Dorset Limekilns: a first survey

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SUMMARY

The primary aim of research undertaken in 1992-3 was to identify and record Dorset's limekilns, as a result of which over 300 sites are now known. The main period of lime-burning was from the mid-eighteenth century to the early twentieth century, and was mostly concerned with agriculture. This paper gives a brief background to the industry in Dorset. The second part examines the distribution and archaeology of the surviving limekilns today.

INTRODUCTION

'Limekilns are amongst the most familiar and least studied of industrial archaeological sites.'

(Cossons, 1975, 221)

There has been little research into the limekilns of Dorset. Some recording was undertaken in the mid-1980s by the Dorset Countryside Volunteers, and more recently, 112 limekiln sites were identified but not published (Hansford, 1989). In 1992, only eighteen limekiln sites were held in Dorset's Sites and Monuments Record.

As with other limestone districts, it has been said that most Dorset villages and private estates had their own limekilns, to produce lime for building mortar and especially for agricultural improvements. The earliest references to lime-burning in Dorset come from accounts of building works and repairs at Corfe Castle in the thirteenth and fourteenth centuries (Hutchins 1861, 491-4).

The use of lime for agriculture dates 'perhaps from the sixteenth century onwards, this being true for Devon (Havinden 1974). The practice was widespread among farmers by the late eighteenth century, when Marshall (1796, 145) was able to record that 'lime is more or less in use, throughout [West Dorset]: being burnt, from stone found within it,' while Stevenson (1815, 351) wrote that 'lime is much used in the Vale of Blackmoor, in the neighbourhood of Sherborne, Cheddington, Beaminster, Bridport, and along the coast from Burton to Abbotsbury, Fleet, and Weymouth.' However, agricultural depressions, competition from chemical fertilisers and large commercial lime-burners outside the county, and the adoption of Portland cement for building purposes, sent the industry into rapid decline by the early twentieth century. Some larger limekilns were erected in the 1920s and 1930s, but few were left operating in Dorset by the Second World War. It is, however, satisfying that lime-burning is still practised in traditional-style kilns at Shillingstone in the 1990s.

Lime-burning for agriculture

The earlier agricultural writers and improvers considered lime to be a manure, which was used alongside chalk and marl. Chalk and marl (a clayey decomposed form of chalk) were commonly dug from pits which are still a feature of some chalk landscapes.

The chemical process of lime-burning is shown below. During the burning or calcining of calcium carbonate at 900°C or above, carbon dioxide is released (dissociation). The limestone or chalk will yield about half its own weight in quicklime, which is a pure form of calcium. This reacts violently with water to form slaked or hydrated lime, which is over a hundred times as soluble as limestone.

Burning (calcining) Limestone or chalk (Calcium Carbonate) CaCO ₃ + heat	\rightarrow \rightarrow \rightarrow	Quicklime + Carbon Dioxide (Calcium Oxide) CaO + CO ₂
Slaking (hydration) Quicklime + Water	\rightarrow	Slaked or Hydrated Lime
$CaO + H_2O$	\rightarrow	Ca(OH) ₂

Calcium is one of the most important constituents of soil. It neutralises soil acidity (even chalk soils can become acid), and thus encourages the action of useful bacteria which render fertilisers and other nutrients available for plant growth, and it improves and alters the texture of the soil.

Table 1 shows the forms of lime available in 1931, when rough chalk was still used occasionally under certain circumstances. Such chalk weathers down slowly. The lump burnt lime or quicklime straight from a limekiln is the most efficient. Today, ground chalk or limestone is the most usual agricultural 'lime' dressing. Although less soluble than the true limes, it is much cheaper and easier to handle.

