

Surrey's Industrial Past

Edited by Glenys Crocker

Surrey Industrial History Group

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This online edition consists of 101 pages in A4 format.

It can be read online or printed out. The formatting allows both to work and colour photographs are now rendered in colour rather than greyscale.

A few amendments or updates are included in the text. They are noted at www.sihg.org.uk/updates.htm.

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New photographs are by Chris Shephard.

Unless otherwise acknowledged in the captions, older photographs are from the Chris Shephard collection.

PREFACE

This book, the work of members of the Surrey Industrial History Group, sets out to complement the series of industrial history Guides published by SIHG since 1990 and nearing completion in 1999. These are in the form of gazetteers, one for each of the eleven administrative districts of the county, and readers are referred to them for information on individual sites.

The book makes no claim to be a comprehensive survey of Surrey's industrial history but reflects members' interests and, in some cases, first-hand knowledge of industries in which they have made their careers. In part it provides a summary of published information in fields which have already been well-researched, but it also contains less-accessible material as well as results of new research. In these cases, reference to sources is given in the text or in notes to the chapters as appropriate.

Few chapters are the work of a single individual. Authors are not therefore identified in the text but are listed, with a note of their principal contributions, as follows: Stuart Chrystall (waterways); Alan Crocker (corn mills, paper mills); Glenys Crocker (gunpowder, textiles and leather); Francis Haveron (car manufacture, entertainment industry); Gordon Knowles (railways, aviation, aircraft industry); Christopher

Mann (water supply); John Mills (sewage disposal, gas, chemical and process industries, gravel extraction in north-west Surrey); Gerry Moss (chemical and process industries); Derek Renn (roads and bridges); Jeff Sechiari (breweries); Chris Shephard (defence, sand and gravel extraction in south-west Surrey); Malcolm Tadd (extractive industries); Peter Tarplee (defence, electricity, ice houses, watercress beds, essential oils); Peter Wakefield (communications).

The maps showing geology, turnpike roads, waterways and railways are from

A Guide to the Industrial Archaeology of Surrey, which was published by the Association for Industrial Archaeology in 1990 when its annual conference was hosted by SIHG.

New photographs are by Chris Shephard, who has also acted as picture editor for the volume and has played a major role in planning and organising the compilation of the book. Finally, the project would not have been brought to completion without the hard work and determination of Peter Tarplee who has steered its progress throughout.

Glenys Crocker

May 1999

Chapter 1

INTRODUCTION

Before the industrial revolution, when heavy industry became established in the North and Midlands, Surrey was a considerable manufacturing county. England was a great producer of wool in the Middle Ages. The monks of the Cistercian abbey of Waverley, near Farnham, reared sheep on the downs and by about 1300 were supplying raw wool to the cloth-manufacturing centres of Italy and Flanders. From being an exporter of wool, England became a manufacturer of cloth and 'Cloths of Guildford', which were made in a region extending from south-west Surrey into Sussex and Hampshire, gained a high reputation. The southern part of Surrey was on the fringe of the iron-working area of the Weald, which used ore from local ironstone, charcoal for fuel from local woodlands and water power for working bellows. Another early industry, in the district around Chiddingfold, was the manufacture of glass, again using local wood both for charcoal, for firing the furnaces, and for potash, to mix with sand as raw material.

The English woollen industry contracted in the seventeenth century as a variety of worsted and mixed fabrics — the 'new draperies' — became fashionable and different centres of manufacture grew up. Surrey was one of the districts where the old industry almost died out. Iron smelting too declined in the region after Abraham Darby introduced coke-fired furnaces at Coalbrookdale in Shropshire in the 1720s. The glass-makers left rural Surrey because of legislation in 1615.

The old woodland industries of coppicing and charcoal burning continued though and supplied one of the raw materials for the new industry of gunpowder making. The gunpowder industry, in which Surrey played a leading part in the early years, was one of many new industries which used water power. Watermills had long been used for grinding corn and from the thirteenth century onwards many were used to operate fulling stocks for processing woollen cloth.

When the woollen industry declined many redundant fulling mills were converted to paper mills, which also used water-powered hammers to reduce linen rags to pulp. Other water mills were used for crushing dyewoods, grinding tobacco for snuff and driving machinery in metal-working trades. Industries grew up along rivers, and not only the larger ones like the Wey and the Mole but also their small tributaries.

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The sixteenth and seventeenth centuries brought a great increase in industrial 'projects', as the enterprises of the period were known. Among the Tudor and Stuart 'projectors' were members of the Evelyn family who established gunpowder mills at Tolworth and Godstone and at Wotton and Abinger in the Tillingbourne valley where they also set up brass and copper mills. The Tillingbourne, which rises on Leith Hill and joins the River Wey just south of Guildford, also drove waterwheels for corn milling, fulling, iron forging and papermaking and provided power for the Chilworth gunpowder mills which operated for nearly 300 years. The valley is now largely rural, its ponds used for fisheries; and watercress beds, established in the 1850s, are still active in the 1990s at Abinger Hammer.

Even more bustling with activity in the past was the River Wandle, considered at the beginning of the nineteenth century, when forty industrial undertakings were carried on along its course, to be the hardest-worked river of its size in the world. The Wandle is, however, largely outside the scope of this book, since it belongs to that part of Surrey which has been lost to London.

The historic county of Surrey extended to the south bank of the Thames but local government changes in 1889 and 1974 took away about a fifth of its area and a larger proportion of its population and industry, leaving the administrative centre of Surrey, Kingston upon Thames, outside the modern county. The changes of 1974 also brought an addition in the form of Spelthorne, an area north of the Thames which historically had been part of Middlesex, and a loss in the vicinity of Gatwick airport.

The Surrey of this book is the modern county, but the lost metropolitan areas are not rigidly excluded because the influence of London cannot be ignored. It is most obvious in the spread of the built-up area and the growth of commuter suburbs and transport links but Surrey has also provided London with services of many kinds — sites for storage reservoirs, hospitals for the mentally ill and handicapped and the Victorian cemetery at Woking with its rail link to Waterloo.

The industries of the historic county, up to the beginning of the twentieth century, are admirably described in the Victoria County History, the four-volume work published between 1901 and 1911 as part of a national series. The second volume contains chapters on iron; lime burning, stone quarries, fuller's earth etc; pottery; glass; Battersea enamels; gunpowder; leather; cloth; miscellaneous textile and allied industries; tapestry; felt and hat making; dyeing, bleaching, calico printing; brewing; distilling; vinegar and British wines; aerated and mineral waters; soap and candle making; metal and machinery works; paper; printing and printing machinery. Many of these, such as Liberty's textile printing works at Merton, Mitcham lavender, Paine's fireworks at Mitcham and Brock's at Sutton, were carried on in metropolitan Surrey but the modern county has had a wide range of manufacturing industries, such as the wax refinery and the Monotype works near Redhill, the Thames Ditton statue foundry whose products went all over Britain and the Empire, the knitwear industry at Godalming, British Aerospace and the firms which make Formula One racing cars.

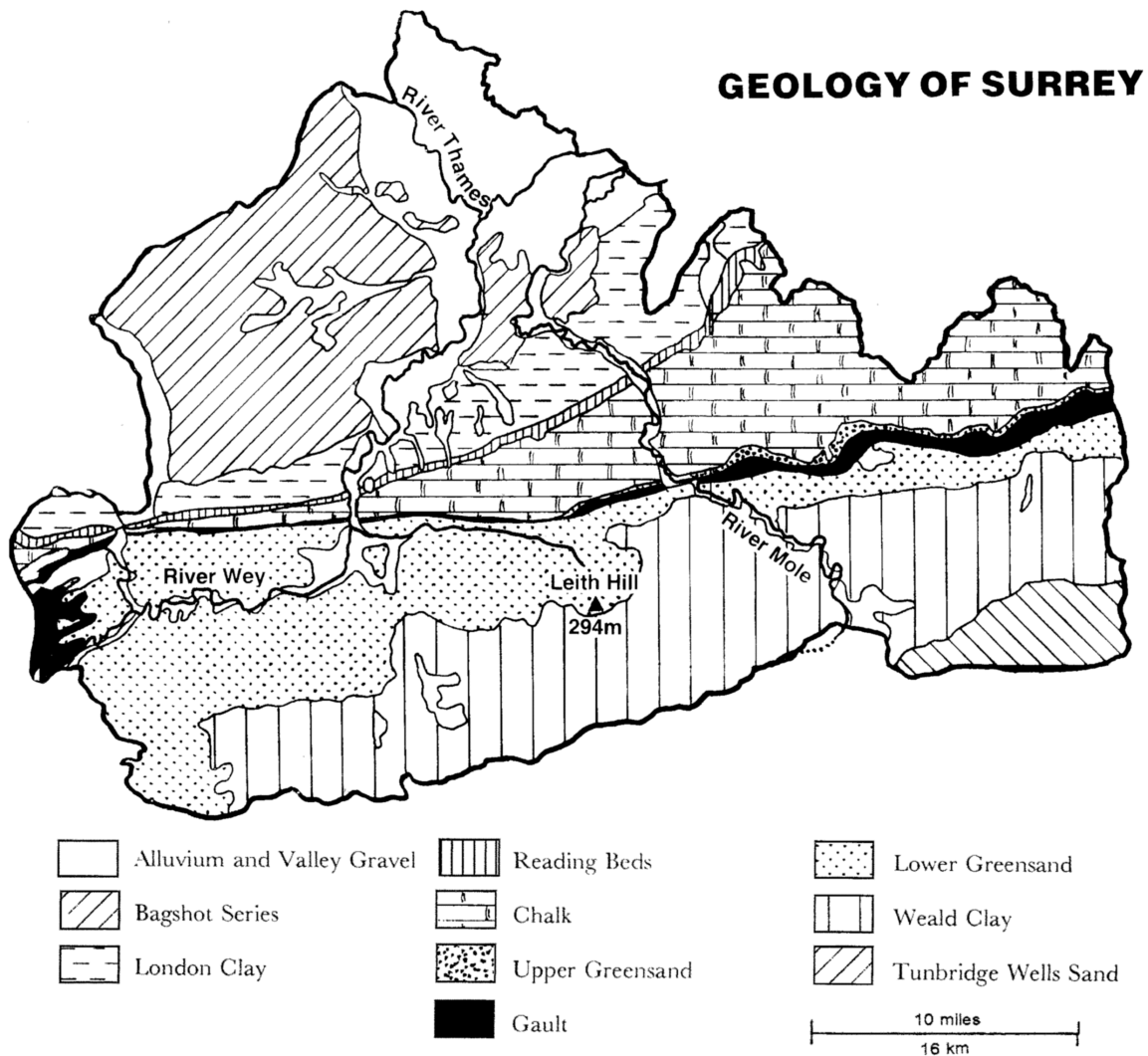
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Surrey has played a major role in nursery gardening, on the sandy soils of the north-west, and in market gardening to supply London. Work on the land, however, is a major study in itself and beyond the scope of this book. The model farms of the nineteenth century are therefore excluded, as are the systems of water management devised from the late sixteenth century onwards for seasonal 'floating' of the meadows, to improve their fertility. Some crops are featured: watercress growing, with its special irrigation works, hop growing in relation to brewing, herb growing in relation to the distilling of essential oils and woodlands as a source of fuel and raw material for early industries.

The book begins with the natural resources of the underlying rocks, the quarrying and mining industries which exploited them and the industries based on processing the materials extracted out of the ground. Next it moves to corn milling, the earliest industry to use water and wind power and to the brewing of beer. The woollen industry, the next to use water power and the most important industry in the Middle Ages, comes next followed by other textiles and the manufacture of leather; then the other manufacturing industries which developed from Tudor times onwards. The supporting industries follow, first transport by road, canal, rail and air and the manufacture of aircraft and vehicles, then public utilities for the supply of water, power and communications, defence and finally the leisure and entertainment industries.

Chapter 2

SURREY'S EXTRACTIVE INDUSTRIES



Extractive industries — the digging of chalk, clay, sand and gravel, flint and building stone, fullers earth and iron ore — and the lime works, brick works, iron and glass works which depended on them, have been the most widespread of Surrey's industries. Most are now extinct. The Wealden iron and glass industries have long since disappeared and at the end of the twentieth century stone quarrying, fuller's earth and chalk extraction are about to join them. Environmental considerations limit sand and gravel digging and even brick works are declining in number. Despite this, disturbed ground, lakes, tracks, place names, workers' cottages and even whole villages will for long provide a reminder of these once significant industries. Countless small pits, ponds and scars on the landscape date back as far as history.

The Rocks

Surrey encompasses part of the Weald and part of the Thames valley. At the end of the Jurassic period, about 140 million years ago, a trough filled with fresh water covered what is now south-east England, the

English Channel and northern France, and a ridge of high land ran across what is now London. A tropical swampy river delta, in which dinosaurs lived, extended into Hampshire and material washed into this area became the Hastings Beds and, overlying them, the Wealden Clay. The sea overran the Weald and sediments which settled on the bottom became our present Lower Greensand, Gault Clay and Upper Greensand. The Chalk came next, laid down in seas far from land as a white calcareous mud. Chalk as we know it today is composed mainly of calcium carbonate derived from the calcite plates which protected microscopic planktonic algae, the rest being made up of microscopic fossils or shell fragments. The Upper Cretaceous period, during which the chalk was laid down, ended 65 million years ago.

In the Tertiary era which followed, the Weald was on the fringe of the earth movements which produced the Alps and the Himalayas. The chalk rose from the sea as a dome or anticline, over the present Weald, and a complementary trough or syncline formed in

what became the Thames valley. The land was eroded, principally by water, and the softer clay formations were eroded most. In Surrey this produced, from north to south, the line of the North Downs, a Gault Clay valley, the Lower Greensand ridge, the Wealden Clay lowlands and the Hastings Beds of the High Weald.

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Strata laid down in the Thames valley during the Tertiary period include the sands, loams and clays of the Thanet, Woolwich and Reading beds, the London Clay, a thick uniform deposit laid down in a shallow tropical sea, and the sands and gravels of the Claygate, Bagshot, Bracklesham and Barton beds. Apart from the London Clay, these were not laid down over the whole Thames valley and, unlike the strata of the Weald, they do not come to the surface in any simple pattern. Some of them would once have covered the eroded surface of the Weald, but little remains because of later erosion. There are also superficial 'drift' deposits, formed locally by erosion and deposition in the last million-and-half years. These include the river gravels of the Thames and Blackwater valleys in north and west Surrey, deposited on a series of terraces, and the thin layer of Clay-with-Flints, produced by weathering of the chalk, which caps the North Downs. The flint itself originated in particles of silica which recrystallised in layers in the chalk as it formed.

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Sand and Gravel in North and West Surrey

The minerals of industrial importance in Surrey from the younger deposits north of the Downs are almost entirely sand, gravel and clay, which sometimes alternate over short distances. While the digging of clay for brick-making has long since ceased in the area, gravel extraction has continued on an ever increasing scale up to the present day at Thorpe, Hersham, and Staines Moor. This is not welcome to the local population and there is generally opposition to the opening of new pits.

Worked-out pits have been treated in various ways. The best-known ones are the flooded pits incorporated into the Thorpe Theme Park. Another pit, close to the Thames, has been converted into the Penton Hook Marina. Others have remained dry and have been filled with refuse and others have remained dry and empty and have been landscaped, as at Heather Gardens in Windsor Great Park. At Englefield Green, local people were allowed to help themselves to scouring sand for many years until the deposits were worked out for the building of the adjacent Royal Holloway College. The resulting pits were landscaped as part of a botanical garden but the site has since been

sold for housing development. A novel way of winning gravel has been adopted by the Thames Water Authority by digging out the bottom of the Queen Mary reservoir, doubling its capacity and financing the work by the sale of the gravel.

In the west of the county, near the Hampshire border, the river gravels of the Blackwater valley have been extensively worked. There is now an almost continuous series of flooded pits, mainly preserved as nature reserves. The last extraction in this area was near Tongham, where a new pit was opened to provide ballast for the building of the Blackwater Valley Relief Road in the 1990s.

Further south, the Farnham area was well dug over for sand and gravel by the end of the nineteenth century. Today the gravel has been largely worked out but sand extraction from the Lower Greensand continues apace with applications for new licences being made in both the Wey valley to the west of the town and the Runfold area to the east. The earliest workings were small pits in the river gravel terraces extending upwards on the north and south valley sides. There is some evidence for prehistoric use for flint implements, particularly to the north of Farnham at Caesar's Camp. Later uses largely revolve around ballast for concrete making and there are small numbers of houses in the town built of this material in about 1900.

