AN ASSESSMENT OF WOODLAND HISTORY AND ARCHAEOLOGY: A CASE STUDY APPROACH

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ABSTRACT

Woodland history in Derbyshire has not been extensively researched. Indeed the area between the rivers Derwent and Rother is archaeologically under-recorded in the Historic Environment Record. Woodland research elsewhere has revealed significant archaeological remains. There is scope to increase the understanding of Derbyshire's ancient woodland heritage. Case study woods on two geological zones were selected for intensive study and several other woods less intensively. Archaeological, ecological and historical surveys were made of the woods. Features were recorded, located using GPS, mapped and presented in a Gazetteer. Possible evidence of former land use was revealed. Early exploitation of mineral resources was found, including possible Romano-British and late medieval quern stones. On the Coal Measures medieval iron working slags were found associated with charcoal platforms and Q-pits, possibly whitecoal production sites for lead smelting fuel. In woods located on the Millstone Grit remains of kilns and charcoal platforms were found, these are also thought to have produced whitecoal. These remains and contemporary documents illustrate the demand for fuel as industrialisation increased in the sixteenth century. Further evidence in the form of woodland boundaries, track ways and ecological change suggest increased exploitation using coppice with standards. There is evidence of different responses to woodland use between woods on the Coal Measures and those located on the Millstone Grits. The dominance of oak and the demise of other species is noted, documents record the importance of oak tan-bark and also the commercial use of many more species than can be

seen today. Episodes of felling and re-planting have created woods very different in character to those of the seventeenth century; woodland flora is confined mainly to the margins. The findings demonstrate the importance of the woods to the local communities and industry as fuel and raw materials. Composite time-lines were produced combining the strands of research showing graphically the changes in woodland usage to the present.

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ABBREVIATIONS

DRO Derbyshire Records Office.
GPS Global Positioning System.
HER Historic Environment Record.
OSG Ordnance Survey Grid reference.
SMR Sites and Monument Register, data base for archaeological sites in Derbyshire. Now superseded by HER.

CONVENTIONS

Measurement
length: centimetre (cm) and metre (m)
distance: kilometre (km)
area: hectare (ha) followed by (acre)
mass: kilogram (kg)
Maps
maps and drawings unless stated otherwise are oriented North to the top of the page in portrait and to the spine in landscape.

GLOSSARY

adit used here to mean a horizontal entrance to a coal mine as opposed to shaft.
bellpit an early method of underground working for coal and ironstone. A surface entry by shaft was enlarged underground to form a bell-shaped excavation.
blackbark coppice standard of 50 years growth[1]
bloomery early iron-smelting technique, using foot operated bellows to provide an air blast and produce a bloom, a pasty mass of semi molten iron.

bole lead smelting method, sited on west-facing hilltops using natural draught and a wood fire, used from medieval to early seventeenth century.

compartment area of woodland within a wood defined by boundaries Inside which coppice could be enclosed and new shoots protected from damage

coppice **a**. from the French *couper* to cut. The periodic cutting of broad-leaved trees which regenerate by sending out new shoots from the base; **b.** area of woodland which is periodically cut, to produce a regular supply of young wood.

cord a volumetric measure of cut wood, locally 4ft (1.2m) wide x 4ft (1.2m) high x 8ft (2.4m) long, 128 cubic ft (3.45cu m). The actual volume of wood is about 75 cubic ft (2.13 cu m)[3] Price quotes 2ft 2ins (66cm) wide x 2ft 2ins (66cm) high x 27ft 4ins (8.3m) long, the same volume.[4]

cupola reverberatory lead smelting furnace introduced into Derbyshire in the mid-eighteen century, using mineral coal and superseded the ore hearth smelt mill.

gads Somerset term for whitecoal, possibly meaning *wedge.*

grip woodland drainage ditch

girth dimension round tree trunk at approximately 1.2 m from ground.

herrier coppice standard of 75 years growth[1]

holloway sunken track way formed by long-term use and surface erosion

kiln furnace structure built to heat or burn, ie whitecoal kiln.

load volumetric measure of wood from horse load about 2 cwt (100kg)

Mapinfo mapping software licensed to Sheffield Hallam University.

orehearth lead smelting blast furnace fuelled by whitecoal introduced into Derbyshire in the late sixteenth century.

platform levelled area dug into a slope often with down slope revettment, charcoal may be present, interpreted as charcoal platform but could have other uses.

puncheon, punch wood local term for pit props

quern circular, small diameter millstone for hand milling

quern-roughout part-made, damaged or unfinished quern

Q-pit (Q-hole) pit or bowl-like feature found on the Coal Measures, with a concentric ring of up-cast spoil broken by a gap down slope which often continues as a ditch, numerous local variations, thought to be used for making whitecoal.

ride broad estate-made woodland track or road

red lead lead oxide compound formed by heating and grinding lead to a fine powder for use in paint[2]

semi-natural ancient woodland shown by documentary evidence to have been in existence before 1600 and therefore likely to be medieval or earlier and has a suite of specialised floral indicator species.

slag residue from smelting

slag hearth charcoal blast furnace for reworking orehearth slag to obtain an inferior lead.

springwood produce of a coppice, spring synonym for coppice.

timber large trees grown for building and construction

timber tree tree of 100 years growth[1]

underwood small wood produced from coppicing or pollarding

wayvers, weavers coppice standard of 25 years growth[1]

whitecoal chopped coppice wood dried in a kin or Q-pit for use in the orehearth smelter.

Notes

1 Farey (1813)

2 Kiernan (1989)

3 Portland Papers

4 Oxtoby and Price (1959)

1 INTRODUCTION AND LITERATURE REVIEW

Until the nineteenth century woodland was a vital community resource providing fuel, raw materials, pasture and employment (Rackham, 2006). Today it survives in much altered form from its days as an integral part of the working landscape. Often neglected and unmanaged however, it is recognized increasingly as part of local heritage. Careful research and field survey can show the history of these relict survivors (Jones, 1989). Recording and interpreting woodland features is part of that research, and industrial remains often form a significant part of the archaeological record (Beswick *et al.* 1993; Rotherham *et al.* 2007). The approach taken focuses on using detailed case studies in Derbyshire woods to increase the awareness and knowledge of the woodland industrial heritage in this wider context.

1.1 Research overview

The wooded landscape of the Gritstone fringe and the Coal Measures of North Derbyshire has not been extensively studied in terms of linking ecology land-use and exploitation (Jones and Rotherham, 2000; Pigott, 1993).The research that has taken place has been of three types:

- Site specific, where a particular feature has been studied, such as "Q Pits" (e.g. Franklin, 1991; Fowkes, 1992).
- The impact of North Derbyshire woodland resources on industry in adjacent other areas, such as lead smelting (e.g. Barnatt and Rieuwerts, 1995).
- Management-focused site assessments to assess developmental impacts or management strategy (e.g. Garton and Brown, 1995; Rotherham and Avison, 1998)

This is in stark contrast to research in South Yorkshire, where local woodland has been extensively studied for the last twenty years (e.g. Jones 1986; 1989; Jones and Rotherham, 2000). It has been recognised that conventional archaeological surveys often fail to either recognise or record the "bigger picture". By concentrating on monuments *in* the woods they miss the archaeology *of* the woods (Rotherham, 2007; Rotherham and Ardron, 2006). This applies particularly to those features indicative of a working past, which could be earthworks or just as likely relict trees, ground flora or soils. A multi-disciplinary holistic approach involving historical, archaeological, ecological and conservation research has revealed a complex record of woodland resource exploitation in the region. Furthermore the lack of recent gross disturbance has ensured a high level of survival of many archaeological features unique to these woodlands (Hart, 1993; Jones and Jones, 1985; Jones, 1986, 1989, 1993; Rotherham, 2007; Rotherham and Ardron, 2006). There is a widely held view that much of the archaeology of Derbyshire's Coal Measures landscapes has been destroyed (Myers, 2001). Two centuries of industrial activity, particularly railways and coal mining, have removed much of the evidence. The study examines this view and attempts to increase our knowledge of this important aspect of local cultural and industrial history.

A further issue is that archaeological research activity is unevenly distributed across Derbyshire. Away from the Peak District National Park, which employs full-time archaeologists, much of the remaining work is dominated by 'rescue archaeology', where development threatens or may destroy significant archaeological remains (Collis, 2001). This is particularly evident in the major urban centres where rebuilding and renewal create opportunities to investigate settlement development. Major infrastructure projects also have to comply with planning legislation, in particular Planning and Policy Guide 16 (PPG16). In doing this they may be required to fund archaeological investigation of the groundwork. In addition, a 'watching brief', is maintained on important buildings, including stately homes, castles and churches, during any works, whereby actual and potential threats to the fabric or local environment are monitored. This has the effect of skewing and diverting archaeological activity away from the apparently more mundane sites. Indeed Bolsover Castle (Sheppard, 2007), Hardwick Old Hall (Sheppard, 2001), Chatsworth House and Park (Gilbert, 2004) and Staveley Hall (Robinson and Baker, 2007) are typical of the high-profile locations which have featured in recent work. A review of reports and papers published in the *Derbyshire Archaeological Journal* serves to illustrate the point. In the last eight issues of the journal (2000-2007), of 142 articles twenty-three or 16 per cent related to the Coal Measures; including five reports on Hardwick Old Hall and Bolsover Castle. If these are eliminated the total is eighteen or 11.6 per cent. It can therefore be argued that the area is under-represented in the archaeological record, since the Coal Measures (Scarsdale) represent at least 20 per cent of the recording area. Other organisations are also undertaking research in the area: The Peak District Mines Historical Society, the North-east Derbyshire Industrial Archaeology Society and the Sheffield based Hunter Historical Society and Sorby Society. These organisations cover a diverse range of subject matter. Their interests are both regional, (Hunter and Sorby Society) and national and international (North-east Derbyshire Industrial Archaeological Society) and the (Peak District Mines Historical Society). They have all reported on aspects of the regional industrial archaeology, but the woodland legacy remains to be studied in depth.

Archaeological research has also concentrated on the prehistory of the region at the expense of other periods and therefore there is considerable potential for post-medieval research. The Coal Measures of North Derbyshire was an area of "...complex economic relationships...amply demonstrated by standing buildings, by relict landscape features and by archaeology." (Crossley,1990). In particular, the relationship between coppice woodlands and lead production and other industries is in need of recording. Similarly the remains of early clay and coal working landscapes should be investigated (ibid.). There is still a lack of evidence for early Coal Measures industry. Barrett notes that the Trent and Peak Archaeology Unit's (Challis and Southgate, 1999 and Beswick and Challis, 2004) excavation of an extensive iron smelting complex at Stanley Grange gave an idea of the huge archaeological possibilities, which may exist elsewhere. This is of course subject to remains surviving later industrial activity (Barrett, 2001a).

Barrett in a later analysis also notes the importance of industrial development in the area, 'the iron coal mining industries in the east of the county have featured less in archaeological recording and analysis." Although an English Heritage funded project to record early coal mining was in progress (Barrett, 2001b). He also makes the point that woodland surveys are needed to record coppice woodlands and reveal surviving earthworks, as established in South Yorkshire (ibid.). Myers also notes a similar need to record remains of industrial activity in the post-1750 (modern period). He also fears wholesale destruction of the remains by later industry. Despite records of coal mining in later years HMR/SMR content is poor (Myers, 2001).

The considerable potential to add to our knowledge of former industry in North Derbyshire is therefore acknowledged. It is also implicit that woodlands are important in that process. Work in South Yorkshire and North Derbyshire has indicated that the surviving woodlands contain not just relics of former woodland management, but also evidence of many other industrial, agricultural and domestic activities over many centuries (Jones, 1993; Ardron and Rotherham, 1999; Jones and Rotherham, 2000).

1.2 Woodland: the historic background

The North Derbyshire uplands had probably been partially cleared of woodlands by the time of the Roman invasion in the first century AD. At this time a pastoral way of life prevailed, possibly involving transhumance, with animals moving between high pasture and valley settlements. The absence of recorded substantial settlements may reflect this (Hicks, 1971). However the Roman market economy increased the demand for grain. Land clearance accelerated to provide arable land and a mixed farming economy flourished. Woodland clearance may also have increased to meet the demands of Roman lead production. After the collapse of the Roman economy medieval farming reverted to pastoral and the cultivation of arable land was reduced. However upland soils were so degraded as to preclude woodland regeneration and remained suitable only for grazing (ibid.). However in recent times several phases of regeneration have been recognized in the pollen record with ash (Fraxinus), birch (Betula), oak (Quercus) and alder (Alnus) in evidence (ibid.). In fact tree and shrub pollen accounted for less than 50 per cent of the total in 2,300 BP, before the Roman invasion (Day, 1993). Roman society placed a huge demand on the woodland resource, for building and construction and also for fuel. Wood was the major source for domestic heating and for firing pottery, bricks and tiles. It is accepted that woodlands were probably managed as coppice or pollards rather than clear felling (Steane, 1986). However, it is clear in recent decades that woodland has re-colonized extensive areas of moorland following cessation of grazing in particular but also possibly other complex environmental factors such as climate change, pollution and land management.

Very little is known about the Derbyshire woodland in the valleys and lower land to the east and south of the pollen sampling area on the high moorlands. It is now thought that the post-Roman agricultural society was probably one of continuity rather than war and oppression and the population may well have continued at the Roman period level. Marginal land in some areas may well have reverted to pre-Roman woodland or pasture when the need for cash and grain for the occupation army and taxes disappeared. The landscape altered only in emphasis rather than wholesale change, although it's also likely that woodland continued to be cleared (Esmonde Cleary, 1995; Prior, 2010). The earliest documentary evidence is the Domesday survey of 1086, from which estimates suggest slightly less than 15 per cent of England was wooded (Rackham, 2006). However, there were considerable regional variations and a figure of slightly less than twenty per cent has been calculated for South Yorkshire (Jones, 1993). The analysis, shown at Appendix 5, calculates that Domesday wood pasture (s*ilva pastilis*) covered thirty per cent of Derbyshire's total land area and a further one per cent was coppice (s*ilva minuta*). The north east part of the area towards the Magnesian Limestone, which has good arable land, may well have been substantially cleared. The lack of woodland clearance names and the only examples of coppice (s*ilva minuta*) recorded in the Domesday survey for Scarsdale, were at Barlborough, Whitwell and Elmton, which may well suggest intensive agriculture and early land clearance. This is analogous with findings on the Magnesian Limestone in the eastern part of South Yorkshire

(Jones, 1993). Scarsdale Wapentake, the north eastern part of Derbyshire was very heavily wooded; calculated at just over ninety square miles or 40 percent of the land area. This represents a region with substantial woodland resources; indeed Newbold, Tupton and Norton between them accounted for about thirty seven square miles of woodland pasture. Considerable caution is needed in using the analysis since the true nature of 'woodland pasture' is not known and the survey was a financial survey and not a geography. The narrow and steep valleys of the small tributary rivers and streams, which feed the rivers Derwent and Rother, then as now were heavily wooded. Land which is too steep, or soils which are too thin or wet to farm and a topography deeply incised by small streams has remained wooded, these are the ancient woods studied in this project.

The Monastic settlements in Scarsdale are shown below, they "reclaimed land from the wilderness .. and was instrumental in changing the character of the landscape" (Hart, 1981)

Location	**House**	**Order**
Harewood Grange	Beauchief Abbey	Premonstratensian
Scarcliffe Grange	Darley Abbey	Augustinian
Birley/Barlow Grange	Louth Abbey	Cistercian
Hardwick	Newstead Priory	Augustinian
Walton Grange	Sempringham	Gilbertian
Elmton	Thurgurton Priory	Augustinian

Table 1. Monastic settlements in Scarsdale

It is likely that woodland was cleared in the upper valleys for agriculture, particularly pasture for sheep, which were to become the major economic driver in the Middle Ages. Indeed field walking in the Upper Linacre Valley has recorded twelfth and thirteenth century pottery (C. Cumberpatch pers. comm.). In addition Neolithic flint, possible Romano- British pottery and a stone spindle whorl have also been found (Smith and Carr forthcoming). These finds suggest that the landscape may well have been less wooded than might be supposed and that episodes of clearance and re-growth may have occurred. It would appear that by the twelfth century the area was wooded to some extent ((DRO D1005 Z/E1:3).

Further encroachments into the woodland were made by emparkment and the creation of deer parks. Although to what extent woodland was removed is not clear, but there were probably thirty-one parks of which twenty-one can be traced the remainder are less secure (Wiltshire and Woore, 2009). Some of the parks were very large two square miles in area was not unusual. Further encroachments would have been likely as the population increased.

Place names help to illuminate this phase of woodland development and they may indicate a landscape prior to clearance or a function after settlement was established. The Coal Measures and the Gritstone fringe have numerous examples of woodland settlement names. This selection is from places close to the study areas. Barlow was formerly called Barley: others include, Brierley Wood, Lea Wood and Lea. These all suggest clearings from Old English *leah,* a woodland clearing. Leashaw Wood, *leah* and *sceaga* clearing and possibly narrow wood and Lea Hurst, *leah* and *hyrst,* clearing and wooded hill, contain two woodland elements. There is an example of Old Norse in the former Carr Wood from Old Norse *kjarr*, meaning a wooded marsh (Cameron, 1993; Jones, 2007). Very little is known about the make up of the woodland, its species, management or how it was exploited. Domesday uses four terms to describe woodland in Derbyshire, wood pasture (*silva pastilis*), underwood or coppice (*silva minuta*), woodland, unpastured fit for hunting (*silva non pastilis apta venationi)* and unpastured woodland (*silva non pastilis*) (Morris, 1978). Domesday Book however remains silent about tree species or industrial exploitation, other than lead production in Derbyshire. Later woodland settlement is indicated by a group of place names such as Barlow Woodseats, 'Houses in the wood belonging to Barlow', Barlow Lees 'clearing belonging to Barlow' and Dronfield Woodhouse 'Houses in the wood belonging to Dronfield' (Cameron, 1993). There is also a group of names such as Hasland, Birchett and Swathwick that are thought to be Scandinavian in origin and relate to the early medieval wooded landscape. However the later medieval period brought changes to the landscape. Monastic foundations intensified agricultural activity and they also established or increased metalworking and mineral exploitation. Indeed, the earliest documentary evidence for industrial activity in the study area comes from the Leake Cartulary, a sixteenth century transcript of documents possibly now lost. It describes in several parts, a gift by Hasculus Musard in the twelfth century to the Cistercian monks of Louth Abbey in Lincolnshire, of land and woods and rights in *Barlei* (Barlow). It was confirmed by Walter de Abbetoft, with liberty of free entry and exit from their woods and fields, and also, "2 forges or hearths, *viz* one bloom smithy in the woods and one forge in the monk's courtyard, with coal of dried wood and ore for one forge throughout the wood, and for burning the ore, dry birch, alder and oak when necessary..." it continues, certain fallen trees belong to the lord "and the rest are to be used for charcoal.." (DRO D1005 Z/E1:3)

This is the first mention of industrial activity in the Barlow area and confirms early iron ore exploitation, bloomery and a smithing forge. Two of the tree species, alder and oak are consistent with the Upper Linacre Valley today; birch is usually found as a coloniser. However, the document mentions the bounds of the land gift being "as far as the moor", and it is possible that the wood was moorland fringe regeneration. The mention of dried wood as a fuel and to roast iron ore is also of note. Hey (2004) suggests that it is not specially grown coppiced wood. "The woods were not yet coppiced as intensively as they were to be from Elizabethan times onward." The monks were also granted 2 acres of land in Brampton in the early thirteenth century at Seacolepytte, a place now lost, but an early mention of the medieval name for mineral coal working.

For the next six centuries the woodland resource was exploited by the local settlements and often-competing industrial demand from the local area. Although demand fluctuated, as the socio-economic and demographic requirements changed, generally the pressure on woodlands was maintained. Agricultural growth resulting from an increasing population, up to the fourteenth century, was evident in assarting. This involved small clearances in the woods, with or without the Lord's permission. On the Coal Measures settlements in Dronfield parish for example, "place names such as, Birchett, Woodhouse, Stubley, Mickley, Summerley and Cowley all refer to the clearing of woodland" (Hart, 1981). This resulted in a piecemeal but steady reduction in the woodland cover. Expanding agriculture and construction, both lay and monastic, increased the demand for building materials. These included lime, metals and ceramics with a consequent increase in the demand for fuel. This intensified into the early modern period when in the sixteenth and seventeenth centuries litigation reports suggest extreme pressure on local woodlands. In parts of Derbyshire, both the lead smelters and the iron workers were competing for the rights to exploit the woods. The industries survived and production increased by managing woodland more intensively and by technological process improvements and by the later use of mineral coal in such industries as brewing, lime burning and smithing (Peterken, 1994; Rackham, 2006).

1.3 Historic woodland research

It is recognised that landscape is a complex record of human settlement and endeavour over time and that woodland is an important component in that record. This record is dynamic, constantly changing and has been called a palimpsest, comparable to a parchment on which writings are erased and over which new script is written (Aston and Rowley, 1974). The initial studies by Hoskins (1955) and Beresford (1957) have been expanded and refocused as different disciplines seek to add new dimensions to the studies. For example, these include archaeology (Aston, 1985); ecology (Rackham, 1976, 1986, 2006); geography (Muir, 1981, 2000, 2006); history (Thirsk, 1976) and place names (Gelling, 1978).

An early multidisciplinary study was made of the English Lake District and sets the scene: "..any attempt to consider the British vegetation in terms of its environment can only be done so against a background of human history." The study was defined by the regional geology and archaeological and historical research was correlated with pollen and organic mud core analyses to outline a regional history. (Pearsall and Pennington, 1947). More recently Oliver Rackham in a series of publications explored aspects of ancient woodlands, their history, ecology and place in the landscape. His most influential books, written from the perspective of his research in Cambridgeshire and Essex, challenged many long-held assumptions about woodland (1976, 1980). These were important books, introducing the concept of ancient and planned landscapes. A later book placed woodlands in their historical context as elements within the countryside. The topics included climate soil and landforms; plants and animals archaeology and historical documents (Rackham, 1986). Whilst his latest book, 'deals...with the multiple interactions between trees and the environment, trees and other trees, trees and other plants, trees and fungi, trees and animals, and trees and people.' His themes are historical ecology and woodland history. Emphasising the investigative, through documentary research, long-term observation and study (ibid. 2006). Pigott (1993) expands the research by looking at other woodlands in England, in the Lake District and Surrey. He also uses the Polish forest of Bialowieža as close analogy for lowland primeval forest, to assist his research into the special flora of ancient woodlands in England. By far the most relevant literature on local regional woodland history is the work of Jones (1986, 1989, 1993, 1997, 2000). In a series of publications Jones describes in detail his research into the working woods of South Yorkshire. Given access to detailed records and accounts from the Wentworth family archives, he has been able to demonstrate the workings of a large wood. He has compiled evidence for the many industrial and craft uses for wood in the Sheffield area and provides a methodology for examining ancient woods and reporting the finds and through historic evidence the positioning of woodlands in the social landscape past and present. Jones and Rotherham (2000) reflect on the piecemeal approach to research into Derbyshire's ancient woodland despite valuable early work, they contrast it with South Yorkshire where detailed regional studies have been written. They urge further study in Derbyshire to inform managers of the ancient woodland heritage resource.

1.4 Derbyshire woodland research

There have been a number of archaeological surveys of North Derbyshire woodlands, usually aimed at specific features and followed by excavation. The earliest took place in Oakes Park, Norton in 1946, in the Moss Valley south of Sheffield (Timperley, 1952). He described a circular depression on sloping ground, with a raised spoil rim and a lip on the lower edge such that their plan resembled the letter "Q", which is still used. In many ways this is a seminal work, although not recognised by the authors at the time, many of the features described in the report are now accepted as indicative of whitecoal processing. He recognised eighty-six such Q-holes in the Moss Valley. In the preamble Timperley also anticipates later work with a survey "... agricultural, natural history, and archaeological .." Some of the conclusions suggesting that they were part of a prehistoric settlement landscape and probably ceremonial or sacrificial sites are mistaken. However, the report will be returned to later in this chapter in connection with whitecoal production.

In the 1980s, surveys in Cordwell Valley when 129 Q-holes were recorded and two excavated in Holmesfield Park and Little Hag Wood. A connection was made between old coppice oak woods and the Q-holes. 400 Q-holes were recorded across Derbyshire along with other features but was unable to interpret them with certainty (Franklin, 1991). Richard Doncaster had also begun extensive woodland surveys in north Derbyshire and South Yorkshire. Unfortunately his research was never published though fragments of his work and oral testimony give some insights (Ian Rotherham, pers. com.).

A management focused site assessment in the Moss Valley advised the owners, the Woodland Trust on how best to manage the wood with minimal disturbance to the archaeology and ecology. It noted a number of Q-pits (an alternative name for Q-holes and the term used in this work) and iron working slag (Rotherham and Avison, 1998). Trent and Peak Archaeological Trust surveyed the archaeological remains on the Linacre estate for the landowners Severn Trent Water (Garton and Brown, 1995). They identified charcoal platforms, Q-pits and numerous other features some in Ducksick Wood, (a case study site). The survey was very rapid and as a result some features were missed. In particular, the iron-working sites and their possible connection with other features on the site were not noted. The SMR notes that Trent and Peak Archaeology Trust also surveyed Kings Wood which is located to the north of Cobnar Wood (a case study site in this research), in advance of works. Here a possible whitecoal kiln was recorded. Archaeology Research Consultants University of Sheffield also surveyed land in Sheepbridge to the east of Cobnar Wood in advance of construction work, and recorded possible Roman, medieval and post- medieval features, including tracks and buildings.

Duffield Frith in central Derbyshire, on the fringe of the southern study area has been the subject of extensive research. It is a detailed study of the history and development of a Medieval Park (Wiltshire *et al.*, 2005). It contains detailed analyses of woodland management in mid-sixteenth century. They describe amongst other things species grown and the number of oaks. The northern parish of Duffield Frith is on the south bank of the River Derwent, opposite Bow Wood and Lea Wood and may demonstrate parallels to the present study in woodland ecology and history.

There are reports on woodland conservation and management of Derbyshire's woodland heritage. A report on Cobnar Wood for example on management plans to maintain its amenity value fails to recognise its historic value as relict woodland and its contribution to local cultural heritage resulting from its industrial past (Thornhill, 2006). The initiatives prepared by the Lowland Derbyshire Biodiversity Partnership (2006) are valuable for the maintenance and improvement of habitat potential in semi-natural ancient woodlands in Derbyshire, however very little weight is given to the potential risk to archaeologically sensitive areas of these woodlands. Whilst large veteran trees (girth greater than 3.2m) are acknowledged rightly as important, relict coppice stools however are not recognised as being potentially equally ancient. Part of this, as they recognise is lack of knowledge of the condition of many woodland sites. The risk to vulnerable woodland sites can be high particularly where the use of modern heavy machinery is used. A multi-disciplinary approach therefore is desirable to provide the totality of knowledge and ensure the continued survival of the woods.

1.5 Woodland industry

Prior to the widespread use of mineral coal as a fuel and cast iron as a structural component, wood was the most widely available resource. It provided fuel for metalworking and firing pottery and for heating and cooking. It was also used to make furniture, domestic utensils and all manner of agricultural equipment (Hather, 2000). It is not surprising therefore that a large number of crafts and small scale industrial users had developed a range of skills and techniques to exploit and perpetuate their raw material, the woodland resource.

Industrial exploitation was widespread and could be destructive, for example in the Weald and the Forest of Dean, where litigation was common (Perlin, 2005). In Derbyshire too, particularly on the Coal Measures there was widespread use of wood as an industrial fuel, as evidenced by small but extensive deposits of bloomery slag and lead smelters, (see later in this work). Apart from perhaps a small group of skilled iron workers and craftsmen the woods were exploited either by part-time or itinerant workers. Some workers like wood colliers lived all or part of the year in the woods (Muir, 2006), whilst others may have had dual occupations possibly as agricultural workers.

Woodlands were a complex resource and they were exploited in a number of ways. Wood was converted on site for use as specialised fuels, construction components and as raw materials for craft use. Woods also provided fodder, grazing, bedding and shelter for stock to be used by local communities and itinerant workers often with competing demands. They were also exploited for the mineral resources beneath the surface, stone, ironstone and coal in particular, but also ganister and clay. The coincidence of resources such as ironstone and lead ore, water and suitable wood for fuel led to mineral processing.

Over time the woodland crafts and industries developed skills, techniques and products, which utilised a range of woodland components. Certain tree species had specific uses and were selected for shape, size or durability. Usage could be complementary, different parts of the tree used by different crafts. Bark, from oak in particular was an important tanning agent for leather, ashes were converted to lye for making soap and elsewhere crafts such as makers of brooms or besoms, baskets, fencing and poles consumed smaller more specialised woody components. Careful management of the woodland resource was practised, to ensure a plentiful and continuous supply of raw material (Jones and Rotherham, 2007).

Any discussion of woodland industry must include comment on the interaction between demand and the sustainability of supply. Wood and wood products were managed systematically to ensure long-term supplies. Contrary to long established opinion industry did not destroy woodlands. It seems that woods were lost to agriculture, it being in the interests of industrial users to ensure continuity of supply. When English broadleaved trees are cut down they readily send out new shoots from the cut stem. This phenomenon has been utilised to obtain a continuous supply of special types of wood product.

1.5.1 Fuel

Wood was the primary source of fuel for domestic heating and cooking and for industrial processing until it was replaced by coal. In the seventeenth century ninety per cent of English wood output was used as fuel (Collins, 1996). Woodlands were managed as coppice, a tradition that lasted a thousand years until its virtual demise in the early twentieth century (Rotherham, 2005). Woodlands were cut on a rotational basis and yielded a sustainable crop of varying aged wood. The rotation varied according to species, growth-rate and end use "coppicing was, in essence.. tree farming .. the object to supply a regular crop of young wood" (Collins, 1985). In Derbyshire there were competing demands from the iron and lead processors in addition to other trades such as soap boilers, lime burners, potteries in addition to domestic use. It was common amongst earlier commentators to bemoan the dearth of wood (e.g. Pilkington, 1789; Lander, 1905). However it is now thought that there was no serious shortage of industrial fuel or that the destruction of woodland was imminent (Collins, 1996). Indeed the industrial demand for charcoal preserved many of the woods in South Yorkshire and Northeast Derbyshire (Rotherham, 2005).

Demand for increased industrial output in the late sixteenth and early seventeenth centuries led to technological change in lead and iron processing and placed a heavier burden on wood supply. Lead smelting in Derbyshire may have required as much as 18000 acres of woodland for fuel supply in the late seventeenth century (Crossley and Kiernan, 1992). Calculations suggest, (Detailed at Appendix 7) possibly a further 20,000 acres of woodland to supply the iron smelters in Scarsdale Hundred alone (Beckett and Polak, 1993, Collins, 1996). Up to twenty ore hearth lead smelting mills were operating in Scarsdale in the mid-seventeenth century almost half of those thought to be in operation in Derbyshire at that time (Crossley and Kiernan, 1992). Metal smelting alone therefore consumed approximately 30,000 acres of woodland from a land area of 145,000 acres in Scarsdale or almost twenty-one percent. This is probably too high, given the rapid woodland clearance recorded elsewhere (Rackham, 1980). Nevertheless the woodland had declined from a possible forty percent of land cover at the time of Domesday to around twenty per cent in the mid-seventeenth century. It is known that some iron smelters looked beyond the county for wood supplies, Sitwell for example obtained wood from Sheffield Park (Riden, 1985). Was this level of consumption sustainable? Probably not, indeed many of the lead smelters moved west nearer the ore-field and to where there was less competition for fuel. Some of those that remained were red-lead mills probably fuelled by coal. It is very likely that coal was in use for other trades at an early date, the seams particularly on the Brimington anticline were easily mined. Twenty-six coal mines were recorded in Scarsdale in 1652 (Beckett and Polak, 1993) and coal was being used for smithing in the thirteenth century in Nottingham (Schubert, 1957) it was not used in the local iron smelting processing until the introduction of coke in the eighteenth century.

The supply of wood fuel used in metal smelting remains hard to evaluate, it is possible that many older woods and the remnants of medieval parks were cleared and there is a reference in Barlow to grubbing up woods in this period (157/DD/P/73/3). Further research is required into the wood supply in Scarsdale, particularly into the length of leases and coppice cutting cycles, given the view that coppice cycles were increasing and woodland may well have been nearer ten percent of the available land area (Rackham, 1980).

1.5.2 Charcoal

Charcoal is the porous, black carbonaceous residue from the partial combustion of wood in the absence of a free supply of air. It has been found in archaeological contexts from the earliest human occupation sites (Rackham, 2006; Rotherham and Jones, 2007). In the historic period it has been made in industrial quantities for fuel, for making gunpowder, blacking in iron foundries and as a domestic fuel. It also had medicinal uses and as artists materials (ibid, 2007). It continued in use in Sheffield for making blister steel into the twentieth century. The last known charcoal burner in the Sheffield area, William Ogden died in 1911 (Jones, 1989). It was still in use as a smelting fuel at Alderwasley in 1856, long after it had been superseded by coke elsewhere (Judge, 1993). Later charcoal making in Derbyshire appears to have been similar process to that described by Jones (ibid, 1989; Rotherham and Jones, 2007). Wood was piled into a conical shaped stack, with a narrow hollow core, the outside of the stack was covered in turves leaving a small opening to the core. Burning wood was placed via the opening into the core of the stack, when the fire was burning sufficiently the openings were blocked and the stack left to burn without oxygen. It needed constant supervision and could take from two to ten days to complete. Charcoal burners lived in the woods close by in conical huts made from wood and turf. The remains of platforms can be found in many woods in Derbyshire. Their form and shape is remarkably consistent, oval platforms approximately ten metres x six metres set into a hillside and revetted on the down slope edge (Ardron and Rotherham, 1999). A distinct spread of dark debris is usually noticeable down slope where fragments of charcoal can be found.

Charcoal making is mentioned in the Leake Cartulary (Pegge *c.*1770), a twelfth-century gift to the Cistercian brothers of Louth monastery confirming the right to obtain a supply of trees to make charcoal to fuel their furnaces. There are frequent documentary references to charcoal making in north Derbyshire, particularly in the Portland of Welbeck Deeds and Estate Papers (e.g. 157 DD/P). In old documentary sources it is often referred to as wood-coal, black-coal or charke. A lease in 1513 from Robert Lynacre to Godfrey Foljambe of Walton, of woods in Linacre with turf and *hillyngs* to cover his charcoal pits (157 DD/P/84/1). In 1571, a sale by James Lynacre to Godfrey Foljambe of timber in his woods at Linacre with right to make pits for charcoal and turf to cover them (157 DD/P/53/3). In 1578 Peter Barley leased springwoods at Dunston to Henry Berisford and the right to make them into charcoal taking turf to do so (157/DDP/73/1). Peter Barley also allowed Roland Eyre to operate a lead smelting mill in Barlow and to supply charcoal and white coal (157 DD/P/42/10). In 1596, Thomas Burton leased woods in Linacre, with rights to make pits for charcoal and white coal, and to hilling, bracken and turf for making the coal (157DD/P/84/3). Charcoal manufacture continues to be mentioned throughout the seventeenth and eighteenth centuries and is mentioned in the Welbeck household and farm accounts for Jan 1819 – July

1819 (DD/P/6/7/10/295)

A common feature of many of the sixteenth century documents is the term charcoal pit, pitt or pyt, and not the hearth, pitstead or platform used today. Charcoal was made in pits which were often required to be filled in after use (Rackham 1980:143).

Figure 1 below shows two methods of making charcoal as described in 1540: kilns and iron retorts were also used in more recent times.

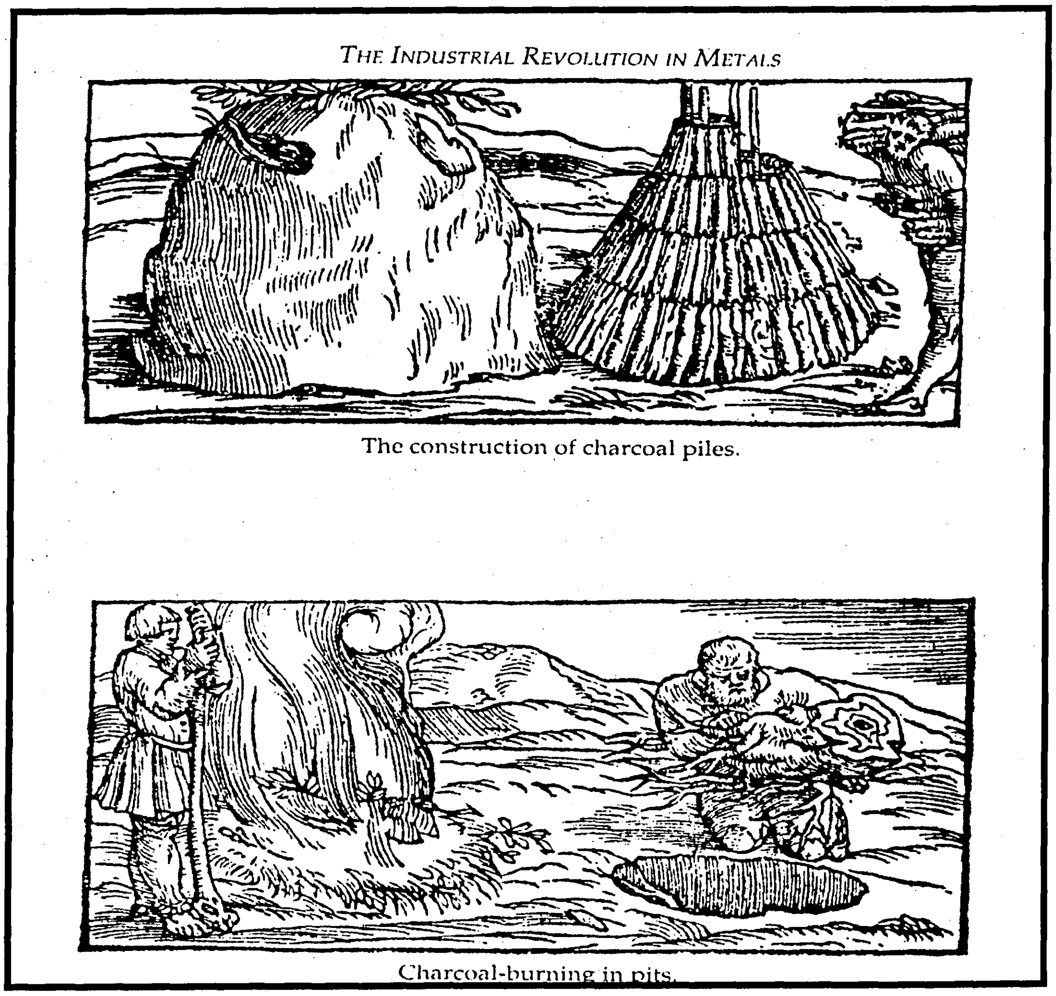


Figure 1. Charcoal burning, on the surface left and in a pit bottom right,Biringuccio Pirotechnia (1540), from Day and Tylecote (1991).

An account by Joseph Sharpe of his experience as a charcoal burner in Owlercar

Wood, Coal Aston, Derbyshire in the last quarter of the nineteenth century is worth repeating in full.

> "The pit had been dug one and a half feet deep (45cm), and was four yards across (3.6m) and round like a plate. In the centre the sticks had to be firmly wedged. Then against this were leaned the still green boughs of trees. It took us (with Mr Archer, the collier) a fortnight to gather sticks for a charcoal pit. Then when it was piled higher than you or me and all covered with sods and soil we lit it through the little hole we had left in the top. After that we hadn't to leave it not for an hour. We took it turns to watch and we had a cosy little cabin close by. The little hole in the top was filled in and whenever smoke appeared we had to cover it up with soil, for half a ton of charcoal can burn to dust in a very short time." (Connole, 1932-36).

The account confirms a number of constructional details although the pit size is smaller than field observations suggest in other places. It should be borne in mind that the platforms seen in woods today probably include a working area around the stack, which therefore was a smaller diameter. If the stack was indeed smaller it may well have been in response to reduced market demand rather than a design feature. Wood was collected rather than cut, which suggests that coppice management had been abandoned, this is probably consistent with observations elsewhere (Jones and Rotherham, 2007). It seems a new site was constructed, this may have been standard practice, but more likely that former sites were not available or overgrown. Earlier documents elsewhere occasionally specify no new charcoal sites will be allowed, this was in an era when presumably there was intense pressure on the woodland resource and potential damage was kept to a minimum. The account does not refer to the type of wood used.

1.5.3 Whitecoal

Whitecoal was wood that had been subjected to a drying process in a kiln or pit and was used as a fuel in the ore hearth lead smelter. Initially wood was the fuel used to dry the whitecoal, but mineral coal may have been used in the early eighteenth century. In many Q-Pits and kilns a deposit of coal and ash fragments has been noted at the entrance. The ore hearth smelting process was introduced into Derbyshire in the third quarter of the sixteenth century (Kiernan, 1989).

Whitecoal has not been made for at least 200 years and no detailed contemporary account of its manufacture in Derbyshire has survived (Jones, 2003). What is known comes from a variety of sources; accounts of chopwood or whitecoal production in the Yorkshire Dales are well known (Raistrick, 1975). Whilst in Derbyshire a number of historians have described the process for example (Crossley, 1992, 2005; Jones, 2003; Kiernan, 1989; Kirkham, 1968-9). Although the process is generally known specific details such as cut size, age and wood species and method of furnace charging are not well known. Some of these issues are considered in Smith (forthcoming) where it is suggested that on the Coal Measures charcoal and whitecoal production may have shared some common technological features. In particular, contemporary written sources refer almost exclusively to charcoal and whitecoal pits and where iron slag has been found so called charcoal platforms are rare. In a number of locations on the Coal Measures the ore hearth smelting mill appeared to be a short lived innovation. In the Gritstone woods however recognisable stone built kilns have been found usually with an associated charcoal platform and a long-term lead processing enterprise.

1.5.4 Bark

Leather, in the past provided the raw materials for many vital everyday domestic and industrial products. Heavy cattle hide was used to make shoes, garments and harness for domestic and farm use and bags, bottles, buckets and bellows for industry. Tanning was a large and influential industry in England. In Sheffield by the end of the seventeenth century they were the fourth largest group of workers after metal, cloth and agricultural workers (Clarkson, 1960).

Tanning was first mentioned in Chesterfield in 1185, when Richard *le Tanur* is recorded as a tenant of the Templars. A charter of 1294 enshrined the burgal privileges as the sole buyers and tanners of hides and skins. The locality provided all the raw materials; hides from cattle sold and butchered at market, lime, water and bark (Bestall, 1974). Heavy cattle hides were initially soaked in a lime solution, which loosened the hair and fat and allowed it to be scraped off. Further steeping in a solution containing dog or bird droppings further prepared the hides for tanning. The initial processes opened up the hides to allow tanning agents to penetrate fully. In England prior to the nineteenth century tanners used oak bark as a vegetable tanning agent. The hides were left to soak in a solution of water and oak bark for up to two years. The process required considerable skill and was the subject of legislation in the Leather Acts of 1563 and 1604, which sought to ensure quality.

Light leathers, such as sheep, goat and calfskin, used in glove making and light leather goods were not tanned in this way and did not consume bark (Clarkson 1960). Oak bark therefore was a vital component of the tanning process, however it was a by-product, and it seems unlikely that a tree would be felled simply for its bark. It relied on the availability of trees felled for other purposes, for fuel or building. In North Derbyshire coppice woodlands had supplied wood for both domestic and industrial fuel since at least the fifteenth century and oak may well have been the preferred species. Bark is mentioned in the wills of several tanners listed in Chesterfield wills and inventories recorded in the years1521-1603 (Bestall and Fowkes, 1977). Tan bark, presumably bark that had been used in leather tanning was used as a fuel in red lead manufacture. The process involved "stacking clay pots containing vinegar and lead which were then heated by means of layers of manure and tan bark." (Willies, 1999). Oak bark and copperas were used to dye woollens, producing a purplish blue colour and oak sawdust was also the principle vegetable ingredient in dying fustian, a coarse fabric (Pilkington, 1789).