Table 1: Forms of Lime Available for Agriculture

Туре	% Lime	Action	Dressing per acre
Rough Chalk	50	very slow	20-80 loads
Ground Chalk	52	moderate	3 tons
Ground Limestone	54	moderate	30-40cwt
Precipitated Chalk	30-53	moderate	30-50cwt
Hydrated Lime	70-75	rapid	20-30cwt
Lump Burnt Lime	90-95	rapid (caustic)	2 tons
Ground Burnt Lime	80-95	rapid (caustic)	$\frac{1}{1}$ -1 ton

Source: University of Reading and Dorset County Council 1931, 25.

In the late eighteenth century, John Claridge (1793, 18) wrote that 'a great deal of lime is used as a manure, and twenty hogsheads of four bushels each, per acre, is esteemed a good dressing.' It was, however, Stevenson (1815, 351-4) who gave most account of the application of lime to the land at this period. The true nature of lime was later better understood, when Henry Stephens (1871, 527-9) offered sound advice to farmers. Lime was taken from the kiln in lumps which were allowed to slake in the corner or head of a field before being progressively harrowed and ploughed in. Farmers applied the lime at different times of the year, but mostly in the spring or autumn.

Other uses of lime

Before the advent of Portland and other cements, lime was used extensively for building, where mortar was produced by the additon of slaked lime to sand. It continued to be sold to the building trade in the twentieth century. The banks of large kilns at Apsley and Foxholes at Poole would have produced lime for building works in the district and neighbouring Bournemouth. Lime for plaster and stucco work was burnt in Purbeck and at Uplyme, just over the Devon border. Hydraulic cement was manufactured at Lyme Regis, where Blue Lias stone was collected from tumbled masses on the beach and quarried from the cliffs behind. A cement factory was worked during the period 1850-1914, when there was also an associated limekiln. Cement stones were gathered at Charmouth, where a mill was built close to the shore in the 1850s. A limekiln (site 51) behind it seems to be related.

For the Dorset cottager, lime ash was used for laying hard floors, an improvement on beaten earth. White-wash was made from from lime and whiting. Victorian public utilities sought lime, for example, for softening water. The limekiln (site 275) which stood outside the Weymouth Gasworks in 1866 was undoubtedly to produce lime for purifying coal gas. A bushel of quicklime could treat up to 10,000ft³ (283m³) of gas (Tomlinson 1854, 741-2).

Early limekilns

Corfe Castle had the earliest known limekilns in Dorset. Medieval limekilns, referred to by Hutchins, were probably similar to two excavated at Portchester Castle in Hampshire (Cunliffe 1977, 56-60), but the earliest existing structure is a pit kiln at Wytch Heath (site 78), dating from agricultural improvements on the heaths in the early eighteenth century. Excavations showed it to have a single flue with raking pit and to be an intermittent or flare type, which was fired and allowed to cool before discharge (Cox and Hearne 1991, 104-7).

In the same parish, a lease of 1730 gave one William Cooper 'the free liberty and priviledge of making errecting and setting up a Lime kiln' at Ower, and a lease three years later refers to the 'new...Lime kilne' (DRO.D/RWR/T75/4). A map of 1772 shows such a limekiln on North Heath at Ower Passage (site 76, DRO.D/RWR/E16/9), while an accompanying map shows almost certainly two limekilns at Limekiln Close and Black Hills near Bushey (sites 75 and 71, DRO.D/RWR/E16/5). The Ower and Limekiln Close kilns, which had two flues each, are on a later map of 1805 (DRO.D/RWR/P3). Hutchins (1861, 511) noted a limekiln near St Edwards Bridge at Corfe Castle in 1753. Elsewhere, Isaac Taylor's Map of Dorsetshire shows a limekiln outside Blandford Forum in 1765 (site A9).

