DUKES QUARRIES – INTERPRETATIVE GUIDE

Dukes Quarries comprise a cluster of sandstone workings scattered over half a mile in the Derwent Valley Mills World Heritage at Whatstandwell, Derbyshire. Started over 200 years ago, they include the only building stone quarry still operating in the DerwentWISE area. They have supplied resilient stone, often as large blocks, nationally to projects as varied as prisons, bridges, churches, docks and stations. This guide provides a brief glimpse into that story.

This guide has been drafted by Ian Thomas, (former Director of the National Stone Centre) a geologist and quarry historian. Its preparation is one of the projects of DerwentWISE (the Lower Derwent Valley Landscape Partnership), supported by the National Lottery Heritage. A sister project, Delving into Quarry Heritage, has generated much of the historic content; the research contribution of Grenville Smith has been especially significant and is gratefully acknowledged.

INTRODUCTION

How to use this guide

The Guide covers the Dukes Quarries area under three main topics:

- **Geology** – features seen in the rocks themselves
- **History** – the story of activities and the items made here
- **Ecology** – the pattern of wildlife after quarrying

The Guide begins with a general account of each subject. The second part identifies possible things to look out for on site.

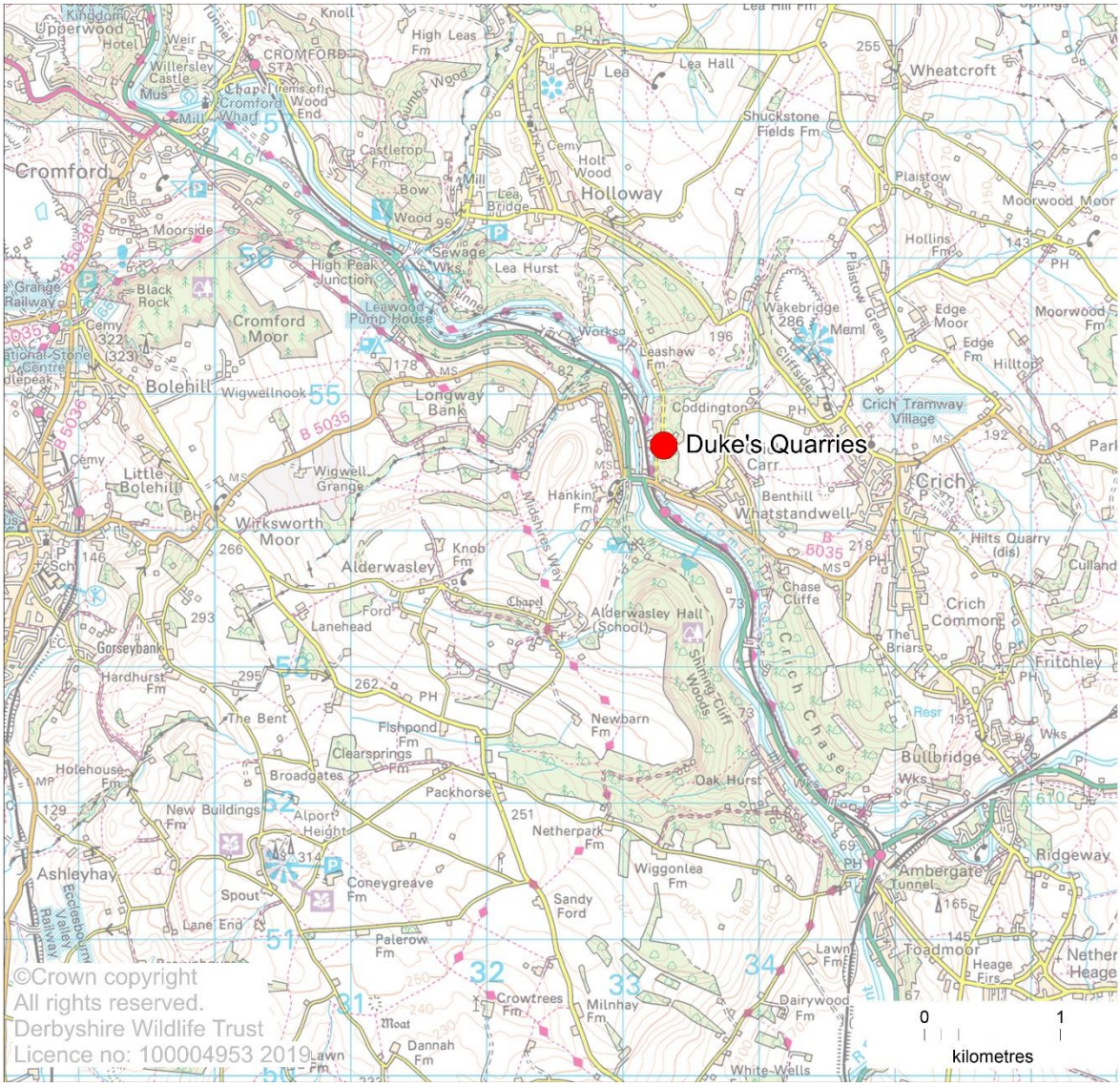
The whole area is generally known as Dukes Quarries, named after the main owner, the Duke of Devonshire. Within this are five main sections of the site which together cover an area about 0.75km from south to north and 0.5km wide (see general location map on page 2):

- **Old Quarry** – infilled – no access
- **Bridge or South Quarry** – a single long quarry face
- **Middle Hole** – currently an active quarry with **strictly no access**
- **North or Winson Quarry** (sometimes referred to alone, as Duke's Quarry) – two main quarry areas – a single opening in the west, whereas the eastern part includes a number of individual faces.
- **The area west of Robin Hood Road** – including the former workshop areas (completely demolished), the Cromford Canal and Derwent Valley Rail Line, and (private) the smithy and manager's offices