1.5.5 Potash

Whilst potash production is well known in other regions particularly the Lake District (Davies-Shiel, 1972, 1974), no account has been found by the author in Derbyshire to date. However there are some oblique references, which suggest the possible existence of the process. It is well known that Chesterfield had a thriving and important textile industry in the Middle Ages. Supplies of alum used in dying were imported into Chesterfield in large quantities in the fifteenth century (Bestall, 1974). It can be assumed that the wool or linen would require washing at some point in the process and that the soap was made locally. The main ingredients were ash, lime and animal fats all of which were available locally. But no references to its manufacture connected with local woods have been found, but Thomas and Joshua Beard, soap boilers were mentioned in a Cobnar Woods lease of 1751 (SHE80). It may be that they were somehow involved in the collection and processing of wood ashes.

1.5.6 Crafts

The manufacture of chip boxes for pills and ointments was an important industry in Chesterfield. They were formed into boxes from willow shavings, which had been peeled as veneers from sawn and dried timber. Robinson's Ltd was making pillboxes from willow in Chesterfield from 1839 until possibly the 1880s, when Henry Astwood an employee, was said to have "used up all willows in Derbyshire, Nottinghamshire and the neighbouring counties". It was probably Crack-willow *Salix fragilis* which is still abundant on steam-sides and grows to a large size. Willow timber was later imported and eventually the boxes were imported complete and finally superseded by paper. Robinson's also made turned wooden boxes on special purpose lathes, by scooping out the centre of solid boxes to form a hollow core. The type of wood is not given, but mention is made of poles to be barked and left to dry suggesting coppice wood. Bobbins for holding yarn were also produced from the same wood and the waste used to make chip boxes, the wood was most likely willow (Porteous, nd). The demand from the local textile industry was important; other companies were also turning bobbins, such as Damstead Works in Dronfield. They also manufactured turned tool handles an important market in the region (Smith 2004). Textile bobbins was a huge market in the early nineteenth century; a single large cotton mill in Stockport was said to have 10 million bobbins in use with a weekly replacement of 350,000 in 1843 (Collins, 1985). Four-inch (10cm) diameter alder was used to make bobbins and the bark used for dying in Manchester (Farey, 1813). Baskets were made in villages in North Derbyshire, for use in the coal mining and iron working industries. In Cutthorpe for example five families made baskets from oak and willow. It is not recorded if their raw materials were obtained locally, but a lease of the late nineteenth century mentions the Withy

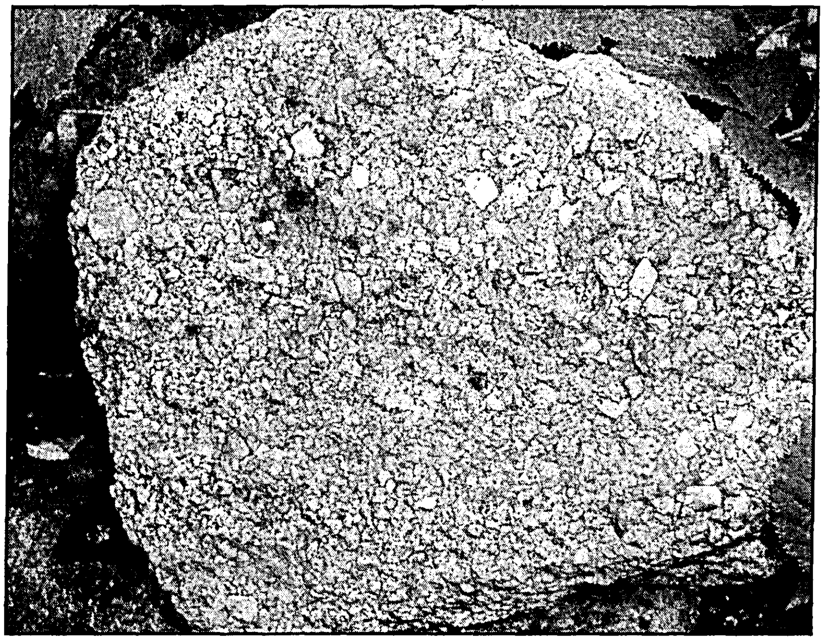
Beds at Sutton-cum-Duckmanton. Birch and heather brooms, or besoms, were also made in Holymoorside until the mid twentieth century (Stubbs, nd).

1.5.7 Mineral extraction

Most woodland surveys record the extraction of minerals. On the Coal Measures there are bands of coal, ironstone, pot and brick clays, ganister and sandstones some of which outcrop within woodlands. On the Millstone Grits there are various grades of sandstone which were used to make millstones and grindstones and for building and occasionally thin coals and ironstone (although none in the case study woods). Surface deposits of suitable coarse Gritstone were exploited over a considerable period to make rotary querns. They are small diameter, typically 35 – 85 cm diameter and of varying thicknesses up to 40cm. Rotary querns are small diameter hand operated stones for milling grain. They were operated in pairs, an upper and lower stone, the upper pierced by a central grain feed hole and a second hole in which to fit a handle to allow it to be rotated. The two working surfaces were dressed to allow a more efficient milling process. Grain passed through the hole in the upper stone and was ground between the two stones, emerging from between them as flour or meal (Curwen, 1937).

Both the Ashover Grits which overlays more than half of the surface of the wood and the underlying Millstone Grit have been extensively exploited in the past. Ashover Grits are coarse sandstones often showing large quartzite pebbly inclusions in the sandy matrix and were used locally for millstone making.

Photograph 1 overleaf shows a typical sample of Millstone Grit, this type of coarse stone appears to have been used to make querns.



Photograph 1. Millstone Grit showing a quartzite pebbly matrix, the largest inclusions are up 1.5cm across

1.5.8 Coal

The Leake Cartulary, which details the gift of lands in Brampton to Louth Abbey in the early thirteenth century, contains the lost place name *Seacolepytte.* It is mentioned twice so may have been of significance locally (Pegge, 1770). It is generally accepted that seacoal was an early name for mineral coal, and was therefore being used at this early date. Fourteenth century references exist which suggest the existence of a coal mining industry. At Wingerworth for example, in 1313 Maud Webster was killed "when a mass of soil fell on her" whilst gathering sea-coal (Lander, 1905). Evidence of coal mining can be found in many woods in North Derbyshire. It is likely that adits were dug into exposed seams or pits sunk wherever the geology was suitable. Underground working required timber roof supports, known as punch wood or puncheons in Derbyshire. It is not known what type of wood was used or indeed the size. Present day examples of Larch supports seen at Eckington suggest a diameter of fifteen-centimetres where supports are less than two metres in length and twenty centimetres diameter if the supports are over two metres in length. It is known from documents that timber was felled at between twenty-one and thirty years growth in Derbyshire, which would yield hardwood of up to fifteen centimetres in diameter.

1.5.9 Metalworking

The Leake Cartulary (Pegge, circa1770), a transcript of twelfth century deeds now lost, contains grants of land and woods to the monks of Louth Abbey, in *Birleia* (Birley) and *Barleia* (Barlow). In particular it confirmed the right to site forges and bloom smithies, and to obtain a supply of trees to make charcoal to fuel the furnaces. Birley and Barlow are situated on the western fringe of the Coal Measures west of Chesterfield and two kilometres west of the case study sites at Ducksick and Cobnar Woods. The document illustrates the intimate relationship between woodlands and iron production. The bloom smithy was sited in the woods close to the ironstone, thus reducing the bulk movement of ores, gangue material and wood. The finishing operations were carried out at the forges in the courtyard of the Grange. Mention is also made of the use of 'dried wood...for burning the ore, dry birch, alder and oak when necessary' (ibid: 2). An alternative reading might be 'dried wood for the bole...' (I am grateful to Mary Wiltshire and Clive Hart for transcribing this part of the document and the alternative reading). This introduces two elements of fuel use, 'bole' an early lead smelting technique and 'dried wood' a fuel usually associated with ore hearth smelting in the late sixteenth century (Kiernan, 1989). Iron slag has been found by the author on a hilltop location in Linacre Wood and it is suggested that the medieval iron smelting furnaces at Stanley Grange may also have been wind assisted. (Challis and Southgate, 1999) Furthermore, Willies notes finding iron slag at a bole site near Sheldon (1990). The local place name Bole Hill therefore may not be exclusively associated with lead smelting, although further research is clearly required. The significance of these terms will be discussed in the next chapter.

1.5.10 Management

Woodlands were a valuable resource and were exploited by many people in the community. Wood provided domestic firewood for heating and cooking, timber for building, underwood for crafts, fuel for iron and lead smelting and raw material for making, soap, glass, dyes and tanning. Woods also provided bedding, pasture and fodder for livestock. Systematic management of the woods achieved these various demands. It is known from archaeological research that wood was being used selectively in prehistory. Remains have been found of wooden track ways over the Somerset peat bogs. The track ways were used from the Neolithic to the Anglo-Saxon period. The Sweet Track has been dated to 4000 B.C. It used a variety of small section tree species many of which were selected for size and may well have been selected from coppiced trees. It also seems probable that a primary use was fodder; some of the rods had been lopped and showed signs of re-growth (Rackham, 1980).

It is likely that the Romans managed the woodlands intensively, given their demand for fuel for heating and industrial processes. Wood was the main structural component in house building; even where suitable stone was available wood remained the most widely used material. Timber planks with wattle and daub infill, with local variations were widely used. The technique has been found in excavated levels dated to the Anglo-Scandinavian period and it remained substantially unchanged for peasant housing until the extensive use of the wood saw after the Norman Conquest (Richards, 2007). Wattle construction requires a supply of thin pliable poles capable of being woven to form a semi-rigid partition, which can be incorporated into a timber framework and then coated in a clay mix. The poles would almost certainly be obtained from coppiced woodlands. This would ensure a supply of consistently sized poles, which could be selectively cut for the purpose.

In 1404, Joan Countess of Kent leased the manor of Chesterfield which included an ironstone mine and an early reference to coppiced woodland, " ..included the underwoods, apart from the young ash shoots, the tenants making sufficient enclosures for the spring of these woods." (Bestall, 1974:76-77).

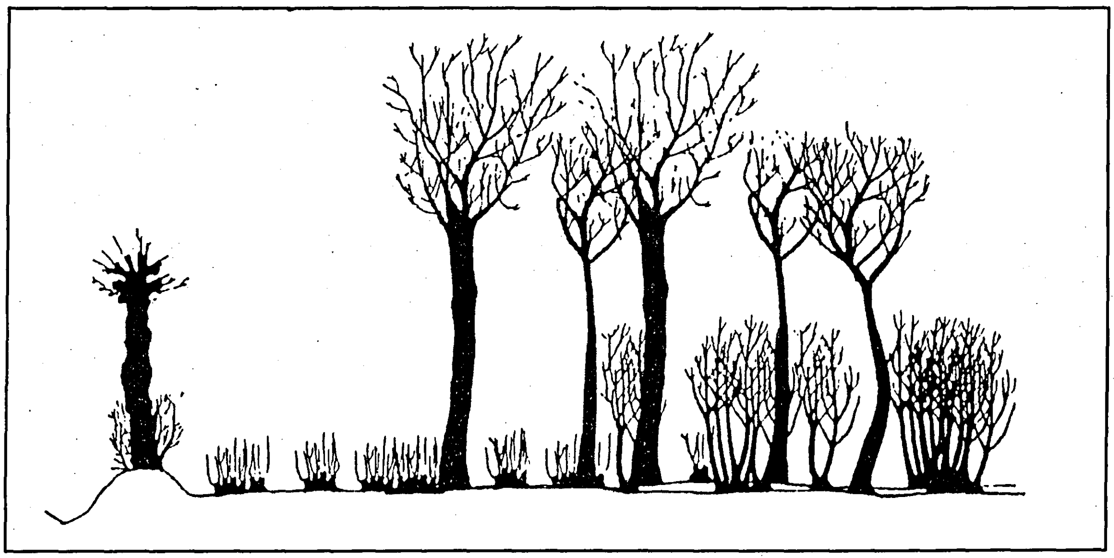


Figure 2. Coppiced woodland structure. (Jones, 2003)

Figure 2 above shows the essential developments of a coppice with standards management system. A bank and ditch to give a security and prevent stock and deer from entering and browsing the new tree shoots. Cut trees in progressive states of re-growth and standards in various stages of maturity.

References to coppice woodland become more common in the sixteenth century as demand for fuel increases. The element *spring wood,* is found in woodland names for example, *a spring wood called Fyrthe:* Frith Wood, Unstone 1561; *a spring of wood called Kynges Wood:* Kings Wood, Dunston, 1561; Cobnar Spring, Dunston, 1586 and Hewe Wilson's Spring, Brampton, 1571 (Cameron, 1993) Spring wood refers to the shoots that 'spring' up from tree stools when cut and regenerate the underwood; it is synonymous with coppice (Rackham, 1980).

The Portland Estate papers give details of coppice with standards management regime. In 1513 Robert *Lynacre* sold timber in Linacre to Godfrey Foljambe '*except 42 trees be chosen by RL to stand'* (157DD/P/84/1). Later in 1571, James *Lynacre* sold all the timber in Over Linacre Woods (and others) to Godfrey Foljambe to make charcoal and 100 herriers to be appointed and set forth (157/DD/P/83/3). In 1596 James and Gilbert Linacre sold the wood from Over Linacre Wood to Thomas Barton, except 60 of the best timber trees as herriers (157/DD/P/84/3). The last two extracts show that Over Linacre Wood was probably cut after twenty-four years and that certain shoots were allowed to grow on as herriers for timber. Over Linacre, Ducksick Wood and several other woods were leased for twenty-one years in 1602 by Gilbert Linacre to Roger Newton and William Stafford, 'except 45 trees in the Over Wood left at the last felling'. They were also instructed not to graze their cattle in the woods and not to fell more than once in certain woods (157/DD/P/84/4). Other leases in 1630 and 1703/4 in Chesterfield and Dronfield also insert clauses forbidding the grazing of cattle and livestock for four years and six years after felling (157/DD/P/67 and 71). Whilst charcoal and whitecoal production is mentioned the tree species are not defined. However the 1571 sale referred to above, gives James Lynacre the right 'to have the bark at every fall'. A sale of woods in Unstone dated 1748 'all timber except cordwood pilled (removing the bark) each year to be cleared before 25th March following' (157/DD/P/60), strongly suggesting oak trees were very important. In 1578, the right to dig up thorns, briers, hazels, elders, gorse, broom and 'such like *wedes*' was granted to the lessee. (157/DD/P/73/1). Perhaps this indicated an attempt to suppress other species and encourage oak, particularly at the early coppice stage. Many of the documents are concerned with the maintenance of hedges, boundaries and means of access. A number of springwoods on the Coal Measures contain ironstone and coal and landlords were anxious to ensure that these commodities had free egress from the woods. A number of documents give the hauliers of charcoal, whitecoal, ironstone and *seacole* (mineral coal) rights to cross fields if the usual tracks become impassable. These extracts illustrate the intensive management of Derbyshire Coal Measures woodlands in the sixteenth and seventeenth centuries. Demand remained high throughout the eighteenth century although products and markets changed. Management also changed as the demand for wood fuel decreased, the demand from coal mines for supports grew. New species, such as larch, which grew faster but were not suitable for coppicing were planted. Longer cutting cycles to produce larger diameter poles were introduced and the traditional coppice management, which was based on the supply of fuel, began to decline, but was replaced by demand for smaller underwood. A revival of coppice woodlands produced wood for a booming textile industry, canals brought woodland products to a wider market and transport demanded packaging and a huge demand for barrels, baskets, crates, domestic tools and utensils. Whilst land enclosure created a demand for hedging, hurdles, gates and posts. Large old oaks, particularly from parks were still available but the Government was the only major customer.

Old species such as hazel were being removed, they grew too slowly and were a temptation "to idle and mischievous persons to trespass on the fields and woods" (Farey, 1813).

1.5.11 Summary

The history and archaeology of woodland in Derbyshire has not been intensively researched. The intimate connection between surviving woodland and an industrial past has been suggested. Archaeologists and ecologists have recognized the need for detailed research and various agendas have been published. The ability to carry out the work is constrained and research, particularly on the Coal Measures has not been prioritised. Woods provided fuel, raw materials, fodder and food to the local community. The provision of those commodities and in particular industrial fuel has left an indelible mark in surviving woodlands. Woods also provided minerals, stone, ironstone and coal and were managed in a way that preserved their productivity and exploitation.

1.6 Aims of the study

The aims of this study are to evaluate the impact of and evidence for former industrial activity on selected ancient woodlands in Derbyshire. This will increase understanding of the nature and complexity of the relationships between former industry and the woodland and it will help to reveal how these are reflected in its archaeology and ecology.

1.7 Objectives of the study

The study objectives are:

1 To assess the scale and nature of industrial exploitation of the woodlands

2 To establish a series of time-lines for selected North Derbyshire woodlands.

3 To investigate the scale and diversity of industrial use of woodlands and assess any physical remains.

4 To evaluate the potential use of various sources of evidence to inform such studies and relate to 1-3 above.

5 To outline the need for research that might enhance the local authority Heritage and Environmental Records database of archaeological finds and which may be a transferable approach to other areas.

6 To provide a basis for greater awareness of woodland history and to assist conservation and management of the woodland heritage.

The second part of this research is based around a selection of in-depth case study investigations. It consists of fieldwork in four semi-natural ancient woods in Derbyshire; two located on the Coal Measures and two on the Millstone Grits on the east bank of the River Derwent.

The woods were selected according to the following criteria:

- Documentary evidence for ancient woodland status, and therefore in existence before 1600.
- Easily accessible and convenient for survey.
- Relatively free from dense undergrowth and extensive conifer planting.
- Permission to carry out survey work from the owners.

2 METHODOLOGY

2.1 Introduction

Semi-natural ancient woodlands are highly complex landscape components which influences the potential choice of research methodologies. They are derived from a living element, which may be a modern plantation or the remains of an older woodland management regime. They may include relict landscapes recognisable by archaeological earthworks and features some of which may be industrial. Some features are ephemeral and others are more lasting and more easily interpreted. This landscape overlays an often complex geology of ancient soils and highly specialised flora. To obtain a clear understanding of this complex environment requires an holistic approach. Therefore the use of multi-disciplinary techniques and analysis to record the numerous facets of woodland has been adopted in this work. This use of mixed-methodologies and techniques adds a crucial extra dimension and allows the "...potential to triangulate multi-disciplinary findings and give confidence in the outputs." (Rotherham, 2007). Ultimately, the findings can be triangulated to help draw out robust conclusions and to lend confidence to the interpretation. The Woodland Heritage Manual (Rotherham *et al.*, 2007) offers a working template for conducting woodland research. It includes guidance for surveying and interpretation of results. It is based firmly on a multi-disciplinary model and includes survey recording sheets for researchers. These sheets have formed the basis for some of the surveys in this work.

The surveys included the three elements below:

- Environmental
- Archaeological

•Historical

This approach is shown in the diagram below.

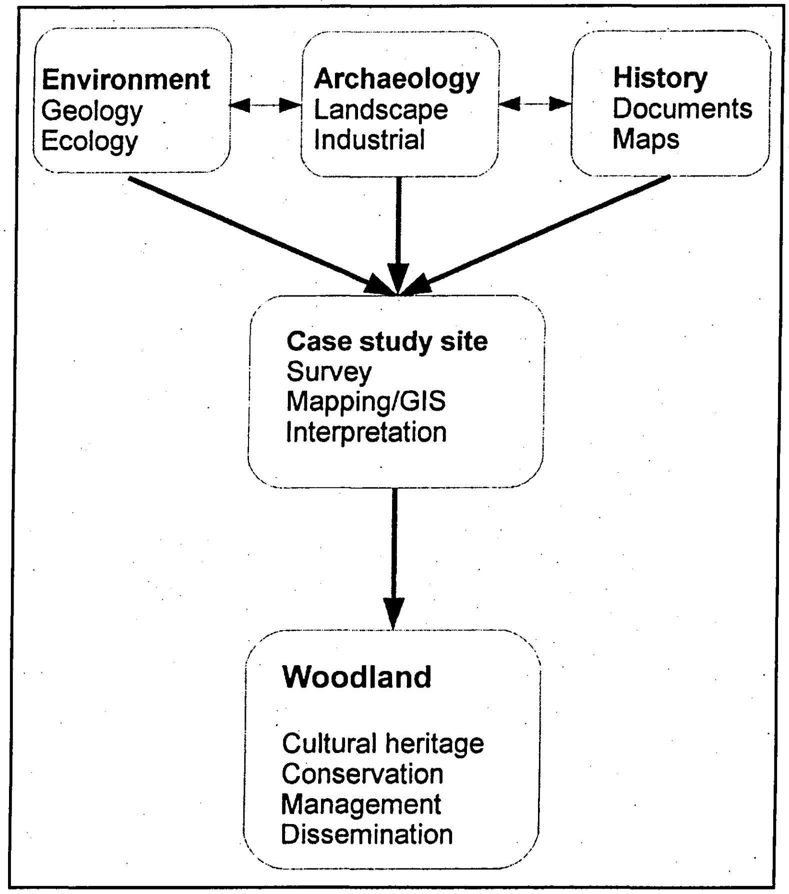


Figure 3. Multi-disciplinary woodland investigation

The techniques share a number of common elements such as:

- Cartographic data, including Ordnance Survey and geological maps
- Environmental and archaeological fieldwork, data collection and analysis
- Archive plans and historic documents.

This multi-disciplinary approach allows the construction of a woodland 'biography' showing the major contributors to the woodland development. A series of time-lines chart the socio-economic and political changes that have acted over time to develop the present woodland environment.

2.2 Environmental survey

This section is concerned with describing the techniques used to record and analyse the woodland landscape in the four case study sites, including the geology and hydrology, soils and outline ecology.

The solid geology map, Chesterfield, sheet number 112 at one inch to the mile (1:50,000) scale has been consulted and its corresponding memoir. (Smith *et al.*, 1967) In addition the surface geology maps at six inches to the mile (1:12,500) scale have also been used and can be seen within the case study results. These are particularly useful for illustrating mining and seam outcrops on the Coal Measures and have been used to draw the geological sections. Soil samples have been taken to give a general impression of pH and profiles at selected points within the sites. Geological data, including soil, aspect and slope were collected on pre-printed record sheets. Colour and texture were referenced against standardised colour charts (Munsell, 1954; Hodgson, 1976; Trudgill, 1989). Soil samples were obtained from various woodland compartments and the pH recorded. The analysis was completed away from the field using a Tecpen pH703 and 4 pH and 7 pH buffers and following the soil testing methodology in Soil Analysis KW/FEB 1993 (SHU, 1998). The soil sampling was not to a statistical sampling plan it was to try and obtain a rapid overall picture for the various case study woods.

The ecological element of the survey has only recorded tree species and ground flora. No attempt has been made to record fauna. The survey optimises the time available and is broadly based. To achieve a representative coverage ground flora data were noted whilst simultaneously surveying the archaeological landscape. It is acknowledged that this approach may not be acceptable as a botanical survey as such; neither the time nor the necessary expertise were available for a more systematic floral survey. The danger is that the floral data collected only represents the environment of the archaeological locale. Charcoal and whitecoal production sites may well have impoverished the woodland soils and modified the ground flora (Ardron and Rotherham, 1999). However, a wide range of archaeological features were noted giving a wider spread of floral sampling opportunities. External data sources have been consulted and used to supplement and interpret the broad results obtained here (e.g. Clapham, 1969; Hall *et al.*, 2004; LBAP, 2006). A hand held GPS unit was used to record compartments and individual plants (this technique is described in detail below) and Mapinfo for graphic display. Specialist advice was sought to ensure that the species recognition was reliable. Results have been expressed using the ACFOR scale: Abundant, Common, Frequent, Occasional or Rare. Whilst it is recognised that the technique is highly subjective, cannot be analysed statistically and that conspicuous plants may well be overestimated, it is nevertheless a useful technique for initial surveys. (Chalmers and Parker, 1989). Reference was also made to various flora key publications such as Rose (1991). Field recording used the Woodland Heritage Manual pre-printed data collection sheets, Woodland Structure and Diversity record sheet and the Botanical Ancient Woodland Indicators record sheet (Rotherham *et al.*, 2007).

2.3 Archaeological survey

The archaeology of woodland can be divided into two types:

- The archaeology **of** the woodland, including evidence of the use and exploitation of the wood itself, such as wood fuel conversion, compartment boundaries and drainage grips.
- The archaeology **in** the woodland, including activities such as quarrying,

mining, communications and evidence of earlier land use.

Generally detailed archaeological survey of woodland is difficult, line of sight is obscured and the ground surface may be concealed under dense ground cover. GPS was used to record features and map them using Mapifo GIS software.

Traditional compass survey is also difficult due to lack of landmarks and line of sight, although this can be partially overcome by using temporary datum points such as painted markers or lights. There remains however the problem of locating the datum points accurately within the woodland environment. However with care and by combining techniques a reasonably reliable survey of woods can be achieved. It was decided that recording the feature and positioning it with sufficient precision to allow it to be found again was the most important aspect of the survey. To this end it was decided to use the Global Positioning System (GPS), this system consists of three parts:

- The 27 satellites orbiting the earth and transmitting positioning signals
- Ground stations which control the satellites and update the system
- A hand held receiver which collects satellite data and computes its position.

The US military have removed their Selective Availability and accuracy is now improved.

GPS was used where possible for the following reasons:

- Surveying was quick and simple, allowing rapid surveying.
- The results were recorded in grid reference form for easy manipulation and compatibility with Ordnance Survey mapping
- Software is available to process the data and to interface with GIS mapping software.

- The new generation hand held GPS units are cheap, reliable, lightweight and robust and can store up to 1,000 waypoints.

A new generation of processors can display elevation and averaged positional accuracy for each reading (De Priest, 2003). A hand-held Garmin GPSmap 76CSx device was used to locate and record features on site. The locational field data were recorded on the device and downloaded to PC using Garmin Mapsource software; it was then entered onto Excel spreadsheet with descriptions of the feature to be used as a gazetteer. Where appropriate features located during the surveys were sketch plotted.

Some doubts linger as to the accuracy of GPS surveys and it is by no means universally accepted. Indeed there are occasions and locations when GPS is inappropriate, such as under dense, wet canopy when signals may be deflected, clearly this must be borne in mind at the outset. Modern devices have satellite displays and an accuracy facility, which shows whether the conditions are suitable. Attempts have been made therefore within this study to assess the accuracy of the GPS data. This has involved mapping GPS data such as point features in relation to known features on Ordnance Survey maps. In all cases re-location of the feature was possible and often so precisely as to be able to position the feature within five metres of a known location. This is acceptable and within the research parameters.

As noted above woodland archaeological features fall into two main categories, those which relate to aspects of wood and timber use such as charcoal hearths, whitecoal kilns and wood banks and those which have been preserved in the woods such as quarries, holloways and mineral workings. They can be recorded as point features such as querns or Q-pits and linear features such as tracks and walls. Identifying, recording and interpreting the various woodland features require considerable skill and experience. It was decided at the outset that invasive techniques such as test-pits or excavation would not be used in the surveys. They demanded too much time and unless done correctly under supervision are worthless. Occasionally auger samples have been taken on platforms to search for charcoal and establish a possible production area. It would also have been of benefit to date some representative features, but Carbon Dating proved to be too expensive. Grants naturally could be given only to accredited and supervised excavations. Whilst basic skills of identification and recording are learned at undergraduate level in classroom and fieldwork the more specialist skills were learned at various woodland workshops organised by the South Yorkshire Biodiversity Group. The workshops used both seminar and field visits to South Yorkshire woods with acknowledged specialists such as Professor Mel Jones, Professor David Hey, Professor Ian Rotherham and Dr Paul Ardron. However it must be noted that the woods visited in the Sheffield area are Coal Measures woods with their own particular archaeology, whilst that archaeology appeared to be similar to Coal Measures woods in North Derbyshire the woodlands on the Millstone Grits were different. There has not been sufficient research on these woodlands to establish guide lines or a typology of features. Some doubts remain over the interpretation of woodland features. An apparent kiln in Padley Woods has been interpreted as either a whitecoal kiln or corn drier (Clive Hart pers. comm.). The smelt mill and kiln in Froggatt Woods appear to be unique in design and location. It serves to emphasise the variability of woodland remains and the use of the topography and environment. I have been fortunate therefore to have the advice of Dr Paul Ardron and to consult Dr David Barrett, Dr Lynn Willies and Clive

Hart during visits to the case study sites. I am reassured that the interpretations contained in this work are accurate given the present state of woodland research in Derbyshire and that in fact they may well form the basis of later work by others. Published sources were consulted for specialist advice (e.g. Rackham, 2006) but with the caveat that not all woodland archaeology is readily transferable across the country, indeed it varies across Derbyshire.

2.4 Historic survey

This section is concerned with the documentary evidence of exploitation of the woodland resource in the case study areas. Although all the woods studied are ancient woods, the documentary evidence is highly variable. The Portland Estate Archive has proved to be very useful for the Coal Measures woodlands for the sixteenth-eighteenth centuries, they are also available on-line. I have used the translation given on the website. Bow Wood and Lea Wood are mentioned in the Nightingale Family Papers (DRO) and have proved to be useful for the eighteenth and nineteenth centuries, earlier documents have not come to light. Political, economic and social events over time have interacted in various ways to influence and shape the woodlands of today. These events can be shown graphically as a time-line. This technique has been developed and used successfully for woods in South Yorkshire (Rotherham and Jones, 1998; Rotherham and Ardron, 2006; Rotherham, 2007).

3 CASE STUDIES: RESULTS AND ANALYSIS

3.1 Introduction

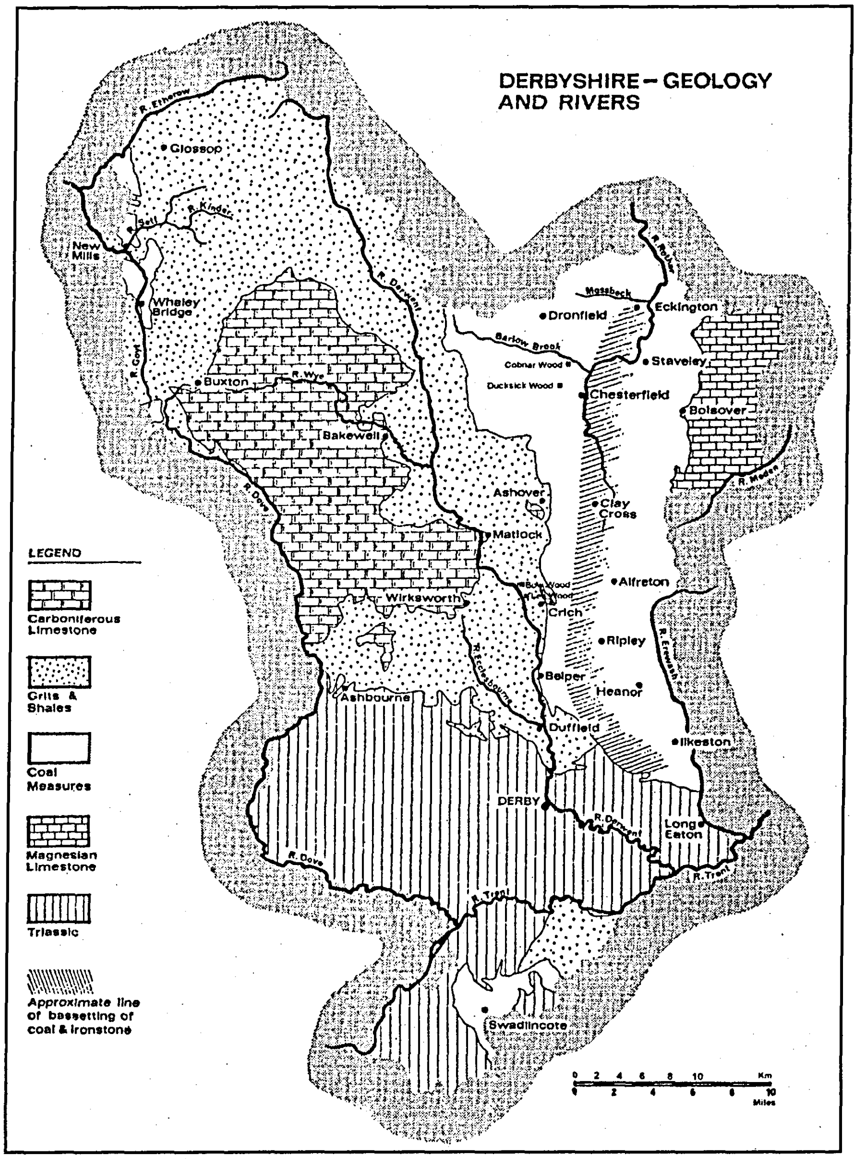
Four woods were selected as case study sites. Ducksick Wood and Cobnar Wood are situated on the Lower Coal Measures and Bow Wood and Lea Wood on the Millstone Grits.

Map 1. Case study sites location

The results of the site investigations in this section are presented in a uniform manner. The woods are introduced and located and the environmental, archaeological and historical surveys are detailed and in a final section the separate strands of the surveys are drawn together in a composite time-line.

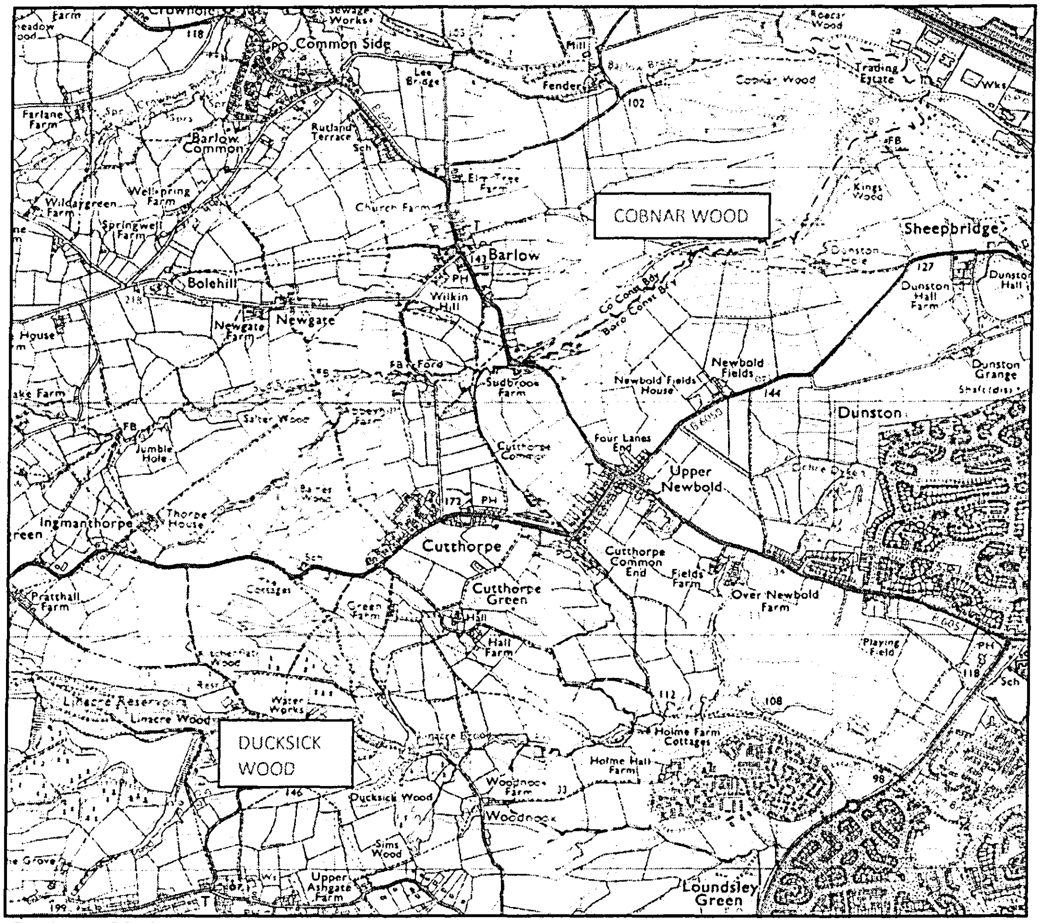
Chronological information is incomplete; inevitably some generalisations have been used for the sake of continuity. This format follows that established by

(Rotherham, 2007) and is adopted for the woods considered here.



Map 2. Derbyshire geology. (From Nixon, 1969).

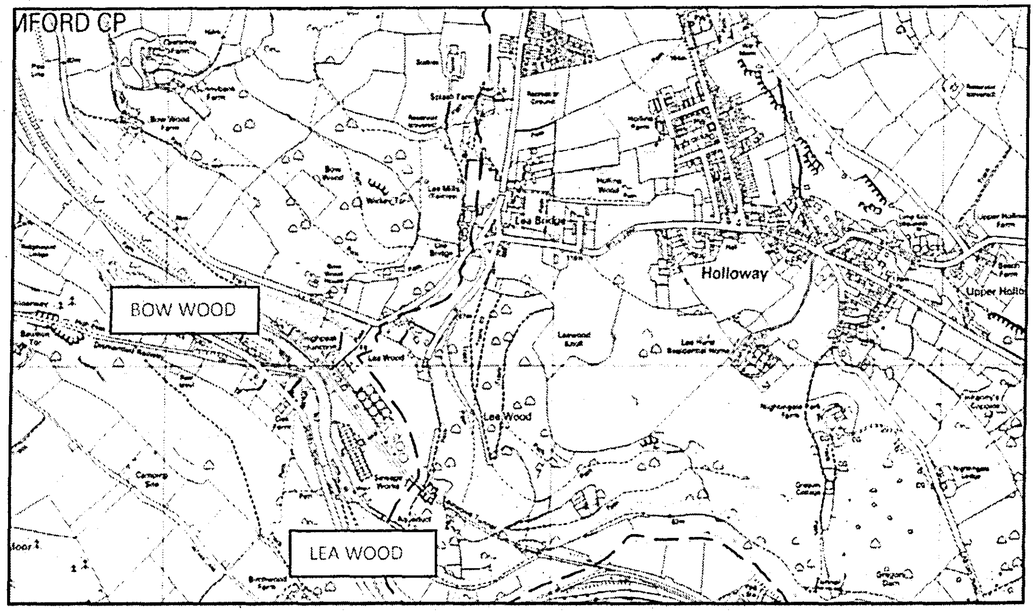
It will be shown in the results that follow that geology has a key role to play in the development of a wood. The case study sites are located on the Derwent-Rother interfluve. This area comprises the Carboniferous sandstones of the Middle Grit series. On the east bank of the River Derwent two important Gritstone horizons can be seen, the Chatsworth Grit and the Ashover Grit, with occasional shale bands which has led to some landslip in the immediate area of Bow Wood and elsewhere. Two of the case study sites Cobnar Wood and Ducksick are situated on the Lower Coal Measures to the west of Chesterfield. Bow Wood and Lea Wood are sited on the Millstone Grits and Shales south of Matlock (Smith *et al.*, 1967).



Scale 1:20000

Map 3. Coal Measures case study sites location: Cobnar and Ducksick Woods.

Cobnar in the north east is on the edge of a highly industrialised part of the western fringe of Chesterfield. Ducksick in contrast in the south is more rural and part of Chesterfield's south west residential area.



Scale 1:3000

Map 4. Millstone Grit case study sites location: Lea and Bow Woods.

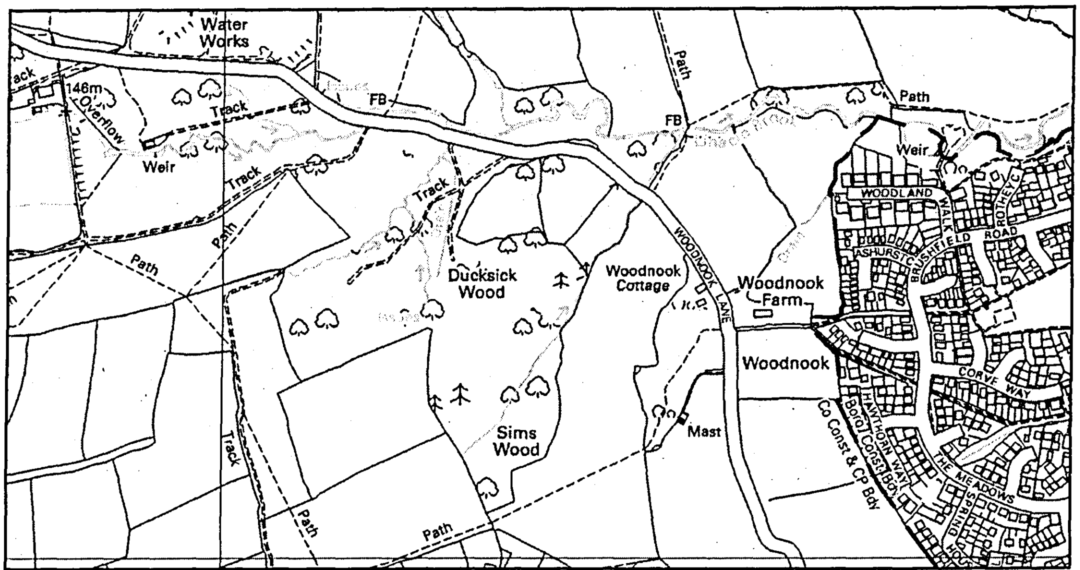
Bow Wood in the north-west and Lea Wood in the south above to the east of the Cromford Canal, the railway and former High Peak Railway. A substantial industrial complex still operates at Lea Bridge, but the area is predominantly rural.

