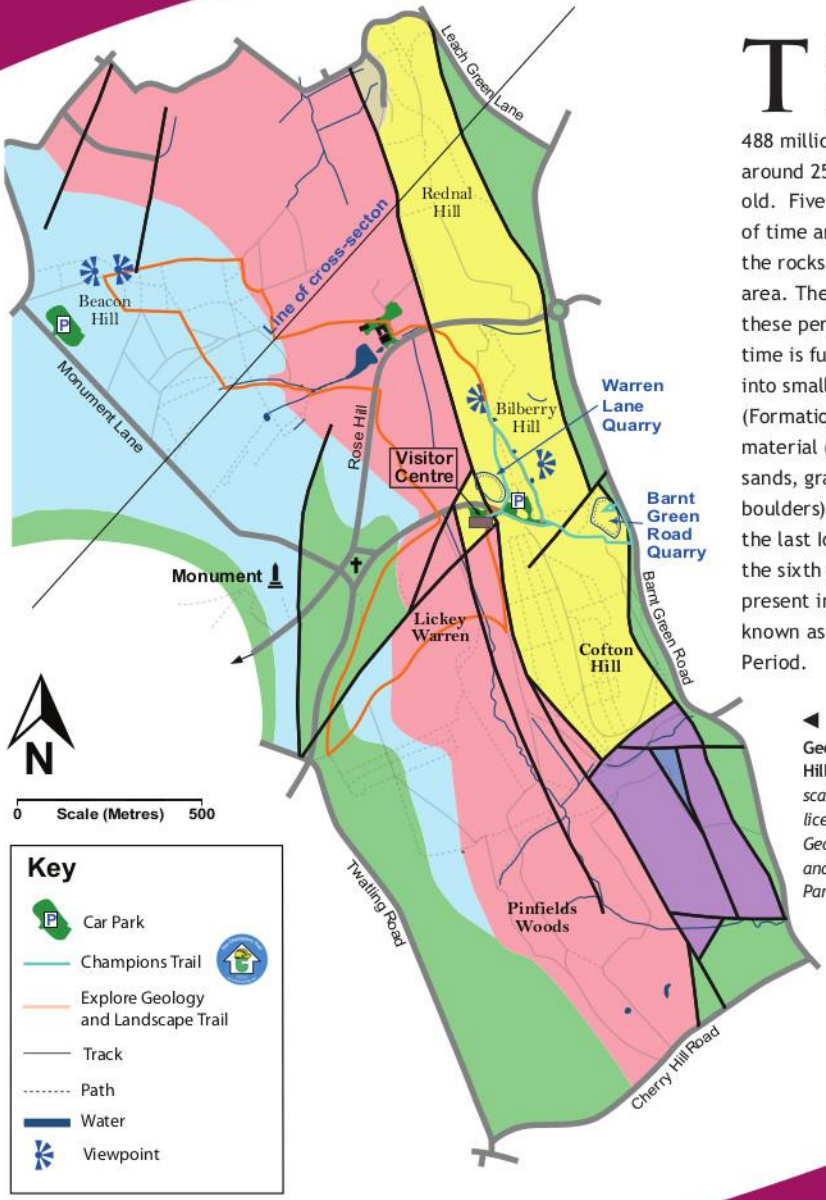
6. Permian (299 million years ago to 251 million years ago)
   - Red desert sandstones. At the start of the period, breccias (sediments containing angular fragments) formed during catastrophic events such as flash floods or earthquakes. These rocks are found in small areas in the north and west of the county.

7. Triassic (251 million years ago to 199 million years ago)
   - Sandstones, conglomerates, evaporites (salts), breccias and mudstones - all representing a change in environment from a flat, arid landscape covered in rivers and lakes, into oceanic conditions. These rocks predominate in Worcestershire.

8. Jurassic (199 million years ago to 145 million years ago)
   - Limestones and mudstones deposited in a warm, shallow sea. These rocks are found mainly in the south-east of the county towards the Cotswold Hills.

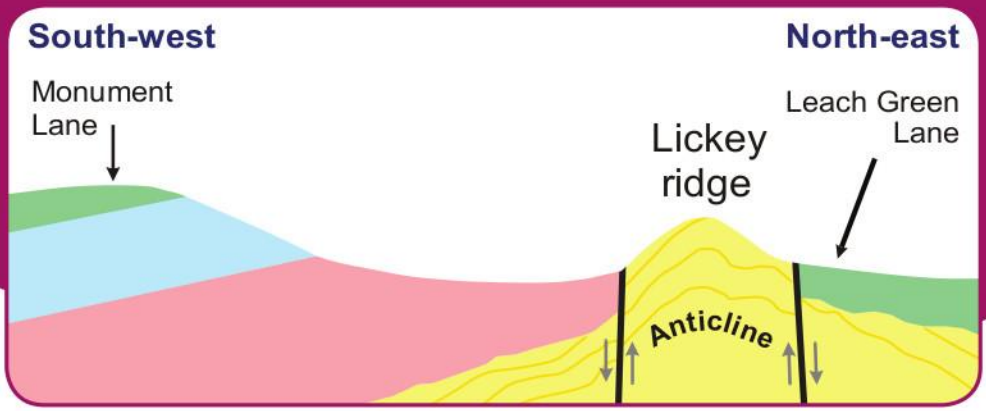
9. Quaternary (2.6 million years ago to recent)
   - Glacial deposits, river sands, gravels and alluvium, plus chemical deposits such as tufa, overlying the hard rocks (not shown on the geological map).

# Geological History Of The Lickey Hills




The rocks of the Lickey Hills range in age from around 488 million years old to around 251 million years old. Five geological periods of time are represented in the rocks of the Lickey Hills area. The rocks of each of these periods of geological time is further subdivided into smaller units of rock (Formations). Superficial material (clays, silts, sands, gravels, pebbles and boulders) deposited during the last Ice Age represent the sixth geological period present in the Lickey Hills, known as the Quaternary Period.

**Geological map of the Lickey Hills.** *Derived from 1:50,000 scale BGS Digital Data under licence 2007/137ED British Geological Survey © NERC, and the Lickey Hills Country Park's Visitors' map*




▲
**Cross-section through the Lickey Hills along the line shown in the map opposite.** *Adapted from the Lickey Hills Society's Geology Guide*

Geological Key

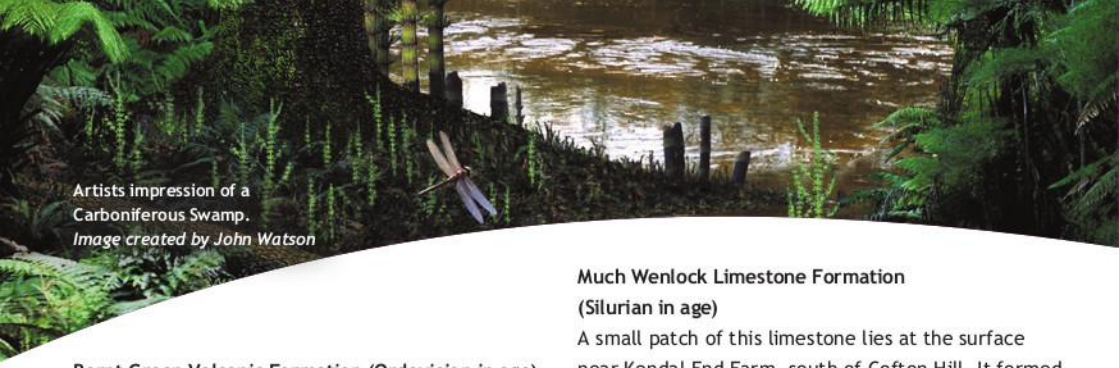
- Kidderminster Formation (Triassic in age )
- Clent Formation (Permian in age)
- Salop Formation (Carboniferous in age)
- Halesowen Formation (Carboniferous in age)
- Much Wenlock Limestone Formation (Silurian in age)
- Lickey Quartzite Formation (Ordovician in age)
- Barnt Green Volcanic Formation (Ordovician in age)
- Fault Lines

As the geology of an area becomes better understood, the names given to the units of rock are often changed.

