



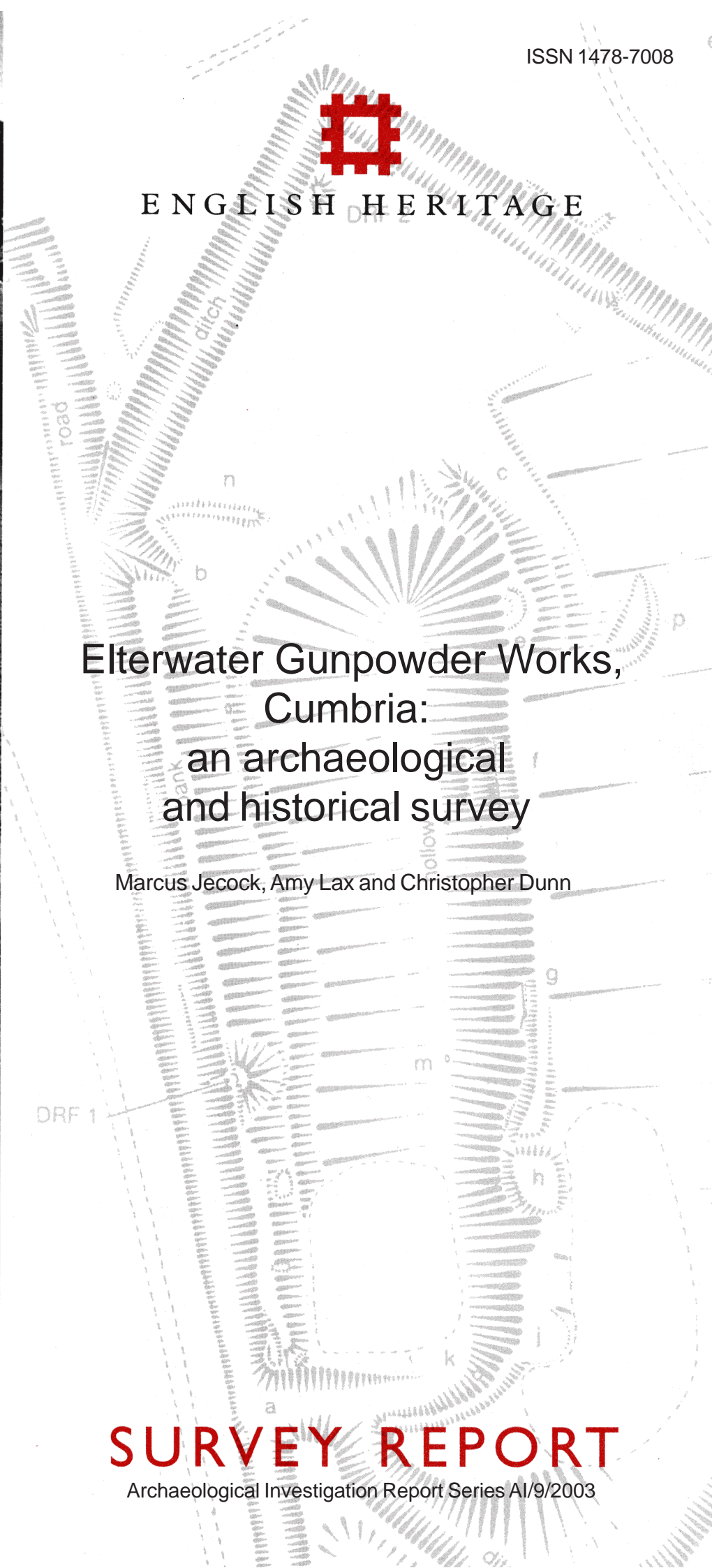
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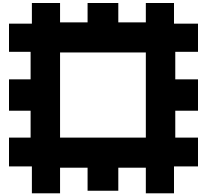
Elterwater Gunpowder Works,
Cumbria:
an archaeological
and historical survey

Marcus Jecock, Amy Lax and Christopher Dunn

SURVEY REPORT

Archaeological Investigation Report Series AI/9/2003





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1. INTRODUCTION, SITE LOCATION AND SUMMARY

In late summer and autumn 2001, English Heritage (EH) carried out archaeological survey and investigation at the site of the former Elterwater Gunpowder Works, in Cumbria. The survey was undertaken as part of a wider thematic project investigating gunpowder manufactories across the whole of Cumbria, initiated in June 1999 (Dunn 2001) as the logical progression to EH's Monuments Protection Programme's (MPP) Step 3 and Step 4 reports for the gunpowder industry nationally (Gould 1993; Chitty 1996). Although there has been considerable interest and research into the Cumbrian works in recent years, directed at both the group as a whole and individual sites (eg Wilson 1964; Marshall & Davies-Shiel 1969, 75-88; Crocker 1988, 36-41; Crocker and Crocker 1992; Patterson 1995; Palmer 1998; Tyler 2002), this has mostly concentrated on the documentary evidence with little formal examination or detailed recording of the physical remains. EH's Cumbrian Gunpowder Industry Project is intended to rectify this omission, and will aid conservation management of those powder works which have been designated in whole or in part as protected monuments; the inclusion of all sites irrespective of their current level of designation will also enhance our overall understanding of what was an important regional industry.

The works at Elterwater is one of seven powder manufactories (eight if Gatebeck is treated as two sites) which operated in the historic counties of Westmorland and the Furness area of Lancashire (present-day south Cumbria) at various times between c 1764 and 1936. All produced gunpowder chiefly for the civilian, as opposed to the military, market. Geographically, the factories are concentrated at four locales across the region: Old Sedgwick, New Sedgwick, and Basingill lie in close proximity along the banks of the River Kent 5-6km south of Kendal; the Gatebeck High and Low Works lie adjacent to each other about 4km to the south-east of this first group; Blackbeck and Lowwood occupy neighbouring valleys close to Haverthwaite; whilst Elterwater forms an outlier at the foot of Great Langdale (Fig 1).

The industry became established in Cumbria mainly in response to the increasing demand nationally for blasting powder from mines and quarries through the 18th century. The Lake District provided a very suitable environment for gunpowder manufacture: the numerous rivers could supply the waterpower needed by the different processes, while the rural and wooded locations were commensurate with the desirability to remove the works from populous areas and to minimise the effects of any explosions. Later on, as more regard began to be paid to the safety of the workforce as well, several mills – including Elterwater – even incorporated trees and natural rock outcrops into their layouts as barriers to dampen and help contain blasts. Furthermore, wood was locally available for charcoal and for making barrels and packing crates, whilst proximity to the coast meant that other raw materials (sulphur and saltpetre) could be readily imported. As a result of these overseas contacts – mostly routed through Liverpool – the Cumbrian gunpowder industry was able to build up a healthy market for its products abroad, particularly in parts of the British Empire, as well as at home. After c 1860, alternative forms of explosive based on the nitration of a variety of organic compounds began to appear. Other English powder works diversified into producing the new explosives, but the Cumbrian mills stuck with their traditional stock-in-trade, now re-christened blackpowder to distinguish it from the newer forms. Despite this failure to diversify, the Cumbrian blackpowder industry continued to prosper until the end of World War I, when demand for the product collapsed catastrophically. The Cumbrian mills' response was to merge with their competitors as part of Nobel Industries (from 1926, itself incorporated into

ICI); but by 1928, ICI had started the inevitable process of rationalisation in order to concentrate blackpowder production at a single site: Ardeer in Scotland. Production in Cumbria finally ceased in 1936, with Gatebeck the last site to close (Crocker 1988, 1-2; Patterson 1995, xi and 44).

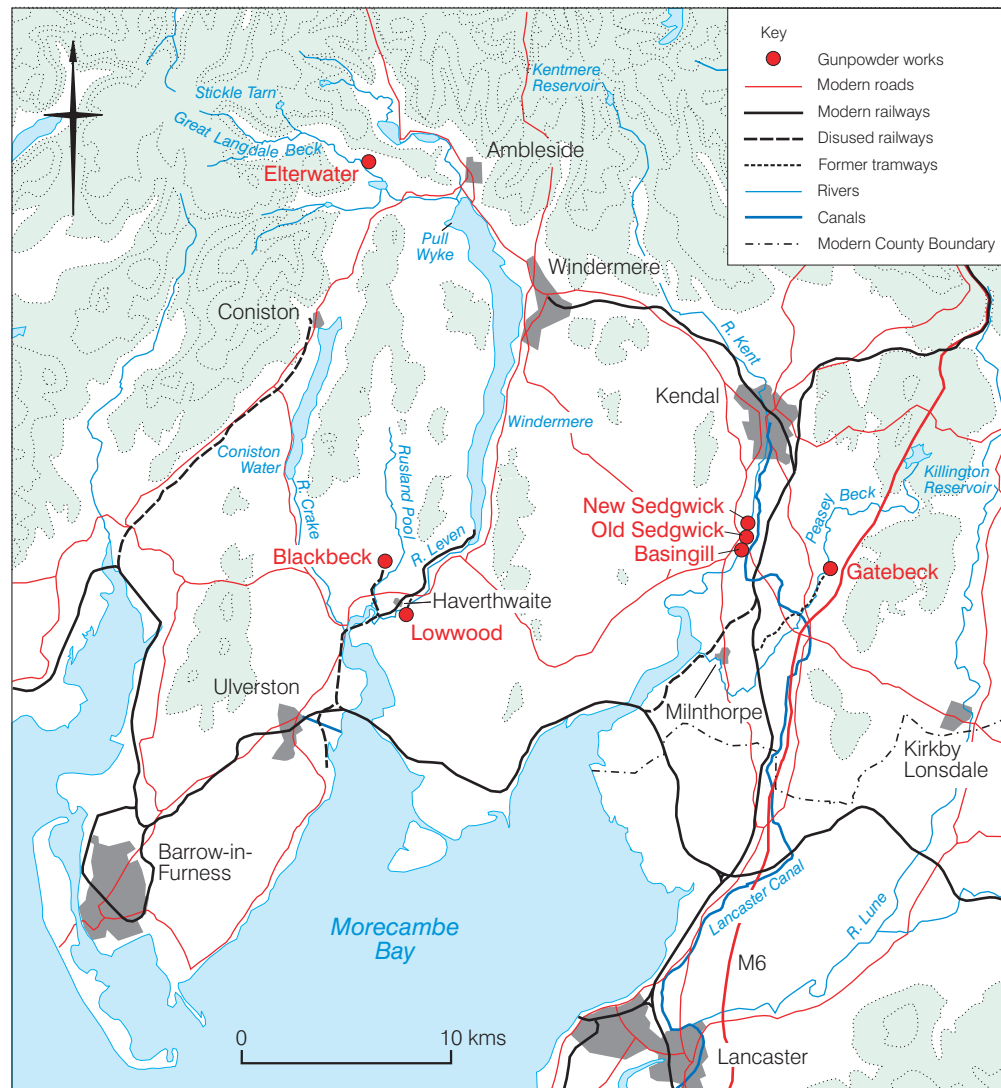


Figure 1.
General location
diagram

The Elterwater works is the third of the Cumbrian blackpowder sites to appear in this EH report series. Field survey was carried out to Level 3 standard (as defined in RCHME 1999, 3-5), backed up by less intensive documentary research confined to readily available published sources and limited search for historical archive material. The works lies some 5km west of Ambleside, on the north bank of the Great Langdale Beck immediately west of Elterwater village, centred at National Grid Reference (NGR) NY 326 049 (Fig 1). It was established in 1824 by David Huddleston, a retired banker, in conjunction with a number of partners, on the site of earlier water-powered corn and fulling mills, and was the third gunpowder works to be built in Cumbria, after Old Sedgwick and its outstation at Basingill (c 1764/1790), and Lowwood (1799). Initially, the factory comprised only a single incorporating mill, but it prospered and quickly expanded with additional mills, corning house, glazing house and other buildings added before 1840. It traded under a variety of names, but for most of its life was known as the Elterwater Gunpowder Company (after 1866 the Elterwater Gunpowder Co Ltd). The factory continued to prosper and expand, until by the time it closed in 1930, the main site covered a roughly triangular area of

c 9.1ha, with a number of ‘danger’ buildings located on a small divorced sub-site (‘Cylinder Hill’) on the valley side to the north. In the early years, transport of raw materials and finished gunpowder was by water between the port of Greenodd at the mouth of the River Leven, and Pull Wyke staithe on the shores of Windermere (Fig 1), and by horse and cart between there and the factory. But after 1846, the carts (in the early 20th century supplemented by specially adapted motorised vans) ran instead between the works and the railhead in Windermere town. Use was also apparently made of the railhead at nearby Coniston, but since this branch connected into the Furness railway and not the main London line, such use seems to have been only small-scale and occasional. No investigation of the archaeology of these transport routes has been made for the present report, although limited discussion of some of the documentary evidence is included.

At closure, the danger buildings such as the incorporating mills, corning house, glazing house and magazines, were burned down as required by law because of the danger of gunpowder residues. Shortly afterwards, the main site was purchased and converted into a holiday centre. Several of the standing buildings were retained and converted into hotel/hostel accommodation, whilst the millponds were utilised as swimming lakes, *etc.* But otherwise for over 50 years many of the ruined structures on site remained neglected and untouched. Since 1981, the pace of change has accelerated markedly. The former owners were bought out by the Langdale Partnership, and the site transformed into a timeownership, hotel and country-club complex, with much newbuild development. In consequence, although the site was evaluated by EH at Step 3 of the MPP process (Gould 1993), it was not recommended for statutory protection at Step 4 (Chitty 1996). The Cylinder Hill sub-site on the other hand became a private residence and garden in 1930. Between 1946-8 one of the buildings was reused as a studio (‘Merzbarn’) by the German Nazi-refugee artist, Kurt Schwitters, who created a mural on one wall. Mural and wall were both removed to Newcastle University’s Hatton Art Gallery in 1965 (Burkett 1979).

2. GEOLOGY, TOPOGRAPHY AND LAND USE

The main part of the Elterwater gunpowder works occupies a roughly triangular area of land in the bottom of Great Langdale, bounded to the east by Elterwater village, to the north by the modern valley road, and to the south-west by the Great Langdale Beck (Fig 2). Prior to the establishment of the works, the valley road would have passed through the centre of the village which had grown up around the junction of that road with a second route heading south across the beck and out of the dale towards Colwith and Coniston. But as the gunpowder works expanded, so the valley road was moved progressively northwards in order to skirt the factory; it now effectively by-passes the village (compare Figs 3 and 4).

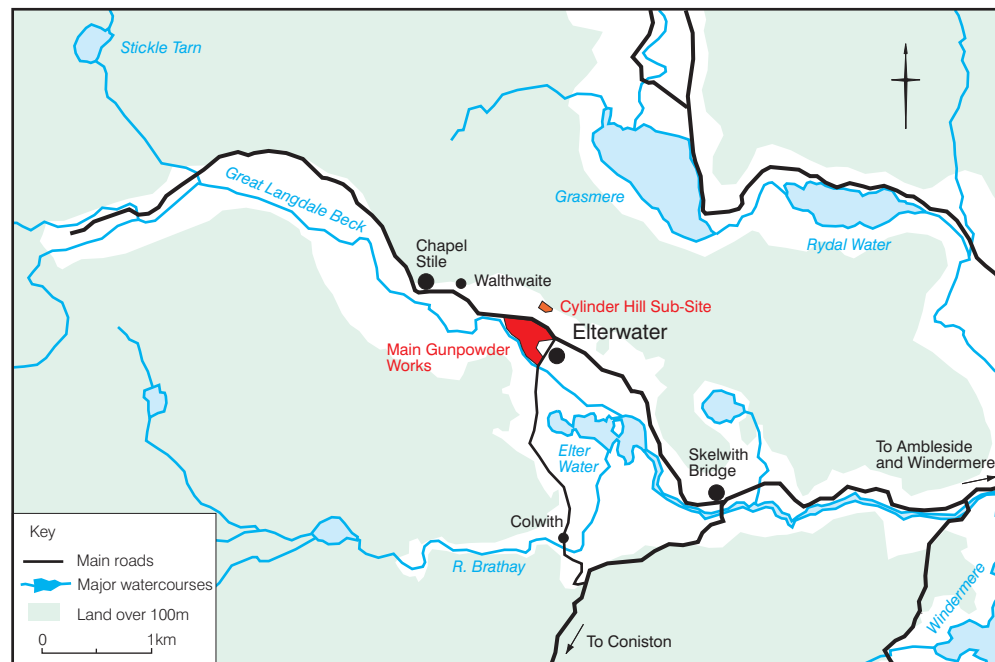


Figure 2.
Local location
diagram

Overall, Great Langdale has the typical smooth, U-shaped, profile of a glaciated Lake District valley, but in the immediate vicinity of the village and works the topography of the valley floor becomes more rugged with frequent rocky tors and hillocks (rock drumlins and/or roches moutonees), reflecting the interplay between local variations in the hardness of the underlying geology - an admixture of tuffs and andesite lavas of the Borrowdale Volcanic Group (IGS 1980) - and the carrying/scouring capacity of the glacier. One particularly large hillock lies at the very eastern end of the works, and accounts for the sharp northward turn taken by the old valley road immediately west of the village prior to 1861 (compare Fig 3).

Historically, the area surrounding the village (including the site of the gunpowder works) was common pasture known as Walthwaite Wood, although what remains of the common is now more generally called Walthwaite Bottom. Just below the village, a glacial tarn lies at the confluence of the Great Langdale Beck with the River Brathay which flows down Little Langdale: this is Elter Water from which the village takes its name. The first edition Ordnance Survey map (Fig 3) shows a number of small ponds scattered across the common, which are described as gravel pits; it is unclear if this tag should also apply to a small lake - now known as Hobson's Tarn - lying within the area of the works. Map evidence (Figs 3 and 4) also shows that from the mid-19th century the factory site was afforested in marked contrast to land outside

still used as common pasture. This may in part represent natural woodland regeneration linked to the removal of grazing pressure, but no doubt much of the planting was deliberate since tree cover was recognised as helping to limit the fallout of debris when, inevitably, gunpowder buildings exploded.

When the factory was closed in 1930, the ‘process’ or ‘danger’ buildings were burned down due to the danger of powder residues. ICI sold the site to a local timber merchant who stripped it of mature larch, and then sold the main factory area on to Richard Hall who converted it into a holiday centre known as the Langdale Estate. Several of the standing buildings were converted into holiday accommodation and the various mill ponds became swimming pools (*The Gazette*, 25 May 1935), whilst the shells of other buildings gradually deteriorated. In 1981, the site was acquired by a new consortium called the Langdale Partnership, who proceeded to turn it into a timeownership resort: eighty lodges were established amongst the trees, and the existing small hotel and surrounding area was developed into a luxury 4-star hotel and country club. The site has subsequently changed hands twice more, and is now in the hands of Langdale Owners plc, although trading as Langdale Leisure Ltd (Langdale Leisure nd).

In contrast, at closure the Cylinder Hill sub-site on the valley side above passed into the hands of a local farmer/landscape gardener, Harry Pierce, who converted the old smithy into a house, and the area behind (the location of the 19th-century charcoal retorts) into a garden. The Cylinder Hill magazine, constructed in 1882 a little to the east of the smithy, had been burned down at the factory’s closure, but was rebuilt by Pierce as a shed. In 1947 he offered it to the German, Nazi-refugee, artist Kurt Schwitters as a studio. This period of use of Cylinder Hill, and the subsequent conversion of the magazine/shed into Schwitters’ ‘Merzbarn’, is usefully summarised in a small pamphlet published by the Abbot Hall Art Gallery (Burkett 1979). The site is now abandoned and heavily overgrown. Apart from to the country club, there is no public access to any part of the former works without permission.

3. HISTORY OF RESEARCH

Until the present EH investigation, all published studies of the Elterwater works have been based primarily on documentary evidence. Of the various researchers, Mike Davies-Shiel is the only one to have carried out original fieldwork, making an invaluable plan and photographic record of the site as it survived in the 1960s and 1970s before development as a timeshare and country club; he has also carried out oral-history research, having conducted taped interviews with former employees. Unfortunately much of his detailed research is as yet unpublished.

The earliest historical account of the Elterwater works was in fact published whilst the factory was in the process of being closed, and is contained within a relatively brief, but nevertheless informative, article (Anon 1929, 343-8) which appeared in ICI's in-house magazine as part of a series of potted histories of the group's constituent companies. This article was a prime source for Paul Wilson's subsequent short account of the factory, included within his seminal historical overview of the Cumbrian blackpowder industry (Wilson 1964, 59-60). In the 40 or so years since, only three further researchers have published accounts of the Elterwater factory: Mike Davies-Shiel, Ted Patterson and Ian Tyler. The Davies-Shiel article deals with the Cumbrian industry as a whole, but much of it is based on Elterwater as, at the time, the best preserved and most readily accessible site (Marshall and Davies-Shiel 1969, 75-88). Patterson – who worked at ICI's Ardeer gunpowder factory in Scotland to which production transferred after the Cumbrian sites closed – had access to records on Elterwater not available to Davies-Shiel, particularly a plan of the site identifying the functions of all buildings at the works in 1926, and the final Manufacturing Method Book (Patterson 1995, 20-3). Ian Tyler in the most recent published study of the works (Tyler 2002, 160-95) has drawn on all these sources, and in addition seems to have identified much that is new.

Fieldwork for the present EH survey has been accompanied by a limited search for primary documentation as well as by a reading of this secondary literature. However, primary documents from which the history and development of the Elterwater works may be reconstructed are sparse and scattered. For the most part, the company papers do not survive - reportedly burnt at the factory's closure in 1930 (Marshall and Davies-Shiel 1969, 86) - although a few facts presumably derived from them are preserved at second-hand in ICI's short company history published soon afterwards. A number of documents seem to have been transferred by ICI to Ardeer in Scotland, but all that now survives there is the letter book of the company's founder, David Huddleston - presumably the original of a facsimile copy deposited in the Cumbria Record Office, Kendal (CRO(K)) - and a paper copy of a plan of the works (Fig 5) annotated by the HM Inspectorate of Explosives in 1926 (Peter Cartwright, ICI, Ardeer, pers comm). A copy of the Manufacturing Method Book or MMB (detailing the production methods followed in the final years of the factory's existence), came into the possession of Ted Patterson in 1985 (Patterson 1995, 1), and is now deposited with the Patterson archive at the NMRC.

Otherwise, the principal primary sources used by EH in the current study are a series of hitherto unrecorded property deeds in the possession of Cayley Barter (heir to Richard Hall, who bought the disused factory site in 1930), the two 19th-century 25-inch map editions of the Ordnance Survey (Figs 3 and 4), and an unpublished, annotated, site plan dating from 1932 (Fig 6) also in the possession of Cayley Barter. Local newspaper accounts, and after 1875, a series of reports into fatal accidents issued by

the newly-formed HM Explosives Inspectorate, have provided further useful details, but the search of newspapers has not been exhaustive (in the main confined to a brief search of microfilmed issues of the *Westmorland Gazette* around the date of events known from other sources). It is apparent that further primary documentation does exist, for Tyler's recently published account of the works (2002, 160-95) includes many facts and details unmentioned by the other sources used. However, his book is not closely referenced and much of the new information it contains must, for the time being at least, be taken on trust.

In certain respects, information contained within all the various sources, primary and secondary, seems contradictory (in particular the ICI company history, Tyler, Davies-Shiel and the Barter property deeds), and in most cases it has proved impossible to check or reconcile such differences. The discussion of the works' history which follows in section 4 of this report, therefore, should be seen as an interim statement only, and as a closely-referenced starting point for further research.

4. THE DOCUMENTARY HISTORY OF THE WORKS

Licence to operate a gunpowder works at Elterwater was first granted to David Huddleston on 16 January 1824, by magistrates sitting in Quarter Session at Kendal. This licence must subsequently have been kept on prominent display at the works, for it is referred to in the first HM Inspector's accident report (Explosives Inspectorate 1878, 1), and in 1929 the then owners, ICI, were able to reproduce a photograph of it (Anon 1929, 348); it is now lost. Huddleston was an erstwhile banker who had retired to Elterwater in January 1823, but had apparently rapidly tired of his new-found leisure and decided to try his hand at manufacturing gunpowder (Anon 1929, 343-4; Wilson 1964, 59; Tyler 2002, 160-1).

According to the official ICI history, the works was set going in 1824 as a single incorporating mill, trading under the name of David Huddleston & Co; it sold its powder unpressed and uncorned. Despite these shortcomings in the quality of the product, the business prospered and by 1829 three further mills and a press house had been added (the latter not water-powered, but hand-operated). At this time the factory reportedly covered some 7 acres of land, and the Company's assets, which included two cottages as well as its gunpowder buildings, were said to be worth £49 4s 1¹/₄d (Anon 1929, 343-4).

However, property deeds and other papers in the possession of Cayley Barter (hereafter referred to as the Barter collection - see details in section 9 below), together with contemporary newspaper accounts and information in Huddleston's letter book, paint a somewhat different picture of the Company's early development. The deeds reveal that in 1823 when he retired, Huddleston already had a part-interest in a water-powered corn mill on the edge of Elterwater village, inherited from his late father-in-law, John Coward, miller of Skelwith Bridge, although undisputed freehold title to the mill was not finally gained until July 1824. Meanwhile, in February 1823 (only a month into retirement) he purchased the adjacent fulling mill, together with other property, from a certain John Fleming for the princely sum of £755. Furthermore, by the end of that year he had the consent of the villagers (and from May 1824 the consent of the Lord of the Manor) to enclose an estimated 7 or 8 acres of the common of Walthwaite Wood adjacent to the Langdale Beck, seemingly in recognition of his payment for a school-house and the repair of local roads. It thus seems very likely that Huddleston had been formulating his idea to manufacture gunpowder for some time before moving to Elterwater, and that retirement was merely the trigger to start putting those plans into action. As previously stated, licence to operate the works was granted in January 1824, but it was not until almost two years later - on 28 December 1825 - that the factory actually opened for business (*Westmorland Gazette*, 31 December 1825; reference supplied by Mike Davies-Shiel). A letter from Huddleston to his agent dated 24 March 1826 (CRO(K) WDY 448) confirms the ICI account that the factory commenced production with only a single incorporating mill, but also states that a second was already under construction; it was completed in December of that year. According to other newspaper reports of late 1825/early 1826, this early factory was also already equipped with a corning house, a glazing house, a watchman's hut and a magazine, whilst the old woollen mill had been converted into offices, changing rooms for the workforce, and a saw mill and packing house (Mike Davies-Shiel, *in litt*).

Other documents in the Barter collection show that by 1826 the business consisted of eight co-partners (namely Huddleston himself, John Gaskarth, Isaac Wilson, John

Green the Younger, John Robinson (Huddleston's brother-in-law), James Bousfield, John Braithwaite and Thomas Benson), was already trading as the Elterwater Gunpowder Company, and owned considerably more land and property than the 7 acres and £49 4s 1¹/₄d reported by ICI. One particularly informative covenant (bundle 3, document 3), dated 30 July 1827, enables the position and extent of the early factory to be accurately located. This deals with the conveyance by Huddleston of 'all that plot piece or parcel of land or ground called Wallthwaite (*sic*) Wood' upon which 'the said several parties...have erected and built the Elterwater Gunpowder Works' to a certain Jeremiah Coward (presumably a relative of Huddleston) in trust on behalf of the Company. The said land covered 13 acres, 1 rood and 20 perches, statute measure (*ie* 13³/₈ acres, or *c* 5.4ha), and is described as bounded 'towards the east by the road leading from Langdale to Hawkshead on or towards the west by a rivulet or stream called Great Langdale Beck and on or towards the north and south terminating in a point'. In all likelihood, this land parcel is the same as the '7 or 8 acres of common' which Huddleston was given permission to enclose in 1823/4 - the apparent discrepancy in size explicable as the difference between customary and statute acres. In the north of England, a customary acre covered 65.62 ares, some 1.62 the size of a statute acre at 40.47 ares (Seeböhm 1914, 109-14). Thus 8 customary acres are equal to 13 statute acres.

Whatever the true initial size of the factory, further expansion quickly followed. A (new?) magazine was ready by the end of 1827 (Tyler 2002, 162), while two more incorporating mills and a press house had been constructed by 1829, and in 1837 the Company was damming Stickle Tarn higher up the valley (Fig 2) in order to raise its level and act as a holding reservoir to supplement the flow of the Great Langdale Beck in dry weather (Anon 1929, 344; Tyler 2002, 165 and 169). The latter act suggests that extra water-powered plant had already been installed, or was in the process of being added, at the works. Indeed, according to Tyler (2002, 165), the Company had purchased additional land in 1834 for just this purpose, but strangely there is no record of this transaction in the deeds making up the Barter collection, strongly suggesting that the land in question lay separate from the main site. By 1840, when there was a multiple fatal accident, the local newspaper report of the coroner's inquest makes clear that the factory contained the full range of manufacturing processes normally expected of a gunpowder works of this period, with mention of a sulphur refinery, watch house, cooperage and counting house, in addition to the press house, corning house, and glazing house which were all destroyed in the explosion (*Westmorland Gazette*, 1 February 1840). According to the ICI history, the Company purchased additional common land following the explosion in order to increase the distance between the process buildings and to separate them from private dwellings, as well as to prevent the public using the road through the factory (Anon 1929, 346). But again, there is no record of such a purchase amongst the deeds in the Barter collection, and it may be that the Company rather expanded onto land they already owned (Walthwaite Wood, this section above), or that the event has somehow become confused with later recorded expansion (this section below). According to Tyler (2002, 175), it was not until 1850 that the works was surrounded by a stone wall as a further measure to improve security and public safety.

In these early years, the Company imported its supplies of saltpetre and sulphur from India and Italy. To begin with, it also purchased charcoal from external (local) suppliers. But because of problems with quality, it very quickly installed its own cylinder retorts on site; these operated until 1866, after which time charcoal was once more sourced externally. These retorts were located away from the main factory on a divorced sub-site on the valley side about 150m north of the works (Marshall and

Davies-Shiel 1969, 77-80), which came to be known as 'Cylinder Hill' (Tyler 2002, 179). As no deed for the Cylinder Hill sub-site can be identified amongst those in the Barter collection, it must be a distinct possibility that the reference Tyler has uncovered to the Company acquiring land in 1834, relates to its purchase (this section above). Other conveyances in the Barter collection (bundle 2, documents 5 and 7) make clear that the Company was also purchasing coppice woodland around this time (Steps End Coppice in 1826 and Thrang Wood in 1833), possibly as part of a related effort to guarantee charcoal supplies.

By the time of the earliest surviving map depiction of the site in 1859 (Ordnance Survey 1861; hereafter referred to as the OS first edition), we can see that the factory had grown from its humble origins to cover approximately 15 acres (6.1ha) sandwiched between the then valley road and the Great Langdale Beck. The map (a late engraving/reprint of which is reproduced here as Fig 3) shows some 30 free-standing buildings and ranges within the works, mostly situated close to and on either side of a new purpose-built main leat which originated at a weir some 550m upstream of Elterwater Bridge. The leat is shown splitting into a number of branches before feeding in to what looks very much like an earlier leat system (presumably associated with the former corn and fulling mills on whose site the works had been established) close to the village, and rejoining the beck immediately above the bridge. Given the level of effort expended in damming Stickle Tarn in order to guarantee a sufficient and reliable source of water, the new leat's construction should presumably be dated to between 1829 and 1837, although the land on which it lies was seemingly acquired by Huddleston as early as 1824 (Walthwaite Wood, this section above). None of the buildings is named on the map, but the functions of several can be deduced from their depiction (*eg* the incorporating mills), whilst for others a guess can be hazarded with the benefit of later annotated factory plans of 1926 and 1932 – always with the proviso, of course, that some of the buildings will have changed function over time. From these sources, we can state confidently that by 1859 there were ten incorporating mills at the works: a lower set of three pairs built around a small mill pond close to the site of the original fulling and corn mills (hereafter referred to as the lower mill pond), and another set of two pairs arranged across a bifurcation in the new main leat towards the upper end of the site. (The two sets will hereafter be referred to as the lower and upper mill sites, respectively). It is also apparent that store buildings were clustered adjacent to the beck at the upper end of the site, where the saw mill, saltpetre refinery and preparing house were also situated; that the press house (by now seemingly water-powered), corning house and glazing house all seem to have been located adjacent to the beck in the centre of the site; and that an outlying building in the north-east corner of the works was in all likelihood a magazine. Other buildings lie dotted around, including what must be the charcoal retorts and a coppice barn in the divorced Cylinder Hill sub-site on the hillside above (Fig 3: land parcel no. 488).

Further expansion of the site is documented in 1861 when for reasons of improved public safety the Company gained permission to enclose an additional area of Langdale Common, and re-route the valley road (which then skirted the north-eastern edge of the works – see Fig 3) further to the north (CRO(K) WQ/A/H/17). This increased the main area of the works to almost 22.5 acres (9.1ha), as shown by the subsequent OS map depiction surveyed in 1897 (Ordnance Survey 1898; hereafter called the OS second edition (Fig 4)). Allegedly, the Company had already purchased several acres of common land after the fatal explosion of 1840 in order to prevent the public from using the road - which until then had run through the factory - and to increase the distance between the process buildings (this section above), but if so, the property

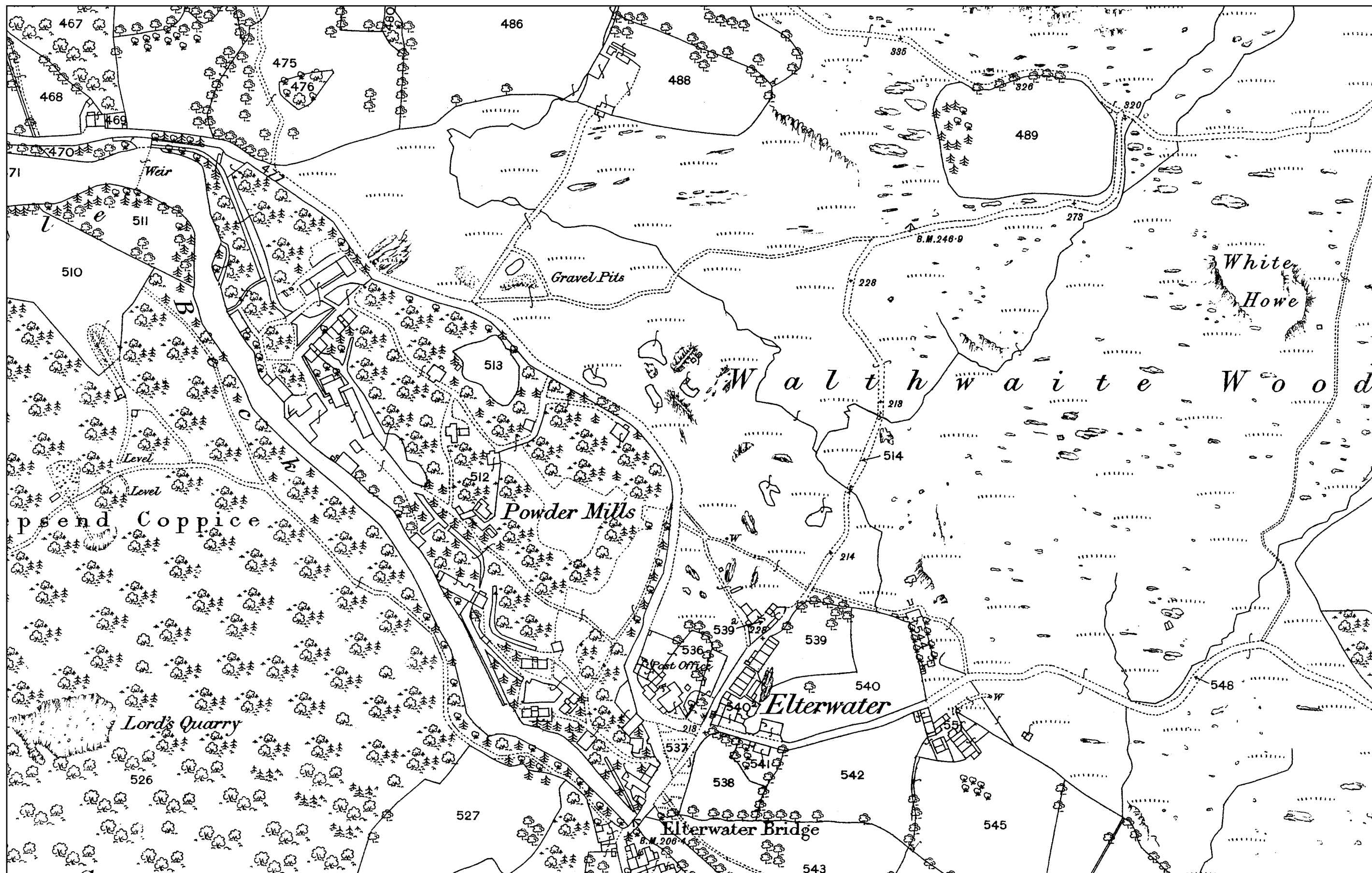


Figure 3. The site of the Elterwater Gunpowder Works as mapped at 1:2500 scale in 1859. (Reproduced from the 1861 Ordnance Survey map) NB. Different engravings show slightly different detail particularly in the pattern of tracks around the press, corning and glazing houses.

deeds do not survive in the Barter collection, and EH has found no record at the CRO(K) of the necessary application to divert the highway. It may be, therefore, that the events of 1840 and 1861 have somehow become confused and conflated; before 1840 the road may have run through the works, but following the explosion was simply diverted to run round its perimeter (as shown on the OS first edition). If the public highway did originally run through the factory rather than around it, as this reading of the evidence suggests, it would certainly help to explain the existence of an old cottage within the curtilage of the works only 25 yards from the upper incorporating mills. This cottage was still being rented out by the Company to its workforce as late as 1878 (Anon 1929, 346), but was subsequently turned into a watch and change house.

In 1866, the Company changed its status to that of a limited liability company, trading under the name of the Elterwater Gunpowder Co Ltd (Anon 1929, 343). The workforce numbered around 50 people, capable of producing 25 tons of blackpowder each week. But more importantly the change in status re-capitalised the enterprise (it now had access to capital of £51,000), enabling investment in new plant and machinery. One consequence was that, by 1867, the factory had an internal network of proper, edged roads, which were swept on a daily basis to help prevent foreign matter entering the mills and causing explosions (Tyler 2002, 175-6).

Despite such safety precautions, three further fatal explosions occurred at the works, in 1878, 1901 and 1916. Reports on these accidents published by HM Inspectors of Explosives (Explosives Inspectorate 1878; 1901; 1916), supplemented by the OS second edition map and two later, annotated, plans of the factory layout, are the major sources of primary evidence used by EH to chart the development of the works through the final 50 years of its existence. The Inspectors' reports also provide interesting details on the specifics of the design of the corning machinery employed. In addition, a manufacturing method book (MMB) gives a detailed account of the actual processes of manufacture employed in the final years of the factory's existence. Patterson (1995, 20) thought the MMB typescript dated to *c* 1927, but a dated longhand emendation on page 7 shows it was in existence by October 1925. The contents of the Inspectors' reports and the MMB will not be reviewed in detail here, but have been used to inform aspects of section 5 and appendices 1 and 2 of this report.