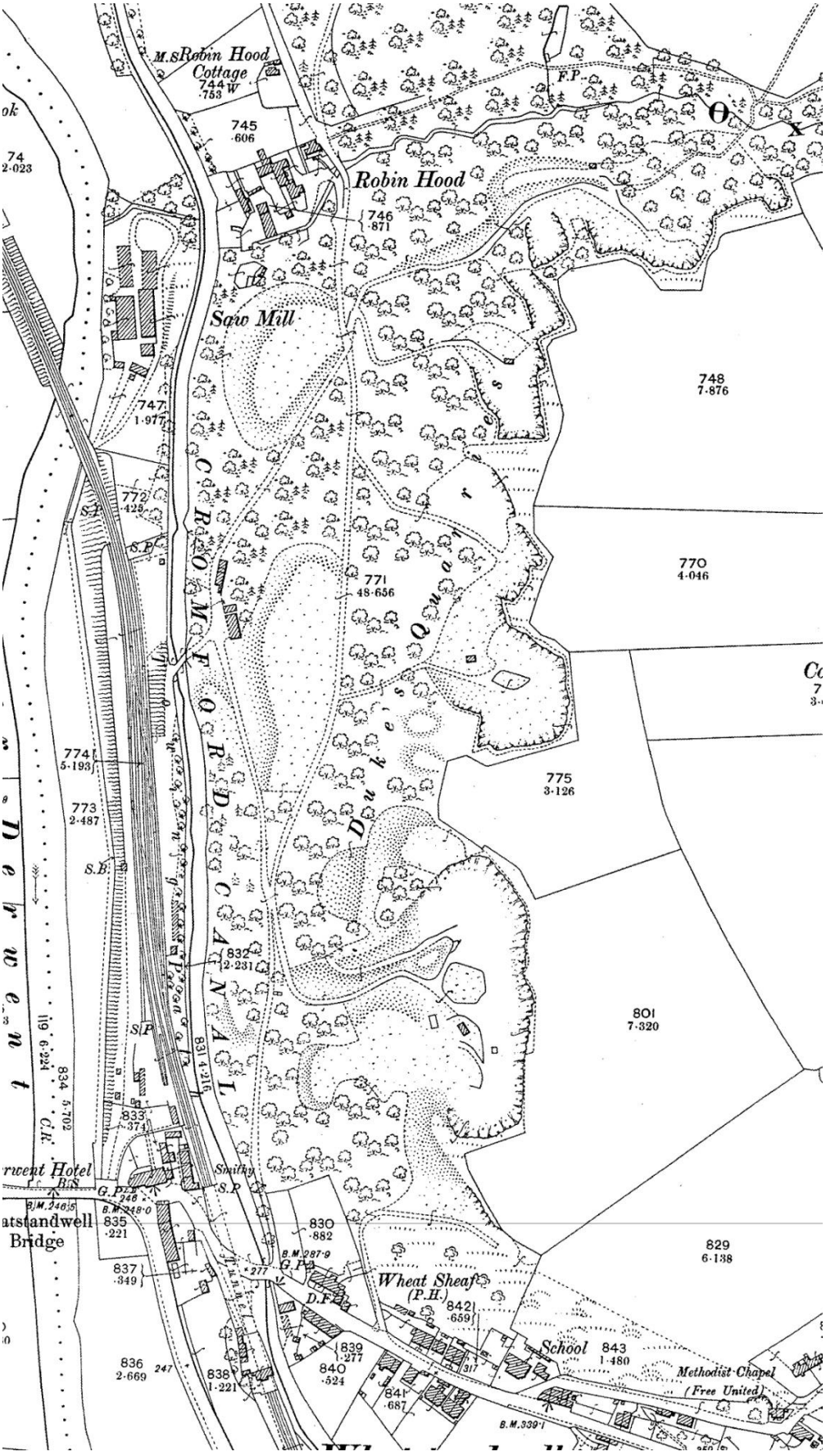
Remarkably few changes have been recorded since about 1900. As the maps of that period show great detail (often omitted from later maps), they provide a useful base onto which key features have now been highlighted. The saw mill on the 1900 map was for timber, not stone.

A public footpath runs through Bridge Quarry and another public footpath skirts much of the North Quarry, from which there are obvious informal side paths.

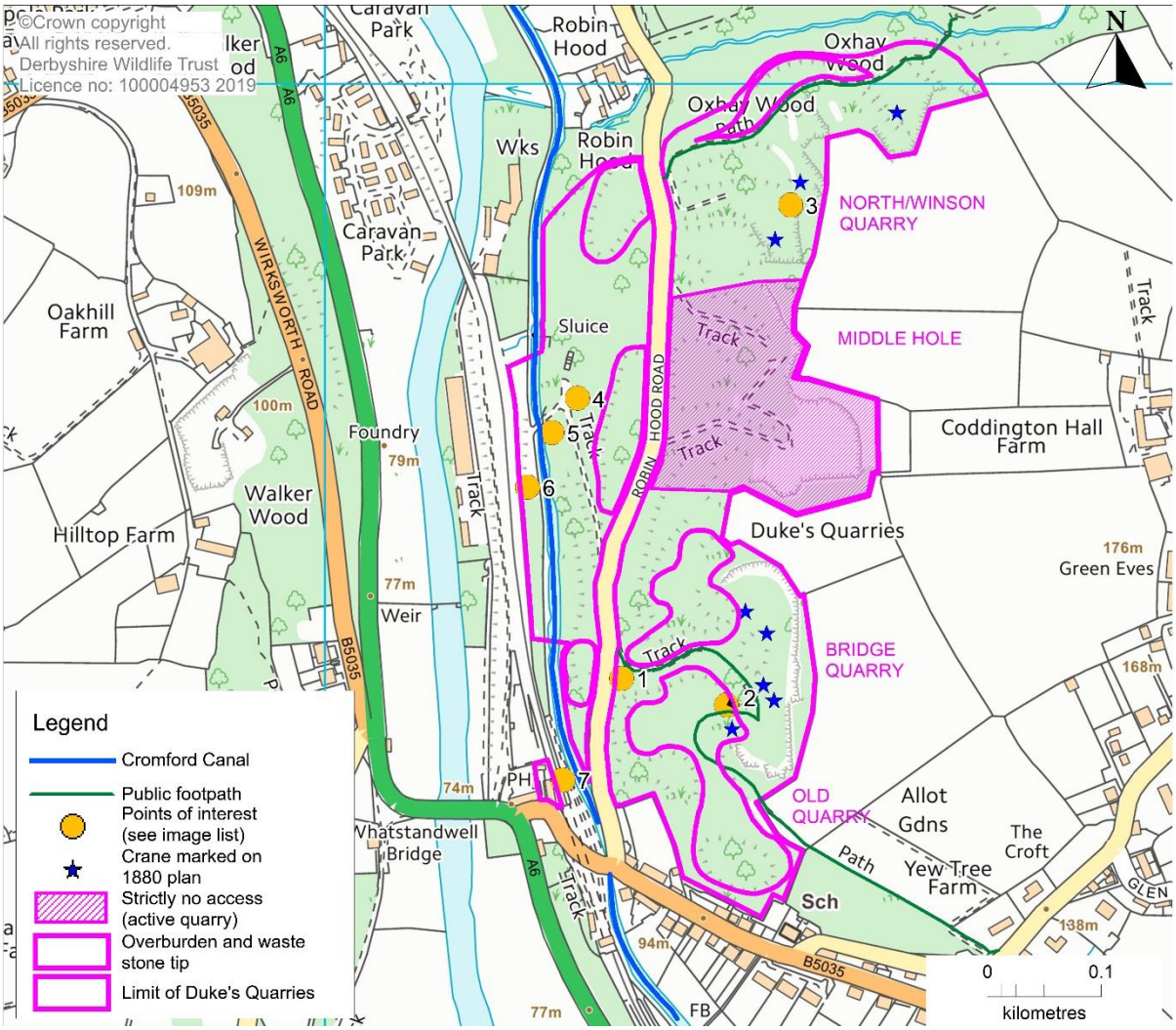
None of the individual quarries show **all** of the best examples. The suggested routes can all be extended to link to places of interest outside the Guide area.



Map 1 –Location



Map showing general location of quarries in 1900



Map with key for Duke's Quarry – numbers refer to key features

When is the best time to visit? The geological and industrial heritage is best seen in the winter and ideally in February/March, when the vegetation is less likely to obscure the view. On the contrary, the wildlife, especially flowering plants, is most prolific in the late spring, before extensive leaf tree cover darkens the ground and clouds out growth. As part of the project a number of self-set trees (mainly sycamores) have been removed strategically to open up views and stimulate ground cover.

HOW TO GET THERE (see Map 1)

Post code (southern end) DE4 5HE/DE4 5HG

NGR (southern end) SK 333543

NGR (northern end) SK 335550

Road – via A6 = 2 miles (4km) north of Ambergate/ 4miles (6km) south of Cromford ie junction with B5035 to Crich.