3.2 Ducksick Wood

3.2.1 Environmental survey

This eleven hectare mixed woodland is owned by Severn Trent Water Plc and managed by Derbyshire County Council. It is located at the eastern end of the Linacre Valley and is part of the extensive land holding surrounding the Linacre Reservoirs, which originally supplied Chesterfield with drinking water. The reservoirs were decommissioned in 1994 and the land surrounding them including Ducksick Wood is now managed as an amenity resource. It is linked by footpath to

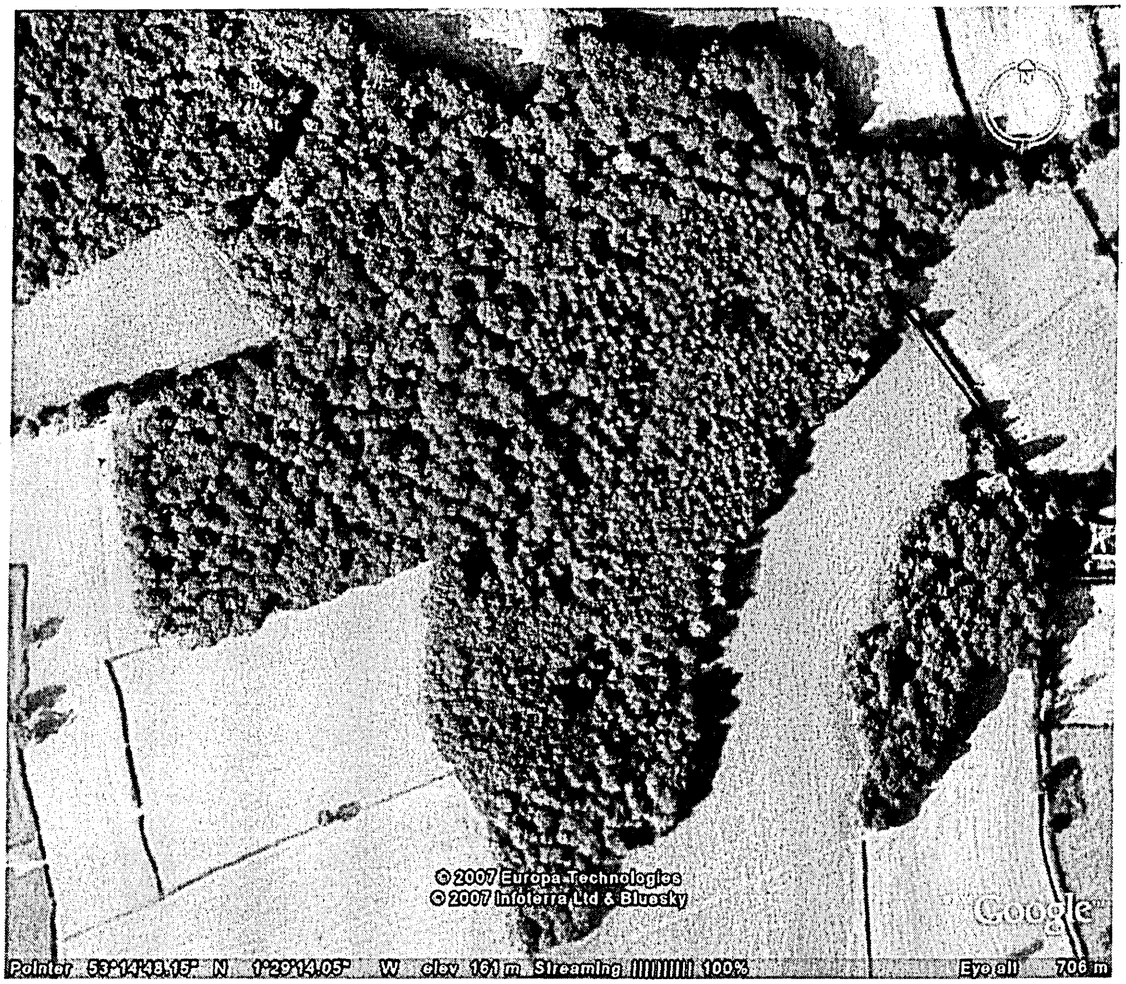
Holme Brook Valley Park to the east with links into Chesterfield and a wider amenity area.



Scale 1:10000

Map 5. Ducksick Wood

Ducksick wood is situated five kilometres west of Chesterfield, one kilometre north-east of Old Brampton and a similar distance south of Cutthorpe. It is bounded to the north and north east by Woodnook Lane a bridleway linking Ashgate and the former water works and by a track to the fields in the north-west. It is surrounded on the west, south and east by agricultural land.



Photograph 2. Ducksick Wood: aerial photograph

Ducksick Wood has a northern aspect, the site slopes gently from the south, to a steeply incised stream valley east - west, which joins the Holme Brook to the north. It falls about 35 metres from about 160 metres at the southern boundary to 125 metres in the valley bottom. Geologically it is located on the Lower Coal Measures, with underlying flaggy sandstone, which can be seen exposed in the stream bed and sides. There is evidence of some exploitation of the stone in abandoned quarry workings in the south, although not as extensive as elsewhere in the locality, such as Kitchenflat Wood to the north and Freebirch to the west. An important geological feature is the occurrence of coal; formerly coal mines were located to the south west around Old Brampton, in the north near Cutthorpe and Ingmanthorpe and to the east in Ashgate. Coal debris has been found at the eastern edge of the wood and a thin coal seam can be seen in the banks of the stream, which flows west to east through the wood. Map 6 below shows the coal outcrop crop of two seams, the Mickley Thin running west to east through the centre of the wood and the Upper and Lower Brampton seams in the south with a fault running north west-south east across the valley and bisecting the wood. Geological surveys in the wood have recorded ironstone in the stream beds and in spoil around some pits. Ironstone is found in association with coal seams, to the south-east are extensive workings in the Blackshale at Ashgate and Loundsley Green where the spoil can be seen in Ashgate Plantation. The soil overlying the sandstone is generally thin and clayey, this results in surface water and several springs. Some effort has been made in the past to control the surface water by digging grips and drains, however the wood is still very wet. Surprisingly, tree species such as willow and alder, commonly associated with wet conditions are not particularly common. The trees generally are not old, although a large oak with a girth of approximately 3.8m has been noted at the junction of the hedged boundary with Woodnook Lane in the east and two multi-stemmed oaks (*Quercus petraea)* have been recorded within the wood, see Photograph 3 overleaf.

Photograph 3. Ducksick Wood: multi-stemmed sessile oak

Broad leaved species are confined to a wide margin around the central core of the wood which has been planted with larch (*Larix* sp.) probably in the mid-twentieth century. Earlier maps show that this central area had been cleared and enclosed in the past and was probably pasture. The ground flora here is dominated by bracken (*Pteridium aquilinum*) and bramble (*Rubus fruticosus*) whereas on the woodland fringes a more diverse ecology is apparent.

Common name		**A**	**C**	**F**	**O**	**R**
Alder	*Alnus glutinosa*				X	
Ash	*Fraxinus excelsior*				X	
Beech	*Fagus sylvatica*					X
Birch	*Betula pendula. B. pubescens*				X	
Elder	*Sambucus nigra*					X
Wych elm	*Ulmus glabra*					X
Hawthorn	*Crataegus monogyna*		X			
Hazel	*Corylus avellana*		X			
Holly	*Ilex aquifolium*		X			
Larch	*Larix decidua*	X				
Sessile/ English oak	*Quercus petraea/ robur*		X			
Rowan	*Sorbus aucuparia*				X	
Sycamore	*Acer pseudoplatanus*		X			

Table 2. Ducksick Wood: tree species

The main broadleaved species are oak, sycamore, holly, occasional rowan, alder and immature beech in the north, presumably a recent planting episode. Smaller species noted included hawthorn, hazel, elder and occasional immature elm.

Dog's mercury is abundant throughout the Linacre Woods particularly beside roads and tracks where road stone has been used possibly raising pH. It is also found growing with wood anemone on bloomery slag deposits. This relationship prompted a rapid soil pH survey as an attempt to explain the relationship. All the soil tests are shown at Appendix 1 Ducksick Wood results are shown overleaf in Table 3.

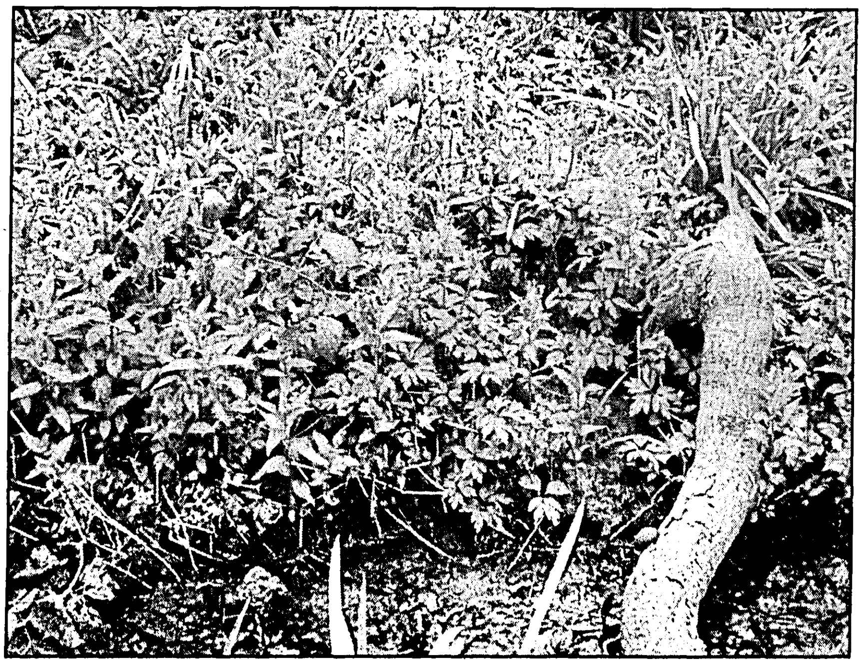
Wood	Ref	pH	Location
Ducksick	1	4.9	Nr Q-pit
	2	5.5[1]	Slag
	3	4.3	Central larch/pine
	4	4.7	By ironstone workings/ Q-pit
	5	6.2[2]	Waterlogged ex pasture
Median		**4.9**	

Table 3. Ducksick Wood: Soil pH results

The first slag deposit reference 2 above and shown at Photograph 3 overleaf had a soil pH 5.5. The same plant relationship at a second site, Reference 4 above and shown in Photograph 4 overleaf had a soil pH 4.7, which is lower than the median value of pH 4.9 for the wood generally, but may well indicate pockets of varying pH amongst the slags.

The high value for **5** above is the former improved land shown on First Edition Ordnance Survey maps and is now a Larch plantation. It contrasts with the unimproved larch plantation with a value pH 4.3. No firm conclusions can be drawn from such a limited sample, but the same plant relationship has been found in Cobnar wood. It was hoped that this relationship might be useful as an indicator for early iron-working sites, but at the present the data are insufficient.

Photograph 4. Ducksick Wood: *Mercurialis perennis* and *Anemone nemorosa* growing on bloomery slag, this can be seen at bottom left.



Photograph 5. Ducksick Wood: *Mercurialis perennis* and *Anemone nemorosa* growing on an ironstone working area.

The nettles were confined to the southwest corner of the wood where rubbish had been dumped. The flora listed in the table below tends to be distributed around the woods fringe, although the open wet areas are also well populated.

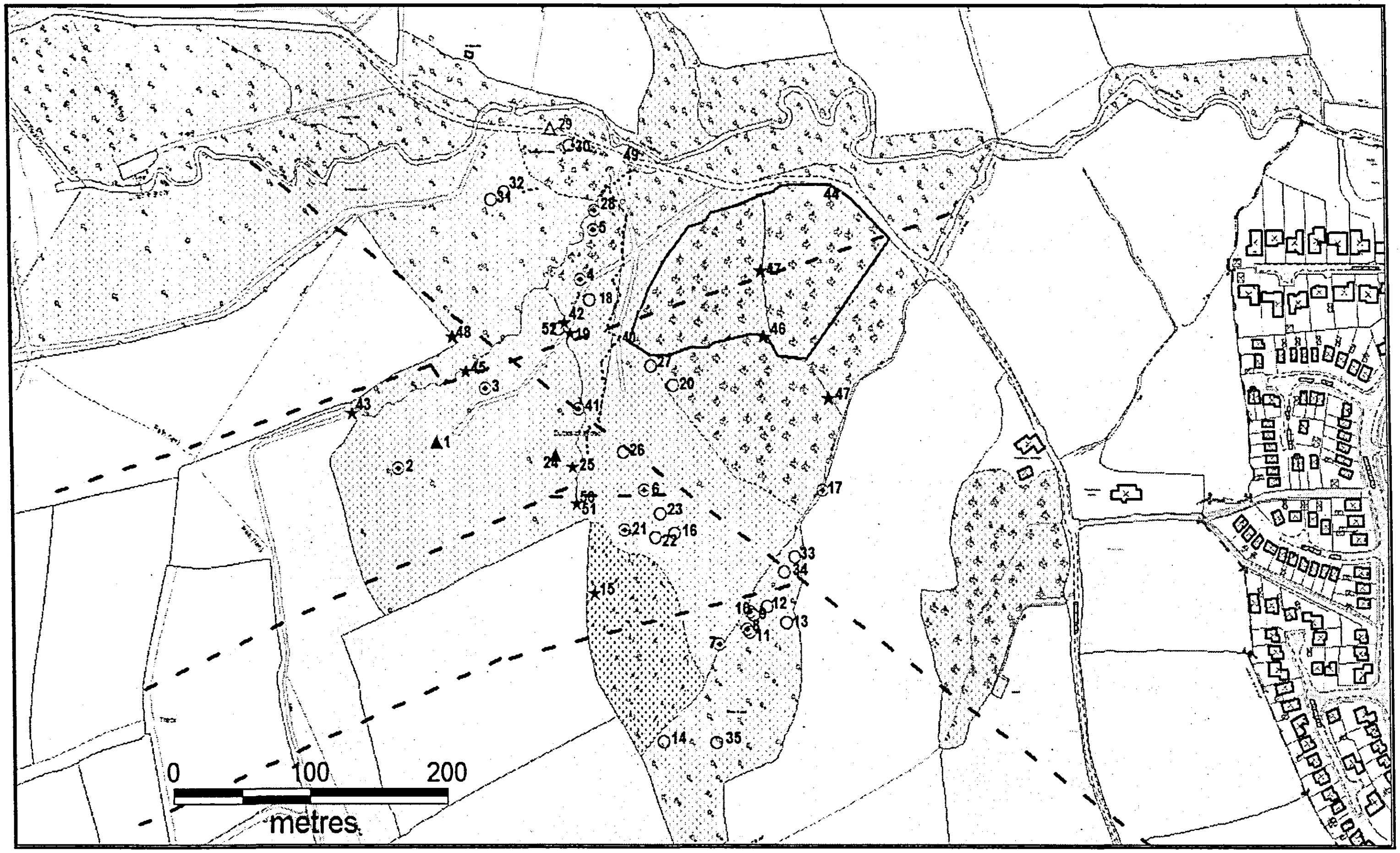
Common name		**Common name**	
Bluebell	*Hyacinthoides non-scriptus*	Ramsons	*Allium ursinum*
Bramble	*Rubus fruticosus*	Opposite-leaved Golden-saxifrage	*Chrysosplenium oppositifolium*
Bracken	*Pteridium aquilinum*	Woodrush	*Luzula sylvatica*
Dog's Mercury	*Mercurialis perennis*	Wood Anenome	*Anemone nemorosa*
Dog Rose	*Rosa canina*	Wood Millett	*Milium effusum*
Enchanter's-nightshade	*Circaea lutetiana*	Wood-sorrell	*Oxalis acetosella*
Foxglove	*Digitalis purpurea*	Yellow Archangel	*Galeobdolon luteum.*
Herb-Robert	*Geranium robertianum*	Broad Buckler Fern	*Dryopteris dilatata*
Honeysuckle	*Lonicera periclymenum*	Male fern	*Dryopteris filix-mas*
Ivy	*Hedera helix*	Creeping Soft-grass	*Holcus molis*
Nettle	*Urtica dioica*	Tufted Hair-grass	*Deschampsia cespitosa*

Table 4. Ducksick Wood: ground flora species. I am grateful to Dr John Rose for his help in identification

3.2.2 Archaeological survey

Ducksick is a small compact wood and is reasonably easy to survey. That being said the central core of conifers is overgrown by bracken and brambles. It can only be accurately surveyed in the winter months when the growth has died back, and it is possible that this area is under-recorded.

Archaeological features have not been found in the cleared central area, other than the field boundary ditches. This may be because the subsequent conifer plantation has destroyed or obscured them or they were obliterated when the fields were created or the archaeological features post-date the fields. The features tend to circle the plantation and cluster in several nodes and be related to the Coal Measures geology, particularly the ironstone deposits, the results are shown on Map 6.



Map 6: Ducksick Wood: archaeological finds.

Key: ⊙ Q-pit; ▲ Charcoal platform; □ Quarry; ○ Other pits ★ Other features; - - - - - coal seam;

...... holloway/ditch.

The site contains more than fifty distinct archaeological features, approximately four per hectare. Significantly there are none recorded in the previously improved land in the centre of the wood. This area was enclosed and shown on Senior's seventeenth century estate map; any features in the area may have been filled. Although the land now is wet and waterlogged in part s, probably not the best site for Q-pits or charcoal hearths.

Quantity	Feature
2	Platform
12	Q Pit
10	Circular pit
8	Sub-rectangular pit
1	Coal pit
3	Slag
5	Water management
4	Boundary
4	Communications
2	Former buildings

Table 5: Ducksick Wood: summary of archaeological features

Platforms

Two platforms have been recorded, No. 1 is approximately six metres in diameter and charcoal has been found and No. 24 is oval in plan approximately ten metres by six metres but no charcoal was found. Platform 1 has been interpreted as a charcoal production area. It is typologically similar to others elsewhere and charcoal has been seen. However, there is a trackway leading to it from the east, which is visible and is marked on early maps. The platform may have been a dwelling a limited excavation could determine this. Analysis of the charcoal sample found on platform No 1. proved to be oak (*Quercus* sp.) of about thirty years growth. The full charcoal analysis can be seen at Appendix 6.

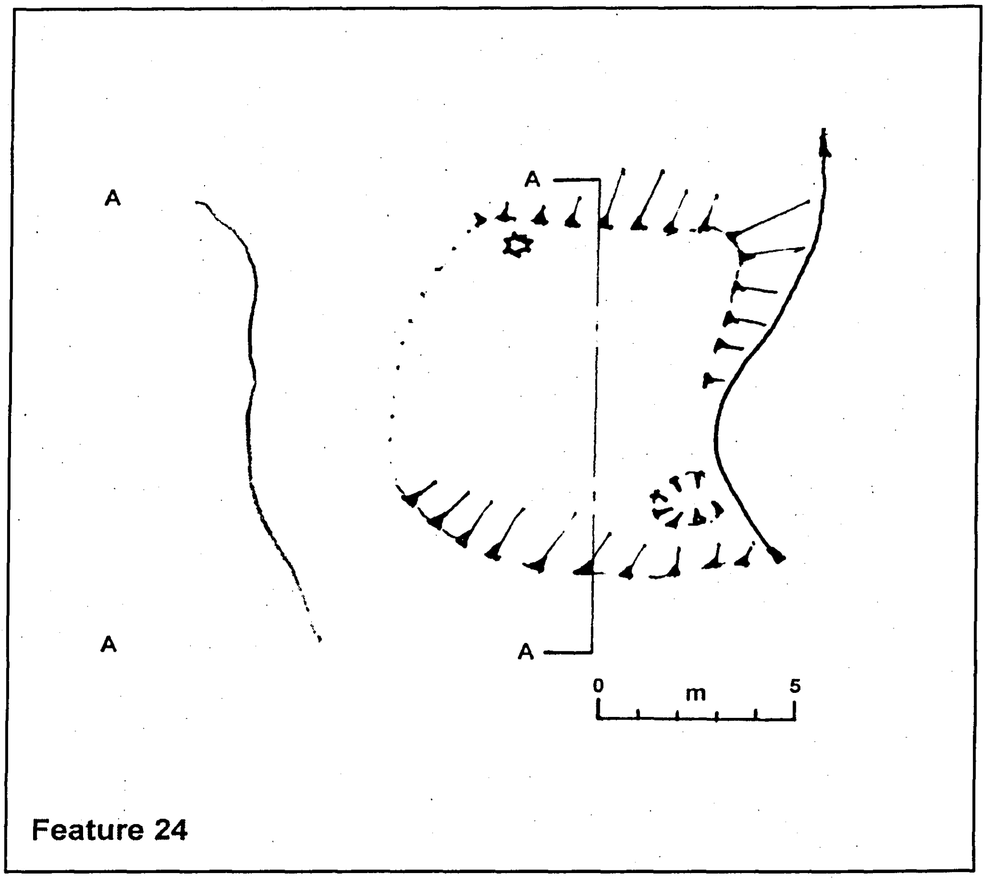


Figure 4. Ducksick Wood: platform **24** showing typical profile

Pits

'The pits recorded have been divided into four categories: Q-pits, circular pits, sub-rectangular pits and one possible coal mine. Only the Q-pits have been interpreted with a degree of confidence, the others tentatively with reference to their proximity and the spoil evidence. It is not known whether the features are contemporary or if they were all used in the same way. The wood has changed very little in area since William Senior's plan of 1630. It was at this time that white coal was being produced in Q-pits, to fuel the ore hearth lead smelters, although both local smelters had probably ceased production by this date (Crossley and Kiernan, 1992). Whitecoal therefore would be a likely woodland product and Q-pits would be expected.

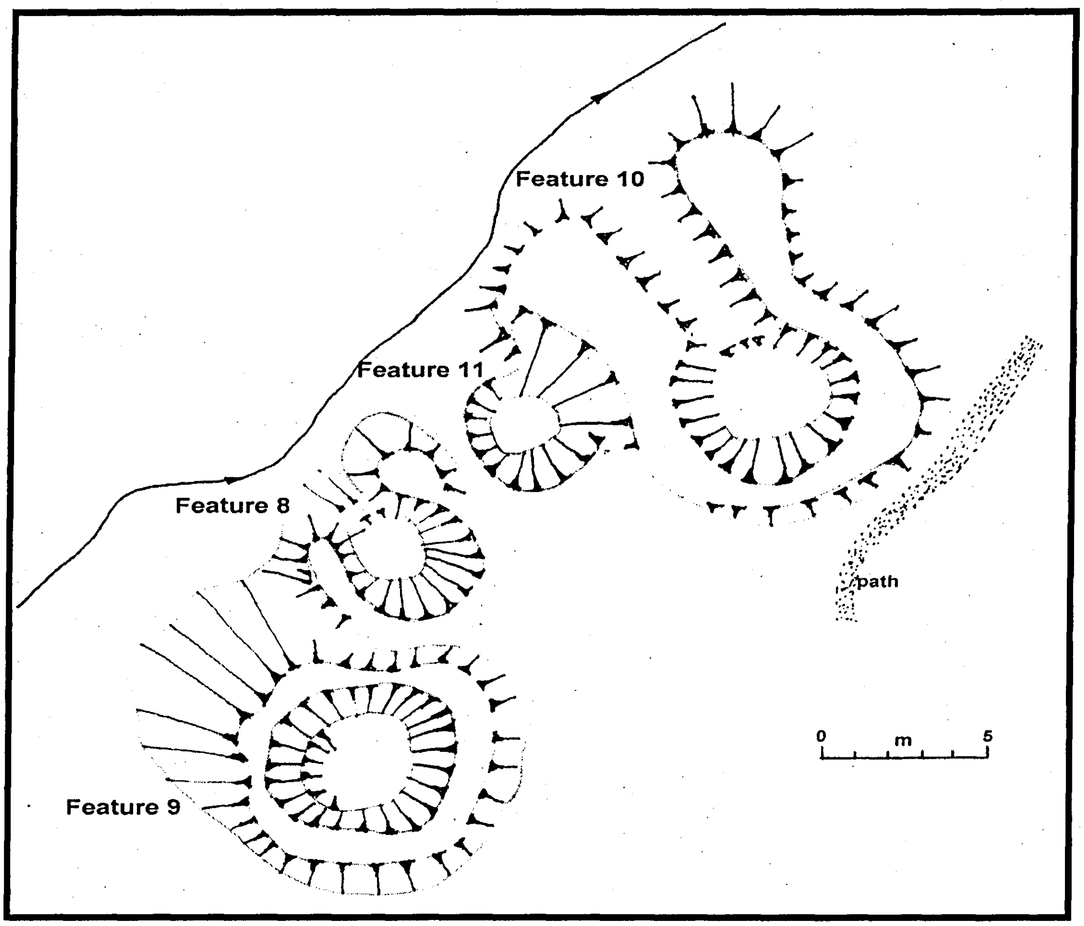


Figure 5. Ducksick Wood: pits complex, features **8,9,10,11**

Twelve pits, just over one per hectare, Numbers **2-8,10,17,21,28,41** were recorded and interpreted as Q-pits. Typically they comprise a central pit, surrounded by a concentric ring of spoil in which there is a break down-slope see No. **10** above. The shape approximates to a letter "Q" in plan. The diameters range between four to seven metres and vary between .75 and 1.8 metres in depth. Seven were located close to streams and one example had a long 'leat' to the stream. As noted by other researchers coal and cinders have been found in the soil of some of the pits (Franklin, 1991; Fowkes, 1992). No excavations were carried out although auger tests and soil probing was attempted but they did not reveal concealed masonry or superstructure, such as that found by Timperley (1952).

Circular pits.

Ten circular pits, Numbers **9, 12, 13, 14, 20, 26, 32, 33, 34, 35** were recorded. These differ from the Q-pits in not having a distinct break in the spoil bank. Some are remote from a water source, some others, unusually for this site, are water filled.

Sub-rectangular pits

Eight sub-rectangular pits, Numbers **11, 16, 18, 22, 23, 27, 30, 31** were recorded, with a size range of 4-7 m x 3-4 m and 0.5-1 m deep. The pits are difficult to interpret, some could be clay pits, Q-pit excavations (Franklin, 1991; Fowkes, 1992) elsewhere in the area have noted successive clay "floors" and the slag finds are evidence of iron working and early furnaces were constructed of clay. There was clearly a demand for clay and any suitable deposits locally would have been worked.

Coal Mine

Feature, Number **14** is sub-circular; water filled and is two metres in diameter and 0.75 metres deep to the water. It is surrounded by debris composed of fragments of coal and shale. The sides of the pit are sharp and may well be modern. Tentatively interpreted as a possible trial coalmine solely on the appearance of the debris. There is no written evidence of coal mining here, although several small mines operated nearby in Old Brampton, just under a kilometre south west of Ducksick Wood, where the Upper Brampton seam was worked. The mine could have been a trial for coal in the same seam, which is shown to outcrop in the wood. It is not obvious that the shaft is lined or that there is any dating evidence. It is close to a modern footpath; and to the east of a spring, which is shown on early Ordnance Survey maps, but no tracks or access points are shown.

Slag deposit

The slag deposit at **15** was seen in the footpath and also as a spread from beside the field edge to within the wood. It was mixed with asphalt floor screed and other debris, it may be a dump from a local source or used to fill in holes in the wood. The area appears to have been levelled producing a distinctive edge within the wood. The slag is pale-to dark grey in colour, dense with small from a modern iron blast furnace, and has been used throughout the area as hardcore for paths and tracks.

The slags found at **25** and **42** are older and may well be medieval, (Dr R Doonan pers. comm.). They are bloomery tapping slags formed as molten slag was run out of the furnace during iron smelting. The charcoal-blast furnace was introduced into the area at the beginning of the seventeenth century. A water driven blast furnace was in operation at Barlow in 1605-6 (Riden, 1993). They replaced the woodland bloomery smelters although the chronology here is not known. A 'knife wheel' is shown on William Senior's 1630 estate map which may have forged and ground locally produced iron blooms.

Included in the above data are two features, which are derived from documents but are not visible on the ground. A corn mill is shown on William Senior's map of 1630; although there are no visible remains the approximate location with reference to water supply and topography appears to be correct. The Nether Lead Mill is mentioned in a lease of 1600 but the grid reference and location however do not fit the modern landscape (Crossley and Kiernan, 1992). The OSG reference places it in the modern wood, which was *Millthorp pingle* on Senior's map. The site is close to a ditch or drain (located using GPS). It is hard to see it as a water supply to drive a mill. The Holme Brook, which would surely have been the preferred site is fifty metres away to the south. There may well be an error in grid reference.

Communications and boundaries

The main change in communications has been to re-orient the woodland paths. An early enclosure wall in the north was extended to the small stream enclosing a section of stream presumably for stock watering. It is shown on the First edition OS map and the remains of a dry-stone wall, **45** can be seen beside the stream and its foundations are visible in the modern path. This wall effectively closed off north-south communication with the result that paths tended to be west - east. A well-made path crosses a culverted spring and led towards platform **1.** Other tracks shown on the First edition OS map may have been associated with the fields and mills shown on Senior's map of 1630. The eastern boundary of the wood is

Woodnook Lane, which now continues north east around the wood, but originally forded Holme Brook and climbed the opposite bank and continued as Barnabie Lane. The sinuous southern boundary, which follows a small stream may well have been a ditch and is probably ancient (see below).

3.2.3 Historical survey

Cameron suggests the name probably means a wet place where there are ducks (1993). It may also be interpreted as 'small stream' with ducks, in particular tiny watercourses, the 'sick' ending may be from Old Norse, *sik* rather than Old English *sic* which can produce 'sich' endings (Gelling, 1984). Ducksick Wood was first mentioned in a lease of 1602. It is clearly shown on a map of 1630, when William Senior surveyed the Earl of Shrewsbury's land holdings. (STW). The boundaries can still be recognised on modern maps today. The two arable fields on the east of the wood were marked on Senior's map as Spittlehouse and a building marked, two bovates of land were granted to the Hospital of Saint John in Brampton in 1185 (Jeayes, 1906). If these fields are in fact those referred to above then this sinuous boundary may be extremely ancient. However, caution is required because in 1622 Gervase Eyre left a small sum in his will to 'Olde Spittlehouse' a wood collier (Kiernan, 1989). A single worked flint was also found in these fields by the author. A lease of 1602 relates to timber resources and its conversion to fuel. In the arable field to the south of the wood adjoining Sims Wood large quantities of pottery spoil has been found. The pottery was typical local Brampton ware and was often dumped as fill for pits or excavations. It is possible that bell pits may have extended into this field, continuing the features found in the south east of Ducksick.

The information in Table 6 below is of necessity selective and a composite of local information and examples from the wider region. (Rotherham, 2007:103)

The dynamics of woodland development can be seen from the time-line. Today's picture is one of continuous woodland, whereas in fact internal compartments existed in 1630 (Senior) and were extended in the nineteenth century. Modern maps show that the compartments have reverted to woodland and are now planted with conifers. There is very little evidence of former woodland management. Some banks and ditches are visible and several multi-stemmed oaks have been recorded in the southeast of the wood. Large diameter stumps can be seen throughout the wood, evidence of a previous episode of felling. Three reservoirs were constructed in the Linacre Valley between the early nineteenth century and the early twentieth century to provide drinking water for Chesterfield. These undertakings necessitated large quarries, roads and water treatment infrastructure and changed the nature of the valley. Further efforts at water control and conservation, including tree planting increased the amenity value of the valley. De-commissioning of the water facility in 1994 has led to the Linacre Valley being an integral part of the Holme Brook Valley amenity corridor, featuring extensive walks, Ranger management, interpretive boards and visitor facilities.

Ducksick Wood Selective Timeline

Dates	Landscape	Consequences
Iron Age/Roman	Extensive upland woodland clearance.	Reduction in woody species
1200s	Iron working by Cistercians in west of Linacre Valley.	Woods confined to wet areas and steep stream sides.
C12th-early C16th	Bloomery iron working. Charcoal burning, ironstone mining. Enclosure of fields, e.g. Millthorpe pingle and creation of field boundary ditches.	Coppice management established
Late C16th-C18th	Continued exploitation of woodland resource for fuel. Whitecoal and charcoal for local lead smelting mills and edge tool wheels. Tracks established to service woodland industry and mills.. Drainage increased. Fields cleared within wood.	Use of turf to cover charcoal and whitecoal pits. Loss of woodland flora to woodland edges and wet areas.
Late C18th	Demand for wood fuel reduced, increased use of mineral coal, some charcoal may still have been produced. Break up of estate. Continued attempts at drainage.	Decline of coppice management.
C19th	Enclosure of fields within woodland for agricultural use. Possible extraction of stone for walls. Decline of coppice management. Introduction of Larch possibly to meet the demand for pit props. Beech introduced beside trackways.	
1825	Formation of Chesterfield Waterworks and Gas Light Co and construction of small dam to supply Chesterfield.	
1855-1904	Construction of lower Linacre Dams and associated water works. Extensive quarrying for construction. Possible planting of beeches on boundaries.	
Early-mid 1900s	Final Linacre dam constructed. Possible wide scale felling for 1914-18 war effort.	No veteran trees.
Mid 1950s	Conifer plantation on former enclosed land within the wood.	
1963	Creation of north Derbyshire Water Board.	
1973	Severn Trent Water takeover operations.	
1994	Reservoirs decommissioned,	
1999	Holme Brook Valley amenity corridor created. Interpretation boards, ranger appointed, toilet facilities and picnic tables for increased numbers of visitors.	Path erosion, conservation and health and safety issues from higher visitor numbers. Increased management input. Removal of alien species. Introduce limited coppicing and planting of hazel.

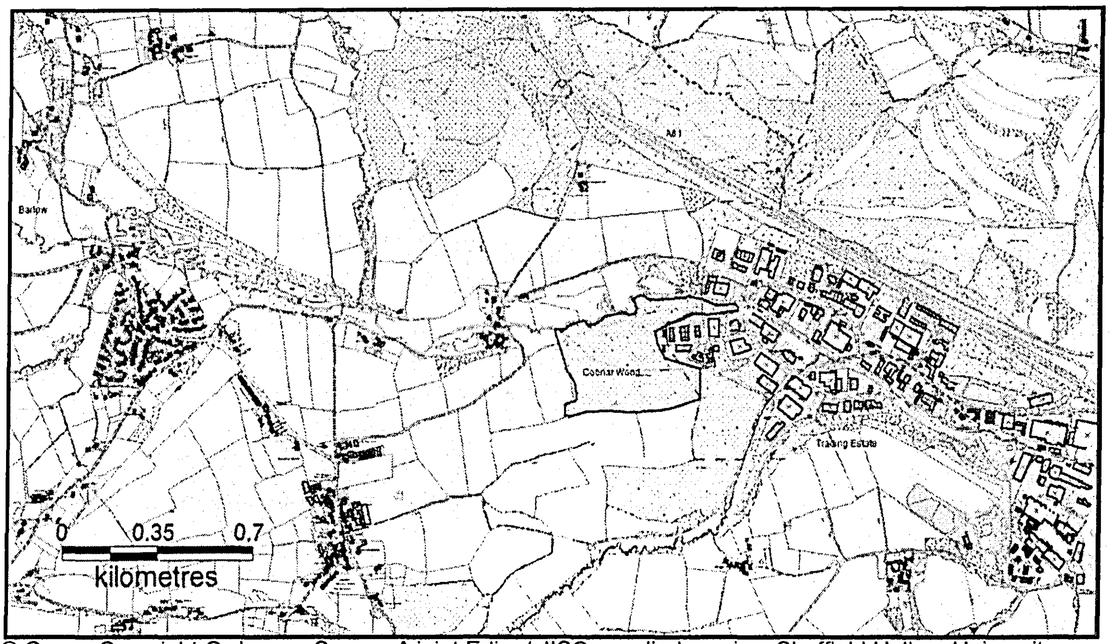
Table 6. Ducksick Wood: selective time-line

3.3 COBNAR WOOD

3.3.1 Environmental survey

Location

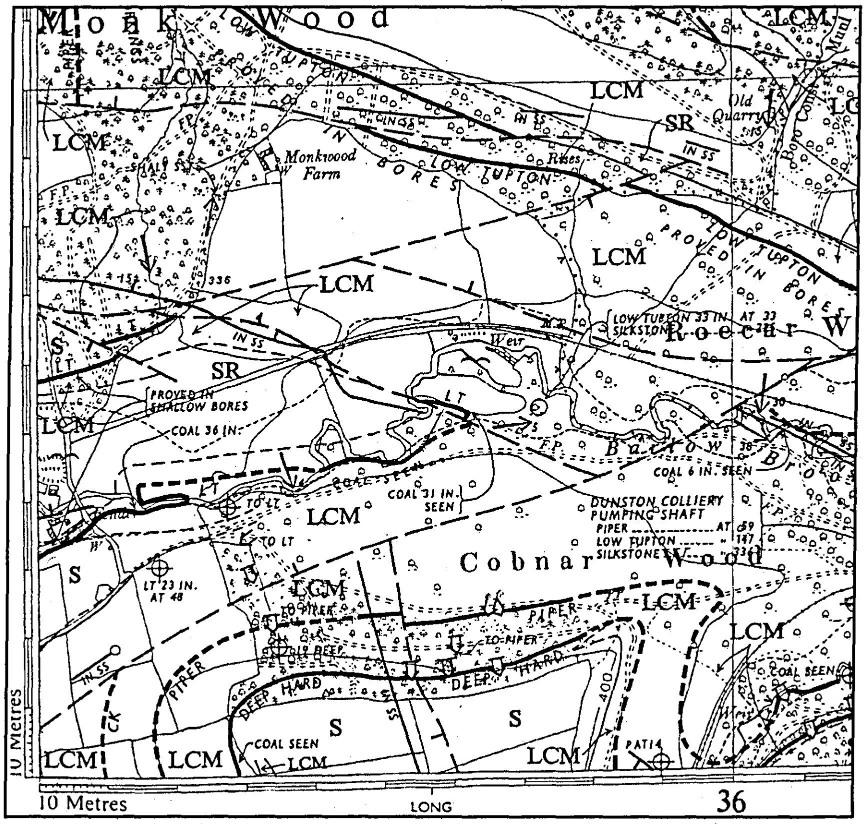
Cobnar Wood is located 4.5 kilometres north west of Chesterfield, Ordnance Survey grid reference SK 4355 3753, shown on Map 6 below.



Map 7. Cobnar Wood: location.

Chesterfield's largest industrial and trading estate forms the eastern and south-eastern boundary of the wood. It is approximately two kilometres east of Barlow and two-and-a-half kilometres north-west of Dunston. These are the nearest settlements and as a consequence the wood appears to have fewer vandalism problems than many urban woodlands elsewhere. The wood is owned by Chesterfield Borough Council and has public access with several footpaths and a main track way giving access from the trading estate east west through the northern part of the wood to Furnace Lane, Barlow.

It is situated on the outcrop of the lower Coal Measures, generally around 100-200 metres OD an undulating landscape of mudstone and sandstone. Coal seams outcrop in the area and numerous thin bands of ironstone, known locally as the Blackshale Rake occur between the coal seams (Smith and Eden, 1967). The nature of the coal outcrop can be seen in Map 8 below.



Map 8. Cobnar Wood: surface geology (OS 1958), scale 1: 10560

Three coal seams have been worked in Cobnar Wood; south to north they are the Low Tupton, Piper and Deep Hard. The Low Tupton coal was worked from a shallow shaft in the extreme north-west corner of the wood beside the Barlow Brook and also by adit in the west. The Piper coal was worked by shafts in the south west and south east of the wood and by adits on the lower part of the scarp.

The Deep Hard coal was worked by a number of adits also on the rising ground to the south. These workings, particularly into the Piper seam, have left a large linear spoil heap along the western boundary, which is composed of dark clay shale with coal fragments. It is mostly bare but birch, sycamore and some small oak are well established. The rising ground is marked by collapsed shallow workings into the Deep Hard coal, which is only a few metres below the surface at this point. The remains of ironstone workings can be seen in the form of bellpits and shallow open trenches and a sample of a septarian ironstone nodule has been collected (L. Willies pers. comm.). The area around these exposed workings was planted with beech around the end of the nineteenth century (CRDC, 1966). It is relatively sparse with holly occupying the dense canopy and planted larch and Scots pine on the fringes. The northern boundary is the Barlow Brook; its course was altered in the early twentieth century to create a reservoir for industrial use. The spoil from the new watercourse is piled between the east west track and the new river course. The spoil heaps have been colonised by sycamore, birch, hazel, holly and oak, with a herb layer including bluebell, ivy and bramble. Further north-east along the riverbank beyond the spoil the original ground surface contains multi-stemmed oak, alder, holly and hazel and the ground flora contains Ramsons, bluebell and bramble, see Photograph 6 overleaf.

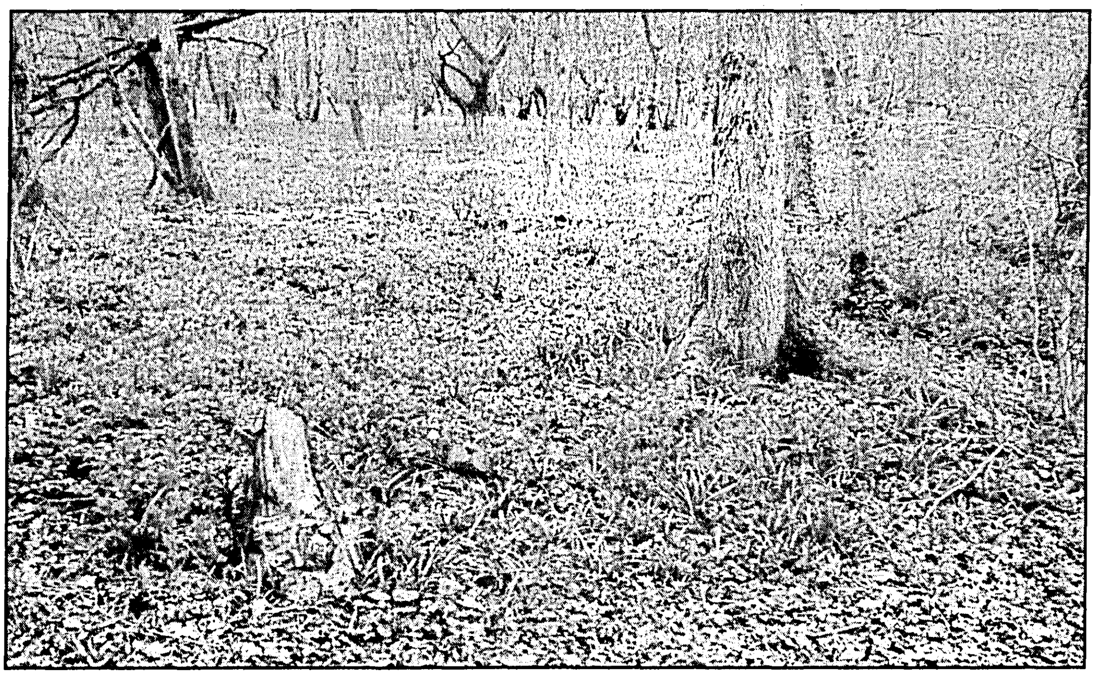
Photograph 6. Cobnar Wood: north-east

The eastern edge of the wood is predominantly immature birch plantation with oak, occasional holly and bluebell, bracken and bramble beneath and was probably cleared for possible expansion of the industrial estate. The south east section of the wood is wetter and often waterlogged, there is alder, goat willow, crack willow and oak. The ground flora includes dog's mercury, bluebell, yellow archangel and broad-leaved helleborine. Table 7 below summarises the ground flora noted in the survey and some species not noted but given in Thornhill (2006). A full botanical survey has not been attempted; the distribution is varied and has been truncated in areas due to industrial activity. Dog's Mercury is not widespread but again has been noted thriving on iron slag with wood anemone, pH 5.6, this was also noted in Ducksick Wood. The soil test results are shown below at Table 7, the full results can be seen at Appendix 1.

Wood	Test	pH	Description
Cobnar	1	4.7	River terrace
	2	4.4	Nr Q-pit
	3	5.6	Slag heap
	4	4.5	Central birch plant
	5	4.1	Rising ground under beech
Median		**4.5**	

Table 7. Cobnar Wood: summary of soil sample tests

Photograph 7 below shows a flush of Dog's mercury growing on slag, this in contrast to the Ducksick Wood examples is a dry area.



Photograph 7. Cobnar Wood: *Mercurialis perennis* and *Anemone nemorosa* growing on iron bloomery slag

Common name		Common name	
Bluebell	*Hyacinthoides non-scripta*	Ivy	*Hedera helix*
Bramble	*Rubus fruticosus*	Nettle	*Urtica dioica*
Bracken	*Pteridium aquilinum*	Ramsons	*Allium ursinum*
Dog's Mercury	*Mercurialis perennis*	Red Campion*	*Silene dioica*
Foxglove	*Digitalis purpurea*		
Greater Stitchwort*	*Stellaria holostea*	Greater Wood-rush	*Luzula sylvatica*
Ground Ivy*	*Glechoma hederacea*	Wood Anemone	*Anemone nemorosa*
Hogweed*	*Heracleum sphondylium*	Wood Millett	*Milium effusum*
Herb-Robert	*Geranium robertianum*	Wood-sorrell	*Oxalis acetosella*
Honeysuckle	*Lonicera periclymenum*	Yellow Archangel	*Lamiastrum galeobdolon*

Table 8 Cobnar Wood: Summary of ground species

*Noted in Thornhill (2006) but not seen in this survey.