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Flint, Chalk and Lime: Industries of the North Downs

FLINT

Flint was used to make tools in prehistoric times but is most obvious in the landscape as a building material for the picturesque houses and walls of the

chalk districts. Flints were picked from the fields and knapped to expose the shiny black interior for visual effect. Unknapped flints have been widely used in road building, and 'hogging' — flint fragments embedded in a clay matrix, found in Tertiary deposits — is still used for the foundations of drives and car parks. Pits are still being dug for hogging near Warlingham.

CHALK

Chalk has been used for improving acid soils since before Roman times. It was dug from bell pits or more elaborate workings known as dene holes. Narrow shafts were dug through the clay on the crest of the Downs into the chalk below. When structurally sounder chalk was reached at about 60 feet down the shaft could be extended horizontally, sometimes forming elaborate chambers. When it became im-



Gravel extraction at Weydon Lane, Farnham, early twentieth century.

practicable to work a pit, another would be started alongside and so clusters of pits developed. Dene holes are common in Kent and occur in east Surrey. There are no open ones in Surrey and they are generally difficult to locate, though occasionally alarming craters open up to reveal their presence.

Lumps of chalk were cast onto fields at the end of autumn and left to weather over winter, releasing calcium carbonate and other trace minerals to the soil. The process is known as marling, though the term is often used loosely for substances other than chalk. It did much to improve agriculture but was inefficient as chalk needs to be spread as a fine powder. It will then quickly neutralise acid and cause clay particles to coagulate, allowing air into the soil and improving drainage, and it will make calcium easily available to plants. The modern method is to crush and dry the chalk into a powder mechanically but it was common practice in the past to apply quicklime to fields. The effect is ultimately the same, whether chalk, quicklime or slaked lime is applied. Quicklime is calcium oxide produced by heating calcium carbonate in the form of chalk or lime so that it loses carbon dioxide. Quicklime from the kiln was not entirely reduced to powder but when it was deposited in small heaps throughout a field the action of rainwater would powder it to slaked lime. In all cases the process needs repeating year by year since the chalk or lime sinks from the top of the soil and the calcium is lost as crops are lifted.

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LIMEKILMS

Farmers on clay soils even back to the sixteenth century would have their own small limekilns. The name Firsfield or Furzefield may indicate the presence of a kiln because furze was used as fuel. In the type known as a flare kiln, the chalk was constructed as a dome over the furze or brushwood and fuel and it would take 24 hours of burning to convert it to quicklime. A model of such a kiln can be seen in Guildford Museum and it is still possible to find remains in the field. Farmers who lived some distance from the North Downs had chalk carted to them but when chalk pits, equipped with large industrial kilns for limeburning, were opened in the nineteenth century farmers were able to dispense with private kilns. The expansion of the building trade in the eighteenth and nineteenth centuries stimulated the limeburning industry. Brick buildings need mortar to bind the bricks together and before cement was invented mortar was made on site from quicklime, sand and water. In a large flare kiln chalk is roasted in a single batch, using coal, coke or wood as fuel. There are still remains of industrial flare kilns at Brockham. Those at Merstham disappeared under land-fill and road building but an old photograph survives and shows them in operation. Another group of kilns, which worked until the 1960s, can be seen at Oxted. They are built into a bank supported by a brick retaining wall, which also provided insulation. The tall tops stand proud of the ground, and

they narrow towards the bottom where the burnt lime settled. They are built of brick with a lining of refractory fire bricks which would eventually burn away. While most kilns were running, one would be cooled and relined, so bricklayers were kept in permanent employment on the site.

The Oxted kilns are known as mixed-feed kilns because they were loaded from the top with chalk and fuel mixed together, and they were also called draw kilns because the lime was continuously drawn out at the bottom. The portion of the kiln above ground was a pre-heating zone where waste heat from the kiln proper dried the layers of fuel and chalk as they passed downwards into the burning zone. Operation was started by lighting a temporary fire in the chamber at the bottom of the kiln under the criss-cross of iron draw bars. These held back the contents of the burning zone until it was time to start drawing off the lime through the exit hole in the roof. The process is an art and the man in charge of the kiln would know by experience when to start drawing — too early and the chalk would not be completely burnt to quicklime — too late and the chalk would be overburnt and too hard for the purpose. During operation, the draw-bars would be manipulated to control the flow of quicklime out, while doors in the bottom chambers allowed the draught to the kiln to be controlled. The lime was drawn off in the form of lumps which were carried in trucks to crushers. As lime was taken from the bottom so more chalk and fuel was added at the top and the process continued until the kiln needed relining.

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Chalk pits had internal railways and overhead cableway systems to bring chalk from the pit-face to the kilns, and crushers and sieving equipment were placed near the kiln top to break and sort the lumps of chalk to the right size. Small pieces would clog the kiln and large ones would not burn properly, so chalk pits are always associated with mountainous heaps of waste. Continuous-burning kilns needed an uninterrupted supply of coal or coke for fuel. Major chalk works were therefore connected to the national railway system by spurs and sidings, which may sometimes still be detected today.

Cost-effective production meant using the minimum amount of fuel and the design of lime kilns captured the imagination of some nineteenth century engineers, who were especially concerned with the problem of drying the damp chalk before it reached the burning zone of the kiln. A local landmark at the site of the Betchworth limeworks is a pair of brick towers of twin Dietzsch kilns, a type which was designed for cement manufacture but built here for lime in 1887. The Dietzsch kiln consists of a tall tower in which the

bottom half is off-set from the top half. The burning zone was in the short horizontal section joining these two halves and fuel was added at this level. Chalk was loaded in at the top of the tower and was dried by waste heat from the burning zone as it sank down the tower. It was raked into the burning zone and descended the bottom half of the tower to be drawn out as lime at the bottom. The bases of the towers at Betchworth are split by arches because each comprises two back-to-back Dietzsch kilns. The two towers are connected by remains of a chalk-loading gantry.

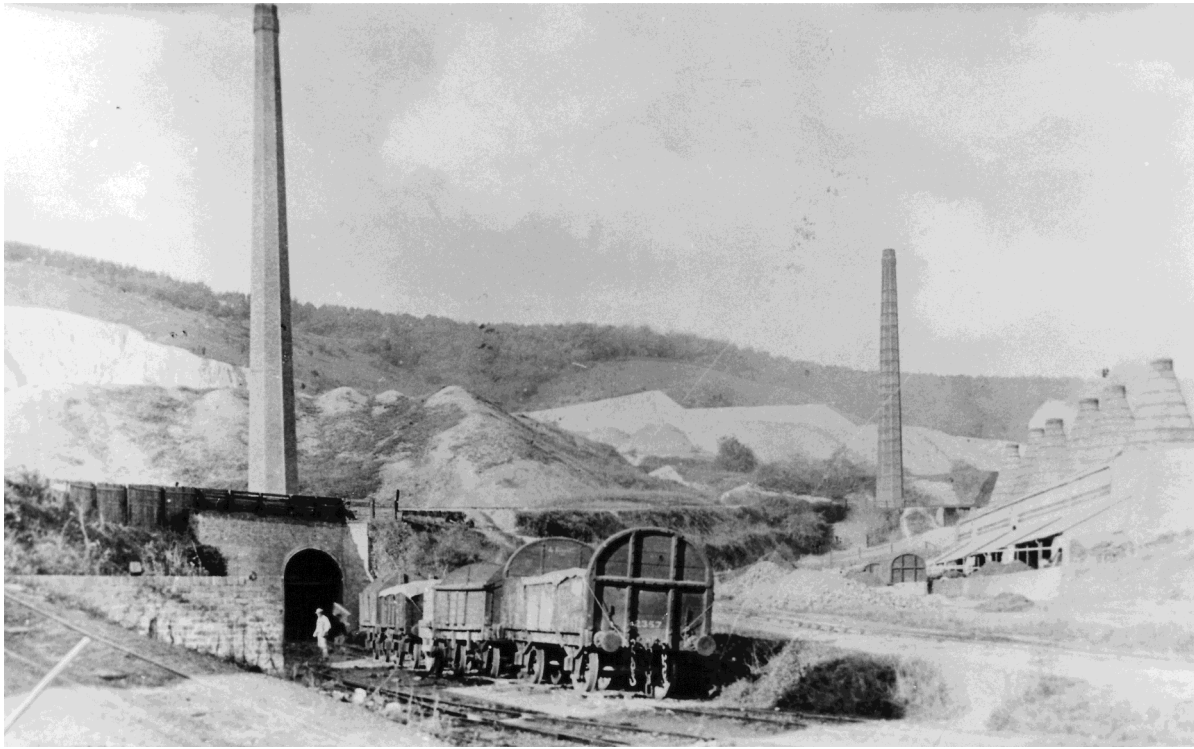
Another solution was devised by Alfred Bishop, manager of the Brockham works, who patented the Brockham Kiln in 1889. He reasoned that the lime-burning process would be improved if additional fuel in the form of small coal was shovelled directly into the burning zone continuously. This was done through small openings with lids, arranged around the periphery of the kiln. Brockham kilns were very labour-intensive and were not widely used, although two at Oxted were in use until the 1960s. In the 1990s these still survive, though ruined, and the fuel openings with their lids are still visible on one of them. A Brockham kiln at Brockham itself, which had survived complete with its top, was unfortunately vandalised while ineffectual efforts were being made to protect and preserve the structures in the early 1990s.

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Another lime burning system attempted in the nineteenth century was the Hoffmann system, which is mainly associated with brick-making. The basic principle is that there is a ring of chambers which are fired in sequence, with a central chimney for waste gases. A fire travels round the ring continuously and as chambers are loaded in front of it lime is being drawn from the chambers behind. There are remains of Hoffmann kilns at Betchworth.

A key processing plant at a limeworks is the hydrator, in which quicklime is converted to slaked lime (calcium hydroxide) with much emission of heat and steam. Despite the simplicity of the principle of adding water to burnt lime the process needs controlling carefully and the structures are very complex. Hydrators have not survived as well as kilns but a modern one worked at Oxted into the 1990s. It served the Oxted kilns themselves until the 1960s. It was then used to hydrate burnt lime brought in bulk containers from elsewhere but was demolished in 1998.

Geologically the chalk of the Downs has three principal divisions. The Middle and Lower chalk are the important strata for extraction. Of these, the Middle Chalk is white and produces a white lime, while the Lower Chalk is contaminated with clay and is grey in colour, a fact which was emphasised in the name of



Betchworth limeworks in 1900.

the Dorking Greystone Lime Company at Betchworth. Grey chalk produced lime with the important property of hardening under water and was therefore known as 'hydraulic lime'.

Besides mortar, lime was formerly used to make plaster and, despite the reactivity of quicklime, it was common for it to be transported in this form to be slaked by the plasterer on site.

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OTHER USES OF CHALK

Another important product of chalk was whiting, a finely ground powder produced as a sediment by grinding chalk under water. The remains of a whiting works may be found near The Clears at Reigate. Whiting was used as whitewash, was incorporated into paints and putty, or was sold as blocks for rubbing on doorsteps or whitening canvas shoes.

Chalk also yielded a limited amount of a building stone known as clunch, which has been hardened through recrystallisation of the calcium carbonate. Clunch is a freestone, meaning that it can be cut in any direction. It was taken from underground workings, for example at Racks Close in Guildford and Chapel Farm Chalk Mine, West Humble, Dorking. The latter has been a bat hibernaculum since 1971 but when visits are permitted it is possible to see large discarded blocks of chalk in the partially collapsed workings. Traces of clunch can be found in many old buildings in Surrey and some was used by Sir Christopher Wren in the reconstruction of St Pauls Cathedral between 1685 and 1690.

Firestone and Hearthstone: Industries of the Upper Greensand

Beneath the North Downs the chalk merges into the Upper Greensand. This contains a band of rock which has been worked for building stone near Farnham but has more interesting associations with the area in east Surrey between Brockham and Godstone. Here the workings were underground and are generally known as firestone or hearthstone quarries. Neither name is satisfactory since the first refers to the refractory property of the stone and the second to one of its uses. Both names date from the nineteenth century but some of these quarries may date back to the twelfth.

The Domesday Book of 1086 mentions only one quarry in Surrey, at Limpsfield Manor. This could correspond to the workings known as Chaldon quarries which can still be seen north of Rockshaw Road, Merstham, and in Spring Bottom Lane, Bletchingley. For the Normans bringing a stone-based architecture to Britain this was a useful source of building stone close to London. Christopher Wren reporting in 1713 on the dilapidated stonework of Westminster Abbey considered that this 'Ryegate' stone had been used by the Norman architects as a less durable substitute for their own Caen stone.

Because of its lack of durability — Wren used it only for interiors — Reigate stone was little used for building by the mid-eighteenth century, except locally. Nevertheless it had earlier been associated with prestigious buildings, possibly because of its lightness and acceptability to masons. These include London Bridge,

Westminster Palace and Abbey, the Tower of London, Rochester Castle, Guildford Palace, Southwark Cathedral, Leeds Castle in Kent, Windsor Castle, Eton College, Hampton Court, Nonsuch Palace and Whitgift's Hospital, Croydon.

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The first recorded use of the stone for its refractory properties, in bakers' ovens, domestic hearths and glass manufactories, dates from the eighteenth century.

The quarries at Chaldon which started in medieval times have a few dates inscribed on their walls but none later than the eighteenth century, suggesting that they were exhausted by then. The area of working was limited by the water table to the north and possibly by property boundaries to the east and west. However, related underground quarries on the west side of the A23, along the south side of Gatton Bottom, were worked from at least the thirteenth century into the second half of the nineteenth.

The method of working the older quarries remained unchanged for centuries. The structure of the Weald has meant that the Upper Greensand and its band of stone dips to the north in east Surrey so the quarrymen had to work down the dip. Only a thin seam of suitable rock, no thicker than a man's height, could be followed under the North Downs as far the water table permitted. The workings have been explored and surveyed by cavers and their plans show an elaborate system with a wide extent from east to west. The method of working is known as pillar-and-stall. From an east-west route, parallel passages were worked in a northerly direction. At short intervals the passages were linked by further extraction of stone. Thus in time a large open space interrupted by numerous stone pillars would be created. What is to be seen underground however is a network of torturous passages lined with dry-stone walls which hold back waste stone. Only part of the rock was suitable for cutting building blocks and even when roughly shaped blocks were cut from the face they were trimmed underground. Thus about 60 per cent of the cut rock ended as waste.

In the nineteenth century many landowners saw an opportunity to exploit the resources on their estates. Stone had been quarried from the Clayton estate at Godstone since at least the seventeenth century but the heyday of these quarries was in the mid-nineteenth.

One of the major developments of the nineteenth century was at Merstham where Sir William Jolliffe and Edward Banks developed both stone quarries and limeworks. The Merstham quarries were on lower land which had been avoided by the medieval quarrymen and Jolliffe had to find a way of draining the workings. He first adopted the conventional mining method of driving an adit under the Rockshaw ridge to drain the floor of the mine but this soon collapsed and he resorted to pumps, powered by steam. Jolliffe and Banks were also directors of the Croydon Merstham and Godstone Railway, which was planned to connect the works at Merstham and Godstone to the Surrey Iron Railway, the horse-drawn railway from Wandsworth to Croydon which had been opened in 1803. The extension opened to Merstham in 1805 but plans to continue the line to the stone quarries at Godstone were never realised. Thus the Godstone quarries suffered from isolation from a main railway line, although the railhead reached Caterham in 1856.

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Various railways, drawn by men or horses, were used within the Godstone workings themselves and have left well-preserved traces underground. It is fortunate that there was local interest in Godstone quarries at the end of the nineteenth century and contemporary accounts have survived. It is striking how few people worked the quarries at any one time – a maximum of about twenty workers. We may assume that this would have been true of the Chaldon quarries too and the large worked-out area may owe more to about 700 years of operation than to the number of quarrymen at any one time. Indeed the medieval quarries may only have been worked by general labourers when agricultural duties were slack.

In the early nineteenth century a fashion started for smartening domestic hearthstones, window ledges and door steps by rubbing them with stone and some of the east Surrey building stone quarries were re-worked for 'hearthstone'. It is thought that this was preferred to chalk because of its very slight green tinge but, whatever the reason, a thriving hearthstone trade developed which even extended to export. The business lasted until the end of the Second World War at Godstone but the later hearthstone mines, at Brockham and Colley Hill, Reigate, survived longer. The mine at Colley Hill, which operated until the 1960s, was developed solely for hearthstone and used higher strata than those used earlier for building stone. The hearthstone from Brockham was sold as lumps whereas that from Colley Hill was made by grinding the stone and mixing it with a little cement to form blocks, which were stamped 'London'.



Park Pit, Buckland: extracting sand for glass manufacture.