Bus – Transpeak (Derby-Manchester – Whatstandwell request stop) – weekdays hourly/Sundays 2 hourly (www.derbysbus.info/times/timetables/TPKT-170129.pdf)

Rail – Derwent Valley (Derby/Matlock) Line – Whatstandwell Station – hourly (then via Cromford Canal towpath) (www.eastmidlandstrains.co.uk/train-times)

Walking – paths from Crich; Cromford Canal towpath

Food – The Family Tree (previously Derwent Hotel) – wide range of snacks and meals [booking advisable at busy periods]

KEEPING SAFE

This extensive area poses a number of risks and potential hazards.

Robin Hood Road (leading to Leashaw Road) runs through the entire length of the site. It is unfenced, narrow, lacking footways and in parts, winding and dark. Parking areas are limited but a small public car park by the canal road bridge may have spaces. Always walk along the road facing on-coming traffic – wear reflective clothing if possible.

Play it safe – always keep to obvious well-worn paths – these include public footpaths and former working trackways. Access to any areas outside public footpaths should be agreed with the Devonshire estate prior to any visit to this site.

Access to the Middle Hole area is very strictly prohibited as this is still a working quarry.

The most obvious dangers elsewhere are the former quarry faces, most of which are unfenced and unsigned – they may look safe but there is always a risk below, of falling rock, or above, of slipping over an edge – so keep at least 15m away from any rock face.

Just in front of a number of quarry faces beware of unfenced very steep gullies – these were often the last areas where stone was extracted and originally only accessed by ladders. At the time of writing there were no areas of standing water, but some of these deeper areas have held water in the past.

There are numerous slip and trip hazards, even on the public footpaths along which, rough surfaces are common (particularly note a set of broken steps leading south above Bridge Quarry). These are especially common on the very extensive areas of overgrown waste stone tips, with moss-covered extremely rough ground and steep muddy slopes.

There is a risk, particularly in wild weather conditions, of falling branches and trees (many of which are shallow rooted , on steep slopes and aging).

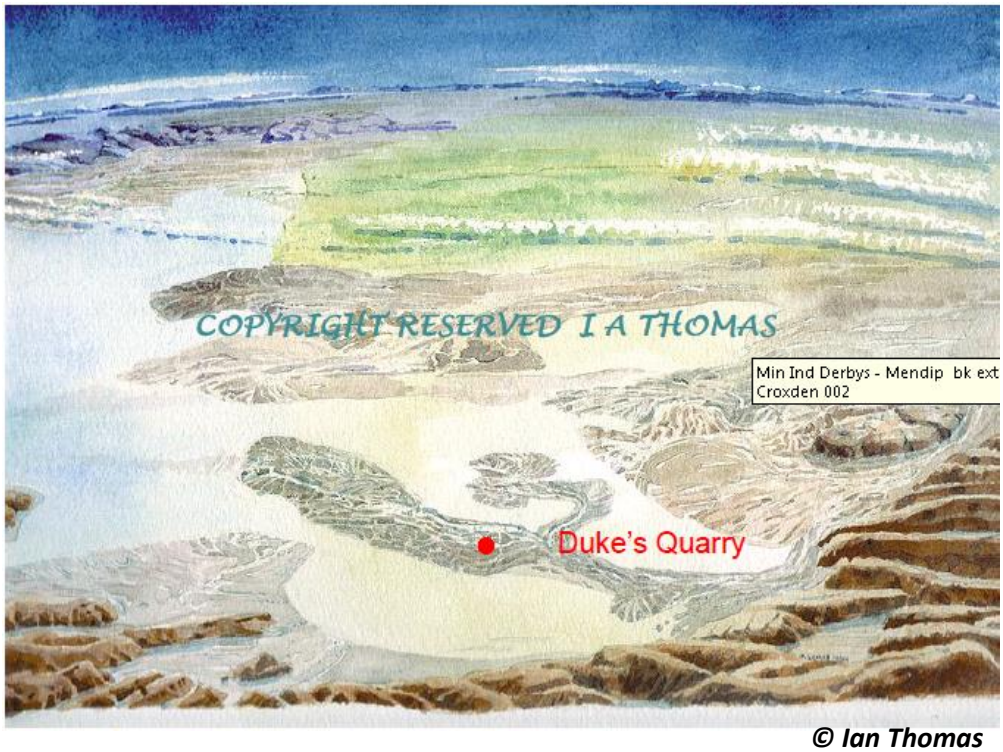
The mainline railway (fenced) and the Cromford Canal (not fenced) run along the western boundary of the site; these form an important part of the Dukes Quarries story, but the standard access cautions still apply.

ORIGINS – A 317 MILLION YEAR STORY

The Bigger Picture

The limestones seen nearby at Crich Quarry and throughout the White Peak, were formed as limy deposits in azure tropical seas just south of the Equator. This idyllic setting was brought to an end abruptly by plumes of mud, the first indications of a complex system of advancing deltas. These were fed by massive rivers on the scale of today's Brahmaputra in Bangladesh. A considerable range of mountains, the Caledonides, running from Greenland, across Scotland and through Scandinavia, were rapidly being eroded; the products of this process, solidified over time to become the **sandstones** seen here. The first deltas extended into the Pennines mainly from the north, forming the highest ground of the Dark Peak. But here further south, sands and muds were swept in from the south east, ie from the Nottingham area, across central Derbyshire into east Staffordshire. The resulting stone in these quarry faces is known as the Ashover Grit. All this happened around 317 million years ago, during the Namurian, within the Carboniferous Period.

Formation of the Ashover Grit



© Ian Thomas

Close study of the stone, reveals that it is mainly made up of sand grains of glassy quartz, smaller amounts of milky textured feldspar and occasional silvery flecks of muscovite, white mica. Sandstones such s these, with a marked proportion of feldspar are termed '**arkoses'**. These are all the results of the disintegrating Caledonian granites, far to the north.

When the meandering currents slackened or flows ceased altogether from time to time, there would be a break in sand being deposited, seen today as roughly horizontal cracks in the quarry face; these are **bedding planes**. Where rocks have been affected by Earth movements, bedding planes may be tilted or elsewhere, more severely distorted. In places, feint parallel markings can be seen tracing a sharp obtuse angle to the major bedding. This feature, known as **cross-bedding** , was formed as grains of sand toppled over steeply dipping delta fronts; by taking hundreds of measurements of cross-bedding alignments, geologists can calculate the flow direction of the originating rivers. Sometimes when currents were diverted, thin layers of dark fetid mud accumulated during floods or 'slacks' between flows. Collectively these are **mudrocks** – where these are seen as thinly laminated beds, they are **shales**; otherwise they are **mudstones**.

The sandstone beds here are particularly massive which makes them especially attractive to building stone quarriers. But the muddy layers are important for two reasons. Firstly they represent unusable material which has to be removed and dumped. Not only is this an additional cost, this sticky material may be difficult to shift, especially in wet weather. Secondly, natural water at the surface readily seeps through the breaks in the sandstones, but ponds up above the mudrocks as they form impervious seams in the sequence; the wet conditions add to the problems of stone extraction. Narrow, near vertical uneven breaks in the rock face are called '**joints'**. They result from a combination of minor volume adjustments as the beds of sand contract when they solidify to become sandstone, and secondly, minor responses to Earth movements. More dramatic events produced '**faults'** during which rock on each side of a fracture moved in relation to the other. The suite of Dukes Quarries provide a good 3D picture of the Ashover Grit, viewed both across the strike and dip.

What's the difference between a sandstone and a **gritstone**? Although 'gritstone' is not a term recognised by most geologists, it is widely used in the North of England to describe conveniently, the more coarsely grained sandstones, particularly when the grain edges are angular.

