CHALK QUARRYING IN SURREY *c.* 1800-1914 AN HISTORICAL ANALYSIS

BY
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INTRODUCTION

THE subject of chalk quarrying and lime burning in Surrey during the nineteenth century has already been discussed in two recent volumes of the *Surrey Archaeological Collections* (see Robinson and Cooke 1962 and Gravett, Wood and Gollancz 1967). This paper attempts to expand this theme, both in space and time, by examining the changing geography of the industry within Surrey between 1800 and 1914.

The paper begins with a reconstruction of the geography of chalk quarrying and lime burning in Surrey at the turn of the eighteenth century, thus providing a datum against which subsequent developments are measured.

The next section examines the period 1800 to 1850 and consists of three case studies, namely the chalk quarries at Dorking, Guildford and Merstham, which highlight significant trends within the industry before mid-century.

The third section, in analysing the records of the Merstham Lime Works, traces the relationship between railway expansion and the growth of the chalk and lime industry in Surrey after 1850. The penultimate section, based upon official quarrying statistics, is a reconstruction of the industry at the end of the century.

The paper concludes with a comparison of the locational patterns of chalk quarrying in 1800 and in 1900, whilst at the same time offering some general observations on the development of chalk quarrying in Surrey throughout the nineteenth century.

THE SOURCE MATERIALS

The picture of chalk quarrying and lime burning in nineteenth-century Surrey which emerges from contemporary sources is fragmentary. Information both in time and space is neither uniform in quality nor quantity about all aspects of the industry. In the light of this problem of coverage it has first seemed desirable to examine the limitations and potential of the available sources before proceeding any further.

Broadly speaking the sources which have been used are either literary, statistical or cartographic in nature and will be examined under these headings.

Literary Sources

There are two major types of literary source from which evidence has been derived.

First, there is the group of agricultural writings and reports which described Surrey in the early nineteenth century. Between 1790 and

1810 a wealth of such material appeared, covering in detail the agricultural and general economic geography of Surrey for this period. Of these works, Malcolm's *Compendium of Modern Husbandry*, written in 1805, is the most valuable, providing the earliest and most complete account of the then basically rural industry of chalk quarrying and lime burning. Malcolm's work not only provides a list of the largest Surrey chalk quarries at the turn of the century but also devotes considerable attention to other aspects of the industry such as the nature of markets, and costs of transporting chalk and lime. As such the information it gives is far more detailed and comprehensive than that contained in either of the Board of Agriculture Reports for Surrey or in the Reports for other chalk-consuming counties;[1] it thus forms the basis from which the nature of chalk quarrying in Surrey at the beginning of the nineteenth century has been reconstructed.

A later source in this agricultural category is Evershed's 'Prize Report on the Farming of Surrey'. Written in 1853, this has been used to compare chalk quarrying and lime burning for agriculture at mid-century, with the position in 1800. This Report devotes considerable attention to the use of lime in Surrey in 1853 and provides, though indirectly, valuable information on the condition of the industry at this date.

In contrast to the agricultural writings and reports the second group of literary sources comprises the several county histories, topographies and town guides which appeared in Surrey throughout the nineteenth century.[2] Besides antiquities, it was only the exceptional which caught the eye of the traveller or the attention of the historian. Both the area and material covered depended upon the whim of the author and in most cases reference to a chalk quarry or lime burning was merely incidental to a more unusual topic. However, in this concern for the unique and the unusual this group of sources provides valuable insight into the nature and the relationships behind the development of some large scale quarries and limeworks in Surrey, particularly in the period prior to 1850. Compared with the agricultural writings, however, these sources are not only biased but inaccurate. For example, care must be taken in dating the information they contain, for often data are copied word for word from earlier sources. In this respect Malcolm's account of chalk quarrying and lime burning in 1805 has been widely plagiarised by later writers and the pattern of operations at the turn of the nineteenth century thus fossilised in subsequent accounts.

Considered together these two categories of literary sources provide most of the available data from which the geography of chalk quarrying and lime burning before mid-century has been reconstructed. The agricultural writings provide an extensive and unbiased view of the day-to-day nature of the industry *c.* 1800; while the second category allows an analysis of some of the more significant features in the development of the industry up to 1850.

[1] See for example the Board of Agriculture Reports for the counties of Kent, Sussex, Hampshire and Wiltshire.

[2] See for example Manning and Bray (1809), Allen (1828), Brayley (1841) and Smith (1828).

Statistical Sources

The material concerning Surrey chalk quarries and lime works in this category is mainly legal, commercial or official in nature.

For the chalk quarries of the Guildford area of Surrey an extensive collection of leases and agreements concerning the conveyance of quarries and the sale of chalk has been used.[3] Dating between 1770 and 1840 these documents describe conditions of tenure, methods of working, and the general day-to-day running of chalk quarries in this area, thereby supplementing the information of the literary sources for this period.

More specific are the records which have survived, relating to the carriage of chalk and lime from the various Guildford quarries by means of the River Wey Navigation. These begin as early as 1776 though the main record extends in an unbroken series from 1827 to 1914.[4] The most valuable of these is the first series from 1776 to 1778, which relates solely to the riverage of chalk and lime. For by 1827 little use was made of the Wey Navigation for the distribution of Guildford chalk and lime, and these records therefore no longer provide an indication of the level of quarrying activity in the area. However, despite these limitations these early riverage records are invaluable in providing the first, though indirect, quantitative record of the industry in Surrey.

Far more comprehensive and indeed the only complete record known to have survived for a chalk quarry in nineteenth-century Surrey are the records of the industry at Merstham.[5] These business records extend back in broken series to 1872. They have suffered considerably from damp and only a few were at present available for study. The journal or day book of the works for 1872-6 has been extensively used for it provides a daily analysis of outward business during this period, mostly the sale of grey lime. This together with other of the records such as the Merstham Trade Ledgers and Wages Book has allowed a detailed analysis of the activities of this quarry and limeworks at a significant stage in the evolution of the industry within Surrey – the period following the consolidation of railway expansion. However, the existence of these records is probably due solely to a provision in the lease of the Merstham limeworks that accounts should be prepared. No other business records are known to have survived for any other of the Surrey quarries and limeworks.

With the passing of the Quarries Act in 1894 all quarries more than twenty feet in depth were bound to supply their annual figures of production and employment to the Inspector of Mines. From 1895, therefore, the Reports to H.M. Secretary of State for the Home Department by H.M. Inspector of Mines provide accurate statistics on chalk quarrying both in Surrey and in the other English chalk-producing

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[3] Leases re chalk pits and quarries near Guildford. G.M.R. LM 358/117/1-4.

[4] Wey Navigation diaries G.M.R. 129/2/10–15.

[5] Business Records and leases relating to Merstham Lime Works S.R.O Acc. 566 and 641.

counties.[6] Unfortunately statistics are not disaggregated below county level and thus do not directly indicate the relative size and importance of Surrey quarries between 1895 and 1914. However, these Reports do allow an accurate cross-section of the industry to be drawn for the period at the end of the nineteenth century.

Cartographic Sources

A severe handicap in the analysis of chalk quarrying in Surrey before *c.* 1870 is the inadequacy of map sources in the coverage of the industry. Of the sources used in this study the six-inch Ordnance Survey coverage of Surrey *c.* 1870 is the first to show the distribution of quarries both large and small at county level.

Before this date even fairly large scale maps such as the Surveyor's Drawings prior to the one-inch Ordnance Survey[7] fail to show all but the largest of quarries and are thus of limited value. Theoretically it would have been possible to reconstruct the distribution of chalk quarries in Surrey before 1870 from tithe maps but it was felt that such a task was beyond the scope of this study. Use of this source therefore has been confined to selected parishes.[8]

Thus the major cartographic source used in this analysis is the six-inch Ordnance Survey of Surrey *c.* 1870. This provides a comprehensive cross section of the distribution of quarries after the railway age as well as suggesting – as will be seen later – the probable distribution at the beginning of the century.

The sources described above are not exhaustive as regards the subject of chalk quarrying and lime burning in Surrey during the nineteenth century. However, they do represent a stage beyond which further investigation of more indirect original sources, such as the tithe maps or local newspapers, would have yielded diminishing returns and has thus not been attempted.

CHALK QUARRYING IN SURREY *c.* 1800

According to one authority writing at the beginning of the nineteenth century 'chalk pits or quarries were very abundant in Surrey' (Stevenson, W., 1809, I, 496). Unfortunately the detail behind this generalisation is hard to establish, though a more precise account of numbers and distribution of quarries is given by Malcolm: 'the chalk stone quarries are at Godstone, Catterham, Reigate, Merstham, Buckland, Beachworth, Epsom, Leatherhead, Bookham, Effingham, W. Horsely, Clandon, Stoke near Guildford, Guildford and Puttenham' (Malcolm, J. A., 1805, I, 57) while other sources describe chalk quarries at Dorking, Sutton and Croydon.

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[6] Annual Reports by H.M. Inspector of Mines 1895–1914, in Cambridge University Library.

[7] Surveyors' Drawings for Surrey in Map Room, British Museum. See also Stockdale's Map of Surrey (1798), Cary's Map of Surrey (1801), Bryant[0]s Map of Surrey (1828) in S.R.O.

[8] Tithe maps for the parishes of Banstead, Betchworth, Caterham, Coulsdon, Dorking, Leatherhead, Merstham, Shalford, St Nicholas Guildford, and W. Horsley in S.R.O.