According to Tyler (2002, 179) a new works manager, James Bousefield (*sic*), took up post shortly before the 1878 explosion, and oversaw a period of modernisation and expansion during the next few years. This is borne out by the OS second edition map surveyed in 1897 (Fig 4), which shows that compared to the first OS survey in 1859, considerable changes had taken place. Only the more obvious changes will be highlighted here; in many cases their exact dates are unknown - some, of course, will have been introduced before Bousefield became manager. First, the system of leats and millponds had been enlarged, and now incorporated a small lake which had been turned into a millpond/holding reservoir by bringing in a feed from the existing main leat parallel to the river. The lake is unnamed by the OS, but was apparently later known as Hobson Lake (Anon 1929, 345); it is now called Hobson's Tarn (Langdale Leisure nd), although in origin it may be a flooded gravel pit rather than a natural glacial feature (section 2 above). Water from it was being used to power the re-sited glazing house. A second important difference shown by the map is that there was now a narrow-gauge tramway system within the works; according to Tyler (2002, 176), this was constructed around 1867. The map also documents changes in the number and disposition of individual buildings, the most obvious differences being

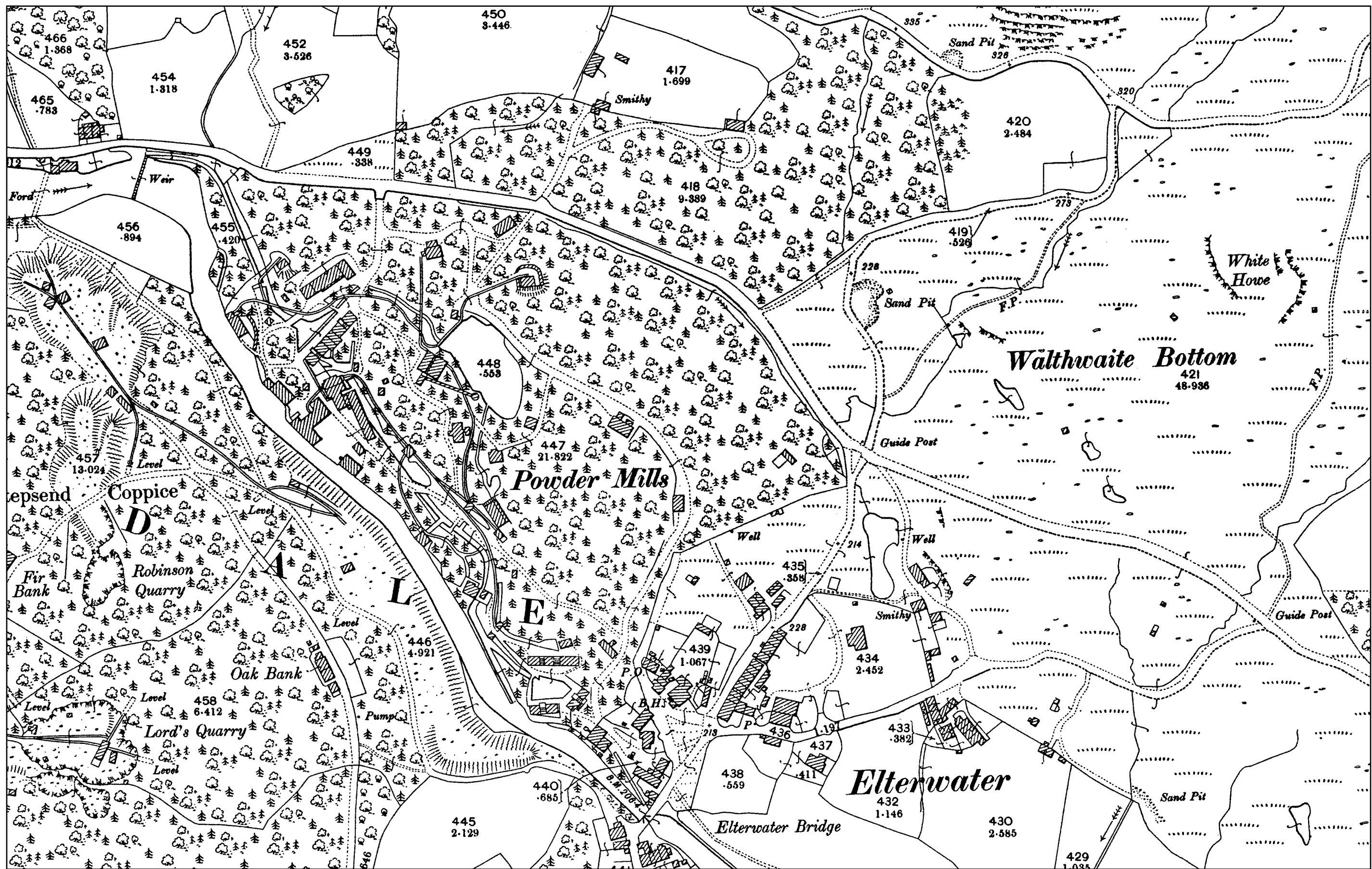


Figure 4. The site of the Elterwater Gunpowder Works as mapped at 1:2500 scale in 1897.
 (Reproduced from the 1898 Ordnance Survey map)

amongst those at the centre of the site, where for example a new large steam-heated drying house had been added, with a stone flue leading to a divorced chimney some distance downwind of the boiler house, on the edge of Hobson's Tarn. Davies-Shiel (Marshall and Davies-Shiel 1969, 84) dates its construction to 1881, replacing an earlier gloom stove. Furthermore, the map shows that before 1897 the works' incorporating capacity had been increased by the addition of a sixth pair of mills at the lower mill site. This extra milling capacity would have had knock-on effects throughout the works, and may well have been the driving force behind the construction of the new drying house already mentioned. It probably also accounts for a new magazine erected at the now disused Cylinder Hill sub-site, whose construction Tyler (2002, 179) dates to 1882. This building is unnamed on the OS second edition, but can be readily identified nevertheless since it is set well away from most other buildings, and has a wagon-turning circle up against its southern wall.

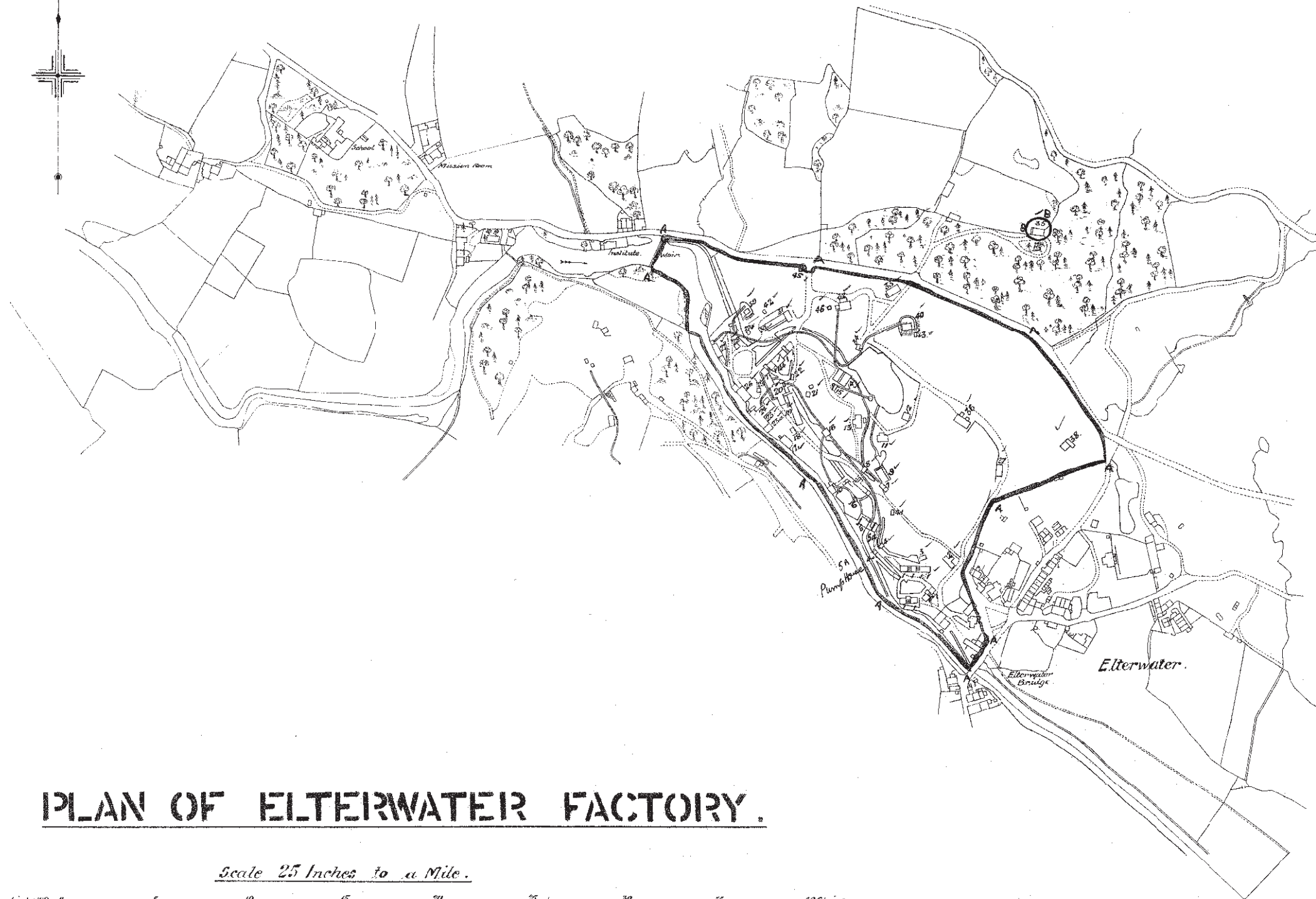
There was also greater investment in the workforce around this time, with the Company encouraging the establishment of a Mechanics Club in 1871 to foster learning (Tyler 2002, 176). Deeds in the Barter collection (bundle 5) record the sale by the Company in 1880 of a small parcel of land just upstream of the upper weir to Robert Crewdson, apparently with the idea that he build a lecture hall on it. Written into the deed was a clause by which the Company reserved an option to purchase any building Crewdson subsequently erected. In 1889 the option was duly exercised, and the hall became home to the Mechanics Institute.

The factory was badly affected by flood towards the end of 1898. The Great Langdale Beck broke its banks on 2 November, and badly damaged the press house and the lower incorporating mills; the weir was totally destroyed (Tyler 2002, 180).

Although the Ordnance Survey subsequently revised its large-scale mapping of this part of Westmorland in 1912, the main area of the works was unfortunately left blank on the published map because of wartime security measures (Ordnance Survey 1915). However, by chance two annotated plans of the works have survived for the later period, the first marked up with the function of buildings as they were in 1926, the other dating to 1932 a few years after the factory closed. These documents will hereafter be referred to as the 1926 and the 1932 plans respectively. The 1926 plan survives as a paper copy held by ICI at their Ardeer site, and together with the MMB seems to be the authority for Patterson's (1995, 20-3) published plan and account of the factory. Information on the original plan not mentioned by Patterson, shows that it was surveyed in 1921, but that the annotations are the work of Lt Colonel R A Thomas, HM Inspector of Explosives, in connection with the granting of Amending Licence no. 3041 in December 1926. Such licences were issued pursuant to the 1875 Explosives Act whenever a modification was made in the local rules governing the operation of a gunpowder factory; licence no. 3041 was presumably the final licence issued by the Inspectorate to the Elterwater factory before it closed. The plan is reproduced here as Fig 5.

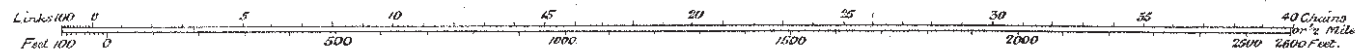
The 1932 plan in contrast, is signed by a certain J Carlyle, and was produced on behalf of Richard Hall, the then owner, in connection with the sale of one of the former gunpowder buildings (by then known as Brackens). It, too, includes a key identifying the function of buildings, although some of the identifications differ from those on the 1926 plan. The histories of the two documents suggests that the 1926 plan must be regarded as the more reliable. The original of the 1932 plan (now in the possession of Cayley Barter, nephew of Richard Hall) was lent to Mike Davies-Shiel in 1966 when the latter was undertaking research into the Cumbrian gunpowder

Factory No. 34, Westminster
 Plan to Amending Licence No. 3041.



PLAN OF ELTERWATER FACTORY.

Scale 25 Inches to a Mile.



Plan No.	Description of Building
1	Incorporating Mills
2	Watch & Change House
3	Store - no rush goods
4	Change Ho. - 4a-Save Depot
5	Coring House & Pumps. SA
6	Accumulator House
7	Blacklead Store
8	Empty Barrel Store
9	Glazing House
10	Press House
11	Sulphur Store
12	Store - general goods
13	Barrel Store
14	Stores
15	Boiler House
16	Expense Magazine
17	Joiners Shop & Boxmakers
18	Store for Timber
19	Sawmill & Shed
20	Preparing & Mixing Ho.
21	Charcoal Store
22	Change House
23	Gas Engine House
23a	Generating House
24	Refinery & Bag Store
25	Paint & Nail Store
26	Potash & Soda Store
27	Carriage House
28	Fire Engine House
29	Close
30	Watch & Change House
31	Store for Timber etc.
32	Dust House
33	Saw Pit
34	Dipping & Packing House
35	Magazine
36	Magazine
37	Care Shed
38	Dog Kennels
39	Carriage House
40	Packing House
41	Wire Webbing Store
42	Close
43	Close
44	Turbine & Pump House
45	Searchers Hut
46	Motor House

R.A. Thomas & Co. Ltd.
 117, Inspectors of Explosives.
 26th December, 1926.

H. O. 15 - 10
 D.

27 - 6 - 21.

Figure 5. The plan of the works accompanying Amending Licence No. 3041 ('the 1926 plan'). (ICI plc, copyright reserved)

industry, and is a key source for the overview and site plan of the Elterwater factory which he subsequently published (Marshall and Davies-Shiel 1969, 75-88). However, Davies-Shiel annotated the original plan in biro with his field observations. Whilst this is unfortunate in that it has despoiled the document, the comments are themselves now historically important for they were made at a time before the timeshare/hotel development obscured many of the building remains then still extant. Thus the plan preserves for us a commentary on, for example, the construction sequence of the individual buildings making up the lower incorporating-mill complex, based on Davies-Shiel's personal observation. His comments were also informed by interviews conducted at the time with former Elterwater employees (Mike Davies-Shiel, pers comm). The plan, biro and all, is reproduced here as Fig 6.

It is interesting to note that the 1926 plan names a turbine house, accumulator house, gas-engine house and generating house, showing that by the end of its life the factory was no longer solely reliant on waterwheels to generate mechanical power but was making limited use of alternative sources. According to Tyler, these changes date to after 1878, and are connected in the main with the introduction of cartridge packing: although the press for this new process was initially powered by a waterwheel, it was soon replaced by a 25hp Gilkes turbine assisted by a 32hp National gas-suction engine. Later around 1890, a dynamo was introduced bringing electric light to the factory for the first time. Despite its name, it is clear that the accumulator house had nothing to do with electricity generation, but instead produced hydraulic power (section 5.2.1 below). Around 1890 an additional step in the cartridge-manufacturing process was introduced whereby the cartridges were dipped in hot wax after packing to make them airtight (Tyler 2002, 179-80). The building where this process was carried out is also identified on the 1926 plan.

There is confusion in the published literature over when exactly Elterwater closed: 1928, 1929 and even 1931 have all been claimed (*eg* Wilson 1965, 59; Patterson 1986, 13 and 27; 1995, 21 and 41; Crocker 1988, 38; Tyler 2002, 192), but 1930 which is the year given in a near-contemporary newspaper article (*The Gazette*, 25 May 1935) seems the most likely date. Certainly the incorporating mills were still turning in 1929, for Patterson (1986, 29) records that there was an explosion in one of the mills that year, and the ICI Magazine article published in October 1929 (Anon 1929) speaks of the works as if closure was threatened but not yet a reality. At closure, the factory was bought by a timber merchant, who swiftly sold it on to Richard Hall for development into a holiday centre

A number of other sources provide information on aspects of the factory's operation such as production levels and the transport of goods to and from the site. In 1887, a Parliamentary Select Committee took oral evidence on a bill to extend the Windermere railway up to Ambleside. The line was never built, but evidence given by Mr G H Perks, the works' manager, states that at that time (and by implication for some years previously), the factory was importing about 1400 tons of raw materials and exporting 1000 tons of gunpowder annually. This equates to weekly production of some 20 tons, but apparently the factory was working below full capacity so as not to depress the price of its product (Anon 1887, 81-5). Before the advent of the railway, all transport seems to have been by horse and cart between the works and Pull Wyke staithe on the shores of Windermere, and by barge between there and coastal-trading vessels berthed at the port of Greenodd at the mouth of the River Leven. However, after 1846 when the Windermere Branch Line was opened, the carts (in the 20th century augmented by motorised vans) travelled instead to Windermere Station (Anon 1929, 347-8; Tyler 2002, *passim*). When the Furness Railway's branch line to

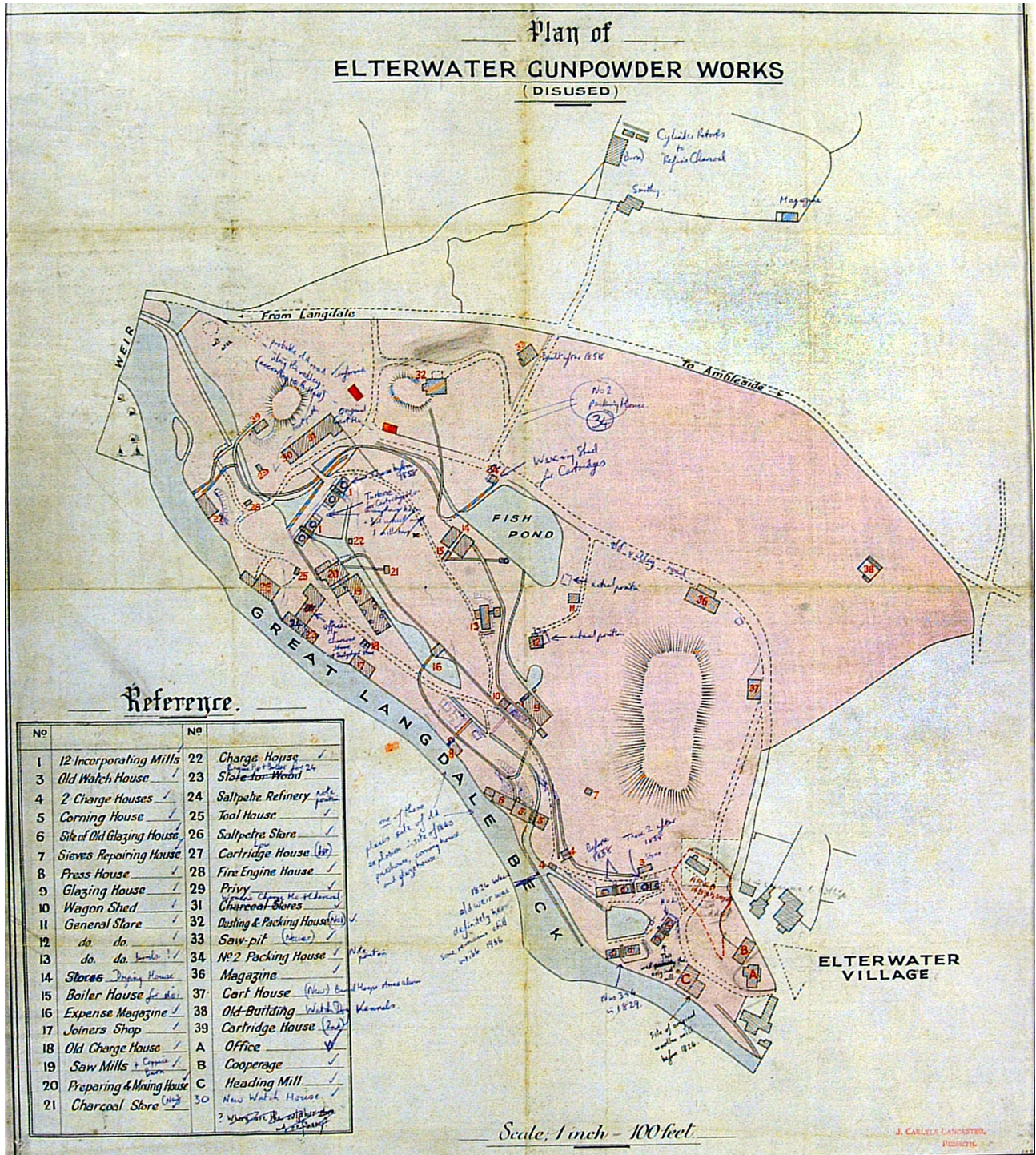


Figure 6. The plan of the works accompanying the sale of Brackens ('the 1932 plan').
(Barter collection, copyright reserved)

Coniston opened to freight in 1860 (Norman 1994, 73) some thought was apparently given to using that railhead instead, but despite the Company spending upwards of £1000 on improving the roads, goods continued to be shipped mainly through Windermere because of the latter's better connection to the London mainline (Anon 1887, 82). This dalliance with the Coniston railhead, however, is presumably the context for an application made by the Company (CRO(K) WQ/A/H/19) to divert the public highway between Elterwater and Colwith Bridge in 1863 (Fig 2). It has been suggested that raw materials and finished gunpowder were moving between Greenodd and the Elterwater factory *via* Coniston Water even before the coming of the railway (Lowe 1968, 9, quoted in Bowden 2000, 37), but the present study has found no independent evidence to substantiate such a claim.

There is a considerable photographic archive of the Elterwater works. A few prints date from the late 19th and early 20th centuries whilst the factory was operational, but record social events and only show buildings and machinery incidentally (several are reproduced in Tyler 2002). A far larger body of photographs document the site in the 40 or so years following closure. The main such collections belong to Cayley Barter and to Mike Davies-Shiel. Both have kindly granted EH access to their collections, and given permission to reproduce selected material in this report.

5. FEATURE CATALOGUE AND DESCRIPTION OF THE REMAINS

The following catalogue of features is divided into two parts: the first (section 5.1) deals very briefly with features which are likely to pre-date the gunpowder works; the second much longer part (section 5.2) describes the structures which made up the works itself. For the purposes of the present report, all buildings for which there is cartographic evidence have been allocated a unique number, although this does not extend to those for which there is documentary evidence but which cannot at present be securely located. Numbered buildings can all be found on Figs 73-80 in section 6 below. The numbering system adopted follows and builds on that of the 1926 plan of the works (Fig 5), and bears no relation to the order in which buildings were constructed or how the site developed over time. Numbers on the 1932 plan (Fig 6) are slightly at variance with those on the 1926 plan; where such discrepancies occur they are highlighted in the text. All structures for which there is cartographic or documentary evidence have been included in the catalogue, regardless of whether there is still any physical surface evidence for them; in similar vein, a number of built features – principally blast walls – not represented on the maps are also described. The overall EH plan of surviving structures is shown at Fig 7, while Figs 29 and 42 show details of the principal surviving structures at the sites of the lower and upper incorporating mills.

In order to present a coherent description of the works, section 5.2 is arranged by process (rather than in date or any other order) with sub-sections describing the various buildings and structures according to the functions for which they were used. This itself creates problems, however, for inevitably many buildings changed function over time. Where this is the case, cross references will guide the reader to other relevant sections of the catalogue. Section 5.2.1 discusses the evidence for the various sources of power employed by the works, whilst section 5.2.2 covers the structures used in the preparation and storage of the three raw materials from which gunpowder is made (saltpetre, sulphur and charcoal); section 5.2.3 follows the process of gunpowder production from mixing of the ingredients through to packaging and storage of the finished product, whilst section 5.2.4 deals with those buildings specific to cartridge manufacture – a process only introduced to Elterwater in 1878. Ancillary buildings are detailed in section 5.2.5, and buildings of uncertain purpose in section 5.2.6. Section 5.2.7 deals briefly with transport issues, and finally section 5.2.8 covers a miscellany of other features such as the proofing range and Mechanics Institute.

Those readers unfamiliar with the way gunpowder was manufactured are advised to read section 5.2 below in conjunction with appendix 1 at the end of this report, which gives a precis of the general method and explains the technical terms used.

5.1 Phase 1. The pre-gunpowder landscape

According to documents in the Barter collection (bundle 1, document 1), by 1824 Huddleston possessed the freehold of two adjacent water mills: one for grinding corn, the other a fulling mill. These both stood ‘on the Forest or Common of Great Langdale near to Elterwater Bridge’. The corn mill is mentioned as early as 1653 (Mike Davies-Shiel, *in litt*), but the fulling mill was not erected until 1714 or shortly thereafter. The latter lay west of the corn mill, and shared its weir, water and leats.

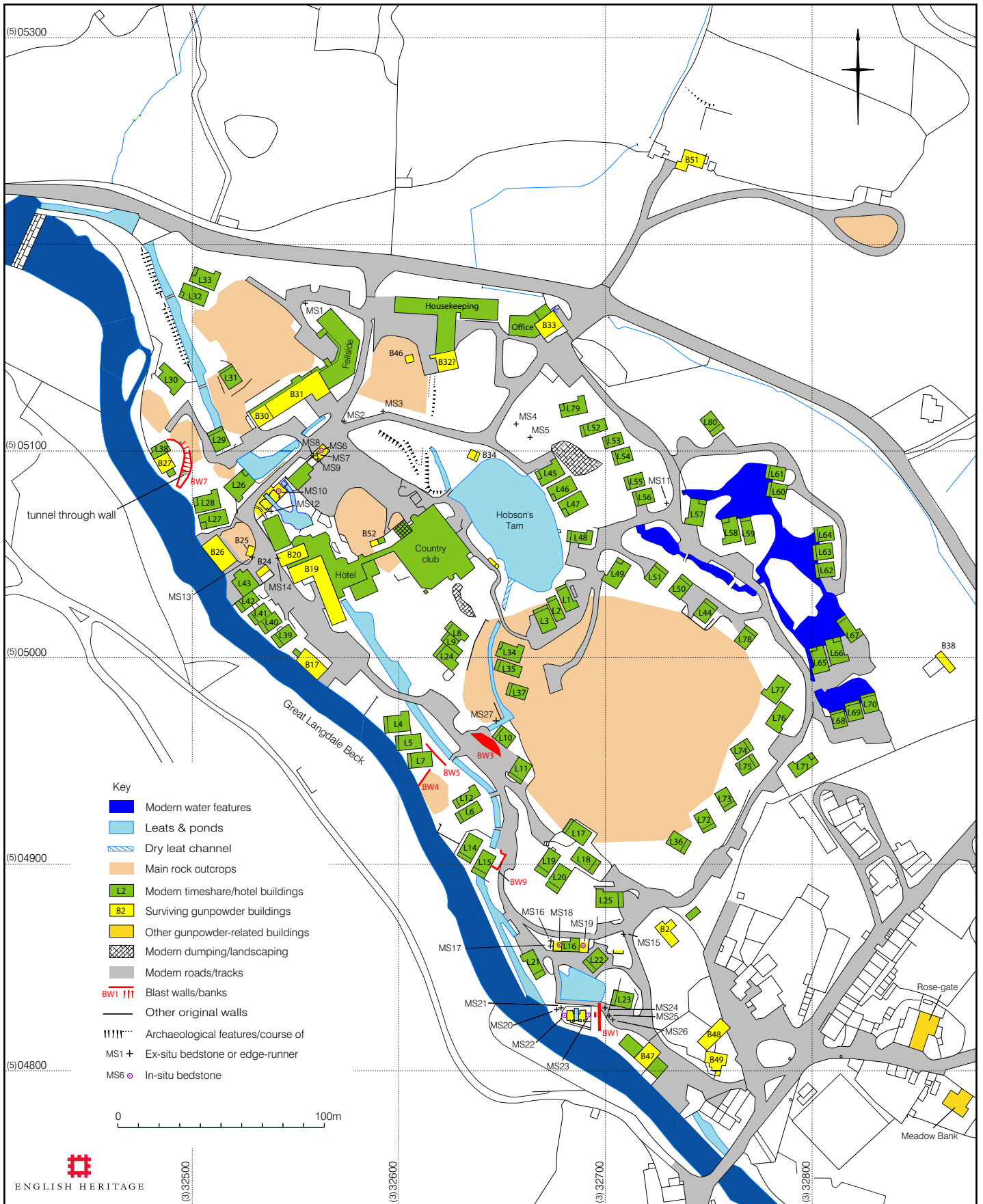


Figure 7. EH plan of the works, reproduced at 1:2500 scale.
 (This plan includes data taken from the OS map, and is reproduced by EH with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office, © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence Number: GD03085G)

Cartographic and topographic analysis support the idea of an earlier leat system at the lower end of the site. Here, close to Elterwater Bridge, is what looks very much like a mill pond (the lower mill pond), fed by a leat coming off the Great Langdale Beck *c* 50m upstream where very slight traces of a wooden weir are still just visible in the bed of the river (at NY 32635 04875); a tail race - for the most part now covered over - returns water to the river just before the bridge. According to Davies-Shiel's comments on the 1932 plan (Fig 6), the fulling/woollen mill is the building marked 'C' on that plan (at NY 32720 04807). However, since the documents in the Barter collection state that the fulling mill lay west of the corn mill, this building is in fact more likely to be the latter. It still survives on the ground, although there is now no visible external indication of its original function, and the interior has also been extensively gutted. During the lifetime of the gunpowder works, it seems variously to have served as offices, change house, saw mill, cooperage, hoop loft and heading-up house (sections 5.2.3 and 5.2.5 below), and is now used as a general workshop by Langdale Leisure; modern extensions have been added on both sides (Figs 8, 9 and 28). The fulling mill, however, does not survive; the likelihood is that it was demolished to make way for, or converted into, the single incorporating mill with which the gunpowder factory commenced production in late 1825 (section 4 above). If we accept Davies-Shiel's siting for this initial incorporating mill (section 5.2.3 below), it is likely that the fulling mill lay immediately east of the lower mill pond (at *c* NY 3271 0483). Both corn and fulling mills would undoubtedly have had internal waterwheels, in order to protect them from icing up in winter (Mike Davies-Shiel, pers comm).

In acquiring the corn and fulling mills, Huddleston also gained a number of associated structures, including dwelling houses, a drying kiln, a peat house, a stable and a barn (Barter collection). These presumably all stood in the immediate area of the two mills, and most probably include those buildings fronting onto the road by Elterwater Bridge shown on the OS first edition map (Fig 3; numbered buildings 53 and 54 on Figs 73-80 for the purposes of the present report). Other sources record that in 1829 the company owned two cottages, but there is no information as to where either was situated or whether they were the same as the dwelling houses acquired with the mills - one for example could be the cottage later reported as existing in the vicinity of the upper incorporating mills (section 4 above). It is not known when the cottage was built or first acquired by the company, but after 1878 it was converted into a watch and change house (building 30, section 5.2.5 below).

5.2 Phase 2. The gunpowder works

5.2.1 The power systems

The main source of power at Elterwater throughout its life was water. Initially, the water drove a series of wheels producing mechanical power, but later it powered turbines and hydraulic rams as well. Sometime after 1878 a gas-suction engine was introduced as back up for the turbines when water ran low, and from 1890 dynamos produced electric light for the factory. By the time the factory closed the dust house was being powered by an electric motor.

Water power

Initially the weir and leats supplying the earlier corn and fulling mills (as described in section 5.1 above) seem to have been adequate to satisfy the new gunpowder



Figure 8. The corn mill/heading mill (building 47) from the north



Figure 9. The corn mill/heading mill from across the Great Langdale Beck

factory's requirements for mechanical power. However, as the works expanded, both in terms of production capacity and spatial footprint (many of the additional buildings would have had to have been set well apart for reasons of safety), a more extensive system of leats and ponds was needed. Circumstantial evidence suggests that construction of this new system - for which the first direct evidence is the OS first edition map surveyed in 1859 (Fig 3) - most probably dates to sometime between 1829 and 1837. (The suggested *terminus ante quem* is the year when Stickle Tarn was dammed in order to regulate and improve water flows along the Great Langdale Beck (section 4 above)).

At the factory, a second (upper) weir was constructed across the beck at NY 32420 05203 some 400m upstream of the existing (lower) weir, in order to divert water into a new main leat. This upper weir was stone-built (it still survives), unlike the lower one which was of wood and iron (Fig 11). The OS first edition map shows that the new leat ran parallel to the river for some 150m, before widening out into a small mill pond (hereafter referred to as the upper mill pond) and branching into three channels (a short leat which returned water to the beck before this point was probably only an overflow). Each of the channels powered a different waterwheel - two driving the two pairs of upper incorporating mills and the third situated between the preparing house and saw mill. Field observation shows that this third channel must have been carried in an elevated wooden launder, the stone supports for which still survive (Figs 10 and 22). The map depicts all channels reconverging after the



*Figure 10.
The stone base
(now surmounted
by a modern fence)
for the elevated
launder to the
preparing house
and saw mill*

preparing house, and a broadened leat with irregular sides (suggestive perhaps of it occupying a natural depression?) carrying on past the saw mill. The map then shows a branch leading off at right-angles back towards the beck in order to drive a wheel at what was presumably a new, re-sited, mechanically-driven press house, replacing the manually-operated press with which the factory had reportedly commenced production (section 5.2.3 below). Shortly afterwards, the main leat swung sharply south towards the beck, and powered a wheel for the corning and glazing houses, whilst another branch came off at the turn to provide power to an extra pair of

incorporating mills added since 1829 on the hillside above the lower mill pond (mills 5 and 6, section 5.2.3 below). Below the corning house, the main leat turned back parallel to the beck - from which field evidence shows it was now only separated by a thick stone wall - and merged with the earlier leat system to the lower incorporating mills, and/or discharged along a long tail race into the beck some distance below the lower weir. The lower weir was now effectively redundant; certainly it is not shown on any OS map edition. However, a surviving sluice in the tail-race wall a little upstream of the weir suggests it was retained, and indeed an old photograph in the Barter collection (Fig 11) shows it still apparently in good repair into the 1930s. If so, it must have been rebuilt following the 1898 flood (section 4 above). It may have been retained in order to permit independent operation of the lower incorporating

mills when the main leat system was isolated for maintenance. Many other sluices would once have existed all along the main leat and its branches in order to control water flows and/or isolate individual sections for repair as the need arose; several still survive and are maintained in working order by Langdale Leisure.



*Figure 11.
The lower weir, as
shown in an old
print thought to
date to the 1930s.
(Barter collection,
copyright reserved)*

The evidence of the OS second edition map (Fig 4) shows that at some time before 1897 the water-power system was further expanded by the construction of a fourth channel which took water from the upper mill pond and fed it into an existing flooded gravel pit or natural pond (now known as Hobson's Tarn) lying within the northern curtilage of the works, effectively turning the latter into a third mill pond; another new leat ran from the southern end of the tarn and delivered power to the re-sited glazing house. Comparison of the two OS map editions (Figs 3 and 4) shows that the tarn had also been enlarged before 1897 to increase its storage capacity. Although the second edition map is the first direct evidence for any of these changes, the essentials must have been complete before 1878 as the new glazing house was operational by that date (section 5.2.3 below). The second edition map also shows that a fifth channel had been added by 1897 flowing out of the upper mill pond and between the two pairs of upper incorporating mills: this drove a turbine (this section below) powering the two cartridge houses and also the later dust house.

The upper weir and much of the leat system is still maintained in good working order by Langdale Leisure as an attractive water feature within the timeshare development, although the channel supplying the northern pair of upper incorporating mills has been infilled to create a car park, as has the branch to the upper bank of the lower mills (Fig 12). In addition, much of the leat flowing into Hobson's Tarn, plus the start of that flowing out of it, has been covered over and/or conduited, presumably for reasons of public safety. Further cosmetic alterations have been carried out to the main leat below the upper incorporating mills where new hotel and restaurant buildings have been constructed over its line behind the former saw mill and coppice barn (Fig 7).

Turbine and hydraulic power (buildings 5a, 6 and 44)

According to Tyler (2002, 179), a turbine (manufactured by the firm of Gilkes, and capable of generating 25hp) was installed in the period after 1878 in connection with

the introduction of cartridge pressing (section 4 above). Logic would demand that this turbine was accommodated in the turbine and pump house (building 44) which the 1926 plan depicts sandwiched between the two pairs of upper incorporating mills (at NY 32548 05084); since this building appears on the OS second edition map (Fig 4), the turbine was certainly in place by 1897 when that map was revised. It remained operational right up to the closure of the works, for the MMB (dating to c 1925, section 4 above) records that a Gilkes turbine was then still in use as the main source of power for pressing cartridges. According to the MMB, the later dust house (building 32, section 5.2.3 below) was also turbine-powered, although in the typescript the words have been crossed through and 'electric motor' substituted in longhand, suggesting that the power source was subsequently altered. The identification of building 44 as the turbine *and pump* house shows that the turbine produced hydraulic, not electrical, power. A tunnel through the southern end of the blast wall (BW7) surrounding the earlier of the two cartridge houses (building 27, section 5.2.4 below) is original (Fig 7), and may well have been intended to allow passage of the hydraulic pipes connecting the turbine to the pellet presses. Pipes would also have been necessary to take power to the second cartridge house (building 39, section 5.2.4 below), and to the dust house, but there is no evidence for how these were routed. In the case of the dust house, the MMB seems to imply that before the introduction of the electric motor it also had its own turbine for those periods when power was not available from the main turbine; this auxiliary turbine was powered by a gas-suction engine.

Neither building 44 or the turbine it housed survives. Richard Hall who converted the disused factory into a holiday centre in the 1930s apparently employed a turbine to provide electric light to his various sleeping cabins and cottages (*The Gazette*, 25 May 1935), but it seems unlikely that he used the original Gilkes machine which in all probability would have been salvaged by ICI at the factory's closure. Indeed, a photograph in the Barter collection looking across the site of the upper incorporating mills and building 44 towards the charcoal store, taken in the 1930s, shows that the turbine house had already been dismantled (Fig 43). Much of the surviving stonework on the site of building 44 is modern, and the remains of a turbine housing relate to one installed on an experimental basis in the 1980s and 1990s to provide power for the country club (Mike Davies-Shiel, pers comm).

Davies-Shiel has suggested that after 1893 the press house (building 10, section 5.2.3 below) was also powered by turbine (Marshall and Davies-Shiel 1969, 83). The MMB states quite unequivocally, however, that c 1925 it was being powered by pumps driven from the corning-house waterwheel. It is possible that Davies-Shiel has confused the main powder-pressing and cartridge-pellet pressing processes, therefore. It is clear, nevertheless, that the press-house ram was operated by hydraulic power. The 1926 plan identifies a pump house (building 5a) immediately adjacent to the corning house (at NY 32647 04904), and an accumulator house (building 6) midway between it and the press house (at NY 32630 04932). Analogy with what is documented at the New Sedgwick gunpowder works (Dunn *et al* in prep), suggests that the pumps in the pump house would have raised a head of water in the accumulator house, which in turn drove the hydraulic ram in the press house. According to the MMB, the pressure exerted on this ram was 25cwts psi.