There is an impressive range of both tree and ground flora species, it is known from documentation that Cobnar is an ancient wood and such a suite of plants is to be expected.

Common name		A	C	F	O	R
Alder	*Alnus glutinosa*			X		
Ash	*Fraxinus excelsior*				X	
Beech	*Fagus sylvatica*		X			
Birch	*Betula pendula. B. pubescens*	X				
Crab apple	*Malus sylvestris*					X
Elder	*Sambucus nigra*				X	
Wych elm	*Ulmnus glabra*					X
Hawthorn	*Crataegus monogyna*		X			
Hazel	*Corylus avellana*		X			
Holly	*Ilex aquifolium*	X				
Larch	*Larix decidua*			X		
Oak	*Quercus petraea/robur*		X			
Rowan	*Sorbus aucuparia*				X	
Sycamore	*Acer pseudoplatanus*		X			
Scots pine	*Pinus sylvestris*				X	
Goat willow	*Salix caprea*			X		
Crack willow	*Salix fragilis*			X		
Guelder rose	*Viburnum opulus*					X
Field maple	*Acer campestre*					
Yew*	*Taxus baccata*					

Table 9 Cobnar Wood: Tree species

•Noted in Thornhill (2006), but not seen in this survey.

3.3.2 Archaeological Survey

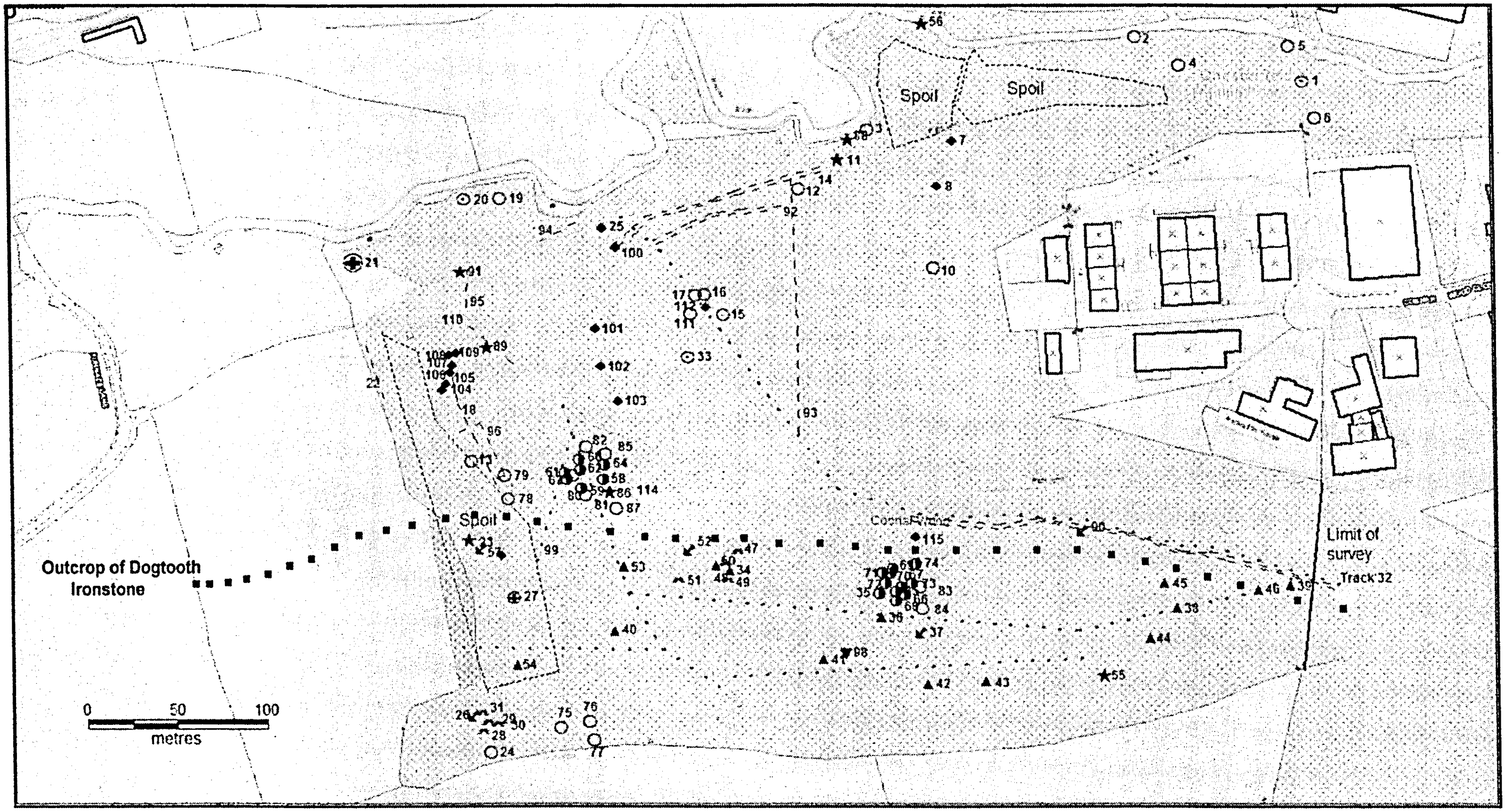
Cobnar Wood although well represented in early documents is not thought to be of any particular archaeological or historical significance, aside from later industry, possibly part of a hunting forest and a boundary stone wall (Thornhill, 2006). This is often thought to be the case in Coal Measures urban woodlands, however as the survey below shows there are in fact a number of archaeological features which contribute to our understanding of industrial land use and exploitation.

Quantity	Feature
3	Q-pit
14	Charcoal platform
1	Platform
27	Pit
18	Bell-pit
2	Coal pit
5	Adit
8	Collapsed workings
16	Spoil heap
8	Other features
13	Linear features

Table 10. Cobnar Wood: archaeological features

It can be seen from the table above that most of the archaeological features are industrial and represent the period from the late medieval until the mid-twentieth century.

This is an important period, it encompassed the move towards large scale industrialisation, the development of coal and iron production exploiting local resources and its eventual demise in the twentieth century.



Key: ⊙ Q-pit, ▲ Charcoal platform, ○ Pit, ◑ Bell-pit, ◇Small heaps, ⊕ Coal mine, ↙ adit, ◓ Collapsed workings,

...... Spoil heap, ★ Other features, . . . Track, - - - Ditch/ Holloway, ■ ■ ■ ■ Outcrop of Dogtooth Ironstone.

Map 9. Cobnar Wood: archaeological features

Linear features.

Some of the linear features may well be of an earlier period, with 14, 92 and 97 probably holloways, deeply incised tracks which have been truncated by later developments. Feature 14, shown in Photograph 8 below is 2m deep and 5m wide and heads west possibly towards Barlow. If so it would have passed through the enclosed field beyond the boundary to the west. This field is shown on Senior's map of 1630, the holloway therefore probably pre-dates the enclosure.

The track, No. 97, appears on the First Edition OS map (1883) and gives access to Cobnar Barn a structure on the south side of the enclosed field called Cobnar Top.

Photograph 8. Cobnar Wood: holloway, Feature **14** looking west

Track No. **32,** appears for the first time on the Second Edition OS map of 1899 and can be associated with the coal mining activities below the rising ground in the south of Cobnar Wood.

A network of ditches can be seen, Nos. **9**, **18**, **22**, **93**, **94**, **95**, **96** and **110**, some of which appear to be associated with trackways and are probably attempts to drain them and nearby mine workings. Others may be the remains of woodland compartments, No **93** shown in Photograph 8 below is probably a woodland compartment or enclosure boundary ditch and bank. It runs north to south from close to the river towards the tracks in the centre of the wood. Cobnar is a large wood, just over 108 acres according to Senior (1630); the Barlow woodlands contained between 800 and 900 acres in 1786 and were cut about every twenty-seven years (Hanson, 2006). A compartment was likely to be about thirty acres; Cobnar therefore could have been divided into four compartments of approximately twenty-seven acres. Whether by chance or design, Senior also shows Cobnar Coppice at twenty-eight acres, How Clough Wood twenty-six acres and Nether Row Carr and Row Carr between them fifty-two acres. (Senior does not show the latter two as wooded). After a compartment was felled it was enclosed to prevent damage to the trees by animals browsing or trampling the new shoots.

Photograph 9. Cobnar Wood: woodland boundary

It is noticeable in photograph 9 above that the banks of the ditch are rounded suggesting an earthwork of some antiquity.

Q-pits

Three features have been identified as Q-pits, Nos. **1**, **20** and **33,** however as there are many pits and shallow excavations within the wood, misinterpretation is a possibility. It would be surprising if there were not more Q-pits, based on evidence elsewhere, but much of the wood has been altered and any remains may be obscured or destroyed. Figure 6 below shows a typical Q-pit, in this case with the opening to the north and facing the river, no structural remains were noted. They were typical of Q-pits recorded elsewhere, a steep-sided pit about 0.75-1 metres deep surrounded by a concentric ring of spoil with a break or entrance on one side. The examples in Cobnar Wood are not sited on particularly sloping ground, two

Nos. **1** and **20** are close to the river, the other No. **33** is towards the centre of the wood.

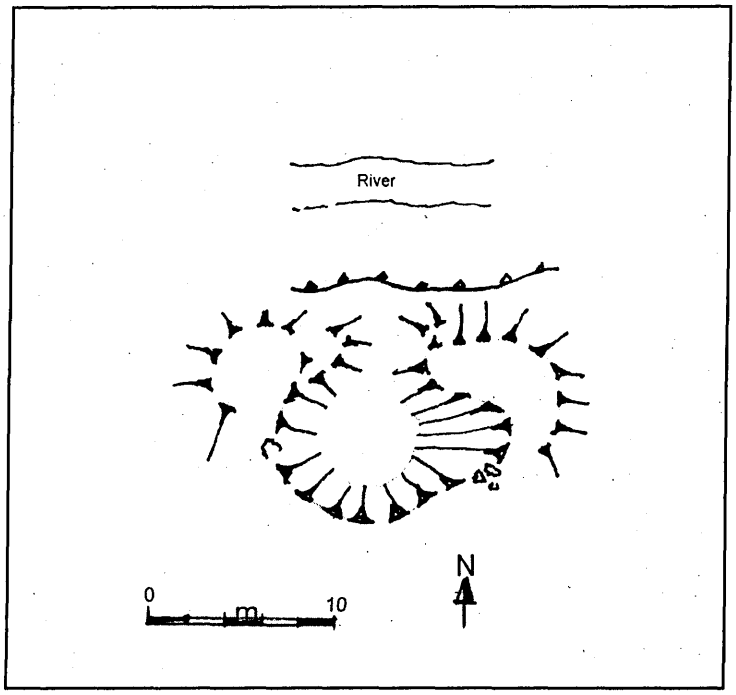
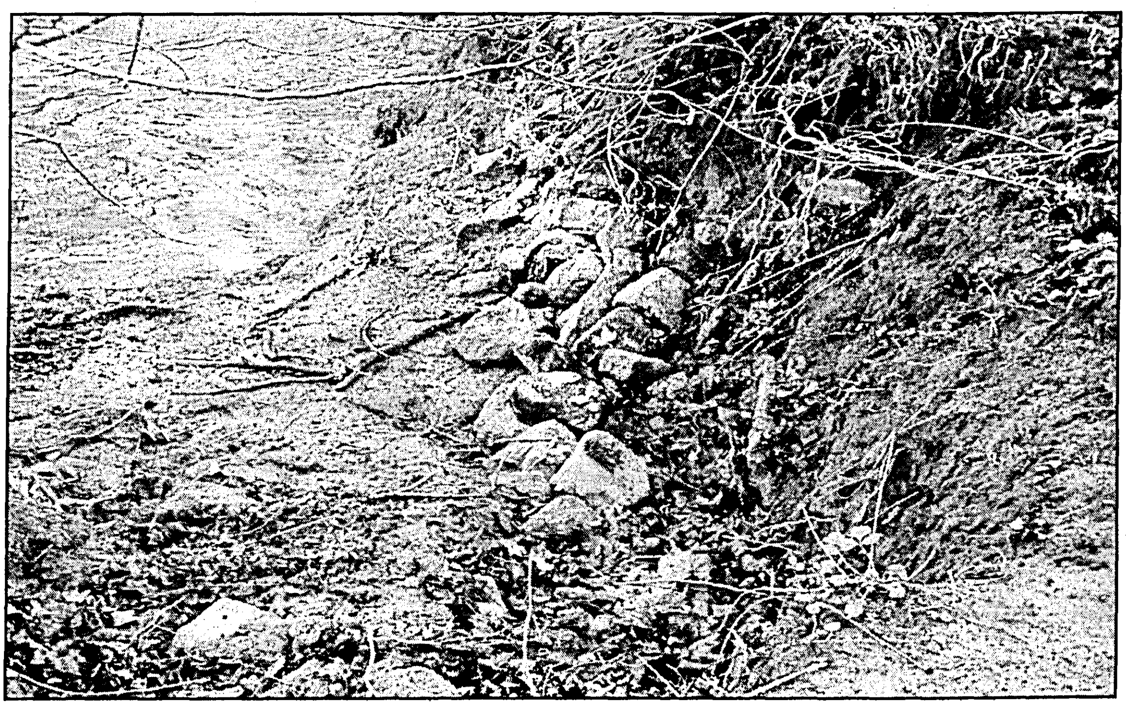


Figure 6. Cobnar Wood: Q-pit feature **1**.

An ore hearth smelter operated at Lea Bridge, Barlow, upstream from Cobnar between 1582 and 1652. Others were also in operation at Barlow Grange and Holmesfield until 1756. Documents in the Portland Archives record whitecoal production in the Barlow Woodlands between 1586 (157 DD/42/P/42/10) and curiously 1762 (157 DD/P/42/70) after local ore hearth smelting had ended (Kiernan, 1989) and they had been replaced locally by the reverberatory or cupola furnace using mineral coal (Willies, 1971).

Slag deposits

One of the most intriguing finds in this survey is feature No. **56**, which is shown below in Photograph 10. Floods washed away part of the river bank and revealed a row of stones. The feature has a course of gritstone masonry two metres long emerging from the river bank and ending at the re- aligned river's edge, a small deposit of lead slag has been noted beside the masonry at the water's edge. A number of the stones have a creamy deposit typical of slag seen on lead smelting sites elsewhere. A problem in interpreting this site is its position on the edge of the re-aligned river, part of the feature was probably lost when the new cut was made. It is unlikely that the stones were re-used from elsewhere with lead slag intact it is likely that the masonry is *in situ*.



Photograph 10. Cobnar Wood: lead slag and masonry Feature **56**

Figure 7, below shows the position of the feature beside the Barlow Brook.

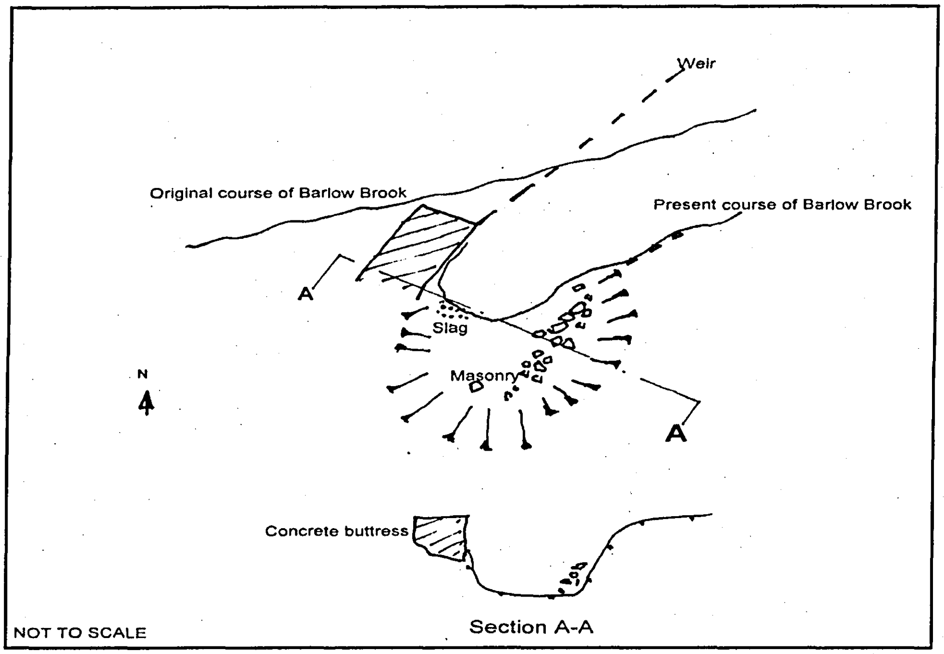
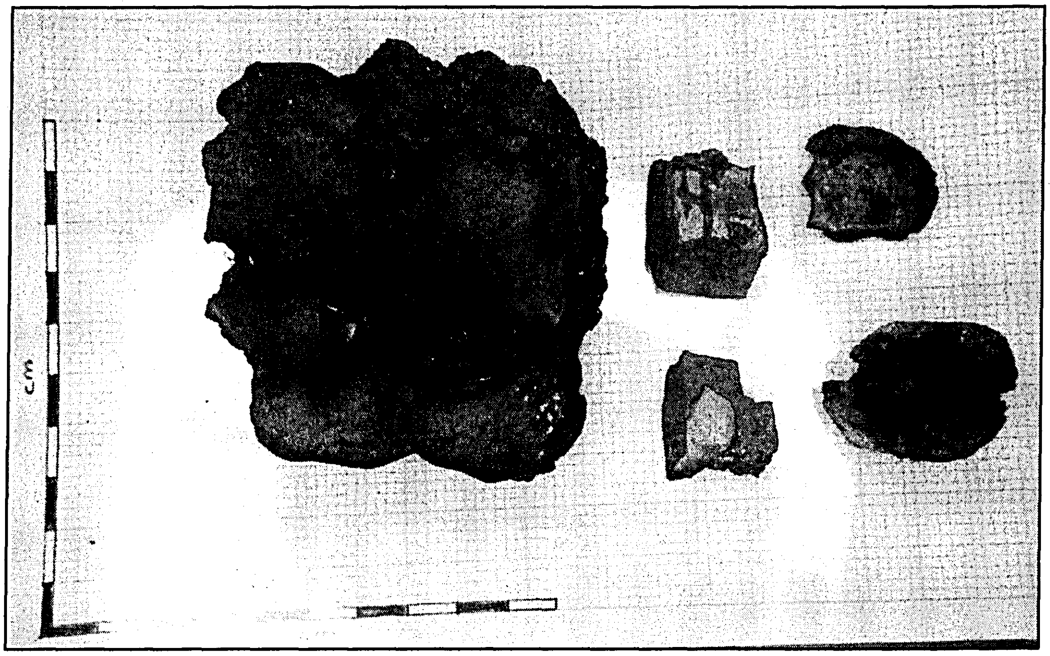


Figure 7: Cobnar Wood: lead slag feature **56**

The masonry is approximately two metres below the present ground level which obscures the southern part of the wall; future excavation may reveal further structural remains and possible hydraulic infrastructure. Senior does not show a building on the 1630 estate map and there is no documentary evidence for a lead smelting mill in Cobnar Wood, however the following quotation from Milward (1992:37). "Later, when the Earl had lordship of Barlow (1589-1613) he [Arthur Mower] paid Arthur Barker, the bailiff, on the way from the lead mill at Cobnar Spring."

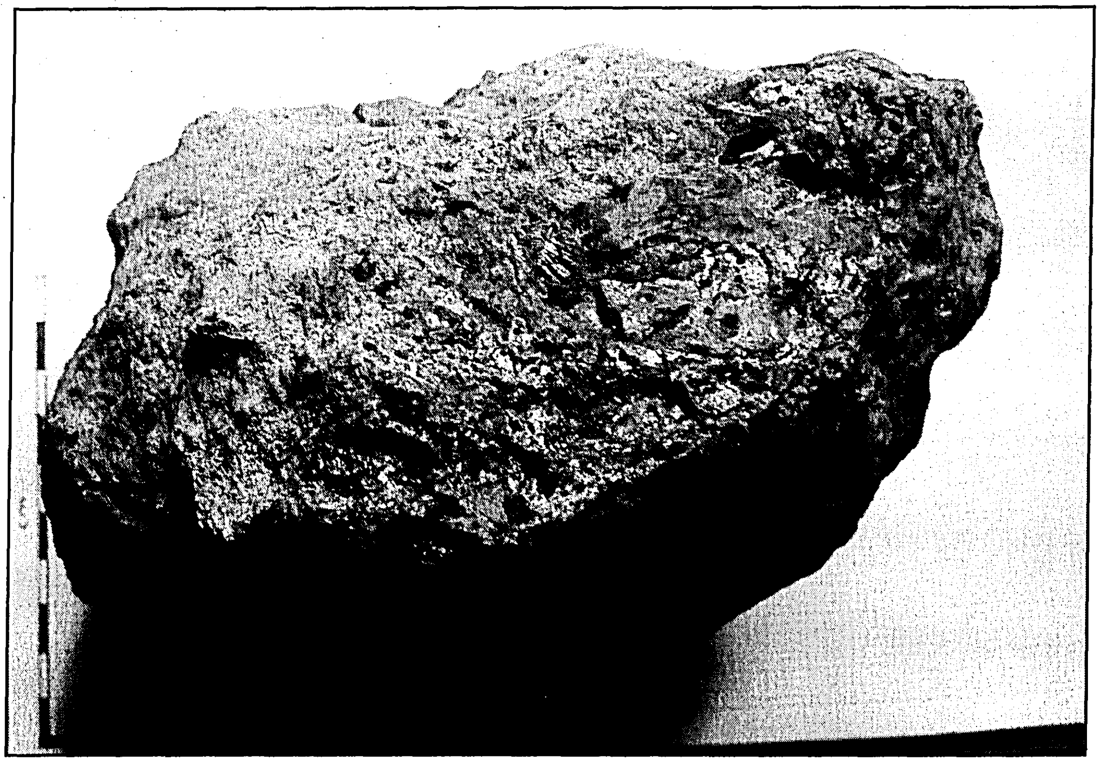
Sadly the quotation is ambiguous and whilst does not really advance our knowledge, it offers a tantalising possibility of an unknown lead working site.

Two other features Nos. **11** and **88**, relate to metal working in the wood, No. **11** is a large deposit of iron slag beside the main east-west path towards the west of the wood. Both deposits contain typical bloomery tapping slag (Tylecote,1962).



Photograph 11. Cobnar Wood: bloomery slag left, ironstone fragments and charcoal fragment bottom right. Two charcoal samples found in the slag deposit were from holly *Ilex aquifolium* and alder *Alnus glutinosa.* See Appendix 6.

The bloomery, or direct process converted iron ore into wrought iron using charcoal and a foot operated blast. It was small scale often sited beside streams although water was not used as a power source (Tylecote, 1992). It was replaced by the water powered charcoal blast furnace in Derbyshire in the early seventeenth century. In addition to the slag, fragments of ironstone, which were the result of hammering to remove the outer mudstone, and also an area of compacted earth was revealed beneath the slags and which may be a working surface. Charcoal, burnt clay and a possible furnace base have also been found. The latter is a hard clay mass containing fragments of charcoal, iron and iron ore, which was found beside feature 88 and is shown below in Photograph 12.



Photograph 12. Cobnar Wood: furnace base

Iron working was an important part of the local economy, and was first documented in the twelfth century when Cistercian monks were granted access to woods and the right to operate forges at Barlow Grange. The Portland Archives contain numerous references to ironstone getting and charcoal production in the Barlow area. No records of bloomeries operating in the area have been found. However a charcoal blast furnace and associated forges were in operation just along the Barlow Brook between 1605-6 and the early eighteenth century (Riden, 1993).

Charcoal platform

Fourteen charcoal platforms were noted: Feature Nos. **34**, **36**, **38-46**, **50**, **53** and **54**. They are located on the rising ground to the south and sited along the contour and linked by trackways. Charcoal was found at each location, a platform feature **98**, however whilst similar in form charcoal was not found, it may have had another purpose, such as a loading area or the base for a shelter. Considerable quantities of charcoal were required for iron smelting at both bloomery and blast furnace for re-working lead slags and domestic use. Many documents in the Portland Archives contain references to charcoal making around Barlow between 1564 (157DD/P/42/48) and 1762 (157DD/P/42/70); it still featured in the Welbeck household accounts in 1819, although not obtained from the Barlow woods which became part of the Rutland Estate in 1813. Analysis of a charcoal sample taken from a charcoal platform was shown to be oak and from a small branch of 8/9 years growth. See Appendix 6.

Bell-pits and other pits

Eighteen pits were recorded as bell-pits. These features are also quite difficult to interpret; they may be shallow shaft workings or trial pits for either coal or iron. However seven bell-pits, **58-64** straddle the Dogtooth Ironstone outcrop see Map 7 above, the line of outcrop has been added from a mineral lease (SHE77, 1862). The other seven pits noted at this point, **80-87** and **114**, may also be bell-pits, but are shallower with a slight ring of spoil and may be shaft mounds. A nodule of ironstone was collected at **55**; ironstone was probably worked all along the outcrop on the rising ground. Another cluster of bell-pits can be seen further east, **35**, and **65-74** and **83** and **84,** which may be shallow shaft mounds. The Dogtooth was one of several argillaceous or clay ironstones within the Lower Coal Measures, found between the Tupton and Piper coals (Smith and Eden, 1967). It was worked extensively in the 19th century by opencast which leaves 'discontinuous banks along hillsides above the outcrop', by bellpitting and by other underground methods (Willies, 1997:3; Farey, 1813). Collapsed workings were noted, Nos. **28-31**and **47-51** which take the form of irregularly shaped trenches 1m wide several metres long and up to 2m deep or sometimes circular holes 2m wide and 1-2m deep. These are high on the rising ground and are probably shallow workings in the Deep Hard Seam. Worked by The Cobnar Wood Colliery Company until 1947 when it was abandoned as uneconomic (Coal Authority, EM 797, 1947). Plans also show that the seam had been worked by the Sheepbridge Iron and Coal Company. Twenty-seven other pits of varying type were noted ranging from probable shallow ironstone workings to modern excavations.

Coal Workings

A large elongated spoil heap at the west end of the wood running up slope north-south, leads to an air-shaft lined with curved bricks 3 feet (91cm) diameter Feature No **27,** and a mine entrance, feature No **57**. This was the adit from which the Cobnar Wood Colliery worked the Piper Seam until 1944 and reopened briefly in May 1947 to work the Deep Hard Seam and closed in October 1948. (EM796; 13805) Feature No. **23,** nine threaded rods set in concrete may have been the foundation for a hauling engine. Other adits were noted features, Nos. **26**, **33**, **52** and **90**, working both the Deep Hard and Piper Seams. Feature No. **21** was the abandoned coal mine shown on Map 7, in the previous section, which worked the Low Tupton coal.

The archaeological findings confirm an industrial landscape, created over at least five centuries. It shows vividly the progression of Derbyshire through its phases of industrialisation. From small scale possibly medieval iron bloomery working to the large scale coal and iron workings of the late nineteenth and early twentieth centuries and its decline and replacement by light industry in modern units. This transformation is echoed in the woodland itself. Where there is large area of mining spoil with only a sparse covering of immature sycamore and birch and very little ground cover. Around the wood a margin of traditional oak/hazel relict coppice and ancient woodland ground species survive. On the rising ground an even aged mature beech plantation probably to mask the effects of earlier mining.

3.3.3 Historical survey

Gelling (2000:176 and 272), suggests Cobnar Wood refers to 'Cobba's promontory-tip', since it is on the edge of a small rounded hill-spur, or less specifically 'Cobba's bank or slope'. The earliest reference is in 1324, *a wood called Cobbenouere, Cobnour* in 1556, *Cobnor Spring* in 1586 and *Cobnor Spryng* in 1587 (Cameron, 1993:206). This clearly suggests that by this time the wood was under management as spring is a dialect synonym of coppice or compartment and alludes to a management system (Rackham, 2006:168). Hey suggests that a more accurate interpretation could be "a flat topped knoll like an upturned boat" (2006:74). Cobnar Wood is part of Great Barlow and before 1066 was in the fee of Staveley (ibid). In the twelfth and thirteenth centuries the Cistercians of Louth Abbey were granted rights to operate forges and obtain wood for fuel (Pegge, 1770). Bloomery slags in the wood also point to possible medieval iron working. The wood may well have been part of a deer park, suggested by field names such as Park Meadow and Launde. It was in existence in the mid sixteenth century but may possibly only have been short lived (Wiltshire and Woore, 2009). The late sixteenth century was a period of expansion in lead and iron processing; woodlands became vital assets and were intensively exploited. It is likely that ironstone was obtained locally for smelting either at the bloomery or the charcoal blast furnace, which was in operation in the opening years of the seventeenth century. There are numerous references to making charcoal, getting ironstone and coal in the Portland Estate Papers, from 1564 (157DD/P/42/48). Coal mining grew from the seventeenth century there were three mines in Barlow and one in Dunston. The area continued to be well wooded, with Barlow in Staveley being twenty per cent and Dunston twenty five per cent wooded, according to the Scarsdale Surveys of 1652-62, if the surveys are reliable (Beckett and Pollack, 1993). In the eighteenth century the demand for timber changed. Ore hearth lead smelting declined and with it the requirement for whitecoal; whilst charcoal continued in use as a fuel for iron smelting until superseded by coke in the late eighteenth century. The growth of coal mining led to an increase in demand for props or puncheons and new faster growing tree species such as larch were introduced at the expense of traditional species such as oak.

In 1786, Barlow possessed between 800 and 900 acres of woodland worth £600 per annum, about 30 acres per year were cut and yielded about £20 per acre and were ready for cutting again in 27 years (Hanson, 2006). In 1813, the Duke of Rutland obtained the Barlow Estate in exchange for lands at Whitwell. A new phase of development began with increased industrial activity throughout the valley. In 1858 the Dunston and Barlow Mineral Company was founded to take over existing mines at Dunston and elsewhere with leases from the Dukes of Devonshire and

Rutland and others. Railways were built and the company was reformed as the Sheepbridge Coal and Iron Co Ltd in 1864. They acquired twenty-eight small ironstone mines and three coal mines but the iron was rapidly exhausted and the mines were closed down in the late 1860s. (Jenkins, 1995)

A water main was laid along the southern part of the wood extending east west which is now the route of the path. The demand for process water led first to the creation of a reservoir then later the river was diverted to create a further larger reservoir on what had previously been the southern boundary of the wood.

Coal continued to be mined in a small way. In 1908 the Sheepbridge Coal and Iron Company employed nine below ground and one surface worker. The Cobnar Piper Colliery was working in 1923 with just four underground workers; in 1938 the Cobnar Wood Colliery Co Ltd employed twenty-seven miners and five surface workers. Underground work finished in 1948 when the coal was exhausted (Colliery Guardian 1942, Coal Mining History Records and Coal Authority 1308, EM596/7). The Deep Hard and Piper Seams were opencast mined in the southeast part of the wood in 1955 and the end of the exploitation of the mineral resources in Cobnar Wood. The site was purchased by Chesterfield Borough Council from the Staveley Iron and Chemical Company in 1965. Construction of the Chesterfield Trading Estate in the 1970s encroached on the east and south east part of the wood. Since its purchase it has been managed as amenity woodland and is perceived as a valuable component in the local landscape. (Thornhill, 2006)

Cobnar Wood Timeline.

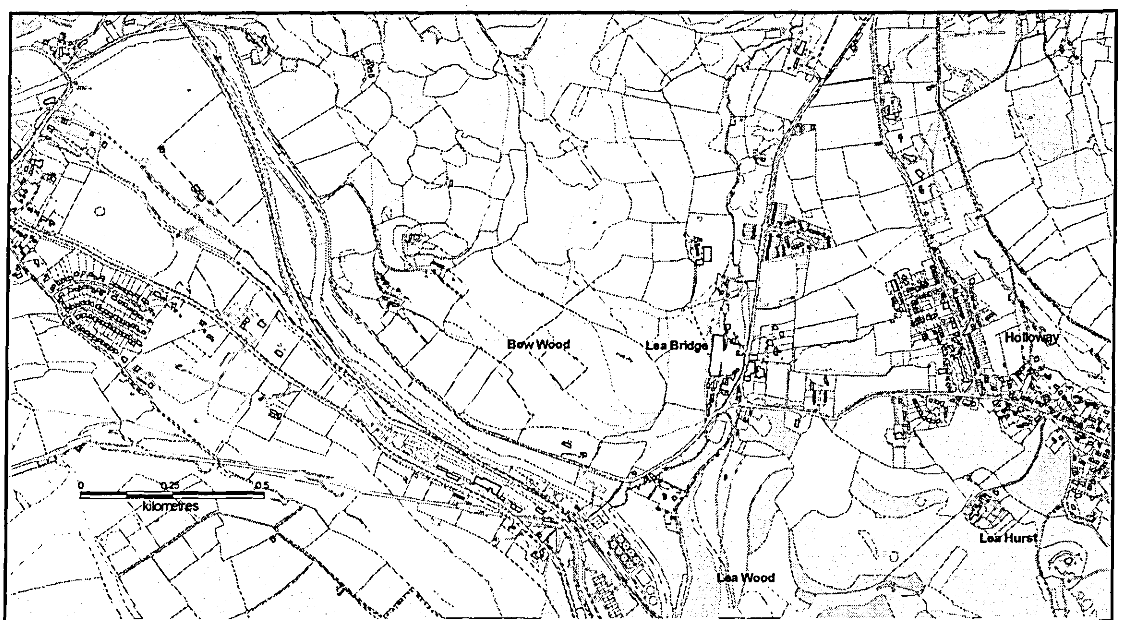
Date	Landscape/activity	Result
Iron Age/ Roman	Extensive upland woodland clearance	Reduction in woody species
1200s	Iron working by Cistercians at Barlow Grange,	Woods confined to wet areas and steep stream sides.
C12th-early C16th	Ironstone mining, bloomery smelting, charcoal making and enclosure of fields	Coppice management
Late C16th-early C18th	Orehearth lead smelting Lee Bridge, whitecoal production. Charcoal iron blast furnace Barlow, increased demand for charcoal.	Turf and topsoil used for fuel production, possible partial loss of ground cover species retreat to margins and wet areas
Mid C19th	Sheepbridge Coal and Iron Co. Increase ironstone and coal mining, builds railways, reservoir and factories.	Reduction of woodland and field layer end of charcoal era pit props and bark sales/
Late C19th	End of ironstone mining	Mining spoil planted with beech and conifers introduced
Early C20th	Small scale coal mining	Spoil heaps, birch and sycamore
Mid C20th	Coalmining ceases 1948, opencast mining ends 1955	Regeneration of woodland. Relict coppice grown to canopy.
Late C20th-early C21st	Wood purchased by Chesterfield BC. Part taken for industrial estate. Remainder managed as amenity, with public access	Elements of oak/hazel coppice woodland preserved, no veteran trees.

Table 11. Cobnar Wood selective time-line.

3:4 Bow Wood

Introduction

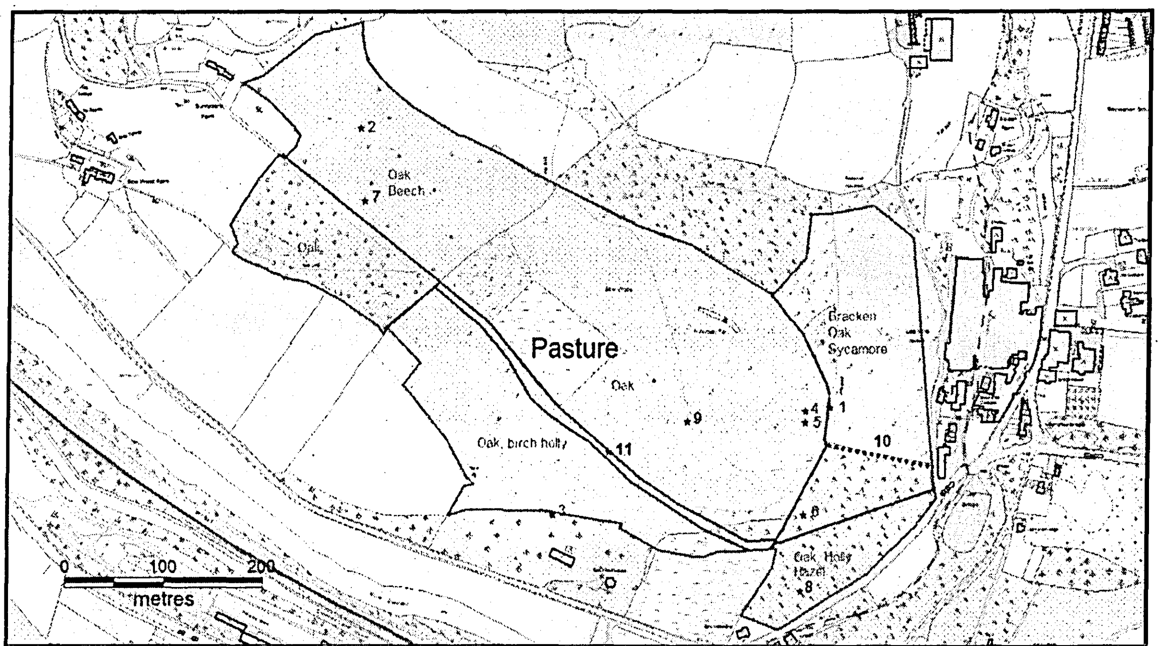
Bow Wood is situated on the south-west slope of the east bank of the River Derwent at OSG SK 315 565. Cromford is 2.5 kilometres north-west, Wirksworth 3.5 kilometres south-east and Matlock is 4 kilometres to the north. It is bordered by the River Derwent to the west and south and the Cromford to Crich road south and east. To the north is farmland.



Map 10. Bow Wood: location

3:4:1 Environmental survey

Bow Wood is ancient semi-natural woodland and retains some characteristics of a coppiced sessile oak wood. The geology is Carboniferous sandstones, with an overlying cap of Ashover Grit on Millstone Grits and shale. An area of landslip to the north and north-west is separated by a thin ridge of Ashover Grit extending northwards from the wood to an elevation of 180 metres. A small area of landslip can be seen in the south of the wood. Exposures of Gritstone have been worked in numerous small surface delves and small quarries. Abandoned quern roughouts have been found in the wood probably taken from the surface or from shallow pits. The soils are thin, sandy and acidic, with a pH 4. The ground flora is variable, reflecting several geological zones, which vary from bare rocky outcrop through to a damp alluvial valley bottom.



Map 11. Bow Wood: Extent of study area, zones and features

Sessile oak is widely distributed in every part of the wood. The ground flora is relatively impoverished, creeping soft grass, bluebells, with bracken and bramble in open areas. There some relict coppice oak stools, extremely gnarled and twisted specimens, which may be of some considerable age. In those areas where beech dominates, the shaded understorey is poor with bluebells, occasional broad buckler fern and creeping soft grass. Down slope where the soils are slightly deeper and adjacent to the bridle path the flora is more diverse, hazel, a single alder, oak and crab apple. To the west of this area there appears to be the remains of an old boundary hedge, with hawthorn, holly and hazel.

Common name		**A**	**C**	**F**	**O**	**R**
Ash	*Fraxinus excelsior*				X	
Alder	*Alnus glutinosa*					X
Beech	*Fagus sylvatica*		X			
Birch	*Betula pendula/ pubescens*	X				
Blackthorn	*Prunus spinosa*					X
Crab apple	*Malus sylvestris*					X
Elder	*Sambucus nigra*				X	
Wych Elm	*Ulmus glabra*				X	
Hawthorn	*Crataegus monogyna*				X	
Hazel	*Corylus avellana*		X			
Holly	*Ilex aquifolium*		X			
Small-leaved Lime	*Tilia cordata*				X	
Field Maple	*Acer campestre*					X
Sessile Oak	*Quercus petraea*	X				
Rowan	*Sorbus aucuparia*				X	
Sycamore	*Acer pseudoplatanus*	X				

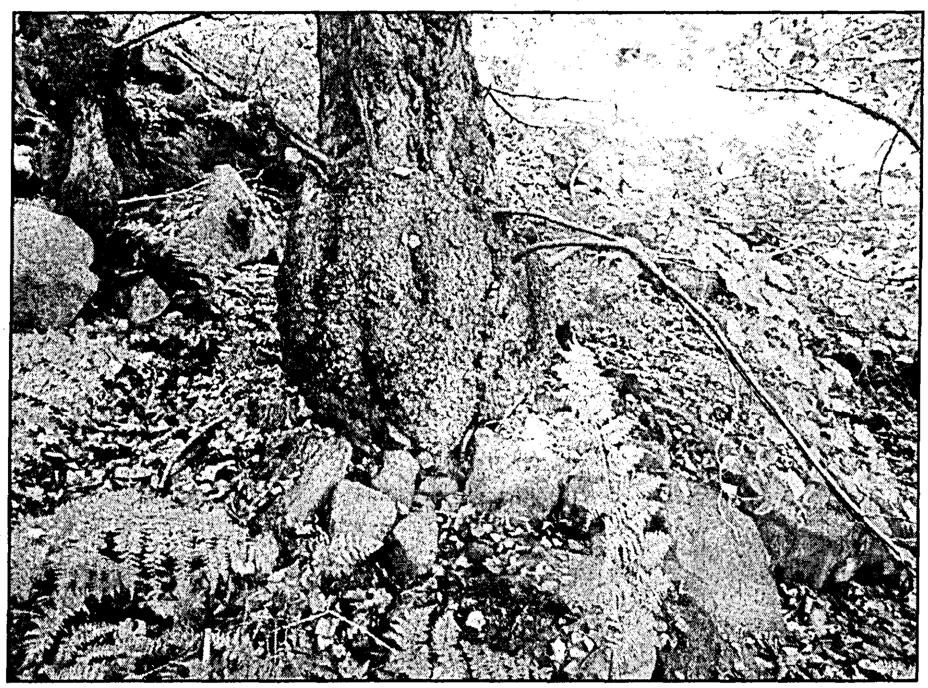
Table 12. Bow Wood: tree species

Fifteen tree species have been recorded. The oak and small-leaved lime are possibly the oldest, probably remnants of former coppice management. There are many multi-stemmed veteran oaks and also some individual stems which may well be part of the same plant.

Photograph 13. Bow Wood: Multi-stemmed sessile oak

Photograph 14. Bow Wood: multi-stemmed small-leaved lime

Similarly the small-leaved lime examples, Photographs 13 and 14 appear to be coppice remnants, often in groups of two but may well be the same plant. One example has a plant 2.5-3m girth with seven stems and 2m away another plant 1.5-2m girth with four stems, it may well be that these are the same plant. Lime grows slowly (Mitchell, 1996), therefore conventional age estimates do not apply and these trees may be very old. A multi-stemmed sycamore **7**, has also been noted with 10/12 stems at 30/40 cm diameter. It is documented that sycamore poles were sold in early nineteenth century and this unusual tree could also be old.



Photograph 15. Bow Wood: Feature **2** small-leaved lime showing stony site.

Several large, low branched beech trees can be seen with up to 3.6m girth possibly 140 years old (ibid.). They can be seen beside the bridleway, in the north-east section of the wood, which may have been more open. Photograph 16 overleaf shows beech planted beside a boundary wall.

Photograph 16. Bow Wood: mature beech beside wall in the east

The wood is free from introduced species often seen elsewhere such as Rhododendron or conifers for example. Similarly a lack of dog's mercury, nettle and rose bay willow herb may be testimony perhaps to a lack of later disturbance.