However, it is not possible either from these sources alone or from contemporary maps to estimate the number of pits and quarries active at each of these chalk quarrying centres at the beginning of the nineteenth century. Therefore the first edition six-inch Ordnance Survey maps have been used for this purpose. Surveyed in Surrey between 1866 and 1870 they show in detail the distribution of the many disused and the fewer active, quarries at this date. Where a quarry, whether abandoned or not, is shown on this later coverage of Surrey it has been assumed that it was in existence and, as later evidence would suggest, probably active at the beginning of the century. This interpretation gives a total of roughly a hundred chalk quarries operative in Surrey in 1800, distributed mainly along the northern and southern edges of the chalk outcrop (see Fig. 1).[9]

TABLE I

LIST OF QUARRY LOCATIONS TO SUPPLEMENT FIGS 1, 5 AND 7.

1	Dorking	18	Clandon
2	Brockham	19	West Horsley
3	Betchworth	20	East Horsley
4	Buckland	21	Effingham
5	Reigate	22	Bookham
6	Merstham	23	Leatherhead
7	Coulsdon	24	White Downs
8	Caterham	25	Epsom
9	Whyteleafe	26	Epsom, No. 2
10	Kenley	27	Highfield Farm, Epsom
11	Oxted	28	Kingswood
12	Riddlesdown	29	Chipstead
13	Seale	30	Belmont
14	Puttenham	31	Banstead
15	Guildford Station	32	Sutton
16	Guildford	33	Purley
17	Merrow	34	Haling

It must be stressed, however, that at this date the majority of quarries were worked along very casual lines and were consequently fairly small. A lease concerning a chalk pit near Guildford, dated 1772, indicates the nature of the early exploitation of chalk in Surrey. The lessee was bound

> not to permit or suffer the said chalk pit (The Quarry Chalk pit) to be shut up or kept from digging chalk. But that he . . . shall use his utmost endeavour to supply all people that shall apply for chalk nor deny chalk to any person or persons who shall require the same paying the usual accustomed price.[10]

In this case it would seem that anyone was free to dig chalk at the quarry on payment to the landlord 'of the usual accustomed price'. The only equipment required was a pick or crowbar to remove the chalk from the face and a cart to carry it away. Thus quarries were 'generally wrought without much expense or difficulty' (Stevenson, W., 1809, 1. 496), and the employment of regular quarrymen was unnecessary. This

[9] Tithe maps for the parishes of Banstead, Betchworth, Caterham, Coulsdon, for chalk, which peppered the chalk outcrop throughout the nineteenth century. They have been disregarded in this analysis, which is concerned only with the more organised forms of chalk quarrying in Surrey.

[10] G.M.R. 43/449.

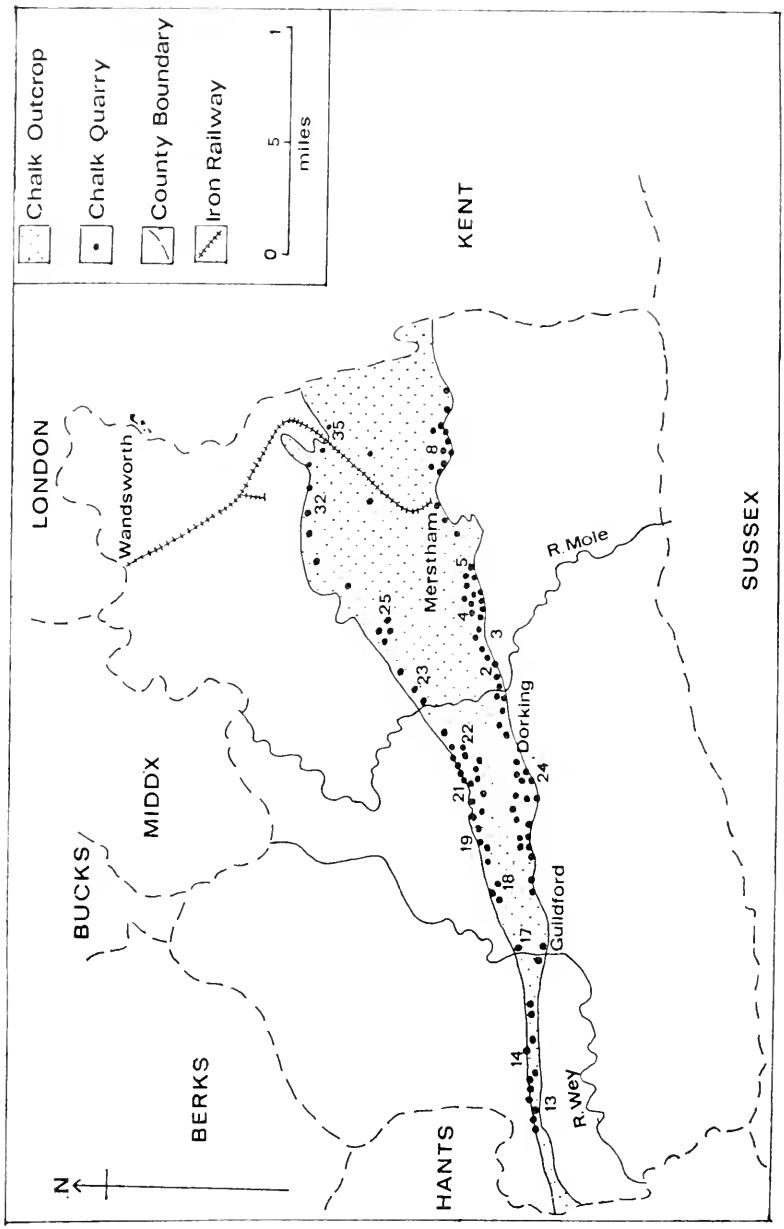

FIG. 1. PROBABLE DISTRIBUTION OF CHALK QUARRIES IN SURREY *c.* 1800.
For locations of quarries see Table I.

situation, coupled with the fact that most quarries were exploited on an *ad hoc* basis when and where demand arose, in part explains the large number and small size of chalk quarries active in 1800.

As regards the demand for Surrey chalk and lime at this date Stevenson states that it was employed almost 'solely for the purposes of agriculture', i.e. as an improver of heavy clay and acid soils (Stevenson, W., 1809, 55). According to Malcolm the widespread use of chalk and lime in Surrey was readily explained for:

> As this county not only contains a great tract of chalk hills, which divide it longitudinally into two parts; but also possesses soils extending from the base of these hills to the southern and western extremity of it, which are peculiarly proper for all calcareous manures; it will almost follow as a consequence, that chalk, either native or calcined, is used to a considerable extent (Malcolm, J. A., 1805, II, 31).

Around 1800 therefore the major area of demand for Surrey chalk and lime was confined to the south of the county, the Surrey Weald and in particular

> in that tract of country which extends to the southward from Godstone, Reigate, Dorking and Guildford to the extent of the country . . . (Malcolm, J. A., 1805, II, 39).

Though there were preferences for chalk from particular quarries such as the ones at Godstone, in 1800 chalk was dug at various locations

> according as the farmers are more or less intelligent, according to the system of farming pursued by them, and the difficulty or facility of getting at it, or of procuring other sorts of manures. (Malcolm, J. A., 1805, I, 57).

Of these factors that of accessibility, 'the difficulty or facility of getting at it', was perhaps the most crucial in determining the location, distribution and number of chalk quarries in Surrey in 1800. Of the quarries shown on Fig. 1, nearly all were located either directly on, or had access to, a north-south or east-west road and such a location was a general prerequisite for the exploitation of chalk at this date.

Even then, however, the inadequate transport facilities of the day, especially the clay tracks of the Surrey Weald, severely limited the economic distance of carriage from a quarry. Where chalk was burnt into lime at the pit it cost between £7 and £8 a kiln, but at a distance of 7 to 12 miles from the pit the price was usually from £10 to £14 the kiln (Malcolm, J. A., 1805, I, 59). This increased cost, due to transport over the poor roads of the Surrey Weald, rose precipitously away from the pit. Market areas were therefore limited; a distance of ten to fifteen miles would seem the maximum, and this resulted in a large number of small chalk quarries to satisfy this geographically restricted demand.

Also, because of the prohibitive costs of transport it has been demonstrated that in most cases

> it was much cheaper to burn the chalk in the Weald rather than at the quarry since this would have involved many more miles of transport and an increased cost of the finished product.[11]

Lime kilns were therefore quite distant from the chalk supply although

[11] Robinson D. J. and Cooke R. U. (1962) 25.

situated as close as possible to fuel supplies. This separation of the processing from the extractive stage of chalk quarrying in 1800 served further to enforce the pattern of many small quarries, by preventing the realisation of economies of scale within the industry.

This section has shown that in 1800 chalk quarrying and lime burning in Surrey was essentially a rural industry and that factors such as the intermittent nature of agricultural demand, limited market areas, and the general nature of exploitation were the reasons behind the large number of small quarries operative in Surrey at this date.

CHALK QUARRYING BEFORE 1850: THREE CASE STUDIES

The previous section showed that the great majority of quarries in 1800 were producing chalk and lime solely for agricultural purposes. A few, however, were producing lime for the London building trade and such quarries according to Malcolm were to be found at Dorking, Merstham, Sutton, Carshalton and Guildford (Malcolm, J. A., 1805, 1, 51). The relationships behind this early industrial development are examined in this section and in particular for the chalk quarries and lime works at Dorking, Guildford and Merstham.

The Dorking Chalk Pits

During the first half of the nineteenth century three pits were worked in the Dorking area of Surrey. The largest of these Malcolm describes as a 'pit of excavation . . . not less than 40 ft. and its diameter perhaps 40 rods' (Malcolm, J. A., 1805, 1, 50). This one pit supplied chalk for six lime kilns while the other two served three kilns. Compared with the smaller agriculturally orientated chalk pits elsewhere, the Dorking pits represented a considerable industrial installation operated along organised lines:

> these pits employ daily a great number of hands in digging, wheeling, preparing, charging, burning, emptying and loading the lime; and there appears scarcely a possibility of calculating their termination. (Malcolm, J. A., 1805, 1, 50).

This situation had arisen from the great demand for Dorking lime which prevailed at the beginning of the century.