Rusty Rocks

If the main grain types in sandstones are all very light in colour when pure, why are the rocks now multicoloured? Here for example, when freshly broken or cut, they are typically mauve or light brown. Around Cromford pink or purple stone is common, whereas some old Belper quarries were famed for light buff ('white') stone. One of the other components of granite is biotite, ie black mica. This weathers very easily, releasing iron. Iron oxide spreads through the sediments creating a thin surface film on the other grains. Almost all colour in rocks is the result of various forms of iron oxide – in other words, most rocks are 'rusty'. Coatings of moss or lichen can also add a green or red colour.

OVER TWO CENTURIES OF DELVING DEEP AND DELVING LONG

Geography and geology have come together to make this quarry complex, one of the most important nationally. Firstly the sandstones here are massively bedded and comparatively strong, making it possible for immense blocks of stone to be extracted to meet very demanding engineering specifications. Secondly, the site was one of the closest sources of such stone to many Midlands cities and London, directly connected by canal and later, by railways. Finally, the distinctive mauve colour particularly appealed to many Victorian builders.

At least four separate sandstone quarries have operated here. We know very little about the oldest found in the south, behind the former Wheatsheaf Inn, Whatstandwell Village. Activities probably began here long before 1800 and are now buried in quarry waste.

Why the name 'Duke's'? The land where most of the activity took place was leased from various Dukes of Devonshire. The main operations probably started around 1808 in the south at Bridge Quarry, working northwards through 'Middle Hole' to a site known as North (or Winston; or confusingly, 'Dukes') Quarry' over a distance of about 0.75km. These activities in general are also referred to as Coddington Quarries.

By this point, the adjacent Cromford Canal had opened and operating since1794.

WHO RAN THE QUARRIES?

Early documents are confusing. For example, it is not always clear whether these operations, or those of others to the north on Nightingale's Lea Estates, are the subject. Intriguingly, by 1810, the two groups of enterprises appear to have been linked. On Nightingale-leased land, Joseph Wass had a smithy, a stone wharf on the canal and a tramway from it to Dukes. Shortly afterwards, management probably came under Gabriel Brittain, a local colliery, stone and barge owner, and lime merchant. Major contracts won by Brittain included Derby and Leicester Prisons. However from the 1830s, several generations of the Sims family took control at Dukes. Indeed the Sims connection may well have started even earlier as Samuel 'Simes' (sic) is recorded as tendering to supply stone for the construction of Whatstandwell Bridge in 1795 (possibly from the 'Old Quarry') during the course of which, he makes reference to 'coping stone as the coping at the [canal] Derwent Aqueduct'at Lea (ie built in 1792). The Sims involvement at Dukes continued until at least 1915 when John Sims was killed in a railway accident. However by that time the family connection was embodied in the operating company name, Anthony Sims Ltd which was in control until 1940. J W Wildgoose & Son Ltd, builders and quarry owners of Matlock, took over the management the following year, until closure in c1967. Blockstone Ltd (aka Realstone) one of the UK's largest building stone enterprises and based at Wingerworth, Chesterfield, revived Middle Hole in 1989 as one of its dozen or so network of quarries across England and Scotland.

The companies involved won many large contracts (see below) but there were often lean periods, some of which led to bankruptcies. In contrast, at one point in the nineteenth century, the assets involved were valued at the equivalent in today's terms to several million pounds.

In summary, various parts of the complex of quarries collectively known as 'Dukes' were operational from at least 1808 until World War II, after which activities were more

intermittent until closure in c1967. Since the reopening in 1989, extraction at the middle site has been on a campaign basis, ie lasting for groups of a few weeks each year according to demand.

At various times, the Sims' managed other quarries, notably Walker Wood and Cupola just opposite on the west bank of the Derwent, Birchwood west of Cupola Riber at Matlock, possibly (for a millstones over a short period), Rowcliffe on Shining Cliff, and jointly with Robinson, Barrel Edge/Black Rock above Cromford. Another Sims' site, Meadow Wood Quarry, has yet to be located but may be further north, alongside the A6.

Bridge Quarry c 1890s

Based on a very poor printed image on an office memo – courtesy of Chatsworth Archive (in felt tip by Ian Thomas).

Getting the jobs done

Although no records of the employment of women here have been discovered, a national Government enquiry of 1842 found many children at Dukes aged 10 to 14 years, were engaged for 12 hour-days (with breaks) at a shilling a day, the younger ones, barrowing waste to tips; others broke stones or drove carts. Quarry work was preferred to that in lead mines as being more 'healthy' but the potentially lethal lung disease, silicosis was an ongoing hazard, especially for masons operating in confined spaces.

Numbers employed varied considerably, mainly responding to trade fluctuations. At its busiest points for example in the later nineteenth century, the enterprises occupied over a hundred people,

but this may have also included their other quarries and farm holdings. By around 1900, this had dropped to c30 men and in the mid 1930s there were less than ten, including managers. In more recent years, following reopening in 1989, two heavy mobile plant operatives, based there for only a few weeks annually, could potentially generate similar quantities of saleable block to that of the early 1900s.

There were several distinct jobs.

Firstly ground had to be cleared of soil, clay and weathered or otherwise unusable rock – classed as 'overburden'. This process, known as '**ridding'** was carried out by unskilled labourers and particularly, by boys, digging and barrowing material to tips. Its disposal, along with waste from later processes posed the major problem of finding tipping space; the ratio of stone in products to the total volume extracted is not known, but could well have exceeded 50% and this accounts for the massive hillocks on all the sites.

The task of the **getters** was to assess stone in the quarry face and break it out as blocks, of a size suitable for craning and carting. This highly skilled work required an intuitive appreciation of 'geology' and the mechanical properties of rock. They used metal bars to lever out material utilising natural bedding planes and joints. Where unbroken sections of rock face were too large to handle and needed to be split, a series of round holes were drilled into which pairs of 'feathers' would be inserted; between the feathers, chisel-shaped bars known as 'plugs' would be placed and hammered in to wedge apart the two sides of stone. Not only were plugs and feathers familiar to Roman quarriers, they are still in regular use today. Alternatively black powder' (ie gunpowder), a mild explosive to avoid extensive fracturing, was and still is utilised to separate out block.

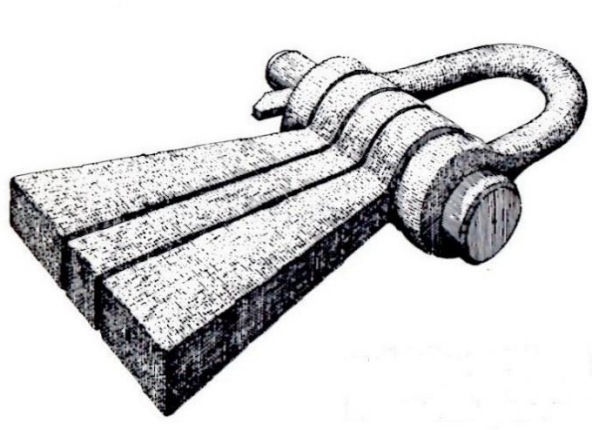
Plug and feathers

To split large blocks, a series of holes are drilled and the feathers (two curved slats) inserted into each. A plug (like a chisel) is hammered between the feathers, wedging the block in two. This method is still used after more than two thousand years.

Scapplers had to carry out the trimming of blocks, squaring them off, removing as much unwanted material as possible in the quarry, before despatch to those responsible for final shaping.