It can be seen from Table 13 below that the soil pH values are fairly uniform, the two readings 3 and 6 are above the median value, 6 is probably as a result of run-off from the improved pasture, the reason for 3 is perhaps local geological variation.

Wood	Ref	pH	Location
Bow	1	4.5	Downslope
	2	4.6	Upslope nr kiln
	3	4.9	Nr S L lime
	4	4.4	Grassy clearing up slope
	5	4.3	Under beech
	6	5.1	SW enclosure by ash
Median		**4.5**	

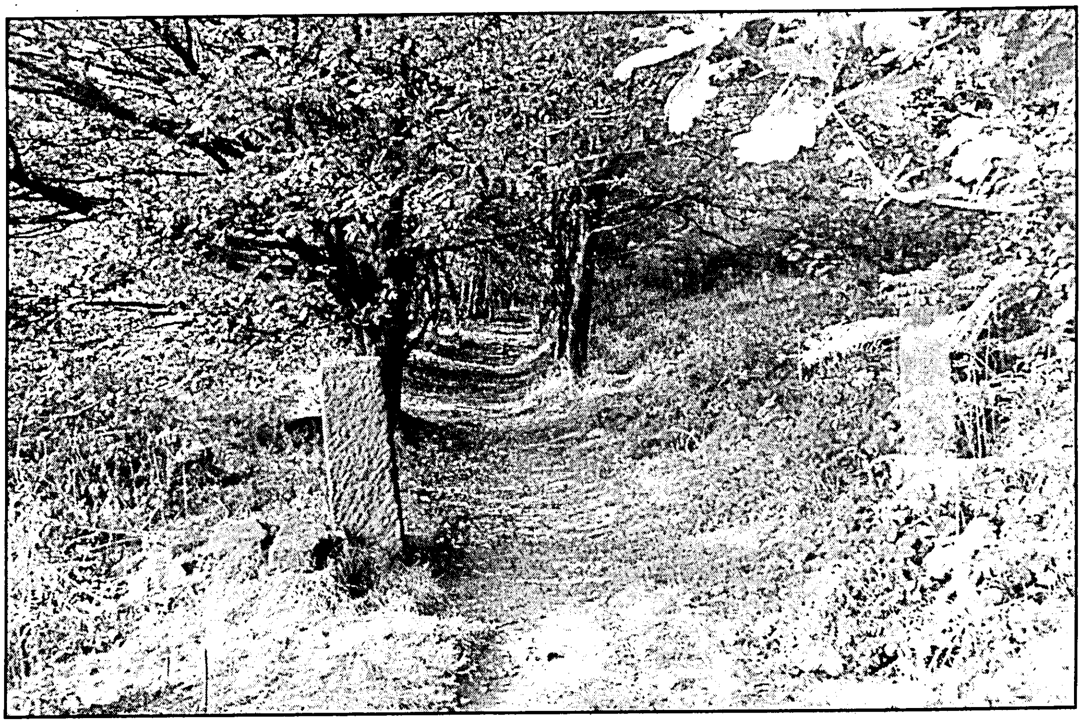
Table 13. Bow Wood: summary of soil sample tests

There appears to have been a fire in the fairly recent past, resulting in some new birch and oak planting in the south-east sector of the wood, presumably by the Woodland Trust.

Photograph 17 overleaf shows the steep southern slope down towards the road. With hazel in the foreground, an alder in the centre and partially obscured a large crab apple. This area although stony is wetter and the soil is slightly deeper as a result of soil movement down-slope.

Photograph 17. Bow Wood: southern slope

An old bridleway, now designated as a footpath, runs through the centre of the wood from east to west which is shown in Photograph 18 overleaf. It forms a narrow ecological corridor, possibly a remnant of the older wood with a diverse suite of flora differing from the surrounding wood: responding to more variable environmental conditions of light shade and moisture and external factors of human and animal movement. A hedge may have existed on the southern down slope edge, as there are hawthorns, hazel, holly and occasional rowan and blackthorn. The ground flora is also diverse including golden-saxifrage, wood rush, foxglove and Herb Robert.



Photograph 18. Bow Wood: bridleway looking west

The species in Table 14, below were noted during the archaeological survey and do not constitute a systematic survey (I am grateful to Richard Carr for his help with identification).

Common name		A	C	F	O	R
Opposite-leaved Golden Saxifrage	*Chrysosplenium oppositifolium*					X
Bluebell	*Hyacinthoides non-scriptus*			X		
Bracken	*Pteridium aquilinum*	X				
Bramble	*Rubus fruticosus*	X				
Broad buckler fern	*Dryopteris dilatata*				X	
Buttercup	*Ranunculus repens*				X	
Creeping soft-grass	*Holcus molis*	X				
Foxglove	*Digitalis purpurea*				X	
Greater Stitchwort	*Stellaria holostea*			X		
Herb-Robert	*Geranium robertianum*				X	
Honeysuckle	*Lonicera periclymenum*			X		
Ivy	*Hedera helix*			X		
Nettle	*Urtica dioica*					X
Wavy hair-grass	*Deschampsia flexuosa*	X				
Wood millett	*Milium effusum*					X
Greater Woodrush	*Luzula sylvatica*					X
Wood-sorrel	*Oxalis acetosella*					X
Yellow Archangel	*Galeobdolan luteum*				X	

Table 14. Bow Wood: ground flora

3:4:2 Bow Wood archaeological survey

Introduction

Bow Wood has been exploited extensively over time for gritstone to make querns and sandstone for building. Its steep slopes are still well wooded and the more accessible areas have been cultivated. Evidence of former coppicing can be seen in relict multi-stemmed sessile oaks, survivors of intensive management for charcoal and whitecoal. It seems to have escaped large-scale gentrification, but shows several phases of planting and felling. An important pre-turnpike route-way passes through the wood linking Holloway in the east and the Derwent crossing at Cromford to the west (Dodd and Dodd, 1980). Subsidiary track ways, enclosures and boundary walls testify to the dynamic of an important woodland resource.

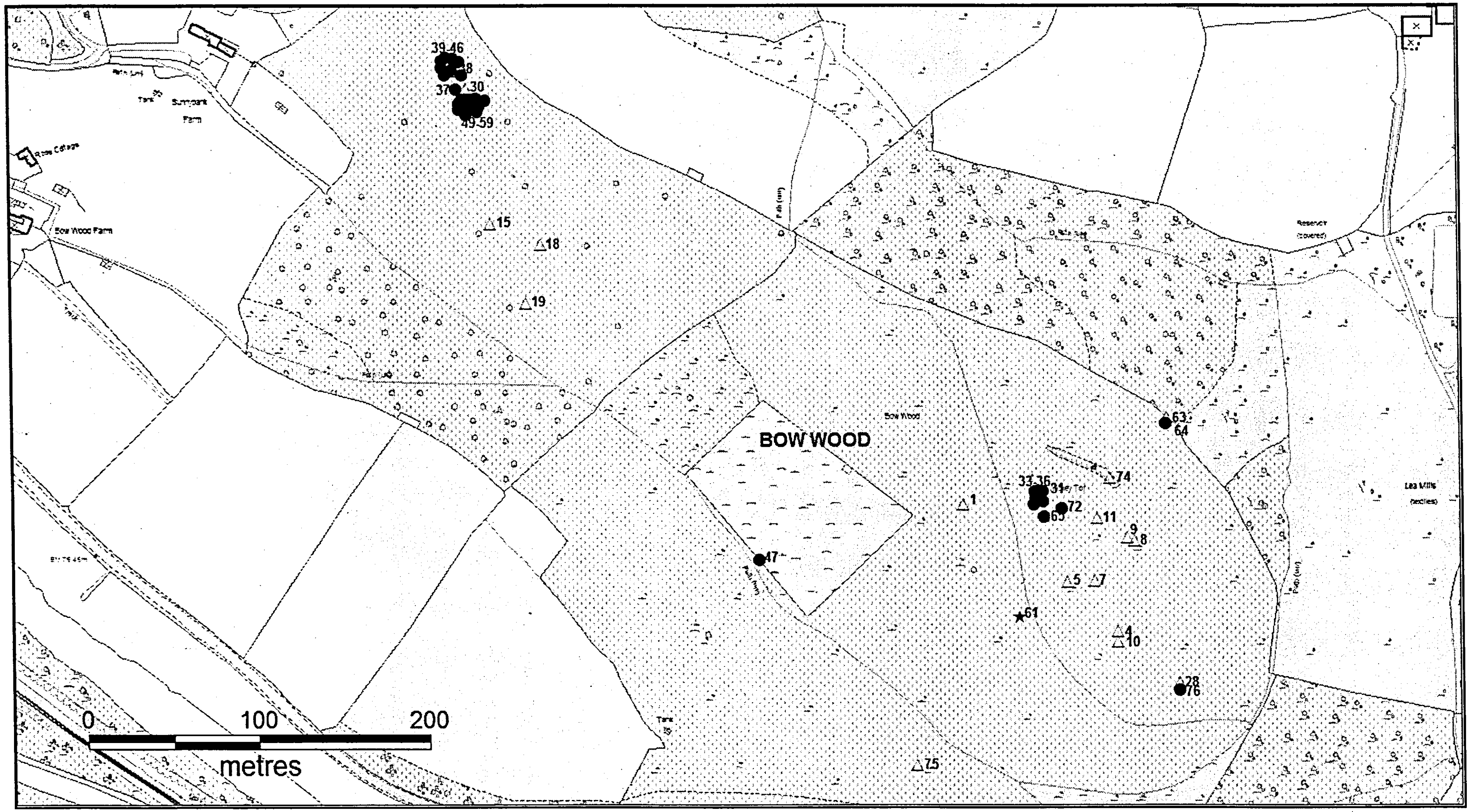
The table below summarises the main archaeological features noted in the survey. Drawings and photographic records are also shown below and a gazetteer of all the features can be found at Appendix 2.

Number	Feature
48	Quarries, stone pits and querns.
6	Whitecoal kilns
13	Charcoal platforms
4	Platforms
3	Tracks
3	Walls
8	Other features

Table15. Bow Wood: summary of archaeological features

The availability of Millstone Grit of suitable quality to make querns and for general constructional purposes has influenced the development of the wood. A web of track ways links the working areas particularly in the north west where evidence is concentrated. There is an enclosed woodland pasture in the centre of the wood and a small barn.

The archaeological features relating to stone working: quarries, working areas and querns are unevenly distributed, clustering in two areas, in the north-west and south-east parts of the wood, which can be seen in Map 12 below.



Map 12. Bow Wood: stone getting features.

Key: △ Quarry and stone pits, ● Quern.

Stone getting

Quarries, pits and working areas

The availability of stone suitable for quarrying led to its exploitation in former times. The coarse Gritstone used to make querns and millstones and finer grained Gritstone possibly for building have both been extracted from quarries Nos. **63** and **74**. A pink fine grained sandstone has been quarried, No. **75** to south of the wood and a finer grained large diameter stone, No. **67** possibly a grindstone was noted.

Reference	**Description**
63,74,75	Quarry
1,4,5,7,8,9,10,1 115,18,19,	Stone pit
28,32,38	Working areas
61	Split stone

Table 16. Bow Wood: summary of stone getting related finds

The quarries noted are small but with established trackways linking them to the main communication routes. The surface of the wood is generally rocky and boulder strewn, making selection, working and removal of stone relatively simple and informal. The remains of these workings can be seen as pits of various sizes, usually surrounded by debris made up of small angular stone chips down-slope from the feature. The larger stone spoil has straight angular edges and some show wedge marks.

Photograph 19. Bow Wood: abandoned slot cut in stone, feature **61**.

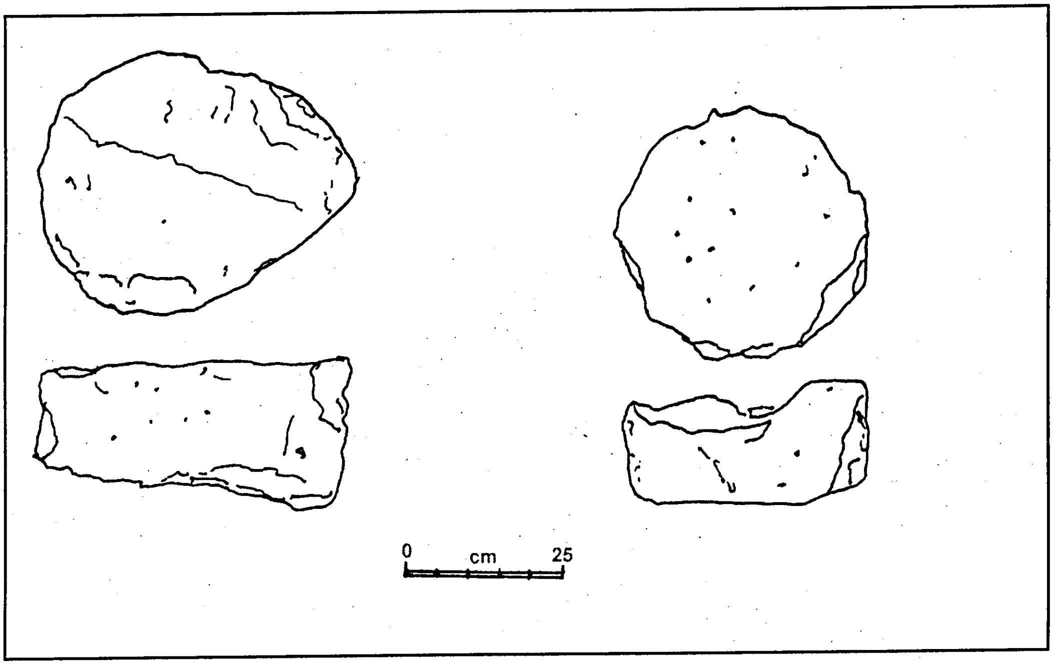
Querns

The querns found are rough-outs, unfinished stones discarded prematurely presumably because of faults in the stone or in manufacture. Thirty-one querns have been recorded, of these twenty-four or eighty percent were found in the northwest section of the wood. It was possible to estimate the measurements of thirty querns, No. **50** is a fragment only. Three querns, Nos. **31, 47** and **65** may be of the beehive or Hunsbury type, possibly Iron Age or Romano/British (Wheeler, 1979). The majority of the querns were abandoned at an early stage, or remain partially buried and could not therefore be measured with precision. Fourteen querns however could be measured accurately and these are shown in Table 13 below. Since the querns are unfinished any conclusions based on the chart are speculative at best.

Diam cm								
35			46,49					
38	37							
40		40						
46		41						
54				44				
65						36		
75						57	33	
80					64	51		58
85					59			
140								53
Thickness cm	**14**	**16**	**18**	**19**	**25**	**30**	**35**	**40**

Table 17. Bow Wood: Summary of measurable quern finds

The querns **53** and **59** at Table 17 above, 140 cm and 85 cm diameter may well be millstones and not querns. Their dimensions fall within those in a survey of millstones in the Peak District which recorded dimensions of 86cm – 216cm in diameter and 22 – 43cm in thickness (Egan, 2000) and 67cm – 170cm diameter and 20 - 42cm thick (Glover, 1829). Two further stones were noted **54**, 120 cm diameter but the underside was not visible and **67**, 125 cm diameter x 13 cm thick, which may possibly be a grindstone. In the table above thickness increases with diameter, but since they are unfinished the final dimensions may well be much reduced. Querns were made in pairs the upper stone thicker or domed. This may be reflected where several thicknesses have been recorded for the same diameter, for example stones **64**, **51** and **58** above. Querns **33** and **50**, may well be the early beehive type possibly Romano-British. Three working areas, **28**, **32** and **38** have been identified where quern rough-outs have been found and what appear to be raised stone working benches surrounded by stone chippings and debris.



`Figure 8. Bow Wood: typical quern rough-outs, left **56** left and right **57**

Photograph 20. Bow Wood: quern **58**, 40cm diameter

Photograph 20 above shows clearly the 'pecked' or worked surface. Although large discarded millstones are well known elsewhere on the Gritstone Edges (e.g. Radley, 1963-4; Tucker, 1977; Egan, 2000), none have been found here. Some have been noted in Lea Shaw Wood to the east and across the River Derwent in Birch Wood and Haytop (author's unpublished survey) and there is documentary evidence for millstone quarrying at Alderwasley (Turbutt, 1999).

There have been no finds to assist in dating the querns. Since none are finished, the final shape and size cannot be determined, which makes typological comparisons difficult. Querns have been found built into kilns some may therefore pre-date the whitecoal era, broadly end sixteenth to mid eighteenth centuries.

Millstones were being made in the area in the medieval period. Lea Gardens are situated about 2.5 km north of Lea Wood '... are sited on the remains of a medieval millstone quarry' (Lea, 2009) and indeed rough-outs can be seen in the gardens. There is very little difference at the rough-out stage of manufacture between Romano British and later medieval querns, and they continued in use until relatively recent times (Curwen, 1941). Querns were used to grind lead protoxide in the redlead process, in 1637 George Heathcote left "one pair of stone Quernes" in his will (Kiernan, 1989:161), these may have been edge stones (L. Willies pers. comm.). Farey notes 'Places where Peak Millstones were formerly made, Lea in Ashover' (1811:211), these are probably large diameter millstones and may refer to Leashaw Wood (see above) also in Lea parish.

Nothing is known of how the industry was organised but it seems likely the querns were taken elsewhere to be finished, since no part finished querns have been found. They are portable and a pair could probably be carried by packhorse. The area has a number of ancient route ways over the River Derwent either by Holmesford to the west or through Bow Wood to the crossing at Cromford or to Chesterfield and Alfreton via Holloway to the north-east.

Fuel

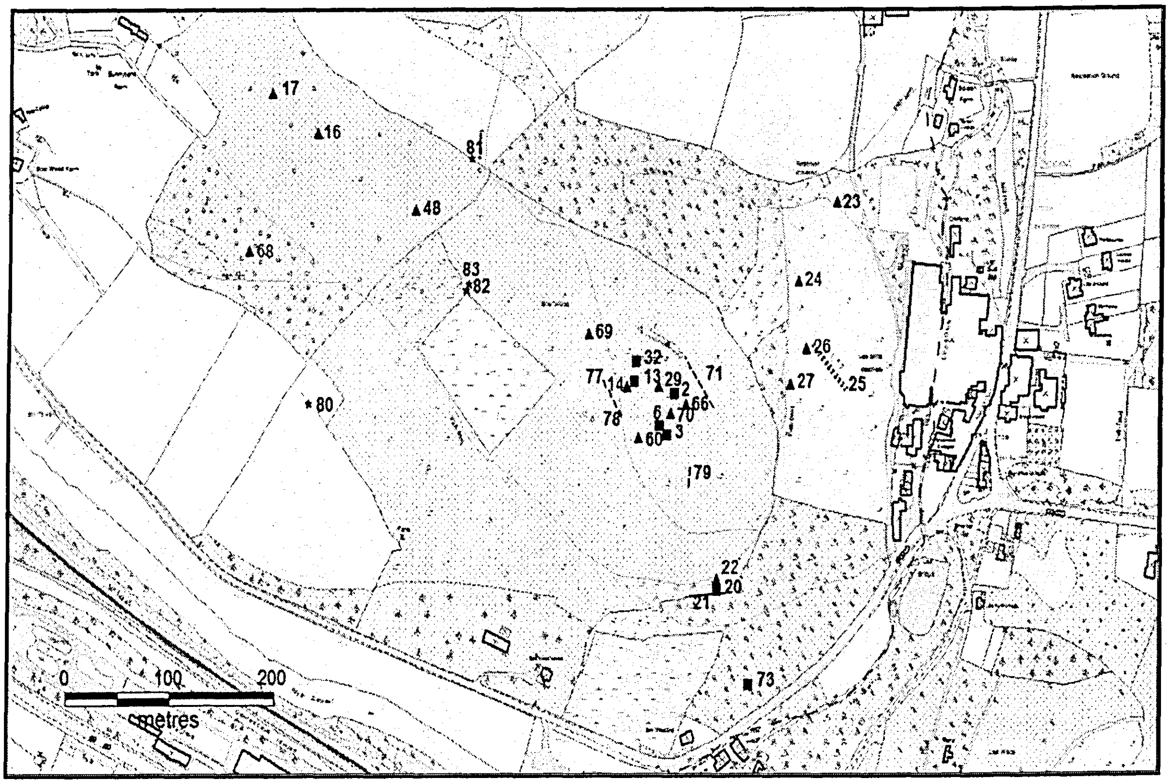
Whitecoal

Structures made of drystone construction and sub-rectangular in plan have been found and are thought to be whitecoal kilns. Coal and cinders have been found at the west-south west gap in the structure, which is probably the entrance. The features found in Bow Wood appear to re-use a suitable stone delve or pit. The table below details the seven features which have been interpreted as whitecoal kilns.

Reference	Description
2	Degraded D4m x .6m deep
3	Degraded 4m x 4m x 1.5m deep
6	Degraded 4m x 4m x 1m deep
13	Sub-rectangular, flat N wall 4m x 4m x 1m deep
20	Degraded D4 x 1m deep, walls evident
32	5m x 6m x 1.5m deep, walls evident, quern built into N wall
73	Degraded 4m x 4m x1m deep charcoal.

Table 18. Bow Wood: whitecoal kilns

Of the seven features recorded, five are degraded but are recognisable as features recorded elsewhere and two are well preserved and in very good condition. All show similarities of size, construction and shape. Generally they are 4-5 metres square and up to 1.5 metres deep internally and have an entrance indicated by a gap between stones, occasionally resembling a squeeze stile facing west- south west.



Map 13. Bow Wood: kilns, platforms and field features.

Key ■ : whitecoal kiln; ▲: charcoal platform; broken line linear features.

Charcoal was found around **73**, but no coal or cinders were found. It has been disturbed by badger activity which may have concealed the coal and cinders found at other kilns. It is possible however, that it was an early example, its location is away from the main activity centres and it may have fallen out of use when kilns nearer the smelting mills to the north were developed or the woodland nearby changed to agricultural use or a charcoal hearth.

Photograph 21. Bow Wood: whitecoal kiln **32** viewed from the entrance

Photograph 21 above shows the interior of kiln, **32.** The end walls are visible and its construction, dry stonewalls incorporating large earthfast boulders can clearly be seen. In the foreground the entrance is visible, a narrow gap can be seen between a large boulder on the right and a thin vertical slab on the left, its sub-rectangular plan can also be seen.

The kiln structures are similar to those recorded (by the author) elsewhere locally, in Lea Wood, Birch Wood and Haytop on the opposite bank of the Derwent. They are generally 4 metres x 5 metres sub-rectangular, with rounded internal corners, whether this was intentional or reflected the nature of the selected location is not certain. They remain up to 1.5 metres high above the present internal floor level. Careful auger tests suggest an accumulated organic debris about 30-40 cm thick, giving a floor to wall height of approximately 1.8-1.9 metres.

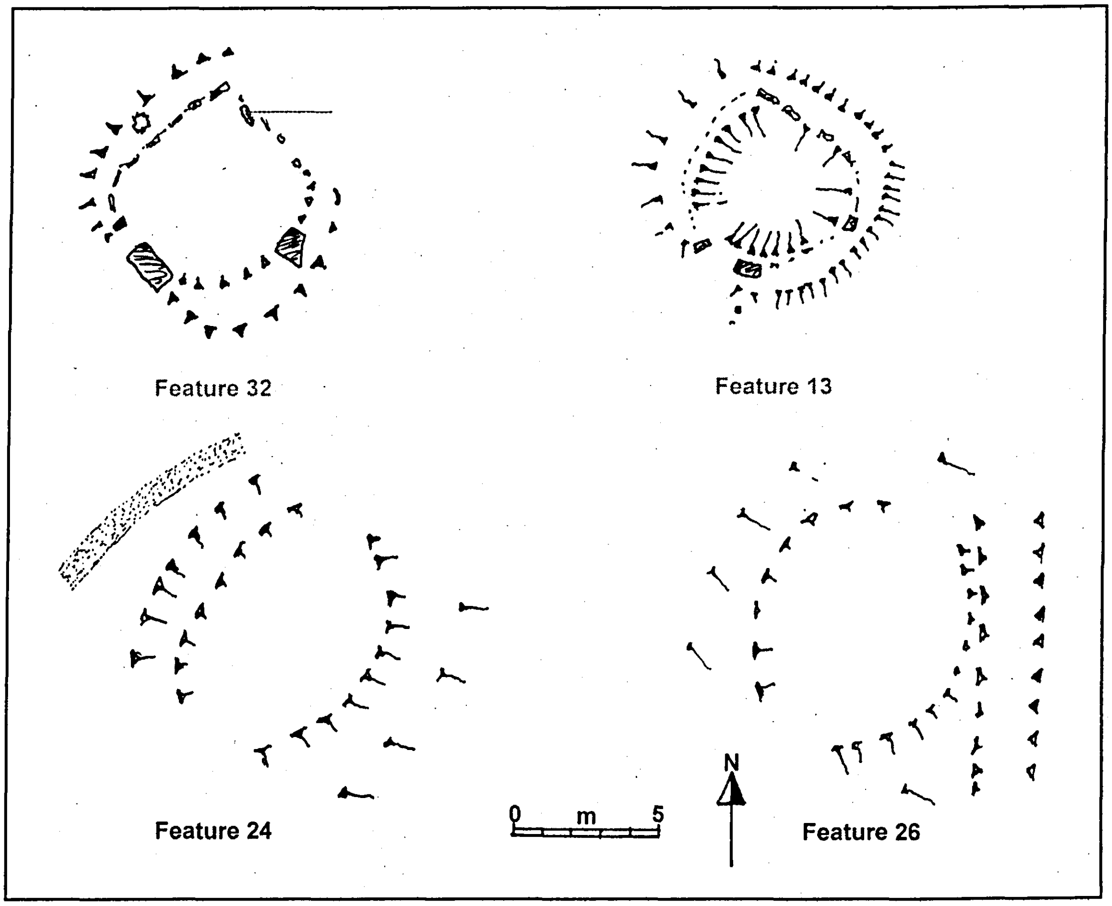


Figure 9. Bow Wood: kilns **13** and **32**; platforms **24** and **26**.

No other constructional features are apparent, unlike the Froggatt kiln where a stone built central pier appears to support a partial stone slab floor. The Froggatt kiln is unlike the forty or so whitecoal kilns noted in woods across the region, in both construction and location next to the smelt mill. This is the only ore hearth lead smelt mill (known to the author) which is located actually in the wood now. This may not have been so in the past. Clearly from an efficiency viewpoint it makes considerable sense to bring wood to a central point beside the smelter where labour is available. All the kilns noted in this survey revealed an external mound beside the entrance composed of cinders and unburned mineral coal. It is widely believed that mineral coal was substituted for wood as the fuel used in the kilns to dry the wood (Crossley, 2005) and coal has been mined locally in the past at Wheatcroft, Alton and across the Derwent at Wigwell (Frost, 1966; Farey, 1813). The kilns appear to be loosely associated with a charcoal hearth, suggesting possible dual working. This may be fortuitous or perhaps a feature of access or topography, or it may indicate a more sophisticated management and working practice than previously assumed, since charcoal was made from wood of 8-14 years growth and whitecoal apparently from 20-25 years growth timber (Crossley, 2005).

Platforms

Fifteen platform type features were recorded and the nine below contained charcoal fragments. Analysis of a fragment of charcoal was shown to be oak. See Appendix 6.

Reference	Description
17	5 x 3 m cut in to slope on trackway
23	7 x 6 m cut in to slope
27	9 x 7 m on track
29	8 x 7 m cut into slope
48	9 x 7 m cut in slope
60	10 x 8 m cut into slope wall down slope
66	12 x 7 m cut into slope
69	8 x 5 m cut into slope wall down slope
70	D8 m cut into slope

Table 19. Bow Wood: platform features with charcoal debris

The six platforms below although similar in typology to those above did not appear to have charcoal debris visible.

Reference	Description
14	6 x 4 m beside track
16	6 x 4 m cut in to slope
22	6 x 4 m degraded by track
24	9 x 6 m cut into slope
26	9 x 7 m beside Holloway
68	9 x 8 m cut into slope near track

Table 20. Bow Wood: platform features no charcoal seen

Five of the platforms above were located on or very close to trackways. They may have been the sites of temporary dwellings, hard standing areas or loading points for stone or fuel. Indeed features interpreted as charcoal platforms on the basis of charcoal debris might also be dwellings. In Haytop Wood the cleared *Rhododendron* has been burned on the existing platforms. This is obvious now but a similar event a century ago would make interpretation difficult today.

Photograph 22. Bow Wood: revetted down-slope edge to platform feature **60**

A stone lined trench, **62**, 4 metres x 1.5 metres x 0.5 metres deep has been noted, it may be a saw pit.

Communications

Given the industrial activity in the wood it is not surprising that a web of tracks and paths can be seen. These tracks connect with the east-west bridleway which pre-dated the turnpike road in the valley as the main route between the Derwent crossing at Cromford and Holloway and the eastern part of the county. The bridleway is well made, paved in parts with irregular stone setts and revetted down-slope in some places. Its location has changed overtime; a slight holloway marks the older route. Species such as holly, hazel and hawthorn are probably the remains of a hedged boundary. A slight holloway **25**, can be seen in the east of the wood. Woodland tracks are barely visible now but can still be seen to contour the hillside, linking in particular the charcoal hearths and as noted in other woodland surveys they often cut through the hearths. This reveals the blackened ash/charcoal residue diagnostic of charcoal making. A quarry track shown as a straight path in the east of the wood on older maps links stone workings at the summit with tracks to the east of the wood. The track is virtually straight, 104-110 cm wide. It has been cut through two large earthfast boulders, **77** and **78**, possibly as a sledge-way for transporting stone to more level ground. Sanderson (1835) shows another track exiting the wood in the east and heading north through fields then turning east, this would have been a possible route to the lead smelting works on the Lea Brook.

Walls and enclosures

There are substantial drystone walls surrounding and enclosing the wood. The stone was obtained locally, probably from surface pits and from field clearance. The south west part of the wood is separated from arable land by a substantial drystone wall. It is probably pre-enclosure; there is a 60 cm difference in ground level each side of the wall. A small encroachment has been made since Sanderson (1835) extending an existing field into the wood. This is visible as wide lynchet **80**, following the course of the older wall. A probable pre-enclosure wall **71**, can be seen in the eastern part of the wood extending north-south from the cliff at the top of the wood, it is made of large irregularly shaped stones possibly of quarry origin. The drystone wall to the north between the wood and Coumbs Wood pasture **81**, is built from thin, flaggy stone, capped with roughly squared coping stones on edge. It reflects the locally available sandstone rather than the coarse gritstones found elsewhere in the wood and is probably post enclosure. In the centre of the wood is a small area of cleared and improved land now rough pasture, which is enclosed by a drystone wall. It is approached by a holloway from the south east almost 1.5 metres deep, the down slope side has been enhanced with a row of large stones, see Photograph 23 below. The stones may have been removed during clearance of the enclosure. It appears to stop at the enclosure wall and no evidence can be seen of it continuing into the enclosure. There is a possibility that it was a woodland division, the stones possibly increased security against animal encroachment.

Photograph 23. Bow Wood: holloway and stone wall

In the north-west corner of the field a small structure has been built on to the wall, made of both sharp and rounded irregular shaped stones. Adjacent to the structure **82**, is a spread of small rounded stones and large boulders, which is probably field clearance debris. The wall is 100cm high up slope and 180cm on the field side down-slope, this is also reflected on the southern boundary seen from the bridleway, which is 100cm below the field surface. Also beside the north west corner of the clearing is a meeting of two large tracks and a levelled area **83**, beside them which may have been a hard standing area for loading quarried stone, or possibly the base of a temporary structure.

3.4.3 Bow Wood historical survey

Bow Wood, or *Boghewode*, in the sixteenth century means bow or arch, referring possibly to its curved profile (Cameron, 1993). *Boughwood* was mentioned in a lease of land to Nicholas Brown of *Wodeseates* (Matlock) by Hugh son of Coteral of Cromford in 1344/5 (D 1233 M/T41), and again as Bughwode in an action between John de Dethick and William de Wakebridge in 1353 (D 1233 M/T44-45). In 1403 the male line ended and Isobel Dethick married Thomas Babington. The Babington's were an influential Derbyshire family with extensive land holdings and were involved in lead mining and smelting until the execution of Antony Babington in 1586 (Keen, 2009). An enquiry into Anthony Babington's affairs prior to his execution 'revealed that he had a smelting house in the woods near Dethick' and was known to have a bole smelter at Riber (Kiernan, 1992). Ownership now becomes obscure, the woods beside the Lea Brook are all confusingly referred to as Lea Woods and Sanderson (1835) omits Bow Wood and marks it as Lea Wood. In a mortgage of half of the Manor of Lea in 1550 by Francis Babington "it was provided that the mortgagees should not cut down the woods on the premises except towards the making of lead and leadworks at or within the lead miln in the manor and the necessary repairs to the lead miln and other houses appertaining to the lead works" (Wood, 1982:128). The smelters were leased and operated by the Clarke and Eyre families in the late sixteenth century, then by the Spateman family together with the woods, where he was known to be a tenant in 1633 (ibid.). He may well have owned the woods in 1703 and sold part to Thomas Nightingale in 1720 (Wood, 1987). The woods were eventually purchased by Peter Nightingale in 1763, including "two parcels of Woodground called Bowood Copies and Bowood pasture, est. 74 acres". Copies is a term for coppice and in 1769 Nightingale marks 1642 standards with white lead and oil in the Storth Brow apparently in the east of the wood, suggesting that it was or had been under coppice with standards management. Nightingale was actively involved in lead smelting in the area and was using whitecoal from Leashaw Wood in 1738 for use at Cowhay (D3581/1/1: 16, 32-33, 64). However, in 1737 *cooks* presumably coke was being sent to Cowhay Mills from Clay Cross Pitts (Wood, 1984). Although whitecoal was still being made in Lea Wood in 1753-54, this was probably the end of the whitecoal era as Samuel or Anthony Wood had added a cupola to their smelting mill at Hollins, on the Lea Brook in the middle of the eighteenth century which burned coal. From the Nightingale estate papers the woods were clearly evolving to meet a new industrial era. New species were being supplied to new markets whilst still supplying traditional customers. In the period 1831-1835 larch, sycamore, *beach* (sic), poplar, Scotch fir and spruce trees were being sold as poles, small and large rods and rails. Interestingly sycamore was sold by the foot as small rods and hoop rods; a significant multi-stemmed sycamore has been noted in Bow Wood. Willow or sallow was being sold for poles, pegs and bobbin poles. Traditional uses of oak, ash and elm for posts, stakes, laths, five-foot cordwood and birch for besoms were recorded. Oak and some ash was also sold to Bradder Mine and Old End Mine presumably for props. Oak was also sold as boat knees to Samuel Wheatcroft at Holston Bridge (D3585/6/1). The Wheatcrofts were one of six canal boat builders on the Cromford Canal between Cromford and Pinxton, they are known to have built at least one boat at Cromford in 1820 and perhaps thirty in all their yards (Heath, 1977). There are a number of oaks in both Lea Wood and Bow Wood whose main branches seem unnaturally bent, these may be relics of a method used to produce these boat knees (I am grateful to Dr Ardron for pointing out this possibility). Oak bark continued to be an important product. The accounts for the nine years 1840-48, show an average of 16 tons of bark sold annually to Derby at £6-10s per ton in 1840 and falling to around £4 per ton in 1848, this included £1-10s peeling and 12s per ton transport, in the years 1849-52, 25 tons were produced *per annum* at a more profitable £4-10s in the woods (D 3585/7/1).

Significantly small leaved lime is not mentioned unless bindings might refer to the use of lime bast, there are now no willows, larch or Scots pine in the wood, a single elm has been noted and a few ash in the south of the wood. This might indicate a lack of investment in the wood after the mid-nineteenth century when management generally changed to high forestry. The present large beeches noted may date from around this period and the softwood species would probably have been felled in the 1914-18 war. Clear felling in the mid-twentieth century may have opened up the west and southern parts of the wood allowing in sycamore and birch, a few large stumps can be seen which may be fifty years old as indicators. There is a planting regime in operation: small oaks can be seen in various parts of the wood. Part of the wood is now owned by the Woodland Trust and has a new role as an amenity asset in the Derwent Valley.

Bow Wood Timeline

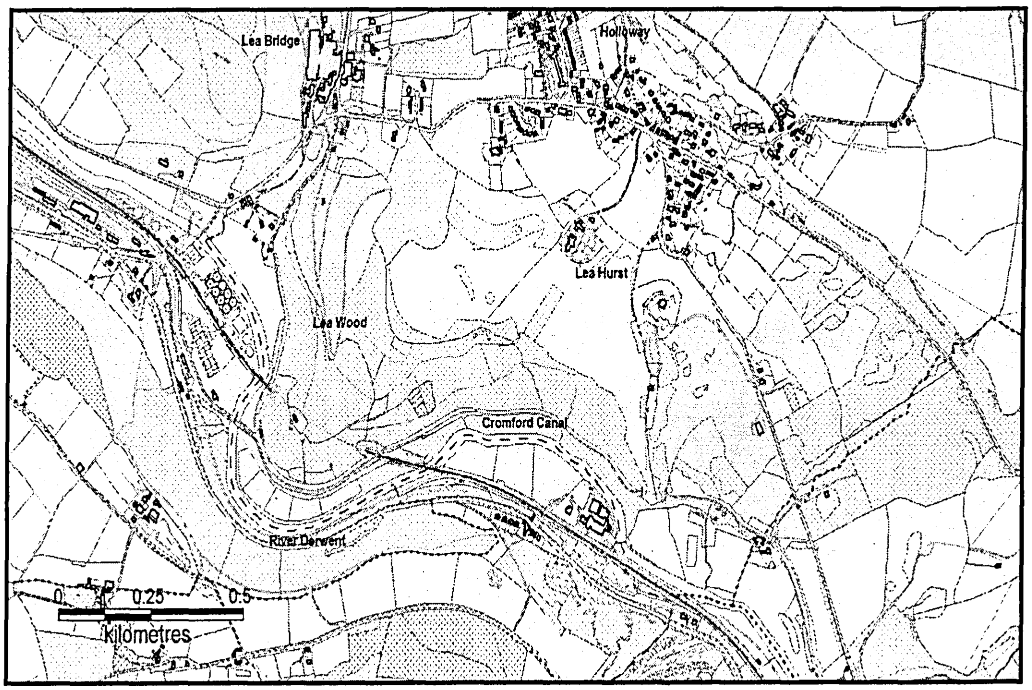
Dates	Landscape	Result
Romano-British	Quern making	Small-scale woodland disturbance
Medieval	Quern and quarrying	
13th - 16th century	Bole smelting	Introduction of coppicing
!6th - 18th century	Ore hearth smelting using whitecoal and charcoal	Intensification of coppice with standards. Use of top soil impoverished ground flora
Mid 18th century	Use of mineral coal in smelting	Reduction of coppice for fuel.
Early 19th century	Cromford canal brings cheap coal takes pit props	Limited re-planting, birch and Scots pine
Mid 19th century	Continued use of variety of species and end uses.	Diverse woodland structure
Late 19 early 20th century	Beech planted	Reduction in species woodland more uniform adoption of high forestry management. Coppice oaks allowed to grow out
20th century	Woods felled in world wars	Invasion of birch, lack of management, more open
21st century	Woodland Trust ownership amenity wood.	Little management bracken and bramble in open areas

Table 21. Bow Wood selective time-line

3:5 Lea Wood

3:5:1 Environmental survey

Lea Wood is situated on a steep sided knoll, 150 metres OD overlooking the River Derwent, centred on OSG 560319, in the Parish of Lea, Dethick and Holloway. The Cromford Canal forms the boundary to the south and a disused canal spur and the Lea Brook is the boundary on the west. The wood thins out to gently sloping farmland to the east, whilst the flat topped knoll adjoins parkland formerly attached to Lea Hurst House. The village of Holloway is less than one kilometre north east and Crich is 3.5 kilometres south-east.



Map 14. Lea Wood: location

Photograph 24. Lea Wood: aerial photograph

The underlying geology is the Millstone Grit series of Carboniferous sandstones and Ashover Grits are apparent on the surface. The stone has been extensively worked over time in many areas. There are three large disused quarries in the wood exploiting various outcrops of Millstone Grit. Elsewhere, small pits can be seen where surface stones and boulders have been extracted and worked. Remains of quern working have also been noted in a number of areas throughout the wood probably using exposed surface deposits of Gritstone.

There is a water utility reservoir in the north of the wood utilising a spring flowing from the wood and an associated pipeline south through the wood.

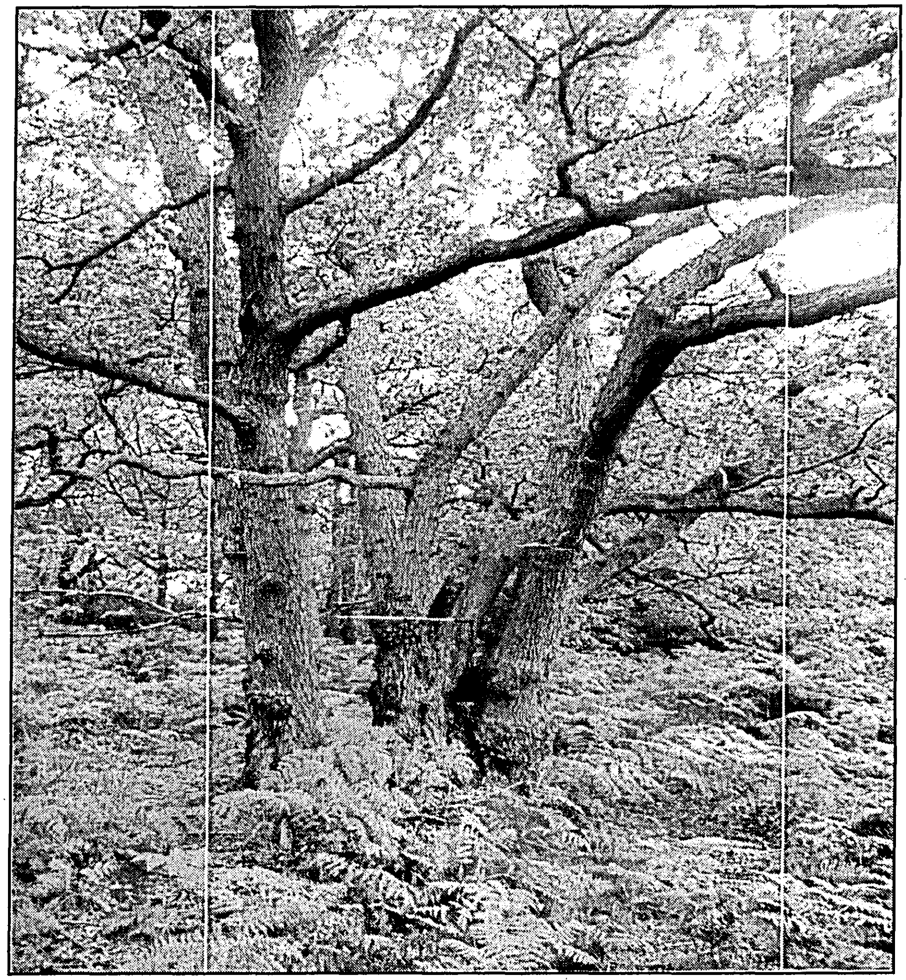
The soil is variable with clays apparent and also thin, sandy and acid soils, pH 4. The ground flora is not rich and there are large open areas dominated by bracken and bramble. Creeping soft grass is also common in some areas and may be associated with the removal of topsoil for industrial processes in the past (Ardron and Rotherham, 1999). There is a large cleared area of meadowland in the south and the remains of two cottages. The remains and their former access trackway are now marked by nettles, rose bay willow herb and Dog's Mercury. The fringe of the meadow contains elder, ash, sycamore, crab apple and holly.