The precise date of the accumulator's introduction at Elterwater is not known, but would seem to have been sometime between 1897 - for building 6 is not depicted on the OS second edition map (Fig 4) - and 1916 when the accumulator is mentioned in the official report of the explosion in the corning house which occurred that year (Explosives Inspectorate 1916, 5). This matches well with what is known for New

Sedgwick where the accumulator existed by 1900 (Dunn *et al* in prep). It may be that the accumulator was installed at Elterwater *c* 1899 following damage to the press house in the severe flood of November 1898 (Tyler 2002, 180). However, since the evidence of the OS second edition map suggests that the pump house (building 5a) existed before the flood, there may have been a period before the accumulator's introduction when the press house was powered directly from the pump house. Alternatively, the accumulator house was already in existence when the map was revised, but was simply not depicted (it presumably consisted of no more than a tank on a concrete base). Earlier still, the ram was undoubtedly powered by pumps worked from the press house's own waterwheel. It is unclear why this original arrangement did not continue, but there is no evidence to support the contention that the press house was ever powered by a turbine. Mike Davies-Shiel's published site plan of Elterwater (Marshall and Davies-Shiel 1969, 79) identifies the accumulator house as the press-plate wash house, but this would seem also to be in error.

Neither pump house or accumulator house now survives. The site of the former lies partly beneath or immediately east of timeshare Lodge 15, while that of the latter coincides with open ground between Lodges 7 and 12, but no trace of either is visible on the surface (Fig 7).

Gas (building 23)

The MMB records that a National gas-suction engine was used to operate auxiliary turbine(s) powering the cartridge houses and dust house when water ran too low in the beck to drive the main turbine. The probability must be that this engine (or engines?) was mobile and was moved around to wherever required – a suggestion supported by the evidence of the 1926 plan (Fig 5) which identifies building 23, formerly part of the saltpetre refinery complex by the beck, as a gas-engine house (at NY 32532 05017). The refinery had become redundant by the final years of the factory's life (section 5.2.2 below), and building 23 was simply being put to an alternative use at this time. There is no evidence for where the engine(s) was accommodated before the refinery became redundant.

Electricity (buildings 23a and 46)

According to Tyler (2002, 180), electric light came to the works around 1890 when the first of several dynamos was installed. However, there is little evidence as to where these dynamos were located or how they were powered. The 1926 plan (Fig 5) does identify a generating house attached to the former refinery by the beck (building 23a at NY 32538 05011), but it seems likely that this building was fairly new at that time (it is not depicted on the OS second edition map (Fig 4) and therefore almost certainly post-dates 1897) and it remains unclear where electricity was being generated when the dynamos were first introduced. Building 23a is not depicted on the 1932 plan either (Fig 6), suggesting it may have been no more than a wooden shed which was destroyed when the works closed.

In all probability, power was conveyed around the site from the dynamos/generator by overhead cables to light individual buildings. Power was presumably also conveyed to the motor house at the west end of the dust house (building 46 at NY 32605 05144) by the same means. This building seems to have been erected *c* 1926 to house a new electric motor driving the oscillating sieves in the dust house previously powered by turbine and/or gas (this section above). The motor would

have had to have been contained within its own building outside the dust house because of the danger of sparks. The motor house still survives (Fig 7): a small rectangular stone building set into rising ground, with a door and window in one side, all beneath a double-pitched roof. It is now used by Langdale Leisure as a general storeroom.

5.2.2 The preparation and storage of raw materials

The Saltpetre Store/Potash and Soda Store (building 26)

On the 1932 plan, the saltpetre store is identified as standing adjacent to the beck towards the top end of the works (at NY 32513 05050), whereas on the 1926 plan this building is called the Potash and Soda Store (building 26 on Figs 5 and 6). However, the two names are essentially one and the same: in the 19th century, raw saltpetre was imported from India or Chile and had to be refined into potassium or sodium nitrate (nitrate of potash and nitrate of soda) at the works (Marshall and Davies-Shiel 1969, 76), although the MMB makes it clear that by c 1925 supplies of pure sodium nitrate were being sourced from the nearby New Sedgwick blackpowder factory instead. The depiction of the store is identical on both plans - a two-celled structure comprising a main storehouse of rectangular plan measuring c 16m by 9m, with a smaller unidentified annexe built up against the north-west gable. Since this portrayal is unchanged from that shown by both the OS first and second edition maps surveyed in 1859 and 1897 (Figs 3 and 4), it would seem that the store was erected very early on in the life of the works, and remained largely unaltered through to the close.

The main store still exists, although the northern annexe has been demolished since 1977 (Ordnance Survey 1978b). Following closure of the works in 1930, the building was initially converted in the 1930s into a campers' recreation hall by Richard Hall, but is now used as hotel bedrooms ('Waterside') by Langdale Leisure. The store sits immediately above the beck, on a level platform cut into the side of a rock outcrop (Fig 7) which would have formed an effective barrier against any explosion originating in the upper incorporating mills only a short distance to the north-east. Original arched entrances, 2.6m wide by 2.7m high, whose blocked outlines are visible in either gable end (Fig 13), would have allowed carts to be brought directly into the building and unloaded in the dry. The roof line of the demolished annexe is preserved as a diagonal line of mortar on the north gable wall. The precise function of the annexe is not known, but its final map depiction which portrays it as open-fronted towards the north-east, plus the fact that it abutted the main saltpetre store with no visible sign of a doorway connecting the two, suggests it served only a general storage function.

The Brimstone/Sulphur Store (buildings 11, 24? and 27?)

The 1926 plan (Fig 5) identifies the sulphur store as building 11 standing in the approximate centre of the site (at NY 32659 05000). The same building on the 1932 plan (Fig 6; confusingly there numbered building 12) is labelled only as a general store, but for the reasons outlined in section 4 above the earlier plan must be the more reliable. The plan depiction of this structure in 1926/1932 - a simple rectangular building measuring c 9m by 7m - is no different from that on the OS first and second edition maps (Figs 3 and 4), suggesting that it is the same building shown by all the maps and that it was therefore in existence by 1859. In the 1930s following closure of the works, it was refurbished and slightly extended to turn it into a private residence.



Figure 12. The leat supplying incorporating mills nos. 5-8 at the lower mill site, now infilled and grassed-over. The ruined walls of building 67 are visible at left of frame



Figure 13. The southern gable of the saltpetre store (building 26), showing the blocked cart entrance

It was still standing in 1977, when it was called Cobblestones (Ordnance Survey 1978a and b), but has since been demolished. The site is now occupied by timeshare Lodges 34 and 35 (Fig 7).

However, photographic evidence from the 1930s shows that building 11 is unlikely to have been purpose-built as a sulphur store, for even before conversion to a private residence it had at least two windows, a chimney stack, and a small doorway unsuited to the portage of large quantities of material (Fig 14). If correct in this observation, there is at present little evidence for what function the building originally



*Figure 14.
Two views of the
sulphur store
(building 11) in the
1930s: (top) before
and (bottom) after
conversion to a
private residence,
'Cobblestones'.
(Barter collection,
copyright reserved)*

served (see section 5.2.6 below), and little evidence either for where sulphur was stored in the earlier period. Logically, one would expect that a sulphur store would be sited as close as possible to where sulphur was needed, *ie* it would be near to the refinery and/or preparing house. If so, one candidate would be building 27 on the 1926 plan. This building was then in use as a cartridge-press house, but this process was only introduced to the works in 1878 whereas the building existed by 1859 (Fig 3). Furthermore, in 1859 it was not surrounded by a blast wall, and a road ran down its eastern flank connecting directly with the preparing house. Part of the shell of this building still stands, converted into timeshare Lodge 38; it is described in more detail in section 5.2.4 below. However, an alternative candidate for the

original sulphur store would be building 24. This is named in 1926 as the 'refinery and bag store', but Mike Davies-Shiel collected evidence in the 1960s which led him to emend the description of the northern part of this building on the 1932 plan to 'offices and charcoal store and sulphur store', with the refinery confined to the southern part (Fig 6). This would make excellent sense from the logistical viewpoint if the sulphur needed to be refined. The conclusions to be drawn must be that not only did the location of the sulphur store move around the site over time - indeed that there may have been more than a single store in use at any one date - but also that it was not deemed necessary to accommodate it within a purpose-built warehouse.

The Saltpetre and Sulphur Refinery (buildings 23 and 24)

Both saltpetre and sulphur needed to be refined before they could be mixed with charcoal to begin blackpowder manufacture. The procedure normally involved gentle boiling and re-crystallisation, during which the impurities were skimmed off. This was evidently carried out in building 24 situated next to the beck (at NY 32533 05027), which is described on the 1926 plan (Fig 5) as 'refinery and bag store', and on the 1932 plan (Fig 6) as 'saltpetre refinery'. There are two forms of saltpetre,

however: potassium nitrate and sodium nitrate. By c 1925 the MMB implies that it was only the former that was still purified at the works; pre-refined sodium nitrate was by then being sourced from the nearby New Sedgwick blackpowder works instead, whilst sulphur was also being imported in a pure state from Texas. For the great majority of the factory's life, however, sulphur and both forms of saltpetre would have required purification on site, and logically, therefore, there must have been a refinery at Elterwater from the very start of gunpowder production in 1825. Building 24 certainly existed by 1859 for it is depicted on the OS first edition map (Fig 3), but it is unclear if it is the same as the sulphur refinery referred to in the newspaper report of the 1840 explosion (section 4 above), or whether an earlier refinery stood elsewhere. (The description of the employee John Ritson as a 'saltpetre refiner' but who was at work in the *sulphur* refinery at the time of the explosion, supports the contention that at Elterwater sulphur and saltpetre were processed in the same building).

Building 24 is only one part of a larger, almost H-shaped, complex of buildings, however, parts of which are described in the final years of the factory's life as fulfilling different functions (particularly building 23 identified as a gas-engine house by the 1926 plan, and as a wood store by the 1932 plan). Mike Davies-Shiel's comments on the 1932 plan show that he disagreed with some of these identifications, or more particularly with which precise part of the complex was used for which function. His reasons for doing so were no doubt partly founded on interviews he conducted with surviving employees, but were also heavily influenced by firsthand observation of the archaeological evidence visible in the 1960s and 1970s, but which is now destroyed. Fortunately, Davies-Shiel made a slide record of this evidence, which has been made available to EH. The simplest explanation of the apparent 'mislabelling' of buildings on the various maps is that the functions of individual buildings changed over time.

Davies-Shiel's slides support his contention that the vats in which the sulphur and saltpetre were heated and refined were located at the north-west end of the range lying immediately above the beck (Figs 15-17), whilst the south-east end of that range (which the 1926 plan labels as building 23 or the gas-engine house, and the 1932 plan as wood store) accommodated the boiler for heating the vats (Fig 18). This contention is represented in part by his working comments on the 1932 plan, and in part by his subsequent published diagrammatic plan of the works and short observation to the effect that the 'saltpetre boilerman's foot-walk' was still visible at Elterwater (Marshall and Davies-Shiel 1969, 79-80). The slides show a roofed stone passage with five openings facing north-east into the 'vat room'. But they also chart the progressive collapse of this structure between c 1967 and 1983 (the building was one of those burned down in 1930, and was apparently never rebuilt by Richard Hall). The ruins were cleared away in the early 1980s by Langdale Leisure, and timeshare Lodges 39-42 built over the site (Fig 7); part of the east end of building 24 may still survive, however, reused as a small garbage enclosure in front of the Lodges (Fig 19).

The Coppice Barn, Charcoal Retorts and Charcoal Stores (buildings 21, 31, 50, 55 and 57-8)

The chief authority for the existence of charcoal retorts at Elterwater is Mike Davies-Shiel. They are not identified on the 1926 plan, since they were then out of use and charcoal was being bought in from external suppliers as the MMB makes clear. But prior to 1866, the Company manufactured its own charcoal. According to Davies-



Figure 15. The boilerman's walk and openings into the vat room in the salpetre/sulphur refinery (building 24), photographed from the south in June 1967 (Davies-Shiel collection, copyright reserved)

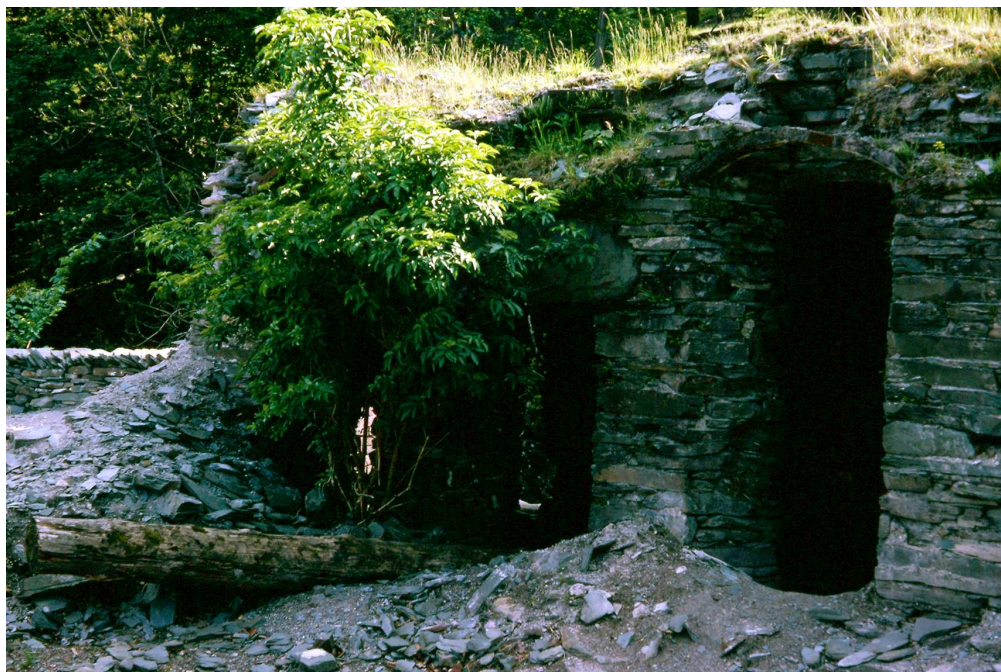


Figure 16. The southern end of the boilerman's walk, photographed from the vat room in June 1967 (Davies-Shiel collection, copyright reserved)



Figure 17. The boilerman's walk and openings into the vat room, photographed from the north-west in February 1983 (Davies-Shiel collection, copyright reserved)

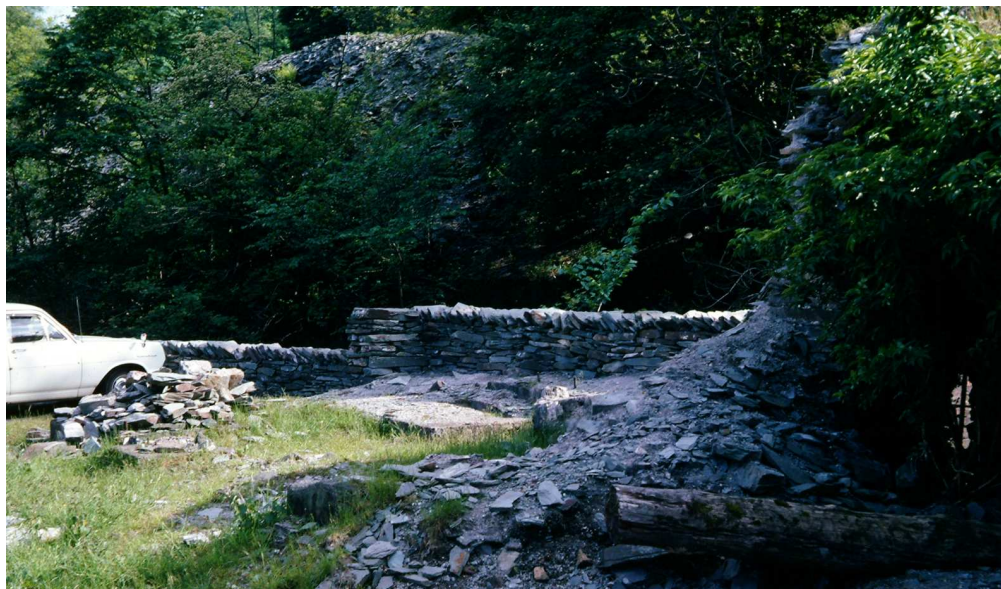


Figure 18. The engine bed in the boiler house (building 23) at the south-east end of the saltpetre/sulphur refinery, photographed from the east in June 1967 (Davies-Shiel collection, copyright reserved)



*Figure 19.
Part of the east
end of the
saltpetre refinery
(building 24), re-
used as a garbage
enclosure*

Shiel's comments appended to the 1932 plan (Fig 6), cylinder retorts were situated on a small sub-site on the hillside above the main works at NY 3274 0527, which acquired the name Cylinder Hill in consequence (section 4 above). The 1932 plan shows a group of three buildings here (the largest of which Davies-Shiel has annotated as a barn) plus a narrow linear, unroofed, structure - a depiction which agrees with what is shown at this location in 1859 by the OS first edition map (Fig 3), although the OS second and third editions suggest that all the smaller buildings and the linear structure had been progressively demolished before 1912 (Fig 4 and Ordnance Survey 1915). The largest of these four structures (Davies-Shiel's barn, numbered building 50 on Figs 75-80 for the purposes of the present report) was in all probability a coppice barn for storing wood ready to be made into charcoal; the functions of the other three are unknown but must be related to charcoal production. The area is now part of an abandoned garden, and no above-ground trace of any of these structures survives.

The 1926 and 1932 plans both identify two charcoal stores (buildings 21 and 31 on Figs 5 and 6), although Davies-Shiel's comments in the key of the 1932 plan indicate that the latter building was the original store and building 21 a more recent addition. This is supported by OS map evidence that shows that building 21 was only constructed between 1859 and 1897, whereas building 31 existed before 1859 (Figs 3 and 4). The 1926 plan also shows that building 31 had at least for a period prior to 1926 been in use as a general timber store, and had only just been (re-?)approved as a charcoal store (in the key 'store for timber etc' has been crossed through and 'charcoal store' substituted). This suggests that, as with the sulphur store (this section above), the location of the charcoal store moved around the site over time, and it is only when there is specific map evidence that we can be sure of its position. The 1772 Gunpowder Act stipulated that a charcoal store must stand at least 20yd (18.3m) from any other process building (Cocroft 2000, 28); buildings 21 and 31 both fulfilled this legal requirement.

Building 31 is an L-shaped affair situated at the upper end of the site (at NY 32547 05125). It consists of two conjoined ranges, one orientated south-west to north-east measuring *c* 22m long by 8m wide, the other at right angles to the north-east end

measuring c 13m by 7m. It still survives (Fig 7), although much altered internally and externally. Following closure of the works, the longer range was progressively converted during the 1930s into a series of holiday cottages (Figs 20, 21 and 43). Since 1981, these in turn have become a series of rooms within Langdale Leisure's 'Fellside' hotel complex. The photographic evidence, however, suggests that prior to conversion the southern face of the range lacked any fenestration and had only a single door,

*Figure 20.
The charcoal store
(building 31)
during conversion
in the 1930s into
holiday cottages.
The porch at left of
frame is the
entrance to the
later upper watch
and change house
(building 30).
(Barter collection,
copyright reserved)*



consistent with its stated function as a charcoal barn. A building attached to the range's south-west end seems always to have been a separate entity (building 30 on Figs 5 and 6), and probably pre-dates the gunpowder works (sections 4 and 5.1 above, and watch and change house, section 5.2.5 below). The shorter range forming the foot of the 'L' has an arched cart entrance in its south gable, now blocked (Fig 67). It is unclear whether this was simply to enable charcoal wagons to be driven inside the store to be unloaded in the dry, or is evidence of this part of the building having been constructed originally to serve as a cart house, as suggested by Davies-Shiel's comments on the 1932 plan (see also building 68, section 5.2.5 below).

*Figure 21.
The charcoal store
in the 1960s after
conversion into
holiday cottages.
(Barter collection,
copyright reserved)*



Building 21 by contrast is a much smaller structure, measuring only *c* 4m by 5m. It stood at NY 32585 05046 opposite the preparing house from which it was separated by the main leat. The 1932 plan depicts a short, dedicated, tramway link between it and the preparing house, but both the OS second edition map and the 1926 plan show only a tramway passing close by *en route* between the preparing house and lower charge houses (buildings 4 and 20, section 5.2.3 below). The building seems to have been demolished at or shortly after closure of the factory. Its site now lies beneath the modern hotel/restaurant complex erected by Langdale Leisure (Fig 7).

The Blacklead Store (buildings 64? and 7)

Blacklead (graphite) was necessary for the glazing process. The 1926 plan (Fig 5) identifies the approved blacklead store as building 7 (at NY 32656 04948) situated adjacent to glazing house no. 3 (section 5.2.3 below). In all probability it had stood in this position since at least 1897 for both it and the glazing house are depicted (unnamed) on the OS second edition map (Fig 4). The plan and map show the store measured some 6m long by 2m wide, and had what appears to be a small uncovered yard area to its rear; they also depict a tramway leading directly from the nearby expense magazine past the glazing house to the store's north-west gable, although on the 1932 plan (Fig 6) the link with the magazine has been taken up and the tramway is instead portrayed as curving past the entrance and back on itself to make a direct connection between the blacklead store/glazing house complex and the press house. It is unclear if this represents an error on the 1932 plan, or a late re-routing of the tramway.

Building 7 is unlikely to have been the original blacklead store at Elterwater, however, even though it existed as early as 1859 (Fig 3): the glazing house then stood on a different site some 50m further south adjacent to the beck (glazing house no. 2, section 5.2.3 below), and the likelihood must be that the blacklead store supplying this earlier glazing house would have been sited closer to it. On this logic, the most likely candidate is the small building shown attached to that glazing house's north-west end (labelled building 64 on Figs 75-77 for the purposes of the present report), but there is no other evidence to confirm this conjecture. The identities of both building 64 and building 7 are discussed further in section 5.2.6 below.

No visible remains of either structure – or the tramway serving the later store – now survive on the ground. The site of building 64 is open ground, but that of building 7 is overlain by timeshare Lodge 11 (Fig 7).

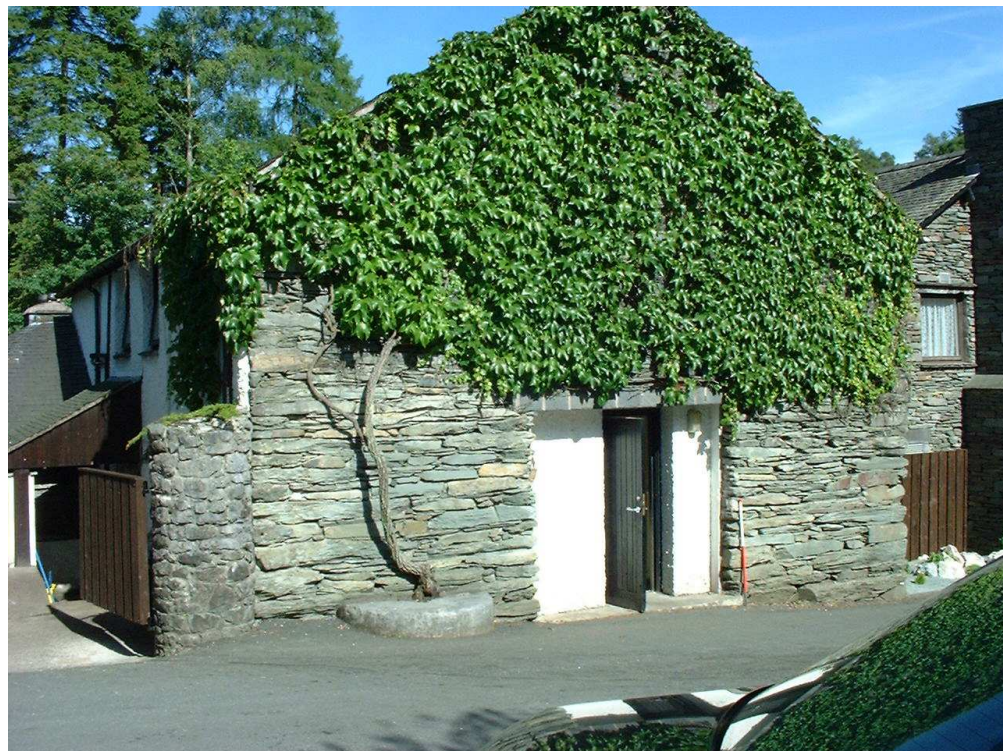
5.2.3 The manufacture of gunpowder

The Preparing House (unlocated and building 20)

On the 1926 plan (Fig 5), the 'preparing and mixing house' is identified as building 20 standing on the edge of the main leat (at NY 32549 05049), and situated between the upper incorporating mills to the north, and the saw mill to the south. The preparing house was where the three ingredients for gunpowder were brought together, ground to fine powder, and mixed in the right quantity to produce a green charge ready for incorporation. The building's location ideally suited this function, for it was close to all the relevant store buildings and to the sulphur/saltpetre refinery (section 5.2.2 above), and was also conveniently situated for the green charge to be conveyed to the upper incorporating mills. There is every reason to believe that it was constructed

specifically as a preparing house, and never served any other purpose. However, it must have been the second such structure at Elterwater, for this part of the factory seems only to have been developed after 1829; an earlier preparing house must have stood somewhere in the vicinity of the lower incorporating mills, which represents the works' pre-1829 core (sections 4 above and 6 below). The precise position of this earlier preparing house is unknown, but since both grinding and mixing processes required power, it must have stood in the vicinity of the lower mill pond, most probably adjacent to either the head or tail race.

The 1926 plan depicts building 20 as broadly T-shaped, with a leat heading south down the west side and turning east to flow through the building at the junction of the head and tail of the 'T'. Much the same footprint appears on the OS second edition map (Fig 4), although the head of the 'T' is there depicted as made up of two parallel ranges. Map regression shows that the southern of these two ranges existed by 1859, but that the northern range was then somewhat smaller (Fig 3). This suggests that the bulk of the building was in existence by 1859, and was apparently little changed thereafter, but that in 1859 the northernmost of the two ranges forming the head of the 'T' probably performed some other function and was only later re-built and incorporated into the preparing house. (For the purposes of the present report, the small northern range on the 1859 map has been classed a separate building (building 69 on Figs 75-76); it may well have been the original upper watch house – see section 5.2.5 below). The leat would have powered a waterwheel sited within the building; certainly the mixing process is recorded as water-powered as late as c 1925 (MMB). However, the 1932 plan depiction differs to the degree that the leat passing through the building is portrayed as uncovered (Fig 6), raising the possibility that the range forming the building's tail was actually part of the adjacent saw mill instead. Sometime after the factory closed in 1930, the northernmost of the two ranges forming the head of the preparing house was demolished whilst the other was converted into a squash court by Richard Hall and no original internal fittings survive; the building now serves as offices for Langdale Leisure (Fig 7), and the fenestration has been further changed (Fig 22) and the wheel-pit blocked up (Fig 23). Thus, evidence



*Figure 22.
The west gable
of the preparing
house (building
20). Note the
column at left of
frame which
supported the
elevated launder
to the wheel-pit
on the building's
southern side)*

for the original external form of the building, and more particularly of the precise relationship between the two parts north and south of the wheel-pit has been obscured or destroyed. The wheel would have been either over- or breast-shot, for surviving field evidence shows that the leat approaching from the north was carried in an elevated launder (Figs 10 and 22, and section 5.2.1 above); it produced power for the adjacent saw mill as well.



*Figure 23.
The blocked
wheel-pit between
the preparing
house (building
20) and the saw
mill (building 19)*

Both the OS second edition map and the 1926 plan show that by 1897 the preparing house was connected by tramways to the saltpetre/sulphur refinery (building 24) and to a charge house (building 4, this section below) serving the lower incorporating mills. The 1932 plan does not show the link to the refinery, suggesting this may have been taken up towards the end of the factory's life when refining was no longer undertaken on site (section 5.2.2 above). The same plan also shows a short tramway link from the preparing house to the nearer of the two charcoal stores (building 21) on the opposite side of the leat. However, Davies-Shiel's published plan of the works (Marshall and Davies-Shiel 1969, 79), which draws on the 1932 plan and his own field observations made on the ground in the 1960s, only shows a dashed line between the two buildings, perhaps indicating that he had doubts over whether it ever really existed.

The Green-Charge House (buildings 4, 4a?, 18 and 22)

The 1772 Gunpowder Act placed strict limits on the amount of powder that could be present at any time within any process building at a gunpowder works. In consequence, charge houses and expense magazines became a legal requirement for the temporary storage of green charge *en route* between the preparing house and incorporating mills, and for ripe charge after leaving the latter but before it proceeded on to the press and corning houses, *etc.* The act further stipulated that powder magazines had to be constructed in brick or stone, and had to be at least 50yd (45.7m) distant from any mill building (Cocroft 2000, 28). However, green charge was less explosive than ripe charge, and it is unclear whether it was subject to the same legal controls.

The 1926 plan (Fig 5) identifies two charge houses: building 4 (at NY 32656 04885) standing *c* 26m from the lower incorporating mills, and building 22 (at NY 32564 05064) *c* 20m from the upper incorporating mills. If the reading of the legislation outlined in the preceding paragraph is correct, the proximity of these two buildings to the incorporating mills suggests that they may have been for the housing of green charge only. Neither building was large, measuring no more than *c* 2-3m by 4m. They were also situated adjacent to, or directly over, leats – possibly for reasons of safety: in the event of an explosion or fire, people could readily jump into water to extinguish burning clothing. However, the evidence of the OS first edition map (Fig 3) shows that neither existed before 1859, and that therefore they cannot be the original charge houses at the works. Since the OS second edition map (Fig 4) depicts the lower charge house as linked directly to the preparing house by the internal tramway system, whilst that serving the upper incorporating mills stands only a few metres off the tramway's line, it is probable that they were both built at the same time as the tramway, *c* 1867, as replacements for earlier charge houses inconveniently situated in relation to the new tramway. Clues for the positions of the earlier charge houses are provided by the 1932 plan (Fig 6), which describes building 4a (at NY 32652 04874) located opposite building 4 as a charge house (the 1932 plan confusingly labels both buildings as number 4), and building 18 (at NY 32566 05008) between the joiners' shop and saw mill as 'Old Charge House'. Although building 4a was clearly not acting as a charge house at the end of the factory's life (the 1926 plan states it was then in use as a sieve depot, see section 5.2.5 below), it is possible that the 1932 plan is preserving a memory of its original use in the same way that it seems to be for building 18. A photograph taken shortly after the factory closed shows building 4a to have been stone-built beneath a double-pitched roof with an off-centre ridge (Fig 24).

Neither building 4 or 22 seems to have survived the factory's closure (probably burned down due to the danger of gunpowder residues): the site of the former lies beneath a grassy roadside verge, whilst that of the latter is covered by the south-western edge of the main country-club carpark. Building 18 also seems to have been destroyed at closure and its site, too, is now tarmacked over (Fig 7). Building 4a on the other hand was upstanding until at least 1977 (Ordnance Survey 1978a); it has since been mostly demolished although the stone platform on which it stood, and the basal courses of the rear and side walls, still survive (Fig 25).



Figure 24. View west across the lower mill pond in the 1930s. The old lower charge house (building 4a) is in the middle distance; blast wall BW1 is at left of frame; while the edge of the wheel-pit to incorporating mills 1 and 2 is just visible at bottom of frame. (Barter collection, copyright reserved)

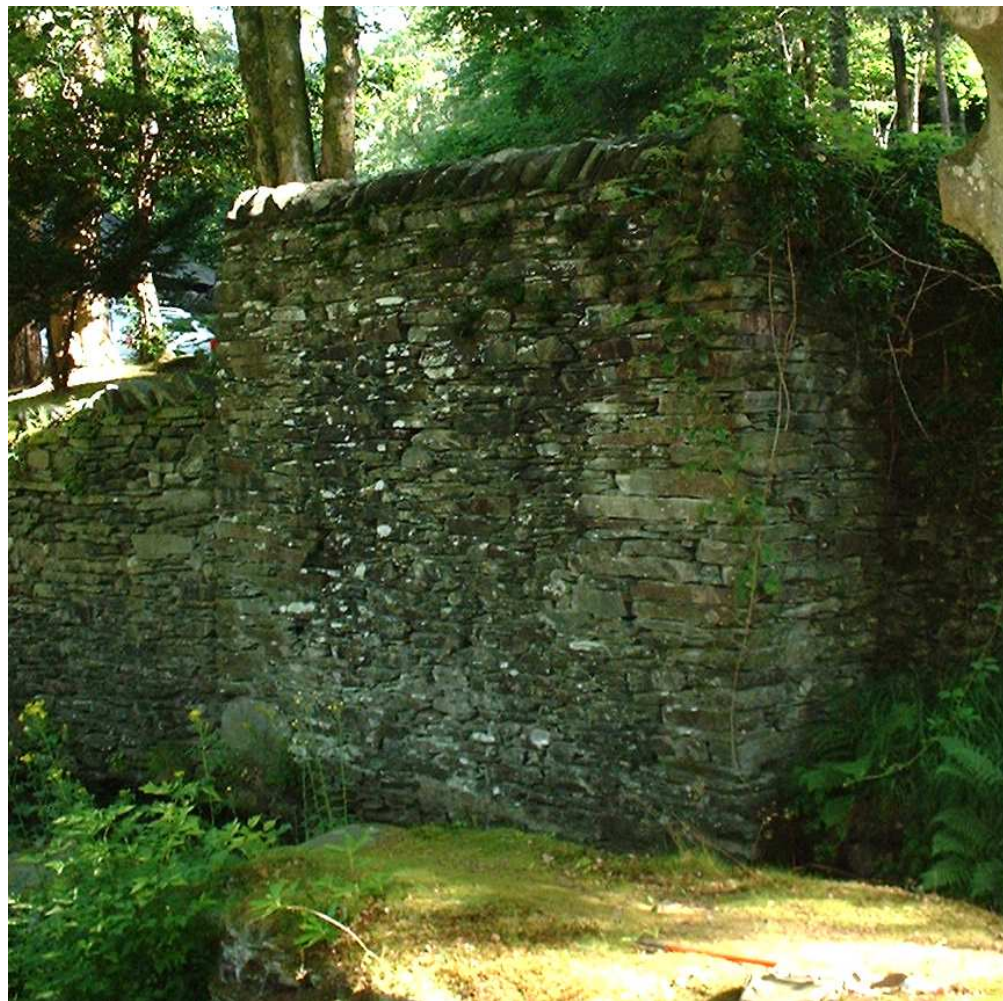
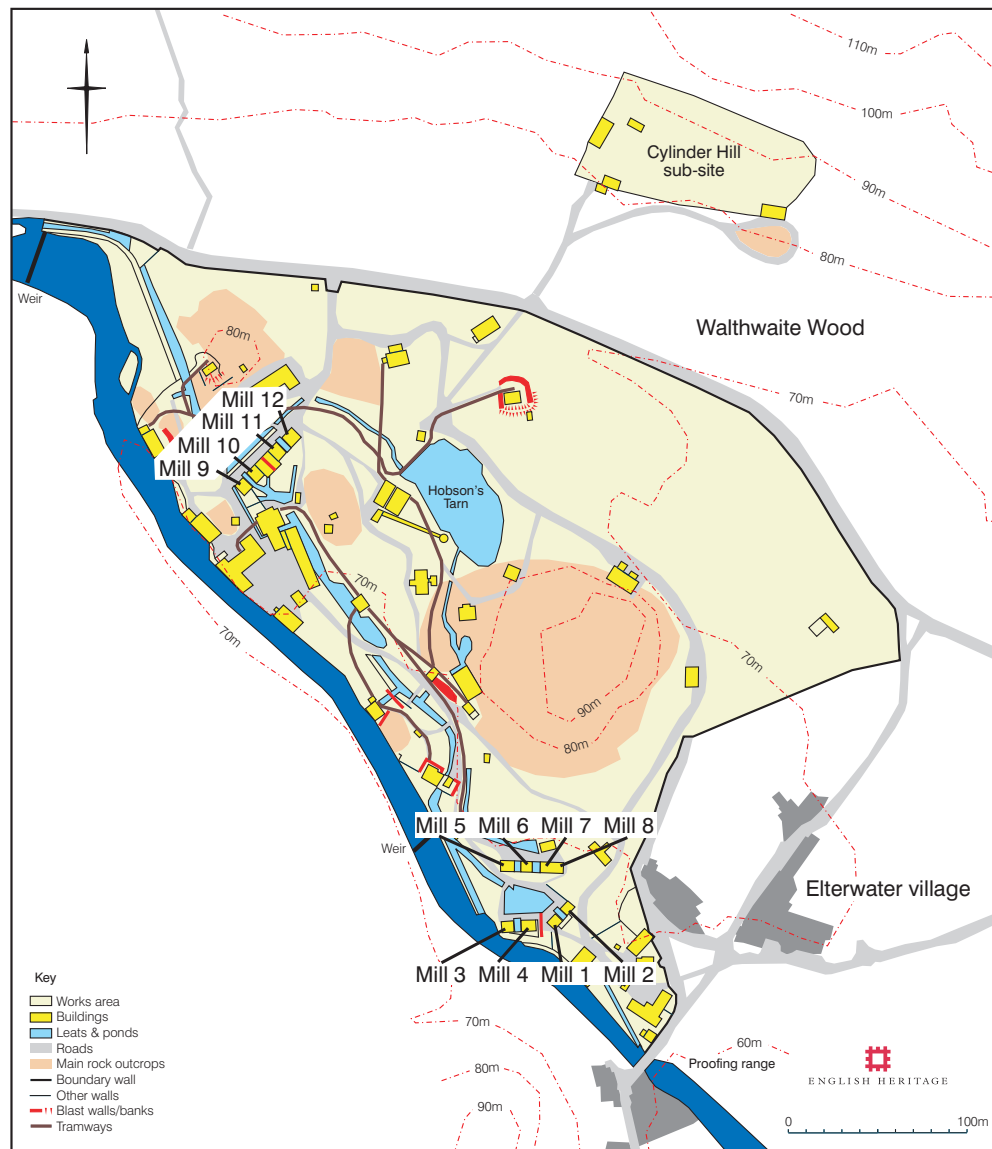


Figure 25. The stone platform for, and basal wall courses of, the old lower charge house (building 4a), viewed from the south-west

The Incorporating Mills (building 1)

Once the three raw ingredients of gunpowder had been mixed, the next stage in the manufacturing process was incorporation to turn the green charge into ripe charge. This involved putting the green charge into an edge-runner or incorporating mill to ensure it was thoroughly mixed and of the correct density. A little water was normally added at this stage to help the charge hold together. By the end of its working life, the Elterwater factory possessed twelve such incorporating mills, arranged in six pairs. These were located in two discrete geographical locations, here called the lower mills (centred at NY 3269 0484) - which eventually consisted of four pairs - and the upper mills (centred at NY 3255 0509) where there were two further pairs. All twelve mills, regardless of location, are identified on the 1926 plan as building 1 (Fig 5). However, the MMB indicates that, at least by *c* 1925, the convention was to regard the mills as forming three groups of four, with the eight mills at the lower site comprising groups 1 and 2, and the four at the upper site, group 3; the individual mills were also by this time uniquely numbered in a single sequence from 1 to 12. Although it is not altogether certain which number relates to which mill on the ground, the following seems the most likely (Fig 26): group 1 refers to the two pairs of mills situated east and south of the lower mill pond, with (for the purposes of the present report) the eastern pair numbered 1 and 2 from south to north, and the southern pair



*Figure 26.
Diagram showing
numbering system
applied to the
incorporating
mills*

numbered 3 and 4 from west to east; group 2 refers to the two pairs of mills in line north of the lower mill pond, numbered 5-8 (again for the purposes of the present report from west to east); while group 3 refers to the two pairs of mills in line at the upper site, for the present report numbered 9-12 from south to north. However, the individual numbers do not correspond to the order in which the mills were constructed, and for this reason different numbering systems must have been in use at other times.