The **cranemen** then took over, lifting block from the quarry floor and onto carts or trucks. In 1880, there were five cranes in the Bridge Quarry and three in the northern workings. The cranes were manually cranked until some point after 1900, when steam power was introduced. Powered cranes were more labour-saving, doing work equivalent to about four getters. Slots would be cut into blocks and gadgets known as a 'three legged lewis' or 'chained dogs' inserted to facilitate lifting.

Three legged lewis



One method of lifting blocks is to cut a triangular slot in the top; the two outside 'legs' are put into the slot, then the middle one and lifting link added; the pin is then inserted.

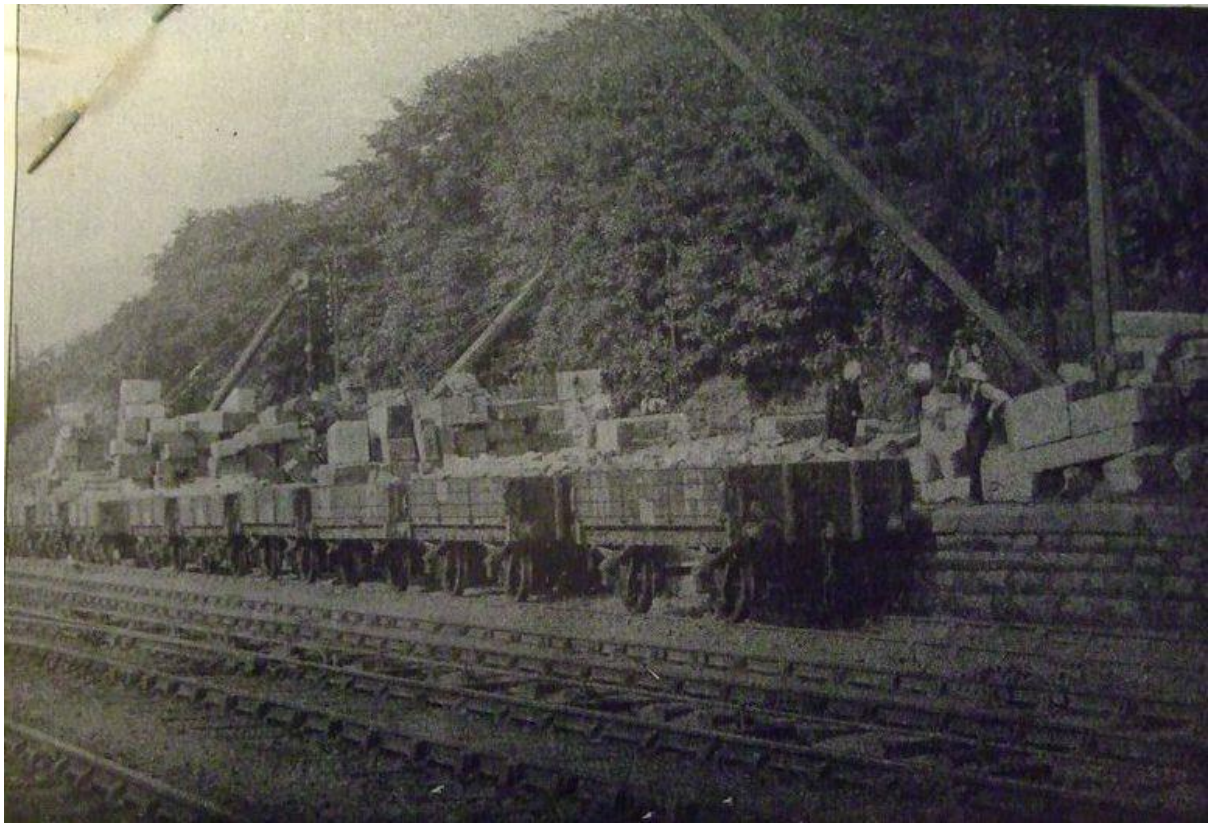
As can be seen in the Dukes quarry image on page 9, the cranes here had remarkably long beams (almost horizontal) attached to masonry-bound anchor points, to secure the upright king post. Extensive checks with cranes of this vintage have failed find any similar examples outside the area, with one solitary example on Portland. However the site at Barrel Edge, Wirksworth and the probably nineteenth century re-opening of Rowcliffe Quarry, Alderwasley both display similar masonry-defined anchor points. It is therefore hardly surprising to note that the Sims family, for many years, the operators of Dukes, were associated with Barrel Edge and apparently, Rowcliffe.

Trimmed blocks were then carried down to the workshops. Rather surprisingly despite not only the scale of extraction (of both usable stone and waste), much of it over fixed routes for very long periods, no evidence of the use of an internal system of tramways or ropeways could be found. So movement was apparently entirely by animal and human power, including in the very early days, boys as young as 10 years old barrowing loads of several tens of kilograms regularly over distances of 150m.

The first process in the sheds was to square-off roughed-out blocks by sawing to the maximum dimensions required for each job. The final production stage involved the highly skilled work of masons known as **bankers** (after the French – banc = bench). Bankers used tools – templates to define profiles, squares, mallets and a range of chisels – would also have been perfectly recognisable to Roman workers. Only the materials of the tools had changed. Although no details have been verified, based on the items produced, in later years, certain activities probably became mechanised. For example sawing and planing machines produced regular flat surfaces; profiling by routing or turning columns used lathes. Not until the last two decades have some earlier 'hand tooling' techniques become powered.

Until the 1940s, almost all finished goods were despatched using cranes to load canal barges or railway trucks. Since then, quarried blocks have been taken by road for finishing, to works initially in Matlock and, from 1989, to Wingerworth near Chesterfield.

Dukes rail loading platform



Loading stone at Sims' railway sidings c 1900 – courtesy Chatsworth Archive

Another essential activity, the regular sharpening of tools, was conducted in the smithy located just off the A6 at the bottom of Main Road, next to the Family Tree Restaurant. The quarry company offices were located in the same yard, on the left (below).

FAMED ACROSS THE NATION….and beyond

Over more than two centuries, Dukes Quarries have contributed stone to a remarkable and impressive range of users. We'll never know the full story as countless private and commercial projects have been supplied, many as block stone through other masonry firms and for which the customer remains confidential or unknown. The quality of Duke's stone was established very early.

Timeline of example contracts

1 Cromford Canal Aqueduct at Lea [1792?]

2 Whatstandwell Bridge [1794?]

3 Millbank Penitentiary, Pimlico, London built - 1812 -1821 demolished 1903

4 Waterloo road bridge London – opened 1817 - internal portions

5 Derby Gaol - 1823

6 Leicester Gaol - 1825

Myth – contrary to popular belief, Dukes Quarries were never operated by George & Robert Stephenson although they were major customers and, via the Clay Cross Co, they ran the nearby Crich Limestone Quarry and Ambergate Limekilns

7 Euston Station London built 1835-7 demolished 1960s

8 London to Birmingham Railway c1835 100,000 charstones [effectively stone sleepers]

Myth – contrary to popular belief, Dukes' stone was not used in the rebuilding of the Houses of Parliament after the 1835 fire, although it was considered along with about a hundred other sources. It may have been used on a small scale internally but this is yet to be verified.