The table below shows what the rock types in this area were once called, as against their most recent names.

Occasionally, the ideas about the relative age (e.g. Cambrian) and, more frequently, the absolute age (e.g. 570 million years old) of a rock can change as more information is gathered. Some early guides on the geology of the area state the Lickey Quartzite Formation to be Cambrian and the Barnt Green Volcanic Formation as Precambrian in age. Nowadays, our understanding is that both units of rock are Ordovician in age.

| Previous Name | Current Name |
|---|---|
| Bunter Pebble Beds | Kidderminster Formation |
| Clent Breccia | Clent Formation |
| Keele Clay/Keele Formation/Alveley Formation | Salop Formation |
| Halesowen Sandstone and Shale | Halesowen Formation |
| Wenlock Limestone | Much Wenlock Limestone Formation |
| Lickey Quartzite | Lickey Quartzite Formation |
| Barnt Green Volcanic Rocks | Barnt Green Volcanic Formation |



Artists impression of a Carboniferous Swamp.
*Image created by John Watson*

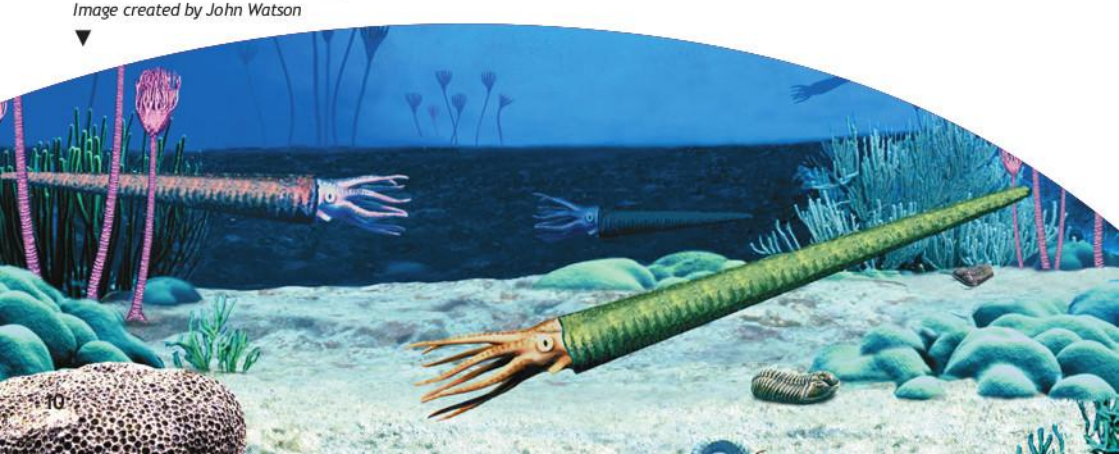
**Barnt Green Volcanic Formation (Ordovician in age)**
These are the oldest rocks found in the Lickey Hills area and form the ground south of Cofton Hill. They are the compacted remains of varied materials ejected from a volcano that erupted some 488 million years ago. We do not know where the volcano was located. Studies by amateur and professional geologists continue to take place in the hope of solving this mystery, which has eluded geologists for centuries. It is a mystery that applies not only to this geological site, but to several others across the West Midlands and beyond.

**Lickey Quartzite Formation (Ordovician in age)**
Forming the Cofton, Bilberry and Rednal Hills ridge-line, this hard, brittle sedimentary rock is composed almost entirely of sand-sized grains. The sand was laid down on the bed of a shallow sea that once covered the Midlands. Sometime much later, circulating fluids filled the spaces between grains with a quartz (silica) cement.

**Much Wenlock Limestone Formation (Silurian in age)**
A small patch of this limestone lies at the surface near Kendal End Farm, south of Cofton Hill. It formed some 425 million years ago when England sat about 30˚ south of the equator. To the east lay a continent, to the west - and beyond the Welsh Borders - was a deep ocean. Hereabout there was a warm shallow tropical ocean teeming with life. Sediments laid down in these tropical waters over time would form into limestone. Though only a small outcrop, it is considered to be of great significance as it is the most easterly exposure of Silurian-aged rocks in the country.

**Halesowen Formation (Carboniferous in age)**
In the north of the area, on the north-western edge of Rednal Hill is a small, low lying area with layers of grey mudstone and grey sandstone. These sedimentary rocks formed in hot, swampy conditions in the middle of a rainforest some 308 million years ago. Occasionally, plant material fell into the swamp. Over time, the muds and sands were fused into their respective rocks and the compressed remains of the vegetation formed into coal. Though in no way comparable to the major coalfields of the West Midlands, traces of coal have nevertheless been observed in the immediate area when foundations were dug at a number of locations around the Bristol Road.

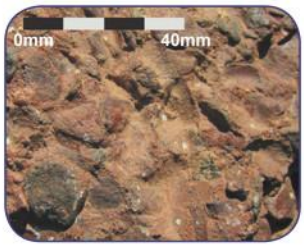
**Artists impression of a Silurian sea.**
*Image created by John Watson*



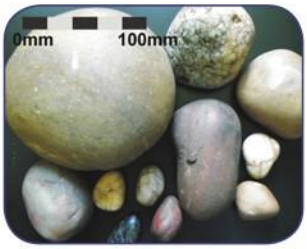
**Salop Formation (Carboniferous in age)**
This soft rock forms the relatively low ground to the west of the Lickey Hills ridge-line and is directly under the Visitor Centre. It is a red-coloured mudstone which formed from weathered material transported by streams and laid down in a calm shallow lake some 306 million years ago. Where the mudstone lies at the surface it has weathered to form red clay. Occasionally, within the layers of mudstone, you can find a thin layer of reddish sandstone, representing a period of increased rainfall that enabled the streams to carry sand grains along with the mud into the shallow lake.

**Clent Formation (Permian in age)**
The higher ground around Beacon Hill is formed of a sedimentary rock, which is composed of angular fragments stuck together by clay. This type of rock is called a breccia. The rock fragments were eroded (broken down) by flash floods on a mountain range some 299 million years ago. The variable size of the fragments, together with their angular nature, show that they were carried only a short distance before being dropped by the water as it flowed out onto an area of flat land. Many of the fragments within the breccia are volcanic in origin; a possible source could be the Barnt Green Volcanic Formation.

▶ Clent Breccia




**Kidderminster Formation (Triassic in age)**
To the east of the Lickey Hills ridge-line and in the south-west of the area lie the youngest rocks in the Lickey Hills. They formed around 251 million years ago, by which time England had travelled to the semi-arid regions situated 31° north of the equator. Flowing north from France to the Midlands was a powerful braided river system, the 'Budleighensis River'. The sediments of this Formation consist of variable proportions of red sand grains and rounded pebbles. The rock is prone to erosion and easily breaks down into loose sand and pebbles.