> At Dorking are the best pits of the country, if not of the kingdom. The stone that is here burnt into lime is sought after by every mason and bricklayer in London as well as in the county for a very considerable distance, who has either brick or stone to lay, when the work is required to be particularly neatly executed to set hard that is to unite firmly with the brick or stone, or to resist water (Malcolm, J. A., 1805, 1, 51).

Other contemporary and later sources comment on the superiority of Dorking lime. An interesting reference is to be found in a building contract for the construction of the Wey and Arun Junction Canal dated 1814, which stipulates that the mortar to be used should be made of the best Dorking water lime,[12] and there were considerable penalties

[12] Surrey R.O. Acc. 209.

for using other inferior materials. Dorking lime, therefore, was undoubtedly in great demand at the beginning of the century, but its superiority over other Surrey limes was in part a fallacy. Derived in part from lower or grey chalk it was undoubtedly suited for use in the building trade as mortar, for the impurities which it contained ensured a lime more like cement than that produced from the upper white chalk, quarried on the dip slope of the Surrey downs. However, equally resistant limes could be and were produced at the beginning of the nineteenth century from chalk quarried at the Reigate, Guildford and Merstham sites working the greystone chalk strata.

The size of the Dorking pits therefore cannot be solely explained by the perceived superiority of their lime, for equally important was the facility with which this lime could be carried to London. Consignments were sent first by road to Kingston and then via the Thames to London, with a back carriage of coals as fuel for the lime kilns. Given the high costs of road transport at that time Dorking chalk enjoyed a considerable comparative advantage, for the road from there to Kingston was comparatively straight and there were no steep hills to negotiate as there were for other quarrying centres such as Reigate.

Accessibility to markets was thus a key factor in the early development of large scale quarrying at Dorking. With the provision of more uniform transport facilities other centres developed and Dorking lost her monopoly. Bright, describing Dorking in 1884, noted that though

> the lime works are still in operation and furnish some of the best lime in England for building purposes . . . the lime mania which once existed has passed away (Bright, J. S., 1884, 136).

The Guildford Chalk Pits

Describing the town of Guildford in 1828 W. C. Smith drew attention to the 'immense quarries of chalk in the vicinity' (Smith, W. C., 1828, 26). Despite the fact that Guildford chalk was considered to be 'an inferior sort' in comparison with the stone to be found at Dorking, Merstham, Sutton and Carshalton it was nevertheless here that chalk was first exploited on a large scale for industry in Surrey.

For while Guildford chalk did not possess any natural advantages of quality it nevertheless enjoyed the then considerable advantage of water transport and thus easy access to distant markets, probably the London building trade. The preamble of an agreement for the riverage of lime between two London building merchants and the proprietors of the River Wey dated 1775 illustrates this use of the Wey Navigation and the stimulus it gave to the development of chalk quarrying and lime burning in the area

> Sam Meeke, Timber Merchant and Henry MacCleod of St Marylebone in the Co of Middlesex, Builder, having erected several kilns and other Works for burning and making lime near Guildford in the Co of Surrey are preparing to supply the London Markets therewith and carrying the same to London by Way of the Navigation on the River Wey.[13]

[13] G.M.R. 129/46 1–46.

Thus even though Guildford lime was considered inferior, the direct and cheap access to London provided by the River Wey resulted in the early development of the industry in this area. Between December 1776 and June 1778, 5,675 tons of lime were carried between Guildford and London, with a considerable backcarriage in coals which not only fuelled the lime kilns but in turn made the riverage of lime more economical (see Table II).

TABLE II

LIME AND CHALK IN TONS* CARRIED FROM GUILDFORD TO LONDON ON THE WEY NAVIGATION 1776–8

	Lime	*Chalk*
1776 December	1258	—
1777 March	411	—
1777 June	1445	30
1777 September	1435	100
1777 December	707	—
1778 March	375	—
1778 June	42	—
	5673	130

* Before 1850 cargoes on the Wey were measured in 'loads'. A conversion factor of 25 cwts to the load has been calculated (Vine, P. A. L. 1965).
Source: G.M.R 129/46/1–46.

There are no other existing records concerning the shipment of chalk and lime on the Wey until 1827, when the Wey Navigation Down Diaries begin. These records show that by 1830 the carriage of lime to London had virtually ceased. Instead traffic was confined to the delivery of small and irregular loads of raw chalk to riverside lime kilns at the various wharves between Guildford and the Thames at Weybridge (see Fig. 2).

By this date it is likely that 'the immense quarries of chalk in the vicinity' of Guildford were producing lime solely for agricultural demand in the Surrey and Sussex Weald, while improved road and other forms of transport such as the Surrey Iron Railway allowed the demands of the London building trade to be satisfied by others of the Surrey pits.

However, for a low value, bulky raw material such as chalk which loses little weight in processing, water transport was ideal and almost vital for distribution in large quantities; this factor in the form of the Wey Navigation more than anything explains the immense size and early development of the Guildford pits compared with other Surrey chalk quarries prior to 1850.

The Merstham Chalk Pits

Neither Cary's County Map of 1801 nor the Surveyor's Drawings 1806 show the Merstham chalk pits and lime works. Yet in 1809 Manning and Bray state that at Merstham 'the business of lime burning is

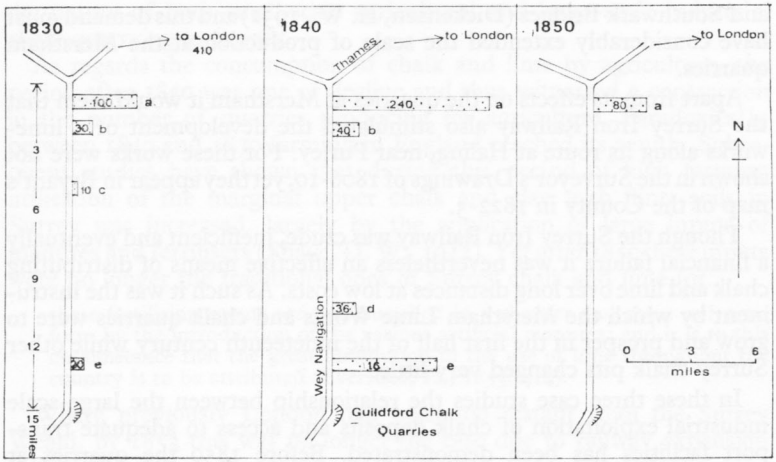

FIG. 2. RIVERAGE OF CHALK ON THE WEY NAVIGATION.

a: Black Boy Bridge, *b:* Newhaw, *c:* Pyrford, *d:* Send, *e:* Stoke.

(The stippled areas indicate quantities of chalk, in tons, delivered to the wharves in question.)

Source: Wey Navigation Diaries.

now carrying on with great alacrity' (Manning, O., and Bray, W., 1809, II, 253). Unless these early maps did not attempt to show limeworks it would seem that between 1801 and 1806 any works at Merstham were too small to be shown, and that a radical transformation had then occurred before 1809.

The key to this development would seem to be the extension of the Surrey Iron Railway, opened between Wandsworth and Croydon in 1803, to the quarries at Merstham in 1805 (see Fig. 1). The first public railway sanctioned by Parliament independent of a canal, the Surrey Iron Railway, was nothing more than a set of iron rails forming a channel for the wheels of horse drawn trucks. Yet at that time it was a revolutionary form of transport; the loads which could be pulled on it by a single horse were phenomenal when compared with those possible on the poor roads of the day.

Malcolm, perceptive as ever, describes its significance in extending the market area of Merstham lime and thus the extent of the chalk quarries

> The iron railway may be considered a prosperous undertaking from the traffic on it every day increasing . . . and from the demand for the valuable production of the Merstham quarries and pits every day gaining ground, and which only required the opportunity of carriage now afforded by railroad to become of general use in the metropolis (Malcolm, J. A., 1805, III, 447).

It is known that Merstham lime was used in many of the great public works of the early nineteenth century, notably the Waterloo, London

and Southwark Bridges (Dickensen, H. W., 1931) and this demand must have considerably extended the scale of production at the Merstham quarries.

Apart from its effects on the quarries at Merstham it would seem that the Surrey Iron Railway also stimulated the development of a lime-works along its route at Haling, near Purley. For these works were not shown in the Surveyor's Drawings of 1806-10, yet they appear in Bryant's map of the County in 1822-3.

Though the Surrey Iron Railway was crude, inefficient and eventually a financial failure it was nevertheless an effective means of distributing chalk and lime over long distances at low costs. As such it was the instrument by which the Merstham Lime Works and chalk quarries were to grow and prosper in the first half of the nineteenth century while other Surrey chalk pits changed very little.

In these three case studies the relationship between the large-scale industrial exploitation of chalk deposits and access to adequate transport facilities has been demonstrated. Before 1850 the quarries at Dorking, Guildford and Merstham were far larger and more organized than any others in Surrey (see Table III). As such this development was mainly associated with their respective advantages in road, water and rail transport.

TABLE III

SIZES OF SOME SURREY CHALK QUARRIES *c.* 1840

Location of Quarry		*Size of Quarry*		
		Acres	*Rods*	*Perches*
St Nicholas Parish, Guildford	No. 1	—	3	35
" " " "	No. 2	1	2	15
" " " "	No. 3	1	5	—
" " " "	No. 4	3*	–	8
Shalford Parish, Guildford	No. 1	8*	2	8
" " "	No. 2	4*	0	0
W. Horseley Parish	No. 1	—	1	32
" " "	No. 2	—	1	36
" " "	No. 3	1	1	1
Leatherhead Parish	No. 1	—	2	29
Dorking Parish	No. 1	9*	–	12
" "	No. 2	3*	1	31
Merstham Parish	No. 1	10*	0	3

*The case-study quarries.

Source: Tithe Apportionments *c.* 1840.