In the early nineteenth century, a single limekiln near Church Knowle (site 67) was recorded on the Old Series One-Inch map, surveyed in 1805-7. In the 1820s, limekilns are known from sources Christchurch (sites A2-3. documentary at DRO.D/RHM/2411) and the Cobb, Lyme Regis (site A8, SRO.DD/TOR 306), while 'a much magnified lime-kiln' is shown beside the beach at Charmouth in a picture made by C. Galpin in 1827 (DRO.D/PAV/8). It is interesting that in February 1825, one Thomas Hardy (the author's grandfather, who was a builder) advertised 'good well-burnt Lime' at Slyer's Lane Lime Kiln, within $1\frac{1}{3}$ miles of Dorchester (see Draper 1989, 18). Unfortunately, this kiln's location remains a mystery.

The lime-burners

Trade directories recorded very few lime-burners, as shown in 1793 (2), c1797 (1), 1830 (1), 1842 (4), 1848 (8), 1855 (12), 1859 (16), 1867 (12), 1880 (8) and 1895 (6). Lime merchants were recorded in 1867 (7) and 1880 (5). The directory for 1903 entered only six lime-burners and an additional five merchants in Dorset, yet contempory maps show at least 100 limekilns still in use. This supports the view that most lime-burners were farmers, and those worthy of entry were commercial burners. Occasionally, there is a 'farmer and limeburner', like John Dunn of Beaminster in 1848, or David Lane of Woodbury Hill, Bere Regis, in 1865. Henry Smith of Stoke Abbot appears only as a 'farmer' in 1895, yet surviving ledgers show he was selling lime to many customers at that time (DRO.D/SSA/E5-7). The entry for c1797 was for Samuel Evans, a 'maltster and limeburner at Blandford Forum. Other dual occupations in 1865 included Abraham Gillingham, a shopkeeper at Bishop's Caundle, while Henry Roper was more appropriately a 'builder, quarryman and limeburner' at Upwey. John Roper had a limekiln here in 1826-46 (DRO.D/FFO/13/26 and 28). An accident report of 1880 refers to a Mr Roper's limekiln, as well as one belonging to John Watters, a 'lime merchant who keeps the Royal Oak Inn' (Dorset County Chronicle 18 March 1880). Lime-burning could be a profitable sideline to quarrying, and in 1858, 'Johnson's Quarry' and Gannetts Quarry near Marnhull both produced stone for building and lime (Hunt 1858, 146-7).

Twentieth-century trade

Most of the rural limekilns ceased to work during the early twentieth century, but a few continued until the Second World War. For example, Waddon Hill was worked by the local farmer until about 1937-9 (pers. comm. D. Tolley), while that at Bothenhampton was still an 'excellent limekiln in working order' when sold in 1945 (DRO.D599/2/8). There was also new activity by commercial lime-burners. On Portland, Sydney Milverton and Sons worked the Avalanche Road limekiln until the mid-1920s when they started a larger kiln at Inmosthay for builders' lime. In 1928, they took over the Whitesheet Hill chalk pit near Maiden Newton where an existing kiln was used and a new one built alongside. The site was taken over in the early 1950s by Soil Fertility Ltd, who rebuilt the two kilns and produced agricultural lime for about twenty years. Milvertons continued at Inmosthay until 1959 (pers. comm. A.E. Milverton). Also on Portland, W.F. Davies built a bank of four limekilns at Wide Street in about 1939 and produced agricultural lime during the war years. A unique limekiln in Dorset was a steel shaft type which was erected at Worth Quarry by 1925. Ten years later, Swanworth Quarries Ltd were still listed as lime-burners.

The site at Shillingstone Hill was a small chalk pit with three farmer's kilns when W.G. Bailey of Corston, Somerset, came here in 1924. The Shillingstone Lime and Stone Co. Ltd. was formed by 1931, and a bank of five new kilns was built in 1936-8, along with the main hydration plant. Two pairs of kilns are still burning (Plate 1). The burnt lime falls through iron bars and is removed by conveyor into the lime shed, where it is fed into the original swing-hammer crusher installed in 1928 (a 'No. 2 Lightning Crusher'). From here a conveyor raises the lime to the hydration plant. In 1993, the site had an annual output of about 1,000 tonnes of hydrated lime which found a market with builders' merchants in the South West and for restoration work at historic buildings. In addition, 15-20,000 tonnes of crushed chalk was supplied as agricultural 'lime'.