Map evidence suggests that the first five pairs to be built followed the same general design, and consisted of edge-runner mills and their gearing mechanisms arranged in mirror image either side of a central wheel-pit; the sixth and final pair differed to the degree that both mills were situated on the same side of the wheel-pit. The first five pairs all seem to have been ‘over-driven’ (*ie* geared so that power to turn the edge-runners was delivered from above), but the sixth and final pair (mills 7 and 8 in group 2) were reportedly by *c* 1925 ‘under-driven’ (with the edge-runners powered by a vertical drive shaft rising through the centre of the bedstone), and it seems likely that at, or shortly after, the time they were built, the other two mills in the group (mills 5 and 6) were converted to be under-driven also (see below). In the over-driven mills, gear chambers or basements adjacent to the wheel-pit accommodated flywheels which linked with further gear wheels and drive shafts to transfer power up, across, and back down to the actual edge-runner mills bedded on solid ground (or raised platforms at first-floor level) at the ends of the building. (A diagram of the probable gearing arrangement is reproduced here as Fig 27). In the under-powered

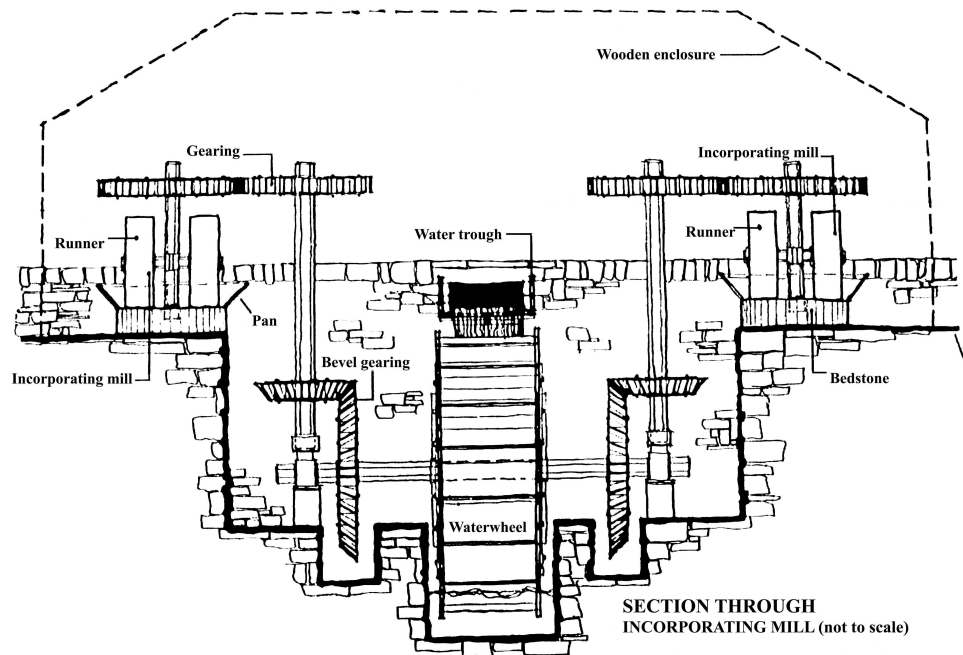


Figure 27.
Reconstruction of
probable gearing
mechanism in an
over-driven mill.
(Langdale Leisure,
copyright reserved)

mills, power seems to have been transferred from the wheel *via* line shafts running through tunnels beneath the solid raised platforms, although most physical evidence has now been destroyed and the exact mechanism cannot be reconstructed. All the mills were built of stone up to the level of these platforms, but seem to have had a wooden-framed superstructure above, and in all probability a wooden or light metal roof. However, the mills were burned down when the factory closed in 1930 because of the danger of gunpowder residues, and nothing now survives higher than basement/platform level.

At closure, the stone gear chambers and platforms were mostly left to decay by the then site owner, Richard Hall. Since 1981, however, all have been built over with the exception of mills 3 and 4 in group 1 and the majority of mills 9 and 10 in group 3, which have been tidied up and laid out as features of historical interest within the timeshare development. The present owners have also retained several bedstones *in situ*, or else set them out at various locations around the site as display items together with some of the stone edge-runners; others have been re-used as decorative planters, or as bases for light fittings and sign posts. The location of all millstones located by EH is shown on Fig 7; a few are described in detail below, but otherwise a basic catalogue is given at appendix 3 at the end of this report. It is apparent that some of those identified had already broken and been put to alternative use before the factory closed, either as building stone or as machine bases.

The Lower Mills (Groups 1 and 2)

When the factory first opened for business at the end of 1825, it is recorded that there was only a single incorporating mill in operation, with a second mill not brought on line until a year later (section 4 above). Mike Davies-Shiel's comments appended to the 1932 plan (Fig 6) show that he thought these two mills should be equated with the pair which the various maps show stood immediately east of the lower mill pond (mills 1 and 2), astride the head race to the disused corn mill, with the more southerly mill being the earlier of the two. There is now no way to corroborate this statement from field evidence, for the site has completely disappeared beneath timeshare Lodge 23, but logic would indeed suggest that the earliest mill would be sited so as to take advantage of the existing leat; in addition, Davies-Shiel's sketching on the 1932 plan (made before the timeshare development obscured the evidence) indicates that the hillside had to be cut back to create room for the northernmost mill of the pair, supporting his contention that it was likely to have been the second to be built. The rock-cut site for this northern mill (no. 2) is visible on a photograph taken looking across the lower mill pond in the 1960s (Fig 28). The photograph suggests that the mill was similar in form to the next pair to be built (see below), and comprised gear



*Figure 28.
View east across
the lower mill pond
towards the
heading mill
(building 47) in the
1960s. The rock-cut
gear chambers for
the original pair of
incorporating mills
(nos. 1 and 2) are
located behind the
fence on the far
side of the pond.
(Barter collection,
copyright reserved)*

chambers cut down into bedrock rather than built up from ground level. This would explain why no stone basements are visible in the photograph: the only part of the mill which stood above ground was the (timber) superstructure which was burned down when the works closed. The edge of the sunken wheel-pit is just visible on another photograph dating from the 1930s (Fig 24).

Documentary evidence records that a second pair of mills had been added at the lower site by 1829 (section 4 above). Davies-Shiel's comments on the 1932 plan (Fig 6) show that he equated these with the pair on the southern edge of the pond (mills 3 and 4). Again, the suggestion is reasonable, for mills here could be powered by the simple addition of a short length of leat connecting the mill pond directly with the beck to the south. This pair are the only mills at the lower site not to have been built over since 1981; instead, the ruins have been tidied up and partly restored by Langdale Leisure, and laid out as an historical display feature. The EH plan of the field remains is reproduced as Fig 29.

The EH survey has revealed that an irregular trapezoidal-shaped area in excess of 9m long by 6 - 8m wide was excavated out of solid bedrock, and the sides revetted with coursed-rubble masonry walling in order to define a space for sunken gear chambers either side of a central wheel-pit, plus in the south a tapered passageway. At the same time, a wall of coursed-rubble construction pierced by three openings was built across the length of this space to form the base of the mills' southern wall, and to separate it from the passage outside. The eastern end of the passage is now marked by a steep, grassy, scarp, but this probably masks stone steps allowing access down into the passage from ground level; the openings in the southern wall would then have permitted access from the passage to each chamber, and also to the end of the wheel-pit.

The chambers are virtual mirror images of each other: both are *c* 4.7m north-south by 3.5m east-west, and open directly onto the wheel-pit except in the north where they are divided from it by stub walls 1.7m long by 0.6 - 0.7m thick. The floors are generally 1.6m below ground level. The interior of the western chamber (mill 3) is mostly obscured by tumble, but the eastern chamber (mill 4) has been cleaned out to reveal a stone-flagged floor with a central longitudinal slot *c* 1.2m wide by 0.6m deep, and, adjacent and parallel to the main wheel-pit, a flywheel-pit *c* 2.8m long by 0.6m wide by a further 0.7m deep (there are slight indications of similar infilled features in the western chamber); a rectangular recess in the floor, 0.09m deep, immediately south of the main slot is probably best explained as a missing flagstone. The lower courses of the east face of the eastern stub wall had to be thinned down by 0.25m to accommodate the flywheel; this thinning would originally have been mirrored in the west face of the opposing wall, but has been lost through that wall's collapse (Fig 34 shows that it has been substantially rebuilt as part of the modern restoration). These flywheels must have transferred power by bevel gearing from the main axle to a vertical shaft anchored in each longitudinal slot. No evidence of how the shaft was anchored survives in the eastern chamber, but an iron rod of rectangular cross-section which protrudes for 0.12m from the floor in the southern half of the uncleared western chamber, close to the projected edge of the slot, may represent part of the fitting on that side. Power would then have been transferred by further gearing in the mill's upper level across and back down to edge-runners rotating on top of static bedstones set into the ground immediately above and beyond the chambers (compare Fig 27). Both bedstones survive *in situ*: that outside the western chamber (millstone MS22) is 2.2m in diameter, while that in the east (MS23) is slightly smaller at 2.1m diameter. The stones also differ in the size and shape of the central

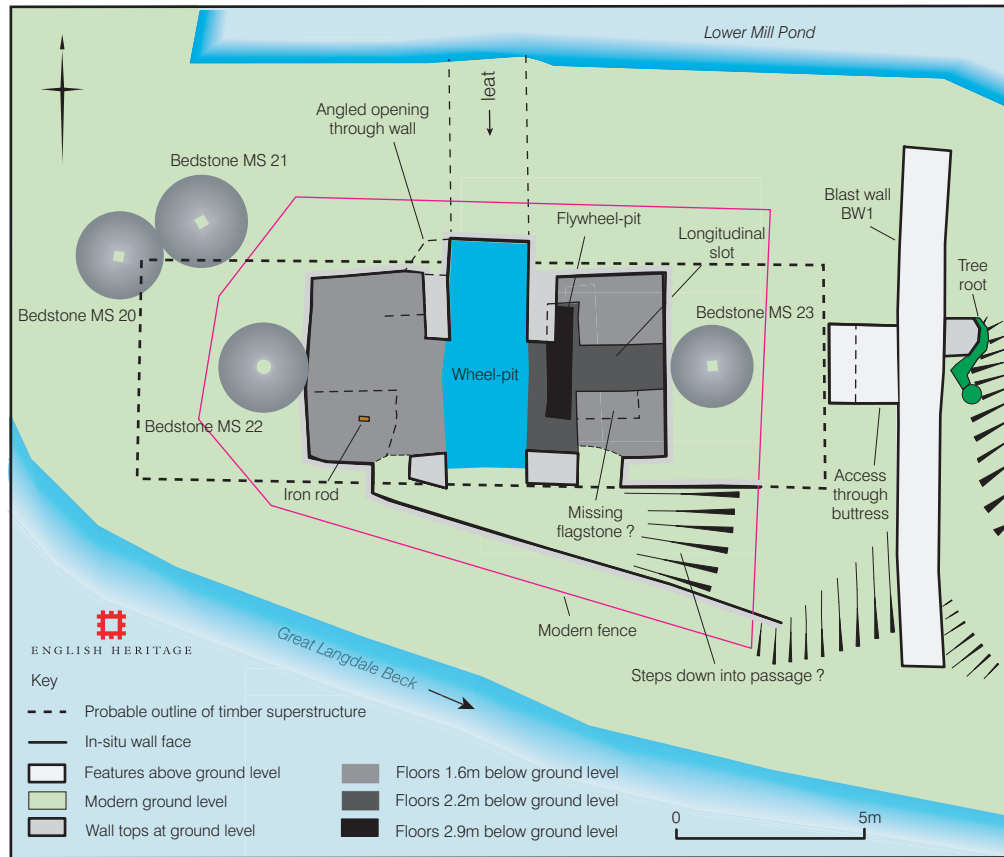


Figure 29. EH plan at 1:200 scale of incorporating mills 3 and 4 at the lower mill site

perforation which accommodated the axle bearing for the edge-runners – the first is circular in section, the other rectangular; MS22 still preserves the iron collar and wooden housing of the bearing mechanism (Figs 30 and 31). A couple of edge-runners (MS25 and MS26) which have been set up on display beyond the blast wall at the east end of the mills also preserve their original axle mounts (Figs 32 and 33), although it is unclear which mill these originate from.

An angled opening, 0.8m high and 0.45m above floor level, at the junction of the western stub wall with the northern wall of the mill is of uncertain purpose, but is

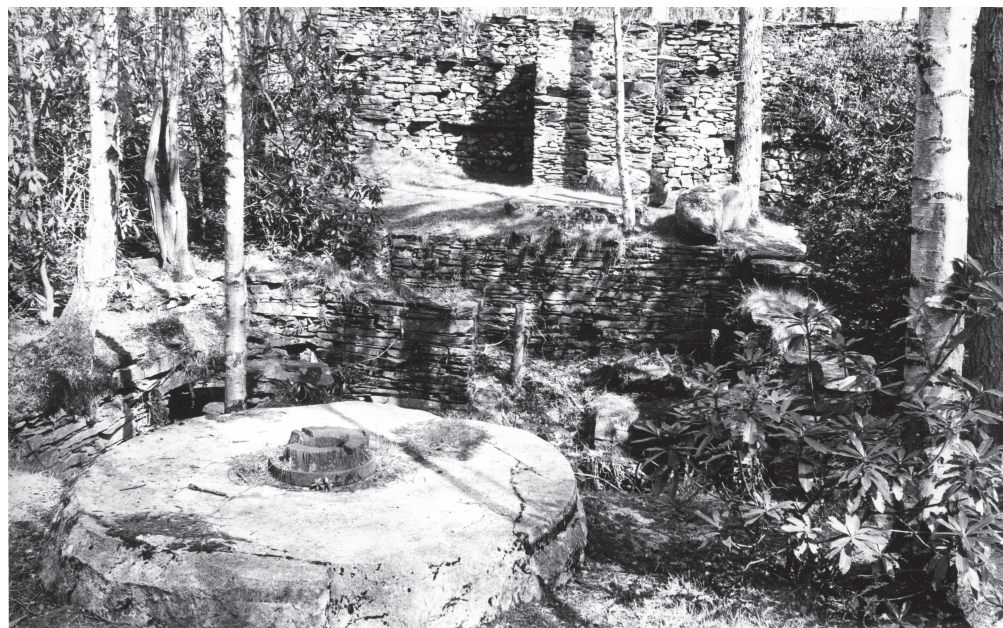
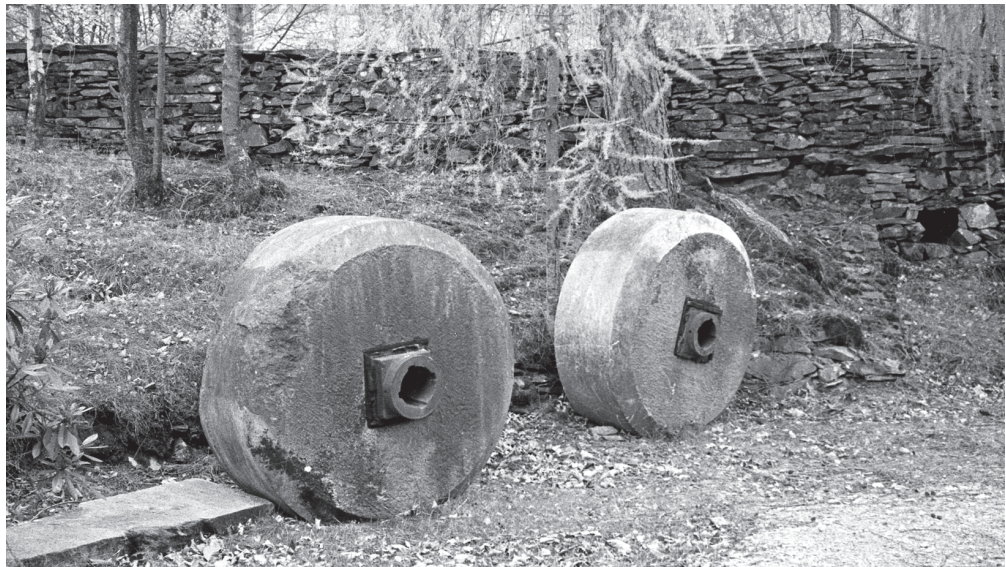


Figure 30. View east over mills 3 and 4 in the 1960s. Note the surviving axle mount in bedstone MS22 in the foreground (Barter collection, copyright reserved)



*Figure 31.
Bedstone MS22 in
mill 3,
photographed in
2001*



*Figure 32.
Edge-runners
MS25 and MS26 in
the 1960s
(Barter collection,
copyright reserved)*



*Figure 33.
Edge-runner MS26
and axle mount,
photographed in
2001*

probably associated with a device for controlling the flow of water onto the wheel. All evidence for such a device, and indeed for the wheel itself, has now rotted and/or been cleared away, but photographic evidence suggests that as late as the 1960s there were the remains of a Rennie's hatch here (Fig 34) – a device used to regulate the flow of water onto a breast-shot wheel. The size of the wheel is unrecorded, but can be gauged from that of the wheel-pit which is 5.8m long by just over 2m wide. No evidence survives for the wheel's axle mounts. Nor is it now clear where the tail race exits into the beck.



*Figure 34.
The Rennie's Hatch
at mills 3 and 4,
photographed in
March 1967. Note
the flywheel-pit and
start of the
longitudinal slot
visible in the far
gear chamber
behind the stub
wall.
(Davies-Shiel
collection,
copyright reserved)*

Comparison with the preserved ground plan of mills 9 and 10 at the upper site (see below and Fig 42) suggests that the superstructure which originally enclosed gear chambers and bedstones was most probably the same width as the external measurement of the chambers, *ie c* 6m. It was presumably of light construction, designed to blow off in the event of an explosion, and was in all probability therefore timber-framed and carried on cill beams for there is no sign that the openings into the gear chambers in the southern wall were capped by stone lintels. The position of the superstructure's gable walls are not definitely known, but the fact that a stone buttress strengthening a blast wall (BW1) to the east has been built in such a way as to preserve access along the western side of the wall (Fig 35), suggests very strongly that the eastern gable either butted up against the sides of the buttress's pier or more likely against its face. If correct in this observation, and assuming the superstructure was symmetrical, the mill building's overall length was in the order of 18m, again almost identical to that of the extant mills 9 and 10. Access was needed between mill 4 and the blast wall in order to reach the steps down into the southern passage leading to the gear chambers. BW1 measures 13.2m long by 1.2m wide, and in the south appears to be partly built up against or over a natural rock outcrop. It is well preserved and stands to its full original height of 2.8m. There is evidence of a second, opposed, buttress low down on the wall's east face, but the modern ground surface has been raised on this side (compare Figs 32 and 33), and the buttress is now mostly buried and/or obscured by this and the roots of a nearby conifer.



*Figure 35.
The buttress
against the west
side of blast wall
BW1 at the
lower mill site*

OS map evidence shows a third pair of mills (nos. 5 and 6) was added at the lower site before 1859. They were located north of the mill pond, and were powered by a branch off the main leat from the upper weir (Fig 3). It is unclear if they were built at the same time as, or after, mills 9-12 at the upper site (see below), but they are unlikely to be earlier. A fourth pair of mills (nos. 7 and 8) was subsequently added to the east of mills 5 and 6 sometime between the dates of survey of the OS first and second edition maps, most probably around 1878 (section 4 above). At this time the branch leat was extended to supply a new wheel-pit situated immediately east of mill 6, and the additional pair constructed in line beyond. The MMB records that by 1925 all four of these mills north of the lower mill pond were under-driven and powered by a single waterwheel. This indicates that at some point alterations must have been made to the design of mills 5 and 6 in order to enable both pairs to operate off a single wheel, and also to convert the earlier pair from an over-driven to an under-driven mechanism. Photographic evidence (*eg* Fig 36) shows that the width of the new wheel-pit was far greater than those of the earlier mills, suggesting that the intention to re-fashion mills 5 and 6 to run off the same wheel as mills 7 and 8 existed right from the start. However, it is less clear whether the change from over-drive to under-drive was also effected straightaway (see below).

Documentary and surviving field evidence suggests that the basic ground plan of this group of mills (nos 5-8) was essentially the same as those already described, except that they were built on sloping rather than level ground. This meant that rather than being excavated into solid rock, the gear chambers could be accommodated within a stone-built basement which was entered from the south or downslope side, while the ends of the basement were filled in to create solid raised platforms for the bedstones accessible at first-floor level from the north or uphill side of the building. Much of the mills now lies beneath timeshare Lodges 16 and 22, or else has been landscaped.



*Figure 36. A 1960s photograph of the southern facade of mills 5 and 6. The start of the facade to mill 7 is visible at right of frame. Note the width of the wheel-pit between mills 6 and 7; this housed a wheel powerful enough to drive four mills.
(Barter collection, copyright reserved)*

Fragments do survive, however (Fig 7), and can be interpreted with the assistance of photographic evidence from the 1960s (Fig 36), which shows the southern basement façade of mills 5 and 6 then still largely intact, and the gear chambers roofed over and converted for use as changing rooms by people swimming in the lower mill pond (the doors into the changing rooms must have re-used the original openings into the gear chambers); the wheel-pit and start of the basement façade of the later mills 7 and 8 is also visible. Lodge 16 now occupies the central part of mills 5 and 6 (principally the area of the wheel-pit and gear chambers) and this part of the façade has been largely rebuilt, but to either side much of the walls constituting the sides of the solid platforms survive, particularly in the lower courses (Figs 37 and 38); indeed both bedstones (MS18 and MS19) survive *in situ* immediately outside the Lodge's gable ends (Fig 7). The entrance to a flat-topped passage also survives in the east end of the platform in mill 6 (Fig 38). This seems to be on line to pass right beneath MS19, but is now blocked just inside the entrance and it is unclear how far it originally extended (although a similar passage which survives at mill 10 at the upper site passes right through the platform and connects with the gear chamber beyond; see below). The function of the passage is unclear. It seems to be an original feature, but is unlikely to have been for access into the chamber since door openings existed in the southern façade; on balance, it was probably built simply to facilitate periodic replacement of the wheel axle. However, if so, it must have been re-used for a line shaft when the mills were converted from over-drive to under-drive. If correct in this assumption, the roof of the passage would then have had to have been modified where it passed beneath bedstone MS19 to allow power to be transferred, *via* a cogwheel on the shaft, to a vertical axle passing up through the centre of that stone and driving the edge-runners. At the same time, a similar tunnel would have had to have been constructed beneath the platform in mill 5 also, although if so all evidence for the feature has been obscured by the modern timeshare Lodge 16.

As already stated, the new wheel-pit constructed east of mill 6 when mills 7 and 8 were added was a substantial, broad feature (Fig 36). However, what survives of it on the ground appears to have been heavily rebuilt and landscaped, for it is now only



Figure 37. Surviving fabric at the west end of mill 5. The larger stones beneath the plant line are in-situ original masonry; the rest has been rebuilt when Lodge 16 was



Figure 38. Surviving fabric at the east end of mill 6. Masonry below the lintel covering the passage is original, ^{erected} everything above is modern



Figure 39. The landscaped wheel-pit between mills 6 and 7



Figure 40. The surviving east end of mill 8

just over a metre wide, and is capped by a modern arch and dwarf wall (Fig 39). Most of the basement façade of mills 7 and 8 east of the wheel-pit (the start of which is also visible on Fig 36) has now been demolished to make way for Lodge 22, although the far (eastern) end wall of mill 8 does survive (Fig 40). However, the original form of the façade is recorded in another photograph from the 1960s (Fig 41). This shows two blocked doorways situated close together approximately in the centre. Since these were presumably for access to gear chambers, it strongly suggests that the mill replicated the same general design as elsewhere (*ie* gear chambers in the middle and solid platforms at either end), but that the wheel-pit rather than being centrally located between the two chambers had simply been removed to one end. Mill 7 must therefore have been constructed with a tunnel through its platform in order to allow a line shaft to reach the gear chambers. Furthermore, the existence of *two* gear chambers suggests that both mills 7 and 8 were originally over-driven as with all other mills at the works, and were only later converted to under-drive.



Figure 41. A 1960s photograph of the southern facade of mills 7 and 8 showing the blocked door openings. The unroofed walls of the old lower watch house (building 3) - with the three openings in its front wall - can be seen behind, whilst its replacement (building 2), by this time converted into a private residence called Brackens, lies to the right. (Barter collection, copyright reserved)

The Upper Mills (Group 3)

The four incorporating mills (nos. 9-12) at the upper site were probably all built at the same time. The exact year of construction is not known, but cannot have been earlier than the construction of the main leat which was most likely built sometime in the 1830s (section 4 above). The two pairs were arranged in line south-west/north-east astride parallel branches of the leat (Fig 26). Their design is identical to mills 5 and 6 at the lower mill group: that is to say, they occupied sloping ground, with the gear chambers either side of a central wheel-pit accommodated in stone-walled basements entered from the south-east or downhill side, whilst at either end solid stone platforms supporting the actual edge-runner mills were accessible at first-floor level



Figure 42. English Heritage plan at 1:200 scale of incorporating mills 9-12 at the upper mill site

from the rear (uphill side) of the building. As with all the mills at Elterwater, the timber superstructures were burned down when the factory closed, and only parts of the stone-built basements are still extant. The northern pair (mills 11 and 12) seem to have been reasonably well-preserved until *c* 1981, but have since been mostly built over and/or the gear chambers infilled. In contrast, the southern pair (mills 9 and 10) have been set out on public display, although the platform to mill 9 is largely obscured. The EH plan of the surviving remains of both pairs of mills is reproduced as Fig 42. Photographic evidence (*eg* Fig 43) shows that a blast wall (BW2) formerly separated the two mill pairs; it no longer survives.

Figure 43.
View north-west
across the ruinous
mills 11 and 12 in
the 1930s, towards
buildings 30 and 31
in the process of
conversion into
holiday cottages.
Blast wall BW2 is
visible towards the
left of frame.
(Barter collection,
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The gear chambers in mills 9 and 10 are virtual mirror images of each other, with internal measurements of *c* 4.4 - 4.5m front to back, by 3.7m wide. They open directly onto the wheel-pit except for short walls at the rear of the chambers *c* 0.5m long; they also now appear open-fronted to the south-east apart from stub walls 1m long at either end, but comparison with what is known of the form of other mill buildings on site strongly suggests that the front façades were originally continuous either side of the wheel-pit apart from narrow door openings giving access to each chamber (*eg* Figs 36, 41 and 43). It seems likely, therefore, that the ends of these stub walls in fact represent one side of door openings into the chambers, whose other side has collapsed and/or been tidied away during the recent 'restoration' to make the structure safe and the interior more visible from the modern restaurant/hotel complex (Fig 44). The surviving walls stand *c* 2.7m above the present floor of the chambers which are now covered by gravel, effectively infilling and masking evidence for the original gearing arrangement connecting the waterwheel with the edge-runner mills at either end of the building, although a small recess in the middle of the base of the western wall, 0.6m wide by 0.5m high and whose top slopes down to the floor, may be in some way associated with it. It seems likely that as in mills 3 and 4 at the lower site, there would have been at the very least flywheel-pits either side of the main wheel-pit. Nothing of the original waterwheel - which has been replaced by a smaller, modern, replica (Figs 44 and 45) - now survives (the antiquity of an old axle on the west side of the wheel-pit is unknown). However, something of the dimensions of the original wheel can be estimated from those of the wheel-pit which measures 6m long by 2m wide. A bridge which spans the tail race immediately below the wheel-pit is probably original: it comprises three stone slabs carried on slight corbelled abutments in the walls of the race. However, it is uncertain if a



Figure 44. Mills 9 and 10 from the south-east, showing the modern landscaped setting and replica waterwheel



Figure 45. View north-east from above the wheel-pit in mills 9 and 10, showing the vaulted passage through the platform of mill 10

millstone fragment (MS12) a little west of the bridge and forming part of a small flight of steps down to it, is *in situ* or has been placed here recently.

The solid stone platform to the eastern mill of the pair (no. 10) is well-preserved, and retains its bedstone (MS10) *in situ*. The surface of the platform is grass-covered. A vaulted stone passage 1.2m wide by up to 1.5m high runs from the gear chamber for the entire length of the platform, passing right under the centre of the bedstone (Fig 45). Since there is no indication of any housing in the roof of the passage beneath the bedstone, however, it cannot have been for a lineshaft powering the edge-runners from below; the absence of a similar passage under the western platform is further evidence that this pair of mills was not under-driven. A similar feature has already been noted in mill 6 at the lower mill site (see above), and the suggestion made that it may have been for access during maintenance and/or replacement of the waterwheel axle. The platform to the western mill (no. 9) is now crossed by a gravel path leading to the first floor of a modern canteen building to the south, and there is no sign of the bedstone on this side although it is possible that it survives *in situ* but is buried. On the other side of this path, the platform's façade has been extended a few metres to the west, and also heightened by the addition of a modern dwarf parapet wall, but a butt joint is clearly visible in the face of the wall between the two phases of masonry (Fig 42). This shows that the platform was c 4.1 - 4.2m long, identical to its better-preserved eastern counterpart.

All that now survives of the northern pair of mills (nos. 11 and 12) are parts of the gear chamber and platform of mill 12, although a photograph of the mill taken in the 1930s (Fig 43) gives some idea of what the whole structure once looked like. The

leats and wheel-pit have all been infilled (the tail race now lies beneath the country-club car park whilst an electricity sub-station stands on the site of the wheel-pit) and the gear chamber and platform of mill 11, to the west of the wheel-pit, have presumably been completely destroyed by the modern boiler house for the country club. Mike Davies-Shiel (pers comm) made a plan of mill 11 before its destruction, however, which shows that it, too, possessed a tunnel through its platform. The gear chamber and platform to mill 12, situated on the eastern side of the wheel-pit, still survive, although the rear edge is overlain/destroyed by the modern road and the chamber has been infilled: the upper 1.2m of the original door opening is visible in the southern façade, although masked by trailing shrubbery (Fig 46). The bedstone and edge-runners have been re-set as display items on top of the grassed-over chamber (MS7-MS9).



Figure 46.
The blocked door
opening in the
facade of mill 12.
Note that the
modern ground
surface has been
raised, and
obscures the base
of the opening

Nothing now survives of the blast wall (BW2) which originally stood between the two pairs of mills. This was most probably constructed at the same time as the mills; it certainly existed by 1859 (Fig 3). Later maps (Figs 4 and 5) show that it was subsequently subsumed within the turbine and pump house (building 44, section 5.2.1 above) built c 1878, but photographic evidence from the 1930s (Fig 43) shows that it was not demolished at that time.

The Expense Magazine (unlocated and building 16)

The purpose of, and legislative requirement for, expense magazines has already been outlined (green-charge house, this section above): they were needed to store the ripe charge produced by the incorporating mills in between its journey through the later stages of the manufacturing process, namely pressing, corning, glazing, drying and dusting.

The 1926 plan (Fig 5) identifies a single expense magazine at Elterwater: building 16 (at NY 32598 05005) adjacent to the main leat in the approximate centre of the site. The location was obviously carefully chosen for it is midway between both groups of incorporating mills whilst the process buildings all lie in an arc to the north and east; the magazine was also connected to these buildings by the internal tramway system, either directly or *via* spurs. A building of the same size and footprint is depicted on the OS second edition map (Fig 4), but not the first edition (Fig 3), showing that it was erected between 1859 and 1897; in all likelihood, it was constructed c 1867 at the same time as the tramway, probably as a replacement for an earlier magazine whose location was inconvenient to the new tramway's line. The position of this earlier magazine is unknown, although road connections shown by the OS first edition map between the various process buildings point to one out of buildings 7, 71 or 72 (section 5.2.6 below) as the most likely candidate (compare Figs 75 and 76).

Building 16 no longer survives (it was presumably one of those which had to be burned down when the works closed). A photograph of it just prior to closure, however, appears in the ICI Magazine (Anon 1929, 345). Its site was subsequently reused by a small stone lodge ('cabin no. 3') erected by Richard Hall; it is this later building which was planned by the OS in 1977 (Ordnance Survey 1978b). The cabin has since been demolished, and the site now lies beneath grass between the main leat and timeshare Lodge 24 (Fig 7).

The Press House (unlocated and building 10)

After incorporation, ripe charge had to be pressed in order to turn it into hard dense slabs which could be broken down ('corned') into grains of the required size. There were at least two press houses at Elterwater during the 105 years of the factory's existence. What was presumably the original press house blew up in 1840 in a catastrophic explosion that also destroyed the corning and glazing houses; it is unclear where this press was located, but its successor stood on the western edge of the site immediately above the beck at NY 32609 04947 (building 10 on Fig 5, although confusingly numbered as building 8 on Fig 6). This later press house was itself badly damaged by flood in 1898 (Tyler 2002, 180).

The ICI company history states that there was no press house at Elterwater until 1829, and that the press then installed was a somewhat primitive affair which had to be screwed down by hand (Anon 1929, 343-4). This press house is presumably the

same as that destroyed in the 1840 fatal explosion – an assumption supported by a close reading of the various witness statements in the local newspaper account of the ensuing coroner’s inquest (*Westmorland Gazette*, 1 February 1840). The newspaper report also records the fact that the press was located some 50yds (45.7m) from the then corning house/glazing house complex. Although the distance quoted should not be taken too literally, it does nevertheless indicate that all three buildings were located in the same general vicinity. Intriguingly, on the 1926 plan (Fig 5), the post-1840 press house (building 10) is depicted as situated some 40m north-west of what was then the corning house. However, it seems unlikely that the earlier press occupied the same position, for if so this would place it outside the presumed area of the pre-1829 factory (sections 4 above and 6 below).

According to Davies-Shiel, the post-1840 press house was powered by a waterwheel generating about 25hp, replaced in 1893 by a Gilkes turbine (Marshall and Davies-Shiel 1969, 83). We may accept the first part of this claim for cartographic evidence shows that as early as 1859 a branch leat ran towards the northern end of building 10 (Fig 3); however, the second part is contradicted by the MMB which states that *c* 1925 the press was ‘driven by pumps, power being derived from the same waterwheel which drives the corning machine’. It seems probable that Davies-Shiel gained his information from interviews with former workers, but that the turbine(s) they mentioned actually powered the pellet presses in the cartridge houses (section 5.2.4 below). The pumps in the post-1840 press house do indeed seem to have been hydraulically powered, but before *c* 1878 power presumably came from the waterwheel at the press house itself, whereas for some reason by 1897 the wheel here was out of use and hydraulic power was being brought in from pumps at the corning house instead (by 1916 at least *via* the intermediary of an hydraulic accumulator; see section 5.2.1 above). There is therefore no evidence that the press house was ever powered by a turbine.

The post-1840 press house no longer survives since it was one of those buildings burned down at the closure of the factory due to the danger of gunpowder residues, but neither is there any surface trace of the branch leat which originally served it. The site is now occupied by timeshare Lodge 7. However, two walls survive to the north-east and south-east, which were presumably designed to provide blast protection (BW4 and BW5 on Fig 7). BW4 is certainly massive: it stands some 3m high, and is 1.2m wide at its base, and is strengthened by being built up against a natural rock outcrop cut back to accommodate the press house (Fig 47). BW5 is of less substantial construction, being only *c* 2.1m high and 0.8m thick. Comparison with a photograph taken in the 1960s (Fig 48) suggests both still stand to something like their original height. The northern end of BW5 is pierced by two arches (Fig 49); it is unclear if they are original, although they do seem to correspond with the mapped position of the former branch leat. OS map evidence (Figs 3 and 4) suggests that both walls were constructed between 1859 and 1897.

The Corning House (unlocated, and buildings 66, 56 and 5)

There were four corning houses at Elterwater (three were destroyed by explosions in 1840, 1878 and 1916). They will be referred to here as corning house nos. 1-4, although there is no evidence they were ever known by these names during the lifetime of the factory. Corning houses nos. 2, 3 and 4 all occupied more or less the same site on the west side of the main leat where it turns south towards the beck (at NY 32640 04909). The location of corning house no. 1, on the other hand, is uncertain.



Figure 47. The northern end of blast wall BW4 shielding the press house (building 10)



*Figure 48. Blast walls BW4 and BW5 from the west in the 1960s
(Barter collection, copyright reserved)*



Figure 49.
Arches through
blast wall BW5,
possibly
marking the line
of the former
leat to the press
house

Corning House no. 1

Little is recorded of the form or design of corning house no. 1 which blew up in 1840, other than it had stone walls and occupied one half of the same building range as the contemporary glazing house. In 1840, it was said to have been in operation for 14 years without problem or accident, although the corning frame had been enlarged in 1837 (*Westmorland Gazette*, 1 Feb 1840). Its position is not known for certain, and therefore it has not been allocated a building number in this report. But since the leat supplying power to the site of houses nos. 2-4 was apparently not built until the 1830s (section 4 above), and the factory could not have started production of gunpowder at the end of 1825 without corning facilities, it seems reasonable to suppose it stood somewhere adjacent to the head or tail races associated with the lower mill pond, which was the core of the early factory.

Corning House no. 2

Corning house no. 2 operated between 1840 and 1878, when it was destroyed in the second major explosion at the works. It is described as a stone-built, two-storeyed affair with a slate roof, which nestled into the valley side so that it could be entered directly at either level; the lower floor housed the drive shaft and gearing mechanism from the waterwheel which lay immediately beyond the south-east wall, whilst the corning and sizing machines were located on the floor above. These machines consisted 'of a frame of wood suspended by ropes from the ceiling, and made to oscillate by means of a perpendicular crank passing through the floor.' Each frame contained a number of wooden sieves: the press cake was put into the first (corning) frame along with blocks of *lignum vitae*, which dashed against the sides of the sieves and broke the cake up; the charge was then transferred to the second (sizing) frame, which lacked blocks, in order to separate grains from dust. Like its predecessor, this corning house is said to have been built under the same roof as the contemporary glazing house, although the latter, situated on its north-west side, was disused by

1878. A separate building is also reported as standing on the opposite side of the leat, then used as a store for sieves (Explosives Inspectorate 1878). This information correlates well with the evidence of the 1926 and 1932 plans of the site (Figs 5 and 6), and is sufficient to show that corning house no. 2 occupied the same site as its two successors. It is this building which is depicted on the OS first edition map (Fig 3; numbered as building 66 on Figs 75-77 for the purposes of the present report).

Corning House no. 3

Unlike its stone predecessors, corning house no. 3, erected in 1878-9, is described as a much lighter construction of wood and corrugated iron. It was also sunk into the ground slightly and screened on three sides by stone traverses (*ie* blast walls); only the side facing the beck was unprotected. Press cake arrived at a door in the north-west side of the building via the works' internal tramway system, which passed through one of the traverses in a tunnel (Fig 50). As before, the waterwheel lay external to the south-east wall (Explosives Inspectorate 1916, 1-3). This description agrees well with the OS second edition map depiction of the building in 1897 (Fig 4), except that the walls shown 'shielding' the building are not differentiated as blast walls, and both that map and the later 1926 plan seem to show the tramway stopping at the press house rather than coming on as far as the corning house. All the blast walls survived until at least 1977 (Ordnance Survey 1978a), but the one shielding the north-east and north-west sides of the corning house (BW8) has since been demolished; it seems likely that the easternmost blast wall (BW9) was in fact the gable wall of the former sieves depot opposite corning house no. 2 (building 67, sections 5.2.5 and 5.2.6 below). If so, it is still extant (Figs 12 and 71).