RAILWAY EXPANSION AND CHALK QUARRYING AFTER 1850

During the period 1830-1848 the two basic lines of the Surrey railway network were established. These were the South Eastern line to Dover and the Brighton Main line, from which subsequent routes were to spring (Course, E. A., 1958). Their growth had far reaching effects on

the nature of both small-scale agricultural and large-scale industrial chalk quarrying in Surrey.

As regards the consumption of chalk and lime by agriculture, the period after 1850 was one of decline and thus witnessed a contraction in the number of quarries producing for agriculture. Paradoxically between 1840 and 1870 farming in England reached its zenith. Subsequent studies have shown that during this period of high farming utilisation of the marginal upper chalk and clay with flints soils in Surrey was increased, largely by the application of large inputs of manures and fertilisers (Shave, D. W., 1942). Yet after 1850 these inputs were no longer the traditional ones of Surrey chalk and lime for

> these fertilising agents are now supplied in a cheaper and more universal form by the introduction of the various artificial manures; and it is to this circumstance that the great diminution in the use of lime throughout the country is to be attributed (Evershed, H., 1853, 414).

Where previously London had been too distant from the Surrey Weald, by 1853 this was no longer the case due to railway expansion and thus

> In consequence of the convenience of carriage great varieties of manures are procured from London and elsewhere; those chiefly used are guano, bone dust, superphosphate, malt dust, ashes, salt and soot (Evershed, H., 1853, 404).

As regards the use of lime in Surrey in the 1850's it was almost exclusively confined to the various soils lying within convenient distance of the chalk, and whereas in 1800 chalk and lime were often carted distances of ten to twelve miles over the poor roads of the Surrey Weald, in the 1850's

> when much cartage is employed, guano is preferred as a cheaper and more efficaceous manure; and almost the only instance of lime being extensively used . . . is when the kiln is situated on the farm, and the materials for burning are near at hand and not otherwise valuable (Evershed, H., 1853, 414).

With the provision of cheap and adequate rail transport in Surrey, chalk and lime faced increasing competition from the more popular and cheaper artificial manures, distributed by rail from London and elsewhere. Consequently agricultural demand for chalk and lime in Surrey diminished considerably, and many of the smaller chalk quarries serving only local markets then fell into disuse.

As regards chalk quarrying and lime burning for industrial demand, railway extension in Surrey and the south east led to the concentration of activity in fewer and larger pits, by enabling them to serve wider lime consuming areas than before.

An advertisement which appeared in the *Maidstone and South East Gazette* in 1851 indicates the significance of rail transport for the distribution of Merstham lime which was then available

> in not less than six yard quantities and put on the railway for all goods stations on the London and Brighton and South Eastern Railways or lines connected with them . . . and delivered to all parts.[14]

[14] Quoted in Dobson C. G. (1949).

The records of the Merstham Lime Works which have survived in broken series for the period 1872-1914, permit a more detailed analysis of this relationship.[15]

The Day Journal for 1872-6 indicates for each load of lime leaving the works its destination and method of carriage; either rail, 'company carman' or collection direct from the works. This data has been analysed and converted into annual totals for the years 1872 and 1875 (see Fig. 3).

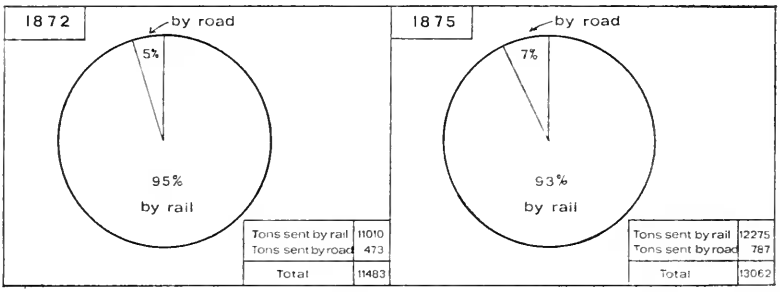

FIG. 3. CARRIAGE OF MERSTHAM LIME BY RAIL AND ROAD IN 1872 AND 1875. *Source:* Merstham Day Book.

It shows the extensive use made of the various branches of the South Eastern Railway for in 1872 over 95% of total output was distributed by rail and in 1875 only slightly less, 93%, while only 5% and 7% were distributed by road in these two years.

Fig. 4 shows the market area of the Merstham Quarry and Limeworks in 1872. Though the market area is here presented as being continuous, it was in fact really a very large number of spots, the various goods stations of the South Eastern rail network, to which deliveries varied from year to year.

In 1872 nearly half (45%) of the total production of the Merstham Limeworks was sent to London; namely to the Bricklayers Arms which was the London goods terminus for the South Eastern Railway. The remaining 55% of the total production for 1872 was distributed extensively throughout the South Eastern region, mainly in Surrey and Kent. Fig. 4 also shows that in 1872 the bulk of production was therefore sold in the area between ten and fifty miles of the works. The largest demand for Merstham lime came from the expanding residential areas of London and its southern margins, accounting for almost half of the quarry's annual output, while the growing towns of Surrey and Kent such as Croydon, Kingston, Canterbury, Beckenham, to name but a few, accounted for the rest of the output in 1872. (See Table IV).

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[15] Surrey R.O. Acc. 566.

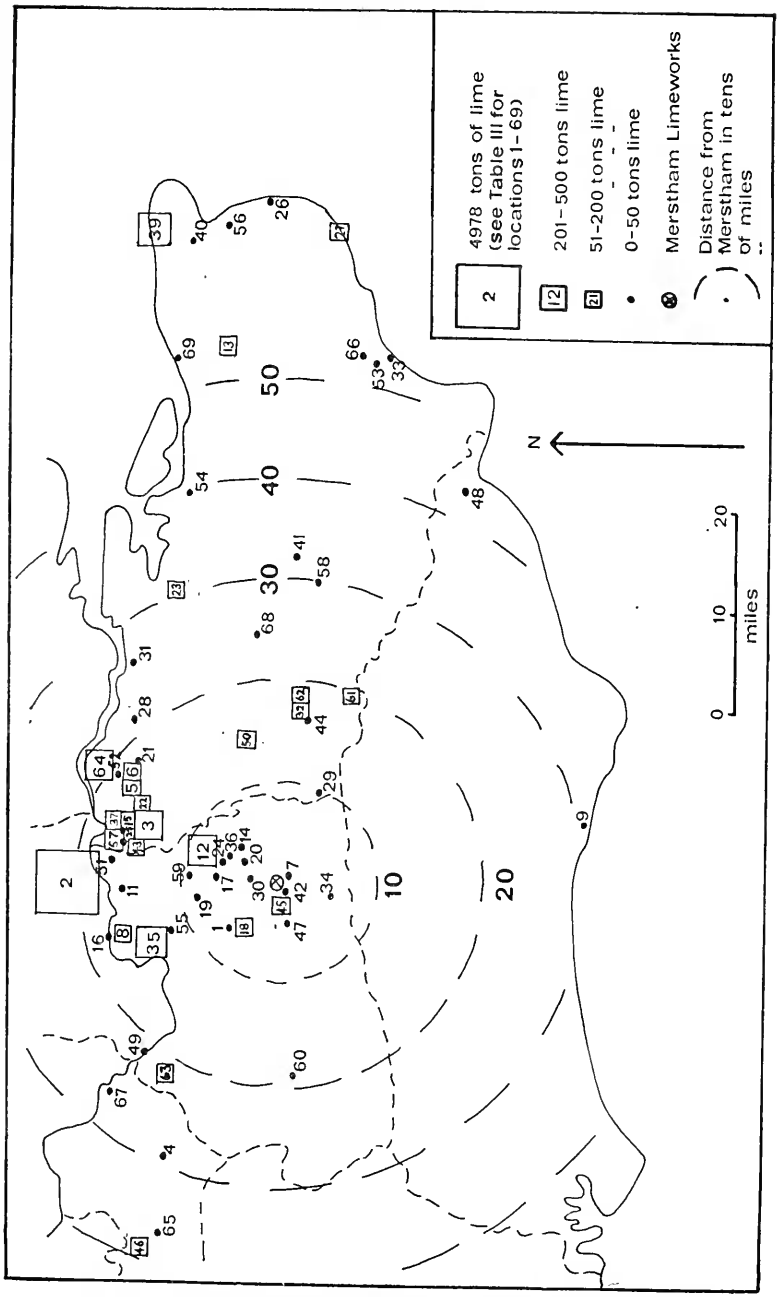

FIG. 4. MARKET AREAS OF MERSTHAM LIME IN 1872. For locations see Table IV. *Source:* Merstham Day Book.

TABLE IV

OUTWARD SALES OF MERSTHAM LIME IN 1872

No. on Map	Location	Tons Lime	No. on Map	Location	Tons Lime
1	Banstead	13	36	Kenley	2
2	Bricklayers Arms	4978	37	Lewisham	64
3	Beckenham	230	38	Leigh	50
4	Bracknell	11	39	Margate	258
5	Buckley	144	40	Minster	5
6	Bromley	84	41	Morden	8
7	Bletchingley	3	42	Nutfield	50
8	Barnes	168	43	Penge	118
9	Brighton	4	44	Penshurst	43
10	Blackheath	14	45	Redhill	62
11	Battersea	15	46	Reading	95
12	Croydon	452	47	Reigate	11
13	Canterbury	141	48	Rye	3
14	Caterham	44	49	Staines	40
15	Chislehurst	182	50	Sevenoaks	146
16	Chiswick	5	51	Streatham	20
17	Chipstead	17	52	Sidcup	23
18	California Junction	57	53	Shornecliffe	15
19	Cheam	7	54	Sittingbourne	5
20	Chaldon	3	55	Surbiton	4
21	Chelsfield	27	56	Sandwich	4
22	Catford	123	57	Sydenham	42
23	Chatham	57	58	Staplehurst	8
24	Coulsdon	2	59	Sutton	9
25	Crystal Palace	20	60	Shalford	5
26	Deal	24	61	Tunbridge Wells	62
27	Dover	59	62	Tonbridge	94
28	Dartford	4	63	Virginia Water	112
29	Edenbridge	5	64	Woolwich	399
30	Gatton	23	65	Wokingham	4
31	Gravesend	21	66	Westernhanger	9
32	Hartfield	35	67	Windsor	15
33	Hythe	20	68	Wateringbury	30
34	Horley	5	69	Whitstable	10
35	Kingston	208			

Source: Merstham Day Book 1872–76.