There are two small plantations adjacent to the Leahurst parkland. The first, in the north-west is a part walled area of mature Scots pine and beech giving way to a dense overgrown area of mature rhododendron to the south. On the knoll proper in the north, a walled compartment contains mature beech, oak and Scots pine and beneath the beech, bare ground with patches of creeping soft grass and bluebells can be seen. This area has been landscaped to create a rhododendron garden, with rock built features, seats and tree lined walks; although now overgrown by the rhododendron it has fine views of the Derwent Valley. On the edge of the park boundary adjacent to the garden enclosure is a notable multi stemmed small leaved lime (*Tilia cordata*), with an estimated girth of seven metres.

The western ride, which is shown in Photograph 25 below is well made and has been planted with common lime (*T.* x *vulgaris*) beech and holly. Hazel is also in evidence beside the track where it is more open.

Photograph 25. Lea Wood: beech and lime beside west ride, looking north.

Beside the ride is the largest if not the oldest tree in the wood, a beech with a girth of 4.4m, giving an estimated age of approximately 175 years (Mitchell, 1999; Wright, 1999). This gives a possible planting date of approximately 1835. Leahurst was rebuilt in the 1820s by the Nightingale family and the planting and landscaping may have occurred at that time. Also notable are large holly trees, one of which has a girth of 1.85m and a height of about 12m. Towards the north-west the track becomes wet where a spring overflows from a catchment tank and golden saxifrage can be seen. The wood is notable for sessile oak and many relict coppiced oaks have been noted and are very important ecologically and historically.



Photograph 26. Lea Wood: relict sessile oak coppice. The pole is one metre long.

In the photograph above multiple stems have grown from the coppice stool. It is a single plant and the opposite side of the stool shows evidence of earlier cutting and re-growth. The age cannot easily be estimated but the stool may well be several centuries old (P. Ardron pers. comm.) The ground flora consists of bracken and creeping soft grass between bare patches of soil and stone.

Photograph 27. Lea Wood: sessile oak showing abnormal bark growth.

The photograph above shows an oak trunk with numerous scars and bark growths. This may have been caused by trimming or pruning, stripping for fodder or possibly caused by disease (Ian Rotherham pers. comm).

Common name		A	C	F	O	R
Ash	*Fraxinus excelsior*				X	
Alder	*Alnus glutinosa*					X
Beech	*Fagus sylvatica*		X			
Birch	*Betula pendula/ pubescens*		X			
Crab apple	*Malus sylvestris*					X
Elder	*Sambucus nigra*				X	
Hawthorn	*Crataegus monogyna*				X	
Hazel	*Corylus avellana*		X			
Holly	*Ilex aquifolium*		X			
Common lime	*Tilia* x *vulgaris*				X	
Small-leaved lime	*Tilia cordata*					X*
Sessile oak	*Quercus petraea*	X				
Rhododendron	*Rhododendron ponticum*		X			
Rowan	*Sorbus aucuparia*				X	
Sycamore	*Acer pseudoplatanus*	X				
Scots pine	*Pinus sylvestris*				X	

*Located inside Lea Hurst Park

Table 22. Lea Wood: tree species

Wood	Ref	pH	Location
Lea	1	4	Above canal in quarry workings
	2	6.4	West end of tunnel field
	3	4.1	North slope
	4	4.1	West near platform
	5	4.3	Open slope
	6	4	Knoll furrow feature under beech
	7	4.2	Knoll ridge feature
	8	4.6	Hazel/oak compartment
Median		4.1	

Table 23. Lea Wood: summary of soil sample test results..

The soil samples above in Table 23 above show an acid soil with a median value of pH 4.1. The highest value, **2,** pH 6.4 was taken on the edge of the improved agricultural land known as Tunnel Field and reflects soil improvement. Samples **6** and **7** were taken from the faint ridge and furrow type features on the knoll. However, the pH 4 and pH 4.2 values were typical of the wood in general and not indicative of the soil having been improved; the features may well be centuries old and any base rich soil components will have leached out. The hazel/oak compartment, Sample **8** was slightly high at pH 4.6. This sequence appears to fit the *catena* model of oak or oak/holly on the upper steep slopes of an infertile rock, with hazel on the 'footslope' with elm and alder nearer the stream bottom. This is due to a *catena* of soil development, washed out minerals have accumulated in the downslope soils to the advantage of more demanding trees (Rackham, 2006). This development has been truncated by the canal construction on the south and west edges of the wood. The table overleaf notes the plants recorded whilst conducting the archaeological survey. The grasses typical of this type of woodland were dominant and may well be the result of top soil stripping for charcoal cover. Some species associated with ancient woodland have been noted particularly beside the bridleway.

Common name		A	C	F	O	R
Opposite-leaved Golden-saxifrage	*Chrysosplenium oppositifolium*					X
Bluebell	*Hyacinthoides non-scripta*			X		
Bracken	*Pteridium aquilinum*	X				
Bramble	*Rubus fruticosus*	X				
Broad buckler fern	*Dryopteris dilatata*				X	
Buttercup	*Ranunculus repens*				X	
Creeping soft grass	*Holcus mollis*	X				
Dog's Mercury	*Mercuriais perennis*					X
Foxglove	*Digitalis purpurea*				X	
Greater Stitchwort	*Stellaria holostea*			X		
Herb-Robert	*Geranium robertianum*				X	
Honeysuckle	*Lonicera periclymenum*			X		
Ivy	*Hedera helix*			X		
Nettle	*Urtica dioica*					X
Rosebay Willowherb	*Chamerion augustifolium*					X
Wavy Hair-grass	*Deschampsia flexuosa*	X				
Wood Millett	*Milium effusum*					X
Great Wood-rush	*Luzula sylvatica*					X
Wood-sorrel	*Oxalis corniculata*					X
Yellow Archangel	*Lamiastrum galeobdolan*				X	

Table 24. Lea Wood: ground flora.

These were noted during the archaeological survey and were not systematically surveyed. I am grateful to Richard Carr for help in identification of the flora.

3:5:2 Archaeological survey

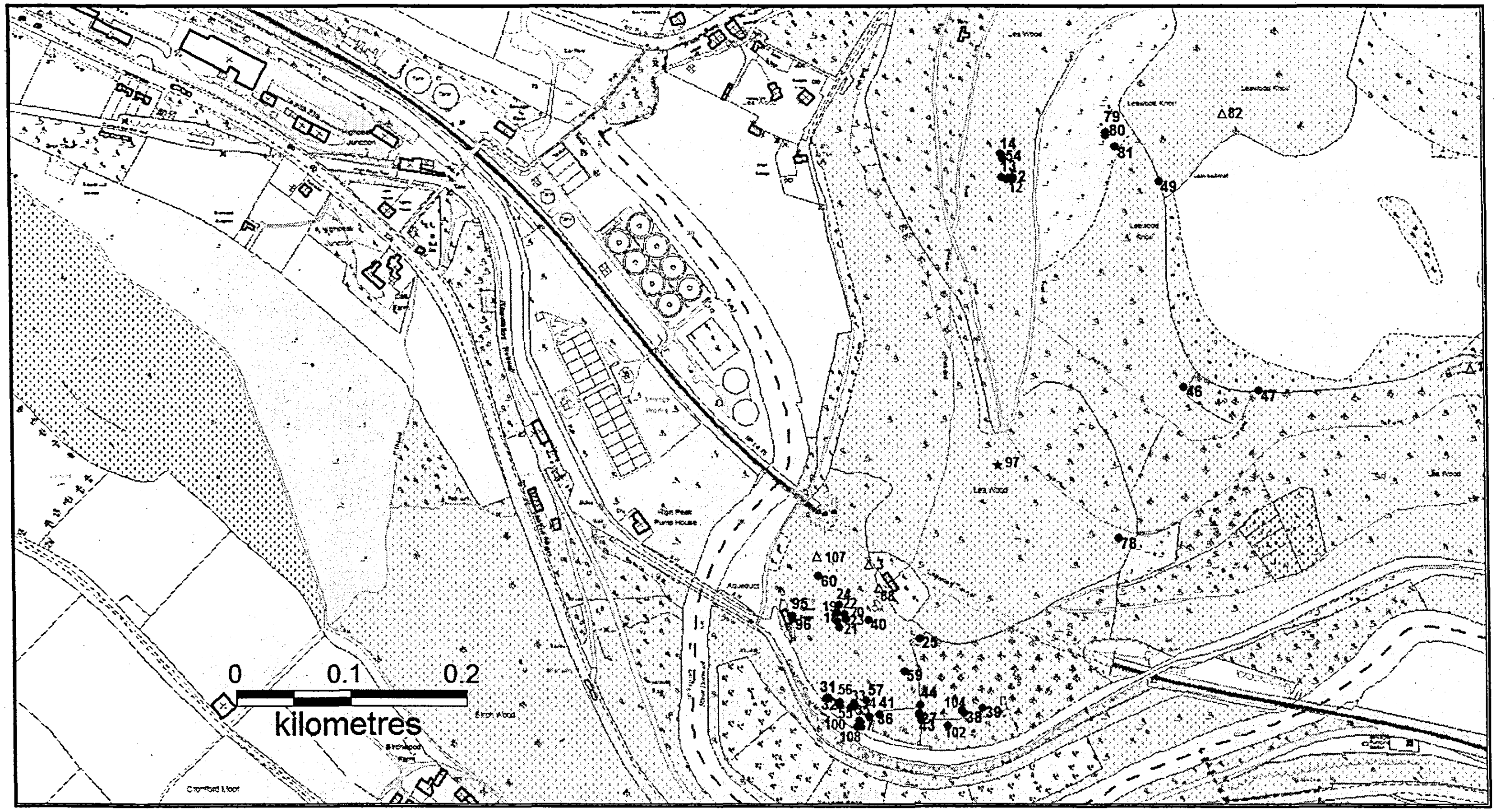
Lea Wood is a multi-period historic landscape. It is defined by the remains of former exploitation of the woodland, including quarries, trackways, boundaries, charcoal platforms, kilns and relict trees outline its former industrial use. The canal, railway and water reservoir give further evidence from a more recent age of industrial change and contrast with the later gentrification and present day amenity use.

Table 25 below summarises the archaeological features noted in the survey; they are detailed in the gazetteer at Appendix 2.

Number	Feature
1	Lithic
47	Querns and quarries
26	Whitecoal kilns and charcoal platforms
8	Walls, tracks and rides
1	Leawood Knoll
4	Buildings

Table 25. Lea Wood summary of archaeological features

Geology and topography are the key determinants of the landscape in Lea Wood. The steep, stony, boulder strewn surface beneath the scarp and the generally thin sandy soils in most of the wood have made it unsuitable for agricultural use, except perhaps for limited grazing. This has ensured an undisturbed woodland environment retaining much of its archaeology. However, parts of the wood have been cleared and a relict agricultural landscape also exists, reflecting locally a more fertile soil and topography suitable for limited improvement.



Map 15 Lea Wood: lithic, quern and quarry sites. Key: ★ Lithic, ● Quern, △ Quarry

Lithic

A single chert flake No **97** was found on the surface of the path at the northern edge of the meadow and may be Neolithic. Chert is found in limestone areas of Derbyshire and may have been introduced with lime used on the field. The meadow which slopes gently to the south probably benefits from more fertile soils resulting from downward soil movement. It is attached to former cottages which stood on the edge of the southern scarp. The drystone wall surrounding the meadow is sub-circular in shape; although much altered it may be an ancient clearance. Its shape can be contrasted with the pasture enclosed in Bow Wood which has straight walls and is sub-rectangular in shape.

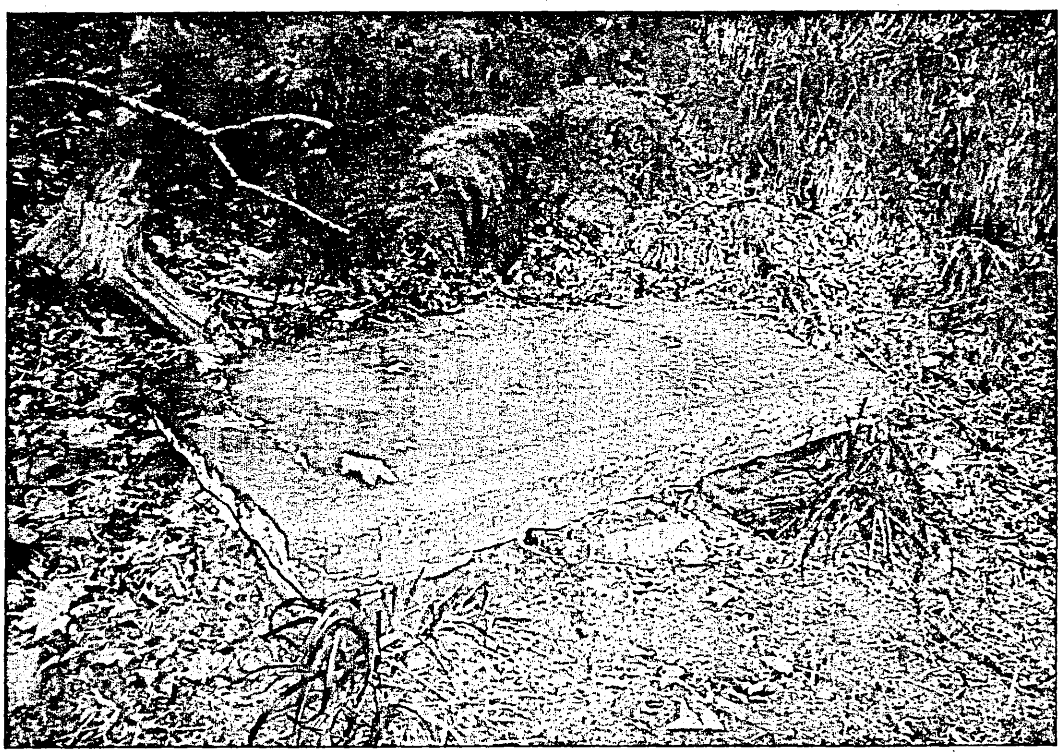
Quarries

The Environmental Survey above outlined the main geological characteristics underlying the wood and referred to the Gritstones, which have been extensively exploited. Several large quarries can be seen in the wood and also many small delves or stone getting pits, the quarries are summarised in Table 26 below.

Reference	**Description**
82,3,4	Abandoned quarries
5	'Old Quarry'

Table 26. Lea Wood: summary of quarry features

A large quarry No **5,** is marked on the First Edition OS map SK3225 5578 and on subsequent editions as 'Old Quarry'. A quarry at Lea-wood (Knowl) is mentioned by Farey (1811:419), these are probably identical. Two large flat dressed stones have been set up in two locations in the woods to serve as seats. They were clearly re-claimed when the cottages in the wood were demolished, but no doubt they were made locally (W. Allen pers. comm.). An iron wedge, known locally as a gad has been found in the quarry (Richard Carr pers.comm.).



Photograph 28. Lea Wood: large worked stone grooved peripherally possibly a draining slab.

Farey (1813) also mentions a saw mill at Lea Wharf for cutting stone used 'for building, paving purposes etc.,' (ibid. 423). The other quarries recorded are not shown on any maps consulted. The demolished cottages were perched on the edge of a quarry, No **88** and may pre-date it. Large dressed stones have been aligned to outline the cottages' original position.

Evidence of stone working can be seen elsewhere, Photograph 29 below shows an irregular edge along a block of stone where wedges have been hammered into a pre-cut slot cut along the stone to break away a section away.

Photograph 29. Lea Wood: wedge marks along the top edge of the stone, the scale is 15cm

Querns

Forty-four rotary querns have been found in the wood. Of these fifteen were part querns or fragments, in all it was possible to measure forty examples and they are shown in Table 27 below.

Diam. cm												
32						F						
34			D	D								
35					F			F				
36	DD			F	D							
37										F		
40		F		FF	F	F		F			F	
41						F						
43				DF F								
45		F	F	F		FFF	FF F		F			
46		D										
50		D		D	F	F		F	D			
55						F						
60												F
Thickness cm	**9**	**10**	**11**	**12**	**13**	**15**	**16**	**18**	**20**	**22**	**23**	**25**

Table 27. Lea Wood: Summary of querns. D: domed profile, F: flat profile

Of the forty querns measured, thirty were flat and ten were domed, some may well be of the 'beehive' type, mid range in diameter, 40cm, but relatively thick 18cm or thicker. These it is thought may well be of an early date, possibly Romano-British (Curwen, 1937).

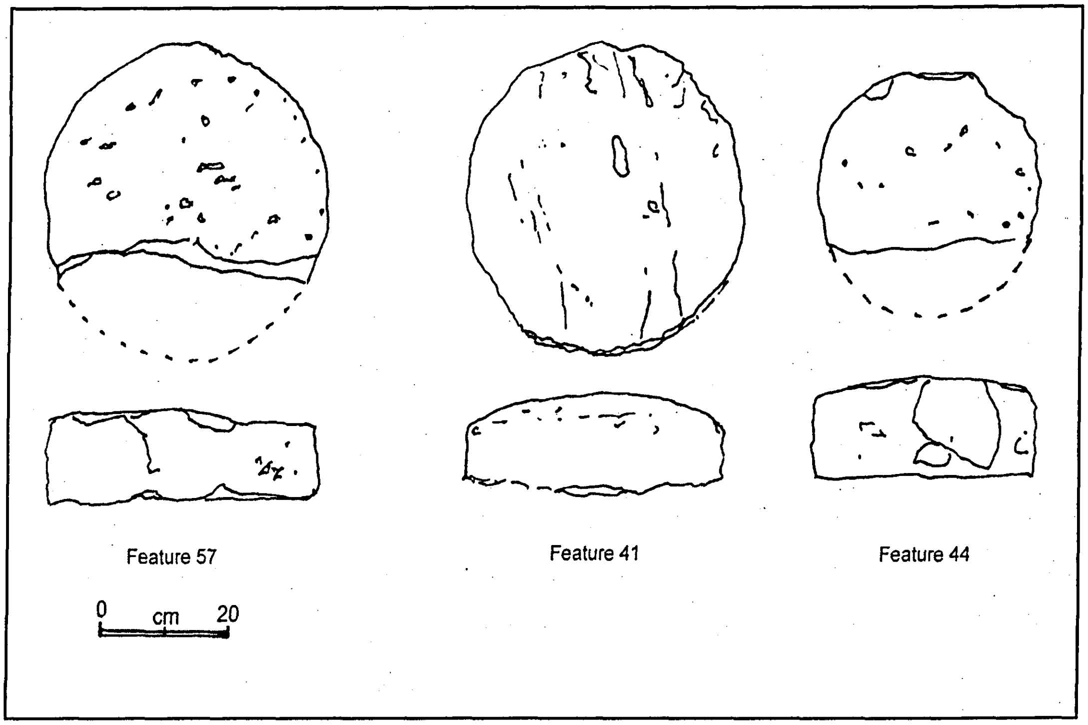
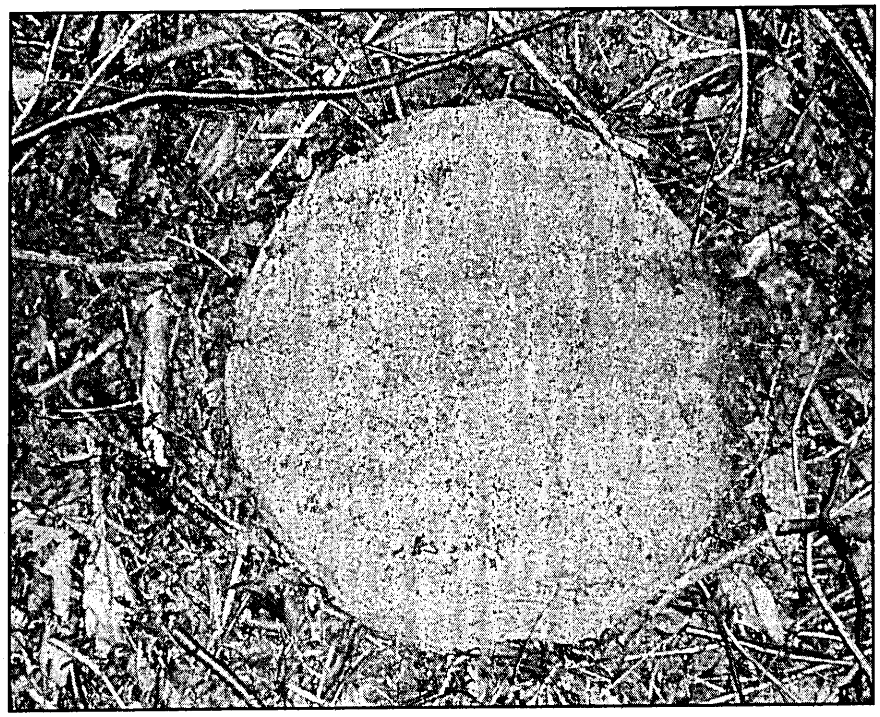


Figure 10. Lea Wood: drawings of quern roughouts

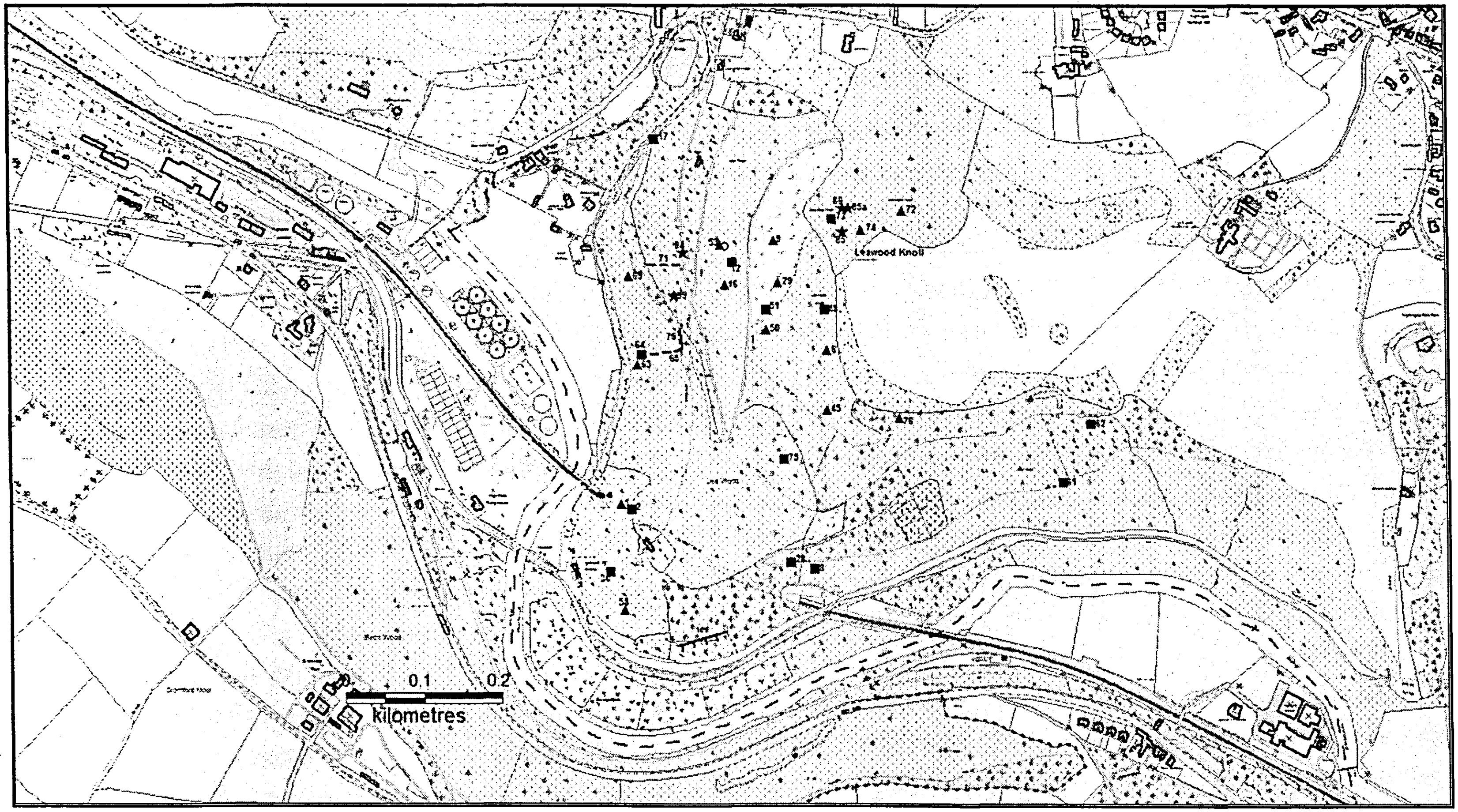
It is not known if any are actually *in situ* but some have been found in stone working pits and appear to be chocked as if being worked on. However, later stone wall builders have used querns as coping stones and may also have chocked them for trimming. Wall builders also took stone from some of the pits and quarries. A large coping stone can be seen abandoned in one of the quarries. Two querns were buried under later quarry tailings.

Eighty per cent of the Lea Wood querns were found in the south of the wood, some have been brought there to cap the walls and some may have been disturbed. It seems likely that this was a manufacturing area. Significantly the cap of Ashover Grit has disappeared in this area to reveal the underlying Millstone (Frost, 1966), perhaps resulting in a broken surface which is more easily worked. The area between the Cromford Canal and the River Derwent (outside the study area) has not been searched, more examples may well be found there.



Photograph 30. Lea Wood: quern rough out No **78.** 40cm in diameter

Other archaeological features



Map 16. Lea Wood: archaeological features. Key: ■ Kiln, ▲ Charcoal platform, ★ other.

Whitecoal kilns

The table below details thirteen features which have been interpreted as whitecoal kilns

Reference	Description
2	Degraded, D4 x 2m deep, robbed?
8	4 x 4 x 1m deep, stone lined
12	4 x 4 x.75m deep, stone lined
17	D3 x 1m deep, stone at entrance.
28	4 x 3 x 1m deep
30	4 x 4 x 1.5m deep, former delve?
48	Degraded D4m
51	4 x 4 x 2.5m deep
61	? Degraded D3 x 1.5m deep
62	?Degraded D4
64	Degraded D4
73	Degraded 4 x 4 x 1m deep
75	Degraded D4 x 1.5m deep/path

Table 28. Lea Wood: whitecoal kilns

It can be seen that of the thirteen features recorded, eight are degraded and five are in reasonable condition. The latter five have retained some of their lining wall and vertical entrance stones. The features do not appear to be structurally similar to the Froggatt kiln, which has an internal dividing wall and spanning stone lintels.

The kilns above face west/southwest towards the prevailing wind. The dimensions despite the degraded nature of some of the features are remarkably consistent, being approximately 4 metres x 4 metres x 1-2 metres deep and cut into the hillside. It is likely that existing stone pits or delves, or natural features were used. Large earth-fast boulders can be seen incorporated into some of the walls.

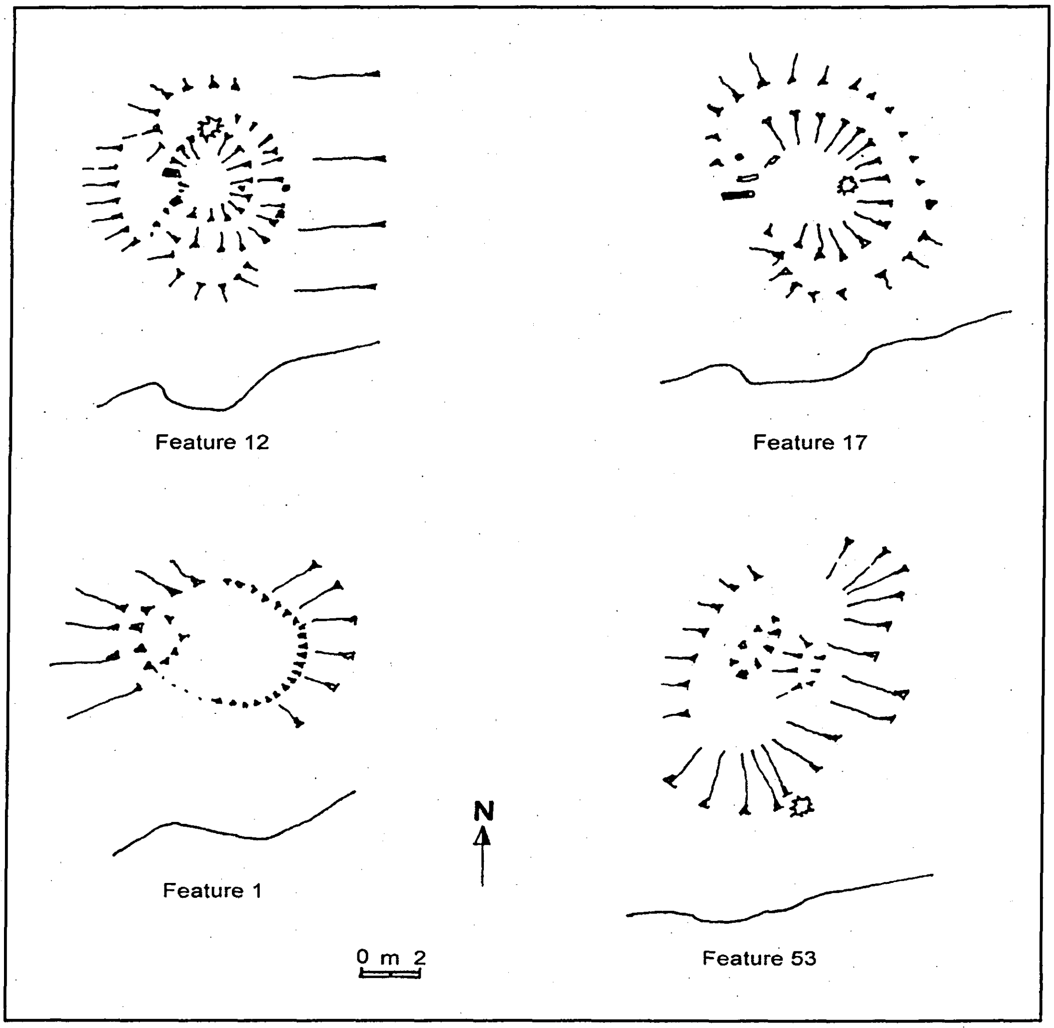


Figure 11. Lea Wood: examples of kilns **12, 17** and charcoal platforms **1, 53.**

Coal and cinders or coke were found at the mouth of each kiln. This is a feature of all the whitecoal kilns recorded in this survey. It can be seen from Map 14 that the kilns are evenly distributed throughout the wood, but fewer in the south. This may be due to under-recording of kilns in the dense *Rhododendron* cover or because they were filled in when the gardens were created. They are sometimes in pairs and often associated with a charcoal platform. Some squared or worked stones can be seen in the kiln walls and also querns have also been built into walls. These may have already been abandoned in the stone pits. Communications seem to be a lesser consideration and in some cases trackways cannot now be seen.

Charcoal platforms

Reference	Description	Charcoal present
1	D5m	x
6	8 x 5m no	
9	8 x 5m	x
15	D7m no	
29	6 x 5m	x
45	D8m	x
50	10 x 7.5m	x
53	D8m	
58	6 x 5m cut by path	x
63	7 x 4m	x
69	Degraded	x
72	9 x 6m cut by path	x
74	D6m	x

Table 29. Lea Wood: charcoal platforms

These platforms are generally flat or slightly dished and cut into the slope. The down slope edges are often reinforced with a stone revetment. They are often associated with a whitecoal kiln nearby, which may be because they were operated in unison by the same team. It may just be fortuitous, since so little is known about whitecoal production in Derbyshire it may not have been possible to work side by side. What is significant, in contrast to the kilns, is the location of the platforms at or near a pathway. This may mean that there were fewer requirements for a specific site and that transport was a more important consideration. Analysis of a charcoal sample from a platform is probably holly *Ilex aquifolium,* it is abundant today throughout the wood.

Linear features

Walls

The walls in the wood have not been fully surveyed but from the limited work so far at least five types of wall have been noted.

Type 1 wall: a single row of orthostats, or stones set in the earth and standing vertically, 14 metres long, No. **71** is visible below the ride in the west of the wood which terminates up-slope amid a scatter of large earth-fast stones. The area is relatively clear and a large beech and a lime have been planted beside the ride which is metalled and kerbed. It is suggested tentatively that it may be the remains of an early wall, although the presence of planted trees beside the track could also indicate a Victorian feature.

Photograph 31. Lea Wood: orthostat wall. Feature **71**

Type 2 wall: Also on the west side of the wood a robbed out wall No. **65** stretches up-slope approximately 40 metres from a single isolated earth-fast rock to a bank and ditch No. **66**. It is made from a single height of large un-worked slabs laid with their long axis on the contour of the slope each approximately level and set into the top soil. They appear to be a foundation course for a wall the upper courses of which have disappeared. They are similar to the Roystone Grange type 3 Medieval walls (Hodges, 1991).

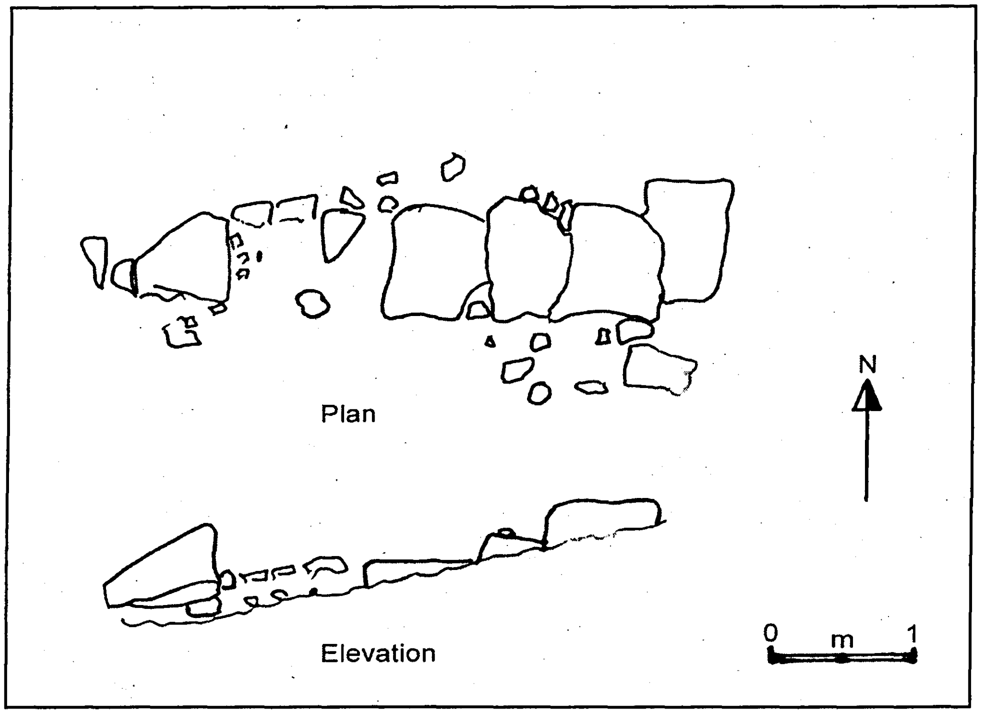


Figure 12. Lea Wood: wall foundations. Feature **65**

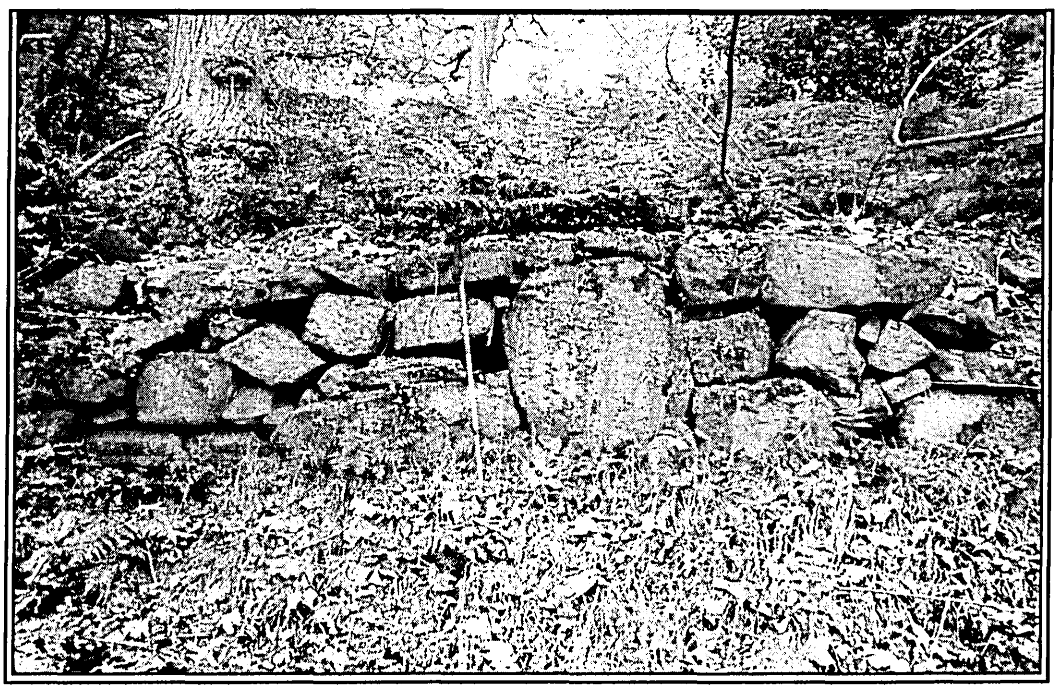
It is possible that this isolated section of wall is earlier than the surrounding later enclosure walls and further detailed surveying might reveal more sections of this wall.

Type 3 wall: this type of wall is of the enclosure type but lower and with cruder coping stones. It thought that this is possibly seventeenth century.

Type 4 wall: this wall type is of the late enclosure type standing up to 1.8m high and tapering from 60cm at the base to 40cm at the coping stones. This wall can be seen beside the Cromford Canal and used querns as coping stones and is probably contemporary with the canal, late eighteenth or early nineteenth century.

Type 5: A more recent type of wall it is similar to the above but slightly better quality. It has coping stones which are mortared in place. It can be seen abutting an older wall enclosing the ruined cottages and also enclosing the deer park and may be late nineteenth century.

Wall Type 2 ends at a short length of bank and ditch. The ditch is 1m wide and .5m deep, and the bank is 2m wide and 0.5m high. It is crossed by a modern path entering this area via a wall opening. The 110cm wide gate posts are still standing but the gate has gone. The wall has been re-aligned to incorporate the gate and allow oblique access for the path. It is shown on the early OS maps but the original path is now obscured and a more modern informal path uses the entry. The reason for the ditch is not known. A further linear feature, No. **101** in the south of the wood is a substantial retaining wall approximately parallel with the canal but not in line with existing walls. It runs between two small abandoned buildings, the eastern possibly a field barn. The wall is over 50 metres in length, 90 cm in height and 170 cm wide. its purpose is not known. It is shown in Photograph 32 below.



Photograph 32. Lea Wood: retaining wall, Feature **101** the pole is one metre

Paths and rides

The wood is crossed by a web of paths, tracks and rides. Some of the paths which are defined by kerbstones and now obscured by *Rhododendron* were probably part of a leisured landscape constructed in the nineteenth century. Others for example leading from the Aqueduct Cottage are surfaced with sandstone fragments possibly from stone workings nearby or broken *in situ,* possibly also nineteenth century. There are a number of wide formal rides which may well be improved former quarry tracks. They are kerbed, walled and metalled in places although the north-east ride from Leahurst via the Old Quarry is unfinished. It appears to stop at gateposts and large stones on the edge of the north-east corner of the meadow. The ride then continues from the north-west corner of the meadow from a single gatepost, where there is an area of spoil associated with recent activity. The ride continues along the western edge of the wood to the lodge at the northern entrance to the wood. This part of the ride is metalled and presumably is used by water company traffic to service their equipment in the wood. Less formal and probably much older tracks can also be seen in the woods, they may have linked the various fuel processing sites with destinations to the north and west.

Leawood Knoll

Leawood Knoll, a walled enclosure on the summit of the wood, planted with beech, conifer and rhododendron, contains a number of enigmatic features. There is a degraded whitecoal kiln, No. **73** and a charcoal platform No. **72**. In addition there are three rock built features, a sub-rectangular construction, No. **85** almost completely obscured by rhododendron and not surveyed, a stone construction, No. **86** and a further stone feature, No. **76.** These appear to be part of a garden or leisure area, possibly comprising a grotto with seats and view point.

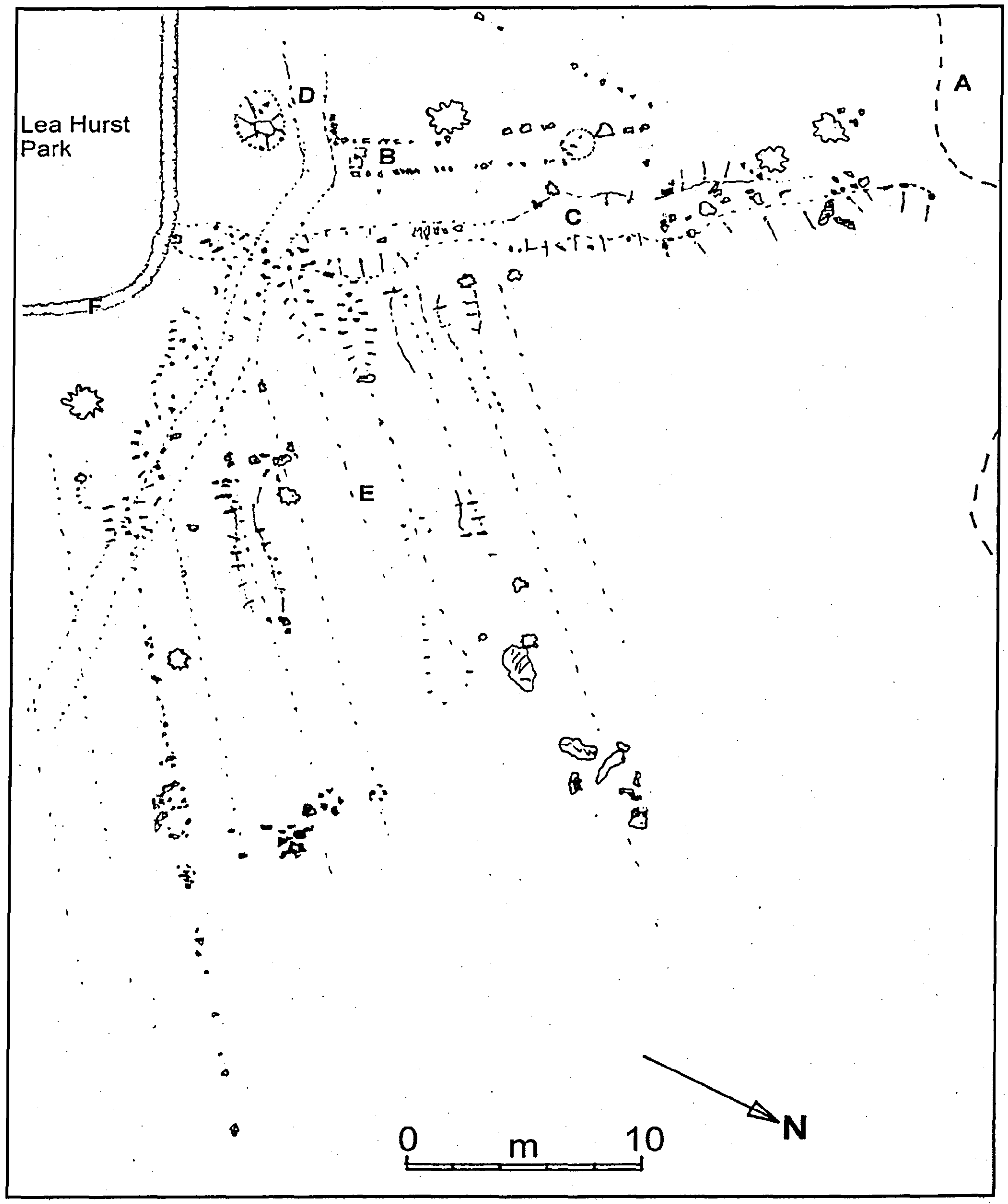


Figure 13. Lea Wood: partial survey of Leawood Knoll

Key

A Rhododendrons

B Kerbed and flagged path

C Wall debris.