Building Stone, Sand and Fuller's Earth: Industries of the Lower Greensand

STONE FROM THE LOWER GREENSAND

The Hythe beds of the Lower Greensand contain chert which resembles the flint found in chalk. It is a hard stone formerly used for road building. Stone quarries in the Lower Greensand at Limpsfield Chart are recorded in the Domesday Book and local stone can be seen in some of the old buildings in this locality. Traces of former chert pits may be found near St Andrews Church, Limpsfield Chart, and the Nature Reserve in Rabies Heath Road on Tilburstow Hill near Godstone consists of spoil mounds and gullies made by working this locally important chert pit in the nineteenth century.

A dark brown ironstone known as carstone is seen in some old buildings, often as galletting in the mortar. No workings have been identified and the stone appears to have been picked from the sand. Around Godalming the Bargate beds of the Lower Greensand yield a distinctive hard, brown, calcareous sandstone which, cut in irregular blocks, can be seen in many houses and walls in the district. Bargate stone occurs in irregular masses, known locally as 'doggers', within softer sandy beds. These lumps were extracted by the technique of 'jumping the stone' whereby a group of quarrymen inserted a crowbar, placed a plank across it at right-angles and jumped up and down on the plank, using long poles to balance themselves. Several quarries were worked near Godalming until the Sec-

ond World War, particularly in later years for stone to be crushed for road metalting, but after the war the workings were abandoned.

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SAND EXTRACTION

Three divisions of the Lower Greensand are important for sand extraction: from youngest to oldest, and therefore from north to south, they are the Folkestone, Sandgate and Hythe Beds.

Sand pits in the Folkestone Beds are one of the most familiar sights in Surrey. In the east there is an almost unbroken line of sand pits along the outcrop, many abandoned and some still active, for instance at Godstone, Reigate and Bletchingley. In west Surrey, the route of the Farnham bypass, which actually bisects the town, follows a line of old sand pits which provided an undeveloped, level and relatively straight line from west to east for the construction of the road. Traces of the original pit edges can still be seen alongside the bypass, marked occasionally by fences formed of the old narrow-gauge railway track which was once used to work the pits. The working area in the 1990s is to the east of Farnham around the villages of Runfold and Seale, though many of the pits there have already been used for refuse land-fill.

Despite its name of Greensand, the sand is usually yellow or white and sometimes red. Hence the place-name Redhill. Sand is mainly silica which is chemically silicon dioxide, colourless and crystalline. The yellow

or red colour comes from iron staining which does not matter when the sand is used in the construction industry, as vast quantities are. The white variety, known as silver sand, is used in the manufacture of clear glass. In the 1990s there are still active pits for silver sand at Reigate and at South Park, Godstone. Silver sand underlies the yellow sand in some locations and was dug from underground workings, resulting in caverns under the town centres of Godstone, Dorking and Reigate.

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Sand formerly had domestic uses as scouring powder and for sprinkling on floors to be swept up with dirt. This would be important where, as was quite usual, the floor was simply beaten earth which would be turned to mud with water. In large houses the sandman would make a weekly visit and children used to be urged to sleep with the threat of the sandman coming to sprinkle sand in their eyes.

The Hanson Group's Reigate Quarry, better known as the Buckland sandpits, between Buckland and Reigate, is a good example of modern sand extraction. Some old abandoned pits can be seen in the area but the Tapwood pit, north of the A25, is still active in 1997 and seeking to expand, against much local opposition, to supply the demands of the glass industry. Tapwood pit is large and gives a high yield but it can be worked by just two or three men using a Caterpillar digger and two mechanical shovels.

For glass manufacture the sand must be iron-free and conform to a strict range of particle sizes. The sand is made into slurry by jets of water and piped to Park Pit on the south side of the A25 for processing. There it is sorted into particle sizes by the action of jets of water and any iron is removed chemically.

FULLER'S EARTH

Eastwards of Redhill in the Sandgate Beds the Lower Greensand has been exploited for fuller's earth or calcium montmorillonite. Fuller's earth is composed of the elements silicon, aluminium, oxygen and hydrogen and is classified as a clay, although it lacks the plasticity normally associated with clays. Its molecular structure is such that water can penetrate between the sheets of atoms. The amount of water it contains determines its properties and allows it to be used in a wide range of industrial applications. It will absorb large quantities of grease so before cheap soap and modern detergents became available it was used in the fulling of woollen cloth. There were laws preventing its export but in 1825 these were repealed and a large profitable market was opened up in the USA.

In the late nineteenth century it was found that fuller's earth was effective in the decolourising and deodorising of edible vegetable oils and mineral oils. It was therefore used in the new margarine industry and the emergent oil industry. Many new uses were found in the second half of the twentieth century and production rapidly increased. Fuller's earth has the property of *adsorption* — the attraction of impurities on to the surface of the particles — which make it suitable for recovering spent lubricating oils from cars, buses and aeroplanes, cleaning up radioactive waste and using as an antidote to heavy metal poisoning. The *absorption* properties which in the past were employed for degreasing wool are still used, for example as a matrix for pesticide granules in agriculture, as baby powders and facial mudpacks, and for cat litter — an extravagance which was exploited by opponents of planning applications for new pits in the 1980s.

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It is not known when fuller's earth was first dug in east Surrey although there are claims that it started in Roman times. Through the centuries of its use in the woollen industry it was probably sold by farmers, perhaps from bell pits. Then near the end of the eighteenth century William Grece became the first person to devote his business life to its extraction. The arrival at Merstham of the railhead of the Croyden, Merstham and Godstone extension of the Surrey Iron Railway in 1805 may have helped in the marketing of the earth, which was sold from wharves at Wandsworth.

The person most associated with the large-scale developments at Nutfield is James Crawley, who in the late 1840s opened two pits, Cackle Works west of Nutfield and Park Works on the north side of the village. Perhaps Crawley's most significant venture was to amalgamate the Surrey businesses and those in Somerset into one price-fixing cartel, The Fuller's Earth Union (later FEU) in 1899. The FEU continued until 1954 when it merged with Lahore Industries.

In the early twentieth century German chemists discovered that the fuller's earth available in their own country could be activated — to improve its effectiveness in decolourising mineral oil — by treating it with hydrochloric acid. Alarmed by the threat to their business, the Fuller's Earth Union Ltd of Britain experimented in producing its own activated earth. Lt Col Wilfred Taunton Raikes was appointed in Surrey to design and build an acid activation plant at Cackle Farm, Nutfield. Raike's process, which used sulphuric acid from the nearby Nutfield Manufacturing Company, was quite novel. Essentially the earth as dug was digested in a pressure vessel and after separation the earth was washed free of acid and dried.

In 1981 Laportes commissioned a completely redesigned activation plant in the north of England at Widnes which signalled the beginning of the end for the fuller's earth industry in east Surrey. The old pits were exhausted and, after vigorous public debate, planning permission to open new pits at Goldstone and Tandridge was refused. Some of the oldest pits were reopened and a fresh thin seam was worked at Glebe quarry.

The closure of the last remaining plant, Copyhold Works, was reported in the Surrey Mirror on 30 May 1996. Low level extraction still continued and in 1997 only one or two men were reworking with earth diggers an area near the site of William Grece's pit — a far cry from the 400 employed in the heyday of the 1909s.

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'SWELLING CLAY'

An industry related to fuller's earth was the production of the mineral bentonite, also known as 'swelling clay' because it swells when wetted. In bentonite the calcium

in fuller's earth is replaced by sodium to give sodium montmorillonite. It was discovered early in the twentieth century that when oil wells were sunk it was frequently necessary to line the drill hole with clay, to prevent the hole from caving in and the oil from seeping away into any permeable strata. Bentonite was particularly useful as a component of such muds, but does not occur naturally in Britain.

The company D'Arcy Exploration, which pioneered oil prospecting in Persia, was concerned that it was dependent on imported bentonite and approached the Fuller's Earth Union in east Surrey to see if its fuller's earth could be converted. In theory this was easy since by treatment of fuller's earth with soda the conversion should have occurred readily by a process known as cation exchange. In practice it was difficult to achieve but the FEU's research chemists rose to the occasion and by the 1940s the company was selling synthetic bentonite as Union Bentonite No 1. Later it was called Fulbent and was to play a part in North Sea oil exploration.

The swelling property of bentonite is used in civil engineering for sealing reservoirs and for excluding water from excavations. For instance, at the new development of The Quadrant, in the boggy north-east part of Redhill, the initial excavation was lined with thin bentonite-impregnated boards to prevent water from entering at the sides.

Bentonite is also used in thixotropic suspensions — best known in non-drip paints — which liquefy on disturbance so that they can be pumped. The construction of deep and narrow concrete 'diaphragm' walls underground is often imperilled by possible collapse of the trench which must be dug before pouring the concrete. The trench can be supported temporarily during excavation by topping it up with a bentonite mud.

The pits and processing works of the fuller's earth industry once dominated the A25 on the ridge between Redhill and Nutfield but by 1997 most of the pits had vanished and Cawley's Park Works and Cockley Works were totally demolished. The abandoned Copyhold Works which dominates the skyline at the top of Redstone Hill just outside Redhill still stands but the site is now owned by a firm which hopes to build a giant incinerator. The adjacent deep pits are being used as a landfill site and are being grassed over as the process continues. Nearer Nutfield on the north side of the ridge older parts of the former site are maintained as a nature reserve although this has been threatened by a proposed golf course. A pit here, fast being covered by new growth, was a nineteenth century settling pit where different grades of fuller's earth were separated after being ground under water. Behind the Inn on the Pond on Nutfield Marshes are remaining small steep-sided pits. Pits such as these were once a familiar feature of the landscape but few now survive and modern methods of digging which do not use draglines mean that they are no longer made. One of the last pits to be dug was Glebe Quarry, part of which has been remodelled and preserved for fishing.

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Nutfield village itself is a monument to the fuller's earth industry. Some of the houses are built of a poor quality grey stone which was dug from the fuller's earth pits. It was confusingly called coine stone which should indicate that it was used for the corners of the houses but in fact the corners are always brick. A superior house in the village is Well House which is Cawley's old house. It was formerly named The Tower because of the quaint little tower, which still exists, built in the garden. Another house which recalls the industry is Chart Lodge on the south side of the A25 at the top of Redstone Hill outside Redhill. This was built by John William Grece in 1870 and has some old workings behind it which possibly indicate underground working.

Chapter 3

CLAY, WOODLAND AND METAL INDUSTRIES

Clay has been dug for making bricks, tiles and pottery in many parts of Surrey and the heavily wooded lands on the Weald Clay in the south supported early glass and iron industries. The iron was smelted in the Weald but on rivers in northern Surrey, nearer the London markets, water power was used to work iron and non-ferrous metals into consumer goods.

Pottery

Before the Staffordshire potteries came to dominate the national market in the eighteenth century an important pottery industry flourished around the Surrey-Hampshire border. It supplied London in the Middle Ages and in Tudor and Stuart times but goes back much further, to the Roman period, when there was a major centre of production in Alice Holt Forest, close to Farnham but just over the county boundary. Its remains have been excavated and its products studied over many years. Research in the 1970s included the reconstruction of Romano-British kilns and the experimental firing of reproduction pottery, with valuable results.

In the Middle Ages coarse pottery was made in south-east Surrey around Limpsfield. The sites of two pottery kilns of thirteenth to fourteenth century date, situated on the Gault Clay, were excavated in advance of the building of the Clacket Lane service station on the M25 motorway. Archaeological displays have been placed in both the east-bound and west-bound service areas.

The county was best-known from the thirteenth century onwards for the pottery known as Surrey White-ware, which was made from white-firing clay from the Reading Beds and decorated with a translucent green lead glaze. It has been studied in detail from the large quantities found in archaeological excavations in London and divided into groups according to the location of production sites: Kingston ware, Cheam ware and Border ware from the Surrey-Hampshire border near Farnham. The term Tudor Green ware has also been used for the fine pots with a white fabric and green glaze made between about 1380 and the mid-sixteenth century. The Farnham area has outcrops of Reading Beds clay for whiteware and also of London Clay and Gault Clay, both of which produce pottery with a red fabric. Products included dishes, bowls, jugs and other cooking and drinking vessels, and also items such as money boxes, lamps and crucibles.

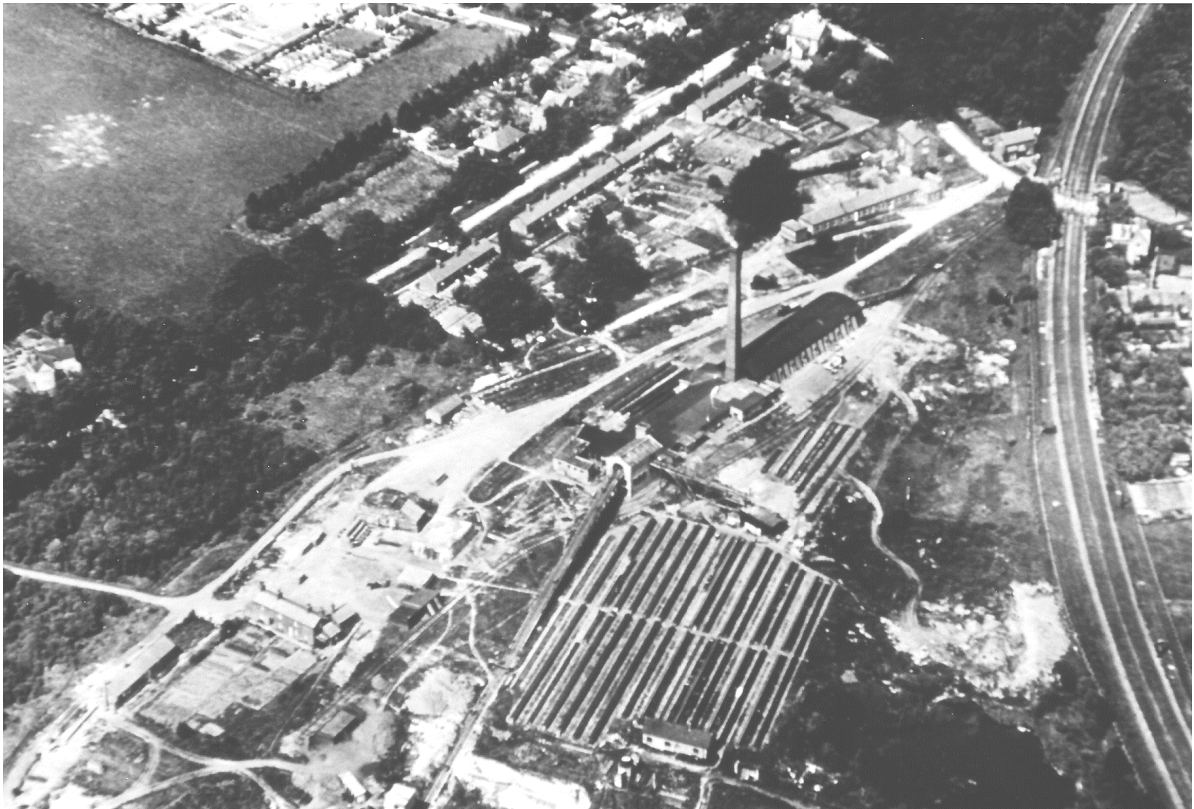
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Although Surrey potteries lost their major London market for table ware in the eighteenth century, many continued into the nineteenth century and later, supplying a local demand for garden and utility products.

Several specialist craft potteries have operated in the county in more modern times. Some were associated with the Arts and Crafts Movement of the late nineteenth century and in particular with the Home Arts and Industries Association. The artist George Frederic Watts and his wife Mary Watts, who lived and worked at Compton near Guildford, were supporters of the Association and Mary Watts, besides building the memorial chapel for her husband, established a pottery in the village which continued until 1956.

Ashted Pottery Limited was established in 1922 by Sir Lawrence and Lady Weaver to employ ex-servicemen who had served in the First World War. The pottery occupied the Victoria Works which had originally been a photographic works and had then been used for various purposes including a depot for imported steam cars. Between 30 and 40 people were employed by 1926 but the pottery closed in the depression of the 1930s. Its distinctive decorative products have since become collector's pieces.

A country pottery which has been recognised as of national importance is at Wrecclesham near Farnham, where Absalom Harris, a member of a family with a long tradition of pottery making in the area, established his works in 1872. Using local Gault Clay, the firm produced bricks, tiles and architectural mouldings. As part of the Arts and Crafts Movement, it revived post-medieval 'Farnham Greenware' and produced a range of 'Art Pottery' in collaboration with the Farnham School of Art. The works continued under five generations of the Harris family, but seemed likely to close in the 1990s. In 1998 however negotiations began for the purchase of the premises by the Farnham Trust. The buildings, including the best example of a traditional wood-fired pottery kiln in the country, and the unique collection of nineteenth century tools and equipment, are being recorded. It is planned to continue the pottery on a smaller scale and to establish other craft workshops on the site.