At the turn of the century the maximum economic radius of most of the Surrey quarries was limited to a distance of ten to twelve miles from the pit. Yet in 1872 only a negligible percentage of Merstham lime was sold within ten miles of the works. The extent of this local demand, 5% of the total, indicates both the small urban population to be found within ten miles of the works in 1872, and how small total demand for chalk must have been at quarries serving local markets at the beginning of the century.

In 1872 the Merstham Limeworks were serving a regional rather than a local market; annual production was considerable (see Table V) and by 1890 the works covered twenty acres, and included eighteen lime kilns, workshops, railways and spoil banks[16] (See Plate I).

[16] Surrey R.O. Acc. 641. Lease of 1890.

TABLE V

MERSTHAM LIME
PRODUCTION IN TONS* 1872–1889

Date	*Grey Lime*	*Ground Lime*	*'Chalk' Lime*	*Total*
1872	8,930	1,696	857	11,483
1873	8,795	2,401	1,025	12,221
1874	9,222	2,465	1,184	12,872
1875	9,109	2,418	1,485	13,062
1876	10,854	2,290	1,382	14,527
1877	11,007	2,360	1,138	14,506
1878	12,238	2,599	908	15,745
1879	11,402	2,184	1,061	14,648
1880	11,613	2,641	1,068	15,323
1881	11,256	2,528	898	14,732
1882	9,154	2,948	978	13,085
1883	8,791	3,058	812	12,661
1884	8,955	3,320	712	12,987
1885	6,881	2,618	838	10,337
1886	5,735	1,845	790	8,370
1887	5,990	1,635	921	8,546
1888	5,524	1,518	1,120	8,212
1889	5,863	1,567	1,110	8,540

*Before 1914, lime was measured in yards: one yard weighing approx. ½ ton.
Source: Merstham Day Journal 1872–6 and Trade Ledgers 1876–89.

The effects of railway expansion on chalk quarrying in Surrey were not, however, confined solely to the development at Merstham. For in 1872 there were also large quarries operating at Dorking, Betchworth, Brockham, Reigate, Coulsdon, Whyteleafe and Caterham (see Fig 5). Development at these locations would also seem to have awaited the provision of rail transport and the opening up of larger market areas, for the tithe maps of these areas *c.* 1840 show only small scale chalk quarrying before railway expansion in Surrey and the South East at mid-century. Apart from these large quarries the six-inch Ordnance Survey *c.* 1870 also shows considerable small scale development of chalk quarrying and lime burning near various stations on the South Eastern Railway, e.g. as at Guildford, Sutton, Belmont and Purley, which presumably supplied only local demand.

In contrast the majority of chalk quarries shown as disused in Surrey *c.* 1870 were those which lacked access to railways (see Fig. 5). They had thus found themselves at too great a disadvantage at a time when, as has been shown above, a railway outlet was a vital prerequisite for the successful development of a quarry and they had thus been abandoned.

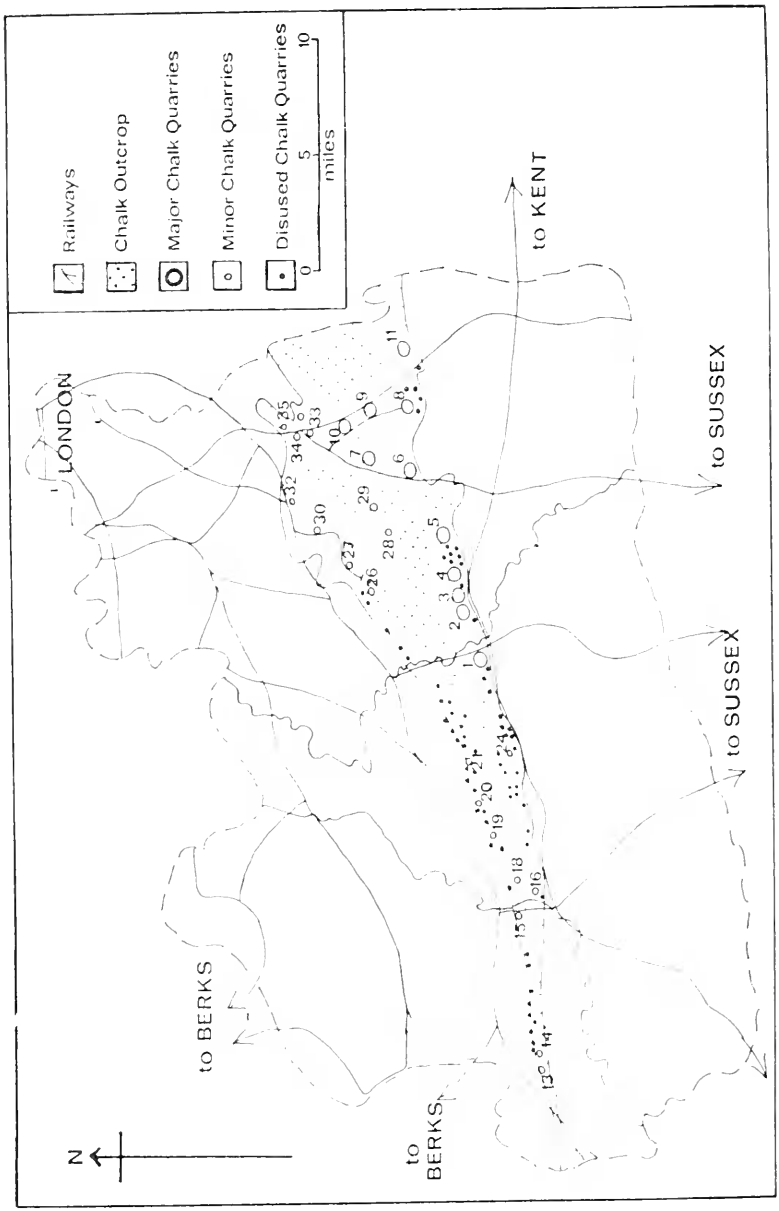

FIG. 5. RAILWAYS AND CHALK QUARRIES IN SURREY *c.* 1870–1890. For locations of quarries see Table I. *Source:* 1st. edit. 6 in. O.S.

CHALK QUARRYING IN SURREY 1895-1914

Until the passing of the Quarries Act of 1894, no uniform statistics concerning chalk quarrying were available either at County or National level. Consequently the Act of 1894 brought all quarries more than 20 feet deep under the supervision of the Inspector of Mines.

From 1895 therefore the Annual Reports and list of Quarries for Surrey show the changing pattern of chalk quarrying for each year up to 1914. The maximum number in operation during this period was twenty-three in 1896, and the minimum was fourteen in 1909-10 (see Fig. 6). Taken together the figures for 1895-1914 exhibit a marked and steady decline, and indicate a general contraction in the chalk quarrying industry of Surrey at this period. Yet in itself this gross trend is misleading, for examined in more detail the figures for 1895-1914 show that the pattern of large scale quarries, which accounted for the bulk of Surrey's output, was remarkably stable and underwent little change. Table VI gives the numbers employed at the various Surrey chalk quarries for 1896; these figures show both the number of men engaged in winning the chalk, under 'in' and those involved in its transport and conversion into lime under 'out'. As such they indicate the comparative sizes and importance of the Surrey quarries in 1896. Out of a total of twenty-three quarries shown as active for that year only eight, those at Betchworth, Brockham, Dorking, Merstham, Oxted, Reigate, Riddlesdown and Coulsdon (see Fig. 7) were of any size.

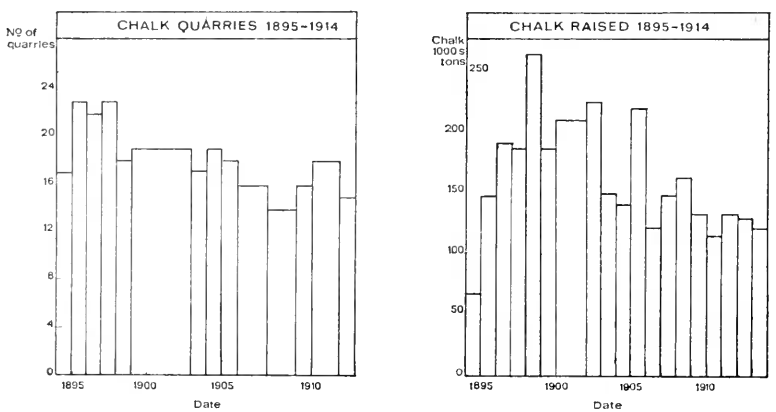

FIG. 6. SURREY CHALK QUARRIES 1895–1914 AND TONS OF CHALK RAISED IN SURREY 1895–1914. *Sources:* Quarry Lists 1895–1914 and Quarry Reports 1895–1914.