Plate 1. Two pairs of limekilns burning at Shillingstone Limeworks, with hydration plant beyond. June 1989.

Dorset limekiln types

The basic rural limekiln recorded in this Dorset survey was the draw or running kiln, a type which was burnt continuously for weeks or intermittently for a single firing. Limekilns are difficult to date. Hunt (1987, 137) gives an eighteenth-century date for Woolcombe Farm (site 265), but the majority of surviving structures in Dorset must belong to the early to mid-nineteenth century.

Figure 1 shows the features of a 'typical' Dorset draw kiln, built into a bank with protective wall around the top or kiln head. Construction was of stone, with thick insulating walls. The shape of the brick-lined pot (charging hole, well or burning cone) was like an inverted bottle, round with vertical sides tapering towards the base where there was an iron grate or grill. The main feature was a single draw arch (access arch) in the front wall. It opened into a recess or lobby which narrowed towards the back wall where the draw-hole (eye) provided the draught to the kiln and the means for drawing out the burnt lime. Above the draw-hole, poking holes were small square openings through which an iron rod (bar) was inserted to test the extent of burning and loosen the charge should it become stuck.

It was common for a lime shed to be attached to the front of the kiln, covering the draw arch and giving protection from the wind and rain to the working area where the burnt lime was being handled. Deep access tunnels served the same function at seven large commercial-sized limekilns, at Apsley Limeworks (site 174-5) and Shillingstone (site 228-32). The latter have an additional shed in front where the lump lime is ground by machine before further processing.

With two exceptions, the few double kiln banks were for the larger commercial kilns operated by lime merchants, mostly in the twentieth century. Map evidence suggests the kiln banks at Foxholes (sites 176-9) were two pairs of converted Suffolk kilns, more usually associated with brickmaking and fired intermittently. In contrast, a modern steel cylinder type of limekiln was operated at Worth Quarry (site 290) in the 1920s and 30s.

Working practice

The limestone or chalk was delivered by cart or barrow to the kiln head, where it was broken down by sledge hammer to fist-sized pieces before being tipped into the pot. One side of the kiln head, or an area close by, was reserved for storing the fuel, which was mostly culm or slack coal. To light a kiln, sticks and culm were first placed on the grate or bars at the bottom of the pot, then a barrow-load of stones, followed by another layer of culm and two loads of stone. The kiln was then lit and once it had taken, more stones were added. Charging continued, using a wheelbarrow to tip in alternate layers of fuel and stone in the usual proportions of one to four until the kiln was full. It was important to have voids between the stones, for the even distribution of heat and to allow the escape of carbon dioxide ('carbonic acid').



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As the burning proceeded and the lime was extracted through the draw-hole at the bottom, the charge sank down and more fuel and limestone were added. It might take three to four days for the charge to descend through the kiln, the time depending on such variables as the size of the kiln, the draught and the type, density or dryness of the fuel and limestone.

Controlling the burning was an art. Overburning was wasteful in fuel and the stone might become vitrified, while underburning produced an unburnt core which had to be returned to the kiln. The process needed a good air distribution, and the draught was regulated through the iron draw-hole door, if fitted. The top of the kiln was usually open, but sometimes might be covered with turves to retain the heat. Calcination was complete if the charge gave little resistance when a bar was driven in to test it.

The knobs of lump lime retain the shape of the original stones, but are considerably lighter in weight and break down readily to a powder when slaked. In the lime shed, the lime was bagged, barrelled or stored in bulk. It might be slaked here, or by the purchaser. Most sheds had wide doors to enable the lime to be loaded direct to a cart or waggon.