*Figure 50.
Blast wall BW8
shielding the
northern corner of
corning houses
nos. 3 and 4,
photographed in
the 1960s. Note the
arch for the
tramway
(Barter collection,
copyright reserved)*

The building contained machinery of a more up-to-date design than its predecessor, namely a series of gunmetal 'crackers' (rollers) to break the press cake up, and a wooden frame into which 'scrics' (sieves) of different mesh were inserted according to the size of grain required; these frames were agitated with a circular motion by vertical cranks connecting to lugs on the side of the frame, to separate grains from dust (Explosives Inspectorate 1901, 4; 1916, 2). The machinery was destroyed in another explosion in 1901, but this time the building was largely undamaged (Explosives Inspectorate 1901, 5) and did not have to be rebuilt. Building and machinery were

both destroyed, however, in the next major explosion at the works in 1916. For the purposes of the present report, the building is numbered 56 on Fig 78.

Corning House no. 4

A fourth corning house was constructed at the same location following the 1916 explosion (building 5 on the 1926 and 1932 plans). No constructional details are known, although the 1926 plan suggests it replicated its predecessor's footprint exactly. The MMB's description of the machinery shows that this was also essentially a copy of that installed inside corning house no. 3. The building was burned down/destroyed in 1930; its site is now occupied by timeshare Lodges 14 and 15, and no trace survives (Fig 7).

The Glazing House (unlocated and buildings 65 and 9)

After corning, the ripe-charge grains had to be smoothed and polished, the latter normally done by coating them with a very fine layer of blacklead (graphite). Both these processes were carried out in the glazing house. Three glazing houses are documented at Elterwater, and will be referred to here as glazing house nos. 1-3 although there is no evidence they were ever known as such during the lifetime of the factory. The position of glazing house no. 1 is uncertain, but glazing house no. 2 was integral with corning house no. 2 adjacent to the beck. Before 1878 glazing house no. 3 was constructed on a new site about 50m further to the north.

Glazing House no. 1

Nothing is known of glazing house no. 1, apart from the fact that it formed part of the same building range as corning house no. 1, and was totally flattened along with it in the fatal explosion of 1840 (*Westmorland Gazette*, 1 Feb 1840). It is not clear where it was located, and for that reason has not been allocated a building number for the purposes of the present report, but the most likely position would be adjacent to the head or tail races associated with the lower mill pond (see corning house no. 1, this section above).

Glazing House no. 2

The 1932 plan (Fig 6) shows that glazing house no. 2 (described as 'building 6: site of old glazing house' on that plan, although numbered building 65 on Figs 75-77 for the purposes of the present report) stood adjacent to the beck (at NY 32628 04915). It, too, occupied one end of the same stone range as the contemporary corning house (no. 2), but had a wooden roof unlike the latter which was slated (Explosives Inspectorate 1878, 2). It is depicted on the OS first edition map of 1859 (Fig 3), which shows it to have measured *c* 14m by 9m. Nothing now remains apart from the stone-revetted platform on which it stood, which survives immediately west of timeshare Lodge 14 (Fig 7).

Glazing House no. 3

Sometime before 1878 (Explosives Inspectorate 1878, 2), glazing house no. 2 was replaced by a new structure, building 9, on a site some 50m further north (at NY 32653 04964), as shown by both the 1926 and 1932 plans (Figs 5 and 6). The plans show that this building - glazing house no. 3 - measured *c* 10m by 17m, and was

*Figure 51.
The wheel-pit to
glazing house no. 3
(building 9) in
1982. According to
the MMB the wheel
was under-shot, but
Mike Davies-Shiel
suggests it was
close-breasted
(Davies-Shiel
collection,
copyright reserved)*



therefore larger than its predecessor(s). According to the MMB, by c 1925 it housed five glazing drums, each divided into two compartments capable of holding 1600lbs of powder, and all powered by an under-shot waterwheel although Mike Davies-Shiel described the surviving remains in 1982 as close-breasted (Fig 51). Davies-Shiel has also been able to reconstruct what these glazing drums looked like from his interviews with former employees of the company (Marshall and Davies-Shiel 1969, 'e' on diagram on p82). The MMB states that c 1925 the building also housed two polishing reels, but that these were then both disused. Map evidence (Figs 4-6) shows that the waterwheel lay adjacent to the western wall of the building, and was fed by a head race emanating from Hobson's Tarn; the tail race from this wheel fed the water back into the main (lower) leat parallel to the beck for reuse in the lower mill pond if required. A tramway ran along the building's southern side, and provided direct connections to the nearby blacklead store as well as to the expense magazine, corning house and stove house. Nothing now remains of the building which was one of those burned down/destroyed at the factory's closure in 1930, although the wheel-pit survives as an attractive modern water feature at the north-west end of timeshare Lodge 10 (Fig 52). A massive blast wall (BW3), 3m high by up to 1.1m wide, also survives immediately to the south-west (Figs 7 and 53) and corresponds to an irregular lozenge-shaped feature shown on the various plans and maps. However, BW3 probably pre-dates the construction of the glazing house (see buildings 7, 71 and 72, section 5.2.6 below).

*Figure 52.
The wheel-pit to
glazing house no. 3
in 2001, from the
south-west*



The Stove House and Boiler House (unlocated and buildings 14 and 15)

Once glazed, the gunpowder had to be dried to remove any moisture remaining from the incorporating process. This was done in the stove or drying house. There are references to two stove houses at Elterwater. The earlier building was a gloom stove – a room heated by a metal dome or wall plate behind which was an open fire; its position is undocumented (although it most probably stood on the same site as its successor; see building 61, section 5.2.6 below). It was replaced in 1881 by a safer



*Figure 53.
Blast wall BW3
to the south of
glazing house
no. 3*

design heated by steam pipes fed from an external boiler (Marshall and Davies-Shiel 1969, 84).

The position of the later stove house on the western edge of Hobson's Tarn (at NY 32614 05063) is depicted on both the 1926 and 1932 plans (building 14 on Figs 5 and 6; the 1932 plan describes building 14 as 'stores' in the key, but this would seem to be a misprint for stoves and has been corrected to 'drying house' by Mike Davies-Shiel). Map evidence shows that this later drying house consisted of two building ranges lying parallel and very close to each other (Figs 4-6). The MMB states that there were 'two stoves either side of a roofed passage', indicating that each of the ranges depicted on the maps was a separate 'stove'. The MMB also records that each building was used for stoving a different product: one dried cartridges, and was limited to 2 tons at any one time; the other dried loose powder, limited to 3 tons per loading. The maps show that the western of the two buildings was slightly narrower, and it may well be therefore that this was where the cartridges were dried. The maps also show that a tramway branch connected the northern end of the stoves directly to both the glazing house and the two cartridge houses; other branches linked them with the cartridge-dipping house and dust house. According to the MMB, powder and cartridges were placed in trays on racks within each stove, with loose powder stoved for one night, cartridges for two (*ie* for 30-36 hours); the temperature never fell below 100°F day or night. The boiler providing the steam stood just outside the southern end of the stoves in a separate building (building 15 on Figs 5 and 6), with a horizontal flue leading to a divorced chimney some 35m downwind on the south-western edge of the tarn in order to minimise the danger of sparks carrying on the breeze (Fig 54). Patterson (1995, plan facing p 20) erroneously shows this flue as a tramline on his published site plan.

At closure, both stove house and boiler house were converted into hostel-type accommodation (*The Gazette*, 25 May 1935). Photographs in the Barter collection taken in the 1960s depict the conversion, and show the boiler house had been extended or replaced by a new single-storey range (Fig 55). The whole complex has



Figure 54. A 1960s photograph of the boiler-house chimney on the edge of Hobson's Tarn. Note the dipping and packing house at right of frame (Barter collection, copyright reserved)

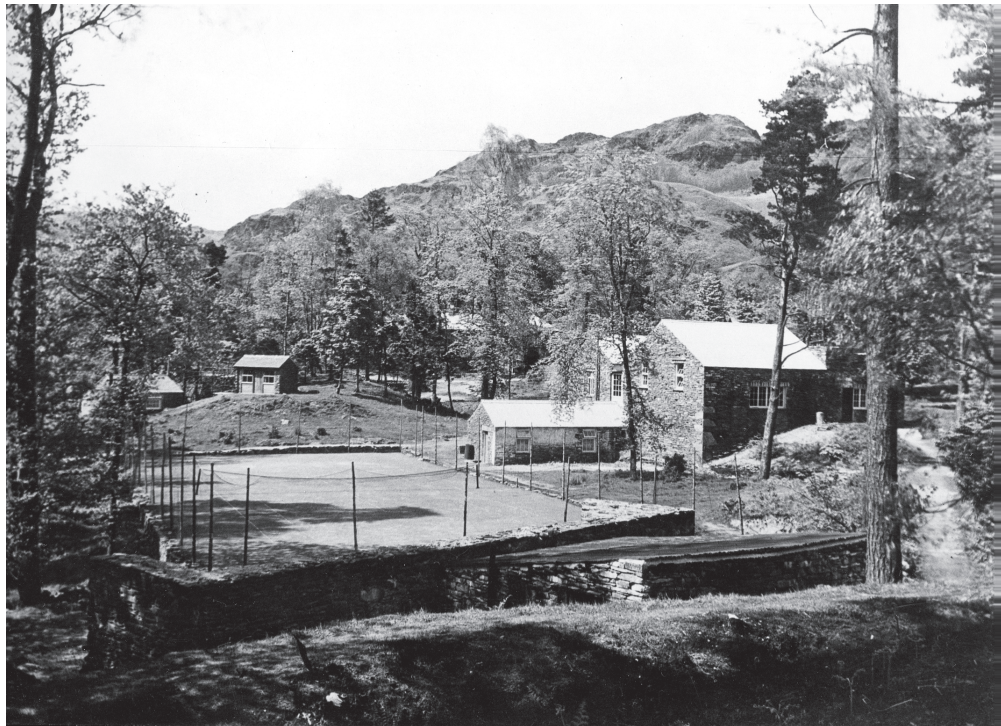


Figure 55. The later stove house and associated boiler house (buildings 14 and 15), as converted into hostel accommodation in the 1960s. Note building 52 on top of the mound at left of frame, and the remains of building 13 in the foreground (Barter collection, copyright reserved)

been demolished since 1981, and replaced by the present swimming pool and leisure complex (country club) erected by Langdale Leisure. The only surviving trace of the boiler house is a short length of flue and the divorced chimney on the edge of Hobson's Tarn (Fig 7); repairs to the chimney were carried out in summer 2001.

The Dust House (unlocated and building 32)

After drying, loose powder was sent to the dust house so that any under- or over-sized particles could be removed by gentle sieving. In all probability there were two if not three dust houses at Elterwater. The 1926 and 1932 plans (Figs 5 and 6) both identify the final dust house as building 32 (at NY 32623 05145) close to the northern edge of the works. (The 1932 plan also labels building 32 as a packing house, but this is unlikely; see heading-up house, this section below). However, whilst building 32 appears on the OS second edition map and therefore existed by 1897 (Fig 4), it lies on land which was only incorporated into the factory in 1861 (section 4 above, and compare Figs 3 and 4). The location of the earlier dust house(s) is unknown (but see buildings 13 and 63, section 5.2.6 below).

Map evidence shows building 32 was a rectangular affair measuring c 11m by 8m. The maps also depict small 'annexes' attached to the building's northern and western sides, but since these front onto one of the intra-works roads and a branch of the internal tram system respectively, they were probably no more than covered loading bays in which carts and bogies could be loaded/unloaded protected from the weather. According to the MMB, c 1925 the 'separator' within the dust house was an enclosed wooden box containing a series of sloping sieves of differing mesh size, arranged one above the other, with the coarsest at the top to retain the 'stops' (over-sized particles), and the finest at the bottom allowing any under-sized dust to pass all the way through. Both stops and dust were returned to the mixing house to be re-processed. The sieves were agitated by cranks powered by a long belt drive. When the MMB was first produced (1925 or earlier), the belt was being turned by a turbine itself powered by a National gas-suction engine, or failing that by the main turbine (section 5.2.1 above). However, the relevant sentence in the MMB has been crossed through and a longhand emendation indicates that the belt was later propelled by an electric motor. Since the 1926 plan depicts a small motor house (building 46, section 5.2.1 above) immediately west of the dust house, the change in power source must have been effective by that date. Small fragments of the walls of the dust house may still survive, incorporated into the end of the 'Housekeeping' building erected since 1981 by Langdale Leisure (Fig 7).

The Heading/Packing House (unlocated and buildings 40 and 47)

Before the 1875 Explosives Act, gunpowder manufacturers mostly sold powder loose by the barrel or fraction thereof; after the act they also sold it as pre-formed blasting cartridges. 'Heading' refers to the closing of gunpowder barrels, and the heading or heading-up house therefore is simply a place where loose powder was packed. Cartridge preparation was a totally separate process and is described in detail in section 5.2.4 below, although at Elterwater it seems that the finished cartridges were boxed up in the same building where loose powder was barrelled.

The 1926 plan (Fig 5) identifies the packing house as building 40, situated well away from most other buildings close to the northern edge of the works (at NY 32683 05118). It is depicted as rectangular in plan, measuring approximately 10m by 7m,

and surrounded by what would seem to be a combination of earthen traverses (blast banks) and stone blast walls (BW6). A tramline is shown connecting it directly with the dust house and various cartridge buildings - suggesting it was handling both loose powder and cartridges - whilst roads led from it to the two magazines (buildings 35 and 36, this section below). Thus, loose powder and cartridges were presumably both brought in via bogie (tramcar), but taken away by horse and cart. According to the MMB, by c 1925 powder was packed into hessian, calico or rubber bags before being placed into barrels, depending on whether it was for home or foreign use, and whether it was manufactured from potassium nitrate or sodium nitrate. (In the earlier period it is likely that powder was not pre-bagged, but went loose into the barrels). By c 1925 finished cartridges were also being individually wrapped in the packing house before being packed into wooden boxes lined with brown paper, tarred on one side. The 1932 plan (Fig 6) also describes the dust house (building 32, this section above) as a packing house, but such a double function seems unlikely given the potentially dangerous nature of the two processes; certainly the 1926 plan makes no mention of the building being approved for packing.

Building 40 cannot have been the first packing house at the works, however, for it is located on land which did not form part of the factory until 1861 (section 4 above, and compare Figs 3 and 4). It is unclear how soon it was constructed after the acquisition of the land, although it certainly existed by 1897 (Fig 4). The location of its immediate predecessor(s) is presently unknown (although see building 72, section 5.2.6 below), but according to Mike Davies-Shiel (*in litt*; section 4 above) when the Elterwater works first opened for business at the end of 1825 the old mill (building 47) at the lower, east end of the site served as a packing house as well as a saw mill, change house and general offices. If so, it may have quickly ceased to be used as such, for a marginal note added to a conveyance of property between the Elterwater Gunpowder Company, and its incorporated successor the Elterwater Gunpowder Company Ltd (Barter collection: bundle 1, document 10) states that 'the mill...[has] been for 40 years used as Cooperages and Hoop Loft.' Nevertheless, the local memory of such a use would help explain its description as 'heading mill' on the 1932 plan (building C on Fig 6; numbered building 47 on Figs 73-80 for the purposes of the present report).

It is likely that building 40 was amongst those structures which had to be burned down at closure of the works, due to the danger of gunpowder residues. Certainly the 1932 plan (Fig 6) omits it. Other map evidence, however, suggests that at least some of the blast walls survived as late as 1977, and that Richard Hall had in the interim erected a new building inside them (Ordnance Survey 1978b). There is now no visible above-ground trace of any structure - building or blast wall - at the site, which is mostly overlain by timeshare Lodge 79 (Fig 7). The corn/heading mill (building 47) still survives, and is now used as a general workshop by Langdale Leisure (section 5.1 above, and Figs 8, 9 and 26).

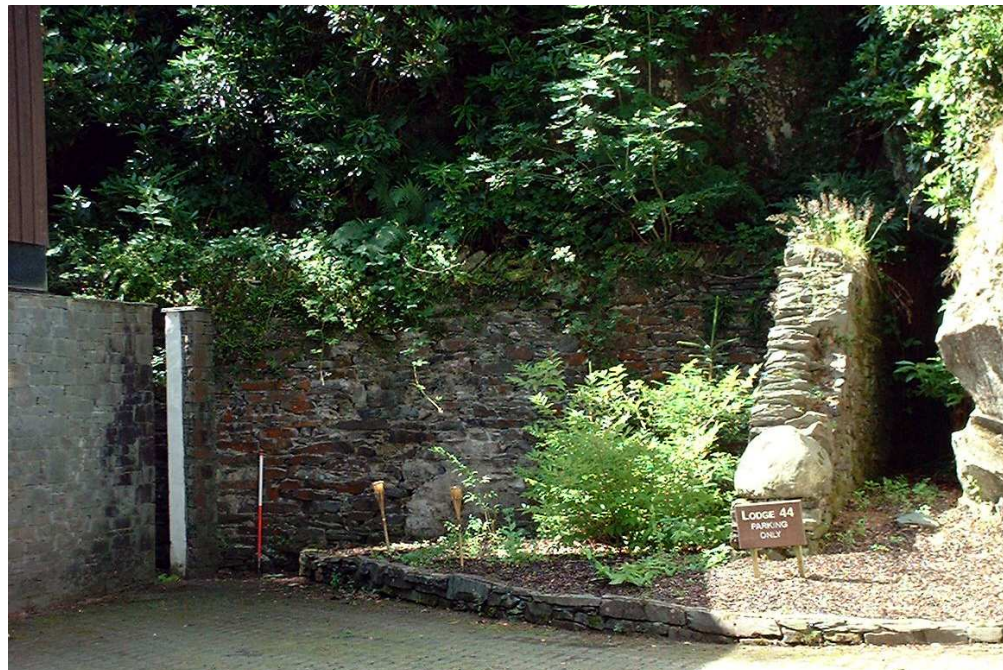
Magazines (buildings 35 and 36)

The 1926 plan (Fig 5) identifies two buildings as magazines: building 35 on the divorced Cylinder Hill sub-site (at NY 32828 05222), and building 36 in the largely empty north-east quadrant of the main works (at NY 32746 05020). These would both have been store magazines for the storage of the finished product as opposed to expense magazines where gunpowder was kept during the course of manufacture. Newspaper accounts state that a magazine existed at the factory as early as 1825

(section 4 above); its position is unknown. David Huddleston's letter book (CRO(K) WDY 448) indicates that a new one was erected in 1827 which Tyler (2002, 161-2) has equated with building 36. Building 35, however, was not constructed until 1882.

Although it is debatable whether building 36 is the same as the magazine erected in 1827, the building certainly existed by 1859 for a structure of similar size and plan, but slightly shorter to that on the 1926 plan, is shown in the correct position on the OS first edition map (Fig 3). Against the assumption that it was then in use as a magazine, however, is the observation that despite its general seclusion within the factory complex and the fact that it is shielded from the rest of the works by a large hill (Fig 7), it nevertheless lay very close to the works boundary wall and to the public highway beyond. But public safety seems not to have been the highest consideration governing the layout of gunpowder works in the 19th century (*eg* Anon 1929, 346). In any case the matter was soon rectified: in 1861 the Company purchased an additional area of Walthwaite Common (section 4 above), and henceforward building 36 lay at the approximate centre of the works over 100m from the nearest highway (compare Fig 4). The Cylinder Hill magazine was built in 1882 (section 4 above), apparently sited in order to utilise a natural rock outcrop as ready-made blast protection (Fig 7). Both buildings would have been constructed in stone as required under the 1772 Gunpowder Act.

It seems likely that the two magazines would have been amongst those structures demolished at the factory's closure in 1930 due to the danger of powder residues. Certainly building 36 had disappeared by 1977 (Ordnance Survey 1978b), whilst the Cylinder Hill magazine was rebuilt as a shed and had a subsequent history as an artist's studio (the 'Merzbarn', section 1 above). Building 36's site is now occupied by timeshare Lodge 44 (Fig 7); all that survives is the rear wall and rock-cut stance excavated into the base of the hill behind (Fig 56).



*Figure 56.
The rock-cut
stance and
walls of the
earlier
magazine
(building 36)*

5.2.4 The manufacture of cartridges

In 1875, the Explosives Act made the filling of blasting cartridges illegal except from on licensed premises. Before the act, cartridge preparation had been very much a home industry carried out by miners and others by candlelight! (Marshall and Davies-Shiel 1969, 84). After the act, most blackpowder manufacturers obtained licences to manufacture cartridges at their works. Elterwater commenced cartridge manufacture in 1878.

The Cartridge Houses (buildings 27 and 39)

The 1926 and 1932 plans (Figs 5 and 6) agree in identifying two cartridge houses at the works, both located at the north-west end of the site: building 27 right on the edge of the beck (at NY 32486 05094), and building 39 about 50m north-east from it on the other side of the main head race (at NY 32516 05136). Although the plans label each building simply as ‘cartridge house’, Mike Davies-Shiel has added ‘1st’ and ‘2nd’ to the key on the 1932 plan, indicating that he had information that building 27 was the earlier of the two. Cartridge manufacture involved forming gunpowder into solid pellets under great pressure, with a pre-formed central hole (created by a spike in the top plate) into which the fuse could later be inserted. According to the MMB, c 1925 building 27 housed two presses each capable of producing 80 cartridges at a time, while building 39 contained one press of 96 pellets and another of 42, although usually only the former was operational due to shortage of water power. Mike Davies-Shiel was able to reconstruct what these presses looked like from interviews conducted in the 1960s with surviving employees (Marshall and Davies-Shiel 1969, ‘f’ on diagram on p82). The MMB states that all the presses were then hydraulically operated, powered by a Gilkes 25hp turbine, or if water levels ran low by a National gas-suction engine of 32hp (see also section 5.2.1 above); pressure on the rams powering the presses was 20cwts psi. Three women and three men worked in building 27, two women and one man in building 39.

On the OS second edition map revised in 1897 (Fig 4), building 27 is depicted as a rectangular structure c 14m long by 8m wide. The map clearly shows what a potentially dangerous business cartridge packing was deemed to be, for the building is depicted as shielded from the rest of the gunpowder works to the south and east by a curving blast wall. In addition, access to it was restricted to a single footpath approaching from the south between the blast wall and beck, and a tramline leading to what was presumably a wooden canopy at the northern end of the building where deliveries of powder *etc* could be unloaded, and completed cartridges despatched, in the dry. The tramline connected the cartridge house directly with the dipping and packing houses (building 34, this section below, and building 40, section 5.2.3 above), and also intersected with another line to the drying house, all of which were places the cartridges would have had to travel on to in order to complete the manufacturing and packing process. However, the same building also appears on the OS first edition map surveyed in 1859 (Fig 3), indicating that building 27 was not newly erected in 1878; indeed, it has already been suggested that it may originally have been the sulphur store (section 5.2.2 above). The shell of the building still survives heavily modified, converted into timeshare Lodge 38. The blast wall (BW7) also survives (Fig 7), although now heavily overgrown (Fig 57). It consists of a natural rock outcrop faced by stone walls, the inner of which is up to 3m high; it is a maximum of 4m wide. Towards the south it is pierced by a corbelled tunnel c 1m wide by 1m high: this was presumably a passage for the hydraulic pipes from the turbine house (building 44, section 5.2.1 above).



*Figure 57.
Blast wall BW7
shielding cartridge
house no. 1
(building 27)*

According to Davies-Shiel, building 39 was a later creation than building 27. Its precise date of construction is unknown, although it existed by 1897 (Fig 4). It was a much smaller building, measuring only *c* 7m by 4m, presumably because, unlike building 27, it was constructed specifically for cartridge manufacture. All the maps depict it as almost entirely surrounded by blast walls and/or earthen traverses, apart from a small west-facing gap through which ran a branch from the main tramway. Field inspection, however, indicates that the stance for the cartridge house had been excavated back into a small hillock and the southern traverse (BW10) was in fact a small wall built upon solid rock. Photographic evidence shows the building had completely disappeared by the 1960s (Fig 58), perhaps suggesting that it was of wooden construction. The site is now occupied by timeshare Lodge 31; only parts of the blast/retaining walls survive (Fig 7).



*Figure 58.
The rock-cut stance
for cartridge house
no. 2 (building 39),
photographed in the
1960s. Blast wall
BW10 is visible at
left of frame
(Barter collection,
copyright reserved)*

The Dipping and Packing House (building 34)

After the cartridge pellets had been pressed, they were despatched to the stove house for drying, before progressing to the packing house to be wrapped. At the end of the factory's life cartridges were wrapped in pairs and boxed in quantities of 25lb, 50lb or 100lb (MMB). Around 1890, however, an additional step in the manufacturing process was introduced which necessitated the wrapped cartridges being dipped in hot wax to make them airtight (Tyler 2002, 179-80), for blasting powder was manufactured from sodium nitrate which was prone to absorbing moisture from the air, thereby losing its efficacy. The 1926 plan (Fig 5) identifies building 34 (at NY 32635 05098) adjacent to Hobson's Tarn as the place where this was carried out (in the key it is labelled the dipping and packing house). On the 1932 plan (Fig 6) it is called simply 'No. 2 packing house', although Davies-Shiel's added comments make it clear that he was also aware that waxing took place here. The same building appears on the OS second edition map (Fig 4), proving it was in existence by 1897. Logistically it was well sited for its function, for all three maps agree in depicting a tramway running past its eastern side *en route* between the two cartridge houses, stove house and (in the case of the cartridge houses) the packing house.

The building still survives (Fig 7). It measures 5.1m long by 3.6m wide, and has a verandah running the length of the eastern side which now makes the building 5.5m wide overall. Although the verandah existed in the 1960s (Fig 54), it is unlikely to be an original feature from the gunpowder era. The building seems formerly to have had opposed entrances in the two long walls: a doorway still exists opening onto the verandah, whilst there is evidence for a blocked doorway in the western wall (Fig 59). It is now used as an office by Langdale Leisure.



*Figure 59.
The dipping
and packing
house
(building 34)
from the north-
west*

5.2.5 Ancillary buildings

Watch and Change Houses (buildings 2, 3, 30, 31? and 69?)

During most of the factory's existence there were two watch houses at Elterwater, one for overseeing the operation of each set of incorporating mills. In the later period at least, these watch houses also doubled as change houses where the workers could

don and doff their works clothing. It is probable that after 1878 when women began to be employed at the works to press and pack cartridges, there was also a separate women's change house.

According to the 1926 plan (Fig 5), the watch and change house for the lower mills (building 2) was then located on the eastern periphery of the works (at NY 32729 04866), whilst that for the upper mills (building 30) stood adjacent to the timber/charcoal store (at NY 32533 05116). Neither building can have performed this function in the earlier period of the factory's existence, however, for building 2 was only constructed sometime between 1859 and 1897 (Figs 3 and 4), and building 30 was until 1878 a rented cottage (section 4 above). It may well be that the predecessor to building 2 was building 3, for the latter is described as 'Old Watch House' in the key to the 1932 plan (Fig 6). There is no similar documentary reference to help identify building 30's predecessor, but the closest building to the upper incorporating mills on the OS first edition map (Fig 3) is a small structure, measuring in plan some 9m by 4m, attached to the northern end of the preparing house (labelled building 69 on Figs 75-76 for the purposes of the present report), and it may well be that this was the original upper watch house. Davies-Shiel's comments in the key of the 1932 plan (Fig 6) and his published plan derived from it (Marshall and Davies-Shiel 1969, 79), indicate that he had information that the west end of building 31 (the timber/charcoal store, section 5.2.2 above) at some point also served as a women's change house, but as yet no other evidence has been found to support this claim.

OS map evidence shows that the original lower watch house, building 3, was extended between 1859 and 1897 (Figs 3 and 4). In its final form it measured c 9m by 5m, and was a single-storey range of two bays, built of stone under a double-pitched roof. It was allowed to fall into disrepair at closure of the factory (Fig 41), and has since been demolished although its site is undeveloped. Its successor as the lower watch house, building 2, was considerably larger, was sold off by Richard Hall as a private dwelling after the factory closed (the 1932 plan seems to have been drawn up as part of the sale process), and was renamed 'Brackens' (Ordnance Survey 1978a). It has since been re-purchased by Langdale Leisure, and extended and refurbished to turn it into holiday accommodation (Fig 7). OS map and early photographic evidence, however (Figs 4 and 41), shows it originally consisted of a single-storey main range measuring c 14m by 5m, with a small annexe (porch or privy?) attached to the north-east façade. At the upper mills, building 69 had been demolished and/or assimilated into the preparing house before 1897; there is no evidence for its appearance, although it was presumably very similar to building 3. Its successor, building 30 (Figs 20 and 21), was a pre-existing two-storeyed cottage (section 5.1 above). This has been used as a holiday accommodation almost continually since the works closed, and is presently part of Langdale Leisure's 'Fellside' complex (Fig 7). In consequence, although the shell of the building still stands, it has been much altered inside and out; a flight of stone steps against the south-western gable wall giving external access to the first floor is one such modern addition.

The Searchers' Hut (building 45)

The 1875 Explosives Act placed a legal requirement on the owners of blackpowder works to prevent the introduction into certain parts of their factories 'of fire, lucifer matches, or any substance or article likely to cause explosion or fire' (Explosives Inspectorate 1878, 2). In consequence the Elterwater company was by 1926 using 'searchers' to stop unauthorised personnel from entering the factory, and also prevent workers bringing in contraband (pipes, matches, *etc*) which could pose a safety risk.

But it is by no means clear that searchers were employed before the date of the act, or that there was always a high concern for security and safety. For instance, as late as 1878 the factory apparently lacked a secure boundary wall or fence (Explosives Inspectorate 1878, 6), and that same year when building 30 near the upper incorporating mills was still let out as a cottage the works manager was appalled one night to find one of the occupants smoking (Anon 1929, 346). The management were also severely criticised at the coroner's inquest into the fatal corning house explosion in late November 1878 for failing to ensure that workers changed out of their working clothes before leaving the premises for lunch, and for not having them searched when they returned (Explosives Inspectorate 1878, 4-6).

After 1861 when the works expanded to its final size (section 4 above), the main entrance seems to have been located in the north (*eg* Fig 4), and the 1926 plan (Fig 5) duly identifies the searchers' hut as building 45 (at NY 32574 05179) immediately inside this entrance. It is depicted as a very small structure, only *c* 3m by 3m in plan, and may have been no more than a wooden shack. It is not depicted on the OS second edition map (Fig 4) but it is unclear if this should be taken as indicating that it did not exist in 1897, or merely that it was too small/insubstantial for the OS' rules of depiction. Building 45 was presumably destroyed at or very soon after the factory's closure – it is not shown on the 1932 plan (Fig 6). No trace of it survives on the ground today, although its site is an undeveloped open space (Fig 7).

The Saw Mill (buildings 47 and 19)

Both the 1926 and 1932 plans (Figs 5 and 6) identify the saw mill as building 19 (at NY 32565 05032), standing adjacent to the main leat and preparing house in the approximate centre of the site. Both also depict it as a long, slightly L-shaped, building, comprising a main range orientated roughly north-south measuring *c* 34m by 7m with a much shorter west range attached to the northern end; the two plans convey different messages, however, as to whether the west range was truly an integral part of the saw mill or instead formed part of the preparing house to the north (building 20, section 5.2.3 above). In addition, the 1932 plan shows the main north-south range subdivided into two parts of approximately equal length, with Mike Davies-Shiel's annotations showing the southern part was open-sided and functioned as a coppice barn as can be seen in a 1930's photograph (Fig 60). It seems likely that the mill drew its power from a waterwheel within the preparing house (section 5.2.3 above). The presence of a saw mill at the works disproves Tyler's statement (2002, 176) that circular saws were not allowed at the factory, and all sawing had to be done manually at the saw pit (building 33, this section below).

It is not known when the mill/barn complex was built, although OS map evidence shows it existed by 1859 (Fig 3). It is unlikely to have been the original saw mill at the works, however, for it lies outside the core area of the early factory. Indeed, documentary evidence (section 4 above) suggests that when the Elterwater works first opened for business at the end of 1825 the saw mill was then accommodated within the old corn mill at the lower, east end of the site (building 47, section 5.1 above).

At closure, walls and fenestration were added to the southern, open-sided coppice-barn element of building 19 and the entire structure converted into a hotel (called 'The Pillars') by Richard Hall (Figs 60 and 61). The shell of the building still survives, although the walling and fenestration at the southern (barn) end have been further altered; the whole range is now used as office accommodation by Langdale Leisure (Fig 7).



Figure 60. The southern, coppice-barn, element of the saw mill (building 19), in the 1930s before renovation and conversion (Barter collection, copyright reserved)



Figure 61. The saw mill in the 1960s after conversion into the Pillars Hotel (Barter collection, copyright reserved)

The Saw Pit (building 33)

The 1926 and 1932 plans (Figs 5 and 6) both identify building 33 (at NY 32672 05161) situated just within the factory's northern perimeter adjacent to the track leading up to the Cylinder Hill sub-site, as the 'Saw Pit'. There is no evidence that the building was ever supplied with mechanical power, and therefore all sawing of timber here must have been done manually. The saw pit presumably handled timbers which were too large for the saw mill (building 19, this section above).

The building dates from between 1861 (the year the factory expanded onto this part of the site - section 4 above) and 1897 (Fig 4). The shell survives seemingly in something approximating its original form, but the interior has been much altered since the factory closed: between c 1930 and 1981 it was re-christened 'The Gateway' and put to use as a combined office, shop, café-restaurant and kitchen complex downstairs, with separate hotel accommodation upstairs (*The Gazette*, 25 May 1935); since 1981 it has been refurbished by Langdale Leisure who now use it as office accommodation (Fig 7). As it survives, it is a two-storeyed building of rectangular plan measuring c 14m by 8m, comprising three bays facing south-east all built of stone under a double-pitched slate roof, but it is unclear how much if any of the fenestration is original – the majority may only have been inserted in the 1930s. Before 1981, access into the ground floor seems to have been via a door at the northern end of the south-east wall, although this has since been moved to the southern end (Figs 62 and 63). External stairs against the south-western gable give separate access to the first floor, and although perhaps not an original feature (G Corbett and C Giles pers comm), certainly existed by 1897 (Fig 4). It is possible that the first floor was originally a store over the saw pit proper on the ground floor; certainly the size of the floor joists and lack of heating support an industrial rather than administrative or domestic function. There is now a single stack against the same gable as the external stairs, serving a fireplace on the ground floor whose hearth is formed of a broken bedstone originating from one of the incorporating mills, but neither stack nor fireplace seem to be original features (G Corbett and C Giles, pers comm). The saw pit itself on the ground floor must have been filled in when the building was first converted to other use in the 1930s.

The Cooperage (buildings 47 and 48)

A marginal note added to a conveyance of property between the Elterwater Gunpowder Company, and its incorporated successor the Elterwater Gunpowder Company Ltd (Barter Collection: bundle 1, document 10) indicates that before 1867 the cooperage was accommodated within the old corn mill (building 47, section 5.1 above) by the beck at the lower, southern end of the site. However, the 1932 plan places the cooperage in an adjacent building closer to Elterwater village, at NY 32753 04818 (building 'B' on Fig 6; labelled building 48 on Figs 75-80 for the purposes of the present report). Since the latter building existed by at least 1859 (Fig 3), either it was not built specifically as a cooperage, or the information in the 1867 conveyance is incorrect. However, since the old corn mill was also described as a hoop loft before 1867, it may be that the two buildings fulfilled different aspects of coopering. Strangely, the 1926 plan (Fig 5) does not name building 48, although it is depicted as lying within the curtilage of the factory.

Both buildings survive (Fig 7), although devoid of any original internal fittings, and with new fenestration, *etc.* The old corn mill has already been described above (section 5.1), and need not be described further. Building 48 on the other hand comprises a single-



*Figure 62. The saw pit (building 33) in use as the Gateway Cafe in the 1960s
(Barter collection, copyright reserved)*



Figure 63. The saw pit in 2001, from the south

storey rectangular range, measuring c 14m by 7m, built of stone under a double-pitched slate roof. Photographic evidence taken before its refurbishment as holiday accommodation by Richard Hall in the 1930s shows that it then had three stacks (Fig 64). The easternmost of the stacks is clearly constructed in brick and was presumably, therefore, a later addition, raising the possibility that the east end had at some point been divided off from the rest of the building, but if so the purpose of the subdivision is unknown. All the stacks have now been removed, and the building joined at its southern corner to the adjacent former office (building 49) via a short corridor.



Figure 64.
The cooperage
(building 48) in the
1930s before
refurbishment
(Barter collection,
copyright reserved)

The Joiners' Shop and Boxmakers' (building 17)

The 1926 and 1932 plans (Figs 5 and 6) both place the Joiners' Shop (building 17) adjacent to the beck in the centre of the site (at NY 32558 04996); the former plan also describes it as the Boxmakers' – presumably reflecting the need after 1878 for the works to produce packing crates for the new blasting cartridges. The OS first edition map (Fig 3) shows the building existed as early as 1859; in all probability it had been purpose-built as a joiners' workshop sometime during the previous three decades.

At the factory's closure, the building was re-christened 'Beckside' and converted by Richard Hall into holiday accommodation (*The Gazette*, 25 May 1935), a use it retains to the present day (Fig 7). It is a two-storeyed building, of simple rectangular plan measuring c 14m by 9m, built of stone under a double-pitched slate roof. In its present form it comprises four bays, but the fenestration in the north-east façade is without exception secondary. A door in the south-east gable at first-floor level and external stairs giving access to it are also modern, but the location of an original window opening, now blocked, is indicated by a lintel in the stonework above the door. A second blocked opening, much wider but again retaining its stone lintel, indicates that the original ground-floor access lay at the northern end of the north-east façade (Fig 65).

The Smithy (building 51)

According to the OS second edition map (Fig 4), in 1897 the works' smithy was then located at the divorced Cylinder Hill sub-site (at NY 32742 05241). It is not known when it was first built, but it seems to have existed by 1859 for a structure with the same outline appears on the OS first edition map although without any accompanying published description (Fig 3); the likelihood is that it was disused by 1926, for

*Figure 65.
The joiners'
shop and
boxmakers'
(building 17)
from the
north-east*



despite the building being depicted by both the 1926 and 1932 plans (Figs 5 and 6) it is unnamed (except by Mike Davies-Shiel). The location - well away and downwind of the main factory complex - had obviously been carefully chosen in order to minimise the risk of stray sparks setting off explosions in any of the process buildings within the main works, although it is perhaps strange that it appears to have remained in use after 1882 when the new magazine (building 35, section 5.2.3 above) was erected only 80m to the west. It has been numbered as building 51 on Figs 75-80 for the purposes of the present report.

At closure, this part of the factory was acquired by Harry Pierce who converted the smithy into a domestic dwelling (Burkett 1979; section 2 above). The building survives (Fig 7), although now derelict. It is built of stone beneath a double-pitched slate roof, with stable doors in the western gable. Modern breeze blocks indicate that elements of the eastern end have been altered and/or rebuilt.