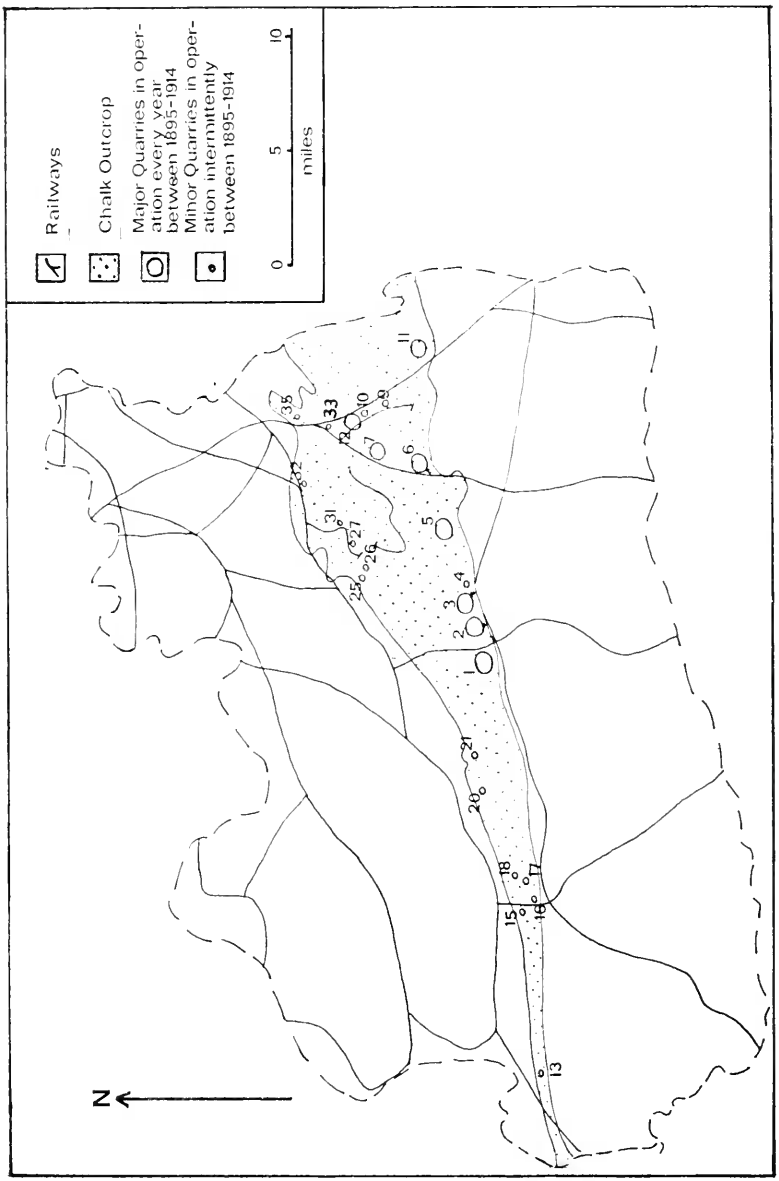

FIG. 7. CHALK QUARRIES IN SURREY 1895–1914. For locations of quarries see Table I. *Source:* List of Quarries 1895–1914.

TABLE VI

EMPLOYMENT IN SURREY CHALK QUARRIES 1896

		Numbers Employed		
	Location of Quarry	*'in'*	*'out'*	*Total*
1	Betchworth	39	32	71
2	Merstham	11	35	46
3	Oxted	20	17	37
4	Brockham	9	26	35
5	Coulsdon	9	9	18
6	Reigate Hill	7	7	14
7	Whyteleafe	14	—	14
8	Riddlesdown	9	1	10
9	Dorking	5	4	9
10	Guildford	8	—	8
11	Purley	8	—	8
12	Croydon	4	2	6
13	Buckland	1	1	2
14	Epsom No. 1	2	—	2
15	Shalford	2	—	2
16	Sutton	2	—	2
17	Highfield, Epsom	1	—	1
18	E. Horsley	+	—	—
19	E. Clandon	+	—	—
20	Effingham	—	—	—
21	Epsom No. 2	—	—	—
22	Kenley	—	—	—
23	Merrow	—	—	—
	Total	151	134	285

+ = worked intermittently.

These eight quarries were in continuous production throughout the period as the annual lists show and thus the basic pattern of chalk quarrying was essentially a stable one between 1895 and 1914.

In contrast other Surrey chalk quarries were worked only occasionally between 1895 and 1914, and then often only for part of a year (see Fig. 7). The casual nature of their exploitation is illustrated by a description of one such small pit at Epsom, in the Inspector's Report of 1896. This 'trumpery pit' was little more than twenty feet in depth and

> anyone was allowed to go and dig a load of chalk on payment of the sum of 9d . . . sometimes eight or nine loads would be fetched in a day by different people.[17]

This 'happy-go-lucky' style of quarrying was undertaken mainly to satisfy local demands for raw chalk to build walls and repair roads, etc.; indeed several of these small pits were worked by various Rural District Councils at that time. As such, demand and thus their numbers varied from year to year, and it is this fluctuation about the mean value of the large industrially orientated Surrey quarries which accounts for the trend shown in Fig. 6. Though significantly Fig. 6 also shows that the number of small-scale quarries was few in 1895 and declined even more up to 1914.

[17] Report of H.M. Inspector of Mines for District No. 9 (1897) p. 37.

As regards the large quarries and lime works, the importance of accessibility to rail transport in the location of these large scale works has already been shown above. Fig. 7 shows that of the eight major quarries operative in Surrey between 1895 and 1914 all were located near the various branches of the South Eastern Railway and that of these the largest at Betchworth, Brockham and Merstham were provided with feeder tracks on to the main line.

Yet equally important in the development of the lime industry in Surrey, and a factor which should be stressed in accounting for the growing concentration of the industry, was the constant improvement in quarrying and processing techniques. Such a trend favoured the mass production of lime and enabled considerable economies of scale to be realised within the industry by large scale producers.

Besides chalk the largest and most expensive raw material used in the lime making process was coal, and it was at the larger pits in Surrey that improvements in fuel burning economy were made. This reduced overall production costs and allowed the markets of the less advanced lime works as, for example, those at Seale and Sutton, producing on a smaller scale and using older, less efficient methods of limeburning to be undercut.

For example, at the Dorking Greystone Lime Co. at Betchworth the first continuous lime kiln, the Hoffman kiln, to be used in England was built in 1865 (see Plate II (a), Townsend, J. S., 1961). This kiln, unlike the flare kilns (used at the majority of Surrey pits until 1914), operated continuously in definite circles thereby effecting a great saving in coal, labour and time. The disadvantages of the discontinuity of the flare kiln process were further emphasised up to 1914 as the cost of labour rose and the larger pits, employing more efficient methods of lime burning, were able to produce more cheaply and thus supply larger market areas than the one man, one kiln type of business.

By 1914 the scale of chalk quarrying at the eight major Surrey pits was such as to demand, firstly, highly organised methods of quarrying and, secondly, efficient distribution of chalk to the kilns.

For example, prior to 1914 there were two main areas of quarrying at the Dorking Greystone Lime Co. at Betchworth – the main pit nearly $\frac{1}{4}$ mile wide and over 300 feet high and a face some 200 feet higher to the east, which was connected to the former by a 1 in 2 incline, the chalk being quarried systematically in a series of trenches (Townsend, J. S., 1961). Prior to the 1870's the chalk was drawn from the quarry face to the kilns by horse-drawn trucks, but as operations grew larger steam haulage was introduced to the pits in 1871 and this method of transport within the pits allowed the movement of chalk and lime on a far larger scale than before (see Plate II (b)). Similarly, large-scale Ordnance Survey maps show that at the other seven major Surrey pits trackway was also used within the pits for the bulk movement of raw chalk to the kilns, though horses and winding gear, not steam haulage, was the motive power in these cases.

Compared with the other quarries shown in Fig. 7 the quarries at

Betchworth, Dorking, Merstham, Oxted, Reigate, Riddlesdown and Coulsdon enjoyed the considerable advantages of greater efficiency and economies of scale at every stage in the lime producing process, from the winning of the raw material to its final distribution in processed form.

Furthermore, the greater efficiency and size of these plants also meant that they were able to adjust more easily than the smaller quarries in Surrey, to the vagaries of the lime industry.

It is hard to generalise about the markets which Surrey chalk and lime served before 1914. Besides Portland Cement and other building materials, such as plaster, mortar and whiting, lime was also in great, demand for use in waterworks, gas works, paint factories, tanneries, edible oil factories and tar macadam plants. However, Fig. 6 which shows the annual total of chalk raised in Surrey between 1895 and 1914 indicates the wide annual fluctuations which were often experienced in the total demand for chalk products.

Of the major Surrey quarries, those situated along the scarp edge of the downs at Merstham, Oxted, Dorking, Reigate, Betchworth and Brockham tended to specialise in the production of grey lime. The lower chalk or greystone strata worked at these quarries was less pure than the middle or upper chalk quarried elsewhere in Surrey; it contained an admixture of marl which gave hydraulic qualities to lime made from it and thus made it especially suited for use in the building trade as a mortar or cement The London and South East building trade therefore formed the major market for the output of these pits and demand from this quarter was far from constant before 1914, both seasonally and annually. Every year the building trade, usually slack in the winter months, would pick up in the spring and early summer and for the majority of Surrey pits the months April to October marked the period of greatest activity both in quarrying and lime burning, after which production was dampened down in the winter months.

The level of total demand depended upon the amount of building activity within the London and South East areas, which in turn depended very much upon the general level of the economy. Shortly after 1905 the building trade ran into a period of depression from which it had not recovered by 1914. While the larger quarries in Surrey adjusted to this by reducing staff, many of the smaller ones were forced out of production. Furthermore, even in periods of economic boom, demand for chalk and lime could still be very variable For example, the marketing of the mineral is considerably affected by weather conditions – in a wet season the building industry is badly hampered and thus the demand for building lime is correspondingly much reduced.