Oxshott brickworks from the air. *Ernest Crossland Collection.*

Bricks and Tiles

Bricks can be made wherever there is clay and brick works are scattered throughout Surrey. Clay pits were often dug to make bricks for an individual house and survive as ponds adjacent to the building. The bricks were fired in clamps, in which the stacked bricks were covered with old bricks and turf. In the nineteenth century bricks were made near the sites of housing developments and it is sometimes possible to detect gaps between houses where the clamps once stood.

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Commercial brickworks have operated at many places in Surrey, on London Clay at Ashted and Oxshott, on the Gault Clay at Brockham, close to both limeworks and hearthstone mines, and especially on the Weald Clay, where some very large brickworks were modernised in the 1980s. The South Holmwood and the Smokejacks Brickworks, for example, each has a production capacity of a million bricks per week.

Bricks are formed by firing clay at 950-1150°C. Their exact colour and composition will depend on the method of firing and the composition of the clay, which varies from place to place. Weald Clay, for example, is not pure clay, which would shrink during firing, but contains varying amounts of sand and silt. Besides minerals such as kaolinite and illite, the clay can also contain soluble salts, in particular sulphates, which if untreated would cause 'dryer scum' on the bricks which have been dried ready for firing, and this would burn to an unsightly white. On some sites

therefore, barium carbonate is added to the water used in preparing the clay in order to 'fix' the soluble sulphates.

If carbon in the form of coke breeze, anthracite dust or town ash is added to clay, as in stock bricks, the bricks themselves ignite during firing, and this assists the kilning process. At high temperatures, of about 1,100°C, the carbon tends to reduce the ferric oxide, which gives bricks a red colour, to ferrous which is black. Hence some bricks are black inside or have a black surface.

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Black-and-red mottled stock bricks are still made in 1997 at Lamb's brickworks, at South Godstone, founded in 1919. The clay mixture or pug is made by mixing water and local clay with spent fuel from fluidised bed furnaces at Oxshott brickworks from the air. *Ernest Crossland Collection.*

such firms as Reed's paper mills and Tate and Lyles' sugar refineries. The blended mixture is conveyed by belts to a machine which presses it into brick-shaped wooden moulds which have been coated with sand. The soft bricks are dropped out of the moulds on to trolleys and pushed along rail tracks to drying sheds where they are dried for several days. The dried bricks are stacked in the kilns (clamps) which are then sealed at their fronts with waste bricks and sand. The kilns are gas fired.

Another active works, the Smokejacks Brickworks near Ockley, uses a modern Hoffmann kiln, installed in 1990. At Ockley, the mixture of clay and water treated with barium carbonate is extruded through grids to break it down and then crushed between heavy rollers with pulverised solid fuel. The resulting pug is then delivered to hand moulders, who press it into wooden moulds, or to a machine which cuts a rectangular column of pug into shapes. Both hand and machine formed bricks are dusted with fine sand before going to the drying ovens. After two days drying the 'green' bricks are taken to the gas-fired Hoffmann kilns, built in a ring as described for lime burning. Each of the chambers holds 19,000 bricks. The bricks are fired in one chamber to 1,030°C or more. After three to five days, firing is complete; the next chamber is fired while the first cools and another is loaded. The gas heating zone is advanced step-wise from chamber to chamber automatically and continues around the ring, never stopping.

Among the many brickworks which have closed, one of particular interest was Frederick Carroyer's works at Newdigate, which was started in the 1920s to provide employment for men in the village. It produced a hard steely-blue brick which can be seen in local buildings such as the school. The works closed in 1974 and the site is in private hands. A large lake in the former clay pit has become a wildlife haven.

At Crowhurst there is an abandoned Staffordshire continuous kiln, a variant of the Hoffmann system, with a ring of 22 chambers.

Tiles differ from bricks only in shape. They were used for roofs in Roman times but then went out of use and were not re-introduced into England until the mid-twelfth century. Medieval kilns for firing roof tiles have been excavated at Guildford Castle, Borelli Yard in Farnham and in the Farnham Park estate of the bishops of Winchester. The Guildford Castle kiln is particularly important because of its early date — the early thirteenth century — and its remarkably good state of preservation.

A particularly important product of medieval Surrey is seen in the famous thirteenth century floor tiles from Chertsey Abbey, which had designs in white-firing clay inlaid on a red ground.

In modern times the demand for clay tiles has decreased as cheaper products made of concrete have become available. Clay tiles are still needed however for the sympathetic repair and restoration of old buildings and they are still moulded by hand at Swallow's Tiles near Cranleigh. [Swallow's Tiles finally ceased production in April 2008.]

Woodland Industries

The Wealden glass and iron industries needed charcoal for fuel. Charcoal was also used, with saltpetre and sulphur, as one of the ingredients of gunpowder and the glass industry obtained potash, to mix with sand as a flux, by burning beech or oakwood. Although reports occur of fuel shortages, in general the woodlands were effectively managed as a renewable resource by a system of coppicing. This involved cutting the trees at regular intervals so that they made new growth of straight poles which were harvested in turn. In the eighteenth century Smith & Son of Guildford and Messrs Young of Dorking are both recorded as suppliers of charcoal to gunpowder makers and in 1792 Messrs Young had a contract to supply the government powder mills at Faversham in Kent and Waltham Abbey in Essex.¹

Coppice wood was also used directly in rural industries such as the manufacture of hurdles, hop poles and brooms and it was shaped by steaming to make hoops for barrels and walking sticks. Large quantities of hazel hoops were shipped down the Godalming and Wey Navigations to supply coopers in London. A walking stick factory at Wormley, which also made shepherds crooks for export to Australia, moved into the manufacture of modern walking aids in the twentieth century. Birch and hazel brooms were made by men known as 'broom squires'; nineteenth century census returns show many of them living in the district around Hindhead, on the heathland in south-west Surrey. The tools of woodland trades, and occasional demonstrations of their use, can be seen at the Rural Life Centre at Tilford, near Farnham.

Wealden Glass

Glass was made by the Romans but its use died out in Britain after they left. It was imported from the continent from Anglo-Saxon times onwards and occasionally made in Britain by craftsmen brought over by monasteries, but a permanent industry was not established until the first half of the thirteenth Century. The Wealden glass industry, which flourished on the Surrey-Sussex border around Chiddingfold from then until the early seventeenth century, was part of an early Forest glass industry which was located in the woodlands of western and central Europe, using charcoal as fuel and beech or oakwood to burn for potash. This was needed as a flux to lower the melting point of the main ingredient, silica, to a level which could be reached in the primitive furnaces of the time, that is from about 1,800°C down to 1,150-1,500°C. The

silica, in the form of sand, was probably obtained from the Folkestone Beds and Hythe Beds of the Lower Greenland, around Chiddingfold, Hambledon and Lodsworth. Lime, which was another necessary ingredient, was obtained from the Chalk and clay for building the furnaces came from the Wealden beds.

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There were also early glass works in Staffordshire and Yorkshire but of some 80 known glass houses of the period between 1250 and 1600, 45 are in the Weald.

Archaeological excavations at glasshouse sites near Alfold and Hambledon have provided information about the quality of the product and the technology used, showing for example that the medieval glass makers used separate furnaces for the various stages of manufacture: the initial heating or 'fritting' to remove scum, the further heating to melting point and the final annealing, to eliminate differences of stress within the product.

Two phases of the industry have been identified, before and after the 1360s when immigrant glass makers began to arrive from Normandy and Lorraine. The early glass had been somewhat opaque and subject to weathering and better quality glass had continued to be imported- green glass from France and Germany and clear crystal glass from Italy. The new products were harder and more translucent and as quality improved the industry became better able to compete with imported glass and expanded to other parts of the country.

The most prominent of the immigrants was John Caré who was granted a patent to regulate the glass industry in 1567. He died in 1572 and his grave is reputed to be under a marble slab near the war memorial at St Nicholas Church, Alfold.

There are few remains of the industry to be seen. The excavated remains of a two-chamber annealing furnace of c. 1550 have been preserved as a feature on a forest trail near Alfold. In Chiddingfold Church there is a window made up in 1916 of 427 fragments of Wealden glass, 224 of them coloured. Most date from the period 1425-1559 but one piece has been dated not later than 1325.

Glass making, which used coppice wood directly as well as for fuel, had to compete for resources with other woodland industries, in particular the iron industry which was essential for the manufacture of ordnance. In the early seventeenth century coal was successfully used for fuel in glass making. In about 1611 the first coal-fired furnaces in England were set up in historic Surrey in Southwark and Lambeth, using 'sea coal' brought by coastal ships from the North-East. The Wealden glass makers began to move to

London and in 1615 James I finally prohibited the use of charcoal for glass making in the Weald and granted a monopoly to Sir Robert Mansell for the coal-fired industry.

Wealden Iron

Surrey was on the periphery of the early iron industry of the Weald which was mainly located in Sussex and Kent. Most of the ore was obtained from clay-ironstone deposits in the Wealden beds, which were worked open-cast or by sinking bell-pits. Clay itself was used for building furnaces and hearths and coppiced woodlands provided charcoal for fuel. The other necessary resource was water power, to work bellows and hammers, and elaborate systems of dams and 'hammer ponds' were created to provide a constant flow of water. A distribution map of bloomeries and blast furnaces shows that they were mostly situated on the older rocks of the central Weald and the Weald Clay outcrop which encircles them, but some were on the Lower Greensand to the west, in the Haslemere district of Surrey, where there were good streams for water power.

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The early furnaces were bloomeries — simple layers of iron ore and charcoal heaped into a dome and enclosed with clay. Temperatures high enough to reduce the ore were obtained by the manual use of bellows at the bottom of the furnace and a hole at the top allowed gases to escape. The process produced a 'bloom', a spongy mass of metallic iron mixed with slag, which had to be removed by reheating and hammering in the bloomery forge. Water power was adopted for operating the bellows and hammers of bloomeries from the twelfth century onwards on the continent and in England from the fourteenth century.

Another improvement was the shaft bloomery furnace which was introduced by the Romans. This was a drum-shaped structure larger than the dome type of bloomery. Its advantage was that ore and charcoal could be added through a hole in the top even while the furnace was being fired. The later blast furnace carried this adaptation further. It was larger and built of sandstone blocks lined with clay. By using water power to operate the bellows temperatures of over 1600°C could be reached to produce molten iron which could be tapped off. The product was pig iron with a high carbon content which was brittle. To make the malleable bar iron required by the blacksmith the carbon had to be burned out in a finery hearth. The 500th anniversary of the establishment of the first blast furnace in England, at Newbridge in Ashdown Forest in Sussex, was marked by the unveiling of a plaque on the site in December 1996.

The Wealden iron industry grew rapidly in the sixteenth century, doubling in size between surveys made in 1548 and 1574. Gun founders provided the major market for the iron and many operated in the region, in peace-time making castings for firebacks, grave slabs and various utensils. Bar iron was supplied in large quantities to ironmongers, many of them in London, and in smaller amounts to local blacksmiths. The industry began to decline in the seventeenth century, facing competition from the Forest of Dean, but it continued to hold its own for the manufacture of high-quality ordnance until 1775, when the Carron ironworks in Scotland began to take a lead. There was a brief revival in the Seven Years War of 1756-63 but then a rapid decline and the last Wealden furnace, Ashburnham in Sussex, closed in 1813.

Surviving features of the iron industry consist of scattered slag, dams and earthworks hidden in the woods and ponds, some drained as at Ewood near Newdigate, but some still in water as picturesque 'hammer ponds', for instance at Thursley in west Surrey. Other water-powered sites in Surrey include Vachery forge and furnace near Cranleigh, West End and Imbhams furnaces near Chiddingfold, Abinger Hammer forge between Guildford and Dorking, and Woodcock Hammer near Godstone.

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The Manufacture of Metal Goods

Besides iron smelting and founding in the Weald, copper, brass and iron goods were manufactured in less remote parts of Surrey. An attempt was made by Thomas Steere to establish a wireworks at Chilworth on the Tillingbourne in 1603 but this was forced to close after only three years because it was infringing

a monopoly held by the Mineral and Battery Works, whose main operations were at Tintern in Monmouthshire. Steere had persuaded workmen at Tintern to come to Surrey. He was making iron wire which was in great demand from the woollen industry for the wire-studded 'cards' used to prepare wool for spinning.

In the 1620s Richard Evelyn set up brass and copper mills at Abinger and Wotton. These produced wire and plate for making consumer goods such as pans and kettles and, despite some disputes with the holders of the monopoly, they continued to do so for much of the seventeenth century.

Metal working, in copper, brass and iron, was carried on from the mid-seventeenth century onwards at several mills nearer London, on the lower reaches on the River Wey and River Mole.² Iron ore occurs locally in the Tertiary Bracklesham beds at St George's Hill, Weybridge, but is now considered to have been smelted in the district only in prehistoric times.³ The proprietors of the mills in north Surrey had major business interests as ironmongers and merchants in London, and some were also associated with metal industries in other parts of the country. John Hitchcock, for example, who was active at Byfleet, Weybridge, Esher and Ember mills in the first half of the eighteenth century, was a partner in the 'Societies of Bristol and Esher for Making Brass, Battery and Brass Wire'. Later in the eighteenth century Alexander Raby operated at Downside Mill at Cobham and at Coxes Lock Mill at Addlestone on the Wey Navigation, before leaving the district in 1807 to develop ironworks in South Wales.

Notes

1. West, J, *Gunpowder, Government and War in the Mid-Eighteenth Century* (1991), 174-75.
2. Greenwood, G B, *The Elmbridge Watermills, Surrey* (1980, limited edition typescript).
3. Potter. J F, '*Iron Working in the Vicinity of Weybridge, Surrey*', *Industrial Archaeology Review*, 6 (1982), 211-23.

Chapter 4

FOOD AND DRINK

Corn milling and brewing were formerly widespread and their characteristic buildings have remained familiar, through mill restoration projects and adaptive re-use. Corn milling in particular has left several well-known landmarks in the form of wind and watermills. Most brewery buildings have been lost to redevelopment but some have been reused, for example at Staines, Horley and Esher, and Farnham Maltings houses a major community centre, while parts of three out of seven Victorian breweries in Godalming can still be recognised as such by the initiated. Among other interesting structures relating to food production, two examples — ice houses and watercress beds — are discussed in this chapter.

Corn Mills

In prehistoric times cereals were ground by hand, using quern stones which are often found on archaeological sites. The first water-powered mills for grinding cereals were probably introduced into Britain by the Romans and several Romano-British and Saxon mill sites have been excavated. By the time of the Domesday Survey in 1086 there were over 5,000 watermills in England, including about 100 in Surrey, but it is not clear whether these were sites, waterwheels or pairs of millstones. A drawing survives of a medieval Surrey watermill in the late 14th century cartulary of Chertsey Abbey.

At the end of the nineteenth century Surrey still had about a hundred active water corn mills but there was then a rapid decline and the last commercial mill in the county, Botting's Albury Mill, closed in 1990. Wheat is now ground only for demonstration purposes at Cobham, where one of a former pair of watermills survives and has been refurbished by a local trust. The earliest windmills in Britain were recorded in the late twelfth century. At least one of these was in Surrey as, between 1189 and 1199, Odo de Dammartin granted his land in Warlingham with the windmill to the Priory of Tandridge. Some forty windmill sites are known in modern Surrey but only five are still standing as recognisable mills and of these only Outwood post mill is able to grind.

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In the past, most parishes had a mill which ground local corn for local consumption. When it arrived at the mill the corn was lifted in sacks to a loft where it was stored in bins. This was usually done using a hoist powered by the waterwheel or windmill sails. Before

it was used, the grain was fed down spouts to be cleaned using shaking or rotating machines known as dressers. It was then returned to the loft, again using a hoist, and fed down different spouts to the millstones. For flour for human consumption the best millstones were imported from the Paris basin in France or from Cologne in Germany and were known as burrs and cullens respectively. For animal feed, millstone grit 'peak' stones from Derbyshire were mostly used. The grain was ground between the furrowed working surfaces of the rotating upper stone and the fixed lower stone and emerged at the perimeter as meal. This descended down spouts to be collected in sacks on a lower floor. It was then transferred to a bolting machine for at least some of the bran to be removed.