9 Birmingham Gaol (now Winson Green) 1849

10 Victoria Docks, East London 1855

11 Eastwood Church, Nottinghamshire – 1858

12 London and North West Railway bridges – c 1860

13 Locks on 'broad' canals (various locations) - 1860s

14 Strutts of Belper – regular large customers of paving slabs – especially 1864 - 75

15 Trent Bridge, Wilford, Nottingham - built 1864 – 76

Myth – contrary to popular belief, Dukes' stone was not used in the rebuilding of the better known Trent Bridge at West Bridgford, Nottingham, at least not as a main component

16 Trent Bridge, Burton on Trent 1864

17 Avonmouth Docks near Bristol 1877

18 Primitive Methodist and Baptist Chapels, Crich - 1877

19 Leicester Waterworks, Bradgate - 1881

20 Grindstones appear for first time in adverts; sales to Norway, India and America are noted, implying that these are destined for producing paper pulp from timber - 1895

21 Grimsby Docks – 1898

22 Derwent Valley Aqueduct - 1905

23 Chantry Bridge, Rotherham - 1906

24 Duke of Devonshire Memorial, Whitehall, London – 1910

Sales of crushed rock for concrete aggregate first noted - 1927

25 Ambergate railway junction, Derbyshire – major widening scheme - 1929-31

26 Worcester – bridge over River Severn - 1931

27 Bridge and reservoir works for Derbyshire County Council – 1935

Sand sales promoted – 1941

Grindstones advertised again in 1951 and until closure in 1967

28 Realstone's headquarters building, Wingerworth, Chesterfield – 1990

29 Cooperative store Hereford 1991

30 St Peters Church Hamilton, Scotland -1992

31 Hereford Cathedral restoration -1994

32 Mappa Mundi Library, Hereford -1994

33 Broadgate restoration, Ludlow*

34 Grand Plaza, Dublin*

35 Building, Nurnberg, Germany *

36 XI Linx building, Ireland *

37 Merryhill Shopping Centre, Birmingham*

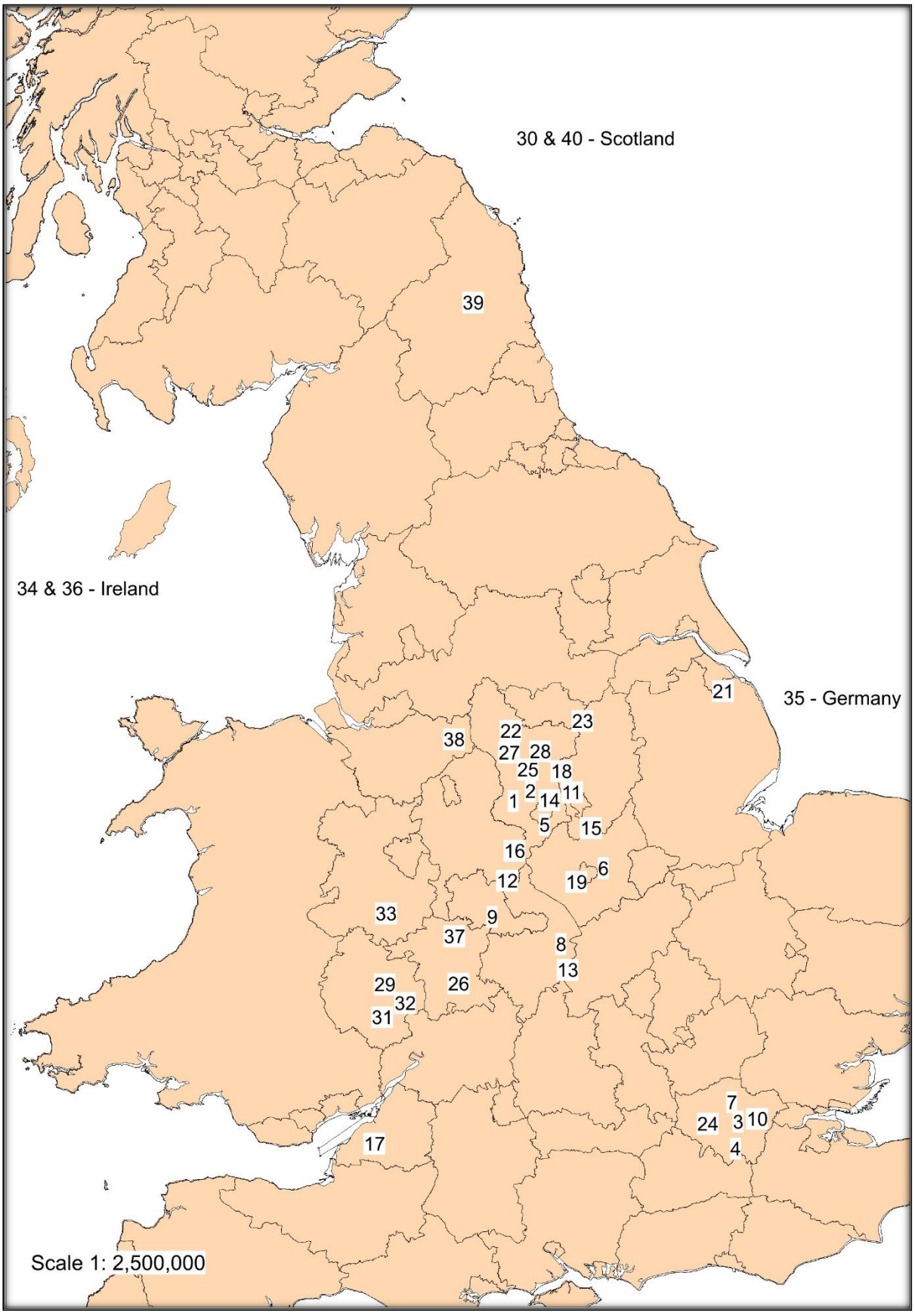
38 Mottram Hall, Cheshire (private residence)*

39 Hartshaugh, Northumberland (private residence)*

40 Building Society, Byres Road, Glasgow*

* Dates not known but all after 1989

Map showing Locations of building projects supplied from Dukes Quarry since c1790



General Products

The following were supplied on a regular basis, often from stock.

Ashlar, ie smooth-faced building stone.
Large base blocks for steam or other engine beds, girder beds &c.
Bridge parapets.
Stone required in railway, dock and canal construction.
Kerbs, paving, sills, lintels, stone dressings,
Sinks
Rubble and wallstone, suitable for building
Caps and coping
Sand and crushed stone aggregate
Grindstones

LIFE AFTER QUARRYING

The full story begins before quarrying started in the eighteenth century. Just to the south west, outside the area was the extensive medieval hunting forest of Duffield Frith. The terrain around Whatstandwell was very similar – steep-sided heavily wooded valley slopes overlooking narrow, flat floodplains. On the more gently rising land to the east, towards Crich, patches of land would have been cleared and farmed. The sharper gradients of our area would have remained wild and, like parts of Shining Cliff woods downstream on the opposite bank of the Derwent ,would now be classed as ancient or 'primary woodland', undisturbed for centuries or probably millennia.

Quarrying, not only the extraction itself, but the tipping of rejected material and especially the generation of dust, would have removed vegetation and inhibited new growth. As activity fluctuated in the various sections of the site, in dormant periods regeneration would begin. Even the first large scale maps, surveyed around 1880, show that on the majority of the site, mixed woodland was already cladding most of the earlier tips and intervening areas.

From the pattern and types of trees present, it is unlikely that organised planting was conducted for example to produce commercial timber, although elsewhere on Devonshire Estates eg in lead mining areas, this was the case. However a document of 1926 does indeed mention 'plantations' between the canal and public road ie part of the Hurt Estate.

The soils here are acidic, contrasting markedly with the calcareous soils of the Carboniferous limestone defining the White Peak and outcropping locally in the Crich inliers. The two types of geology tend to favour different groups of plants.