Similarly, just as the large quarries were able to adjust more easily to reduce demand than the small ones, they were also in a better position to exploit periods of increased demand. For example at the end of the nineteenth century there was a tremendous and sudden demand for white lime and at the Dorking Greystone Lime Co. at Betchworth a face was opened to the west of, and some 250 feet above, the main pit and

an aerial ropeway was constructed to connect this face to the kilns. However, by 1910 the demand had suddenly changed from white lime to grey, working of the face was discontinued and the cableway was dismantled (Townsend, J. S., 1961).

Indeed prior to 1914 the quarries situated along the scarp edge of the chalk outcrop were fortunate in being able to work both the pure upper chalk as well as the greystone stratas. This enabled them in times of reduced demand from the building trade to seek new markets in industry and agriculture for the purer white lime burnt from the upper chalk.

In contrast the two large pits situated on the dip slope at Coulsdon and Riddlesdown quarried mainly the upper white chalk, consequently their markets tended to be more specialised and restricted and thus more vulnerable to the effects of reduced demand. Before 1900 the Coulsdon lime works more or less specialised in the supply of lime to waterworks and gas works, as well as having contracts with thirteen London tanneries Yet the beginning of the century saw this demand much reduced. In 1902 the Army had changed over from leather to webbing equipment, with adverse effects on the tanning industry and indirectly on the output of Coulsdon lime previously used in the tanning process. More serious, however, for the Coulsdon works was the loss of supplies to gasworks after 1905. Throughout the nineteenth century lime had been used by the gas companies to remove the sulphur impurities in coal gas which reduced the quality and the power of light provided by the open jet burner With the invention of the incandescent mantle in the 1880's it became unnecessary to remove certain of the sulphur impurities. But the gas companies were still bound under the nineteenth-century statutes to remove them. However, with the passing of the London Gas Act in 1905 this obligation was finally removed Demand for Coulsdon lime was thus drastically reduced and the Company was forced to seek new markets chiefly connected with building and agriculture (Dobson, C. G., 1949).

Thus prior to 1914 chalk and lime produced from the eight large-scale Surrey quarries seldom consistently supplied the same markets and to attempt a market appreciation on a statistical basis is not possible. Because of the number and variation of markets served before 1914 the pattern of distribution tended to vary from year to year for individual quarries.

However, these markets though varied in nature were nevertheless geographically restricted to the area defined by the various branches of the South Eastern Railway The bulk of Surrey chalk and lime before 1914 was either sent to London or distributed throughout the counties of the south east, mainly Kent. It was this ability to reach distant and varied lime consuming populations, coupled with the economic advantages of large-scale production which accounted for the concentration of the industry at eight major centres in Surrey by the end of the nineteenth century (see Fig. 7).

Considered nationally between 1895 and 1914 Surrey was consistently the sixth or seventh chalk producing county, after Kent, Essex, Sussex, Bedford, Hampshire and Middlesex. Fig. 8 shows the production of

chalk from quarries in England at county level for 1895. The most important chalk producing county was Surrey's neighbour, Kent, which in 1895 accounted for 2,006,511 tons out of a total of 2,922,629 tons of chalk raised. The bulk of Kent's output came from the huge quarries and cement works on the banks of the Thames and Medway, which because of the juxtaposition of chalk and Thames or Medway clay enjoyed a tremendous industrial advantage in the manufacture of Portland cement.

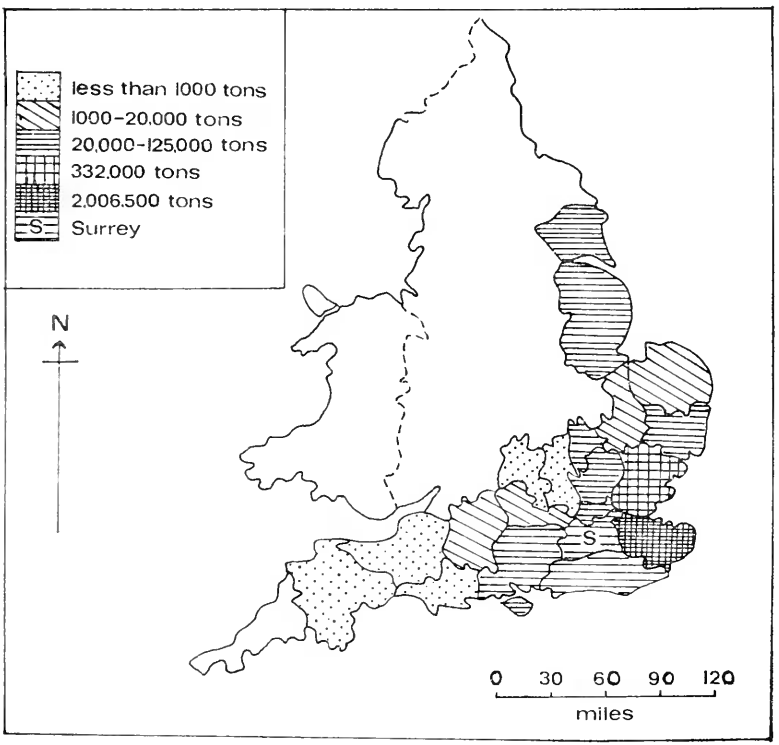

FIG. 8. CHALK PRODUCTION IN 1895. *Source:* First Annual General Report upon the Mineral Industry of the U.K. 1895.

In comparison chalk quarrying in Surrey, as in the other chalk producing counties, was on a more modest scale for smaller and more varied markets. Throughout the nineteenth century the industry had developed from its rural origins until it reached its zenith round about the turn of the century. After 1914 the story of chalk quarrying and lime burning in Surrey is one of retrenchment rather than development and thus the beginning of the Great War is a significant point at which to end this reconstruction.

COMPARISONS AND CONCLUSIONS

The distribution of active chalk quarries at the beginning of the nineteenth century in Surrey, differed markedly from the pattern which had evolved by the end of the century (see Figs. 9a and b).

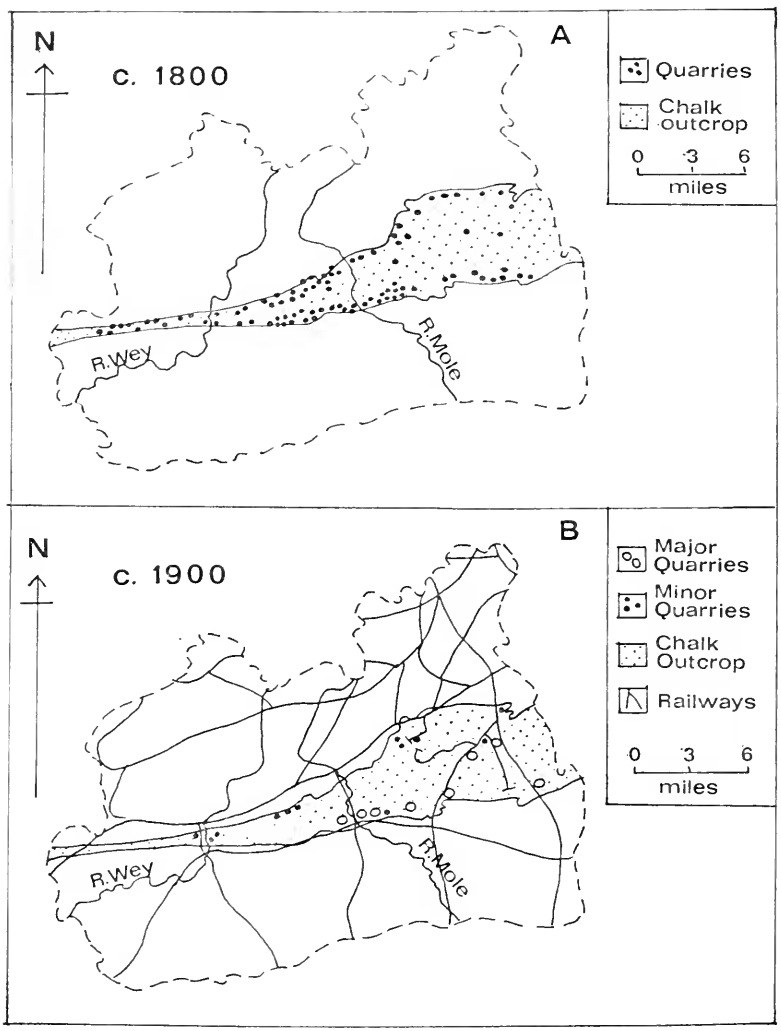

FIG. 9. CHALK QUARRIES IN SURREY *c.* 1800 AND 1900.

In 1800 there were as many as a hundred active quarries in Surrey and these were located all along the scarp face of the chalk outcrop, and on the dip slope where they were to be found in most of the small

valleys. Apart from minor site considerations such as adequate exposure of the chalk strata, and depth of overburden, etc., the dominant factor in their location was accessibility to the markets they served. In the days of horse and cart transport a roadside location was vital for the exploitation and distribution of large quantities of chalk and most of the quarries shown in Fig. 9a were either situated by the side of, or had direct access to, a major north-south or east-west road at the beginning of the century.

The prevailing transport conditions were also in part responsible for the small average size and large number of Surrey chalk quarries in 1800. For, given the poor, unmetalled roads of the day, especially in the Surrey Weald, the price of bulky chalk and lime rose precipitously away from the pit and the maximum distance of carriage was in most cases limited to a 10-12 mile radius. Though total demand from the agricultural sector was large, it tended to be sporadic, and this, coupled with the limited market areas which could be served and the small inputs of labour and capital needed to exploit chalk, favoured a pattern of numerous small quarries at the beginning of the nineteenth century.

However, by the end of the century instead of over a hundred quarries as in 1800 there were no more than twenty quarries active in Surrey, of which eight accounted for the bulk of county output (see Fig. 9b). In 1900 chalk quarrying and lime burning was a large scale and highly competitive industry, and in Surrey the choice of viable locations were fewer and not as flexible as before, for only the chalk deposits favourably situated with respect to a market and to cheap transportation, had commercial possibilities. Location was thus orientated to markets and therefore depended upon access to the South Eastern Railway.