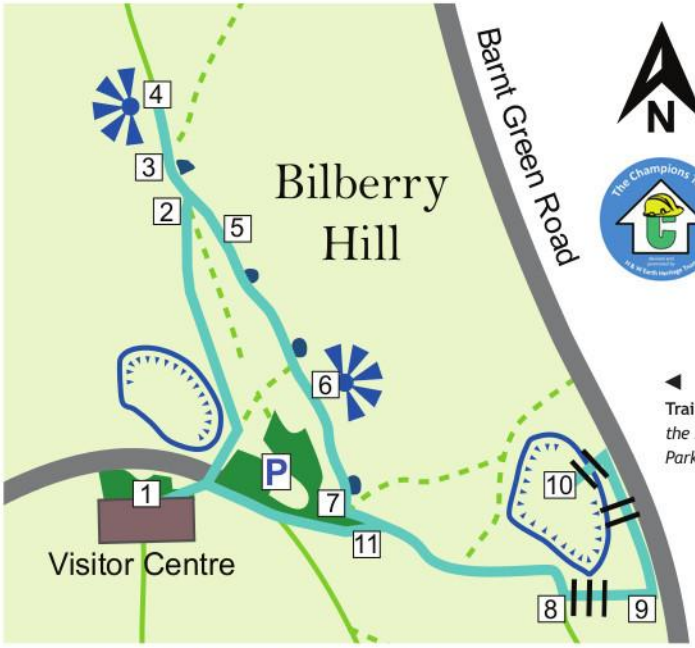



▲ Pebbles from the Kidderminster Formation

**Superficial Deposits (Quaternary in age)**
Over the last 500,000 years there have been three episodes of glaciation in Britain: the Anglian (between 480,000 and 416,000 years ago), the Wolstonian (380,000 to 130,000 years ago) and the Devensian (120,000 to 10,000 years ago). They were separated by interglacial periods when the climate was somewhat warmer than today. We now live in an interglacial that started around 10,000 years ago. Pockets of sand and gravel together with boulder clay deposited from the Wolstonian ice sheet still survive today. During later cold spells ice never reached the Lickey Hills but arctic conditions prevailed, thus freezing the ground, which then thawed in the spring and summer months. These freeze-thaw conditions produced 'drift' deposits containing pebbles derived from the Kidderminster Formation.

# The Champions Trail

This walk to Barnt Green Road Quarry starts at the 'Geology Display' in the Lickey Hills Visitor Centre. The walk via the quarry is approximately 2 miles long and, on average, will take 1½ hours to complete. The footpath leading down to the quarry, from point 7 on the map is moderately steep. The trail is waymarked using the Community Earth Heritage Champions waymarkers.




**Trail route map.** *Based on the Lickey Hills Country Park's Visitors' map*

1) Leaving through the front door of the Visitor Centre turn right along the surfaced path to the 'Welcome to the Lickey Hills Country Park' sign. Cross over the drive and onto the wide grassed path opposite. After 30m turn left along a narrower path. Walk through the wooded area, across the heathland and down to join the main graveled ridge-line path.

**Key**

- Champions Trail
- 5 Way-point positions
- Other Paths
- Steps
- Concrete pools
- Quarry
- Viewpoint

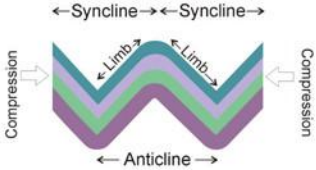
0 Scale (Metres) 500

You now stand on the principal landscape feature within the Park, the Lickey Hills ridge-line. Composed of a hard sedimentary quartzite rock, which formed some 488 million years ago, the ridge-line has better withstood the ravages of erosion than have the rocks in the surrounding landscape. The rocks surrounding the ridge-line are different in nature from the Lickey quartzites and are all younger in age. This poses the question of how these different rock types today sit so comfortably side by side when in reality they formed tens, and in some cases hundreds, of millions of years apart under differing conditions. The answer lies in a complex history of earth movements that has taken place in this area. Unimaginable pressures have been exerted on the rocks resulting in older rocks lying side by side with much younger rocks (refer to cross section diagram through the Lickey Hills on page 9).

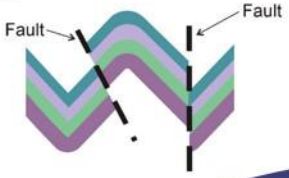
The overriding geological structure of the Lickey Hills is that of an anticline: The once horizontal layers of Lickey Quartzite have buckled and folded due to immense compressional forces being exerted on them (see diagram to right). The story however doesn't end there. These earth movements took place over many phases spanning hundreds of millions of years. Piecing together what happened, and when, is very much a detective story; gathering the evidence is key! A lot can be ascertained by looking at the angle of the layers within each unit of the differently aged rocks, whilst simultaneously applying the laws of 'superposition': if one sedimentary rock overlies another, the rock above is younger than the lower one (exceptions apply); and the law of cross-cutting relationships: a rock or structure must be younger than any rock or structure which it cuts across e.g. an igneous intrusion must be younger than the sediments pierced by it. By applying these methods, we can tell that a number of phases of earth movements have taken place in the area, resulting in several stages of folding and major displacement of rocks along lines of weakness in the Earth's surface (fault lines).

1. Rocks are deposited in horizontal layers.

2. Compressive forces exerted upon the layers of rocks cause them to buckle.




3. When the rocks are stressed beyond their strength they tear apart along fault planes.




▲ Diagrammatic representation of folding and faulting

▲ **Heathland on Bilberry Hill.** The Bilberry, Cofton and Rednal Hills have a very thin covering of acidic soil supporting fine expanses of heathland. Unusually, this is dominated by Bilberry, a plant more typical of true upland areas, although anyone who has stood on Bilberry Hill when the wind picks up will testify to just how fresh it can get! Local people have been harvesting the bushes for their distinctive fruit each autumn for hundreds of year to make jam, preserves and pies. The heathland is home to both the adder and the common lizard.

**2)** Turn left and follow the main ridge-line path to a group of boulders on the right hand side of the path.

These boulders comprise the ancient Lickey Quartzite, and are composed almost entirely of sand-sized grains of quartz (a crystalline form of silica). These particular rock specimens also offer telltale signs of the tumultuous history of the Lickey Hills. Take a close look at the boulders and you will see that they contain broken fragments of the quartzite rock, held together by a grey-coloured cement. During periods of earth movement these rocks were crushed and broken up, then later cemented back together by silica deposited from circulating fluids.


▲ **Brecciated Quartzite**

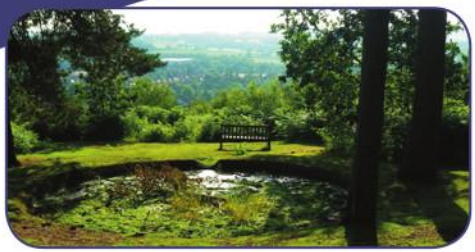
**3)** Continue along the path to a view-point on the left hand side of the path.

From this viewing area, to the north-west, you can see Beacon Hill which is composed of Permian-aged Clent Breccia. The ground in the middle distance is underlain by soft Carboniferous and Triassic-aged sandstones, conglomerates and siltstones. These have been sculpted, by erosion, to form a valley. This valley continues to the east and cuts through the hard quartzite ridge-line, forming the Lickey Gorge. There is still a mystery as to how the gorge came about: cuttings through ridge-lines composed of hard rock tend to develop along lines of weakness in the rock unit, such as geological fault lines. However, no such fault line has been observed along the Lickey Gorge. A proposed hypothesis is that the gorge was formed by the formidable power of meltwater flowing from a retreating ice sheet.