The Sieve Depot and Sieves-Repairing House/Wire-Webbing Store (buildings 4a, 41 and 67)

Sieves played an important role in the manufacture of gunpowder, being used to separate grains into different size ranges and eliminate over- and under-sized particles. Sieve cloth was made from fine bronze, brass or copper wire, or for the finest meshes from silk (and later nylon) mono filament. They were comparatively fragile, and had to be carefully stored when not in use to prevent damage; metal sieves also had to be stored dry to prevent rust (Patterson 1995, 1-2). Their principal uses were in the preparing house to ensure the raw ingredients were sufficiently ground up, corning where the press cake was broken down into granules of different sizes, and in the dust house where under-sized particles were removed at the end of the manufacturing process.

The 1926 plan (Fig 5) states that building 4a, situated close to the beck (at NY 32652 04874) between the corning house and lower incorporating mills, was then in use as a sieve depot (it is mislabelled on the version of the plan published by Patterson

(1995, plan facing p20) as the 'sieve depot'). The building existed as early as 1859 (Fig 3), but other evidence suggests that it had been constructed originally as a charge house (section 5.2.3 above), and sieve storage was a secondary function. Indeed, the official report into the corning-house explosion of November 1878 mentions that another building standing adjacent to the corning-house wheel-pit (presumably the same as that depicted by the OS first edition map - labelled as building 67 on Figs 75-77 for the purposes of the present report) was then used to store spare sieves for the corning machines (Explosives Inspectorate 1878, 2). However, building 67 seems to have been replaced sometime after 1878 but before 1897 (Fig 4) by a new pump house providing hydraulic power to the press house (building 5a, section 5.2.1 above), and it may be that building 4a was converted into a replacement sieve depot at that time. The walls forming the south-eastern half of building 67 still survive to a height of *c* 2.3m (Fig 12). The platform for, and basal wall courses of, building 4a are also still recognisable (Fig 25).

The 1926 plan also identifies a wire-webbing store situated a bit further to the north (building 41 at NY 32667 04920). The 1932 plan (Fig 6) calls this building the sieves-repairing house (confusingly numbered building 7 on that plan), but it seems likely that the two names in fact describe the same function – a place where wire webbing (mesh material) was stored, and where sieves could be taken for repair. It was erected sometime between 1859 and 1897 (Figs 3 and 4), and seems to have survived the factory's closure for the OS depict a small building at this location as late as 1977 (Ordnance Survey 1978a). It has since been demolished, although the site is undeveloped open ground adjacent to the track leading to timeshare Lodges 17-20 (Fig 7).

Miscellaneous stores (buildings 3, 8, 12, 13, 18 and 25)

The 1926 and 1932 plans (Figs 5 and 6) both identify a variety of small store buildings scattered across the works. Several are only identified as general stores, but more specialist functions include the tool house, timber store, barrel stores, and paint and nail store. Few, however, are likely to have been constructed specifically for the purpose stated; many are probably redundant process or ancillary buildings put to secondary use. Building 3 situated close to the lower incorporating mills is one such example. Although identified on the 1926 plan as 'store – no risk goods' (because of its proximity to the mills), the evidence of the 1932 plan suggests it originated as a watch house (this section above). Likewise building 18 between the joiners' shop and saw mill, which the 1926 plan describes as 'store for timber', probably started life as a charge house (section 5.2.3 above). Both buildings have already been described in the sections dealing with their original functions, and will not be discussed further here. Building 13 (at NY 32632 05017) close to the southern edge of Hobson's Tarn also seems too large to have been constructed for the purpose ascribed to it in 1926 (barrel store), although in this case there is no documentary evidence to indicate its original use; it is described and discussed further in section 5.2.6 below.

Only buildings 8, 12 and 25 are likely to have been constructed specifically for storage. Building 8 lay immediately west of glazing house no. 3 (at NY 32638 04966). The 1926 plan identifies it as an 'empty barrel store', although on the 1932 plan (there confusingly labelled building 10) it is described as a 'wagon shed' - presumably referring to the small rail wagons or 'bogies' as they were more normally known (see section 5.2.7 below). It was constructed sometime between 1859 and 1897 (Figs 3 and 4), and disappeared before 1977 (Ordnance Survey 1978a); it measured only *c* 6m by 4m. Building 12 (at NY 32683 05022) is described by both the 1926

and 1932 plans as a general store (although again the 1932 plan confuses matters by labelling it as building 11). Map evidence shows that it was a simple rectangular structure measuring only *c* 6 - 7m square, and in existence by 1859 (Fig 3). Unfortunately, it is impossible at present to say anything more about it: it appears to have been demolished at or shortly after the factory's closure, and no photographs have so far been traced. Its site is now occupied by timeshare Lodges 1 and 2 (Fig 7). In 1926 building 25 (at NY 32528 05051) was in use as a paint and nail store, although the 1932 plan describes it simply as a 'tool house'. It was erected between 1859 and 1897, and from its size – no more than *c* 5m by 4m - is unlikely to have ever served any function but storage. It still survives (Fig 7), although heavily rebuilt and altered; it currently serves as the timeshare public laundry (Fig 66). A broken edge-runner (MS13) has been re-used in the foundations at the southern corner of the building.



*Figure 66.
The paint and
nail store
(building 25)
from the east*

The Cart House (buildings 68? and 37)

There were at least two cart houses at Elterwater. The 1926 plan (Fig 5) identifies the later cart house as building 37 lying towards the eastern edge of the works (at NY 32764 04970) by the side of the old valley road. This building existed by 1897 (Fig 4), but obviously could not have been constructed before the works expanded over the line of the old road in 1861 (section 4 above). In plan it measured some 8m by 12m, but nothing else is presently known of its construction; it was apparently still standing as late as 1977 (Ordnance Survey 1978a), but has since been demolished. The location of its predecessor is not known for certain, but Mike Davies-Shiel's comments on the 1932 plan (Fig 6) make clear that he thought building 37 replaced an earlier cart house comprising the eastern range of building 31 (numbered as building 68 on Figs 75-77 for the purposes of the present report); if so, once building 37 was erected, building 68 seems to have been incorporated into building 31 and become part of a store for, at different times, charcoal and wood (section 5.2.2 above). Certainly building 68, whose shell still survives as part of the modern Fellside hotel (Fig 7), is a likely candidate for the original cart house for the OS first edition map shows it was in existence as early as 1859 (Fig 3) and there is a (blocked) cart entrance in the southern gable (Fig 67). Interestingly, its plan dimensions are almost identical to those of building 37. According to Mike Davies-Shiel's annotations on the 1932 plan, the loft space above building 37 was used as a barrel-hoop store.

*Figure 67.
The blocked
entrance to the
original cart
house (building
68), later part of
the charcoal store
(building 31)*



Davies Shiel (Marshall and Davies-Shiel 1969, 79) and Tyler (2002, 175) both state that the horses to pull the carts were stabled in Elterwater village, in the building sited at NY 32854 04820 now called Rose-gate (Fig 7). This building has not been investigated for the present report.

The Fire-Engine House (building 28)

According to both the 1926 and the 1932 plans (Figs 5 and 6), the fire-engine house stood at the upper end of the works (at NY 32506 05097) in between the upper incorporating mills and first cartridge house. OS map evidence shows it was built between 1859 and 1897 (Figs 3 and 4), and was a small building measuring no more than 4 - 5m square, suggesting that the engine was pulled by hand rather than horse. Documentary references make clear that rather than just being on site in the event of explosions and fire, the engine was regularly used for washing out gunpowder residues from process buildings before maintenance work commenced (*eg* Explosives Inspectorate 1901). Indeed, since this was a legal requirement brought in by the 1875 Explosives Act (Explosives Inspectorate 1878, 2), it is possible that the engine was introduced at that time. The building seems to have been destroyed at or shortly following closure of the works, and its site now lies beneath the modern road running past timeshare Lodge 29 (Fig 7).

The Privies (buildings 29, 42, 43, 59?, 60?, 62?, 70?, 73? and 74?)

The 1926 plan (Fig 5) identifies three closets or privies at the works: buildings 29 and 42 at NY 32517 05112 and NY 32532 05133, both close to the new watch house/ charcoal store at the upper end of the site, and building 43 at NY 32693 05111 close to the packing house. The proximity of buildings 29 and 42 to each other suggests that one may have been for use by the general (male) workforce, the other by the women working in the nearby cartridge houses. Building 29 is the only one of the three structures to appear on the OS second edition map in 1897 (Fig 4), but this may

have more to do with the others being too small for the OS rules of depiction rather than it being the only toilet on site at that time. In contrast, two other buildings of similar dimensions are shown by that map behind the heading mill and outside the office (labelled buildings 73 and 74 on Figs 78-80 for the purposes of the present report); although not named by the map, they look as though they should be privies (see section 5.2.6 below).

Going back further in time, the OS first edition map surveyed in 1859 (Fig 3) depicts four small structures whose precise function is unknown (they had all disappeared or been replaced before the OS second edition map), but which may well be privies (labelled as buildings 59, 60, 62 and 70 on Figs 75-77 for the purposes of the present report). All are discussed in more detail in section 5.2.6 below.

Other privies undoubtedly existed at various times, perhaps attached to the outside of some of the process/ancillary buildings, as has been suggested, for example, in the case of the new lower watch house (building 2, this section above).

The Office and/or Manager's House (building 49)

The 1932 plan (Fig 6) identifies the works office as a roughly L-shaped building standing at the very south-east corner of the factory, fronting onto the small green in the centre of Elterwater village (at NY 32753 04804); the building is labelled 'A' on that plan, but is numbered 49 on Figs 75-

80 for the purposes of the present report. It measured a maximum of c 10m east-west by 12m north-south, and was stone-built of two storeys under a double-pitched slate roof. In all probability it was erected in the mid- to late 1850s, for OS map evidence depicts it as in existence by 1859 (Fig 3), and old photographs indicate it was adorned in the Tudor-Gothic style (Fig 68) popular in the third quarter of the 19th century (C Giles, pers comm). The degree of architectural pretension, however, suggests that it may have been designed as more than an office building, and perhaps originally functioned as combined offices and accommodation for the site manager. Tyler (2002, 175-6) states that another house in the village (that on land parcel no. 437 on Fig 4, situated at NY 32870 04784 and now called Meadow Bank) was the manager's house, but OS map evidence shows that Meadow Bank was not constructed until after 1859 (Fig 3). No investigation of Meadow Bank has been made for the present report. At closure, building 49 was converted by Richard Hall into holiday accommodation (Fig 69), a use which it still serves today (Fig 7); it has since been partly extended, and totally refurbished internally.



*Figure 68.
The works' office
(building 49) in the
1930s before
conversion to
holiday
accommodation.
(Barter collection,
copyright reserved)*



*Figure 69.
The works' office
in the 1930s
following
conversion
(Barter collection,
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5.2.6 Unidentified gunpowder buildings

Buildings 7, 71 and 72

In 1859 the OS first edition (Fig 3) shows a group of three buildings immediately to the left of where the words ‘Powder Mills’ appear on the map. These have been numbered as buildings 7, 71 and 72 on Figs 75 and 76 for the purposes of the present report. Buildings 71 and 72 had been demolished before 1878 to make way for the re-sited glazing house (building 9, section 5.2.3 above) and its associated tramway, but building 7 seems to have survived virtually unaltered until the works’ closure in 1930. The latter was then in use as the blacklead store serving the re-sited glazing house, and has already been described (section 5.2.2 above). No documentary evidence has yet been found to shed light on the functions of buildings 71 and 72.

The 1859 map depiction of this building group is difficult to interpret satisfactorily. At face value the map seems to show building 72 as almost completely enclosed by a wall, whilst another wall ran south from building 71 and dog-legged around the northern end of building 7. Field evidence would suggest, however, that the wall around building 72 was for the most part the (revetted) sides of a rock-cut platform excavated into the foot of the large hill/rock outcrop behind, while the remaining line detail between buildings 71 and 7 could well be a precursor to the massive blast wall which occupies this spot today (BW3, see under glazing house no. 4, section 5.2.3 above). If this suggestion is correct, it implies that buildings 7 and 72 were ‘danger’ buildings that required to be well shielded in case they or others nearby blew up. Danger buildings whose locations are uncertain in 1859 are the expense magazine, dust house and packing house. Comparison with the amount of blast protection and/or isolation provided for these buildings in the later period perhaps tips the balance in favour of building 72 being the packing house (compare building 40, section 5.2.3 above), while building 7 at this time may have been the expense magazine. No function can presently be suggested for building 71.

Building 11

The 1926 plan (Fig 5) identifies building 11 in the approximate centre of the site as the sulphur store. However, the evidence for the form and function of this building has already been reviewed (section 5.2.2 above), and an argument made that it is unlikely to have been built specifically for the use to which it was then being put. The evidence of the OS first edition map (Fig 3) shows it was in existence by 1859, while the presence of windows and a chimney stack points to it having originally served some domestic or administrative function, but it is unclear what this use was.

Buildings 13 and 63

In 1926, building 13 just south of Hobson’s Tarn (at NY 32632 05018) was used as a barrel store (Fig 5). However, as already noted (miscellaneous stores, section 5.2.5 above) the size and shape of the building seem somewhat excessive if this was its original function. OS map evidence shows it was erected between 1859 and 1897, but interestingly also indicates that it replaced a building of very similar plan depicted on the earlier map (compare Figs 3 and 4). In 1897, building 13 comprised a main rectangular range c 13m long by 7m, with a small central annexe against its western side (probably a covered loading bay since it fronted onto part of the internal road network), whilst a narrow corridor or covered walkway connected it to a smaller

building (measuring *c* 5m by 3m) immediately to the east which stood adjacent to the tramway link to the stove house; the corridor is omitted from the 1926 plan, but since it re-appears on the 1932 plan (Fig 6), it is unclear if it had actually been demolished by 1926 or was simply not depicted. The earlier building shown in 1859 (numbered 63 on Figs 75 and 76 for the purposes of the present report) is remarkably similar in plan, only the main range was then narrower and had a larger loading-bay area, while the smaller eastern building is orientated east-west rather than north-south and is unattached to the main range. This similarity in size and general layout suggests very strongly that building 13 was a straightforward replacement for building 63, and that both served the same role. Although there is at present no documentary evidence for what this role was, and the form of the buildings themselves does not offer any obvious clue, it is tempting to speculate that they might have been constructed as dust houses. One possible objection to such an interpretation is that the later dust house at Elterwater accommodated large separators which were mechanically driven (building 32, section 5.2.3 above), whereas these two buildings are remote from any source of mechanical power (at this early period, we should presumably be thinking of water power). However, evidence from the New Sedgwick blackpowder works raises the possibility that in the earlier period, machines were smaller and could be agitated by hand-cranks (Dunn *et al*, in prep).

There is now no trace of building 13, whose site lies partly beneath timeshare Lodge 8 and partly on open ground to the north (Fig 7). The probability is that it became derelict after closure of the works in 1930, and gradually fell into disrepair for a photograph taken in the 1960s (Fig 55) shows the small eastern building re-roofed but still extant and the walls of the eastern half of the main range standing *c* 2m high; the structures survived in this state until at least 1977 (Ordnance Survey 1978b), but have since been demolished.

Building 27

The 1926 plan (Fig 5) labels building 27 above the beck at the upper end of the works as a cartridge house. However, the building's form and history has already been reviewed and the point made that its date of construction is earlier than that of the introduction of cartridge pressing to the works (section 5.2.4 above). The possibility has also been put forward that it was originally built as the sulphur store (section 5.2.2 above), but there is presently no evidence to confirm or disprove this suggestion.

Building 52

Both the OS second edition map and the 1926 plan (Figs 4 and 5) depict a small building situated just north of the later charcoal store (building 21, section 5.2.2 above) in the approximate centre of the works (at NY 32588 05055). Although seemingly not numbered or identified by the 1926 plan, its close proximity to building 21 raises the possibility that the number 21 in the body of that plan is meant to apply to both structures, but this is not supported by the key which names the charcoal store in the singular. The building has been numbered 52 on Figs 78-80 for the purposes of the present report.

The building still stands (Fig 7). As it survives today it measures 3.8m by 2.9m, and is of stone construction apart from the south side which is weather-boarded, all beneath a slate roof which has been extended to the east over a paved outdoor barbecue area for the country club (Fig 70). There are no clues as to its original function, but

*Figure 70.
Small gunpowder
building of
unknown function
(building 52),
viewed from the
south-east*



the different walling material in the south side suggests it was formerly open-fronted and therefore unlikely to have been a charcoal store. Photographs taken in the 1960s show that its south side was weather-boarded even then (*eg* Figs 54 and 55). Two small openings, now blocked, one at either end of the base of the north wall, are of unknown function.

Buildings 59 and 60

The OS first edition map (Fig 3) depicts two very small structures situated between the main leat and building 30 at the upper end of the works. Building 59 at NY 32518 05112 is only *c* 4m by 2m in plan, building 60 at NY 32521 05115 half that length. Both had disappeared by the time of the OS second edition map (Fig 4), although building 59 had been replaced by, or rebuilt as, building 29 (identified as an earth closet in 1926, section 5.2.5 above). Although strictly of unknown function, the probability must be that buildings 59 and 60 were also privies.

Buildings 61 and 62

In 1859, the OS first edition map (Fig 3) depicts a couple of buildings standing immediately west of Hobson's Tarn (numbered 61 and 62 on Figs 75-77 for the purposes of the present report). Building 62 right on the edge of the tarn (at NY 32635 05062) was very small (*c* 4m by 2m), but building 61 situated a few metres to the west (at NY 32620 05058) consisted of a rectangular range measuring *c* 11m by 8m with small annexes in the middle of both long sides; that on the south fronted onto one of the internal roads, and must have been a covered loading bay. Although there is no documented function for either building (both had disappeared before the earliest site plans), the isolation and proximity to water of building 61, and the fact that its site was re-used in 1881 for the new stove house (building 14, section 5.2.3 above), points strongly to it also having been a stove house. Since this earlier building was reportedly heated by a gloom stove (Marshall and Davies-Shiel 1969, 84), the small

annexe on the northern wall is likely to have been the chimney for the fire. Building 62 may have been no more than a privy, or a store for wood or coal.

Buildings 64 and 67

Between 1840 and 1878, the corning houses and glazing houses occupied either end of the same building range by the beck (section 5.2.3 above; buildings 65 and 66 on Figs 75-77). However, the OS first edition map depiction of this building in 1859 (Fig 3) portrays two smaller structures at either end of the principal range (numbered 64 and 67 on Figs 75-77). There is no recorded function for building 64 at the northern end of the range, but it has already been suggested that its proximity to the glazing house makes it the most likely candidate for the blacklead store at this time, although if so it was probably disused by 1878 (section 5.2.2 above). In 1878, building 67 opposite the corning house at the south end of the range is referred to as a sieve depot (section 5.2.5 above), but the reference indicates that it had not always been used as such. Its original use is unknown, but was possibly one that required power for it stood adjacent to the corning/glazing-house wheel-pit. It apparently had two floors, for its walls were still mostly standing as late as 1977 (Ordnance Survey 1978a), and a photograph dating to the 1960s shows two door openings at ground-floor level in the south-west wall (Fig 71). The south-west wall has since been mostly demolished; the south-east gable wall has also been lowered, but still stands *c* 2.3m high (Fig 12).



*Figure 71.
The south-east
gable and south-
west
wall of
building 67,
photographed in the
1960s.
(Barter collection,
copyright reserved)*

Building 69

In 1859, the OS first edition map (Fig 3) shows a small building measuring *c* 9m by 4m attached to the northern end of the preparing and mixing house (building 20, section 5.2.3 above). It is numbered 69 on Figs 75 and 76 for the purposes of the present report. Its function is unknown - it had been demolished and/or absorbed into an extended preparing house by 1897 (Fig 4) - but one suggestion already made is that it was the original watch and change house for the upper incorporating mills, which is otherwise unlocated (section 5.2.5 above). Certainly it was the closest building to the upper mills at this time.

Building 70

The OS first edition map (Fig 3) shows that in 1859 a very small building (labelled as building 70 on Figs 75-77 for the purposes of the present report) stood immediately north of the Joiners' Shop (building 17, section 5.2.5 above). The structure was only *c* 2m square, and had disappeared by 1897 (Fig 4). Its function is not recorded, but the small size and position right next to the beck both point to it being a privy.

Buildings 73 and 74

Two more structures of almost identical size to building 70 are depicted on the OS second edition map (Fig 4) in 1897, at NY 32721 04795 and NY 32739 04815; the former (labelled building 73 on Figs 78-80 for the purposes of the present report) stood behind the heading mill (building 47, section 5.2.3 above), the latter (building 74) in the 'garden' to the site office (building 48, section 5.2.5 above). Although there is no documentary evidence for their functions, both are most likely to have been privies. Building 73 is shown as still extant on the 1926 plan (Fig 5), although its function is not stated; it had disappeared before 1977 (Ordnance Survey 1978a). Building 74 had apparently already disappeared by 1926.

Building 75

In 1897, the OS second edition map (Fig 4) depicts a small building at NY 32743 04792 between the heading mill (building 47, section 5.2.3 above) and cottages 53 and 54 which front onto the road to Elterwater Bridge. The map shows the building measured only *c* 2m by 4m, but also portrays an even smaller, unroofed, feature immediately to the north. There is no published description of the map detail, but the location just inside one of the works' entrances, and analogy with evidence from New Sedgwick (Dunn *et al*, in prep), raises the possibility that the two features together represent a weighbridge-keeper's hut and weighbridge, for verifying the weight of deliveries received by the factory, and checking those of gunpowder carts leaving for Windermere station. Neither feature appears on either the 1926 or 1932 plans (Figs 5 and 6), and had presumably disappeared by that time.

5.2.7 Transport

To and from site

The remote location of the Elterwater works away from both the national canal, and later rail, networks meant that it was always at a disadvantage in terms of communication links compared to its immediate competitors (Fig 1). Some account of the transport of goods and raw materials to and from the works has already been given (section 4 above), but to recap, before 1846 all goods arrived at or departed from the works by a combination of water and road transport. Supplies of saltpetre and sulphur imported through London or Liverpool were shipped north in coastal trading vessels as far as the port of Greenodd at the mouth of the River Leven, where they were transferred onto river barges to continue up river to Pull Wyke staithe at the north-western corner of Windermere; the final few miles of the journey were completed by horse and cart. Apart from local orders, many deliveries of gunpowder were despatched through Liverpool, and therefore travelled the same route in reverse. However, in 1846 the railway reached Windermere, and thereafter rail largely

replaced the inland leg of the journey. Horse-drawn carts now linked the works with Windermere Station, and occasionally after 1860 with Coniston Station as well.

According to Tyler (2002, 178), the carters had to obey strict rules, principally governing how much gunpowder could be carried on any cart (15cwts), and what time interval had to be left between vehicles (20 minutes). In addition there existed a powder magazine and stables at Halfway House below Eller Brow on the old Skelwith Bridge to Ambleside road (Fig 2), where some of the load had to be taken off in order to allow the horses to manage the steep incline (Tyler 2002, 174). In the 20th century the carts were supplemented by specially adapted motor vans (Tyler 2002, 193): the vans covered the stretch between Windermere Station and Halfway House, the carts the remaining distance to and from the works.

Powder magazines would undoubtedly also have existed at the two railheads, and in the earlier period at the ports of Greenodd and Liverpool too, but no investigation of the archaeology of gunpowder distribution has been made for the present report.

Around site

When the works first opened in 1825, powder in the course of manufacture would have been conveyed between the various process buildings by wheelbarrow and handcart, all of which had brass wheels to avoid the risk of sparks. As the works expanded and the distances between buildings increased, horse-drawn carts may have performed some of the journeys; if so, the horses would also have been soft-shod with brass. But it seems that no special care was taken in the make-up of the internal road network until c 1867 by which time according to Tyler (2002, 176) the roads were edged and were being swept daily in an attempt to prevent grit from entering the process buildings.

At some point in the second half of the 19th century, a narrow-gauge tramway system was constructed inside the works. This eventually connected all parts of the factory, with the exception of the incorporating mills and those buildings receiving raw materials and despatching finished goods, all of which came in and went out by road. The tramcars – referred to as bogies - had brass wheels and were pushed by hand; the rails were also coated in zinc to prevent sparking. The system existed by 1897 for it is depicted on the OS second edition map (Fig 4); Tyler (2002, 176) dates its introduction to c 1867. It seems reasonable to assume that the system shown in 1897 was not installed in one go, but expanded over time as buildings changed location or new ones were added; certainly the branch line serving the two cartridge houses at the western, upper end of the site, is unlikely to have been built before cartridge manufacture commenced in 1878. The system does seem to have been fully developed by 1897, however. (The depiction on the 1932 plan differs slightly from that of the 1926 plan and OS second edition map, but it is unclear if this represents alterations actually made on the ground or errors on the later plan). The 1932 plan also describes one building as a wagon shed, presumably referring to tramway bogies rather than horse-drawn carts (see miscellaneous stores, building 8, section 5.2.5 above). But this is the only authority for such a building at the works and may well be in error; bogies may have needed a specialist repair shop, but it seems more likely that empty bogies would simply have been housed within or outside the various process buildings until needed.

Part of the course of the tramway can still be traced immediately west of Hobson's Tarn, where a number of small cuttings and a degraded terraced embankment survive (Fig 7) beneath grass and scrub vegetation, but otherwise all traces have disappeared.

5.2.8 Other gunpowder-related features

Blast walls

Ten blast banks or walls (BW1-BW10) have been identified at Elterwater, either still surviving as field monuments or else recorded on maps and old photographs. Their positions are shown on Figs 7 and 74-80. All are closely associated with a particular building and have consequently been described with the relevant process house. In addition, certain buildings such as the saltpetre store and the two magazines were sited in order to take advantage of blast protection provided by naturally-occurring rock outcrops (see buildings 26, 35 and 36, sections 5.2.2 and 5.2.3 above).

Proofing Range



Figure 72.
The mortar ball
and carrying
callipers used for
test firings on the
proofing range

The Company tested its gunpowder in a field called Lane Ends by the river south-east of the works (Marshall and Davies-Shiel 1969, 79, 82 and 85; Tyler 2002, 174), using an old 8-inch mortar of Napoleonic vintage (Crocker 1988, 38). Until *c* 20 years ago, the mortar survived *in situ* in the field, mounted on a broken millstone originating from one of the incorporating mills (Mike Davies-Shiel, pers comm), but it is now housed within Langdale Leisure's restaurant. The mortar fired a 68lb iron ball, which if the batch of gunpowder was up to scratch was propelled 350yds (319m); this ball together with the callipers for collecting it after firing (repeated firings caused the ball to become hot) survive locally in private possession (Fig 72).

The Dog Kennels (building 38)

The 1926 plan (Fig 5) identifies building 38, close to the eastern edge of the works (at NY 32864 04998), as a set of dog kennels. The 1932 plan (Fig 6) describes building 38 as simply 'old building', although Mike Davies-Shiel has annotated the key with 'Watch Dog Kennels.' According to Tyler (2002, 182) the kennels were actually for the Company's own pack of hunting hounds. Map evidence shows they were built between 1859 and 1897 (Figs 3 and 4); they still survive (Fig 7), although recently (summer 2001) converted into a children's adventure playground. They consist of a long narrow stone range subdivided into three cells, fronted by an exercise yard to the south-west.

The Mechanics Institute

The 1926 plan (Fig 5) labels a building immediately west of the upper weir as the 'Institute' (at NY 32371 05212). This is in fact the home of the Mechanics Club or

Institute, founded by the Company in 1871 to promote education and learning amongst its workforce, although the institute did not move into this building until 1889 (section 4 above). The building still survives, although no investigation of it has been made for the present report.

Revetment along river frontage

The left (north-east) bank of the beck seems originally to have been revetted in stone to protect the buildings sited along it from being undermined and damaged. The need for such protection was demonstrated at least once when in November 1898 the water rose to such a level that it swamped and badly damaged the press house and some of the lower incorporating mills (Tyler 2002, 180). Much of this revetment still survives.

6. DISCUSSION AND CONCLUSIONS

Whereas previous commentators (particularly Patterson 1995) have tended to treat the Elterwater gunpowder factory as if it were unchanging and fully developed right from the outset, the present study has combined archaeological and documentary evidence to show how between 1824 and 1930 the works evolved from an initial small core area of *c* 2 acres (0.82ha) centred around early corn and fulling mills, to cover eventually an area in excess of ten times that size. In addition, it has identified a recurrent theme – unsurprising when pointed out, but which nonetheless has previously not been said – that many of the factory buildings moved location and/or changed their function during those 106 years. This seems mostly to have been the result of changes or additions to one part of the site having knock-on effects elsewhere, either for reasons of logistics or safe-operation. However, it does mean that without documentary evidence, it can be difficult to be sure what role particular buildings had at any one time. This is obviously truest for the earlier periods: although the OS first and second map editions provide us with snapshots of the factory layout as at 1859 and 1897, they contain little or no information on the function of individual buildings. The earliest surviving site plan is not until 1926, only four years prior to closure, and the present report has had to combine the data on that plan with information from a variety of other documentary sources to suggest identifications for the buildings shown by the earlier maps. Undoubtedly, mistakes will have been made in this, but it is felt that it has been a worthwhile exercise since at least it raises questions for future research. Mike Davies-Shiel, who has conducted a thorough search of, for example, local newspaper reports, may well have some of the answers already.

The general phasing of the site has already been outlined in the preceding discussions of the documentary evidence (section 4) and the general feature catalogue (section 5). What follows is offered as a general commentary to try and pull some of the main threads together, and to provide an overall historical perspective of the site's development.

6.1 The pre-gunpowder landscape (Fig 73)

By 1812 David Huddleston had risen from humble clerk to a senior position in Kendal banking circles. In January 1823, at the age of 55, he retired – apparently on account of deteriorating health – and moved to Elterwater. He himself later wrote in a letter to friends that he had rapidly tired of his new-found leisure, and thought of the idea of starting a gunpowder works (a business he would have known had the potential to make money from his banking days) purely as a means of keeping himself occupied. Taken at face value such a decision seems bold, even rash, but he already possessed the knowledge to construct and operate a gunpowder business for in 1811 a grateful customer had rewarded him with a 'little brown book' containing all the necessary blueprints and instructions (Wilson 1964, 59; Tyler 2002, 160; Mike Davies-Shiel, *in litt*). Although the identity of the author of this brown book is not known, logically it can only have been John Wakefield I, the founder of the Old Sedgwick gunpowder works, who had close Kendal connections. Wakefield died in 1811, and it may well be that the book was a deathbed-gift to a business associate and friend.

EH has unearthed new information, however, which paints a somewhat different picture of Huddleston's motivations in establishing his works at Elterwater. Rather than having had the idea of setting up the enterprise merely to give himself something to do in retirement, it seems more likely that Huddleston had perceived a

business opportunity whilst still at Kendal, and that ‘retirement’ was the excuse for turning that opportunity into reality. The evidence for this comes mainly from new light on the timetable and pattern of his acquisition of property at Elterwater shed by the deeds in the Barter collection. These show us that Huddleston was a devisee of the estate of his late father-in-law, John Coward, and together with his brother-in-law, John Robinson, already held the old corn mill at Elterwater in trust before moving to the village (although full legal freehold title was not confirmed until July 1824). On 13 February 1823, however, only a month into so-called retirement, he bought the neighbouring fulling mill, and by December of that year had by a systematic and planned programme of benefactions to the township also gained outline consent to enclose part of the adjoining common of Walthwaite Wood (section 4 above). By the end of 1823, therefore, Huddleston could already be reasonably confident that he possessed sole rights to the existing weir and watermills at Elterwater (access to waterpower was a *sine qua non* in gunpowder manufacture), and had begun to lay the groundwork for the acquisition of extra land over which the factory, if a success, could in due course expand. He may also have reasoned that without this extra space, his chances of being granted the necessary licence to operate the works, as required by the 1772 Gunpowder Act, were almost nil.

Previous researchers have known of the existence of both corn and woollen mills at Elterwater, but have tended to assume that they were one and the same building used for different purposes at different times (eg Mike Davies-Shiel, *in litt*). The Barter deeds make clear, however, that they were separate buildings sharing the same weir and watercourses. The fulling mill was later, and lay west of the corn mill. Since the latter still survives (building 47), it is likely that the fulling mill stood immediately east of the mill pond, most probably on what was to become the site of the first incorporating mill (Fig 73).

6.2 The early years of the Elterwater Gunpowder Company: c 1824-9 (Fig 74)

Huddleston applied for and was granted the operating licence for his gunpowder works on 16 January 1824. Since there were still uncertainties over his and John Robinson’s legal title to the corn mill which were not finally resolved until July of that year, it is possible that construction work on the new factory was delayed for six months. By this time Huddleston had also received confirmation from the Lord of the Manor of the commoners’ permission to enclose part of Walthwaite Wood, but because of the need to site many of the process buildings near to a source of waterpower it is likely that the factory was initially developed wholly on the land which Huddleston acquired with the two existing mills. In fact, Huddleston may well have demolished the existing fulling mill and re-used its site for his initial incorporating mill (section 6.1 above), as has been suggested by Tyler (2002, 161), although the latter erroneously refers to the earlier building as a bark mill. The Barter deeds do not provide sufficient information positively to identify the boundaries of the land which came to Huddleston with the two mills, but Mike Davies-Shiel has information, *via* Sheila MacPherson, that the limits (equating to an area of c 2 acres or 0.82ha) are as shown on Fig 73. The area is extremely plausible, for in 1859 according to the OS first edition map (Fig 3) the works then covered 15.1 acres (6.1ha); subtracting 2 acres from this figure leaves 13.1 acres, not very different to the $13\frac{3}{8}$ acres recorded in the 1827 covenant as the area of Walthwaite Wood taken by the gunpowder works (section 4 above).

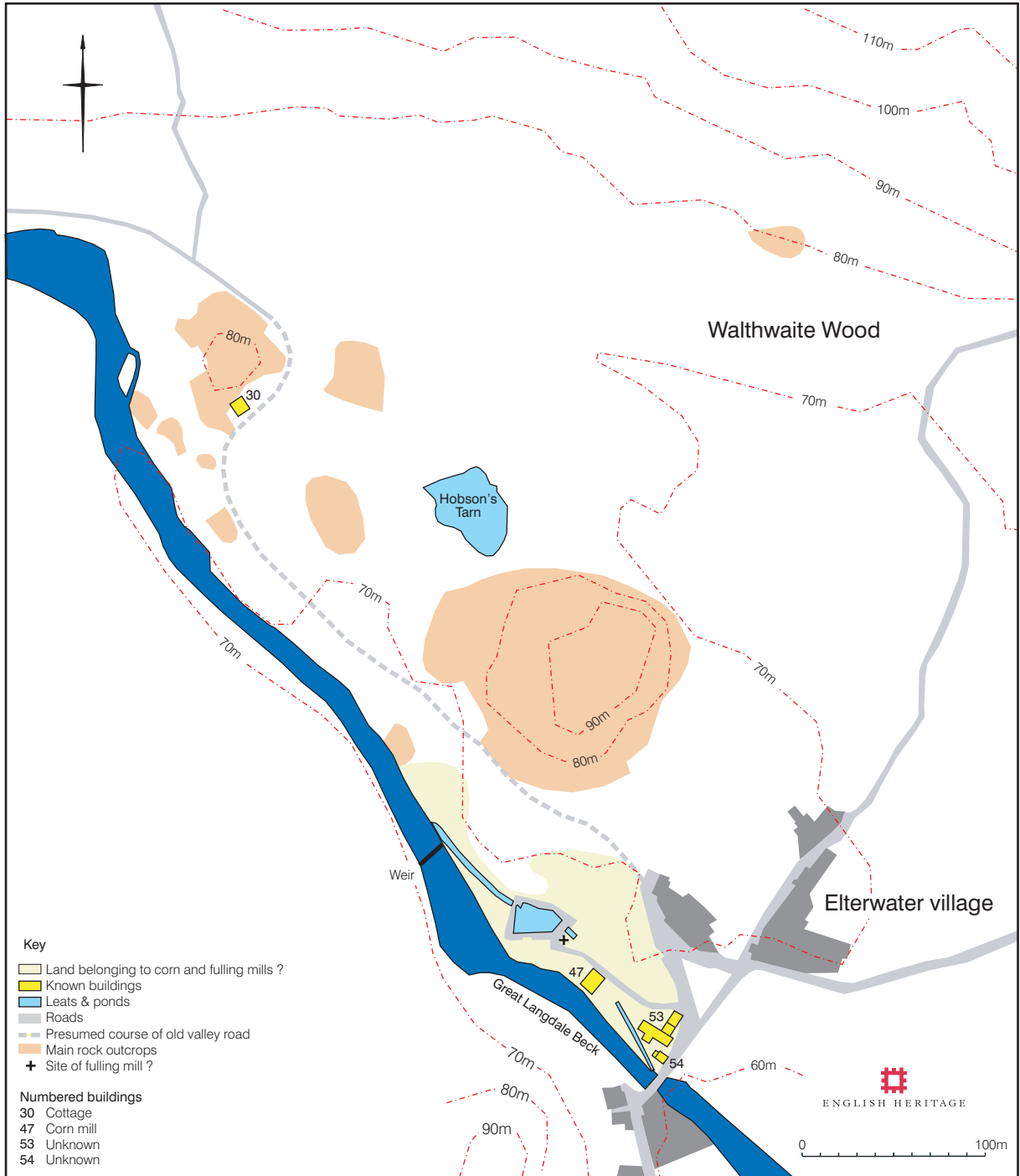


Figure 73.
Plan of the pre-gunpowder landscape

Newspaper sources (section 4 above) tell us that when the factory opened for business at the end of 1825, the old corn mill had been converted to serve as offices, a change house, saw mill and packing house, whilst somewhere on site there also existed a corning house, glazing house, watchman's house and magazine. The positions of these last four buildings are not recorded, although the present report has argued (section 5.2.3 above) that the first two would have had to have been situated somewhere adjacent to the races to the lower mill pond since these processes required mechanical power over a prolonged period that could not realistically be supplied by hand. There must also have been various store buildings, a refinery, preparing house, stove house and dust house on site at this time (although their presence is unmentioned in contemporary documents); of these the preparing house must also have lain close to the existing mill pond or its races in order to be supplied with power. It is possible that buildings 53 and 54 which fronted onto the road to Elterwater Bridge (presumably originally cottages or outbuildings which came to Huddleston as part of his acquisition of the early corn and fulling mills) were put to use serving some of these functions; other structures may have stood on the sites later occupied by buildings 48 and 49 (compare Fig 75). Strangely, there was no press house at the works until 1829. Although this presumably meant that the initial product was in some way of inferior quality (pressing apparently reduced the strength of blackpowder but improved its keeping quality (Curtis 1996, 253-4)), it was obviously good enough for Huddleston to win sufficient orders to justify increasing the works' productive capacity: a second incorporating mill was up and running by the end of 1826 (mill 2, section 5.2.3 above), and two more (mills 3 and 4) by 1829. It is unclear whether Huddleston's local competition – the Old Sedgwick and Lowwood gunpowder works – pressed their powder prior to corning it at this time anyway. Indeed to the contrary there is currently no definite evidence for the existence of a dedicated press house at Old Sedgwick prior to that factory's closure in 1852, although pressing may have been carried on there in the corning house (Jecock and Dunn 2002, 24 and 41).