D Modern track.

E Linear clearance rows

F Enclosure wall.

This area was an extension of the gardens noted above (**76; 85; 86**), with rhododendron **A,** and a kerbed and flagged path **B,** extending north west towards the rhododendron area.

The foundations of a substantial dry-stone wall **C** also extend north-west, parallel to **B.** This has been eroded where it is crossed by a path, **D**, but elsewhere it stands 50cm high. It may well also have been a garden feature; however it appears to form a retaining function where to the east, down-slope a negative lynchet has been enhanced, which may pre-date the garden. A series of linear features, **E** can be seen on the slope to the east of the knoll. Thirty slight ridges can be seen (ten are shown on the survey above), stretching north-east down slope from the wall **C**. The ridges consist of slightly raised linear heaps of stones up to 25cm in height. There are areas of larger stones interspersed with less well defined areas of smaller stones and stony soil. They can be seen as ridges and hollows particularly where crossed by the path. There are a number of small hollows further to the east, possibly the result of stone getting. The linear features do not appear to extend beyond the park enclosure and are lost to the north where a ride crosses east-west. It has been suggested that they may be medieval field patterns (Paul Ardron pers. comm.), but they are suspiciously parallel and laid-out so accurately, to a pitch of 1.5 m ridge to ridge that a garden feature is suspected. To date no plans of the gardens have been seen and early OS maps do not show any features on the knoll. However from the wall evidence the knoll enclosure was probably created by walling off a section of the parkland possibly using stone from wall **C**. It does not appear to have been completed or a rebuild was never finished because many of the coping stones are missing. The beech trees are approximately 60cm in diameter and were probably planted in the 1930s.

Lea Wood

3:5:3 Historical survey

Lea is recorded in the Domesday Book as *Lede* and it 'lies in Crich, pays taxes to Wirksworth' (Morris, 1978). It means 'the clearing' (Cameron, 1993), Gelling (1984) also suggests, 'forest, wood, glade, clearing, later pasture, meadow'. Lea Wood may mean the wood that belongs to Lea. Lea Wood is also used in documents for woods both sides of the Lea Brook which are now Bow Wood and Coumbs Wood and in different parishes (Wigglesworth, 2001; Sanderson, 1835).

Stone was quarried for querns and building use. Across the Derwent to the south in Alderwasley millstones were being quarried in about 1257 (Turbutt, 1999).

Babington family owned much of the land in the area and were involved in the lead trade. They had a bole smelter at Riber and would have obtained wood for smelting from their estates (Kiernan, 1989).

4 DISCUSSION

4.1 Introduction

The case study site surveys have recorded over 200 archaeological and ecologically significant features. The archaeological evidence may not have the same time depth distribution found in Ecclesall Woods for example, but nevertheless has produced some surprising results.

The survival of the woods is due in part to their unsuitability for agricultural use.

The woods have all been encroached upon and land improved for agricultural use at some time, possibly many centuries ago, in the case of Ducksick and Cobnar Woods by the early seventeenth century (Senior, 1630). They also continued in existence because of their value as an important resource. Their importance even in the mid nineteenth century can be seen by the breadth and range of products in the Nightingale accounts book (DRO D3585/1/1). This was approaching the end of the coppice with standards management era and within a generation high forestry management would be adopted.

4.2 Environment

Wood	Geology	Area Ha	Alt	Aspect	Slope	Drain -age
Ducksick	Coal Measures	11	155m	North	Gentle	Wet
Cobnar	Coal Measures	17	145m	North	Steep/shelving	Wet
Bow	Gritstone	22	180m	South/ SE	Steep	Dry
Lea	Gritstone	32	170m	South/ SW	Steep	Dry

Table 30. Case study sites environmental summary

Various episodes of planting have affected each site to varying degrees. Ducksick has a large area of larch, Cobnar has both birch and beech in quantity and Lea Wood has beech and Scots pine, Bow Wood is probably least affected with beech and some recent oak. Sessile oak is common in all woods with sycamore and holly. Small-leaved lime is found occasionally in Bow Wood. Seventeen species of tree were noted in the Coal Measures woods, Ducksick and Cobnar and fifteen in the Gritstone woods, Bow and Lea. A rich suite of ground flora was noted in the all the woods particularly on the margins and rides, many ancient woodland indicators were present. Beneath the canopy however the ground flora was less diverse, with bracken and bramble common, and wavy hair-grass and creeping soft-grass also common. The flora is indicative of ancient semi-natural woodland. Multi-stemmed oak, alder, small-leaved lime and sycamore are present in the woods, some appear to be relict coppice stools. Numerous oaks have a distinct bulbous trunk base possibly also associated with former coppicing (Paul Ardron pers. comm.)

4.3 Archaeology

The archaeology in Cobnar and Ducksick Woods is medieval and post-medieval, represented by bloomery slag and later fuel processing and mining activity. A flint flake, probably Neolithic has been found in a field adjoining the south-east boundary of Ducksick Wood (Richard Carr and Paul Smith). A single worked chert flake has been found in Lea Wood. Early querns have been found in both Bow Wood and Lea Wood, possibly Romano-British based on typological comparison. Lea Wood Knoll the northern high point of Lea Wood contains multi-period remains. Field features in Lea Hurst deer park may well be prehistoric. An enhanced scarp edge and possible boundary wall are visible, but await investigation, it is suggested locally that it may be an Iron Age enclosure (J.

enhanced scarp edge and possible boundary wall are visible, but await investigation, it is suggested locally that it may be an Iron Age enclosure (J. Hawksley pers. comm.). The northern slope of the Knoll has an area of faint ridge and furrow running down slope to the north. Its purpose or age is not known, consequently this area may have been less wooded than today. Woods elsewhere in Derbyshire and South Yorkshire appear to have been cleared at some point and regenerated later as conditions changed (Ardron and Rotherham, 2001). There are features in Lea Wood for example which suggest possible settlement within the wood and all the case study sites have examples of enclosed and improved agricultural land. The Knoll itself was planted with rhododendron and a garden created with rockeries and a possible grotto. A number of planted rides can also be seen throughout the wood. These features are probably Victorian and associated with the Nightingale family, who built Lea Hurst in the mid-1820s. Probable medieval stone getting, early boundaries and wood fuel processing have also been recorded in Lea. No sound dating evidence has been found; carbon dating remains a possibility should funds become available.

The main industrial archaeological features within the woods are shown in Table 31 below.

Wood	**Q Pit**	**Kiln**	**Charcoal platform**	**Quarry**	**Coal Pit**	**Quern**	**Iron stone**	**Iron slag**	**Lead slag**
Ducksick	X		X	X	X		X	X	
Cobnar	X		X	X	X		X	X	X
Bow		X	X	X		X			
Lea		X	X	X		X			

Table 31 Case study sites industrial archaeological finds summary

4.3.1 Stone getting

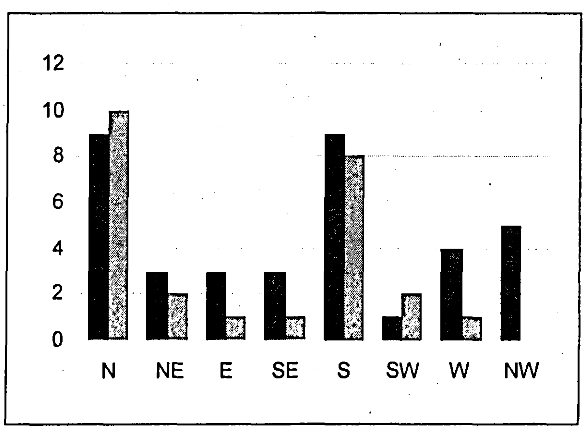
Stone has been obtained from all the woods at some time and in varying quantities. Ducksick was quarried at its northern edge probably for use in building the Linacre Reservoir dams in the late nineteenth and early twentieth century. The stone is Coal Measures flaggy sandstone which is occasionally more massive, it can also be seen in field boundary walls. There are small pits within the wood but it is not known whether stone was taken from them. The Deep Hard sandstone, which can be seen in the south of Cobnar Wood, has been quarried and extensive workings can be seen just outside the study area to the south-east. The Gritstone in both Bow Wood and Lea Wood have been extensively worked. The coarse Ashover Grit has been used to make querns for hand grinding grain to make flour or meal. Seventy-five part-finished querns have been found. Some lie possibly where they were abandoned, others have been used as coping stones on enclosure type walls, two were built into the walls of kilns and two into the buttress of the Cromford Canal lock keepers cottage. The majority are probably medieval, but since they are unfinished an exact dating is difficult. There are possibly four which resemble Hunsbury type, Iron Age or Romano-British querns (Curwen, 1937, 1941). An area in Bow Wood may well be a quern quarry, with working terrace and a possible structure. Numerous abandoned querns, chippings and possible benches can be seen. There is no evidence of final working of the stones, that operation remains to be found or may have taken place elsewhere. A Romano-British quern-manufacturing site has been found at Blackbrook, 10km south near Belper. It remains a possibility that unfinished querns were transported to Blackbrook from local quarries for completion and distribution. (Palfreyman and Ebbins, 2007). Seven abandoned quarries have been noted in Bow and Lea

Woods, two are marked on early Ordnance Survey maps and Farey (1813) mentions them and a stone saw mill on Lea Brook which flows between the woods. Large quantities of stone were required to construct the Cromford Canal and local supplies would have been important. There are examples of stone working in the woods including split stones, abandoned coping stones and dressed stone slabs now used as seats. Numerous small day-working pits can be seen, probably the site of small-scale stone extraction. Large diameter millstones have not been found in these woods, although they are numerous in the woods to the south across the River Derwent, below Riber to the north-west (Richard Carr, pers. comm.). Large diameter millstones and querns have not been found together, this may relate to the suitability of the geology and more research is needed to verify this.

4.3.2 Wood fuel

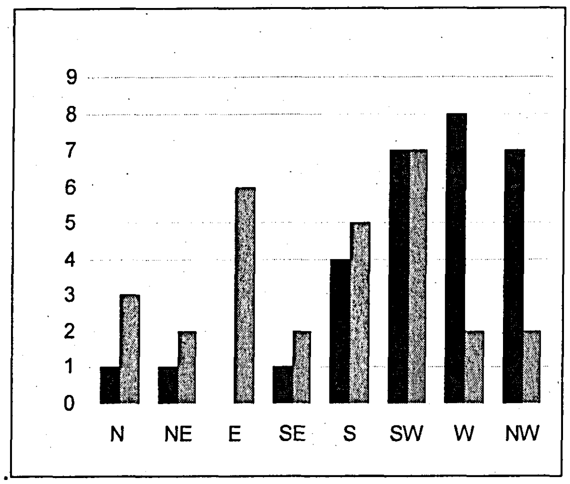
There is evidence from archaeological and historical sources that both Cobnar Wood and Ducksick Wood were being exploited for mineral and wood resources from an early date. Finds of slag not only in the case study sites but elsewhere on the ironstone rake on the Coal Measures, suggest extensive if not intensive iron working. The slag is tapping-slag typical of bloomery iron working, and could be medieval (Dr R. Doonan, pers. comm.). It is known that there were bloomery smelting sites in the area, a late twelfth century Cistercian iron working site has been recorded near Wigley in the upper Linacre Valley (NMR NATINV-314446). This study has found three sites in Cobnar and Ducksick woods and nine elsewhere in other Coal Measures woods (not case studies in this research), but none on the Gritstone case study sites. The bloomery process was superseded by the charcoal blast furnace at the beginning of the seventeenth century in

Derbyshire. Whilst these finds are important, more significant is the number of pits of various kinds also recorded in the survey. Some of these pits are clearly surface workings for minerals, coal, stone or ironstone and some still remain to be interpreted, a number have been described as Q-pits. These pits are numerous not only in Ducksick Wood, a case study site, but elsewhere on the Coal Measures. They have also been noted in other locations in North Derbyshire and South Yorkshire. (For example; Ardron and Rotherham, 1999). The description of these features is consistent across the region, a pit dug into a slope surrounded by a concentric bank with an opening down slope, in plan view like a letter Q. Variants have a shallow leat or drain leading down slope, sometimes the features are paired and are sometimes close to a stream. They appear to be dry and are non-directional. The charts below show the orientation of Q-pit and kiln entry points and the charcoal platform down-slope front edge. The data are a composite of surveys noting Q-Pits and on the Millstone Grit where whitecoal kilns have been noted by the author, they are shown at Appendix 3.



Blue: Q-pit (left hand column)   Red: Charcoal platform

Table 32. Coal Measures woods: orientation of Q-pit entry and charcoal platform edge



Blue: Kiln (left hand column)   Red: Charcoal platform

Table 33. Gritstone woods: orientation of kiln entrance and charcoal platform edge

It can be seen that Q-pits are oriented generally in line with the aspect of the wood, and closely mirrored by the charcoal platform. The kilns, in contrast are predominantly oriented towards the prevailing wind, ninety per cent of the kilns are in the NW/W/SW/S sectors, with the charcoal platforms more evenly distributed. It appears therefore that two distinct techniques were used for making whitecoal. If indeed that is what these features were for. Wind direction does not appear to be a factor on the Coal Measures; Q-pits are aligned with the available slope, which can be slight, although sometimes they are perched on the edge of high stream banks. They are sometimes paired or in multiples with the entry 'spout' leading to a stream, charcoal platforms are less frequent and in Ducksick Wood there is a one Q-pit per hectare. On the Gritstone however, kilns are single, with a stone superstructure, built into a steep slope, oriented towards the prevailing wind and remote from a water supply, often paired with a charcoal platform and a low frequency per hectare of wood.

Location	Area Ha	Q Pit	Kiln	Charcoal platform
Ducksick	11	12		2
Cobnar	17	3		14
Bow	22		7	9
Lea	32		13	13

Table 34. Wood fuel processing features

The low density of kilns could be explained by the slow growth-rate of trees, particularly oak on the thin and less fertile Gritstone soils. Some of the Q-pits that have been excavated elsewhere have internal stonework or channels but super structural remains have not been noted (Clayton, 2000; Fowkes, 1992; Franklin, 1991). It is generally thought that these features are the remains of kilns which made whitecoal, a fuel made from dried wood which was used in the ore hearth lead smelting process. This process was introduced in the late sixteenth century and was superseded in the mid-eighteenth century by the introduction of the coal fired reverberatory furnace or cupola. It is thought that the Q-pits were in fact kilns and that their stone superstructure has probably been robbed and re-used elsewhere, leaving a pit (e.g. Crossley, 2005). In the Coal Measures woods Q-pits are numerous but no evidence of superstructure or stonework internally has been noted in this study. This contrasts with the Gritstone Woods where no Q-pits of the same typology have been noted, but where numerous stone built kilns have been recorded, often with an associated platform. These features have been interpreted as whitecoal kilns and charcoal platforms respectively. The kilns are generally well preserved and the stone-built superstructure is visible. The kilns have a well-defined opening oriented to the south or south west, the prevailing wind direction. Internal dimensions are fairly consistent approximately 4.5 metres x 4.5 metres and 1.5 - 2.0 metres deep. They appear to be built into an existing feature either a small quarry or delve, the internal corners are occasionally rounded as a result and large earthfast boulders have been used in the walls. A down slope spread of debris is usual consisting of un-burnt mineral coal, ash and charcoal. Tracks leading to the kilns are only occasionally visible. Internal supporting walls or stones which can be seen spanning the Froggatt kiln are not present here. Kilns often have an associated platform nearby from which charcoal fragments have been obtained, it seems likely that these structures were used for making charcoal. Generally they are ovoid, 6 - 8 metres x 4 - 6 metres and built back into the hillside. A number have substantial revetted down slope drystone walls giving the impression that they were very much a permanent feature. It is possible that they had some other function, such as a base for a dwelling or a loading point. At Lea Wood Knoll charcoal debris in a path was noted, it was approximately 6 metres in diameter and slightly dished and without revettment.

It seems therefore that two distinct methods of producing whitecoal were in operation, Q-pits in the Coal Measures and woods and kilns in the Gritstone woods. The reason for this is not clear, two documents from the Portland Papers sampled mention whitecoal kilns: In 1586 *supply of kiln dried wood* to Lee Bridge smelter, Barlow (157 DD/P/42/10), and in 1762 *to make pits and kilns for making charcoal and drying white coal* in Barlow (157 DD/P/42/70). Two possible kiln-like structures have been noted by the author in Linacre Woods perhaps kilns were also in use in Coal Measures woods but have yet to be fully recorded.

A feature of the woods on the ironstone deposit in the Coal Measures is the high number of Q-pits in relation to charcoal platforms. It is a possibility that the Q-pits were originally used to make charcoal. Why so many Q-pits were required remains a mystery, unless charcoal making in pits was a relatively slow, inefficient process and small-scale process that many pits were required. Perhaps the later shift to charcoal hearth/platform production recognised this fact. Cobnar Wood in contrast has a large number of charcoal platforms, probably due to its close association with the Barlow charcoal blast furnace located 500 metres to the west of the wood. The lead ore hearth smelting mills were short lived, although there were a number on the Coal Measures streams, few exceeded a life of thirty years, those that did were red lead mills which used mineral coal and other fuels (Willies, 1999). Demand for whitecoal locally therefore was short-lived. The Linacre over and Nether lead smelting mills were working between 1596 and 1613, the Lee Bridge smelting mill in Barlow was in operation in 1582 and last mentioned in 1652. The Gritstone woods however used kilns and ore hearth lead smelting mills in Lea were in operation for well over 150 years. Perhaps the lack of competition for wood from other industrial users on the Gritstone woods or ownership closely linked to local lead production enabled a longer view of investment to prevail; resulting in permanent stone built whitecoal kilns and charcoal platforms. The Coal Measures woods in contrast were under considerable pressure from both iron and lead processors. The wood had a long tradition of charcoal production in pits and possibly continued using the same pits and avoided any additional investment. Perhaps this was a result of ownership by the Portland's whose interests were elsewhere. It does not appear to be a progressive technological change. Q-pits have not been found in the Gritstone woods, but kilns have been recorded in

Shacklow Wood near the River Wye and are probably associated with the nearby ore hearth smelt mill which was operating *circa* 1581.

4.3.3 Metal processing

It has been noted above that iron has been worked since at least the twelfth century in Linacre and Barlow. Evidence for this has been found in Ducksick Wood and Cobnar Wood in the form of bloomery tapping slag and a possible section of furnace base in Cobnar Wood. Numerous pits in Ducksick Wood, ironstone in the streams and large slag deposits suggest considerable iron smelting activity. In Cobnar a large slag deposit has been revealed in the river bank and an associated area with possible working area of compacted earth, a number of small pits beside the river suggest ironstone extraction. Also in Cobnar Stream erosion has revealed the possible foundations of a lead smelting mill, nothing further is known about the site, limited excavation could discover more evidence.

Cobnar Wood is the most difficult wood to interpret; it is documented in the fourteenth century and was coppice in the sixteenth century. It was surveyed by Senior and can still be recognised in part from his map (1630). The late nineteenth and early twentieth century however radically changed the nature and size of the wood. A drift mine worked the Deep Hard and Piper seams in the southern part of the wood and a deep mine in the north worked the Tupton seam. In addition ironstone was extracted from between the Piper and Deep Hard seams by bell pit, these can be seen below the scarp. Collapsed adits and shallow coal workings can also be seen. A line of charcoal platforms has been noted also below the scarp and a further series of charcoal hearths has been noted slightly lower down the slope, some of these could have been for ore roasting, excavation could determine the validity of this. The wood has been much affected by industrial activity in the late nineteenth and twentieth century. Large areas of the wood are covered by colliery spoil and spoil probably from cutting a new course for the Barlow Brook. Extensive heaps of earth can also be seen in the north-east possibly topsoil removed prior to construction of the industrial buildings

4.3.4 Woodland enclosure

Of the woods studied, only Cobnar does not have a defined internal clearing of improved agricultural land, despite there being apparently suitable land. However there is a slight suspicion of feint ridge and furrow suggesting that there might have been such an area but that the boundaries are now lost. There is also the possibility that the postulated deer park fossilized former fields which were then converted to woodland. The ovoid shape of the Lea Wood pasture suggests it may well be ancient. However, the high, drystone-walled rectangular field in Bow Wood and the fact that it also appears to truncate a deep Holloway suggest a later date. The enclosure in Ducksick Wood is shown on Senior's map of 1630, but Senior does not show an enclosure in Cobnar Wood on his Barlow Estate survey of the same period. The provision of enclosed land within a wood was important; it provided grazing for draught animals used in the various woodland activities, packhorses, carthorses and oxen and possibly as a resource for families temporarily (or permanently) at work or even living in the woods. It would ensure that animals were securely excluded and prevented from grazing the coppice shoots. Cleared areas within woods have been noted elsewhere although they have not been studied in any detail.

4.4 The woodland resource

Charcoal was required both to work metals and for other industrial and domestic uses and firewood was needed for heating and cooking. This was provided in the main by underwood, the small rods and poles which sprang from coppiced trees. Coppice woods were cut on a regular rotation the interval determined according to end use, tree species and productive capacity of the wood. The coppice cycle was therefore a key element in woodland management. Present-day charcoal burners prefer wood 3.5 - 15 cm in diameter and a ten –fifteen year coppice cycle (Anon., 1996: Forestry Commission nd). There is virtually no information about the type and size of wood used in the making of whitecoal. Crossley (2005) suggests billets of up to twenty-five years growth, Jones (2003) suggests 15 cm long x 5 cm thick sticks or poles which could be chopped. Raistrick (1975) uses the term chop wood kilns to describe the North Yorkshire version. Poles of this size could come from underwood of about ten - twelve years growth, depending on species for example hazel, wych elm and holly. This was also probably a size suitable for tool handles an important local craft. Documentary evidence from the Portland Deeds and Estate Papers shows that of twenty two leases sampled, fourteen related to woodland and of these eight give a duration for the lease. They span the period 1513 to 1703 and the leases range from four to eleven years. However where property and agricultural land was included the leases generally were for twenty-one years. The leases are detailed in Appendix 4.

Document	Year	Duration	Use
157 DD/P/84/1	1513	4	Charcoal
157 DD/P/53/3	1571	6	Charcoal
157 DD/P/84/3	1596	5	Charcoal
157 DD/P/42/65	1660	10	All woods
157 DD/P/43/76	1692	11	Cordwood
157 DD/P/114/81	1696	7	Charcoal+whitecoal
157 DD/P/114/82	1697	5	Cordwood
157 DD/P/42/68	1703	9	Charcoal+cordwood

Table 35 Portland documents: duration of leases

The documents need careful scrutiny which is beyond this work, but if the lease periods are reliable then the underwood may have been of small size and mixed species. Seventeenth-century Portland leases relating to Carburton, Nottinghamshire mention seven years (57 DD/P/5/17 and 18) and ten years in a Kirkby in Ashfield lease of 1671 (157/DD/P/15/55). Oak which grows slowly would have produced only small wood, it is possible that other species were also important for underwood. One document mentions wood species directly (42/36), the theft of 600 cartloads of ash (*Fraxinus excelsior)* wood, amongst 1000s of loads of copse wood, charcoal and whitecoal whose species are not recorded. Ash may have been more important formerly, it is mentioned in the earliest record of coppice woods in Chesterfield in 1402 and concerns the protection of the ash shoots (Bestall, 1974). An estate account of planting in Moorlawn Coppice, a Coal Measures woodland in Holymoorside near Chesterfield dated 1809-13 is shown below (Barnes BAR 22).

Species	Quantity	Percent
Larch	8310	45
Ash	6000	33
Italian poplar/willow	2000	11
Scots fir	2000	11
Total	18310	100

Table 36. Tree planting Moorlawn Coppice 1809-1813

The information above and sales information between 1824 and 1829 confirm that ash represented 20-25 per cent of wood sales. When it lost its significance is not known. Oak may have replaced other species because its bark was valuable or because the standards were more valuable or a more consistent plant overall. Portland Document (53/3) indirectly mentions *the bark at every fall* and is probably oak. It formed the major part of wood sales in later wood accounts, but was part of a range of other trees. The information from the Nightingale and Barnes archives are early nineteenth century when the coppice wood industry was changing. The eight charcoal samples selected from charcoal platforms for analysis consisted of four oak, two holly, one alder and possibly one cherry. The samples are not dated but they suggest a diverse supply of underwood.

Details on the processing of wood for whitecoal and charcoal are rare, later evidence may well be different from sixteenth century production techniques. Whitecoal in particular has left little trace either archaeological or documentary.

Figure 14 Fuel for furnace from Agricola (Dibner, 1958)

Agricola illustrates wood fuel in a variety of shapes and sizes. Although scale and perspective are artistic rather than realistic fuel is drawn as small section sticks, bundles of faggots and rods and only very rarely large diameter billets.

Wood to make whitecoal was probably made small enough to shovel onto some kind of drying platform, then into panniers, or bannisters and finally shovelled into the smelter. The ore hearth smelter had a relatively small capacity and consequently the fuel may well have been of small section. The discussion of timber size used to make whitecoal is fraught with difficulty. Estate records are often contradictory; Mower's diary for example notes he cut the Earl of Shrewsbury's spring woods every forty years, (although this is not borne out in contemporary documentary evidence elsewhere), he also sold 'kidwood' – kids being bundles of sticks for lighting bread ovens (Milward, 1992:21). Wood of 40 years growth would be substantial timber and not to be confused with wood for fuel. It is likely that woods were cut at between twenty and forty years as documented, but at the same time small wood was extracted from the underwood on a shorter cycle to suit the varying needs of local consumers. This is apparent in the later Nightingale accounts where all manner and type of wood was sold as demand dictated.

What was the impact of local industries on the woodlands? The Scarsdale Hundred, effectively North-east Derbyshire, is used here as an example of woodland exploitation in the seventeenth century. An attempt has been made to estimate the fuel requirements of the iron and lead processing industries. The exercise however is fraught with difficulties, yields, outputs and values are only best estimates. It is based on previous work by Hammersley (1973), Kiernan (1989), Crossley and Kiernan (1992), Oxtoby and Price (1959) and Collins (1989; 1996), the basis for calculation is shown at Appendix 7.

The estimates are deliberately cautious and may underestimate lead production in Scarsdale, but the exercise serves to show the pressure placed on the woodlands as industrial activity increased.

Lead: the ore hearth smelter used dried wood or whitecoal as fuel, in addition charcoal was used to re-smelt slags in the slag mill. However since this was only a small percentage of the wood used it has been ignored.

The Scarsdale Surveys of 1652/3 (Beckett and Polak, 1993), lists fourteen ore hearth smelters, although it is not known how many were actually in production.

Kiernan (1989) estimates an ore hearth smelting mill output at 200 tons per annum and consumed 1.07 tons of whitecoal per ton of lead smelted.

14 x 200 x 1.07 x 1.25 = **3745** acres of woodland

Crossley and Kiernan (1992) estimate 18,000 acres of woodland were needed to smelt the total lead production in Derbyshire in the mid – seventeenth century and the 3745 acres above represents almost twenty-one per cent of their estimate. They list 60 smelting mills, of which fourteen or twenty-three per cent were located in Scarsdale. The estimated acreage therefore appears credible.

Iron: The Scarsdale Surveys list seven charcoal blast furnaces, but eight are known to have been in production at this time – the omission is Barlow Furnace.

Output per furnace is thought to be in the range of 300 – 400 tons of iron per annum (Beckett and Polak, 1993) and 200 – 250 tons at the forge.

To smelt one ton of pig iron Collins (1996) estimates it requires 7.7 cords of wood at 0.9 cords per acre.

8 x 350 x 7.7 ÷ 0.9 = **24000** acres of woodland.

To forge one ton of bar requires 8.8 cords of wood at 0.9 cords per acre.

8 x 225 x 8.8 ÷ 0.9 = **17600** acres of woodland

Total:

- Lead 3750
- Iron blast furnace 24000
- Iron forge 17600
- Total **49090** acres of woodland.

The land area of Scarsdale: 145000 acres, woodland therefore is approximately thirty-four per cent of the land area.

The Scarsdale Surveys suggest twenty-five per cent woodland cover in the mid-seventeenth century. This estimate may not be reliable, apparent ancient woodlands seen today are not listed in the survey and may be recorded in adjoining parishes.

The total acreage of 49090 appears high and may well indicate the pressures the woodland resource was under, indeed the lead smelters began to move westwards towards the wood resources nearer to the ore field but also because competition for wood was less.

However there are also a number of factors which also may have affected and reduced demand.

1 The coppice cycle is clearly of great importance and work elsewhere in this study has suggested shorter coppice cycles may have been in use. Indeed a coppice cycle of twelve years would reduce the requirements to 29,000 acres or 20 per cent of land area a more credible figure.

2 More intensive use of woodlands, removal of undesirable plants and higher density cultivation and encouraging more productive trees such as ash and alder. Hazel in particular was often removed not only because it was a slow growing tree but because it also attracted 'undesirables' collecting nuts. (Farey, 1813)

3 Wood purchased outside the area, coaled and brought back for use by the Scarsdale smelters. Iron masters are known to have obtained wood elsewhere (Beckett and Polak, 1993).

4 The use of mineral coal as a substitute fuel.

It is known that coal was in use at an early date in the area, although it was not used in smelting it was used in drying wood for whitecoal (Kiernan, 1989). Ralph Hethcote, brazier, left "two *lodes* of *seacawles*" valued at 5s-0d in 1576/7, and in 1560 Richard Stevenson a nailer left *coles* valued at 2s-4d. These may be examples of the use of coal in metal working. The iron-working trades were well established by the mid seventeenth century most towns had smiths and smithies, (Hey, 1972). They had probably been using coal in their furnaces for some time as in Nottingham where it was in use by the smiths in 1257 (Schubert, 1957). There may well have been a domestic market for coal, certainly by 1578 Peter Barley gave Henry Berisford the right to "ironstone for his smithies in *Barley (Barlow)* and *sea coal* for his house" (157/ DD/P/71). A document dated 1578 restates the rights of the Earl of Shrewsbury's tenants to dig for coal on the common and for the Earl to sell them coal at 1s-4d per ruck or load (157 DD/P/50/66). These examples show that coal had been used locally since at least the fourteenth century. The impetus for its use particularly after the sixteenth century may have been the erosion of commoners' rights to wood fuel, enclosure of the commons, more intensive (and exclusive) use of woodlands and deterioration in the climate. The 'fireside revolution' (C. Williams pers. com.) of the seventeenth century changed the management of Coal Measures woods dramatically. Whilst coal replaced wood for domestic heating, timber props for coalmines became a significant market. Typically traditional species wood of up to thirty years growth was used, but increasingly new species such as larch were introduced.

There is evidence that coppice cycles increased and that the Portland Estate's Barlow Woods were being managed on a thirty-year cycle in the mid-eighteenth century. Whether this was a response to market changes, the supply of pit props for example or that the woods were becoming less productive is not known. Work by Ardron and Rotherham (1999) suggest that soils in some woods were impoverished by charcoal production caused by the heavy demand for soil and vegetation to cover the charcoal stacks. The exclusion or reduction of livestock grazing may also have reduced woodland soil fertility. This may have resulted in the increase in oak and the reduction of other species.

4.5 Later developments

Sessile oak (*Quercus petraea*) is the most abundant species in ancient woodland in the study areas, usually on the fringe of woods whose interior has been replanted. Oak was an important and productive tree, its timber was prized for construction and its bark was used in tanning. The bark could be worth up to half the value of the wood and the best bark came from young coppice trees of twenty years growth (Clarkson, 1974). By the end of the eighteenth century coal was becoming the most widely used fuel, although some industries would continue to use charcoal. Demand for props (known as puncheons or punch wood locally) for coal mines was increasingly important. Large timbers for canal construction, civil engineering and later railways were also important. The change was radical, in the seventeenth century ninety per cent of England's wood output was used as fuel. Although by 1820 coal was meeting ninety per cent of England's fuel needs, coppice woodlands experienced a revival. Prices remained high as demand changed to supply new industries and products (Collins, 1996). In Derbyshire the textile industry consumed large numbers of bobbins made from wood including 4 inch (10cm) alder poles for bobbins. Larch was introduced in the 1750s principally to supply the mines. The old spring woods continued, mostly oak but also ash, sycamore, hazel, birch and sallow (willow) oak stems were allowed to grow to 21-28 years for puncheons. The underwood also produced fleaks, hurdles, broom-sticks and hedge-stakes, the remaining underwood and the tops of the wood trees were corded and converted to charcoal on the spot (Farey, 1813). The range of products made in the woods was considerable. In 1831-5 Nightingale lists: pegs, poles, bindings, spars, rails, posts, stakes, laths, straps, bobbin poles and various rods. The tree species were also varied including: willow, oak, 'Scotch fir', sycamore, beech, spruce, poplar, larch, ash and elm. (D3585/6/1) These were supplied from Lea Wood and Bow Wood. There are some very large beech trees in Lea Wood which may date from planting at this time, but no willow, poplar, larch, and only isolated examples of ash and elm have been noted.

Enough evidence is available from documents and the woods themselves to be fairly certain that the woods were managed as coppice with standards. They would have supported a skilled work force although nothing is known about them; they may have had dual occupations, combining farming, stone getting or metal processing with woodland work. There is an account of a family of charcoal burners who lived in the woods on the Hurt's Estate in the nineteenth century (Anon, 1909), it is not known whether this was common practice elsewhere in the area. An entry in E Nightingale's 1832 wood book records a Mr Wheatcroft sold oak timber to the Old End Lead Mine and probably employed his own men to cut and cart the timber (D3585/6/1). The Wheatcroft family of Cromford owned premises beside the canal basin, became well known as merchants and boat builders in the early nineteenth century and may well have acted as agents for local woodland owners.

5. CONCLUSIONS

Derbyshire's woodlands have not been extensively researched, particularly on the Coal Measures where it is has been thought to be unrewarding. Yet as this work shows, the woodlands studied contain many archaeological features which combined with environmental and historical background can provide a history of the wooded landscape, albeit biased towards the visible industrial remains. Apart from Domesday Book early knowledge of woodland history is virtually non-existent. Derbyshire woodlands are relict industrial landscapes, fashioned by former socio-economic demands and modified by the long term exploitation of their resources. Their history is largely the history of early modern industrial technology.

There are differences between the case study sites on the Gritstone and those on the Coal Measures. Indeed there are differences within woods on the Coal Measures, between those on the ironstone rake and those woods away from it. In the woods on the Gritstone, the remains of stone getting, quern making, fuel processing in the form of stone built kilns and substantial charcoal platforms were found, whilst in the Coal Measures woods Q-pits, lead slag, iron slag, iron stone pits, stone getting and the remains of coal mining were noted. Geology is clearly an important factor in determining the exploitation potential of the woods. Whether oak, which is dominant in all the woods (in the relict ancient woodland areas), is a result of selection by industrial users cannot be claimed with any certainty. Tradition and culture may well also have affected the ways in which woods were exploited and worked. The Coal Measures woods and their long association with iron working may have led to a more conservative approach to wood fuel and management, continuing with pit-made charcoal. The ore hearth lead smelting boom of the late sixteenth century led to a huge demand for white coal. This could have been met by rapidly adapting the charcoal pits to make whitecoal. When lead smelting moved back nearer to the ore fields, purpose built kilns were introduced along with the more efficient charcoal platform. Q-pits however, may well have continued in use to make coke. This may explain the lack of charcoal platforms in woods on the ironstone rake deposit of the Coal Measures.

Later developments in woodland management systems and ownership have further differentiated the woodlands. The polarisation not only between Gritstone and Coal Measures, but also between woods in similar locations can be seen as a function of later industrial demands. Cobnar Wood on the Coal Measures is much smaller than its Elizabethan extent, reduced by coal and iron-stone mining in the nineteenth and twentieth century, water management and industrial expansion in the late twentieth century. Ducksick Wood in contrast has regained its pre-seventeenth century size. A twentieth century conifer plantation has regained those enclosures shown on Senior's seventeenth century map. Although both woods have been felled in the twentieth century, Ducksick has been managed as part of a water catchment system for over 150 years and there has been limited invasive industrial activity in that period. Cobnar was planted with beech at some point in the early twentieth century, possibly to cover or mask the mine workings; they are now an important landscape feature. The woods today are less diverse than woods recorded in the estate sales books of the early nineteenth century. Ash in particular is relatively rare in the case study woods, although it had been coppiced in former times and is the only tree to be mentioned in early documents. This may be because it was valuable as a fuel or in demand as a raw material and as a result led to over-exploitation. It may be that industrial pollution led to increased acidification of the already nutrient depleted woodland soils. It is abundant on the

Coal Measures in plantations and hedgerows, but its absence from the case study woodlands demands more research. The Gritstone woods retain some of their former industrial character, Bow Wood in particular, although felled and replanted with beech and possibly sycamore, still retains a strong sense of its industrial heritage. Whilst Lea Wood also contains some significant examples of former industrial exploitation, it has been extensively modified. There are large areas of rhododendron, beech and Scots pine plantations, some of which are part of a Victorian leisured landscape. This study has added over 200 new archaeological features to the local knowledge database, indeed the bloomery sites which have not been recorded before may be highly significant. The early iron industry is not particularly well recorded and its association with Q-pits and charcoal has not been discussed fully. Similarly the querns in Lea and Bow Woods have not been noted before and add a new dimension to woodland industry in the region.

It has not been possible to date any of the features other than by broad typological comparison. At some stage in the future small-scale excavation may help to establish a chronology for the woods.

All the woods are owned at least in part by organisations committed to their long-term use as amenity assets and management is benign and non-destructive although it is by no means certain that the full potential of their historical significance is understood. There does not appear to be any immediate threat to the woods but some of the former industrial features are at risk from tree root damage. Cobnar Wood is the only wood suffering from vandalism by motorcyclists and rough camping. Flood water erosion by the Barlow Brook is threatening both the iron slag deposit and lead smelting feature and a limited excavation may be necessary to rescue the archaeology. Some of the shallow coal workings have collapsed and may need remedial action.

It is hoped that this study can be used to increase the awareness of owners of their historic woodland heritage and the techniques which are available to record the remains. This study is of just four small woods. Many more remain to be investigated and researched and it is hoped that this framework can be usefully employed in other locations.

Research outcomes

To what extend have the aims and objectives of the research been achieved?

This study has shown that there is indeed a wealth of archaeology still to be seen, certainly in the case study sites and in other woods across the region. The influence of industrial exploitation is evident in the features and remains recorded, many of them for the first time. To that extent the study has fulfilled a significant part of its agenda. That some of the archaeological findings can also be reinforced by documentary evidence is doubly important. The relationship between industrial exploitation of the woodland resource has been explored and the environmental data which has been collected has highlighted the complexity of that relationship. This further reinforces the mixed disciplinary approach to woodland history and justifies its use here. It has also confirmed some of the difficulties of surveying and recording the archaeology of woodlands. A possibility remains that areas remain under-surveyed as a result of working in difficult terrain and dense vegetation.

A subject not adequately addressed by the study is that of the people who depended on the woods for a livelihood. The woodland workers are largely anonymous in the historical record. More research for the modern period would have helped to flesh out this subject.

Data collection was simplified by the use of GPS and the Garmin device and software enabled observations to be recorded in Ordnance Survey Grid Reference format for easy mapping. This is an easy technique to use and providing conditions are favourable, for example the canopy is not too dense and there are adequate satellites in view the results can be very accurate.

Results of the surveys have been passed to the Heritage and Environmental Records Officer for evaluation and possible inclusion on the database. This was done by assembling a gazetteer of the features on an Excel spread sheet and E mailing the copies. Lack of familiarity with the Mapinfo software precluded anything more sophisticated than the simple map presentations shown in the text. This is a powerful tool and its potential is well known.

The wider picture

How do these conclusions compare with research elsewhere?

Whilst there has been very little woodland research in Derbyshire, in Sheffield and South Yorkshire there has been a considerable amount of work. The case study woods above reflect similar impacts on the wooded environment that has been noted in Sheffield and South Yorkshire, particularly the long term exploitation of the woods for industrial fuel. This is evidenced by charcoal hearths and Q-Pits, the degradation of soils and the dominance of sessile oak. Whitecoal production is well recorded, but the variation in production methods has not been studied.

The influence of geology on the availability of resources in the woods has also been noted, particularly in Ecclesall Woods, where mining and quarrying took place. Nationally comparisons are more difficult, variations in species, geology and local demands have created different responses. In general management techniques of coppice and coppice cycles are broadly similar. However there is no evidence in the case study sites of pollarding or compartments which characterise some woods in other parts of the country.

Further research

Plant association

The plant association noted on the iron slag deposits have not it seems been reported elsewhere, the simplistic view is that higher soil pH provides a suitable environment. However not all iron slags support this plant community and the plants exist elsewhere in other parts of the woods on lower soil pH values. The slags may well be complex deposits of mineral nutrients. This may be as a result of processing characteristics over time. In other words there may be a process/chronological relationship to the slag composition which could be investigated. If the association could be explained it may be a useful archaeological prospecting tool.

Regeneration

The woods vary in their state of preservation, the Coal Measures woods have been extensively replanted, the Gritstone woods less so. However, the Gritstone woods show little sign of regeneration, no immature oaks (other than attempted replanting) have been noted. The only area of regeneration in Lea Wood is on the fringe of the former pasture, mainly elder, hawthorn and birch. The ecological surveys in this work were observations rather than statistically correct botanical samples but nevertheless they recorded two particular anomalies. The first is the apparent lack of regeneration of sessile oak (*Quercus petraea*) in the Millstone Grit woods. The second is the demise of ash (*Fraxinus excelsior*) in all the woods studied compared with recent historical records. This work generally alludes to selective felling or the reduction in soil fertility. There may well be other reasons why these changes have taken place. Have studies elsewhere noted similar phenomena? What part has climate change or pollution played on these particular species? Ash appears to be abundant in hedges on both the Coal Measures and the Millstone Grit why has it disappeared from the woods?

Quern manufacturing

An opportunity exists to establish not only an accurate time-frame for the quern finds, but also a quern finishing site. It is possible that they were taken elsewhere, to Blackbrook for example to be finished, but it is equally possible that they were finished locally. More extensive woodland surveys, nearer to known route-ways and river crossings might provide that evidence.

Whitecoal

Whitecoal which Rackham (2006: 205) calls 'This mysterious fuel' is under-researched, very little is really known about processing methods. This work has recorded two distinct methods of processing, Q-pits and kilns, if that is what they are. Given that the orehearth was a relatively small structure is it likely as Rackham, quoting Crossley (1992) suggests that it was made of 'bigger sizes of wood than usual for charcoal' (ibid)? What else could they be, if they are all kilns why are they so well preserved and others completely robbed of their infrastructure? What are their dates? Is the hypothesis suggested here that Q-pits and charcoal pits were the same feature correct? This is an important area for research, whitecoal has left an indelible mark on North-east Derbyshire's woods yet so little is known in detail about its production and the people who produced and transported it.