**4)** Retrace your steps past the quartzite boulders. Staying on the main path you will shortly reach an interpretation board on your left giving details about the heathland found on the Lickey Hills ridge-line.

**The Roman Road**

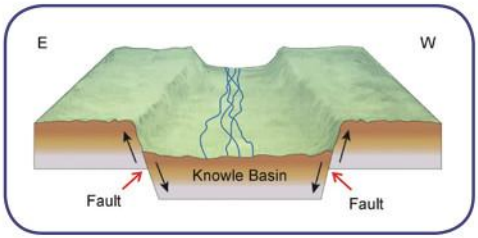
The Upper Saltway linked the Roman camps at Worcester and Metchley (where the Queen Elizabeth hospital now stands in Selly Oak, Birmingham). The route followed roughly the same line as the current-day Rose Hill.



◀ On the eastern flank of Bilberry Hill lie a series of concrete pools. It is believed that they would have been used to provide water for game and for fire fighting purposes.

**5)** Continue along the path to the brick-built viewing platform. From here it is very evident that the Lickey Hills form a notable exception to the generally low lying ground of the surrounding landscape. The vista from here takes in both the city of Birmingham and the West Midlands countryside. The plaques in the viewing platform will aid you in identifying local landmarks.

The underlying geology stretching before you is predominantly of Triassic-aged sediments. If you were to travel back in time to the Permian age, then this area was being subjected to tensional stresses resulting in the formation of a series of 'basins'. These basins were controlled by movement along the fault lines that bounded them (see diagram below). Throughout the Triassic age, the basins gradually filled with vast quantities of sediment deposited both in alluvial fans and from rivers flowing across them. These sediments were later covered by younger material and eventually turned into rock. Most of this younger material has subsequently been removed through erosion. As a result, the present day landscape comprises a swathe of flat plains, occasionally interrupted by gentle hills. This landscape is mirrored to the west of the Lickey Hills (best viewed from Beacon Hill) where another Permian-born depression, the Worcester Basin, also filled with Triassic-aged sediments, stretches westwards to the Abberley and Malvern Hills.




▲ Diagram of a basin

**6)** From the viewing platform, continue along the graveled path leading into a car park. Pages 16 and 17 describe some of the trees and the ferns found around the car park and along the paths leading to Barnt Green Road Quarry.

**7)** Turn left along the left hand side of the car park and follow the path that leads downhill through the woods. After 200m you reach a flight of steps on the left hand side of the path.

**8)** Turn left down the steps and follow the path towards Barnt Green Road. Immediately before reaching the road, turn left again onto a narrow path parallel to the road.

**9)** Follow the path to reach a small set of steps. Go down these steps and continue to another set of three steps on your left. Go up the steps and through the gate into the Barnt Green Road Quarry viewing area.

View east to the city of Birmingham ▶

# The trees along the trail

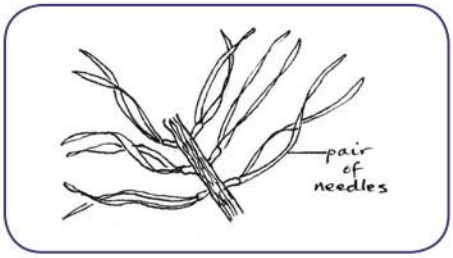
The Lickey Hills Country Park supports a variety of trees in its ancient woodlands, conifer plantations, young woodlands and arboretum. Around the car park and on the path leading down to Barnt Green Quarry you can see the following:

## Conifers

Scots Pine

*(Pinus sylvestris)*

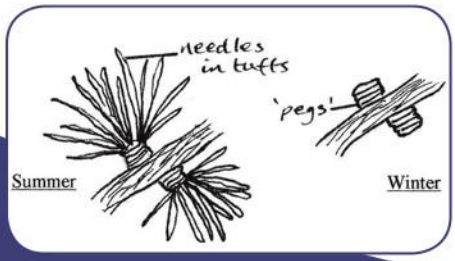
Evergreen. Reddish bark. Mature trees lose their lower branches giving a top heavy appearance. Leaves are dark green 'needles' borne in pairs, which are twisted and approximately 6cm long.




Larch

*(Larix decidua)*

Deciduous i.e. loses leaves in winter. The needles are light green, short and soft. They grow from the stem on 'pegs' which are very visible in the winter when there are no leaves.



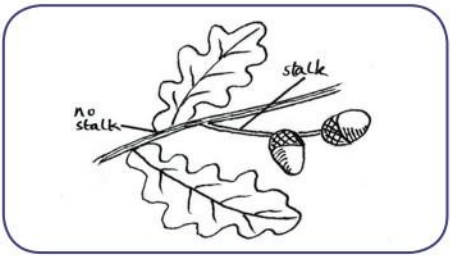

## Oak

There are two types of common Oak in England.

English or Pedunculate

*(Quercus robur)*

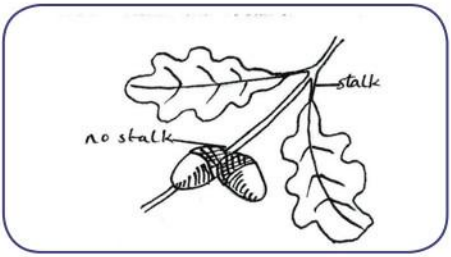
The leaves are stalkless i.e. they grow directly from the stem and are lobed at the base. Acorns are borne on long stalks and are often in pairs.




Sessile Oak

*(Quercus petraea)*

Here the leaves have a distinct stalk and the acorns are 'sessile' with no stalks.

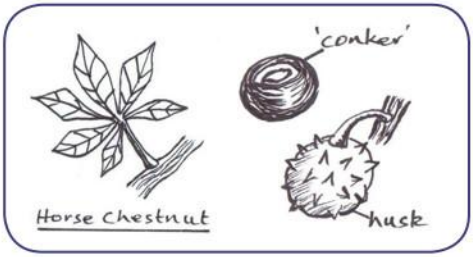



***Sketches and descriptions courtesy of Margaret Maybee***

## Horse Chestnut

*(Aesculus hippocastanum)*

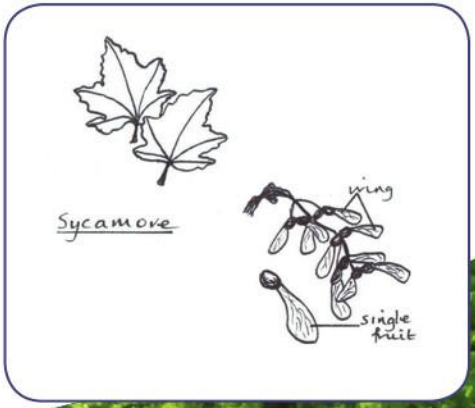
Commonly referred to as the 'conker tree'. The leaves are divided into 5-7 large leaflets. The fruit is known as a conker and is a shiny, rich brown spherical shape contained in a hard, spiky, green husk. The flowers of the Horse Chestnut are a large and 'showy' spike, commonly known as a candle.