The large size of Surrey quarries and the concentration of the industry in 1900 as compared with 1800 was mainly associated with the increased size and variety of markets served at this later date; though technical improvements in chalk quarrying and lime burning efficiency, plus the economic benefits of large-scale production, had also contributed to this trend.

Given the limited scope of this study, many of the significant relationships in the changing pattern and industrial structure of chalk quarrying and lime burning in nineteenth-century Surrey have only been touched upon here. One such neglected topic worthy of further investigation is the past link between chalk quarrying and other industries. In early nineteenth-century Surrey the fusion of chalk quarrying with the coal merchant's trade was a common feature of some of the larger pits, such as those at Guildford and Dorking. For, as both these occupations were then essentially seasonal – coal in winter and chalk quarrying in summer – their combination ensured employment for men and horses all the year round. Similarly, it has been shown that at Merstham chalk quarrying was at first only part of the wider enterprise of a building contractor, whose activities stimulated the development of quarrying at this location.

These examples would thus seem to suggest that it is perhaps necessary to view the early pattern of chalk quarrying and lime burning in Surrey in a more general context of industrial growth rather than in

terms of a single industry Furthermore and equally important in the later stages of the industry's development towards the end of the nineteenth century is the question of the rising cost of labour and increasing mechanisation within quarries to alleviated this problem. These are but two relationships which remain unexplored here.

However, one important theme which has emerged from this study is the close parallel between the growth of chalk quarrying and the improvement of transport in Surrey throughout the nineteenth century. The evidence presented here, especially the analysis of the three case study quarries before 1850 and of the Merstham Limeworks in 1872, is a quantitative assertion of the aphorism that 'quarrying and transport belong together, like workhouses and pin-making' (Hudson, K., 1967, 37)

Acknowledgements

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BIBLIOGRAPHY

Allen, T. (1828), *History of the Counties of Surrey and Sussex.*

Bing, F. C. (1931), *The Grand Surrey Iron Railway*, Croydon Public Libraries.

Bowles, O. and Myers, W. M. (1927), 'Quarry Problems in the Lime Industry', *U.S. Dept. of Commerce, Bureau of Mines Bulletin 269.*

Burnell, G. R. (1850), *Rudimentary Treatise on Limes, etc.*

Brayley, E. W. (1841), *The History of Surrey.*

Bright, J. S. (1884), *History of Dorking.*

Course, E. A. (1958), *The Evolution of the Railway Network of S.E. England* unpub. Ph.D Thesis, London University.

Davey, N. (1961), *A History of Building Materials.*

Dickenson, H. W. (1931), 'Jolliffe and Banks, Contractors', *Transactions of the Newcomen Society*, XII. 1931–2.

Dines, H. G. and Edwards, F. H. (1933), *The Geology of the County around Reigate and Dorking.*

Dobson, C. G. (1949), *A Century and a Quarter* (published privately for Hall & Co.).

Evershed, H. (1853), 'A Prize Report on the Farming of Surrey', *Journal of the Royal Agricultural Society*, XXVI.

Gardner, H. W. and Gardner H. V (1953) *The Use of Lime in British Agriculture.*

Gravett, K. W. E. *et alia* (1967), 'Merstham Limeworks', *Surrey A.C.*, LXIV.

Green, F. F. (1915), *The Surrey Hills.*

Greenwood, C. and J. (1823), *Surrey Described.*

Hooper, W. (1945), *Reigate Through the Ages.*

Hudson, K. (1967), *Handbook for Industrial Archaeologists.*

Kelly's *Directory of Surrey*, 1855, 1878.

Lee, C. E. (1940), 'Early Railways in Surrey', *Transactions of the Newcomen Soc.* XXI. (1940–1).

Malcolm, J. A. (1805), *Compendium of Modern Husbandry principally written during a Survey of Surrey.* Vols. I, II, and III.

Manning, O. and Bray, W. (1809), *The History and Antiquities of the County of Surrey*, II.

Marshall, C. F. D. (1936), *History of the Southern Railway*.

Marshall, W. (1798), *The Rural Economy of the Southern Counties*, II.

Pigot and Co. (1823), *London and Provincial New Commercial Directory*.

Priestley, J. (1831), *Historical Account of the Navigable Rivers, Canals and Railways throughout Great Britain*.

Robinson, D. J. and Cooke, R. U. (1962), 'Lime Kilns in Surrey: a Reconstruction of a Rural Industry', *Surrey A. C.*, LIX.

Shave, D. W. (1942), 'The Distribution of Arable Land in the Upper Wey Basin in 1840, 1870 and 1939' in *The Land of Britain*, Vol. VIII, Part 81, Surrey. Stamp and Willats. 1942.

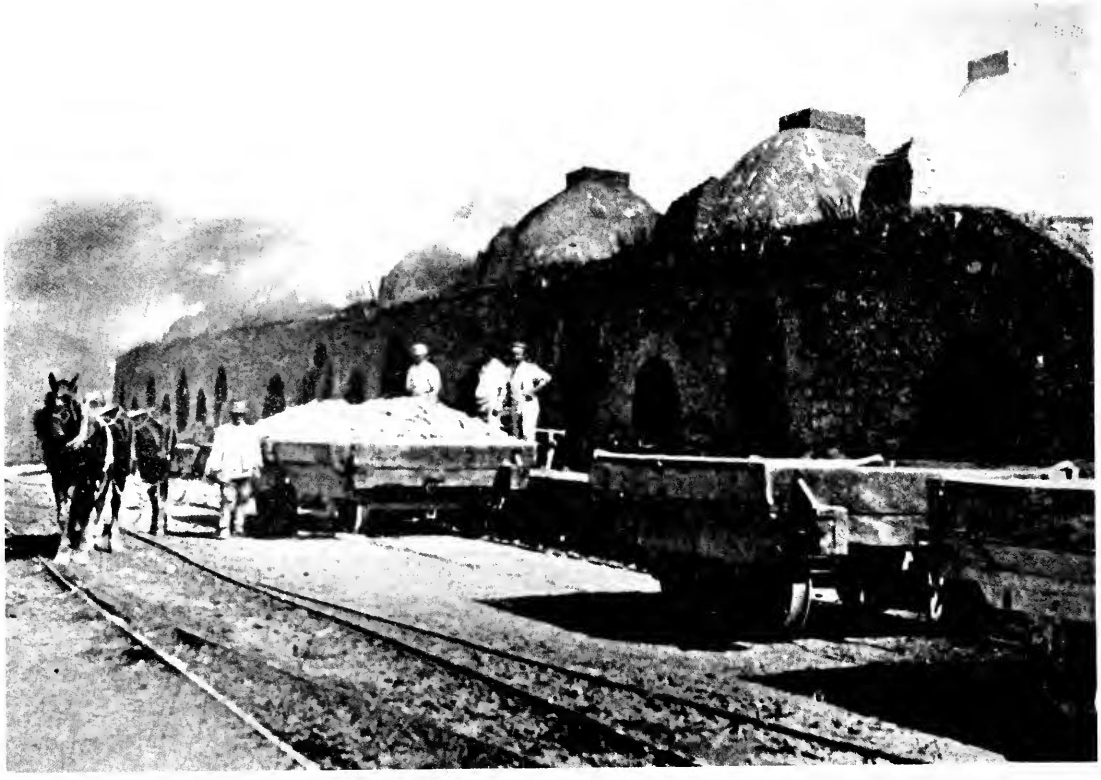
Smith, E. (1910), *The Reigate Sheet of the 1-inch O.S.*

Smith, W. C. (1828), *Rambles Round Guildford*.

Stevenson, W. (1809), *General View of the Agriculture of the County of Surrey*.

Townsend, J. S. (1961), A Century of Lime: *The History of the Dorking Greystone Lime Co.* (unpublished thesis).

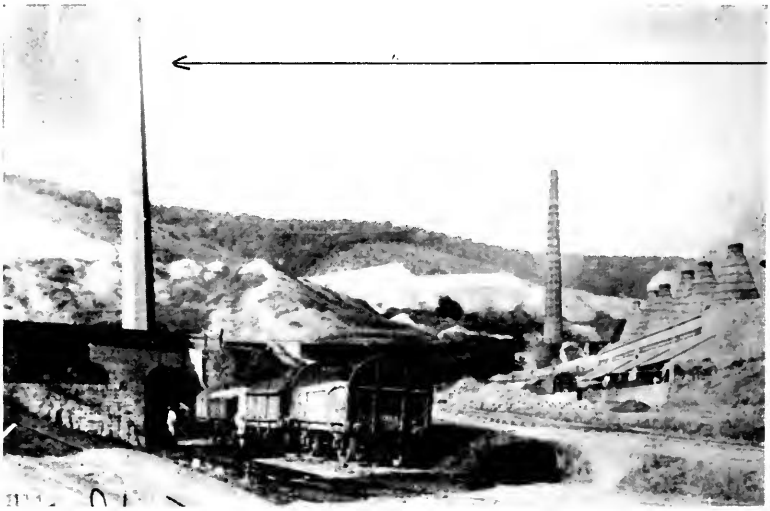
Vine, P. A. L. (1965), *London's Lost Route to the Sea*.



VIEW OF MERSTHAM LIMEWORKS, *c.* 1880.
[*John S. Townsend*]

PLATE I

(*a*) CONSTRUCTION OF HOFFMAN KILN AT BETCHWORTH, *c.*1865.
[*John S. Townsend*]



(*b*) WAGGONS LOADED WITH LIME STANDING BY THE HOFFMAN KILN AT BETCHWORTH, *c.* 1896 Note the battery of Flare Kilns in operation to the right of the Hoffman kiln (see arrow).
[*John S. Townsend*]