The repeal of the Corn Laws in 1846 allowed grain to be imported from overseas and this gradually led to vast quantities being shipped into Britain from North America. Also, in the 1870s, roller mills in which flour is made by passing grain between a series of pairs of iron rolls, rather than between a single pair of stones, were introduced from the continent. This method also involves more elaborate equipment for refining and sifting the partially-made flour at each stage. It was particularly suited to milling North American grain and consequently large steam-powered roller mills were built near the ports. This meant that inland watermills and windmills lost much of their flour trade and were often forced to rely on producing animal feed. Most of them closed in the early years of the twentieth century.

At many mills several generations of the same family are known to have been active. Of particular interest is the Budgen family, an agricultural trading family and founders of the modern grocery chain. They milled at Outwood from 1665 to 1807 when the mill passed to their relatives, the Jupps, who continued until 1934.¹

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WATERMILLS

Waterwheels are classified as being undershot, breastshot, overshot or pitchback, depending upon where the water meets the wheel. Undershot wheels require no head of water and are turned simply by having paddles which dip into a flowing stream. The other types of waterwheel do require a head of water. This may be created by placing a weir across a river upstream from the mill and taking water from



Haxted water mill.

the top of this along a leat to the waterwheel. However on small streams it may be necessary to build a dam to create a millpond or reservoir immediately upstream from the mill. The buckets of the waterwheel are often shaped so that they retain as much water as possible as the wheel rotates, in order to maximise the power. For simple undershot wheels only about one-tenth of the available power may be used but for overshot and pitchback wheels the fraction can be over one-half. Early waterwheels were of wood but during the nineteenth century most of these were replaced by wheels made partially or entirely of iron. Also in the late nineteenth century water turbines were introduced. These are usually much smaller than waterwheels, easier to maintain, far more efficient and more suited to roller mills as they rotate much faster. Many different types of turbine were manufactured. They all have a rotating wheel or rotor which can be mounted either vertically or horizontally. Usually, water is directed continuously through all of the vanes of this wheel, radially outwards, radially inwards or axially. The whole is often enclosed in an iron casing, sometimes out of sight beneath water level. Finally some mills added steam engines or gas engines or turned to electric power.

Inside a watermill, on the same shaft as the waterwheel, there is a vertical bevelled cog-wheel known as the pit-wheel. This links with a horizontal cogwheel known as the wallower on a massive upright shaft. Above the wallower is a larger horizontal cog-wheel

known as the great spur wheel. Engaging with this are located numbers, often two or three, of small horizontal cog-wheels known as stone-nuts. These have short vertical axles which pass upwards to the floor above and drive the upper mill-stones. The upright shaft also goes upwards through the mill to power the dressing and bolting machines and the hoist. Occasionally other arrangements are used including rows of millstones driven by a horizontal lay-shaft beneath the floor.

Most of the water-powered corn mills of Surrey have been destroyed, sometimes accidentally by fire, but usually by conversion into residences, offices, workshops or restaurants, usually with the loss of all of their equipment. Others have been demolished for their sites to be redeveloped. The outstanding, timber-clad Newark Mill on the River Wey, with three waterwheels and eight pairs of stones, burnt to the ground in 1966; the seven-storey, turbine-powered Lock roller mill on the Wey navigation at Addlestone, which worked until 198, was converted into apartments in 1990; the larger of the pair of attractive mills at Cobham was demolished for road widening in 1953; the Upper Mill at Ewell, after a public enquiry, was gutted in 1984, converted into offices and its timber weather-boarding replaced by plastic — which resulted in it becoming one of the listed buildings in Britain to lose its listed status; Stanwell Upper Mill on the River Colne; which had a magnificent waterwheel about 20 feet in diameter by 6 feet wide and also steam power

has become a warehouse and offices; Coltsford Mill, near Oxted, has become a restaurant and, although it produced flour for private use until recently, this has now stopped; and finally Botting's roller corn mill at Postford Mill, Albury, together with its turbine, was demolished for re-development in 1996. Fortunately the Surrey Industrial History Group was allowed to video this last mill working before it closed in 1990. Also in 1996, permission was granted for Paddington Mill near Abinger Hammer, which had not worked for nearly a century, to be recorded in detail before it was converted for residential use. Although all the equipment had been removed many years ago, it was possible, from the traces which survived, to deduce where the machinery had been and how the mill had operated.

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Despite all these losses, Surrey is fortunate that the 18th century Shalford Mill on the River Wey, one of its best watermills, has survived and is protected by the National Trust. The remarkable story of how it was saved is well-known but worth re-telling. It stopped work in 1914 and by 1932 it had become very dilapidated and was in danger of being demolished. However, it was given by the owner to a mysterious but dedicated group of preservationists known as Ferguson's Gang. They collected money to restore the mill, held their secret meetings there and then gave the mill to the National Trust. It has four storeys, is timber-framed, with brick, tile-hung and weather-boarded walls, and has an unusual and large overhanging wing over the door. There is an internal low breast-shot waterwheel and all the gearing is in place. There are two pairs of peak stones, one pair of French burrs and several cleaning and dressing machines.

Surrey has also been fortunate in having had a water-mill museum housed in Haxted Mill, on the River Eden between Lingfield and Edenbridge, near the county boundary with Kent. Built partly in 1680 and partly in 1794, it worked until after the Second World War. Then in 1949 it was purchased by Mr Woodrow who created the museum which opened in April 1966. The mill has three storeys with twin Mansard roofs and is brick and weatherboarded. It has an external hoist protected by a characteristic covered platform, known as a lucomb, projecting at loft level. There is an external overshot waterwheel, all of the gearing is in place and it has three pairs of French burrs around the great spur wheel. In 1992 the mill received SIHG's annual Conservation Award but regrettably it has since been closed to the public.

Other Surrey watermills which retain a substantial amount of their machinery but are not normally open to the public include High Mill, on the River Wey at Farnham, which worked until 1950 and has interesting gearing and a low breast-shot waterwheel; Snowdenham Mill, with a very large mill pond on a tributary of the Wey at Bramley, which SIHG hoped at one time to restore but was denied permission; the small timber Flanchford Mill on the Wallace Brook near Reigate, which is decaying rapidly and has an uncertain future; and Cosford mill on a tributary of the Wey at Thursley, which was lovingly preserved after the Second World War by the late Mr and Mrs Loarridge, who were presented with the first SIHG Conservation plaque in 1983. The mill is now in new ownership.

One apocryphal story about a Surrey watermill needs to be corrected. In 1830, during a period of rural social unrest, the timber mill near the centre of the modern village of Albury was set on fire and an attempt was made to shoot the miller, James Franks, who was also an unpopular overseer of the poor. Subsequently James Warner was arrested, found guilty and executed, but the charge was attempted murder and he was not, as has often been repeated, the last man in England to be hanged for arson.² The mill was soon rebuilt in brick and continued working but in 1910 a later miller, Charles Botting, moved his business to a new roller mill at nearby Postford. The old mill has been used as a laboratory in the twentieth century.

WINDMILLS

Windmills are far more elaborate as engineering structures than watermills because the sails, which in south-east England are often known as sweeps, have to be turned to face the wind. In the earliest type, the post mill, the whole timber body or buck of the mill turns on a pivot at the top of a massive upright post. This is supported by a framework of other timbers around which a building, called a roundhouse, is often constructed to protect it from the weather and to provide storage space. In the smock mill and the tower mill only the cap rotates. The former is weather-boarded but the tower of the latter is of brick or stone. Traditionally windmills were turned into the wind manually by pushing a tail pole protruding from the back of the mill. However in the late eighteenth century the fantail was invented. This consists of a set of small vanes mounted at the rear of the mill at right-angles to the sails and linked to gearing which rotates the buck or the cap automatically. For post mills the fantail is usually located on the tail pole or on the external steps at the back of the mill. For smock and tower mills it is behind the cap.



Outwood post mill.

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In early windmills the sails are covered with cloth, which has to be adjusted for each sail in turn, either working from the ground or, for tall mills, from a balcony around the mill. In the late eighteenth century spring sails with wooden shutters were introduced. These are set according to the average strength of the wind so that strong gusts open them against springs to prevent the sails from turning too quickly. Then patent sails were developed which enable the miller to re-set all the shutters from inside the mill, simultaneously and while it is working. The windshaft to which the stocks of the sails are fixed, enters the mill and acts as the axle for a large cog wheel immediately inside. This drives millstones and other equipment in

the mill and also acts as a brake drum; being almost surrounded by a band of wood or iron which can be tightened against it. In a storm the friction arising from the brake can cause a disastrous fire. Another problem is rapid changes in the direction of the wind. For example, if the eye of a storm passes overhead, it may not be possible to turn the sails into the wind quickly enough and then they and the cap, or even the whole mill, can be blown down. Post mills, because of their light construction, were particularly vulnerable to being 'tail-winded' in this way. However they also had an advantage, in that they could be moved to new sites without being dismantled. They could, for example, be pulled across country on rollers by large teams of oxen or traction engines.

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The outstanding surviving windmill in Surrey is Outwood post mill. This was built in 1665, retains many of its original timbers and is the oldest working windmill in Britain. It has a tarred weatherboarded buck, a roundhouse, four spring sails, no fantail, a pair of peak stones in the head and a pair of French burrs in the tail. The post mill ceased working regularly in the 1930s but some

commercial milling was carried on until about 1949. It has been repaired on many occasions and was in working order in 1962 when purchased by the brothers Raymond and Gerald Thomas. In 1984 they were presented with SIHG's Conservation Award for their dedicated work in maintaining the mill in working order. Sadly Raymond died in 1992 and Gerald in 1996 and a trust is being formed to try to ensure that the mill continues to work.

Another post mill survives on Reigate Heath. It dates from the mid-eighteenth century and worked until about 1868. It is remarkable because the roundhouse was converted into a chapel in 1880 and services are still held there during the summer months. It has been restored with decorative sails and has most of its machinery intact. Also unusual is Lowfield Heath post mill which dates from about 1762 and was last used in about 1880. It was then left to decay until fitted with dummy sails in the 1930s, after which it deteriorated again. It stood just within the county boundary near Gatwick Airport but, when the boundary was moved as a part of local government reorganisation in 1974, it found itself in Sussex. However in 1987 the pillaged wreck which survived was dismantled and carried across the new county boundary back into modern Surrey and rebuilt at Charlwood. The building was officially opened in 1990 and work continued to restore the machinery to working order. The trust carrying out the reconstruction was presented with the SIHG Conservation Award in 1995.

Regrettably, Surrey has no surviving smock mills. The largest smock mill in England, measuring 62 feet to the top of the cap, was built by the Budgen family close to the old post mill at Outwood, some time after 1796.³ It had four patent spring sails with a span of 80 feet, a 5-vaned fantail, a balcony, four pairs of stones and an auxiliary steam engine. It worked until 1914 and then gradually decayed until it finally crashed to the ground in November 1960. Shiremark smock mill, very near the county boundary south of Capel, was very different from Outwood. It was squat with a large octagonal base and had no fantail. Like Outwood, it ceased work in 1914, gradually rotted away and eventually burnt to the ground in 1972.

[Buckland wind-driven sawmill has been restored to working order and received the SIHG Conservation Award in 2004. It is the only wind-driven sawmill still in existence in the country.]

Two Surrey tower mills survive with their structures largely intact. Wray Common mill at Reigate was built in 1824 and worked until 1895. The tower is about 45 feet high and it had spring patent sails and a 6-vaned fantail. It was fitted with dummy sails in the 1930s but no equipment survives below the cap. Ewhurst tower mill with four storeys plus a cap was built in about 1840, replacing a post mill which was tail-winded in a gale and blew down. It ceased work in about 1895 and was converted into a residence in 1901. It originally had patent sails, with shutters on both sides of the stocks and a fantail. It now has dummy sails but the ogee cap still contains a cast iron windshaft and a wooden brakewheel. The rest of the equipment has gone and large windows have been inserted into the tower.

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Ice Houses

Before refrigeration became available, owners of large estates built ice houses in their grounds to store ice. The ice would have been used either as a bed for cold

dishes or for making cold sweets and was also useful for cooling wine and keeping food fresh, either in the kitchen or while it was stored in the ice house.

General use of ice houses began in Britain in the sixteenth century, one of the earliest recorded being at Greenwich in 1619. An early ice house close to Surrey was built at Hampton Court in 1625 but there appear to be no remains of this or even any indication of where it may have been sited. The twelve-sided brick structure in Home Park, near Kingston Gate, was built in 1693 and repairs, including encircling it with iron bands, were carried out in 1700.

The design of the houses varied in detail but, in general, they consisted of an entrance, a passage, a storage chamber and a vault; there are often two or three doors between the chamber and the outside. The chamber for storing the ice is usually underground although ice houses were often built into the side of a hill or buried into a mound which would cover the structure. If not covered with earth, the vault and passage were usually thatched. A few ice houses had no passage, the ice being loaded and removed through the top of the vault. These are sometimes referred to as ice wells. The base of the house was sometimes paved and sometimes of bare earth. A drain, usually covered with a grating (sometimes a wagon wheel) was needed to remove any water which formed as the ice melted.



The ice house at Ockley Court.

The houses were usually sited close to a pond or other source of ice and in some cases artificial ponds were specially dug for the purpose. When ice was formed on the pond it was put into the chamber by the gardeners and layered with straw so that it was easier to remove.

As soon as there was a rail network to transport ice from the docks, an increasing amount was imported into Britain. This came from Norway and the United States, particularly from Wenham Lake in Massachusetts, although after 1873, when a fire destroyed the Massachusetts works, 'Wenham Lake ice' came from Norway. Owners of large houses began to fill their ice houses with this cleaner ice for domestic purposes, rather than dirtier material from estate ponds and lakes.

During the First World War the import of ice stopped and never recovered as mechanical refrigerators had become available. Ice houses in the grounds of stately homes fell into disuse but many survive in varying states of disrepair.

Probably the best example in Surrey which may be easily examined is at Hatchlands, the National Trust property at East Clandon. This ice house is believed to have been built at the same time as the house, in 1757. It is situated on the edge of a chalk pit, making drainage easy to arrange. The chamber is about 10 feet (3 metres) deep and 12-15 feet in diameter, is brick-built and rendered above ground level. It has a

domed roof, with a hole in the centre of the roof for loading the ice, and an arched entrance. A false floor was put in after it ceased to serve its original purpose, so that it could be used as a summer house, but this has been removed.

Ice houses are listed in the SIHG district Guides. Many of the surviving structures are within private grounds but those for Wotton House and Bury Hill are adjacent to public footpaths and that for Ockley Court, which has a tiled roof over the entrance and vault, is in the farmyard behind Ockley Church.

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Watercress Beds

Watercress, *Nasturtium officinale*, grows naturally in many rivers such as the Wandle, Hogsmill and Tillingbourne in Surrey. It was cultivated on a commercial scale by the late eighteenth century in the German Rhineland and on the River Ebbsfleet in Kent by 1805.⁴ The first large-scale cultivation in Surrey was at Abinger Hammer, on the Tillingbourne between Paddington Mill and the site of the forge mill. It was started on this site in about 1850, soon after the opening of the Reading, Guildford and Reigate Railway with its station at Gomshall, which enabled the cress to be delivered to London within a few hours of being cut.

The first beds were made by William Smith, who found the sandy soil and spring water ideal for the



Watercress beds, Abinger Hammer.

crop. The operation was soon taken over by Richard and John Coe, of the local tanning firm, and it has since remained in the same family. By 1888 they had 25 acres of beds which extended from the original site down the valley to Chillworth, and built eight workers' cottages, later known as Fern Cottages, which had extensions at the rear for packing the watercress in flat baskets.

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As a legal requirement, for reasons of public health, the cress is grown in spring water which is kept separate from that of the river. This is taken from several artesian wells which go down to a depth of 150 feet (46 m). The modern beds are in concrete tanks and the water is carried to the most westerly beds by pipes under the road and village green.

Watercress was also grown at Fetcham, near Leatherhead, where Mizen Brothers' market garden included 8 acres of watercress beds in 1921. These were situated near the mill pond of Fetcham Mill, which is fed by springs used for public water supply. Mizens' operation closed in 1957 when their land was taken over by transport and water supply companies.

Brewing and Hop Growing

Ale or beer has always been an important beverage in Britain, particularly in the past when both the sterilising effect of boiling water for brewing and the food value of malt helped to overcome public health problems.

The classic example of early brewing by the ale-house keeper belongs to Surrey,⁵ where the efforts of Elinour Rummige of Leatherhead are recorded by the laureate John Skelton in his poem of 1529, *The Tunning of Elinour Rummige*:

The hens run in the mash vat
For they go to roost
Straight over the ale-joust
And dung, when it comes,
In the ale-tuns.
Then Elinour our takes
The mash-bowl and shakes
The hens' dung away,
And skims it into a tray
Whereas the yeast is
With her mangy fists.