## Sycamore

*(Acer pseudoplatanus)*

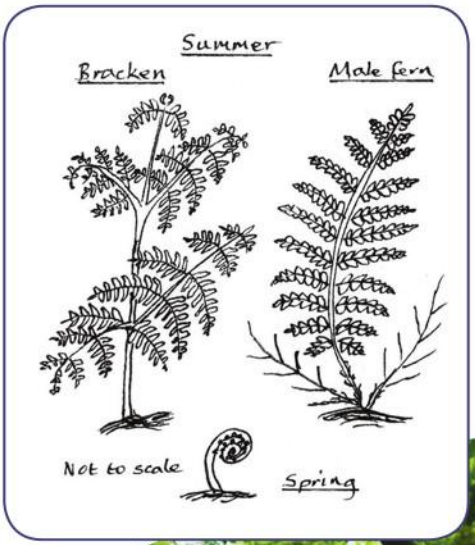
The leaves of the Sycamore are five-lobed. The fruit are small, borne in clustered pairs on stalks and are 'winged'. The flowers of the Sycamore are greenish yellow and dangle amongst the leaves.




## Ferns

Much of the Lickey Hills is covered with a large and very common fern called Bracken *(Pteridium aquilinum)*. It persists in a dead and brown state in the winter, but in the spring the leaves appear as a 'shepherd's crook' and in the summer the growth can reach 1-3m in height. They appear branched and are subdivided into many leaflets.

In amongst the bracken is another well known fern, the Male Fern *(Dryopteris filix-mas)*. Here, the leaves are not branched, but arise as tufts from the underground rootstock as if straight from the ground.

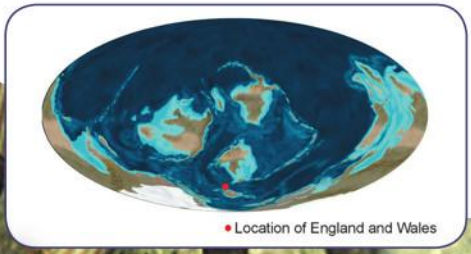


# The Geology of Barnt Green Road Quarry

▲ Barnt Green Road Quarry

The rocks in Barnt Green Road quarry all belong to the Lickey Quartzite Formation, the same rocks that make up the Lickey Hills ridge-line.

These rocks formed approximately 488 million years ago during a period of time known as the Ordovician. If we were to travel back to this period in time, the layout of the oceans and continents across the Earth would look very different; England and Wales were located 60˚ south of the equator, on the coast of a continent called Avalonia. The sediments that form the Lickey Quartzite were deposited in a shallow sea on the edge of this continent. As the ocean lapped up on to the land, the waves and underwater currents moved the sediments (sand and mud) around on the sea floor.




▲ A globe showing the location and shape of the continents in Ordovician times: 470 million years ago. *© Ron Blakey and Colorado Plateau Geosystems, Inc.*

This action caused the sediments to separate out leaving a clean sand, which built up in layers on the sea floor.

It is known that during the Ordovician period volcanic activity took place. Evidence for this can be seen in the slightly older Ordovician rocks that lie south of the quarry, the Barnt Green Volcanic Formation (note - no known outcrops are visible on public land). These 'volcaniclastic' rocks (meaning 'fire' and 'broken') are composed of the compacted remains of different-sized material (mainly ash) ejected from an erupting volcano. This loose material fell into water and was later compacted into solid rock. Currently, it is still not known where the source volcano was located.

Many field explorations and studies have taken place to discover the boundary between the top of the Barnt Green Volcanic Formation and the base of the Lickey Quartzite Formation. However, as yet, no such boundary has been located and so there is no direct evidence showing how the two units are related.

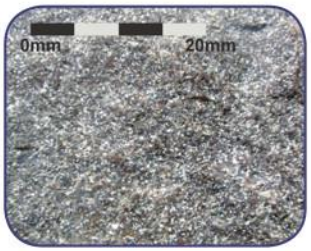
Artists impression of an Ordovician Sea

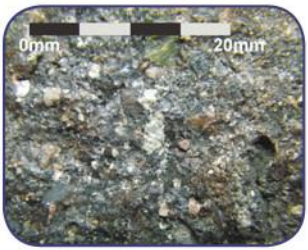
The main rock type in the quarry is **Quartzite.** Quartzite is a sedimentary rock consisting almost entirely of quartz grains. The sizes of these grains that make up the quartzite in the quarry vary between the different layers of rock, ranging from around 0.25mm to a granular 2mm. Some individual quartz grains can be even larger. The rock is held together by a quartz cement, which filled in the pore spaces between the grains of sand during diagenesis (the process of turning loose sediment into a sedimentary rock).

The grains of quartz in the most uniform layers of rock are rounded, due in part to being rolled back and forth by the waves of the shallow sea in which they formed. Some pieces of rock, however, contain angular grains of quartz. Such rock specimens also tend to contain an above-average percentage of mud flakes and other material, suggesting that they formed in slightly differing conditions to the clean quartzites.

Along with quartz, which on average makes up 85% of the rock, the following minerals are present in the quartzite of Barnt Green Road Quarry: feldspar, mica and some mafic minerals (a group name for dark-coloured minerals such as pyroxene and amphiboles).

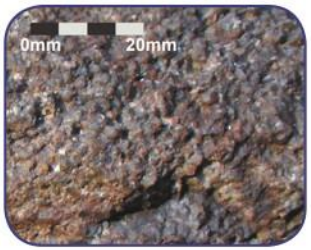
▶ Lickey Quartzite

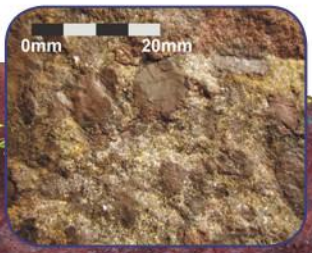



◀ Lickey Quartzite containing a high volume of the mineral feldspar

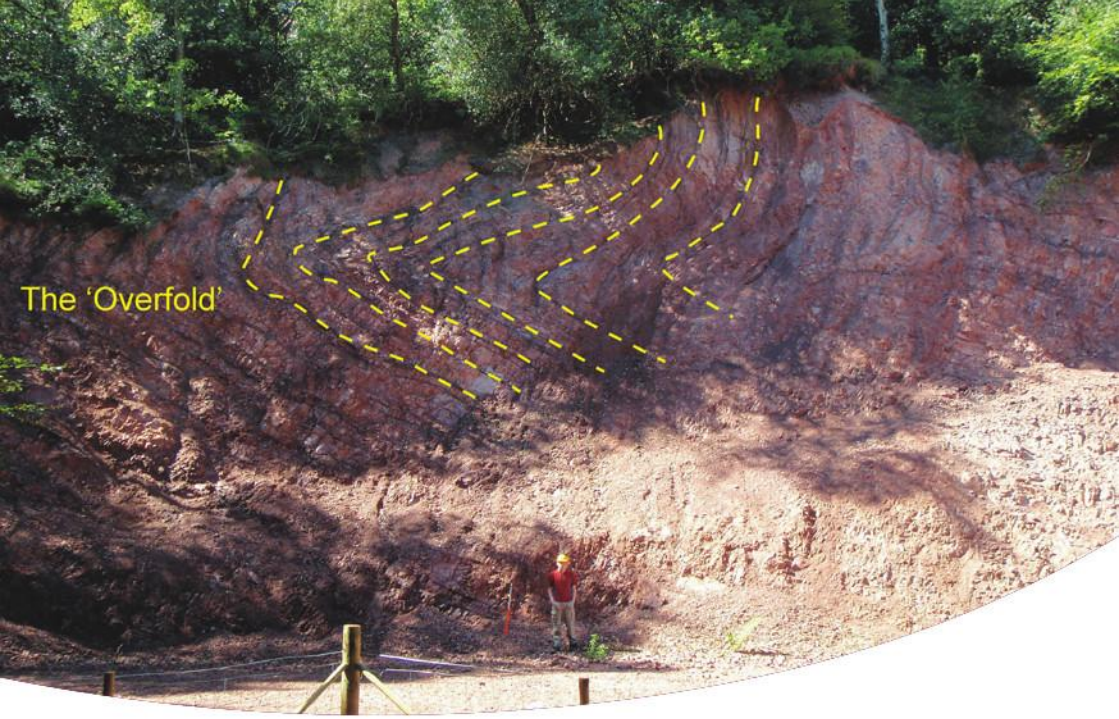
▶ Granular Lickey Quartzite




◀ Posible mud flakes within the Lickey Quartzite

The photograph illustrates how the different layers of quartzite vary in colour. The thin layers of purple sandy mudstones between the layers of quartzite are clearly visible in the picture. Note that the layers of rock are not horizontal but are inclined at an angle of roughly 45 degrees.