Accidents

Recorded fatalities were due mostly to the effects of 'carbonic gas inhaled,' as was the case of a carter and labourer named Charles Wheeden in a limekiln at Ridgeway (DCC 18 March 1880). Children were the saddest victims. On 1 August 1832, four boys aged six to eight climbed over the wall of a Langton Herring limekiln to get down to the heated limestone, where they were overcome and suffocated (DCC, 9 August 1832). Another tragedy occurred one morning in October 1863, when fifteen-year-old James Burt of Shroton fell into the burning limekiln at Melbury Hill in October 1863, while his father and the lime-burner were loading a waggon with lime (DCC 8 October 1863).

A potentially dangerous practice was recorded in 1893, when the geologist George Harris visited quarries at Halfway House (site 166) and observed 'the gunpowder was kept inside a lime-kiln, within a few feet of the furnace doors - to "keep it dry" (BGS.I/969). The kiln and its lime shed are still intact!

The cost of lime

In the 1790s, lime cost $4\frac{1}{2}d$ per bushel (Claridge 1793, 18). A few years later, Stevenson (1815, 352-3) reported that at Sherborne, lime was sold for 6d a bushel, 'but it is supposed farmers can burn it for their own use for $2\frac{1}{2}d$ or 3d a bushel.' Prices were similar in the 1890s, when Waddon Hill lime was sold at 1s 8d per hogshead, or 5d a bushel (DRO.D/SSA/E5). For comparison, prices at Shillingstone in 1993 were about £80 per tonne for hydrated lime, compared with £9 per tonne for ground chalk, excluding transport costs.

Transport

Stevenson (1815, 352) observed that lime was 'carried down very steep hills in panniers by asses,' and it must have been a busy scene when a limekiln was being discharged. Carts were used where roads allowed. In the late nineteenth century, lime was bought at Waddon Hill limekiln (site 249) by farmers and builders in the district. For example, William Tucker of Park Farm, Chideock (eight miles distant), carted away twenty hogsheads a day over 28 days in December 1889-January 1890 (DRO.D/SSA/E5). This represented three tons a day, enough to lime one acre if spread as recommended by Stevenson.

Fuels for lime-burning

The early Corfe Castle accounts mention brushwood, timber and 'sea-coals', and later references suggest a mixed fuel. Where there was a good local supply, furze or faggots were used. Even lignite may have supplemented these fuels at Wytch Heath (Cox and Hearne 1991, 107).

Coal brought coastwise from Wales or the north-east of England to the Dorset ports was available in their immediate hinterlands. Marshall (1796, 145) referred to lime-burning 'with Welch culm; at least in the Bridport quarter.' Culm was broken

Figure 1. Features of a typical Dorset draw-kiln of the nineteenth century.

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anthracite mixed with small coal dust, which could not otherwise be sold, but was ideal for lime-burning. Seven out of eight samples collected from limekilns during the survey were identified as anthracite (sites 11, 80, 132, 207, 212, 265 and 294). In 1893, Neath culm was shipped to a Somerset port such as Bridgwater or Highbridge and thence by rail to a siding at Crewkerne station, where it was purchased for the Waddon Hill limekiln (DRO.D/SSA/E5). It was then easier and cheaper to get this coal via the railways than through the harbour at West Bay. Coke from gasworks was used in the later nineteenth and twentieth centuries. A mixture of 'petroleum coke' and slack coal is used at Shillingstone today.

THE SURVEY

This survey was undertaken between April 1992 and October 1993, to establish the total number of limekiln sites and the extent of their survival in Dorset. Just over 300 limekilns were located (Appendices 1 and 2). There must remain a few which have been overlooked, but it is now at last possible to see the distribution of lime-burning as a whole (Figure 2).

Map sources

The second edition Ordnance Survey 25-inch (1:2500) scale maps of 1900-2 were the primary source for investigating limekiln



Figure 2. Distribution of limekiln sites in Dorset, with limestone and chalk geology.