One would have thought that the water would be in need of boiling anyway, without the help of Elinour's additions to the recipe. In the light of this, perhaps one should be less concerned about the use of modern additives in brewing!

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Originally the product brewed was ale, which was an unhopped drink made from fermenting malted liquor. Following the introduction of hops by Flemish brewers in London in the fifteenth century, the product became known as beer, although the terms ale and beer have often been used to mean the same thing. A degree of caution therefore has to be used when interpreting records. However it is interesting to note that one of the earliest references to a common brewer of 'byere' outside London was John George in Godalming in 1483.

The use of hops had a preservative effect on the product. This meant that beer could be kept for much longer than unhopped ale without spoiling and could also stand up to travel, so that it could be marketed over a wider area. Another preservative was brimstone or sulphur which was burnt to produce Sulphur dioxide. The use of preservatives was initially very unpopular with the authorities; indeed Henry VIII forbade his brewer at Eltham to use hops or brimstone in his ale.

Brewing was historically a domestic activity carried out in the home, on farms and by publican brewers. Common brewers, who sell in bulk to publicans, have played an important role in the south-east since at least the end of the seventeenth century but it is only since the middle of the nineteenth century that, with better and cheaper transport and changes in legislation, they have come to dominate the industry outside London. They had certain advantages over publican brewers: a longer brewing time, which helped to give a more consistent product; keeping stock in hand, which gave the beer longer to mature; and the ability to concentrate on brewing as a primary concern rather than a sideline to the main business of running the hostelry.

THE BREWING PROCESS

The basic principles of brewing have changed very little over the centuries, apart from the modern methods of processing some beer after production

the process involves coarsely grinding malt (partially germinated barley) and mixing this with hot water, or liquor as it is known to brewers, in a mash tun. This converts the grain's starch into sugars which dissolve to give wort. The wort is drawn off the spent grains and boiled in the copper, or brew kettle, with hops, after which it is separated from the spent hops and cooled. Yeast is then added to convert the sugars into alcohol, giving beer. For British beers, top fermentation yeasts are traditionally used. These sit on top of the brew, creating a head of yeast which protects the beer from the air. For lagers, bottom fermentation yeasts, which sit at the bottom of the fermentation vessel, are used.

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HOP GROWING

Loam above chalk provides the ideal foundation for growing hops which, although hardy, require optimum conditions to produce the quality needed for market. A good depth of rich soil and great quantities of manure are required. The plants also need an airy situation with protection from cold winds, moisture but not wetness, and a mild climate.

Hops were originally simply grown up poles but more recently these poles have been connected with wires to allow the vines to climb along. Hop production was an expensive and labour-intensive industry. Even in the 1950s a considerable number of people were employed, but since then mechanisation has taken over. Production has continued to shrink in recent times because of a number of factors including the cost of production, a reduced need as a result of modern strains being much higher in the alpha acids and lupulin required by the brewer, and competition from imports.

Hops were grown mainly in east Surrey around Crowhurst and in the west around Farnham, but are also recorded at Chilworth in the Tillingbourne valley in the seventeenth and eighteenth centuries.⁶ The crop was used both within the county and beyond. The acreage of Surrey hop gardens was always very small but Farnham hops were generally regarded as the finest in England and fetched the highest prices at Weyhill Fair near Andover in Hampshire. It should be remembered that in official excise returns 'Farnham District' actually covered the Hampshire, Isle of Wight, Salisbury and Surrey Excise Collections, although the famed 'Farnham Hops' only came from the area between the foot of the Hog's Back ridge and Wrecclesham and Bentley.

Hop growing was reputedly introduced into Farnham, which had been a woollen manufacturing town, from Suffolk in the mid-seventeenth century and eventually became the main source of the town's wealth. In the late seventeenth century John Aubrey reported that there was 'not a clothier here; Hops being the principal commodity, with about 300 acres planted'. In the mid-nineteenth century the area on which hops were grown was greatly expanded along the foot of the Hog's Back. The official returns show that during the first half of the nineteenth century the Farnham acreage was consistently in the 2,000-3,000 range but in the 10 years from 1852 to 1861 this expanded to 4,000 acres and continued to increase until it peaked at 5,930 in 1885, after which it rapidly fell back. These changes broadly reflected the national trend at the time.

Whereas Farnham had been one of the few areas in the country with specialist hop farmers, rather than general farms which included a hop garden, at the end of the twentieth century there is just one farm in the county, growing some 12 acres of Fuggles hops; however it is encouraging to see that it is hoped to expand this acreage in the near future.

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When they are picked, the moisture content of hops is around 80 per cent. They would rapidly deteriorate and rot if stored in this condition and they are therefore dried in hop kilns — known as oasts in Kent and east Surrey — to reduce the moisture to about 6 per cent, although this rises to 10 per cent on storage. The drying process also ensures that the moisture content is evenly distributed. The dried hops are compressed and packed into large sacks, or pockets, which each hold 1.5 cwt (75 kg). Although hop growing has all but ceased in Surrey we are fortunate to be able to enjoy the sight of a number of hop kilns, often now converted into private houses. Examples can be seen near Crowhurst and South Godstone in the east of the county and at Frensham, Tongham and Puttenham in the west.

MALTING

Malt, the second largest constituent of beer after water, is made by the partial germination of barley. The grain is steeped in water, spread out on floors to germinate and raked and turned to ensure regular growth, heated in a kiln to arrest the process of germination, finally cleaned to remove the husks and rootlets and then stored to await dispatch to the brewers.

Malting was an important industry in the past, particularly in parts of the county near the Thames. Daniel Defoe, in his tour of Britain in 1724-1726; described Chertsey as a town wholly employed either in malting or in the transport of malt by barge to London. Kingston, in the old county of Surrey, had numerous malt-houses and Alderman Frederick Gould recalled that when he moved there from his native Bath in 1839 'there were malthouses visible in all directions, and everywhere one turned there were Inland Revenue officers ...'. In general, malting in Surrey appears to have been on a small scale and it is interesting that, when so many hop kilns have survived, the process of malting has apparently left little evidence. Apart from the large industrial-scale maltings at Farnham, which has become a community centre, and a medium-sized malthouse at Egham which has been converted to offices, few malthouses can readily be recognised as such. Remains are known however in the Farnham area at Tongham, Badshot Lea and Wrecclesham.

There must have been many small malting floors and kilns to service all the brewhouse taverns which once existed and two such small malthouses distinguished by the presence of pierced tiles which formed the floor of the kiln — have been discovered during conversion of old buildings as dwelling houses in West Street and Castle Street in Farnham. One wonders how many more remain to be discovered.

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BREWING IN SURREY

Brewing has, until recent times, always been a very important industry in Surrey, but it was generally concentrated in those areas which are now part of London, especially along the south bank of the Thames. This was no doubt a result of the pressure of space for development on the north bank of the river, combined with the fact that travellers had to use London Bridge and therefore go through Southwark. An example of a Southwark brewery was the Anchor, in its day one of the biggest breweries in the kingdom, whose owner in the mid-eighteenth century, Ralph Thrale, became Sheriff of Surrey. This brewery eventually became Barclay Perkins and then merged with Courage who, confusingly, also had a large Anchor Brewery in Southwark at Horsleydown beside London Bridge.

Nationally the number of breweries peaked in the nineteenth century when most of Surrey outside London consisted of small towns, and villages. By the time population growth had given rise to a mass market, the whole nature of the industry had changed. The Beerhouse Act of 1830 created a vast number of new outlets with neither the experience nor the desire to brew and who therefore needed suppliers. The evolution which has taken place towards brewing by large multinational companies left Surrey, until recently, with no breweries except at Mortlake. The trend is best illustrated by the example of one small village brewery and the series of takeovers that happened to it.

The Byfleet Brewery evolved from the efforts of local tanner Henry Dennett, who reputedly took a few barrels a week around the village for sale. By 1845 his son, also Henry, had set up the brewery and he later took George Barron Holroyd, of the Byfleet Mill family, into partnership. Dennett died in 1870 and Holroyd carried on the business, which was described as 'an extensive brewery' in the 1874 Post Office directory. By this time Byfleet had a population of almost 1,000 but Holroyd owned other pubs in the surrounding areas which gave him a market for his products.

FARNHAM UNITED BREWERIES, LIMITED.

**BREWERS, WINE AND SPIRIT
MERCHANTS.**

Agencies :—
WOTE STREET, BASINGSTOKE.
8, GREAT MINSTER STREET, WINCHESTER.

FARNHAM ROAD, GUILDFORD.
CHERTSEY ROAD, WOKING.

Bottled ALES and STOUT
a Speciality. From 2/- per doz.

Try our noted OATMEAL STOUT
2 6. per doz.

Ales and Stout in all size Casks
10d., 1/-, and 1'6 per Gallon.

TELEPHONE No 10.



**All Orders by Post promptly attended to, and our vans
being in all parts of the neighbourhood daily, we are able
to guarantee immediate delivery.**

LION BREWERY, FARNHAM.

Farnham brewery advertisement from a local guidebook.

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In 1889 the brewery merged with the Friary Brewery of Guildford and in 1890 Healy & Co of Chertsey were taken over to create Friary, Holroyd and Healy's Brewery Co Ltd. The Byfleet Brewery was closed in 1909 and the site was gradually sold off over a number of years. The brewmaster's house, The Beeches, still stands.

Following years of acquiring other local breweries, including its important local competitor Lascelles Ticker, in 1956 Friary merged with Meux of London to form Friary Meux, which itself was taken over by Allied Breweries in 1963. Brewing at Guildford ceased in 1969 and the town's Friary Brewery was demolished; Allied have since become Carlsberg Tetley.

Other breweries in the county disappeared for various reasons, such as the death or bankruptcy of the owner, but most were simply taken over by their competitors, resulting in fewer and fewer companies and the evolution of a number of national brands. Examples include Nalder & Collyer of Croydon, who were acquired by the City of London Brewery in 1919. Page & Overton, also of Croydon, took over Youell & Elkins of Horley and Bradley's of Epsom before being taken over themselves by Hoare & Co in 1929.

Hoare's — whose trademark was the familiar Toby Jug — were in turn taken over by Charrington in 1933 and later became part of the Bass empire. Mellersh & Neale of Reigate bought a number of breweries, including the Swan Brewery of Leatherhead in 1922 and Pagden's of Epsom in 1931, both of which had also taken over others, and then, like Friary Meux, became part of Ind Coope and Allied Breweries. Watney, whose brewing side merged with Courage and was then sold to Scottish & Newcastle, acquired a number of Surrey breweries. These include their present Mortlake site, which had been Phillips More & Co, the West End Brewery at Esher, the Farnham Brewery Company and Ashby's Cobham Brewery. Jason Gurney's Star Brewery at Walton-on-Thames was taken over by Brandons of Putney who went to Mann, Crossman & Paulin and then merged with Watney.

Courage bought Hodgson's Kingston Brewery in 1943. Hodgson had, over the years, taken over many other local companies including Frickers' Eagle Brewery, Kingston in 1903 and Guildford Brewery in 1929. Courage also took over the Claremont Brewery, Esher and the Farnham United Breweries formed from Edward Barrett's Red Lion Brewery and George Trimmer's Lion Brewery.



A modern micro-brewery: coppers and mash tun at the Hog's Back Brewery, Tongham.

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THE REVIVAL OF SMALL BREWERIES

In recent years there has been an explosion in the number of new small breweries around the country and Surrey has had its share. They are subject to change, but recent developments include the Pilgrim Brewery, founded in 1982 at Woldingham which moved to Reigate in 1985; the Hogs Back Brewery, established in farm buildings at Tongham in 1992; the Hale & Hearty at the Ball and Wicket in Upper Hale, opened in 1996; Leith Hill Brewery at the Plough Inn, Leith Hill, opened in 1996; pub breweries at the Cyder House Inn, Shackleford, the Flamingo Brewery which became the Kingston Brewery Co and closed in 1998 and the Forger & Firkin, Guildford; Bob's Brewery, Woking, opened in 1996 as part of the Planets leisure complex; Weltons' North Downs Brewery, Capel, set up in an old milking parlour at Rugge Farm in 1995 but since moved to a factory unit in Dorking; and the Halcyon Brewery at Hersham.

The history of brewing in Britain has been, to a large extent, driven by the need to acquire tied houses to guarantee a market. This system is now under review by the European Union and it could well be that in a few years' time we shall have a very different industry in Britain. In the meantime we are fortunate to be able to witness the resurgence of a local industry.

Notes

1. Davis, R, 'Budgen: a trading family', *Surrey History*, 5.1 (1994), 24-45; *The Story of Outwood Mill* (Thomas Brothers, 1989).
2. *The Surrey Countryside*, (Guildford 1975), 160.
3. Davis, note 1, 27-28.
4. Eve, D, 'Springhead Gardens and the watercress industry', *Industrial Archaeology News*, 105 (Summer 1998), 4.
5. Elinour was an actual person who was fined for selling ale at excessive prices in 1525. The poet, who was attached to the court of Henry VIII, may have visited Leatherhead when the court was at Nonsuch Palace, only six miles away. Vardey, E (ed), *History of Leatherhead* (Leatherhead & District Local History Society, 1988), 66-7, 305.
6. Public Record Office, E134. 7 Chas I, 5 Mich; Northants Record Office, Spencer Papers, SOX 488, hop accounts.

Chapter 5

TEXTILES AND LEATHER

'Of old times divers cloths were made in the town of Guildford and other places within the counties of Surrey, Sussex and Southampton called Cloths of Guildford, which were of good making and good value, and did bear a great name'. This quotation from a statute of Richard II of 1391 shows that well before the late fourteenth century Surrey was part of a larger cloth manufacturing region which extended into neighbouring counties. After the woollen industry declined, there was framework knitting and minor textile industries have included linen, silk and the manufacture of military braids. Other textile industries of historic Surrey, in districts now in London, are outside the scope of this book and too are the stories of the foreign artisans who worked in many of them – the Mortlake tapestry works supported by the Stuart kings in the seventeenth century, felt and hat making, dyeing, bleaching and calico printing in Bermondsey and Southwark, and the bleaching and calico printing works of the Wandle valley.

The leather industry was of such importance in the historic county that in 1703 Queen Anne granted a charter to 'the Master, Wardens and Commonalty of the art or mystery of tanners of the Parish of St Mary Magdalen, Bermondsey in the County of Surrey'. The area was close to the London markets which supplied the skins and tidal streams flowing into the Thames provided a plentiful water supply for the manufacturing processes. Though on a much smaller scale, there was also a substantial leather industry in south-west Surrey, around Guildford and Godalming and in the east of the county around Reigate. Small-scale tanning was carried on in many towns and villages in the past as animals were kept and slaughtered locally.

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Cloths of Guildford

The early wool textile industry made woollens, to which the word 'cloth' strictly refers, as distinct from the lighter worsteds or 'stuffs' which became fashionable in Tudor and Stuart times. Woollens are made from short-stapled wool which is prepared by carding, using pairs of hand-held boards studded with wire. The carded wool is spun into a soft, springy yarn which produces fabric with a soft bulky texture. Worsteds are made from long-stapled wool which is combed to keep the fibres straight and sleek. Woollen cloth came from the loom in a greasy state with a loose, open weave. It was therefore scoured with detergents, such as fuller's earth, to remove the grease,

and shrunk and thickened by beating it with heavy wooden hammers in fulling stocks. It was then stretched out to dry on racks or tenter frames, consisting of upright wooden frames studded with tenter hooks, then brushed with teasels to raise the nap and sheared to produce a smooth, even surface. The product could be dyed at any stage, in the fleece, at the spinning stage or after the cloth was woven.

England was renowned first as an exporter of raw wool, much of which was produced on monastic lands, particularly those of the Cistercian order. Waverley Abbey near Farnham, which the Cistercians founded in 1128, and the Augustinian Merton Abbey in the north of the county, were both supplying wool to the cloth-manufacturing centres of Florence and Flanders in about 1300. The early English cloth industry was carried on in major towns such as Beverley in Yorkshire, Stamford in Lincolnshire and Bristol and Winchester in the south of England. It was organised by merchant and craft guilds. Mechanised fulling mills appeared in the twelfth century and were widely adopted in the thirteenth. The woollen industry spread to rural areas where water-power was available and where guild regulations could be avoided. It is from this period onwards that records are known of the Surrey woollen industry.