As a rule, quartzite rock tends to be grey/off white in colour, yet within this quarry several of the layers of quartzite are purple and brown. Such layers contain fragments of volcanic material that are the same as the Barnt Green Volcanic Formation. Examination of the rocks under the microscope, however, shows that these inclusions in the Lickey Quartzite cannot solely be explained by the presence of eroded pieces from the Barnt Green Volcanics, fuelling speculation as to where this 'other' material had come from. Was it from another source of volcanic rock and, if so, then where from? Perhaps the material came from a volcano that was erupting simultaneously to the deposition of the Lickey Quartzite sand grains on the coast of Avalonia? Speculation and scientific investigations continue.....!

Between the layers of quartzite are thin layers of sandy siltstones and clays. Many of these layers contain lots of flakes of the mineral mica and are generally purple in colour, although some are green. They too are believed to contain volcanic material.

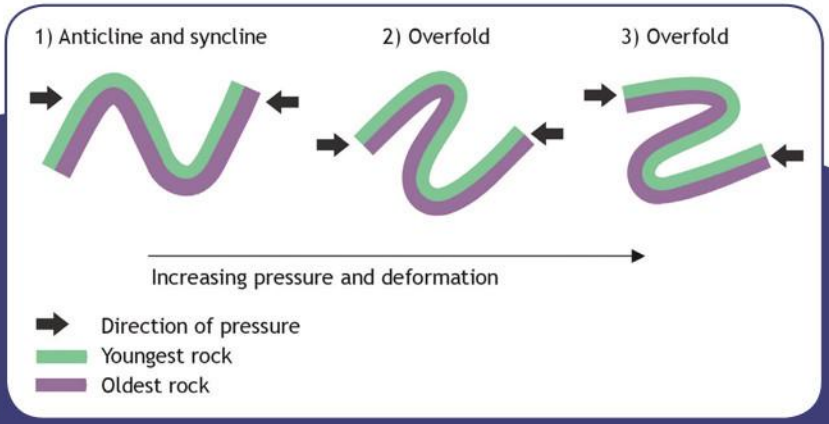
◀ The overfold on the western face of Barnt Green Road Quarry

On the western face, the main face, of the quarry evidence for one of these phases of deformation is clearly visible. Look to the northern end of the quarry and choose a layer (a bed) of Lickey Quartzite, one that is easily distinguishable such as those sandwiched between thin beds of darker material. Now follow the course of this bed southwards across the quarry face. You will see that the layer of rock has doubled back upon itself. This is known as an overfold structure (the photograph on page 20 illustrates this feature). The overfold is contained within the main anticline structure of the Lickey Hills.

The structural geology; the faulting and folding, of Barnt Green Road Quarry is complex. It is also one of its highlights.

The main structural feature of the Lickey Hills is that of an anticline (see page 13). The Lickey Hills are also bounded by a number of faults (see geological map on page 8, and cross-section on page 9). In addition, there are numerous other fold and fault structures within the Lickey Hills area. Collectively, all this deformation and uplift took place during several phases of earth movements, over a period spanning hundreds of millions of years.

Fault structures are also present in the quarry. Running roughly in a north-south direction, to the east of the quarry viewing area, is a significant fault-line which has brought Triassic-aged rocks into contact with Ordovician-aged Lickey Quartzite. Just think, by walking the 20m from the interpretation panels to the entrance gate you will straddle 238 million years of geological time! Immediately to the north of the quarry evidence suggests that a fault running roughly east-west has also brought Triassic-aged rocks into contact with the Lickey Quartzite. Both this fault and the fault to the east of the quarry post-date the formation of the Triassic rocks.




▶ Diagrammatic representation of the formation of an overfold

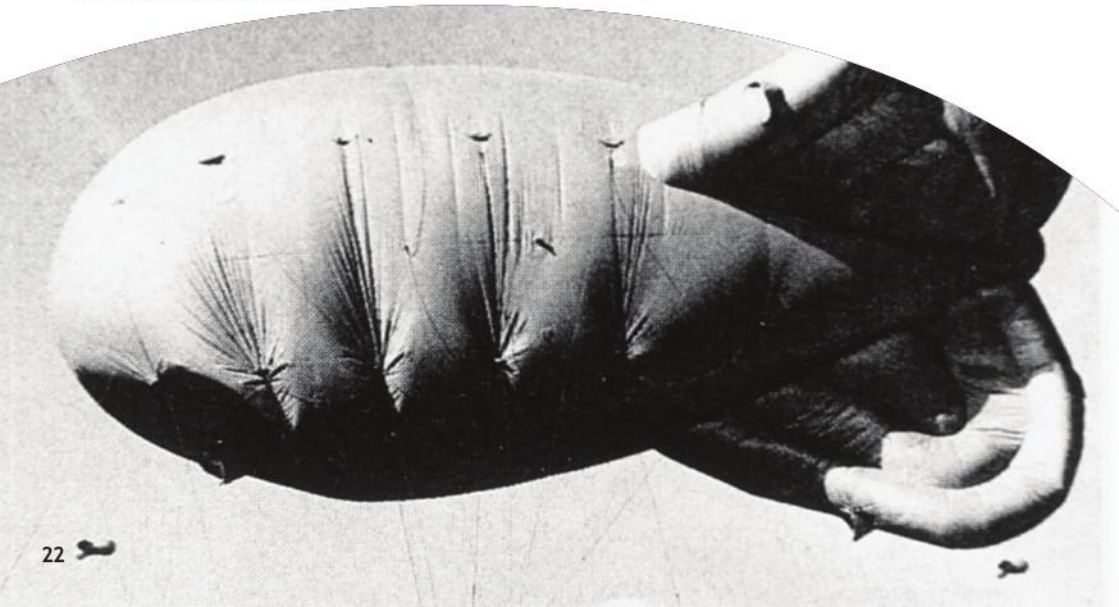
# The Industrial Archaeology & History of Barnt Green Road Quarry