The Future

The semi-natural ancient woodlands are the subject of considerable research and interest (e.g Rackham 1980; 2006). The woods vary in their state of preservation, the Coal Measures woods have been extensively replanted the Gritstone woods less so. However the Gritstone woods show no signs of regeneration, no immature oaks (other than attempted replanted) have been noted. The only area of regeneration in Lea Wood is on the fringe of the former pasture mainly elder, hawthorn and birch. There is no browsing although rabbit is common the explanation for the lack of oak regeneration is complex and beyond this work.

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APPENDICES

APPENDIX 1 SOIL TEST RESULTS

Wood	Test	Date	OSG SK	pH	Description
Cobnar	1	Apr/10	35887 75473	4.69	River terrace
	2		35788 75489	4.44	Nr Q-pit
	3		35529 75440	5.6 [1]	Slag heap
	4		35536 75364	4.52	Central birch plant
	5		35589 75165	4.11	Rising ground under beech
Median				**4.44-4.52**	
Ducksick	1	Apr/10	34097 72309	4.9	Nr Q-pit
	2		34225 72410	5.48[1]	Slag
	3		34312 72250	4.28	Central larch/pine
	4		34363 72227	4.71	By ironstone workings/ Q-pit
	5		34391 72430	6.23[2]	Waterlogged ex pasture
Median				**4.9**	
Bow	1	Apr/10	31600 56150	4.51	Down slope
	2		31380 56320	4.57	Upslope nr kiln
	3		31616 56241	4.92	Nr S L lime
	4		31448 56440	4.41	Grassy clearing upslope
	5		31359 56477	4.35	Under beech
	6		31310 56434	5.08[3]	SW enclosure by ash
Median				**4.51**	
Lea	1	Apr/10	**31681 55551**	**3.99**	Above canal quarry workings
	2		**31796 55694**	**6.44[4]**	West end of tunnel field
	3		**31896 55817**	**4.12**	North slope
	4		**31982 56118**	**4.12**	West near platform
	5		**31910 55912**	**4.27**	Open slope
	6		**32065 56036**	**4.02**	Knoll furrow feature under beech
	7		**32063 56047**	**4.2**	Knoll ridge feature
	8		**31800 55898**	**4.61[5]**	Hazel/oak compartment
Median				**4.12**	

The following values were excluded:
[1] Taken from iron slag heaps and not representative of the surrounding soils, but were colonised by *Anemone nemorosa* and *Mercurialis perennis.*
[2] Sample obtained from what is thought to be abandoned pasture and the high value represents past attempts at improvement.
[3] Sample taken from an area close to enclosed pasture and may contain run off from the enclosure and perhaps explains the presence of *Fraxinus excelsior* an isolated example.

[4]Sample taken from improved grassland
[5]The area around this sample may have been pasture.

SUMMARY

Location	pH
Cobnar	4.5
Ducksick	4.7
Bow	4.5
Leawood	4.1

There is very little difference in median values across the case study sites. However, there is considerable variation within sites. This is caused by anthropogenic processes overtime. Iron smelting in Cobnar and Ducksick Woods indicated by the presence of *Anemone nemorosa* and *Mercurialis perennis* together, this phenomena has been noted in other woods and often indicates the presence of slag. Ducksick Sample **2** , pH 5.5 was a stream bank location, whilst in Cobnar the location of Sample **3** was dry. Sample **5** in Ducksick was from an area thought to be an abandoned enclosure, the value of pH 6.2 may well reflect this, the area is now waterlogged and planted with conifers. Sample **6**, pH in Bow Wood may be the result of run-off from the nearby enclosed pasture which has been improved. Although Sample **3**, it should be noted, near to the *Tilia cordata* also has a similar value pH 4.9 it is possible therefore that pockets of less acidic basal conditions exist throughout the wood. Lea Wood has an area of improved grassland and Sample **2** illustrates this. Samples **6** (Furrow) pH 4 and **7** (ridge) pH 4.2 were taken from field patterns on the knoll. It was a possibility that the ridges may have been 'improved'. The results are not conclusive and other tests may help.

Appendix 2

DUCKSICK WOOD: GAZETTER OF FEATURES

No	Feature	Description	OSG east	OSG north	Notes
1	Charcoal p/f	D6 m	434133	372326	Charcoal found
2	Q Pit	D4 m x .75 deep	434105	372310	
3	Q Pit	4 m x 5 m x 1 deep	434169	372361	Stream side
4	Q Pit	5 m x 4 m x 1 deep	434239	372432	Above stream
5	Q Pit	D6 m x 1.8 m deep	434249	372464	Above stream
6	Q Pit	D7 m x 1.5 m deep	434284	372290	Above stream
7	Q Pit	D5 m x 1 m deep	434338	372196	In wood by small stream
8	Q Pit	5 m x 4 m x.75 deep	434358	372206	
9	Pit	D6 m x .75 deep	434362	372215	No lip, SW of stream, ironstone in river
10	Q Pit	D6 m x 1 m deep	434360	372217	Long leat to river
11	Pit	4 m x 4 m x .75 deep	434360	372205	Iron or coal?
12	Pit	D6 m x .5 m deep	434373	372210	Shallow water filled iron or coal?
13	Pit	D3.5 m x .25 m deep	434387	372210	?
14	Pit	D2 m x .75 m deep	434297	372134	Circular, water filled coal debris
15	Slag	10 m x 4 m	434247	372229	Slag spread by field wall and in wood
16	Pit	S/r 4 m x 7 m x .75 m deep	434306	372268	Iron or coal?
17	Q Pit	D4 m x .75 m deep	434418	372296	Stream side W
18	Pit	5 m x 3 m .75 m deep	434244	372420	Stone?
19	Culvert	5 m x .6 m x .4 m	434233	372396	Trackway over stream
20	Double Pit	S D4 m x 1 m deep. N D5 m x 1 m deep	434306	372364	Interconnected pits, lower open down slope?
21	Q Pit	4 m x 3 m x .75 m deep	434270	372270	On steep, sloping bank
22	Pit	4 m x 3 m x .5 m deep	434293	372266	Ironstone?
23	Pit	6 m x 4 m x 1 m deep	434296	372281	Ironstone?
24	Platform	10 m x 6 m	434225	372315	No charcoal found
25	Slag	20 m x 16 m	434232	372311?	Slag found on platform and in stream
26	Pit	d3 m x .3 m deep	434269	372320	Shallow pit?
27	Pit	5.5 m x 3.5 m x .5 m deep	434290	372376	Shallow pit?
28	Q Pit	7 m x 4 m x .75 m deep	434251	372477	
29	Quarry	D5 m x 5 m deep	434218	372529	Deep pit on edge of cliff

30	Pit	5 m x 3 m x 1 m deep	434232	372518	?
31	Pit	7 m x 3 m x.75 m deep	434174	372484	?
32	Pit	D4 m x.5 m deep	434184	372488	Shallow pit?
33	Pit	D4 m x .5 m deep	434393	372253	Ironstone?
34	Pit	D4 m x 1 m deep	434385	372243	Much spoil by stream, ironstone?
35	Pit	D4 m x .5 m deep	434336	372133	Shallow pit?
36a	Levelled area		434259	372297	
37a	Slag spread		434254	372255	
38a	Holloway 1		434227	372512	
39a	Holloway 2		434208	372490	
40a	Holloway 3		434243	372319	Drain or trackway to slag?
41	Platform		34219	72318	Charcoal platform 5 x 3.5 x .5
42	Q Pit		434237	372348	D3 m beside stream

Appendix 2.2 COBNAR WOOD: GAZETTEER OF FEATURES

No	Feature	Description	OSG east	OSG north	Notes
1	Q Pit	D2 m x 1 m deep	35775	75486	Above river
2	Pit	D4 m x .75 m deep	35684	75523	Ironstone pit: extensive spoil?
3	Pit	D4 m x .75 m deep	35536	75458	Ironstone pit: path through centre?
4	Pit	D5 m x .75 m deep	35708	75495	Ironstone: extensive spoil?
5	Oval pit	6 m x 3 m x .5 m deep	35768	75516	?
6	S/R pit	2 m x 2 m x .5 deep	35782	75465	?
7	Heap	1.5 m high	35585	75461	Spoil heap beside path?
8	Heap		35574	75425	Sub rect spoil heap
9	Linear ditch	.2 m deep	35563	75455	W-E parallel to path
10	Pit	D1.5 x .15 deep	35571	75382	?
11	Slag	20 x 10 m	35519	75441	Slag beside path
12	Pit	D2.5 x .15	35498	75425	Shallow pit sub-surface compacted earth and charcoal dust.
13	Pit	D2 x 1.2 deep	35314	75273	No spoil ?
14	Holloway	2m deep	35461	75424	W from slag 4.5 m wide
15	Pit	3m x 1.5m x 0.75 deep	35454	75355	Modern sharp sided rectangular pit
16	Pit	0.3m deep	35444	75367	Modern rubbish dump
17	Pit	3m x 1.5m x 0.75m deep	35454	75355	Modern sharp sided rectangular pit
18	Ditch	1m x 20cm	35329	75261	Ditch S – N downhill
19	Pit	Shallow	35332	75420	Shallow circular depression
20	Pit	D4.5 x 1 deep	35312	75404	No lip, Q pit 20 m from river?
21	Debris		35250	75384	Extensive modern debris, masonry, former colliery
22	Small pits		35265	75345	Small pits/ditch beside fence
23	Bolts	9 bolts set in concrete	35316	75229	Foundation mounting possibly for Cobnar Wood Colliery machinery
24	Pit		35324	75112	Small stone day-working pit
25	Heap	Oval 7 x 5m	35389	75400	Possibly modern debris (see **100**)
26	Adit	Drift mine entrance	35312	75130	Adit entrance to Cobnar Wood drift mine.
27	Shaft	D91cm (3ft)	35338	75197	Shaft lined with shaped bricks, air shaft?
28	Pit	D4m	35320	75122	No coal spoil possibly stone getting or collapsed working

29	Pit	D5m	35323	75127	As above
30	Pit	Oval 6m x 5m	35328	75126	As above
31	Pit	Linear 2m x 9m	35320	75132	Possibly collapsed workings
32	Track	5m wide	35749	75217	
33	QPit	D6m x 0.75m deep	35435	75332	Open to S, 7m N of track, possible QPit
34	Charcoal platform	Oval 7 x 6m	35460	75213	Charcoal found
35	Bell-pit				
36	Charcoal platform				
37	Adit	6 x 2.5 x 1.5m deep	35598	75175	Collapsed workings or adit coal spoil in evidence
38	Charcoal platform	Oval 10 x 8m	35704	75192	Charcoal found
39	Charcoal platform	D8m	35765	75205	Degraded charcoal found
40	Charcoal platform	Oval 7 x 5m	35393	75179	Charcoal found
41	Charcoal platform	Oval 7 x 6m	35508	75164	Charcoal found
42	Charcoal platform	Oval 7 x 4m	35565	75150	Overlaid with spoil-charcoal found
43	Charcoal platform	Oval 7.5 x 6.5m	35598	75152	Degraded-charcoal found
44	Charcoal platform	D6m	35689	75176	Cut by path-charcoal found
45	Charcoal platform	Oval 6 x 5m	35697	75206	Charcoal found
46	Charcoal platform	Oval 6 x 5m	35748	75203	Charcoal found
47	Collapsed wkgs		35461	75222	Coal workings
48	Collapsed wkgs		35454	75215	Coal workings
49	Collapsed wkgs		35451	75212	Coal workings
50	Charcoal platform	D7m	35449	75216	Charcoal found
51	Collapsed wkgs	Pit 0.6 x 0.75m deep	35428	75206	Coal workings
52	Adit		35431	75221	Collapsed coal workings
53	Charcoal platform	D6m	35398	75215	Charcoal found.
54	Charcoal platform	Oval 9 x 6m	35339	75160	Charcoal found
55	Ironstone		35664	75154	Ironstone nodule found on spoil
56	Lead smelt site		35565	75520	Lead slag and burnt Gritstone beside river
57	Collapsed wkgs	8 x 6m	35317	75222	Coal debris
58	Bell-pit		35388	75263	Scatter of shale debris
59	Bell-pit		35376	75258	As above
60	Bell-pit		35375	75274	As above

61	Bell-pit		35367	75267	As above
62	Bell-pit		35375	75268	As above
63	Bell-pit		35367	75264	As above
64	Bell-pit		35386	75270	As above
65	Bell-pit		35549	75201	As above
66	Bell-pit		35554	75109	As above
67	Bell-pit		35552	75203	As above
68	Bell-pit		35549	75196	As above
69	Bell-pit		35547	75213	As above
70	Bell-pit		35546	75214	As above
71	Bell-pit		35542	75211	As above
72	Bell-pit		35544	75207	As above
73	Pit		35553	75206	
74	Bell-pit		35557	75212	As above
75	Pit	D2m	35363	75125	On slope-no charcoal found- coal?
76	Pit	Shallow	35379	75129	Stony spoil-stone getting?
77	Pit	Large	35380	75118	Spoil heap downslope-stony
78	Pit	D7m	35335	75252	Shallow-partially obscured by trees-coal?
79	Pit	Shallow	35333	75265	Water filled pit and small spoil heaps
80	Pit	D8m	35371	75265	Shallow depression-obscured by holly-spoil ring
81	Pit	D6m	35377	75260	Shallow pit beside track
82	Pit	D5m	35380	75270	As above –low spoil ring
83	Pit		35561	75204	As above
84	Pit	D1 x 0.5m	35561	75193	As above
85	Pit	D4.5 x 0.75m deep	35385	75273	As above
86	Pit	D5 x 1m deep	35381	75259	As above
87	Pit	D5 x 1m deep	35391	75248	As above
88	Iron slag	Large area 20-30 sm	35526	75447	Iron bloomery slag beside path and river
89	Plinth	Rect pit 7 x 6m	35324	75337	With concrete plinth-foundation?
90	Adit		35650	75240	Adit or drain-timber lined
91	Rail	7.5 x 7.5cm x 8m long	35310	75379	Length of narrow gauge tram line, from Cobnar Wood Colliery?
92	Holloway		35411	75410	Deep

93	Ditch		35493	75431	N-S
94	Ditch	0.75 x 0.2m deep	35354	75396	
95	Ditch	1 x 0.75m deep	35313	75360	
96	Ditch		35308	75290	
97	Holloway		35790	75203	
98	Platform	D6	35520	75166	No charcoal found
99	Track	4m wide	35370	75289	Main access track to coal workings?
100	Dump	D6 x 0.3m high	35394	75387	Disturbed area-mortar rubble
101	Dump	D8	35384	75347	Disturbed area-clay-recent>
102	Dump	D5-6 x 0.75m high	35387	75326	Stone/mortar rubble
103	Tracks		35396	75307	Tractor tracks to dump
104	Dump		35299	75313	Rubble
105	Dump		35301	75316	Rubble
106	Dump		35304	75323	Rubble
107	Dump		35305	75324	Rubble
108	Dump		35303	75329	Rubble
109	Dump	9 x 4 x1m high	35307	75333	Piled around trees-spoil?
110	Pit	D2m	35322	75344	Water filled pit beside track-drainage?
111	Pit	1 x 2 x 0.4m deep	35436	75357	Modern rubbish dump
112	Pit		35444	75360	Modern rubbish dump
113	Heap		35326	75218	Spoil heap
114	Steel column	20cm x 15cm column	35391	75269	Column set in concrete and bricks, probably from former colliery
115	Bank	8 x 1m high	35560	75231	Spoil bank beside track

Appendix 2.3

BOW WOOD: GAZETTEER OF FEATURES				
No	**OSG east**	**OSG north**	**Dwg page**	**Notes**
1	31466	56407	1	Pit by track stone getting
2	31550	56391	1	Kiln degraded D4m x .6m
3	31543	56358	1	Kiln degraded 4m x 4m x 1.5m deep.
4	31557	56334	1	Stone pit/platform, stone scatter. 6 x 3.5m
5	31527	56362	1	Stone pit/platform small mounds on edge, 9 x 4 x 1.2 cut
6	31536	56365	1	Kiln degraded 4m x 4m x 1m deep
7	31543	56363	2	Stone pit shallow pit below edge in N, 10 x 9m
8	31567	56386	2	Stone delve in hillside, D6m
9	31562	56388	2	Shallow stone delve, D5m
10	31557	56328	2	Stone delve level platform, 6 x 4m
11	31545	56399	2	Stone pit /delve D3 m
12	31536	56398	2	See 29
13	31512	56400	3	Kiln well preserved, flat N wall, gritstone walls, D5 x 1.5m deep
14	31505	56396	3	Platform, hard standing area, no charcoal, on track, 6 x 4m
15	31190	56569	4	Probable stone pit/delve D4 x .5 deep
16	31205	56594	4	Platform, cut in to slope, 6 x 4 m no charcoal found
17	31162	56625	4	Charcoal platform, cut into slope, on track, some stones, charcoal found sub rect 5 x 3m
18	31219	56557	6	Stone pit? Revetted u/slope D5 x .75 deep
19	31210	56523	6	Stone quarry/delve, D4m
20	31592	56236	6	Kiln, degraded stone evident in sides, D4 x 1m deep
21	31596	56235	6	Wall, .65m x .5m high E-W
22	31592	56245	6	Platform 6 x 4 m degraded by track no charcoal found
23	31704	56539	70	Charcoal platform, charcoal found, 7m x 6m
24	31668	56477	70	Platform, no charcoal, near path 9 x 6m oval
25	31683	56429	71	Start of holloway N running S-SE
26	31676	56425	71	Platform no charcoal, 9 x 7m sub circ, on W edge of holloway see above.
27	31661	56398	71	Charcoal platform, charcoal found, 9 x 7m sub circ, track thro' S part.
28	31593	56304	72	Stone working area D10 m stone chippings
29	31534	56396	72	Charcoal platform, charcoal found, 8 x 7m sub circ.
30	31176	56646	73	Stone working area 15 x 15m
31			73	Quern built into kiln wall D50 x 22.5 cm estimated
32	31513	56415	73	Kiln 5 x 6 m stone walls and entrance stones
33				Quern roughout D75 x 35 cm
34				Quern roughout D40 x 60 (oval) x 15 cm
35				Quern roughout D40 x 46 (oval) x 16-20 cm
36				Quern roughout D65 x 30 cm
37	31170	56647	73	Quern roughout D38 x 14 cm
38	31168	56657	74	Stone working area, much debris

39				Quern roughout D48 x 40 (oval) x15 cm
40	31167	56643	74	Quern roughout D40 x 16 cm
41	31164	56654	74	Quern roughout D46 x 16 cm
42	31179	56631	74	Quern roughout fragment. sub circ 54 x 54 x 15 cm
43	31163	56653	74	Quern roughout fragment D45 x 15/18 cm
44	31169	56648	75	Quern roughout fragment D54 x 19 cm
45	31161	56649	75	??Quern roughout D65 x 70 (oval) x 20 cm
46	31164	56645	75	Quern roughout partially seen D35 x 18 cm domed
47	31348	56376	75	Quern beehive type? D30 x 50 40 cm.
48	31300	56533	89	Charcoal platform, 9m x 7m charcoal frags found.
49	31172	56650	89	Quern roughout D35 x 18 cm
50	31167	56642	88	Quern fragment in working debris
51	31176	56631	89	Quern roughout D80 x 30 cm thick
52	31169	56639	89	Quern roughout. Sub-rect 110 x 80 x 40 cm
53	31178	56641	90	Quern roughout D140cm x 40 cm thick
54	31176	56642	91	Quern roughout D120 cm underside not seen
55	31169	56648	91	Quern roughout fragment D 110 (approx) x 20/40 cm
56	31163	56646	92	Quern roughout D80 x 30/40 cm thick
57	31164	56649	92	Quern roughout D75 x 30 cm thick
58	31166	56648	93	Quern roughout D80 x 40 cm thick
59	31170	56653	93	Quern roughout fragment D85 x 25 cm
60	31516	56356	94	Charcoal platform10m x 8m, built into slope, DSWall revetment downslope, charcoal found.
61	31499	56343	94	Stone with splitting groove, 25mm wide x 50mm deep x 60 cm visible.
62	31568	56520	107	Stone lined trench 4 x 1.5 x .5m
63	31586	46457	107	Contour feature quarry or landslip shale found 10m d/slope to N
64	31586	56457	107	Quern roughout fragment D80 x 25cm
65	31513	56400	108	Quern roughout D50 x 35 cm thick Beehive type?
66	31562	56381	108	Charcoal platform 12m x 7m
67	31391	56245	3-13	Roughout 125 x 13 cm thick possible grindstone
68	31140	56501	2-26	Charcoal platform 9m x 8m 6m S of E-W track, no charcoal found
69	31468	56437		Charcoal platform 8m x 5m, revetted charcoal found.
70	31547	56375		Charcoal platform D8m charcoal found.
71	31587	56380		Wall up hill to cliff large irregular stones, possibly quarry waste.
72	31524	56404		Quern roughout D50 x 40 cm thick underside not seen
73	31623	56163		Kiln, degraded 4 m x 4 m x1 m deep charcoal found
74	31553	56425		Quarry 4m high x 50m. Tumble of angular stone downslope fine Gritstone
75	31438	56257		Quarry 4m high x 30m long face workings pinky fine grained sandstone.
76	31593	56304	72	Quern roughout D43-45 x 10-12 cm thick trammel dimple underside.
77	31482	56400	sheet	Boulder cut for path 120cm wide
78	31500	56372	sheet	Boulder cut for path 104cm wide
79	31566	56332	sheet	Low wall spread 2m x 50cm wide. Ends 31564 56317
80			sheet	Field lynchet of former wall 2m high x 4m spread
81			sheet	Field wall Coumbs Wood pasture, thin flaggy s/stone, modern squared copers 112 x 70/40cm

82			sheet	Spread of rounded stones field clearance
83			sheet	Hard standing area beside track
84	31687	56248		Platform D8m
85	31439	56331		Holloway stone enhanced d/slope bank
	31409	56347		intermediate point
	31396	56366		Holloway joins enclosure wall
86	31588	56252		Kiln 5 x 4 x 2m deep
				Environmental
1	31650	56344	72	Small leaved lime coppice, 4.7m at base.
2	31171	56618	75	Lime coppice
3	31370	56239		Group of 4 small leaved limes
4	31625	56340		Single small leaved lime 6m girth
5	31625	56329		Group of 3 small leaved limes on stone workings.
6	31624	56238		2 multi stemmed small leaved limes on stone workings
7	31176	56646		Sycamore 10/12 stems at 30/40cm

8	31623	56163		Crab apple
9	31506	56330		Beech beside track
10				Beech beside wall
11				Bridleway corridor

Appendix 2.4: LEAWOOD GAZETTEER OF FEATURES

No	OSG east	OSG north	Notes
1	31711	55682	Platform 5D x 50cm deep, frags charcoal 15cm down
2	31724	55676	Kiln, stone scatter, wall 4m E robbed from kiln, D8 x 2m deep
3	31726	55647	Victorian and modern rubbish in former quarry, D5m
4	31728	55653	Stone pit with scatter 3 x 1M
5	31973	55868	Stone revetted platform, no charcoal, shallow pit, 7 x 5m
6	31976	55874	Platform, ?stone revettment, with shallow pit, no charcoal, 8 x 5m
7	31970	55918	Stone pit, shallow, N-S scatter of debris, 2.5 x 2 x .75m deep
8	31958	56002	Kiln, stone wall enclosed D7 x 2m deep
9	31908	56010	Charcoal platform, small scatter of stones, charcoal found, sub circ 8 x 5m
10	31941	55992	Stone pit scatter, sub circ 4 x 2m
11	31985	56029	Stone pit, scatter of stones at W, opening SW ?new, D2.5 .75m
12	31855	55983	Kiln degraded,4 x 4 x 1.5m deep
13	31846	55987	Quern roughout D55 x 15cm only 1 side seen LWQ 20
14	31846	56004	Quern roughout D50 x 10/15cm Lwq 21
15	31822	55944	Trackway up to scarp N-SE
16	31845	55956	Charcoal platform, charcoal, 20cm down, sub circ, 8 x 5m
17	31756	56136	Kiln, stone visible, D3 x 1m deep
18	31698	55598	Quern roughout D35 x 18cm, by kiln see 275 LWQ 14
19	31698	55605	Quern roughout D45 x 15cm, by kiln see 275 LWQ 15
20	31705	55599	Quern roughout D40 x 15cm, by kiln see 275 LWQ 16
21	31700	55593	Quern roughout D50 x 15cm LWQ 17
22	31704	55604	Quern roughout D32 x 15cm LWQ 3
23	31706	55599	Quern roughout D40 x 13cm half LWQ 18
24	31700	55612	Quern roughout D45 x 15cm under tree LWQ 19
25	31771	55583	Quern roughout D45 x 20 in wall half
26	31789	55567	?platform
27	31769	55517	Quern in wall junction coper shaped 45cm
28	31927	55609	Kiln 4 x 3 m
29	31913	55597	Charcoal platform 6 x 5m
30	31698	55598	Kiln 4 x 4 x 1.5m deep. See 16/255 above, stone lined, ex stone delve.
31	31688	55531	Quern roughout on wall D36 x 9/10cm
32			Quern roughout on wall 2m E of 25 D40 x 18cm
33	31712	55526	Quern roughout in wall D43 x 12cm LWQ 5
34			Quern roughout in wall 1m E of 27 D46 x 10/20cm
35	31710	55523	Quern roughout in wall 4m E of 28. D40 x 12cm LWQ 6. (see also 329 p55)
36	31726	55515	Quern fragment in wall D46 x 13cm LWQ 8
37	31717	55511	Quern in wall, thick section early? LWQ 10
38	31809	55518	Quern roughout S of wall D36 x 13/15cm
39	31825	55522	Quern roughout on hillside above massive wall. 37/27 x 20cm domed

40	31726	55599	Quern roughout buried under stone in quarry D44/40 x 20/22.5cm
41	31734	55517	Quern roughout frag 6m NE of 30 side of wall LWQ 9
42	31771	55517	Quern roughout as coper LWQ 11
43			Quern roughout D41 x 15 slight dome part
44	31771	55525	Quern roughout LWQ 13
45	31976	55799	Charcoal platform D8m beside path
46	32002	55802	Quern roughout in wall 35/45 x 12cm (half)
47	32068	55800	Quern roughout frag by beech 6m S of wall D35 x 13 (half)
48	31973	55924	Kiln degraded coal d/slope 4m s/rect near collapsed wall
49	31982	55980	Quern roughout fragment in wall (half) and fragment on ground E of wall
50	31898	55900	Charcoal platform 10 x 7.5m charcoal found
51	31897	55925	Kiln 4 x 4 x 2.5/1.5 deep woody charcoal and ash at 20cm in centre
52			Quern roughout 4m W of 47 D50 x 13cm
53	31839	56004	Charcoal platform D8m 12m N of 47 above
54	31847	56000	Quern roughout D50 x 12/18cm
55	31700	55524	Quern roughout on wall LWQ 4
56			Quern roughout 1.5m N of 55 LWQ 5
57	31723	55529	Quern roughout fragment in wall LWQ 7
58	31715	55551	Charcoal platform c/coal found, 6 x 5m truncated by path
59	31757	55554	Quern roughout fragment 50/36 x 18 1 side seen, small chippings seen
60	31682	55637	Quern roughout covered in veg by path D60 x 25
61	32274	55710	?Kiln D6 x 1.5m deep
62	32310	55783	Degraded kiln 8 x 7m
63	31733	55856	Charcoal platform 7 x 4m charcoal and ?coal found
64	31738	55869	Kiln ?robbed out small stones inside D4m
65	31735	55866	Robbed wall E-W upslope large base stones circa 1m wide beside bank and ditch
66	31789	55873	Ditch and bank see 65
67	31761	55918	Charcoal found ?modern fire.
68	31730	55959	?Fragment of charcoal found
69	31723	55965	Charcoal platform charcoal found
70	31747	55972	Charcoal fragment found ?platform W of wall
71	31788	55979	Line of orthostats ?wall
72	32072	56047	Charcoal platform cut by path. 9 x 6m
73	31983	56037	Kiln degraded,4 x 4 x 1m deep in Rhod's
74	32021	56023	Charcoal platform D6m charcoal frag found
75	31919	55738	Kiln badly degraded by path
76	32067	55788	Charcoal platform 8 x 5m charcoal found degraded
77	31949	55987	Stone delve like a kiln site or shelter
78	31944	55669	Quern roughout D40 x 12cm beside ride.
79	31936	56023	Quern roughout D36 x 12cm slight dome half
80	31936	56023	Quern roughout part D36 x 9/11cm domed
81	31944	56010	Qhern roughout fragment D34 x 11/12cm slight dome half

82	32039	56039	Quarry by track to knoll
83	32049	56020	Old wall by park boundary
84	32048	56021	Old wall above in plantation
85	31997	56020	Rock built feature under Rhod's
85a	32005	56049	Rock built feature under Rhod's
86	31997	56045	Rock pile feature D5m
87	31727	55590	Remains of structure in quarry
88	31736	55625	Quarry below former farm buildings
89			Large coping in above
90	31727	55668	Structure built up to wall
91			Field boundary wall see above
92			Farm/cottage enclosure, mortared coping stones
93			Gated opening in wall
94	31792	55994	Platform, possible structure beside ride
95	31659	55602	Quern in buttress to cottage D45 x 13cm
96			Quern as above D45 x 16cm
97	31840	55734	Flint from path beside seat in meadow.
98	31803	56011	Valve on stone base, water
99	31780	55940	Gate through wall
100	31717	55506	Quern fragment in wall D40 x 17 cm
101	31782	55506	Retaining wall beside canal start
102	31794	55507	Quern roughout in wall D50 x 150cm
104	31807	55520	Quern D38 x 12/15cm
105			Garden enclosure and building
106	32252	55818	Old quarry' OS map
107	31682	55654	Former quarry by path over canal spur.
108	31715	55505	Quern roughout beehive type 40 x 20 cm
109	31710	55668	Quern roughout D43 x 16 cm below quarry
110	31861	56004	Quern roughout D46 x 20cm
111	*31832*	*55910*	Kiln 4 x 6 x 1.5m deep
112	31853	55946	Charcoal platform D8m charcoal found
113	31889	56146	Charcoal platform 8 x 6m
114	31869	55914	Degraded charcoal platform D7.5 charcoal
115	31862	55912	Kiln 5 x 6 x 1.5m near track
116	31733	55957	Charcoal platform D8 charcoal found
117	31845	56155	Platform 5 x 4m
118	31744	55970	Charcoal platform D7 charcoal found
119	31851	56138	Holloway/walled bank
120	31880	56169	Holloway/ ditch and bank
121	31839	56022	Lead slag in metalling of large tracked area
122	31895	56159	Holloway up to wall
123	31880	56050	S L Lime?

APPENDIX 3

Analysis of whitecoal and charcoal production sites in case study and other woods.

Coal Measures woods

	Q-pit								Charcoal platform							
Wood	N	NE	E	SE	S	SW	W	NW	N	NE	E	SE	S	SW	W	NW
Birkinshaw				1	1								2			
Bolehill		1	1							2						
Cobnar	1								9							
Ducksick	6		1		1			4	1		1					
Hardwick				1			1			3	1					
Kitchenflat					1								1			
Linacre				1	3							1				
Moorlawn					4	1	2	3	1				3	1	1	
Ogston Carr	2															
Owler Carr		2											1			
Walton	1	1	2				2		1							
Total	10	4	4	3	10	1	5	7	12	5	2	1	7	1	1	0

Gritstone woods

	Kiln								Charcoal platform							
Wood	N	NE	E	SE	S	SW	W	NW	N	NE	E	SE	S	SW	W	NW
Birch		1														
Bow				1	2	4					1	2	3	4	1	
Haytop	1					1	2	2	2	1	5				1	3
Haywood							1									
Lea					2	2	4						2	3	1	1

Limestone wood

	Kiln							
Wood	N	NE	E	SE	S	SW	W	NW
Shacklow								4

APPENDIX 4

PORTLAND ARCHIVES

Reference	Date	Lease	Turf/	Iron	Iron-stone	Charcoal	Charcoal pit	Whitecoal	White-coal pit	Wood	Seacole/cole	Lime	Coal pit/hole	Notes
BARLOW														
157 DD/P/42/48	1564	nd			X					X (timber)	X			Marriage settlement
157 DD/P/43/13-1	1630	21	X	X	X	X								Conveying
157 DD/P/43/76-1	1692	11		X (dig)						2000 cords				
157/DD/P/84/6-2	1630	21	X	X	X	X	X							Conveying
157/DD/P/42/64-5	1652	nd											X	Sale
157 DD/P/8/133-9	1653	nd				X								Right to convert
157 DD/P/42/10-11	1586	nd				X		X						Lee Bridge
157 DD/P/42/36-11	1663	nd				X								Tresspass (21 yrs)
157 DD/P/42/61-12	1630	21	X				X							Convey minerals
157 DD/P/42?65-12	1660	10				X								
157 DD/P/42/68-12	1703	9				X								
157 DD/P/42/70-12	1762	nd					X		X					Whitecoal late date
157 DD/P/43/13-12	1630	21	X	X	X	X								Onveying
157 DD/P/61/32-13	1748	21				X								No new pits
157 DD/P/71/24-13	1703	nd	X				X							6 yrs no livestock
LINACRE														
157 DD/P/84/1-14	1513	4	X				X							
157 DD/P/53/3-3	1571	5or6	X				X							100 heryers
157 DD/P/84/3-14	1596	5	X				X		X					
157 DD/P/84/4-14	1602	21	X			X		X						
157 DD/P/84/21-15	1682	nd	X				X		X					

157 DD/P/53/28-4	1766	nd				X								
157 DD/P/84/6	1630	21	X	X	X		X							Forge and furnace
COWLEY														
157 DD/P/67/1-2	1630	21	X	X	X	X	X							Convey
DUNSTON														
157 DD/P/73/1-2	1578	21		X	X	X					X			Dig up weed/brush
157/ DD/P/73/14-2	1678	11	X		X	X					X	X		
157 DD/P/73/3-2	1630	21	X	X	X	X	X							Conveying

APPENDIX 5

Domesday woodland analysis.

From Morris, J (1978) Domesday Book. 27 Derbyshire. Phillimore, Chichester.

The Domesday Book enters woodland in four different ways in the Derbyshire folios.

1. *Silva pastilis:* woodland pasture
2. *Silva minutae*: underwood or coppice woodland
3. *Silva non patilis*: Unpastured woodland
4. *Silva non pastil apta venationi*: woodland unpastured fit for hunting.

The first two are generally accepted translations, three and four are less well understood. Number three occurs at Blingsby which now exists only as Blingsby Gate on the Hardwick Estate in Scarsdale Wapentake, the wood may have been part of an early park. Number four is recorded mainly in Longdendale and Ashford both lands of King William in High Peak Wapentake. It can be assumed that this was part of what later became the Forest of the High Peak. The area covered the equivalent of more than 50 square miles. Domesday Book was in effect a tax record, it was not a gazetteer, we will never exactly what meant by the various terms or what the Domesday landscape was really like. Scarsdale was probably well wooded by comparison with the rest of the county is still reflected to some extent today.

Methodology

Woodland is entered in Domesday as a rectangular block, with dimensions for length and width using the league, furlong, perch and acre. The league is assumed to be 12 furlongs or 1.5 miles in length and 8 furlongs to the mile, a perch is 5.5 yards or one fortieth of a furlong. Since woodland is never truly rectangular a form factor is applied. This has been calculated from the shape of ancient woodlands, the factor used is 70 per cent (Jones, 1993; Rackham, 2006). Every woodland entry in Domesday Book has been calculated and converted to the mile (1760 yards), then to the acre (4840 square yards), 640 acres to the square mile. The form factor applied and the resultant acres compared to the area given for each Wapentake, or Hundred as they became known. (Bagshaw 1846). The results are given in the Table below

	Acres	**Silva past**		**Silva min**		**Silva non past**		**Silva non pas a v**	
Wapentake	**Acres**	**acres**	**%**	**acres**	**%**	**acres**	**%**	**acres**	**%**
Scarsdale	144750	56740	39	1512	1	28			
Wirksworth	73880	22468	30	3003	4				
High Peak	203190	15624	8	3444	2			36288	18
Repton	55750	12887	23	165					
Appletree	108170	38704	36	589					
Morleystone	75780	10328	14	322					

The per cent values in columns 2 and 3 are small and have been omitted.

SUMMARY

Wapentake	**Woodland pasture per cent**
Scarsdale	40
Wirksworth	34
High Peak	27
Repton	23
Appletree	36
Morleystone	14
Derbyshire	30

If the *Silva non pastil apta venationi* is excluded, then the county figure becomes 25 per cent wooded. This figure is similar to Rackham (2006), although it masks the considerable variation within the county. Was High Peak really so devoid of wood pasture? We cannot be sure of the actual meaning of the terms in Domesday Book, nor how they were applied, consequently extreme caution must be applied in any interpretation of the results.

APPENDIX 6

Charcoal analysis

Eight charcoal samples were collected from five woods, from each of the case study sites and two from Monk Wood a non-case study site. The criteria for selection were;

- completeness of section
- large size
- possibility of ring ageing
- definition of characteristics.

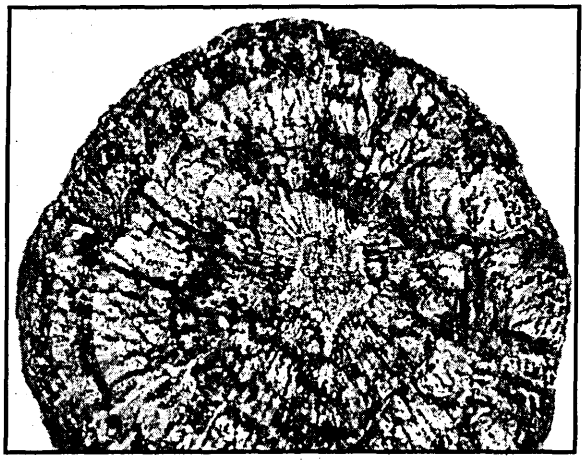
The samples were analysed by Dr Paul Ardron using reference images in Schweingruber (1990) and cross referenced with Hather (2000). Sample age was estimated from the annual growth rings. The results are given below,

Ref	Location	Feature	Dimensions	Species	Age
1	Cobnar	Charcoal platform	D13.5 x 4 cm	*Quercus*	8/9*
2	Cobnar	Slag deposit	D1.7 x 3.2 cm	*Ilex*	9/10
3	Cobnar	Slag deposit	D2.5 x 3.5 cm (2 pcs)	*Alnus*	7/8
4	Bow	Charcoal p/f	D3.2 x 2.5 cm (frag)	*Quercus*	18
5	Lea	Charcoal p/f	D2 x 3 cm	*Ilex*	16/18
6	Ducksick	Charcoal p/f	D5 (est) x 2 cm (frag)	*Quercus*	30
7	Monkwood	Charcoal p/f	Oval 2.5 x 2 x 2 cm	*Prunus?*	10
8	Monkwood	Charcoal p/f	D1.2 x 4.7 cm	*Quercus*	6*

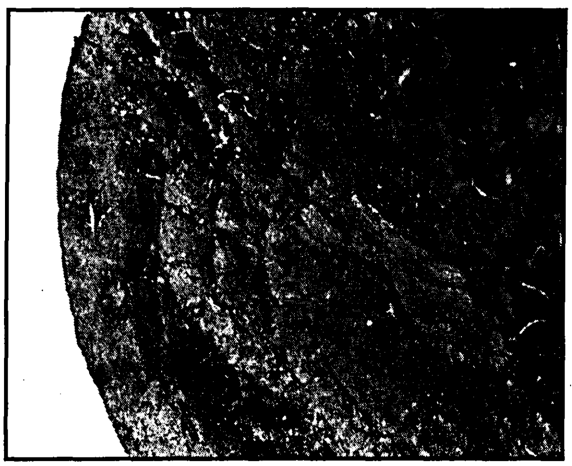
*branch wood.

Table 30 Charcoal sample analysis results.

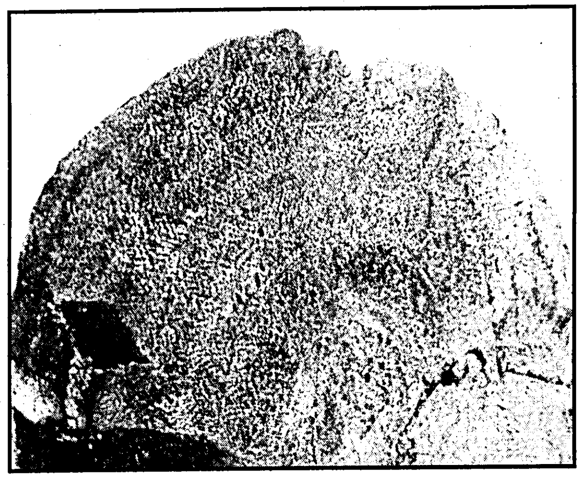
The samples are not statistically significant in any way and any conclusions therefore are purely speculative. However, the species composition dominated by *Quercus* could be said to be typical of woodlands today and with the exception of *Prunus* the other species are also common.



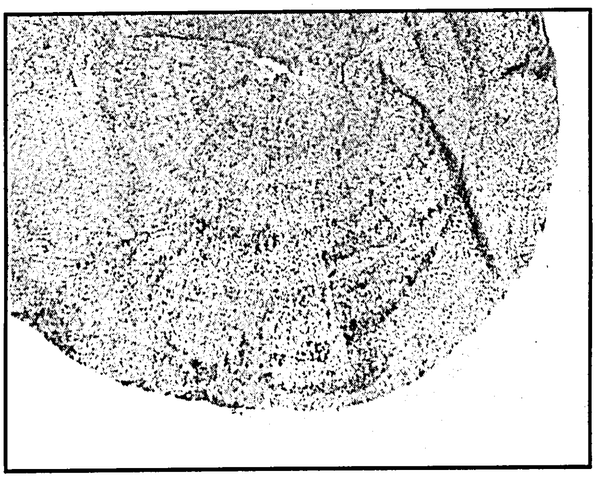
Photograph sample 1 *Quercus*



Photograph sample 2 *Ilex*



Photograph sample 3 *Alnus*



Photograph sample 8 *Prunus*

Photographs by P. Ardron.

APPENDIX 7

SCARSDALE WOOD CONSUMPTION IN THE MID-SEVENTEENTH CENTURY

IRON		TOTAL
Charcoal blast furnaces in blast.	7[2]	
Output per furnace: tons iron per annum	300[4]	
Total pig iron: tons	2100	
Charcoal consumed per ton of iron: cords	7.7	
Charcoal: cords		16170
Forges		
Total tons	1400	
Charcoal per ton bar iron cords	8.8	
Total charcoal cords		12320
Total cords felled		28490
LEAD		
Orehearth smelting mill	21[1]	
Output per mill: tons lead per annum	200[3]	
Total lead: tons	4200	
Whitecoal consumed per ton of smelted lead: tons	1.07[5]	
Total tons	4494	
Equivalent cords (whitecoal)	4993[7]	
Equivalent cords felled	7989[8]	36479
Cords per acre	1	36479

NOTES

1. Beckett and Polak:12.
2. Ibid :10. 8 furnaces noted, 1 out of blast and Barlow not mentioned.
3. Kiernan:159. Range of 150-200 fothers (1.125 tons equivalent) per annum, 200 tons per annum or 178 fothers used.
4. Beckett and Polak:11. Range of 300-400 tons of pig iron per annum, lower value used.
5. Kiernan: 158. 12 loads per fother equivalent to 10.67 loads per ton of lead.
6. Kiernan: load=2cwt. 1.07 tons whitecoal per ton lead.
7. Collins:1102. Firewood, 80 cu ft = 1.05 tons from standard cord. Say .9 ton when dried.
8. Equivalent felled cord 128/80 cuft, muliple of 1.6.