After corn-milling, fulling was the next industrial process to use water-power, and the rapid spread of fulling mills in the thirteenth century has been described as an early industrial revolution.¹ The mills were small affairs, housing just a trough with a pair of hammers. These were raised by tappets on a shaft turned by a water-wheel and then allowed to fall under their own weight. Many such mills were set up alongside existing corn mills and sometimes under the same roof. The King's mills in Guildford, for example, established in 1251, consisted of a corn mill, malt mill and fulling mill. Later there were at least four fulling mills on the River Wey in Guildford. Fulling mills are also recorded in the manor of Woking in 1271 and by 1360, at Catteshall, Godalming, where one was set up beside a long-established corn mill. The fulling mill at Catteshall may have been built earlier because tax returns record the names of Robert le Follar, William le Follar and Thomas le Follar at nearby Farncombe in 1332. There was a fulling mill at Rake near Milford in 1577 and a corn mill and fulling mill at Chilworth in 1589. Many of these mills were converted to other uses, such as paper-making, when the woollen industry declined, and some of them continued as industri-

al sites up to the twentieth century. Chilworth for example became a gunpowder mill and Catteshall a paper mill followed by an engineering works.

Besides mill sites, reminders of the industry survive in the borough arms of Guildford and Godalming, which feature woosacks, and in inn names such as the *Woolpack* and the *Golden Fleece*. In 1574 every alehouse keeper in Guildford was required by the corporation to display a signboard bearing a woosack.

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Another reminder of the industry in Guildford is the place-name of Racks Close, denoting a place where racks or tenter frames stood.

Most of our knowledge of the woollen industry comes from documentary sources, particularly the wills of clothiers and records of court cases arising from the breaking of regulations. Spinning and weaving were domestic occupations, carried out for the clothiers by families in their own homes, women generally spinning the yarn and men weaving. The clothiers received the cloth from the weavers, had it frilled at the mill and carried out the finishing processes on their own premises. Dyeing was often carried out by specialists but some was under-taken by clothiers themselves. John Woods of Godalming, for example, whose will was proved in 1685, left his 'messuage and dyehouse with the vats, furnaces and all other implements and things belonging to the dyeing trade and dyehouse, also his shears and shearing boards, cloth press and parchment for pressing of cloth, and all his racks for drying of cloth and all other implements and tools used about his shearing trade'.² Some of the records of law-breaking in the cloth industry are concerned with clothiers dishonestly stretching their cloth. Indeed, this was the occasion for the statute of 1391, which spoke of the high reputation of 'Cloths of Guildford' in the past. The Tudor period saw a great increase in the number of laws regulating manufacturing industries, including the woollen industry. In the 1330s it became illegal for cloth to be produced outside market or corporate towns, which in south-west Surrey restricted the manufacture to Farnham, Guildford and Godalming. Many clothiers were prosecuted for making cloth outside these towns. For example at Frensham, Witley and especially Wonersh. The reason for this legislation was said to be to prevent the decline of the towns, but it may also have been intended to make the industry easier to regulate. Cloth brought to market was inspected by officials known as ulnagers who attached a seal and collected duty on each piece. Laws were passed to regulate the number of yards in each piece and many prosecutions were made against clothiers who made their cloths longer to reduce the amount of tax.

The records of these various prosecutions provide information about the products of the industry as well as about the families involved and the places where cloth was made. The type of cloth most frequently mentioned is kersey, a fairly coarse narrow cloth, about a yard (90 cm) wide, which originally took its name from a village in Suffolk, but wider cloth known as broadcloth was also made in the region, and John Aubrey, writing in the late seventeenth century, noted that the parish of Shere 'is considerable for the fustian wearers, and hath been so anciently'. Fustian is properly a cotton fabric but the word had other meanings and most likely referred to some kind of woollen cloth in this case. Aubrey also reported that Godalming made 'mixed kerses and blue kerses for the Canaries, which for their colour are not equalled by any in England'.

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The blue cloth mentioned by Aubrey was dyed with woad. This was imported, particularly from France, until the middle of the sixteenth century, when the government began to encourage its cultivation in England. The fens and Somerset became the main areas of production in the eighteenth century but in

Tudor and Stuart times the crop was more widespread. Several clothiers grew woad around Guildford, Wanborough and Godalming and in 1604 a woad house was listed in an inventory of the property of a Wonersh clothier, Nicholas Monger. In 1585 a report on woad-growing in Surrey was written by 'order of the Privy Council to enquire what Oade is sown, on complaint of its occasioning great decay of corn, and damage to clothiers by their spinners leaving their work to engage in this'.³ Woad was a profitable crop - six times as profitable as corn - but it exhausted the soil. It was gradually replaced by indigo, imported from India, which contains the same dyestuff as woad but gives a stronger colour and was less expensive.

Various other dyestuffs are mentioned in the wills and inventories of clothiers in the district. In 1616 for example John Purchase, a dyer of Godalming, left dyers' weeds, madder, brazil and alum and an inventory of Joshua Toft of Godalming, who was a dyer and clothier in the late seventeenth century, listed red wood, logwood, fustic, sanders, galls and alum. Dyer's weeds may have been weld, which gave yellow colours. Madder and brazilwood gave reds, logwood blues and black, fustic yellows and sanderswood browns. Alum and oak galls were used as mordants, to fix the dye to the cloth.

When Aubrey was writing, the cloth industry in Surrey was in decline, and had already died out in Farnham, which was by then a centre of hop-growing and noted

for its wheat market. Aubrey commented that the decline of the industry came about through clothiers dishonestly stretching their cloth and in the sixteenth century several clothiers in the district were indeed charged with that offence. In fact a change in fashion was beginning, from heavy woollens to the lighter worsted and mixed fabrics which were known as the 'new draperies', and the old woollen industry was declining in many parts of the country. In Guildford, George Abbot, the cloth-worker's son who became Archbishop of Canterbury, built the manufactory known as the Cloth Hall, in North Street in 1629 in order to employ poor people in linen and woollen wearing. The project was not successful and the manufacture was closed by a Decree in Chancery in 1656.⁴

The woollen industry had received a serious blow in 1636 when its export market suddenly collapsed. The district's products had all been purchased by a particular merchant, Samuel Vassall, who had an eventful career, trading in various goods in America, the West Indies, Guinea and Dalmatia. He was a Puritan and opposed to the policies of Charles I. Among his clashes with the authorities was an incident in 1630 when his cargo was seized for his refusal to pay tonnage and poundage, or import duty. He broke into the government warehouse, retrieved and sold his goods and was sent to prison. His trade in Surrey cloth in Dalmatia collapsed when the merchants of Ragusa (the modern Dubrovnik) ceased to buy the cloth and prevented him from selling it elsewhere in the region.⁵

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There was only one fulling mill in Guildford after 1649 and in 1701 this was used to house pumps for the town's water supply. Finally, in 1713 the fulling mill was converted to corn milling.

The woollen industry survived longer in Godalming, on a very small scale and in the late eighteenth century water powered machinery was being used for preparing the wool. Caleb Hackman insured his 'mill for carding and scribling wool going by water, dyeing



The Cloth Hall, North Street, Guildford, originally built for Archbishop Abbot's Manufactory Charity. The building was a school from 1856 to 1933. The tower was added in 1891.

house and dwelling house all adjoining' for £300 in 1782 and trade directories show that in the 1790s Edward Rutt was manufacturing blankets, William Seward was making cloth and there was a fulling mill at Westbrook. In the 1810s Charles Cheyne was listed in directories as a manufacturer of flannels and woollens. By this time, however, weaving had long been eclipsed by knitting as the main textile industry of the town.

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Framework Knitting

The stocking frame was invented in 1589 by William Lee of Calverton, near Nottingham. The early framework knitting industry was based in London and was a luxury trade, producing fine worsted and especially silk goods. The industry developed slowly at first but by the late seventeenth century there were two main centres, one in London and nearby country districts and one in the East Midlands. From about this time it began to grow rapidly and to cater for an increasingly popular market, first in worsted stockings and then also in cotton hosiery.

The trade was regulated from London by a city livery company, the Worshipful Company of Framework Knitters. The company lost control during the eighteenth century as the industry became increasingly concentrated in the midlands - in Nottinghamshire, Leicestershire and Derbyshire - and as it became more and more overcrowded with workers whose poverty became proverbial. The saying 'as poor as a stockinger' was heard as early as the 1740s and a century later a Royal Commission was appointed to report on the condition of the framework knitters, so dire had their situation become.

Framework knitting spread from London to Surrey, and also to Hampshire, Berkshire, Hertfordshire and Buckinghamshire, by the late seventeenth century. To some extent it replaced cloth manufacturing in the local economy but it bore no relation to the old woolen industry because the worsted technology which it used was quite different. Godalming and Odiham in Hampshire were the main centres south-west of London. The Framework Knitters Company held courts in various places for members to pay their fees and lists survive in the Company's records of 57 members who paid at Godalming and 30 at Odiham in 1729. Many of the Godalming names are familiar as members of old clothier families - the Bowlers, Chittys, Hookes, Mongers, Shrubbs, Tofts and Woods - some of whom turned to framework knitting when the cloth trade declined.

Letters in the Company's records give an insight into the industry in Surrey in the 1720s. Work was sent out to country districts by London hosiers and carried out by the framework knitters in their own homes or in small workshops containing a few stocking frames. The ill-treatment of an apprentice, John Hart, by his master, James Toft, resulted in a prolonged correspondence, as did the case of another apprentice, Thomas Denver, who set up on his own in Mr Willmore's worsted manufactory at Farnham before he had properly served his time. The industry seems to have been successful in the early eighteenth century, but prospects were evidently less promising by 1735

when Mary Monger made her will, leaving her goods to her grandsons 'for apprenticing them to a handicraft, except that of framework knitter'. By the 1750s many of the framework knitters were earning so little that they were receiving parish relief and the industry in the south of England had begun to decline. By the end of the eighteenth century nearly 90 per cent of the country's frames were in the East Midlands and the industry continued in the south only in London and Godalming. It survived in Godalming mainly because the town began to specialise, first in underwear, from the end of the eighteenth century and then in knitted sweaters from the end of the nineteenth.

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In 1788 George Holland, a London hosier, patented a method of manufacturing fleecy hosiery and set up a 'manufactory' in Godalming in about 1790. His method was to work a layer of combed, unspun fleece into knitted garments so that it formed a coating on the inside. This could be anything from No 1, which had 'a thin sprinkling of the finest wool' and was recommended for summer wear, to No 6 which had a layer of fleece an inch thick and was intended for sufferers from rheumatism and gout. The firm made a variety of shirts, drawers and pantaloons, stockings, night-caps, bootkins, breast-plates or bosom-friends and miscellaneous items such as feet baskets, muff linings and coach carpeting. A broadsheet advertisement for their products contains several letters from satisfied customers, including the Governor of Nova Scotia and the late Lord Heathfield, who wrote:

Having been a long time dangerously ill of the palsy, the gout, etc. I procured in October last some of your Fleecy Hosiery in stockings, socks, mittens, etc, and to the use of them I attribute my recovery.

Holland's fleecy hosiery manufactory brought prosperity to Godalming while the owner's patent lasted and on Boxing Day in 1791 the workforce celebrated by holding a St Blaise procession. St Blaise was the patron saint of woolcombers, having been martyred with the tools of their trade, and processions in his honour were held in many textile manufacturing districts. The Godalming procession was described in the *County Chronicle & Weekly Advertiser* for 3 January 1792. It was led by a man dressed in fleecy hosiery followed by twelve boys in white, a shepherd and a shepherdess with a lamb in a basket, Bishop Blaise and his chaplain on horseback, the woolcombers to the factory, a band of music and one hundred and forty manufacturers wearing cockades, sashes and ruffles made of fleece. The procession walked to Guildford, where it was greeted with church bells and cannon fire, and then returned to Godalming to be regaled with a good dinner by the patentees.

Although the establishment was called a 'manufactory' it was not a factory in the modern sense but an organisation in which the knitters worked as independent craftsmen, usually renting rather than owning their frames. Some of these machines would stand in workers' own homes but most, and certainly the wide machines needed for making underclothing, were in frameshops set up by hosiers or by other people who merely invested in the industry. Whole families were involved in the work, with the men operating the frames, women seaming (all the garments were knitted flat and had to be made up) and children winding yarn for the knitters. This domestic system survived longer in framework knitting than in other textile industries, partly because of technical difficulties in developing powered machinery but also because of the overcrowded labour market.

The late eighteenth century saw many innovations in the knitting industry, of which fleecy hosiery was one. Others were the development of machine-made lace - Nottingham lace - which is technically akin to knitting, and of decorative patterned hosiery. Then in the nineteenth century fashions changed. Women wore longer skirts which covered their ankles and men began to wear trousers instead of breeches. With the depression after the Napoleonic wars and increasing overcapacity in the industry, conditions worsened and in the first half of the nineteenth century there were several political campaigns to try to address the problems. Godalming framework knitters joined a national campaign but this was declared illegal under the Combination Acts often used against trade unions and its papers were seized. Among them, in the record office in Nottingham, are several letters about the campaign in Surrey.

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By 1850 there was another revival of the knitting industry in Godalming with the establishment of some of the earliest hosiery factories in the country. Indeed several skilled hosiery workers and their families moved to Godalming from the midlands to work in them. The Holland family, who had started the fleecy hosiery manufacture in 1790, had built the Langham Factory by 1851 when they showed examples of their work at the Great Exhibition. In about 1860 one of the large hosiery firms in the east midlands, Allen & Solly, took their first step in factory production in Godalming. They probably had connections in south east

England already because it was usual for hosiery firms in the midlands to have a marketing base and warehouses in London. Allen & Solly built a new factory in Godalming in about 1870 but within twenty years they decided to adopt the factory system on a larger

scale, closed down their Godalming works and built a new factory in Nottingham. The Langham factory, then Nevill's, also closed in about 1890 and moved its operations to south London.

The nineteenth century factories in Godalming had specialised in underclothing, especially fleecy underwear and luxury silk goods. As this branch of the industry left the town, another was beginning, and Godalming was again becoming a centre of innovation, this time for the manufacture of sports sweaters. This enterprise was started by Lucy Pitchers, wife of William Thomas Pitchers who was tailor and outfitter to Charterhouse School. Trade directories show that Mrs Pitchers ran her own millinery and drapery business and mourning warehouse in Godalming, but the documentary record gives no indication of her pioneering work. Her descendants recall that she began by employing women to knit cable-stitch cricket sweaters by hand, in the traditional manner, and then devised a method of forming cable stitch on the modern knitting machines of the day. Rapid progress was being made in the design of knitting machines in the 1890s and Mrs Pitchers interacted with manufacturers to have punched cards fitted to their machines. This enabled her to create repeat patterns of purl stitches on a stocking stitch ground. The family firm of W T Pitchers branched out into knitwear and registered many designs for patterned sweaters and stockings in Britain and the USA. The business grew and a new factory was built in the 1920s. This was extended several times over the following decades, particularly after the firm was taken over by the Jaeger company in the 1940s, but it closed down in 1970 and was demolished to make way for road building in the 1980s.

Meanwhile a second knitwear factory had been built in Godalming in 1922 by William Paine, another tailor who had turned to the manufacture of sweaters. This business grew into Alan Paine Limited, which specialised in high quality sweaters made from natural fibres and received three Queen's Awards for export. The Godalming factory closed in 1990 and its site was re-developed for retail stores.

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Worsted Lace and Military Braid

Another specialised textile industry which was carried on in Surrey in the nineteenth century was the manufacture of worsted lace and epaulettes for the trimming of military uniforms by the Appleton family at Haslemere and Elstead. The earliest information about the firm comes from the diaries of the Haslemere papermaker James Simmons.⁶ The father of the family, Henry Appleton, lived in London and in 1835 his son Thomas, then aged about nineteen, set up machinery for spinning and weaving in Pitfold Mill



Pressing sports sweaters at Pitchers' knitwear factory, Godalming, in the 1920s. *Michael Pitchers Collection.*

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at Haslemere, one of the mills which belonged to Simons. Soon afterwards he married and settled at Elstead, where the corn mill had fallen vacant, and started a manufactory there. Details of his workforce are given in the ten-yearly census returns from 1841 onwards and these show that several workers moved to Elstead from outside the county. A wool comber named William Baker came from Mountsorrel in Leicestershire by 1847, married in Elstead and later moved to Godalming to work for the hosiery factories. Others included a worsted weaver, George Cooper, his wife Mary and six children, whose ages ranged from fifteen to three, six woolcombers and two worsted spinners, all men, who lodged with families in the village and a married couple in their thirties who both gave their occupations as 'worsted lace'. In one household, that of an agricultural labourer and his family, there were seven lodgers, all girls and young women aged from ten to twenty who were 'yarn twisters'. Two other young women gave their occupations as 'weaver' and 'lacemaker'.