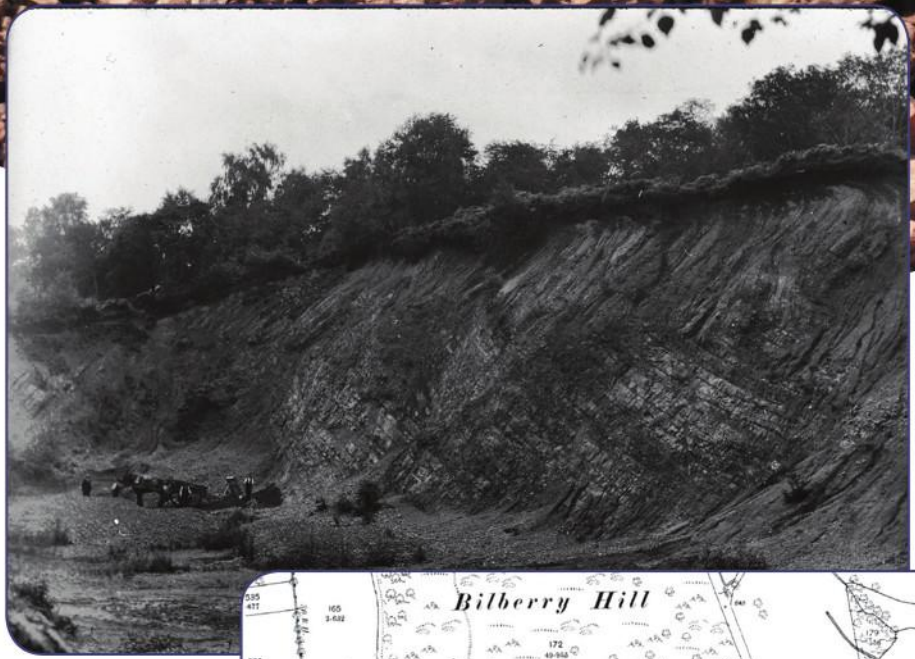
Barnt Green Road Quarry is one of several that exist on the Lickey Hills ridge. Extensive quarrying of the Lickey Quartzite occurred during the 19th century, with some operations continuing well into the 20th century. The last quarry to cease operations was Leach Green Lane quarry, which did so in 1935. The hard nature of the rock made it ideal for use as an aggregate, particularly as a road stone destined primarily to surface and mend local roads.

Historical records state that the road over the hills, Rose Hill, has been a major thoroughfare for centuries which, particularly after being 'turnpiked' in 1726, was regularly maintained. Did they quarry local stone to carry out these improvements back in the 18th century? As well as being used as a road stone, Lickey Quartzite was also one of the materials used in the building of the dam at Frankley reservoir.

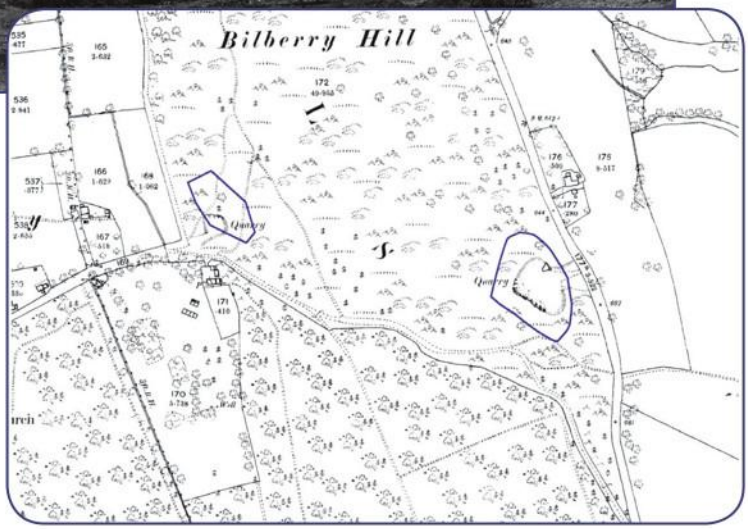
The outbreak of WW2 saw the nearby Austin factory change its function to making military vehicles, ammunition and aircraft. Barnt Green Road Quarry was used to accommodate a barrage balloon mounting, as part of a barrage around the Austin Aero Works. German documents captured in the closing days of the war show that Longbridge aircraft factory and the adjoining aero engine factory were intended targets for German bomber aircraft, but only one bomb was actually dropped near the works. Barnt Green Road Quarry barrage served its purpose!

▼ **A barrage balloon** is a large 'captive' balloon, tethered with a metal cable and used to defend against low-level attack by aircraft. Barrage balloons were intended to damage an enemy aircraft on collision with the cables, or to at least make the attacker's approach more difficult. Some versions carried small explosive charges that would be pulled up against the aircraft on impact in order to ensure its total destruction.





▲ **Barnt Green Road Quarry in the late 19th century.** *Courtesy of the Lapworth Museum*

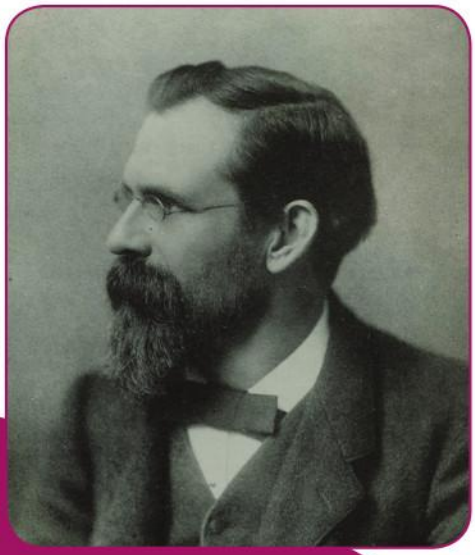



▲ **1st edition Ordnance Survey map dated 1884 showing Barnt Green Road Quarry (right) and Warren Lane Quarry (left)**

# Professor Charles Lapworth & Barnt Green Road Quarry

The Lickey Hills have been a focus of geological research for at least the past 110 years. Among the various geologists who studied the rocks of the hills, Charles Lapworth is one of the more notable to investigate the rocks beneath his feet. Born in 1842 in Faringdon, Berkshire, he initially trained as a school teacher. When posted to Scotland in his early twenties, it was there that his love of geology blossomed.

In 1881 he was appointed as first Professor of Geology at the Mason College, the forerunner of the University of Birmingham. During his years in Birmingham Prof. Lapworth spent time studying the rocks of the Birmingham area, including the Lickey Hills, and he became a leading authority on the subject. His 1899 research paper on the Lickey Hills, published in the Proceedings of the Geologists' Association, is one of only a few complete accounts of the geology of the area. The many maps and diagrams of the geology of the hills that he created, along with his lecture notes, can be viewed today in the Museum at the University of Birmingham. The Lapworth Museum contains the Lapworth Archive, comprising a near complete record of his research and teachings.



▲ Professor Charles Lapworth *courtesy of the Lapworth Museum*

## The Lapworth Museum of Geology

The museum is open to the public and provides for school, college, adult education and community groups. Admission is free. Group visits are welcomed and should be booked in advance.

Opening hours
Monday - Friday 9.00am - 5.00pm
Saturday and Sunday 2.00pm - 5.00pm

For opening hours over Christmas, New Year and Easter, please contact the museum.

For information on tours, talks and access to additional collections, also contact the museum.

Lapworth Museum of Geology
University of Birmingham
Edgbaston
Birmingham
B15 2TT

Tel: 0121 414 7294 or 6751
Email: lapworth@contacts.bham.ac.uk

# The Biodiversity of Barnt Green Road Quarry

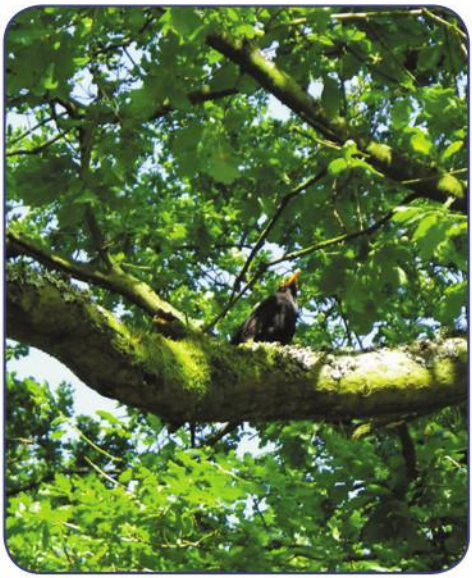
The quarry is surrounded by woodland bearing a canopy of beech, silver birch, goat willow, holly and sycamore, together with shrubs including (locally) frequent snowberry, and a ground flora supporting broad buckler-fern and bluebell. Plants indicative of acidic soils such as wavy hair-grass and bilberry occur around the periphery of the cliff face. The woodland attracts a number of commonly widespread birds as well as those more specific to woodland, such as the wood warbler.