The changes from bare rock to mature woodland are of particular biodiversity interest. The first colonisation of stone piles (which also usually included discarded sand and mudstone) is by lichen (if the air is fairly clean) and mosses. Grasses, brambles and bracken soon follow, then flowering plants. Left untouched, shrubs and small trees, notably thorn and elder take over. Only after a few years do trees begin to emerge as significant players. Here the woodland is all of broadleaved varieties. Sycamore develops as an early and vigorous species, not only dominating other trees, but blocking out essential light to ground cover plants, reducing immediate underlying areas to bare soil in places; only plants able to thrive in shade tend to survive. Sycamore is especially noticeable on the

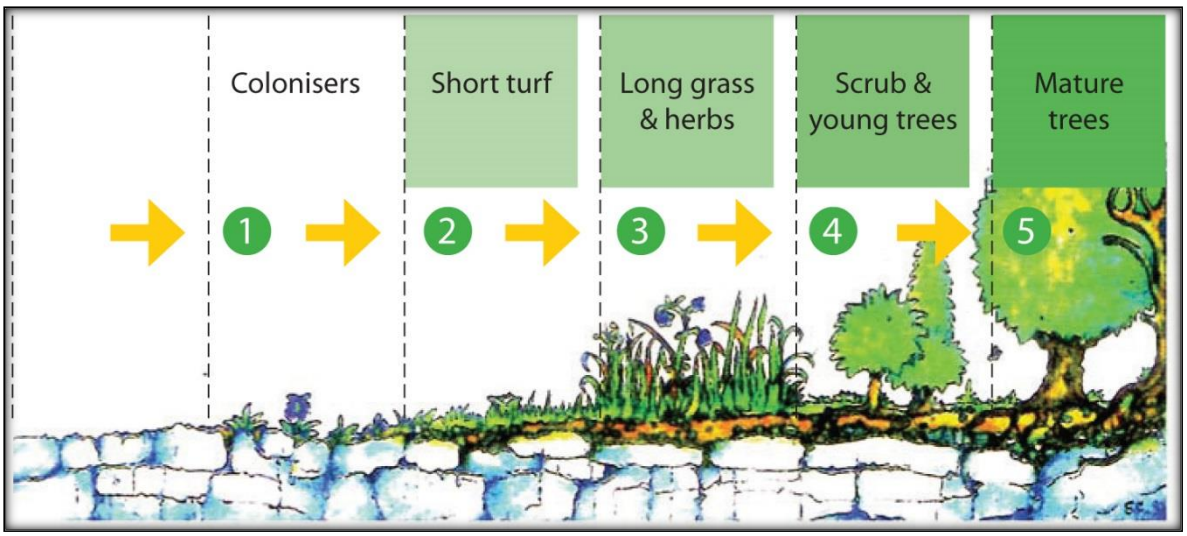
former quarry floors. Nevertheless trees native to the Valley, namely oak, alder and silver birch are present, but far less prolific, mainly found around the woodland edges, especially alongside tracks. Indeed the name 'Derwent' probably came from Celtic – the Welsh word for 'oak' is 'derw'. Holly is seen occasionally in most areas, but particularly in the 'Old Quarry'. There are a number of impressive beech trees; although a 'southern' species and not native to Derbyshire, the massive girth of some examples suggests that they date from the initial days of quarrying if not earlier.

Tree identification chart

Trees can be identified even during the winter using the identification chart above. Images courtesy of the Woodland Trust.

It is possible to plot the height of plants from the first invasion of bare rock to mature forest. Such a line or graph used to be called a 'colonisation curve'. Although professionals feel this approach is too simplistic, it is still a helpful way to understand general changes in Dukes Quarries.

Colonisation diagram



Left to nature, the bare rock of a quarry floor, gradually becomes colonised by a succession of plants from mosses to mature woodland. Image courtesy of Steve Chadburn

GUIDE TO THE SITE

A public footpath runs through Bridge Quarry and another public footpath skirts much of the North Quarry, from which there are obvious informal side paths.

None of the individual quarries show **all** of the best examples. The suggested routes can all be extended to link to places of interest outside the Guide area.

WHAT IS THERE TO SEE?

This Guide does not offer a single fixed route, but points to the main features in the accessible parts of the area. Although parts of the site have been active for more than 200 years, there is precious little evidence on the ground of the techniques used. All metalwork appears to have been removed, mainly for scrap, probably during the two World Wars or when metal prices were high. Timberwork will have rotted away long ago. However there are still clues on the ground and just a couple of very blurred photographs. This information can be compared with maps and other old sites which are better known.

Bridge Quarry

Walking up Robin Hood Road from Whatstandwell (beware of traffic), take the first way-marked footpath (at 100m) on the right. This leads into Bridge Quarry. Large tips of heavily overgrown unusable stone flank the path. As the path swings to the left, look right. The pressure to find tipping

space was so great that at one time a bridge was built over the public road below, so that waste stone could be carted across to be dumped. The abutments (stone supports) remain.

As the path levels off in the broad quarry area, the long quarry face lies ahead, at the base of which beware, there is often a gully up to about 4m deep. This trench strip would have been the last part from which stone was extracted by getters. Rather surprisingly, it is extremely difficult to see any examples of the marks of tools] on the working faces, although occasionally in certain directions of sun-lighting it may be possible to pick out straight narrow, artificial-looking, vertical lines, some of which are almost 3m in length (***Tip***: oddly, tool marks are often easier to spot on digital photos than at the scene!)

Mudstone in sandstone face

Part way down the face of Bridge Quarry is a thin bed of mudstone. This blocks the downward flow of water in the sandstone above, providing an ideal niche for hart's tongue fern to thrive.

Here the beds in the face look as if they are almost horizontal, but, by checking against the beds in the North Quarries, the strata are actually dipping gently towards you. Roughly half way down the rock face is a very noticeable near the horizontal 'groove' running along its length. This is formed by a bed of mudstone about 30cm thick. Rainwater flows from the surface down into the joints and gaps between the grains in the sandstone, where it is known as groundwater. The flow of water is blocked when it reaches the mudstone. The mudstone acts as an impervious seal. As a result, water

drips out over the mudstone; the dampness and shade provide an ideal niche for hart's tongue fern to grow.

Rising 2-3m (or in parts more) above the main quarry 'floor', are at least three mounds; in places these have squared stone blocks, scattered or occasionally aligned as walls. Evidence from a poor photograph and other sites indicates that these ridges formed the anchor points for cranes. Their long timber jibs extended out over the gulf for lifting out blocks up onto the flatter areas for scappling (ie trimming/squaring off) and carting away. In support of this, the 1880 large scale OS map, shows four cranes in this quarry, three of which are approximately in these positions. The relatively level floor here is not solid rock, but quarry waste, back-filled into the deeper workings that went down to the level of the base of the gully.

On the main quarry floor, the most abundant tree type, sycamore is shading out most flowering plants, so a decision was taken by the Derbyshire Wildlife Trust to cull this invasive species to promote greater biodiversity. In the process, the geology and industrial history has also become easier to understand. As a spin-off from felling, using counts of tree rings, it has become possible to estimate their age. One large sycamore at the edge of the gully was found to be about 60 years old. This conveniently coincides roughly with the mid-1950s, a point at which significant quarrying disturbance would have ceased a few years earlier and dust levels (which prior to this would have inhibited growth), would have died down.