It has already been suggested (section 6.1 above) that the 'little brown book' containing the blueprints and instructions which Huddleston followed to build and operate his works, came to him from John Wakefield, the founder and owner of Old Sedgwick. However, if so, the question arises as to why the design of the incorporating mills at Elterwater is so very different from those operated by Wakefield at Old Sedgwick's Basingill outstation. (Wakefield built the Basingill mills 0.5km downstream from Old Sedgwick because there was insufficient room to accommodate extra incorporating capacity at the main site when he wanted to expand production). The present survey has suggested that the Elterwater mills were all over-driven until at least 1878, when four of the twelve then existing were converted to being under-driven (section 5.2.3 above). Recent investigation by EH of the Basingill mills, however, suggests that those were all of a fundamentally different design and were under-driven right from the outset (Hunt and Goodall 2002). Basingill began operating in 1790, and therefore one might expect that the mill designs passed to Huddleston in 1811 would be based on prototypes there. However, there was also a pair of mills at the main Old Sedgwick site, which had been in operation since that works opened in 1768. Almost nothing is known of the form of these mills, which no longer survive above ground (Jecock and Dunn 2002, 24), but it is quite possible that their design was different to those which Wakefield subsequently built at Basingill, by which time he had accumulated in excess of 20 years' experience of what structures worked well and what did not. It may be, therefore, that the design of mill passed to Huddleston represented the design of the initial pair erected at Old Sedgwick, rather than the later examples at Basingill. The idea need not be explored in more detail here, but if correct, one of its

ramifications is the possibility that the 'little brown book' which Huddleston acquired in 1811 actually represents Wakefield's original blueprint for Old Sedgwick.

By 1829, therefore, the Elterwater factory seems to have contained the full range of buildings expected of a gunpowder works of the period; it had also increased its productive capacity from one to four incorporating mills. Many of these buildings are unlocated, but most if not all must have been sited around the existing mill pond and leat system, with little or no expansion onto the additional $13\frac{3}{8}$ acres of the common of Walthwaite Wood acquired by Huddleston in 1823/4. (One possible exception to this is the new magazine documented as under construction in 1827, which Tyler has equated with building 36 situated on the northern edge of the additional area (section 5.2.3 above)). Indeed, there would have been little point in siting process buildings requiring mechanical power in this area until the necessary infrastructure - namely the construction of a new weir and leat system - had been installed. The fact that incorporating mills 3 and 4 brought on line in 1829 were sited around the existing mill pond, is evidence that this infrastructure had not yet been built. The corollary of this, however, is that the various process buildings at this time are likely to have been situated rather close to each other, probably closer than was later deemed desirable from the point of view of safety.

6.3 Expansion onto Walthwaite Wood: c 1830-60 (Fig 75)

Although there is no firm evidence for when the factory expanded onto Walthwaite Wood, this report has argued (section 4 above) that the most likely timeframe for the construction of the upper weir and main leat leading from it is sometime between 1829 and 1837: in 1829, new incorporating capacity was still being installed at the old (lower) mill pond, whereas by 1837 the Company had built a new dam at Stickle Tarn to raise the level of the lake and turn it into a holding reservoir to regulate the flow of water in the Great Langdale Beck, suggesting the need for an enhanced water supply to the works. According to Tyler (2002, 165), this period of expansion can be narrowed down to between 1834 and 1837, and was carried out under John Robinson who assumed control of the Company following Huddleston's death in October 1831. Thus, it is likely that many of the buildings which the OS first edition map (Fig 3) shows existed at the works by 1859 (on which Fig 75 is largely based) were constructed between these two dates.

As well as increasing production, expansion onto Walthwaite Wood provided the opportunity to re-organise the factory spatially, in order to lay it out better with regard to both logistics and matters of safety. All activities to do with storage and refining of the three raw ingredients of gunpowder (section 5.2.2 above) were totally removed to the upper end of the enlarged works, where a new entrance seems to have been made so that materials could be brought in by horse and cart without having to pass through the rest of the factory. Expansion also most probably coincided with the Company changing from reliance on charcoal bought from local suppliers to manufacture of its own at the Cylinder Hill sub-site (buildings 50, 55 and 57-8, section 5.2.2 above), again conveniently situated for easy access down to the new relocated charcoal store (building 31) at the upper end of the main site. Buildings associated with the initial stages of gunpowder manufacture were re-sited to the same area: a new preparing and mixing house (building 20, section 5.2.3 above) was erected adjacent to the leat and extra incorporating capacity (mills 9-12, section 5.2.3 above) built nearby. The earlier mills around the lower mill pond were retained, but this must have been solely on account of the investment already made in them and because the waterpower available here was too valuable not to be utilised.

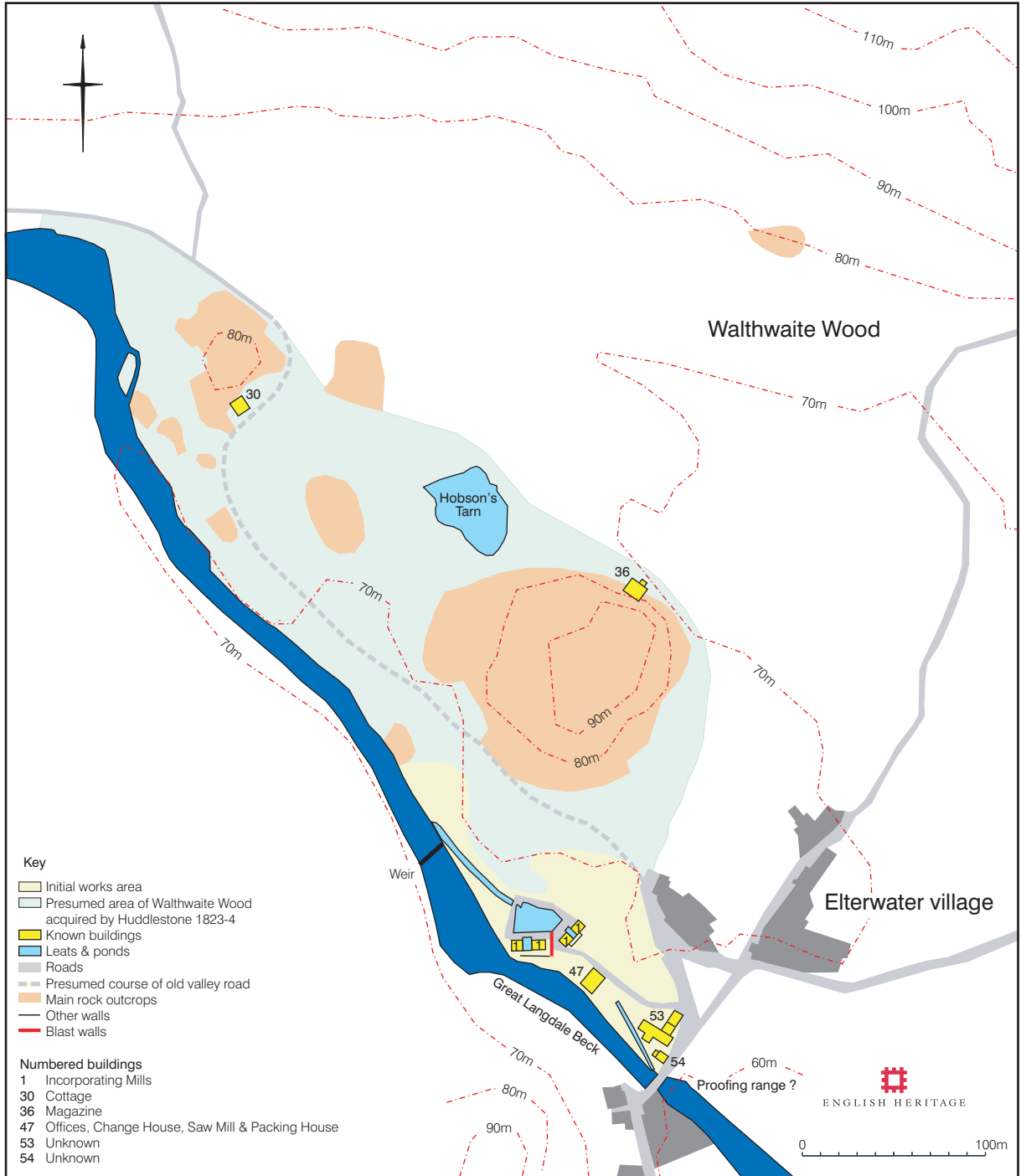


Figure 74.
Plan of the works, c 1824-9

Other process buildings, however, seem to have been progressively removed away from both the village and the two sets of mills, and concentrated in the area in between where rock outcrops provided a degree of natural blast protection. This probably did not happen all at once because of the capital investment tied up in the existing building stock. However, the original press, corning and glazing houses were all destroyed in a massive explosion in January 1840, and were presumably thereafter re-built at the new locations shown on Fig 75 (their earlier sites are unknown). The positions of the remaining danger buildings - namely the expense magazine, stove house, dust house and packing house - are not recorded at this time, but the present report has suggested that they, too, were most likely removed to this central area before 1859 (likely candidates are buildings 7, 61, 63, 71 and 72, section 5.2.6 above). With the erection of new purpose-built premises for both the lower watch and change house and the saw mill (buildings 3 and 19, section 5.2.5 above) - and presumably also the packing house - the old corn mill (building 47) was apparently left to function as the works office although documentary evidence suggests that it became for a time the cooperage before this function passed in turn to a new building (building 48, section 5.2.5 above). A purpose-built works office (building 49, section 5.2.5 above) was seemingly not erected until the 1850s, at which time the old mill may have been relegated to no more than a hoop loft for the nearby cooperage.

The OS map shows a number of other buildings existed by 1859 whose functions are unknown, including buildings 11 and 12. Various suggestions for their roles might be proffered, including the counting house mentioned in 1840 (*Westmorland Gazette*, 1 February 1840), or a laboratory (no documentary reference has been found to the existence of a laboratory at Elterwater, although examples are known from New Sedgwick and Blackbeck (Dunn *et al* in prep; Patterson 1995, plan facing p38)). However, both these suggested functions are more likely to have been located in the original core area of the works around the lower mill pond - in the case of the former because this was where the office/administrative centre was situated, in the case of the latter because this would place it near the proofing range where each batch of powder coming off the production line was tested.

6.4 Further expansion: c 1861-5 (Fig 76)

In real terms there is probably very little to distinguish the years 1861 to 1865 from the previous 30. However, EH has found evidence that in 1861 the Company purchased an additional area of Walthwaite Wood (section 4 above). The exact stimulus for the purchase is not clear: it had the immediate effect of removing the existing magazine (building 36) well away from the public road, but also provided the Company with extra land which they could begin to develop. Eventually, both the dust house and packing house would be re-sited here (compare Figs 77 and 78), but there is no evidence that this happened straight away; indeed it seems improbable that the dust house was relocated before turbine power was introduced with the advent of cartridge manufacture in 1878. It is more likely that the first buildings to be erected on this new land were the sawpit (building 33, section 5.2.5 above), and perhaps the kennels for the Company's hunting pack (building 38, section 5.2.8 above). The reasons for dating the sawpit this early are chiefly its situation adjacent to the entrance to the works directly opposite the road down from Cylinder Hill, and the fact that since all sawing was undertaken manually the building's siting was not reliant on the prior provision of a source of mechanical power. Its situation in relation to Cylinder Hill suggests that the Company may have begun harvesting standard trees - perhaps for structural repairs - from the surrounding hillside (the

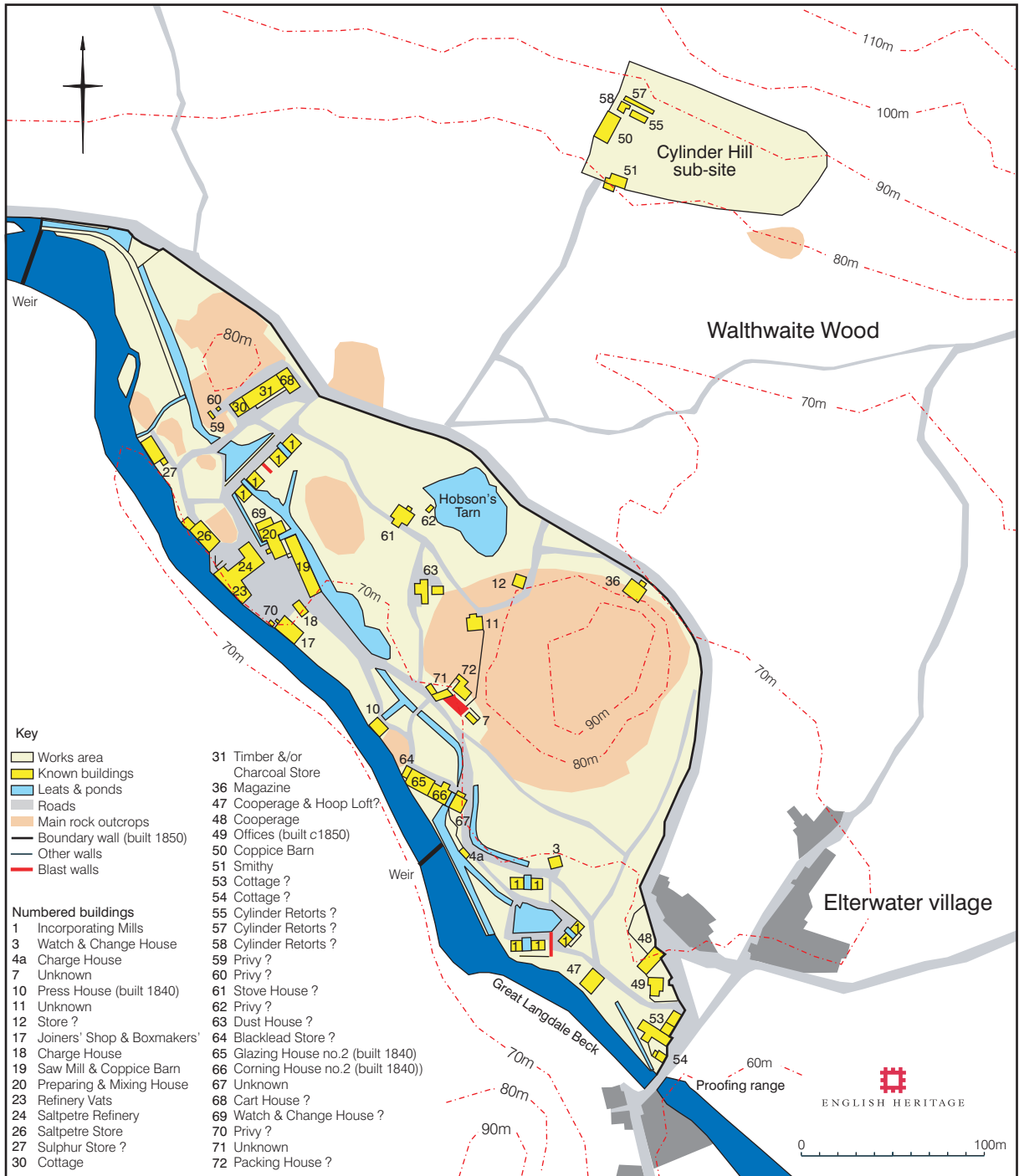
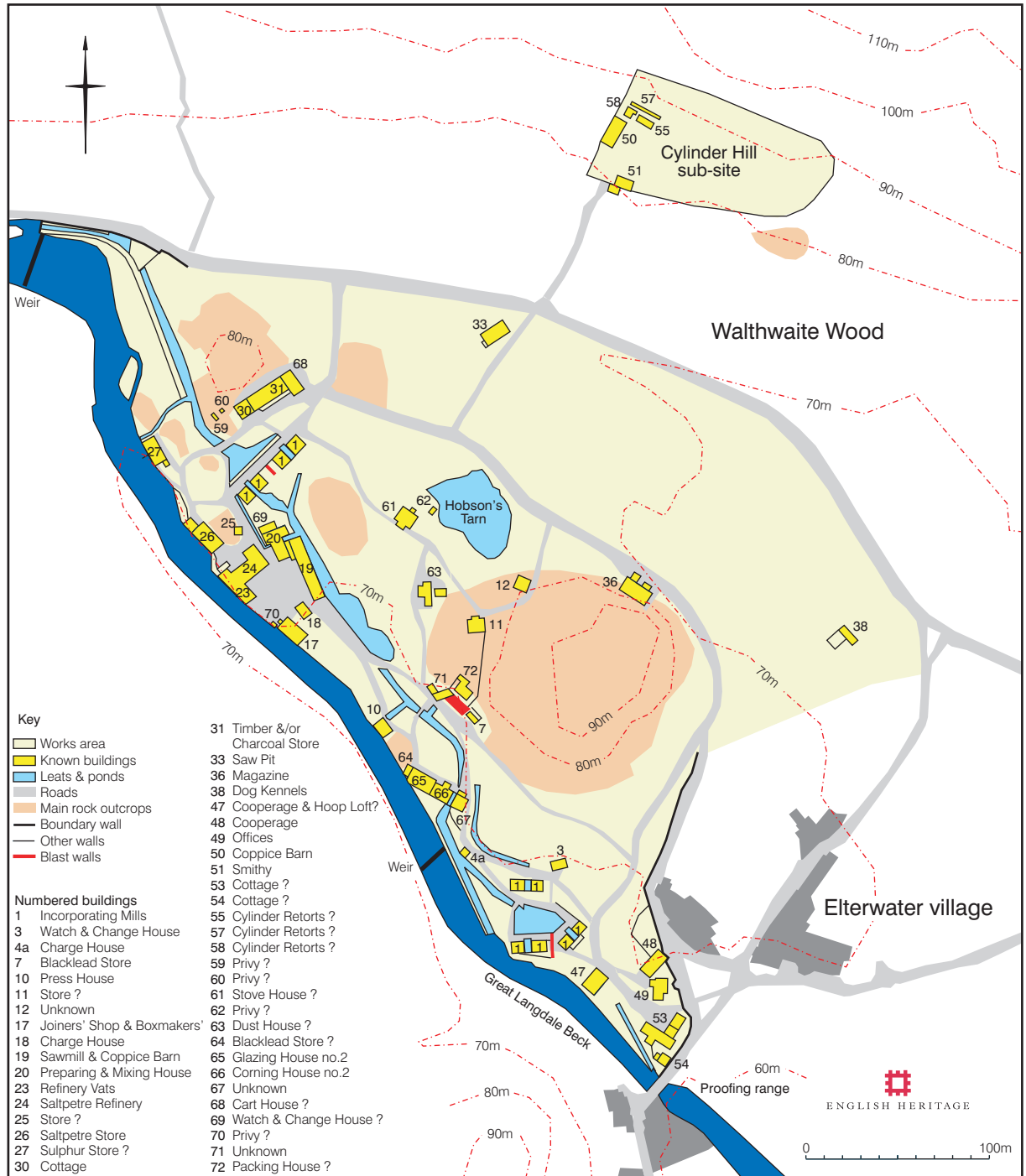


Figure 75.
Plan of the works, c 1830-60



area was certainly heavily wooded in 1897 – see Fig 4), rather than buying in timber from elsewhere, but at present this can be no more than a suggestion.

6.5 Limited company status and fresh capital: c 1866-78 (Fig 77)

In 1866 the Company adopted limited liability status in order to raise fresh capital for investment (section 4 above). The immediate results seem to have been improvements to the network of roads around the factory and the installation of a narrow-gauge tramway system linking the process buildings, both of which developments Tyler dates to c 1867 (section 5.2.7 above). Although not documented anywhere, the present report has argued that these events were probably the impetus for the relocation of the two charge houses and the expense magazine (buildings 4, 22 and 16, section 5.2.3 above) to positions more convenient for the new tramway. Other changes, such as the cessation of charcoal production in-house at Cylinder Hill in 1866, and reversion to purchasing supplies instead from external suppliers (Marshall and Davies-Shiel 1969, 77) were probably co-incidental rather than linked to this re-capitalisation.

Other developments at the site probably took longer to come about, but before 1878 the glazing house, which previously seems always to have been integral with the corning house, had been separated off and re-sited to a new location (buildings 65 and 9, section 5.2.3 above). In order to do this, the water power-supply system had to be extended by constructing new leats leading to and from Hobson's Tarn (the tarn had also been enlarged before 1897, but this need not have happened straight away). The knock-on effect of moving the glazing house, however, was that other buildings needed to be re-sited, in particular buildings 71 and 72. If the present report is correct in arguing that the latter was the packing house at this time, it follows that the later packing house (building 40, section 5.2.3 above) erected on the land newly acquired in 1861, must have been constructed in this period.

6.6 Modernisation and the effects of the 1875 Explosives Act: c 1878-97 (Fig 78)

According to Tyler (2002, 179), James Bousfield who was works manager by 1878, was an energetic man who wanted to update and modernise the factory. A new Explosives Act had passed through Parliament in 1875, which amongst other things reiterated minimum distances between certain buildings and laid down standards for their construction; it also set requirements for special clothing for workers. But by far and away the most important provision of the act was the system it introduced of licensing all places where explosives were manufactured or handled: the system was administered by central Government acting on the advice of a new professional Explosives Inspectorate, rather than by local justices of the peace. The act required each existing explosives factory to apply for a continuing certificate - Elterwater was issued with certificate no. 34 (Patterson 1986, 13) – whilst any subsequent changes in work layout or practice had to be duly authorised by the Inspectorate and an amending licence issued. One immediate consequence was that the manufacture of blasting cartridges (traditionally done by miners working at home by candlelight) was now prohibited except on licensed premises (Cocroft 2000, 99-100). This created a business opportunity for blackpowder factories that Bousfield seems to have been keen to exploit at Elterwater.

In 1878, the Elterwater works commenced production of blasting cartridges. With the agreement of the Inspectorate, an existing building (building 27, section 5.2.4

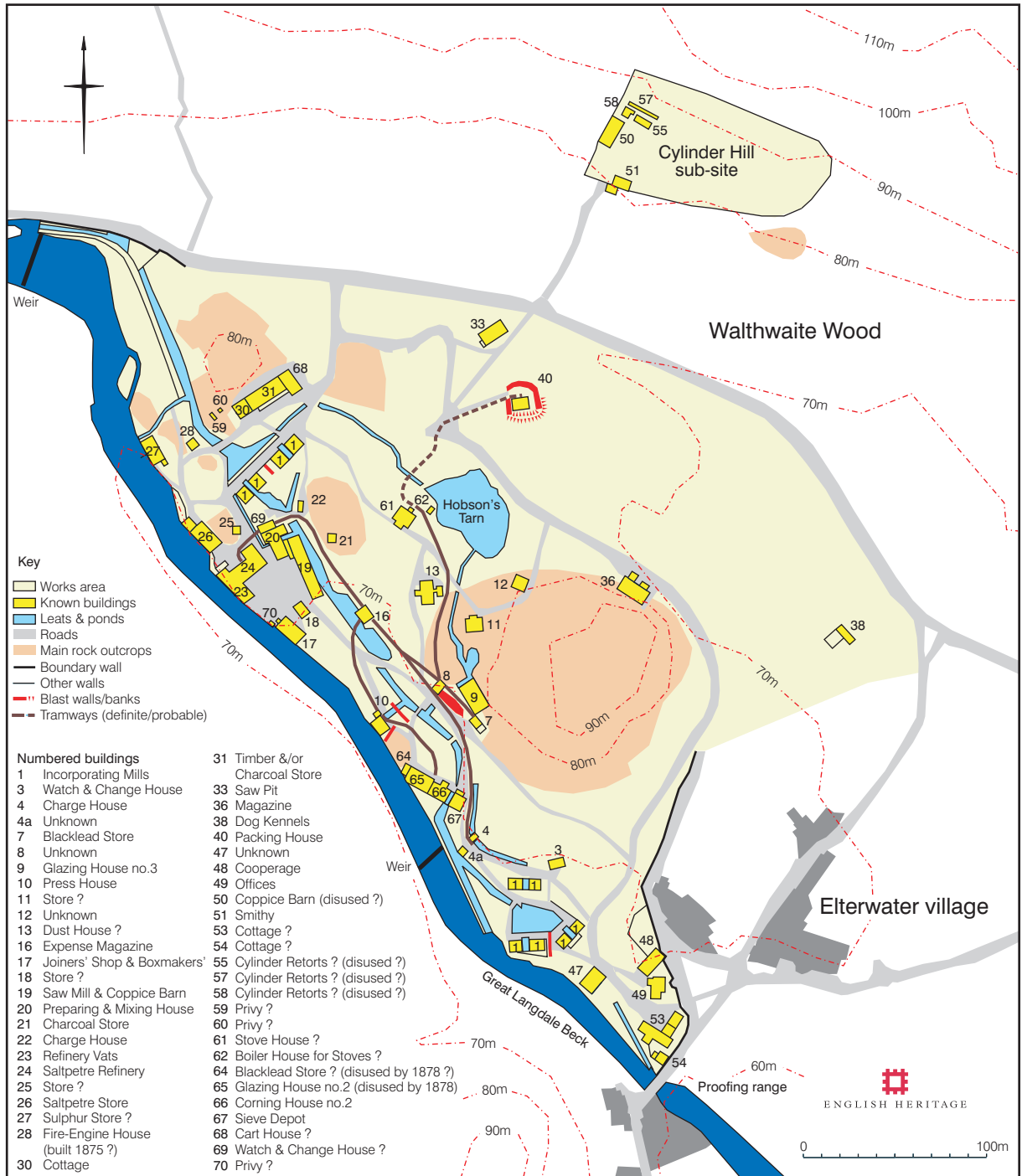


Figure 77.
Plan of the works, c 1866-78

above) sited on the periphery of the works away from most other structures was selected for modification into a cartridge house. There is no documentary evidence for the function of building 27 prior to its conversion, but the present report has argued (section 5.2.2 above) that it was probably the sulphur store since this is later recorded as occupying building 11 situated in a rather inconvenient position remote from both the charcoal and saltpetre stores, and the refinery and preparing house. Unfortunately the amending licence for building 27's conversion seems not to have survived and so documentary evidence is lacking, but the licence apparently necessitated the construction of a massive blast wall to shield building 27 in its new role from other buildings to the south and east. In addition, a new turbine and pump house had to be erected (building 44, section 5.2.1 above) to generate hydraulic power to drive the cartridge presses. This building was sited on a new outlet from the upper mill pond passing between the two pairs of upper incorporating mills, whilst power was conveyed from there to the presses *via* pipes. A second cartridge house (building 39) was subsequently added (in this case purpose-built, not converted from an existing building) sometime before 1897 and provided with power from the same turbine, although the MMB states that by *c* 1925 there was also at least one auxiliary turbine powered by a gas engine for periods when water levels were low in the beck (section 5.2.1 above). The tramway was extended to serve both cartridge houses. Around 1890, a dipping and packing house was also constructed adjacent to Hobson's Tarn (building 34, section 5.2.4 above), where the cartridges were dipped in hot wax prior to boxing to make them airtight and so prolong their shelf life.

It is likely that the inception of cartridge manufacture marked the start of the employment of women at the factory; certainly the MMB records that women were employed to work the cartridge presses 50 years later. Given the social conventions of the day, this undoubtedly necessitated the provision of a special change house for their sole use, and also the provision of a female toilet. Mike Davies-Shiel collected evidence which led him to name the west end of building 31 as the women's change house (section 5.2.5 above); although no independent evidence for this has been found, the choice makes excellent logistical sense since the building is close to both cartridge houses. For similar reasons, the present report has suggested that the two privies which existed at this upper end of the site by 1926 (buildings 29 and 42, section 5.2.5 above) were segregated by gender. The appropriation of part of building 31 as a change house may have been the reason for the construction of the new cart shed (building 37, section 5.2.5 above) around this time, and the absorption of the old cart house (building 68) into building 31.

A further consequence of the 1875 act is likely to have been the need to station a fire engine at the factory, which was housed in the new building 28 at the upper end of the works (building 28, section 5.2.5 above). A fire engine was needed not so much as a precaution against fires, but because it was now a legal requirement to hose out the interiors of process buildings before any maintenance work commenced in order to remove or at least damp down loose powder that had accumulated in them (Explosives Inspectorate 1878, 2). However, it is possible that Elterwater had its own fire engine even prior to the act, for both the New Sedgwick and Basingill gunpowder works possessed fire tenders by 1871 (Dunn *et al*, in prep).

Nevertheless, in the years immediately after 1875 Elterwater seems to have been lax in applying the strictures of the new act. An unannounced visit by one of the newly-appointed HM Inspectors of Explosives, Major Majendie, on 23 May 1878 resulted in convictions for twelve offences under the act, mostly concerning failure to implement measures to prevent the ingress of foreign substances into process buildings and

machinery (Explosives Inspectorate 1878, 3-4; Tyler 2002, 176). This was followed on 29 November that same year, by a massive explosion which ripped through the corning house, destroying it and killing three men working inside. Although the exact cause was never established, Major Ford, the Inspector who reported on the explosion to the Secretary of State as required under the act, thought that one possibility was the importation of grit into the corning house in a sieve brought in from a dirty store (Explosives Inspectorate 1878). The corning house was subsequently rebuilt (building 56, section 5.2.3 above), but to new, safer, specifications - principally a lighter superstructure designed to blow off and so dissipate, rather than contain, the force of any explosion - and modernised machinery installed (the old corning frame was replaced by a set of toothed rollers). Major Ford also commented on the lack of a proper boundary wall or fence to the works at the time of the explosion (Explosives Inspectorate 1878, 6). Although such a wall had reportedly been built in 1850 (Tyler 2002, 175), the factory then occupied a smaller area (compare Fig 75). Apparently, therefore, no new wall had been erected since the factory expanded to the north and east in 1861 (Fig 76). It is likely that this was remedied shortly after the explosion. As a further safety measure, building 30 near the upper end of the site, which hitherto had been rented out as housing, was converted into a new watch and change house for the upper mills (section 5.2.5 above) at around the same time. The preparing house (building 20, section 5.2.2 above) was extended before 1897 and absorbed what presumably had been the old upper watch house (compare building 69 on Fig 77).

The dirty sieve store mentioned in Major Ford's report was sited opposite the corning house (building 67 on Fig 77). The report explicitly states that this building was not badly damaged in the explosion, but the OS second edition map (Fig 4) shows it had nevertheless been replaced by building 5a before 1897. In fact, the present report has shown that the walls of building 67 were retained (presumably as blast protection) and building 5a erected inside (section 5.2.5 above). The 1926 plan identifies building 5a as a pump house, whilst the MMB states that the pumps drew their power from the corning-house waterwheel but then delivered that power to the press house whose own waterwheel for some reason seems to have been disused by 1897 (sections 5.2.1 and 5.2.3 above).

The introduction of turbine power to the works in 1878 opened up further possibilities, including re-siting process buildings requiring mechanical power to the vacant areas at the northern and eastern edges of the factory, which had until then been too distant from the leat system to be utilised properly. Thus, although there is no firm documentary evidence for the date of its construction, the years immediately after 1878 are the most likely time for the re-siting of the dust house to this area (building 32, section 5.2.3 above) which the MMB records as powered by turbine before 1926. Such a dating fits in with other documentary evidence anyway, which points to a concerted programme of modernisation and expansion of the factory being pushed through (presumably by Bousfield) in the years after 1878: the stove house was replaced in 1881 by one that was both bigger and of improved design, whilst an additional magazine was constructed in 1882 (buildings 14, 15 and 35, section 5.2.3 above). Two extra incorporating mills (nos. 7 and 8, section 5.2.3 above) had also been built north of the lower mill pond before 1897: although documentary evidence is lacking for the precise date of construction, the most credible time must be this period between c 1878 and 1882. However, not only did Bousfield raise the productive capacity of the works with these two new mills, but he also innovated with their design. Rather than simply adding another pair of the same pattern as already existed, he took the chance to achieve economies of scale by building the new mills in line with two which already existed and inserting an extra-large wheel-pit in

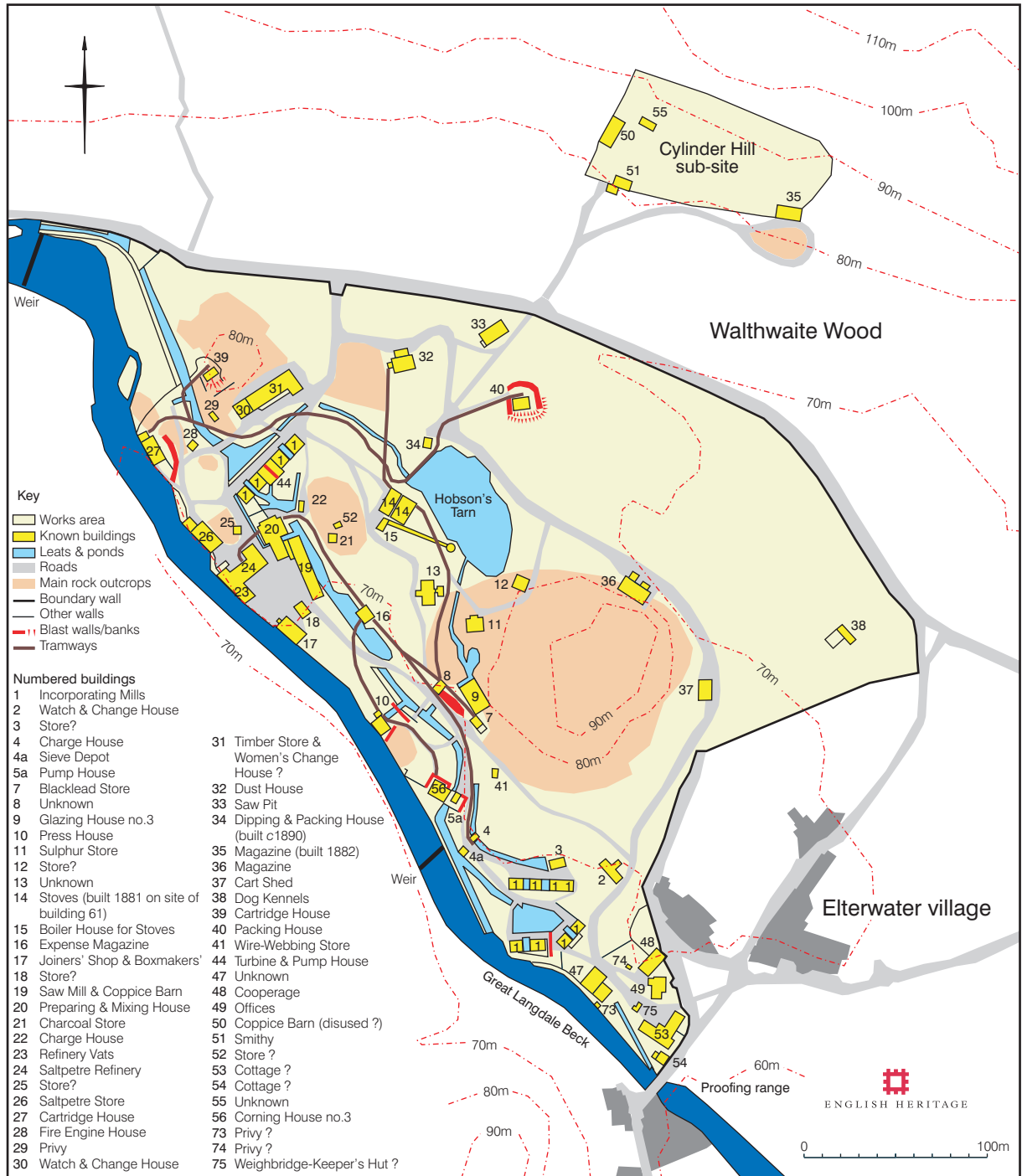


Figure 78.
Plan of the works, c 1878-97

between the two pairs so that one wheel could now power all four mills. In 1925 the MMB reported that this group of four mills was also under-driven rather than over-driven which the archaeological evidence shows was the standard at Elterwater, although it is presently unclear whether this was the case right from the start or whether the drive mechanism was later converted (section 5.2.3 above). The new lower watch and change house (building 2, section 5.2.5 above) was presumably erected at the same time as mills 7 and 8.

Electricity was introduced to the factory around 1890. One or more dynamos were installed at unknown locations, but most probably in the various pump houses. However, no attempt seems to have been made before 1897 to use electricity for any purpose other than simply lighting individual buildings.

6.7 Into the 20th century. Boom and bust: c 1898-1925 (Fig 79)

For the purposes of the present report, this period of the factory's history starts in 1898 simply because the OS second edition map (Fig 4) provides a good snapshot of its development up until 1897. The main changes that occurred between then and the date of the next surviving map of the works – the 1926 plan (Fig 5) – are discussed below. However, although the start and end dates are defined on somewhat arbitrary grounds, the period nevertheless seems to stand in sharp contrast to what had gone before. Whereas the years 1878-97 may be characterised as ones of general expansion and modernisation, the first quarter of the 20th century appears instead as a time of consolidation and quiet prosperity up until the end of the First World War, followed by a decade or so of uncertainty and hardship as a collapse in demand for blackpowder led to attempts to consolidate and rationalise the industry. The Elterwater Gunpowder Company merged with many of its competitors in 1917 to form Explosive Trades Ltd, which very shortly afterwards became part of Nobel Industries Ltd which lasted until 1926 (Crocker 1988, 2; Tyler 2002, 192). All five operational Cumbrian blackpowder works (Lowwood, Elterwater, New Sedgwick, Blackbeck and Gatebeck/Basingill) were now for the first time under the control of a single company.

The main developments at Elterwater in this period occurred before the war, and are mostly to do with innovations in sources of power. There is very little evidence of major alterations carried out to the existing stock of buildings or machinery. A flood severely damaged the press house and some of the lower incorporating mills in November 1898, which had to be repaired (Tyler 2002, 180), and the present report has argued that this was probably the spur for the introduction of an hydraulic accumulator (building 6, section 5.2.1 above) to power the press house. Otherwise, the only structural changes seem to have been a replacement corning house (building 5, section 5.2.3 above) following the destruction of its predecessor in a fatal explosion in 1916 (Explosives Inspectorate 1916), and the addition of a searchers' hut (building 45, section 5.2.5 above) at the works' northern entrance by 1926.