Although the common lizard inhabits the surrounding woodland, at present, these and other reptiles are unlikely to be found in the quarry until the vegetation is re-established.

# Continuation of the trail route directions....

**10)** From Barnt Green Road Quarry retrace your steps out of the quarry and back up the hill.

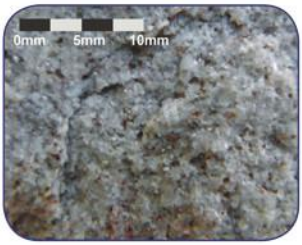
**11)** At the car park, bear left around the edge of the car park to join a path leading straight on to the Lickey Hills Visitor Centre (it runs parallel to the car parking area).



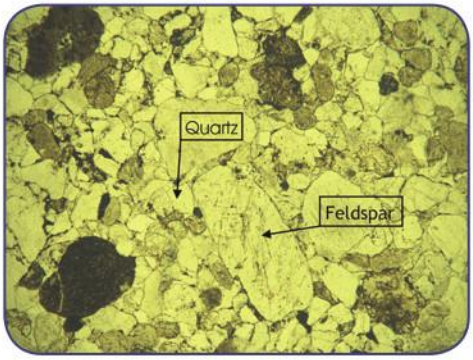

# Warren Lane Quarry

Warren Lane quarry is used today by the Lickey Hills Country Park as a wood store and workshop area.

The quarry lies on the western slopes of the Lickey Hills ridge-line and is composed of Ordovician-aged Lickey Quartzite. Though of the same rock unit as the rocks seen in the Barnt Green Road Quarry, there are clear variations between the quartzites seen in each of these quarries. Here in Warren Lane Quarry, the quartzite is creamy pink in colour (it weathers grey), whereas in the Barnt Green Road Quarry there is greater variation, with strong brown and purple colourings. In addition the quartzite in Warren Lane Quarry is generally a homogeneous medium grain-sized quartzite, lacking the inclusions of 'other' material and the occasional granular texture seen in the quartzites in Barnt Green Road Quarry. These observations suggest that the layers of Lickey Quartzite in Warren Lane Quarry are from higher up in the sequence of the Lickey Quartzite Formation i.e. they were laid down on that shallow sea floor later than the sediments that now form the layers of quartzite in Barnt Green Road Quarry. Though not fully scientifically investigated, it would be natural to conclude that the (speculated) volcanic activity referred to on page 18 had ceased by the time the Warren Lane Quarry quartzite was being deposited.




**Lickey Quartzite from Warren Lane Quarry**




**A microscopic image of the Lickey Quartzite. Alongside quartz, which makes up around 80% of the Lickey quartzite, the mineral feldspar is also present.**

Access into Warren Lane Quarry is by appointment only. Please contact the Lickey Hills Country Park rangers for more information (see page 3 for contact details).

# The Biodiversity & Archaeology of Warren Lane Quarry

The acidic habitats of the quarry include woodland, scrub, heathland and bare ground, which offer ideal conditions to support a diversity of flora and fauna.

Cladonia lichen growing on the rock face

Heathland plants and a number of acrocarp mosses grow on the sloping rock face, together with bryophytes and lichens. There is a strong possibility of both the common lizard and slow-worm inhabiting the quarry.

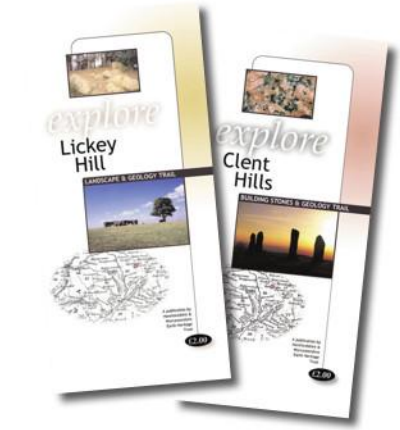
Historically the quarry was used for arms storage and also as a firing range during WW2. It was believed that, if targeted, then the force of the bomb would be contained within the quarry, doing little damage to the surrounding area.

Rifle Range butts

# EXPLORING THE LOCAL AREA

**Local Geology and Landscape trails**

*Lickey Hills Geology and Landscape Trail*
Published by Herefordshire and Worcestershire Earth Heritage Trust




*Clent Hills Geology and Landscape Trail*
Published by Herefordshire and Worcestershire Earth Heritage Trust

**Local Geoconservation Groups and Geological Societies**

- Herefordshire and Worcestershire Earth Heritage Trust. www.EarthHeritageTrust.org
- Warwickshire Geological Conservation Group. www.wgcg.co.uk
- The Black Country Geological Society. www.bcgs.info
- Abberley and Malvern Hills Geopark. www.Geopark.org.uk

**Lickey Hills Country Park walking trails** (available from the Lickey Hills Visitor Centre)

- Circular Walk around the Lickey Hills Country Park
- Lickey Hills Country Park Sculpture Trail

**Long Distance Walking Trails passing through the Lickey Hills**

- North Worcestershire Way: 35 miles. Bewdley to Majors Green, Birmingham
- Bromsgrove Circular Walk. 30 miles
- North Worcestershire Hills Marathon (can be walked!): 26 miles. Circular route from Bromsgrove
- St Kenelms Way: 49 miles. Clent Hills to Winchcombe

# COMMUNITY EARTH HERITAGE CHAMPIONS PROJECT

Supported through the Heritage Lottery Fund and the Aggregates Levy Sustainability Fund, Barnt Green Road Quarry received a makeover in 2010.

The quarry as it had been for nearly a century

The quarry following large-scale site works undertaken by PJ O'Boyle Rural Landscapes, and additional work carried out by the Lickey Hills Rangers and the West Midlands Fire Service



## what is the Community Earth Heritage CHAMPIONS project?

The Community Earth Heritage Champions Project, funded by the Heritage Lottery Fund, and Natural England through Defra's Aggregates Levy Sustainability Fund, has involved communities across Herefordshire and Worcestershire.

Each of the nineteen geological sites chosen for the project has a Champions community group carrying out conservation work, promoting the use of the site to other people in their parish and monitoring the site for any changes in condition.

The idea of the project is to take a holistic view of the environment and to understand the relationships between geology, ecology and archaeology.

The Champions have received training in a number of subjects in order to understand the features observed at their site; knowledge which they will now pass on to new volunteers. The conservation work being undertaken will help to ensure the protection of these important features and enable people to enjoy the natural world for years to come.

Community Conservation Champions

For more information about the project, or any aspect of the work carried out by the Herefordshire and Worcestershire Earth Heritage Trust, please contact us at:

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heritage lottery fund
LOTTERY FUNDED

Herefordshire & Worcestershire EARTH HERITAGE TRUST

Birmingham City Council

www.EarthHeritageTrust.org

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