Turning ones back to the quarry face, there are the remains of a small building topping a steep hillock. Walk along the clear path on the left, up to these ruins. Their original use is uncertain, but it seems likely that this was a foreman's or manager's office. From here it would have been possible to scan over all the important activities and supervise them; when leaf cover is thin, it is still a good viewpoint. A tally of stone extracted and loaded would have been kept, each gang of men and boys operating a particular section or 'sett' of the face, served by a crane. Black powder might have been stored here prior to 1875, after which, explosives had to be stored in a completely separate magazine building. Those tools supplied by the company would have been issued from here, but men often had to buy their own.

Turning again away from the quarry, (in front right) there are a scatter of unevenly shaped blocks of moss-covered stone. The roughly triangular shape suggests that they were probably rejected for a job in hand at the time which typically required stone from which a cube block could be cut, having minimum sides of say 60cm (c2ft). Unlike other tipped material, some of these blocks have small square notches (c3cm^2); these would have been cut to enable pieces to be lifted out using 'dogs', a type of scissor-like grab. So they may have been put aside for other jobs. One solitary block displays the distinctive drill hole about 2cm x 15cm deep.

Follow the obvious path on this higher ground across these wood-covered tips. Although there still numerous sycamores, there is now a greater variety of tree types, including silver birch, beech, rowan, ash, holly and oak, offering more dappled lighting conditions to the understorey. Consequently there is a greater range of flowering plants, including typical woodland species such as bluebells, celandine, common hemp nettle, enchanter's-nightshade, wood avens and dog's mercury. This is probably due to this area being abandoned much earlier than that near the quarry faces, and the ground sloping into prevailing winds, away from dusty activities. Continue along the path (now curving to the left); the earliest workings ('**Old Quarry'**) lie ahead to the right. Access to this 'dumbled' area is ***not*** advised – slopes are steep and **slippery** and there is little of interest. However, even seen from this position, the land has a slightly primeval, jungle-like appearance in contrast to the more open woodland seen previously. Although it is certainly not 'ancient woodland', it was probably filled with debris from later quarrying at an early stage and hence has been colonised over a long period. Holly and silver birch, extensively ivy-clad, predominate here.

Keep strictly to the path as it rises up (the southern end of the main quarry being on the left – caution – steep rock faces – edges hidden by trees). Climb a series of small wooden steps (some missing) which are often slippery. Beyond a small gate, the open land to the left rises gently, echoing the dip of the underlying beds (as exposed in the quarry). The land surface here is defined by the top surface of the Ashover Grit dipping about 4^o west (ie towards the river).

You can now either retrace your steps via the main Bridge Quarry crossing Robin Hood Road, ie the route taken by stone carts to the stone works (now completely demolished), via the loading point on the canal then cross the canal using Sims Bridge to overlook the railway, where stone was also loaded using cranes. Southwards, the canal towpath leads back to Whatstandwell Bridge. Alternatively the path continues, across two small fields, taking a right turn at an old Methodist Chapel onto Hindersitch Lane which, going down, joins 'Main Road' (ie the Crich to Whatstandwell Bridge road; B5035). Turning right here leads back to the Whatstandwell canal bridge.

Middle Hole

The entrance this quarry is gated and a little to the north of **Bridge Quarry along Robin Hood Road. As noted earlier, this is an active quarry and as such, access is strictly prohibited. Entry is only permitted by prior arrangement with the operators; it must always be accompanied by a member of their staff and be compliant with their health and safety requirements.**

As previously noted working here, like most building stone extraction in the UK today, combines modern and ancient techniques. Large blocks are separated from the quarry face by drilling holes using a jib-mounted bit, charging them with black powder and detonating them. The

resultant blocks are then assessed. Where these require further reduction eg to meet lorry load weight limits, a line of much smaller, closely spaced holes is drilled pneumatically; feathers, then a plug are inserted in each, and the wedge-shaped plug is hammered in. This practice, in essence employed for a millennium or more, is capable of breaking large blocks along a reasonably straight line. Echoing the scappling process of the past, a jib-mounted 'pecker' (like very large round chisel) is used to trim rough areas. Blocks are then loaded onto lorries using the same caterpillar tracked machines. They are then taken to masonry workshops elsewhere (typically Wingerworth near Chesterfield) for final shaping.

North (or Winson) Quarry Group

Walking up Robin Hood Road from Whatstandwell (beware of traffic), take the public footpath signed to Crich (at about 350m north of the path into Bridge Quarry) on the right. This leads into a complex of quarries falling into two distinct groups. Whereas they display many of the features seen in Bridge Quarry, some of which are more easily recognisable than in the latter, and the area is more distant from public parking areas.

Sycamores are still the most common tree variety, notably colonising the main stone working floors. They are accompanied by silver birch and occasional beech trees on tipped land.

Once off the road, very soon take a side path to the right. Shortly this enters a moderately large quarried area with less tree cover than at Bridge Quarry. The rock face shows rather feint bedding planes, dipping slightly from left to right, ie westward. More prominent are irregular near-vertical fractures, hardly noticeable in the south. The smaller features are joints. The far larger vertical breaks are probably the result of two processes. Firstly some faulting has occurred, where rocks on each side of the break have shifted as a result of general Earth movements. Just to the north east of here, a very important regional fault following a similar direction, defines the edge of the Crich limestone inlier. The second possibility might be due to relatively recent slippage, known as 'cambering', which if continued, would result in large scale landslip. When 'solid' slabs of rock such as the hard sandstones here, dip steeply towards valleys and also rest on comparatively slippery mud rocks, movement and splitting of the harder beds is likely. Here the dips are small, but landslips nearby were formed in this way. The large amount and severity of fracturing here is likely to have posed a significant problem during quarrying. It also probably explains why so many separate faces were opened up here compared with the south of the site.

The other most noticeable features here are the mounds on the quarry floor, accompanied by large stone blocks forming retaining walls. These were the base points to anchor long-arm cranes, better seen here than at Bridge Quarry. The crane jibs ranged out over trenches (now filled-in, except in the right hand corner). These deeper gullies at the foot of the main faces, were the last areas from which stone was extracted. As in Bridge Quarry, there are the remains of small building on raised ground on the left. Again this is presumed to have been a foreman's or overseers office, offering a good view over operations.

The remaining quarries in the north are reached by returning almost to the road, but taking a right turn onto the main path leading towards Crich. After a short distance, there are a number of openings on the right. In general these are very similar to those already seen, although the vertical fracturing is probably more prominent, probably as they are nearer to the major geological

disturbance running through Crich. In places, these form closely spaced zones of broken rock, in parts weathered almost to sand as the natural cement binding the grains has degenerated making them unworkable. One of the protruding sections of the quarry face exhibits a feature rarely visible in any of the quarries. There are three near-vertical, artificial-looking grooves, probably 2m apart. Each depression is about 3m long, and about 3cm wide. These are drill holes which would have been charged with explosives, in this case, black powder.

Yet again sycamores dominate the woodland.

As the main path continues on its way to Crich, just beyond the last quarry on the right, the small stream ahead is crossed by the green pipeline. This is a section of the Derwent Aqueduct taking water from the upper Derwent Reservoirs to East Midlands cities. This was a matter of contention in 1905 as the route crossed workable stone reserves which would have been sterilised and the eminent engineering geologist Herbert Lapworth was brought in to advise.

You can now either continue off-site to Crich or retrace your steps down the path, crossing Robin Hood Road, ie the route taken by stone carts to the stone works (now completely demolished), and loading point on the canal, then cross the canal via Sims Bridge to overlook the railway, where stone was also loaded using cranes. Southwards, the canal towpath leads back to Whatstandwell Bridge.