6.8 The ICI years and closure: c 1926-30 (Fig 80)

In 1926, Nobel Industries were incorporated into ICI. The new owners made some effort to improve the factory and keep production going. For instance, a new electric motor was installed in its own shed to power the dust house, and a generating house (of uncertain purpose) was tacked on to the southern end of the disused refinery vats (buildings 23a and 46, section 5.2.1 above); improvements were also made to the corning-house waterwheel, since prior to 1926 this had been unable to power both

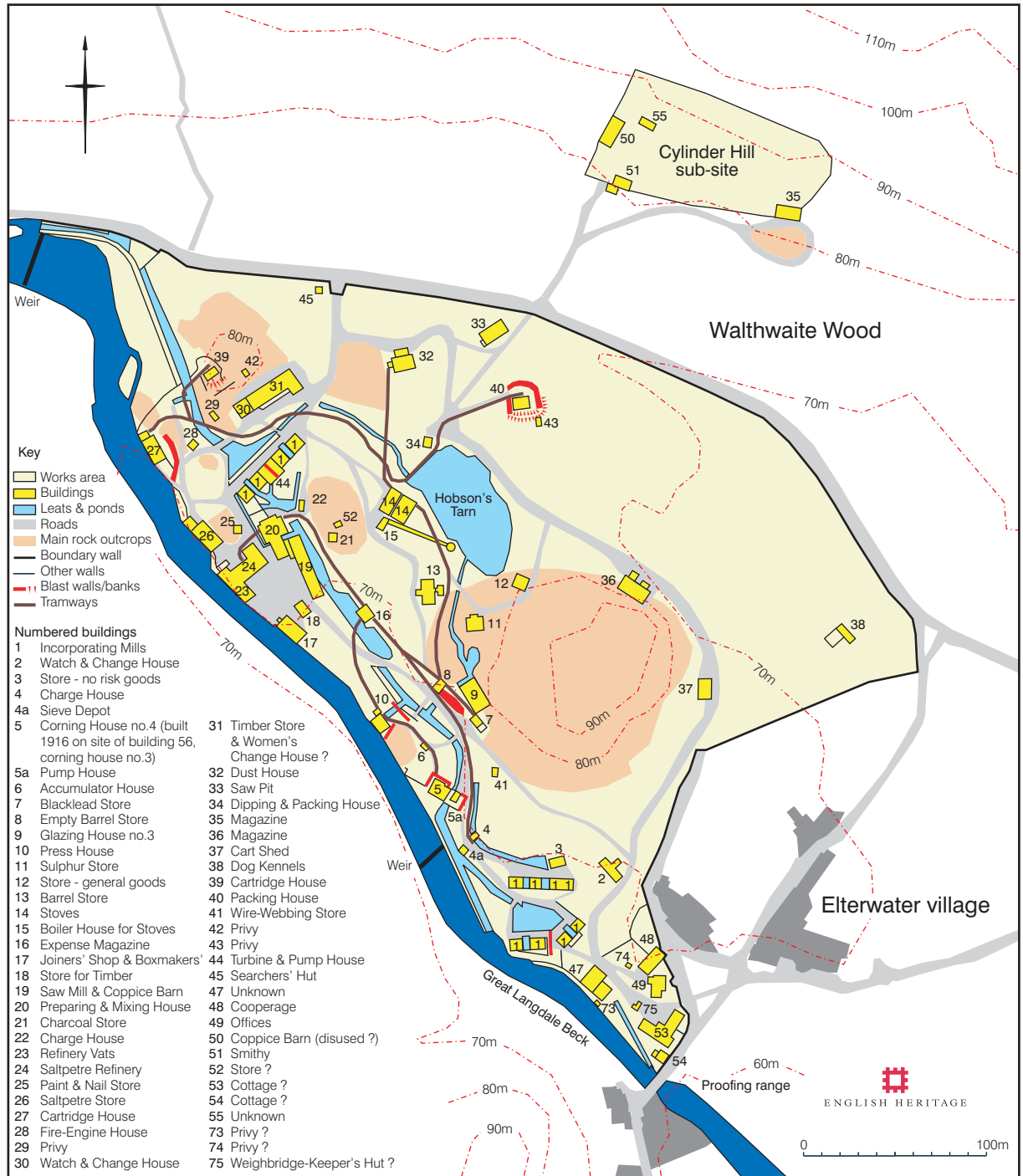


Figure 79.
Plan of the works, c 1898-1925

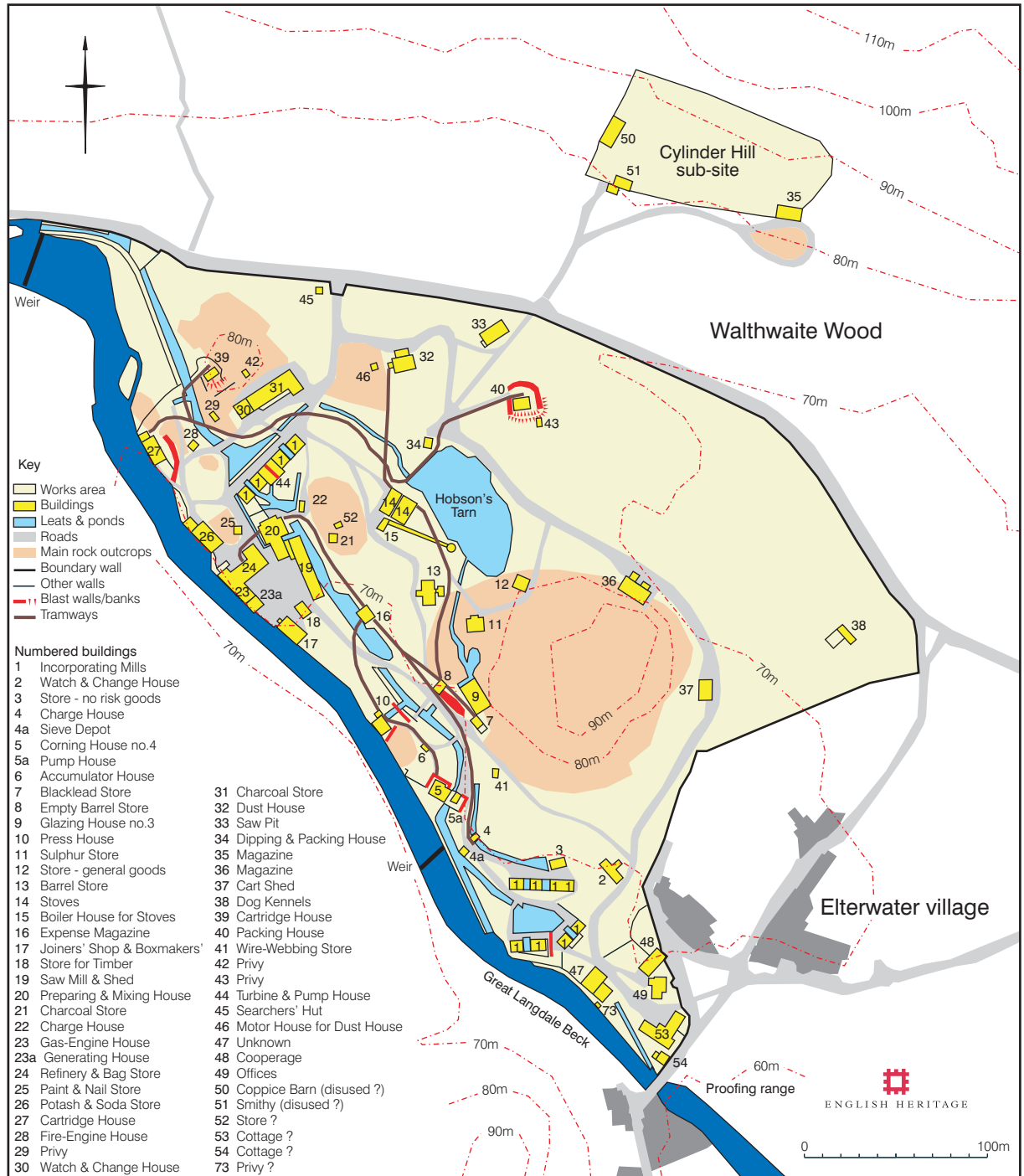


Figure 80.
Plan of the works, c 1926-30

the corning house and the press house simultaneously resulting in lost production (MMB). However, very rapidly ICI seems to have taken the decision to rationalise blackpowder production in Cumbria. Blackbeck was the first factory to close in 1928, followed by Elterwater just over a year later. The decision when it came was no doubt in part influenced by the factory's antiquated infrastructure such as the incorporating mills - which still used limestone bedstones and edge-runners whereas other factories had by this time changed to cast-iron or iron-shod runners - but was most probably chiefly taken on the grounds that the factory was poorly placed in relation to the transport infrastructure: it was distant from both the canal, and more importantly, rail networks. There seems to have been some talk at closure of turning the factory into a museum or a retreat for ICI executives (Anon 1929, 348), but to no avail. Elterwater closed and was sold off, and the majority of its business records burned for fear of the taxman (Mike Davies Shiel, pers comm), thus bringing to an end 106 years of gunpowder milling in Langdale.

7. SURVEY METHODOLOGY

Although measured survey was carried out, much recording was done photographically using a digital camera. Some of the results are presented in this report; the remaining frames are held in the site archive (see appendix 4).

Measured survey was for the most part conducted graphically using a copy of the Ordnance Survey's Land-Line data, plotted out at a scale of 1:2500. Tapes were laid between points of hard detail identifiable on both the map and the ground, and the observed archaeological detail added by hand using standard techniques of offset and radiation. This process identified a number of spatial errors within the existing OS mapbase, and accordingly the depiction of some archaeological detail had to be stretched or shrunk to fit. However, in two areas - the upper incorporating mills, and the surviving pair of lower incorporating mills - divorced surveys were undertaken to create large-scale, metrically accurate, plan records of the surviving field remains. This was done using a Leica TC805 electronic total-station theodolite. Points of archaeological and topographical detail were observed from simple baseline traverses, coded with line and point information, processed using KeyTERRA-FIRMA software, and loaded into an AutoCAD file. Plots at 1:100 scale were taken back into the field and some extra detail added graphically. Both surveys were subsequently used to update the relevant sections of the OS Land-Line file, but again problems of mismatch between the EH and OS datasets has meant that some 'fudging' has been necessary to achieve a best fit.

8. ACKNOWLEDGMENTS

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EH would like to thank Fredericka Johns of Langdale Leisure Ltd for cheerfully permitting access to the site and for permission to reproduce Fig 27, and to Anthony Hutton and other members of staff for the keen interest shown and assistance provided at all times during survey. EH also gratefully acknowledges Cayley and Marion Barter, and Mike Davies-Shiel, for the loan of documentation and archive material in their possession, and for permission to quote from it and to reproduce plans and photographs in this report. Mike Davies-Shiel also enthusiastically shared his own research and thoughts about the site. EH must also thank Miles Ogletorpe at the RCAHMS for providing the contact details for Nobel Enterprises at Ardeer, and Peter Cartwright of ICI for information on the archive material retained there and for permission to reproduce Fig 5. Last, but by no means least, EH would like to thank Mrs Rice for allowing photography of the test shot and callipers in her possession.

9. BIBLIOGRAPHY

Published sources

Anon 1887, *Verbatim Report of Proceedings before the Select Committee on Railway Bills in the House of Commons, March 1887* (Ambleside: George Middleton)

— 1929, 'Short histories of ICI companies: the North of England Gunpowder Group', *ICI Mag*, October 1929, 337-48

Atkinson, T 1865, *Local Chronology: being notes of the principal events published in the Kendal newspapers since their establishment* (London: Hamilton Adams)

Bowden, M (ed) 2000, *Furness Iron* (Swindon: English Heritage)

Burkett, M E 1979, *Kurt Schwitters. Creator of Merz* (Kendal: Abbot Hall Art Gallery)

Chitty, G 1996, *Monuments Protection Programme. The Gunpowder Industry: recommendations for protection (Step 4 report)* (Unpublished EH confidential internal document)

Cocroft, W 2000, *Dangerous Energy* (Swindon: English Heritage)

Crocker, G 1988, *Gunpowder Mills Gazetteer* (London: Soc Protection Ancient Buildings, Wind and Watermill Section, Occasional Publication 2)

Crocker, A and Crocker, G 1992, 'Gunpowder mills of south Cumbria', *Gunpowder Mills Study Group Newsletter*, **11**, September 1992, 8-14

Curtis, W S 1996, 'The deterioration of gunpowder and some of the methods that were used to combat it', in B Buchanan (ed), *Gunpowder: the History of an International Technology*, 253-9 (Bath: Bath University Press)

Dunn, C J 2001, *English Heritage Archaeology and Survey Projects Division Step 4 Industrials Recording Programme Project Design. Project: The gunpowder industry module. Area: The Lake District* (version 3) (Unpublished EH internal document)

Dunn, C, Lax, A, Berry, A, Goodall, I, Hunt, A, Jecock, M and Taylor, S in prep, *New Sedgwick Gunpowder Works, Cumbria: an archaeological and architectural survey* (York: EH Archaeological Investigation Report Series)

Explosives Inspectorate 1878, *Circumstances attending an explosion of gunpowder at a gunpowder factory at Elterwater, near Ambleside, Westmoreland, on the 29th November 1878*. Special Report **19** (London: HMSO)

— 1901, *Circumstances attending an explosion which occurred during repairs to the Corning House, at the factory of the Elterwater Gunpowder Company, Limited, at Elterwater, near Ambleside, on the 23rd October, 1901*. Special Report **149** (London: HMSO)

— 1916, *Circumstances attending an explosion which occurred in the corning house of the gunpowder factory of the Elterwater Gunpowder Company, Limited, at Elterwater, in the county of Westmorland, on the 18th September 1916*. Special Report **222** (London: HMSO)

Gould, S 1993, *Monuments Protection Programme: The Gunpowder Industry. Combined Steps 1-3 Report* (Unpublished report for EH by The Cranstone Consultancy)

Hunt, A and Goodall, I 2002 *Basingill Gunpowder Works and Garden, Cumbria: an archaeological and architectural survey* (York: EH Archaeological Investigation Report Series **AI/42/2002**)

Institute of Geological Sciences 1980, *IGS 1:250 000 series, Lake District sheet 54N 04W, solid edition* (Southampton: Ordnance Survey for IGS)

Jecock, M and Dunn, C 2002 *Old Sedgwick Gunpowder Works: an archaeological and historical survey* (York: EH Archaeological Investigation Report Series **AI/11/2002**)

Langdale Leisure nd [1996], *History* (advertising brochure published by Langdale Leisure Ltd)

Lowe, A 1968, *The Industrial Archaeology of High Furness* (Unpublished BA dissertation, Dept of Geography, Liverpool Univ)

Marshall, J D and Davies-Shiel, M 1969, *The Industrial Archaeology of the Lake Counties* (Newton Abbott: David & Charles)

Norman, K J 1994, *Railway Heritage: The Furness Railway* (Peterborough: Silver Link Publishing)

Ordnance Survey 1861, *County Series 25", Westmorland sheet XXV.8. First Edition*. Surveyed 1859 (Southampton: Ordnance Survey)

— 1898, *County Series 25", Westmorland sheet XXV.8. Second Edition*. Revised 1897 (Southampton: Ordnance Survey)

— 1915, *County Series 25", Westmorland sheet XXV.8. Edition of 1915*. Revised 1912 (Southampton: Ordnance Survey)

— 1978a, *National Grid Series 1:2500, Plan NY 3204-3304*. Reconstituted from former County Series plans and revised 1977 (Southampton: Ordnance Survey)

— 1978b, *National Grid Series 1:2500, Plan NY 3205*. Reconstituted from former County Series plans and revised 1977 (Southampton: Ordnance Survey)

Palmer, A 1998, *The Low Wood Gunpowder Company: its inception and early growth 1798-1808* (London: Gunpowder Mills Study Group/Soc Protection Ancient Buildings)

Patterson, E M 1986, *Gunpowder Terminology and Incorporation* (Faversham: Faversham Soc Paper **27**)

— 1995, *Blackpowder Manufacture in Cumbria* (Faversham: Faversham Soc Paper **43**)

RCHME 1999, *Recording archaeological field monuments: a descriptive specification* (Swindon: RCHME)

Seebohm, F 1914, *Customary acres and their historical importance* (London: Longmans, Green & Co)

Tyler, I 2002, *The Gunpowder Mills of Cumbria* (Threlkeld: Blue Rock Publications)

Wilson, P N 1964, 'The gunpowder mills of Westmorland and Furness', *Trans Newcomen Soc*, **36**, 47-65

Manuscript sources and newspapers

Barter collection (in private possession):

There are five bundles of legal documents in envelopes:

Bundle 1 (labelled 'Mill Kiln')

Document 1. Articles between Leonard Benson and Francis Rigg re the construction of a fulling mill, dated 30 July 1714.

Documents 2 and 3. Bargain and conveyance, dated 1810 but unsigned, whereby John Coward, miller of Skellwithbridge (*sic*), purchases the water corn mill, etc, at Elterwater from Capt Byron, RN, for £31 10/- plus 2/6 free rent.

Document 4. Indenture dated 24 December 1813, between John Fleming and John Coward, to wit that Coward is enfeoffed of a fulling mill at Elterwater for £3 3/-, plus 2/6 free rent.

Documents 5 and 6. Bargain and conveyance, dated 15 July and 16 July 1824, whereby Capt Byron's son confirms that his father duly received from the late John Coward the purchase monies for the water corn mill at Elterwater, and assigns formal possession of the same to John Huddlestone and John Robinson, sons-in-law and devisees of the late John Coward.

Documents 7 and 8. Bargain and conveyance, dated 1 July and 2 July 1826, whereby the devisees of the late John Coward (Huddlestone and Robinson) sell to Daniel Harrison the water corn mill, etc, at Elterwater for £200.

Document 9. Abstract of title, dated 1866, to a parcel of land called Walthwaite Wood containing 13 acres 1r 20p, purchased by and held in trust for the Elterwater Gunpowder Company.

Document 10. Conveyance, dated 2 April 1867, of the water corn mill, etc, from the Elterwater Gunpowder Company to the Elterwater Gunpowder Company Ltd.

Bundle 2 (labelled 'Not applicable except perhaps as regards Fulling Mill')

Documents 1 and 2. Bargain and conveyance, both dated 13 February 1823, whereby John Fleming and others sell to David Huddlestone the fulling mill, etc, and other properties at Elterwater, for £755.

Documents 3 and 4. Bargain and conveyance, dated 1 July and 2 July 1826, whereby David Huddleston sells to Daniel Harrison (as trustee for the Elterwater Company) the fulling mill, etc and other properties at Elterwater lately purchased from John Fleming.

Documents 5 and 6. Bargain and conveyance, dated 17 July and 18 July 1826, whereby John Harden sells to Daniel Harrison (as trustee for the Elterwater Company?) the parcel of land commonly called Spring and Steps End, for £85 12/6.

Document 7. Conveyance, dated 30 September 1833, whereby Jeremiah Coward and others convey to the partners of the Elterwater Gunpowder Company the parcel of land commonly called Throng (*sic*) Wood, for £140.

Document 8. Conveyance, dated 1 July 1842, whereby Thomas Walker and others convey to Daniel Harrison, in trust for the Elterwater Powder Company, a stable cowhouse or outbuildings and garden at Elterwater, for £240.

Bundle 3 (labelled 'Inclosure of part of Wallthwaite Wood, 1824' and 'Inclosure of 10 acres of waste, 1891').

Document 1. Petition, dated 22 December 1823, from various commoners at Elterwater to the Earl of Lonsdale, saying that they unanimously agree to David Huddleston being permitted to enclose part of Wallthwaite (*sic*) Wood.

Document 2. Second copy of document 1, countersigned with Lord Lonsdale's agreement, 27 May 1824.

Document 3. Feoffment and covenant, dated 30 July 1827, whereby David Huddleston grants to Jeremiah Coward on behalf of the partners of the Elterwater Gunpowder Company, all that land called Wallthwaite Wood at Elterwater.

Document 4. Conveyance, dated 2 April 1867, whereby Jeremiah Coward conveys Wallthwaite Wood to the Elterwater Gunpowder Company Ltd.

Document 5. Judgement by the customary court of the Lord of the Manor of Langdale, dated 4 November 1891, whereby the court approves the request of the Elterwater Gunpowder Company to abandon their previous grant as regards Stickle Tarn, and also the proposed reservoir behind White How, and instead to enclose land behind White How for a reservoir to supply Elterwater village, and also to enclose 10 acres of waste between the Grasmere Road and the Great Langdale Road.

Bundle 4 (labelled 'Stickle Tarn')

Document 1. Memorandum of Agreement, dated 2 March 1887, whereby the Elterwater Gunpowder Company Ltd and John Robinson agree on who owns what land on the south side of the Great Langdale Beck upstream from the Company's weir.

Document 2. Judgment of the customary court of the Manor of Langdale, dated 27 February 1890, to the effect that the Company is to be allowed to flood a further 2.5 acres of waste around Stickle Tarn by raising the level of their dam, and also to flood 3 acres of common behind White How.

Document 3. Application to the customary court to abandon the grants made in document 2, and instead proceed with a smaller scheme at White How.

Bundle 5 (labelled 'The Institute')

Document 1. Conveyance, dated 25 February 1880, whereby the Company convey to Robert Crewdson, a parcel of land situated just upstream from the weir, for £17 10/-

Document 2. Indenture, dated 1 July 1889, whereby the Company agree to buy the land and building thereon, then in use as a lecture room, from Crewdson for £500.

Document 3. Memorandum of Agreement, dated 2 July 1889, whereby the Company agree to let the lecture room to Robert Crewdson for 8 months.

Photographs

Two albums of black-and-white prints dating from the 1930s and 1960s.

Plan

Colour-washed plan on linen, entitled 'Plan of Elterwater Gunpowder Works (disused)'; drawn by J Carlyle, 11 October 1932, and annotated with the area of land included in the sale of 'Brackens'.

Cumbria Record Office, Kendal (CRO(K)):

WDY 448 Facsimile copy of David Huddleston & Co's letter book, 1826-9

WQ/A/H/17 Application to divert public highway, Ambleside to Great Langdale, 1861

WQ/A/H/19 Application to divert public highway, Colwith Bridge to Elterwater, 1863

Davies-Shiel collection (in private possession):

No details

ICI, Ardeer:

Original of David Huddleston's Letter Book

Paper copy of plan at 25 inches to a mile, entitled 'Plan of Elterwater Factory, HO/D 15-10', drawn 27 June 1921, and annotated 'Factory No. 34 Westmorland, Plan to Amending Licence No. 3041' by R A Thomas, Lt Colonel, HM Inspector of Explosives, 20 December 1926.

Kendal Reference Library:

Westmorland Gazette, 31 Dec 1825

Westmorland Gazette, 1 Feb 1840

Westmorland Gazette, 7 Dec 1878

Westmorland Gazette, 9 Nov 1901

Westmorland Gazette, 23 Sep 1916

The Gazette 25 May 1935

NMRC Swindon:

Patterson Collection, boxes 1 and 3: various copies of the Manufacturing Method Book for Elterwater Gunpowder Factory

Appendix 1: The process of gunpowder manufacture

The method of gunpowder manufacture has been described in detail elsewhere (Cocroft 2000; Crocker 1999; Patterson 1995) and only a brief outline will be given here. Details of the precise method followed at Elterwater in its final years are known from the factory Manufacturing Method Book (MMB), a copy of which survives in the Patterson Collection in the NMRC. Patterson (1995, 20) thought that this document dated to 1927, but internal evidence suggests it was in existence by 1925 (section 4 above). Limited details of the processes used at earlier times also survive in a variety of other sources which are discussed in the appropriate places in section 5.2 above. Some of the terminology used in the sources appears to be Lake District vernacular; where this is the case other commonly used terms are given in parentheses. Stages of manufacture also varied slightly according to the type and intended use of the powder.

The three ingredients of gunpowder are saltpetre, charcoal and sulphur in the approximate ratio 75:15:10, although the precise mix varied according to the quality of powder desired. These constituents do not react together chemically but are simply blended together. The manufacturing process is therefore concerned with creating a thoroughly combined mixture of the correct density, in an evenly granulated form. Saltpetre has two chemical forms: potassium nitrate (nitrate of potash) and sodium nitrate (nitrate of soda). The former is stable under ordinary climatic conditions and was always the saltpetre of choice. Sodium nitrate on the other hand absorbs water from the air, but was less expensive; it was often used for blasting, but had to be kept dry or it lost its efficacy. Blackpowder made from the two forms was distinguished as N/P or N/S powder (Patterson 1995, 10-11).

The first stage of manufacture was the preparation of the three ingredients. Saltpetre, imported from abroad in its 'grough' or raw state, needed to be refined. The normal method of achieving this was by gentle boiling and re-crystallisation which enabled the impurities to be skimmed off, but by 1925 the MMB makes clear that the Elterwater works was receiving its supplies of sodium nitrate pre-refined from the New Sedgwick factory instead. Imported sulphur could also contain impurities, but again by 1925 the MMB implies that sulphur was being refined before reaching the works. It seems that in the years immediately after the works' foundation in 1824 charcoal was bought in from local suppliers, but within a very short space of time had been replaced by charcoal made on site in sealed **retorts**. After 1866, however, reliance seems to have moved back to external suppliers. These ingredients were all kept in separate stores, known appropriately as the **saltpetre store**, **brimstone** or **sulphur store**, and **charcoal store**. Refining was done in the **refinery**.

In the **preparing house** (mixing house) the charcoal and sulphur were ground to a fine powder in an edge-runner mill. The MMB says that Elterwater followed the same procedure as at New Sedgwick – namely a pair of over-driven vertical cast-iron runners each rotating on a cast-iron bed plate. All the ingredients were then sieved to remove lumps or grit before being weighed out in the correct proportions and mixed in a drum containing rotating arms. At Elterwater, grinding and mixing seem always to have been water-powered. The mixed ingredients, called green charge, were transferred to the **green-charge house** or went straight to the **incorporating mills**.

In the **incorporating mills** the green charge was fed into a series of edge-runner mills that mixed and compacted the gunpowder into a denser mass known as **mill cake** or **wrought charge** (ripe charge). In the latter years of production at Elterwater,

this process took 1 hour 40 minutes, but in 1925 milling time was increased to 2½ hours and later to 2 hours 24 minutes or 2 hours 40 minutes depending on whether it was N/P or N/S powder. During incorporation the process was supervised from the comparative safety of the **watch house**, and the charge periodically dampened to help it meld together. All the mills at Elterwater were driven by waterwheels; most were over-driven (*ie* geared from above), although *c* 1878 four were converted to be under-driven (geared through the bedstone). In addition the material used for bedstones and edge-runners was limestone throughout the life of the factory, unlike at other Cumbrian sites where metal edge-runners superseded stone ones before closure. Once incorporated, ripe charge was removed and stored until the next stage of manufacture. At many sites, there was a dedicated **ripe-charge house**, but at Elterwater the ripe charge seems to have gone straight to the press house or else was accommodated in the **expense magazine** until needed.

At the **press house**, mill cake was compressed to turn ripe charge into slabs of high density. The mill cake was broken down by hand using a wooden hoe, and mixed with dust returned from the corning house before being placed beneath the ram of the press. Initially at Elterwater the press was hand-operated, but an hydraulic press seems to have replaced it before 1859. At first, this was operated directly by pumps driven from a waterwheel, but around the turn of the 20th century an hydraulic accumulator was interposed between the pumps and press. The MMB records that by *c* 1925 ripe charge was spread onto a bogie platform in 25 layers separated by copper plates, all surmounted by a sheet of leather. The platform was then pushed onto the bedplate of the press, and the hydraulic ram lowered which exerted a pressure of 25cwts psi.

By this stage the powder had reached a satisfactory mix and density but needed to be granulated into rounded and evenly-sized grains. This was carried out in the **corning house**. Before 1878 the slabs were broken down by being placed into oscillating scribes (sieves) along with blocks of *lignum vitae*; after 1878, the press cake was broken between rollers. Grains were then separated from dust in scribes of appropriate fineness. Dust was returned to the press house whilst larger pieces went back through the rollers. At Elterwater this process seems always to have been water-powered.

From the corning house, powder then went to the **glazing house** where it was tumbled in barrels with graphite for up to 10 hours. The process made the powder less hygroscopic, as well as smoothing the grains thereby helping the powder to keep its structure. The amount of graphite added depended on the ‘brightness’ required. At Elterwater the glazing house seems always to have been water-powered. After glazing the powder went straight to the **stove house** (drying house) to remove any residual moisture, although from 1878 blasting powder travelled first to the **cartridge house**. At the stove house, before 1882, powder was dried in a so-called gloom stove by means of radiant heat generated from a fire shielded by a metal plate; after that date heat was generated by steam pipes running around the floor of the building, with the steam produced in an external boiler. Powder was left to dry for up to 36 hours.

The dried powder next went to the **dust house** for final sizing. The powder was put into a separator and agitated through sieves of different mesh size; anything too large or too small was returned to the preparing house to start the process again. The likelihood is that at Elterwater the separator was operated by a hand crank until *c* 1878, after which the process was mechanised with the introduction of turbine power. In 1926 the turbine was replaced by an electric motor.

The powder was packed into barrels in the **heading-up** or **packing house** ('heading up' refers to the closing of the barrel) and was placed in the **store magazine** to await despatch. Powder which was in between processes was stored on site in an **expense magazine**.

From 1878, blasting powder followed a different route through the works after leaving the glazing house. Before that date it had been sold loose, but after was sold pre-formed into cartridges. From the glazing house it therefore went first to the **cartridge house**, where it was poured into moulds and compressed into pellets or cartridges. At Elterwater there were four presses in two separate cartridge houses, all hydraulically operated by turbines, and all exerting a force of 20cwts psi. Once formed the cartridges were dried in the **stove house** before being packed into boxes in the **packing house**. From c 1890, the wrapped cartridges were also immersed in hot wax in the **dipping house** to make them airtight before packing. Cartridges were then stored in the **magazine** until despatch.

Each batch of powder was checked for quality and reliability on the **proofing range**. At Elterwater this was done using an old mortar of Napoleonic vintage propelling a 68lb iron shot.

Other buildings known to have existed at Elterwater are the **change house**, **searchers' hut**, **saw mill**, **cooperage**, **joiners' shop**, **smithy**, **cart house**, **fire-engine house**, **office**, **privies**, and miscellaneous **stores**. The function of all these is fairly self-explanatory, apart perhaps from the first two. The change house was where the workforce donned special clothing before commencing their daily tasks, whilst the searchers were in effect the works' security staff employed to ensure that no matches or other incendiary device, or indeed any undesirable persons, entered the premises.

Appendix 2: List of recorded accidents and explosions at Elterwater

It was only with the passing of the Explosives Act in 1875 that reporting of fires and accidents involving explosives at gunpowder works became a statutory requirement (Cocroft 2000, 99). As a result, major incidents after 1875 are recorded in great detail in a series of special reports by the HM Inspectors of Explosives. Before this date, however, the only record we have of accidents is local newspaper coverage, and then normally only if the accidents were spectacular or resulted in fatalities when they would be picked up in the course of regular reporting of coroners' inquests. It may be possible, therefore, to produce a fuller list of accidents by systematic scrutiny of contemporary local newspapers, but such a task is beyond the remit of the present report. The following table lists early (pre-1875) accidents only where references to them have been found in secondary sources. From 1876, minor explosions not resulting in fatalities were noted briefly in the Explosives Inspectorate's annual reports. It has not been possible to consult this report series at first hand, but Patterson (1986, 29) has compiled statistical data from them for explosions which occurred in incorporating mills whilst in motion, and these are listed below. (Other explosions caused by the incautious removal of trod from stationary mills - hard, adherent, powder which accumulated on the mill bed and edge-runners during incorporation - were not included by him in those statistics, and so do not figure below).

Although incomplete, what the figures reveal is that explosions in incorporating mills were frequent, but did not often result in injury or loss of life because the dangerous nature of the process was appreciated, and the mill-keepers retired to the safety of the watch house whilst the mills were in motion. However, other parts of the manufacturing process were also potentially dangerous, and occasionally went wrong with disastrous consequences. At Elterwater, as at other works, the chief culprit seems to have been the corning house. It must be said, however, that Elterwater's safety record was broadly similar to the majority of blackpowder works in Cumbria. Patterson (1995, 41-3) has compiled fatal accident statistics for all seven factories, and if we omit Basingill as being unrepresentative since only incorporation was undertaken there (Hunt and Goodall 2002), then only Gatebeck had a better record, averaging 9.5 years per fatal accident against Elterwater's 8 years.

(NB. n/d in the table below indicates that no details are currently available)

Date	Site	Cause	Damage	Casualties	References
June 1827	Incorporating mill?	n/d	n/d	None	Tyler 2002, 162
July 1827	Incorporating mill?	n/d	n/d	None	Tyler 2002, 162
Aug 1827	Incorporating mill?	n/d	n/d	None	Tyler 2002, 162
9 July 1831	n/d	n/d	n/d	1 man badly burned	Atkinson 1865, 83
Jan 1840	Incorporating mill	n/d	n/d	None	<i>Westmorland Gazette</i> , 1 Feb 1840
23 Jan 1840	Press house, corning house and glazing house	Not established	Press house, corning house and glazing house all destroyed	5 men killed	<i>Westmorland Gazette</i> , 1 Feb 1840
1878	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29

29 Nov 1878	Corning house	Not established	Corning house destroyed	3 men killed, 1 badly injured	<i>Westmorland Gazette</i> , 7 Dec 1878; Explosives Inspectorate 1878
1881	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1883	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1885	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1889	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1892	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1892	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1899	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
23 Oct 1901	Corning house	Naked flame igniting gunpowder residue during repairs	Minimal damage to corning house and machinery	1 man killed, 3 injured	<i>Westmorland Gazette</i> , 9 Nov 1901; Explosives Inspectorate 1901
1912	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
18 Sep 1916	Corning house	Not established	Corning house destroyed, plus secondary explosion in a nearby incorporating mill	4 men killed	<i>Westmorland Gazette</i> , 23 Sep 1916; Explosives Inspectorate 1916
1918	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1919	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1921	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1922	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1922	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1924	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1925	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1926	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1927	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1928	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29
1929	Incorporating mill	n/d	n/d	n/d	Patterson 1986, 29

Appendix 3: Catalogue of surviving millstones at Elterwater

MS1. *Ex situ*. Half of an edge-runner re-used as the base for a light at NY 32554 05171 at the northern end of the Fellside complex. 1.6m diameter by 1m thick.

MS2. *Ex situ*. Half of a bedstone partly buried and re-used as the base for a direction post at NY 32573 05114 in front of the Fellside complex. 2.2m diameter, thickness not ascertained; central perforation 0.3m square

MS3. *Ex situ*. Complete bedstone set on edge at NY 32592 05119 adjacent to road between Fellside and Lodges 45-47. 2.1m diameter by 0.4m thick; central perforation 0.37m square.

MS4. *Ex situ*. Complete bedstone set on edge at NY 32656 05113 just north of Hobson's Tarn. 2.05m diameter by 0.65m thick; central perforation 0.32m square.

MS5. *Ex situ*. Complete bedstone set on edge at NY 32663 05106 just north of Hobson's Tarn. 2.1m diameter by 0.65m thick; central perforation 0.32m square.

MS6. *In situ*. Complete bedstone to mill 12 at NY 32562 05100, re-used as a planter at the entrance to the country-club car park, and mostly obscured. 2.2m diameter, thickness not ascertained. No further details.

MS7. *Ex situ*. Complete bedstone set on edge at NY 32560 05098 at the entrance to the country-club car park. 2.15m diameter by 0.6m thick; central perforation 0.33m square.

MS8. *Ex situ*. Complete edge-runner set on edge at NY 32558 05097 at the entrance to the country-club car park. 1.4m diameter by 0.6m thick; central perforation 0.37m square.

MS9. *Ex situ*. Complete edge-runner set on edge at NY 32560 05096 at the entrance to the country-club car park. 1.4m diameter by 0.6m thick; central perforation 0.37m square.

MS10. *In situ*. Complete bedstone to mill 10 at NY 32541 05080. 2.3m diameter by 0.45m thick; central perforation 0.3m square within circular recess 0.5m diameter.

MS11. *Ex situ*. Half of a bedstone set on edge at NY 32729 05074 between Lodges 56 and 57. 2.25m diameter by 0.55m thick; central perforation 0.37m square.

MS12. *Ex situ*. Fragment of ?bedstone re-used in steps at upper incorporating mills at NY 32537 05071. No measurements possible.

MS13. *Ex situ*. ?Edge-runner re-used in foundations at southern corner of building 25 at NY 32529 05048. No measurements possible.

MS14. *Ex situ*. Half of an edge-runner re-used as planter outside building 20 at NY 32541 05048. 1.3m diameter, thickness not ascertained.

MS15. *Ex situ*. Half of a bedstone laid flat at the road edge south of Lodge 25 at NY 32708 04866. 2.3m diameter by 0.4m thick; immeasurable square central perforation. Stone retains the end of an iron bar set in lead near its centre, and appears to have been broken during attempted re-use as a ?machine base.

MS16. *Ex situ*. Two-thirds of a bedstone laid flat outside the west end of Lodge 16 at NY 32673 04862. 2.4m diameter by 0.35m thick; no central perforation. Stone retains the ends of 7 iron bars set in lead near its centre, and appears to have been broken deliberately.

MS17. *Ex situ*. Complete bedstone laid flat outside the west end of Lodge 16 at NY 32673 04860. 2.1m diameter by 0.6m thick; central perforation 0.35m square.

MS18. *In situ*. Complete bedstone to mill 5 at NY 32677 04860 outside west end of Lodge 16. 2.2m diameter, thickness not ascertained; central perforation 0.32m square within circular recess 0.47m diameter.

MS19. *In situ*. Complete bedstone to mill 6 at NY 32689 04860, re-used as planter outside east end of Lodge 16. 2.25m diameter, thickness not ascertained; central perforation 0.33m square.

MS20. *Ex situ*. Complete bedstone laid flat at NY 32676 04829 south of the lower mill pond. 2.2m diameter, thickness not ascertained; central perforation 0.29m square within circular recess.

MS21. *Ex situ*. Complete bedstone laid flat at NY 32678 04830 south of the lower mill pond. 2.3m diameter, thickness not ascertained; central perforation 0.32m square within circular recess.

MS22. *In situ*. Complete bedstone to mill 3 at NY 32680 04826. 2.25m diameter, thickness not ascertained; surviving wood and metal axle bearing.

MS23. *In situ*. Complete bedstone to mill 4 at NY 32691 04827. 2.1m diameter, thickness not ascertained; central perforation 0.30m square.

MS24. *Ex situ*. Complete bedstone laid flat at NY 32699 04830 south of Lodge 23. 2.3m diameter by 0.37m thick; central perforation 0.32m square.

MS25. *Ex situ*. Complete edge-runner set on edge at NY 32701 04826 south of Lodge 23. 1.5m diameter by 0.6m thick; central perforation 0.37m square with surviving wood and metal axle mount.

MS26. *Ex situ*. Complete edge-runner set on edge at NY 32703 04824 south of Lodge 23. 1.5m diameter by 0.6m thick; central perforation 0.37m square with surviving wood and metal axle mount.

MS27. *Ex situ*. Fragment of ?edge-runner re-used (as axle mount?) in side of wheel-pit to building 9 at NY 32647 04969. 1.4m diameter by 0.6m thick; retains base of iron bar set in lead.

Appendix 4. The archive and photographic record

A survey archive consisting of the field plans and supporting background information such as the Project Design and correspondence, has been deposited with the NMRC in Swindon under Collections reference AF 00082, where it is available for public consultation upon request. Digital plans and photographs are currently retained at the EH York Office; all are publicly available on request.

Appendix 5: Concordance of NMR numbers linked to the survey

SITE NAME	COUNTY	DISTRICT	PARISH
Elterwater Gunpowder Works	Cumbria	South Lakeland	Lakes

SITE NAME	NGR	NMR No.
Elterwater Gunpowder Works (remains of)	NY 326 049	NY 30 SW 55
Corn Mill	NY 32720 04807	NY 30 SW 61
Fulling Mill (site of)	NY 3271 0483	NY 30 SW 62
Lower weir (remains of)	NY 32635 04875	NY 30 SW 63
Stables / Rose-gate	NY 32854 04820	NY 30 SW 64
Manager's House / Meadow Bank	NY 32870 04784	NY 30 SW 65
Upper weir	NY 32420 05203	NY 30 NW 104
Cylinder Hill charcoal works (site of)	NY 3274 0527	NY 30 NW 105
Cylinder Hill magazine / 'Merzbarn'	NY 32828 05222	NY 30 NW 106
Smithy	NY 32742 05241	NY 30 NW 107