In 1851 Thomas Appleton, now aged 35, was in the Elstead census as a 'Master Manufacturer of Small Ware employing 100 hands'. He was still renting mills in Haslemere and bought Sickle Mill from James Simons the papermaker in 1854. The firm left the district in the 1880s but the firm of Appletons still continues in west London in the 1990s and is known for its fine worsted embroidery thread.

Linen

Before it developed as a major industry in Ireland and Scotland and parts of Lancashire and Yorkshire, linen weaving was carried on almost everywhere, on a small scale, for local markets.⁷ Flax and hemp (which was also used for linen) were widely grown and are reflected in placenames such as Little Flexford near Guildford. Margaret, a flaxwoman, to whom Alice Peto of Stoke-next-Guildford left 'all the printed cloths' in her will of 1604, was probably a spinner of linen thread. In some districts weavers worked in both wool and linen, like James Baker of Reigate, who in his will of 1608 left both a woollen loom and a linen loom, which stood in his kitchen. Where a major woollen industry existed in south-west Surrey a few weavers, members of the Purchase and Edsell families, specialised in linen but moved into framework knitting when this industry offered new opportunities.

Silk

Silk crape was manufactured in Haslemere and Thursley at the end of the eighteenth century, by the Nalder family, who were engaged in the silk industry in east London. In 1793, Ann Bicknell, a 'poor child' of Haslemere, was apprenticed to Messrs Frederick Nalder of Cheapside, Thomas Nalder of Shoreditch, crape manufacturer, and Isaac Hawkins of Thursley, silk throwster. Mr Nalder had a crape mill on Thursley Heath which used water power from the hammer pond of the former iron works to drive silk-throwing machinery. There was a crape factory in Haslemere, located where Church Lane now crosses the railway, and the meadows through which the railway cutting was made were known as 'Silk Shop Meadows'.⁸ Edward Brayley, in his *History of Surrey* of 1848, recalls that 150-200 inhabitants of Haslemere had been employed at looms in their own houses, but the industry had ceased by this time. It probably ended by 1812 but there was still a row of houses in Thursley called 'Silk Mills', occupied by labourers' families, recorded in the 1851 census returns.

In the twentieth century, Zoë Lady Hart-Dyke began manufacturing silk on a small scale at her home near Leatherhead, heating the cocoons in a domestic oven and at first reeling the thread by hand. The Hart-Dykes opened a small factory but complaints about the smell forced them to close it and they moved the expanding business to Lullingstone in Kent. Artificial silk was also made for a few years from 1926 by the Rayon Manufacturing Company at Ashted.

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The Poor House

Besides George Abbot's manufactory in Guildford in the seventeenth century, there were many schemes to employ the poor in textile trades. Some textile manufacture was carried out in parish workhouses. This was probably the purpose of several consignments of wool which were sent up the Wey and Godalming Navigations in 1783 for Mr Manning, the Reverend Owen Manning, who was vicar of Godalming.

There are several records of spinning and weaving in the poor-houses of east Surrey in the early nineteenth century, and of blanket weavers from Witney in Oxfordshire moving to Surrey to supervise the work. There was unemployment in the Witney blanket industry at the beginning of the century because machines were replacing hand-looms and weavers were leaving the area to find work elsewhere. Two such men were Thomas Kent, who came to be master

of Charlwood poor-house, and John Rooles who came to be master at Newdigate. Spinning appears to have been done by hand, as there were seven spinning wheels in the spinning room at Charlwood.

The woollen manufacture was started in the Newdigate poor-house in 1801 to make cloth for 'Great-Coats, Waistcoats, Blankets, Horse-collar cloth, Yarn for stockings et''. The Overseer's account book records that 'the first garment a waistcoat that was made was for one George Weller, son of Peter Weller, Price 4s 9d made by Thomas Chart, Vestry Clerk. Name of cloth: Newdigate Frizzle.'⁹

Some of the work was carried out under contract for textile mills in the north of England. The Guardians of the Poor of Reigate; Horley and Nutfield placed an advertisement in the *Leeds Mercury* in 1816, inviting tenders for 'the maintenance, clothing and employment of the poor of the said parishes'. It stated that for the last twenty years 'a manufactory of blankets and coarse woollens has been carried on in the Poor House, to which a fulling mill belongs' and explained that fuller's earth was dug within a mile of the establishment.

Arts and Crafts

The leader of the Arts and Crafts Movement, William Morris, founded his model factory in Merton High Street in 1881 and made carpets and tapestries as well as wallpaper and stained glass. Nearby in Station Road, Littler's mill began printing fabric for Liberty's of Regent Street in 1875. Liberty's took over the mill at the beginning of the twentieth century and as Liberty Mill it continued printing textiles until the early 1970s, while in the modern county of Surrey, the Arts and Crafts movement is represented by the Stockenden Industry which carried out hand-loom weaving at Limpsfield.¹⁰ At Haslemere a Peasant Arts Society was established which produced pottery, furniture and toys as well as textiles. In 1898 Joseph King, a barrister and Liberal MP, set up the Weaving House in Kings Road and cloth was produced there until the 1930s. Silk damasks, brocades and velvets were woven by Harry Hedges at his 'Spitalfields Silk Weaving Works', a small wooden building at the bottom of Wey Hill, and Edmund Hunter wove silks at his St Edmundsbury Works. The Peasant Arts Society as an organisation was disbanded in 1927 and its collection was deposited at Haslemere Educational Museum.¹¹



Workers stretching skins at Chuters' chamois leather works, Mitcham. *Wandle Industrial Museum*.

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Leather

The leather industry was made up of several different trades.¹² xxx There were skimmers; fell-mongers, who removed the wool from sheepskins; tanners who impregnated skins with tannin from oak bark or sumach to turn them into leather; curriers who prepared tanned leather for more refined purposes, such as the making of shoe-uppers; and cordwainers (the name is derived from Cordoba leather from Spain) who made up the leather into shoes. Instead of tanning, the process of tawing, or impregnating with alum, was used for kid leather. Chamois leather was produced by impregnating skins with oil. For this, the outer or grain surface of the skin was generally removed by the process of frizing, to give a softer and more pliable texture, and the oil was beaten into the skins in machines resembling the fulling stocks used in the woolen industry. Tanneries which used bark as a source of tannin had bark mills, for grinding the raw material, and these are mentioned in many records of the industry.

The place-name Leatherhead has no connection with the leather industry, but there was a tannery beside the town bridge from 1826 to the 1870s. Small local tanneries include one at Thursley, where the 1851 census records Martin Tidy, master tanner employing seven men.

Godalming had several tanneries in the nineteenth century. In 1808 Richard Lee built a bark house for his tannery in Mill Lane which later became the important works of Messrs Rea & Fisher. There was another tannery near Meadow, to the north of the town, and at Westbrook Mill Messrs Pullman Limited manufactured oiled leather. Workers at these tanneries are recorded in the census returns which show that in 1871, for example, 72 men were employed in the industry in Godalming.

Some workers had come from outside the district and some had connections with the leather industry in Bermondsey - Thomas Brophy, a 'skinner and frizer' from Ireland, had evidently worked in Bermondsey, where one of his children had been born, before coming to Godalming. The manager of the Westbrook leather mills in 1871, William Henry Lyon, had been born in Bermondsey, and so had a young leatherdresser, John Vaughan, who lived in lodgings at Railway Station Cottages. A tanner called Isaac Woods, a local man, also kept the Waggon and Horses beer house. Thomas Rea of the Mill Lane tannery, described in the 1881 census as Alderman, Magistrate and Tanner, was born in Scotland.

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Many tanneries closed in the early twentieth century. Swabey & Saunders' Rosary Leather Works at Ashted, (locally known as the Skin Factory) operated only from 1911 to 1922. The leather industry ended in Godalming in the 1950s but at Gomshall, in the parish of Shere, a few miles east of Guildford, a long-established tannery was modernised after the Second World War and continued until the 1980s. 'Pelterers' are recorded in Shere as early as 1380 but the earliest recorded named tanner is Anthony Bygnall in 1568, who was charged with selling leather which had not been properly examined and sealed by the excise authorities. There were several later tan-yards in Gomshall. The one which became the modern Gomshall Tannery, on the bank of the Tillingbourne in the centre of the village, was owned by the Coe family (later associated with the growing of watercress) in the seventeenth century and by the Goddards in the eighteenth. The works began to expand in the nineteenth century under the management of John Evershed, especially after the opening of the Reading, Guildford and Reigate railway line in 1849. In 1861 the tannery employed 28 men, five women and two boys. It was bought in 1880 and expanded further by Gilligan and Son, who had offices in Reading and had owned a tannery at Hungerford. There were problems of pollution of the Tillingbourne and a setback in 1892 when the works caught fire, but business was restored and the firm was featured in the *Leather Trades Circular & Review* of 9 February 1893. Their staple product was bark-tanned leather for boot and shoe manufacturers.

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After the Gilligans, there were several short-term owners until The Gomshall Tanneries Limited was formed in 1917. The works still made heavy leathers from hides but after the trade depression of the 1920s and 1930s, when they closed for several years, they turned to lighter products for fashion accessories and garments. These were made from sheep and lamb pelts and they were processed in revolving drums instead of in tan pits. After the Second World War many firms amalgamated and Gomshall became the headquarters of Gomshall and Associated Tanneries. The works flourished up to the late 1970s, becoming a world leader in fashionable for leather garments and developing special products such as dyes for pastel colours and the washable 'Suede 66'. But economic problems in the 1980s brought a decline and the works finally closed in 1988.

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Chapter 6

CHEMICAL AND PROCESS INDUSTRIES

Varieties of products have been made in Surrey, including paper, soap, essential oils, wax, paints and varnishes, linoleum and notably gunpowder, for which Surrey makers held a Crown monopoly in the early seventeenth century.

Gunpowder

Traditional black gunpowder — a mixture of saltpetre, charcoal and sulphur — had been used in England from the fourteenth century onwards and was either imported or made by hand in castles or in the field. Water-powered gunpowder mills were established by the 1540s at Rotherhithe, on the south bank of the Thames which was then part of Surrey. Powder was still being imported though, particularly through Antwerp, which was then in the Spanish Netherlands. This source of supply was vulnerable so the government determined to increase production at home. In 1561 instructions for making saltpetre from collected manure were purchased from a German captain, Gerard Honrick, and several new powder mills were set up. The Evelyn family, who had settled in Surrey, played a prominent role. They established powder mills at Tolworth, probably in 1561, and in the Tillingbourne valley and at Godstone in the 1580s. After the attack by the Spanish Armada in 1588 the government introduced a new system of contracting with manufacturers and organising the collection of saltpetre. Under James I the system became a monopoly and this lasted until the Long Parliament of 1641, on the eve of the Civil War. Throughout this period, Surrey powdermakers held the monopoly and they continued to play a major role in the industry throughout the rest of the seventeenth century.

There were other early centres of powder making in Kent and in the southern part of the Lea valley of Essex and these expanded later. During the monopoly some other licences were granted, in particular to the East India Company, which established the Chilworth gunpowder mills near Guildford in 1626, to make gunpowder for its own use. The Company operated the mills for only some ten years but their powder maker continued the business and was awarded the monopoly in place of the Evelyn family in 1636. The East India Company continued to be important to the industry because it became the chief supplier of saltpetre which it imported from India.

The Chilworth powder mills continued until 1920 but the early mills which had been established by the Evelyns and their associates had all closed by the mid-seventeenth century. However, new ones were to take their place. There was an increased demand for gunpowder in the second half of the seventeenth century during the three Dutch Wars and the wars with France which followed and many mills were converted to gunpowder from other uses such as metal working, grinding dyewoods and corn milling. Many powder mills were established, at a radius of 20 or 30 miles from London, in Surrey, Kent, Middlesex and Essex, and also at Battle in Sussex. New mills were established in Surrey at East Molesey, Wandsworth and Carshalton and the mills at Chilworth were greatly expanded.

So far, the gunpowder industry had been concentrated in south-east England. The main customer was the government, for military powder, but there was also a large market among privateers and merchant ships and, from the late seventeenth century onwards, for blasting powder for use in mines and quarries. Gunpowder was carried on merchant ships both for their own defence and for trade. It was one of the commodities exchanged in the triangular slave trade between England, West Africa and the Americas, although it was a minor one compared with the quantities of textiles and metal goods which were exported. London was the major port but first Bristol and then Liverpool developed in the eighteenth century and powder mills were established near Bristol in the 1720s and near Liverpool in the 1750s. In the second half of the eighteenth century mills were also established in the Lake District to supply mines and quarries and the Liverpool merchants. Before these developments however, gunpowder makers from south-east England had built magazines on the Mersey in order to supply the Liverpool trade. The powder makers of Chilworth and East Molesey were partners in a magazine at Liverpool in the 1730s. Although some of the earlier Surrey powder mills — Carshalton and Wandsworth — closed down after the end of the French wars in 1713, some new ones were established as private trade in gunpowder increased. Worcester Park mills were established in about 1720 on the site of the Evelyn family's mills at Tolworth and new mills were established at Ewell by 1757. However the gunpowder mills at East Molesey closed in 1779 after an explosion and the owners built a fine house on the site.



Stonebridge wharf, Shalford, on the Godalming Navigation, 1915, showing the gunpowder store (left) and treadwheel crane (right).

An insight into the day-to-day working of Chilworth powder mills in the late eighteenth century is provided by the letter book of the proprietor William Tinkler, containing copies of all the correspondence from his London office between March 1790 and March 1791. Powder was sent by barge down the Wey navigation and the Thames to a magazine at Barking Creek, from which it was distributed to customers. The letter book shows that some went by coastal ships to Scotland, much of it to one major distributor, and some by waggons carrying goods in all directions from London. Some went regularly to a mine in Shropshire, and many small orders went to customers all over the country for the shooting season.

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Chilworth's market no doubt changed in the 1790s as powder mills were established in Scotland. These were followed by new developments in Devon and Cornwall, in Wales and in the north of England. The Napoleonic wars brought a huge increase in the government's demand for gunpowder. By this time the government had its own factories, having bought mills at Faversham in Kent in 1759 during the Seven Years War, at Waltham Abbey in Essex in 1789 and at Ballincollig in County Cork in 1805.

The mills operating in Surrey in the nineteenth century were Chilworth, Ewell and Worcester Park. The proprietors of the Ewell mills, the Bridges family, were one of five firms from south-east England who

were selling powder from Liverpool in the early nineteenth century. The Worcester Park mills were closed down in the 1860s, when the district began to develop as a residential area. The Ewell mills closed in 1875, the year of a new Explosives Act which introduced new standards of safety and probably made it uneconomic for them to continue.

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The rest of the history of gunpowder production in Surrey concerns Chilworth. For a brief period after 1885 the Chilworth mills became the most up-to-date in the country, when they were taken over by a German company, Vereinigte Rheinisch-Westphälische Pulverfabriken, to manufacture a new form of gunpowder which was nearly smokeless and was in demand for use with large guns. It was made by using brown charcoal made from straw instead of the conventional black charcoal made from wood. By this time however, high explosives such as ballistite and cordite, which were made from nitrocellulose and nitroglycerine, were being developed and in 1892 a new true smokeless powder factory was built at Chilworth, adjacent to the old gunpowder works. There is no evidence of plant for the production of nitrocellulose and nitroglycerine at Chilworth. These ingredients appear to have been brought in, only the processes of combining and extruding them, with acetone as a solvent, being carried out on the site.

A second cordite factory was built at Chilworth by the Admiralty during the First World War. After the war,



Remains of a range of steam-powered gunpowder incorporating mills at Chilworth, built in 1885.

the entire explosives industry in the country was rationalised in a series of mergers involving Nobel Industries. This led in 1926 to the formation of ICI. Chilworth was one of many gunpowder mills which closed down in about 1920.

Gunpowder, or black powder as it came to be called to distinguish it from modern products, is still used for fuses, fireworks and blasting in slate quarries, where it is less apt than modern explosives to shatter the rock, for firing blank cartridges, for example in historical re-enactments, and for firing antique weapons. It continued to be made until the 1930s at Faversham in Kent and in the Lake District and survived at the ICI works in Ayrshire until 1977. Since then supplies have been imported.

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Chilworth is the only gunpowder site in Surrey with substantial remains. These are extensive, because gunpowder manufacture involved several separate processes: preparing and mixing the saltpetre, charcoal and sulphur; incorporating the ingredients, pressing the resulting 'mill-cake'; granulating, dusting, glazing and drying the powder and finally packing it in barrels to be sent to the magazine. Many of the processes were water-powered so the buildings were strung out along the valley of the Tillingbourne, and were widely-spaced to minimize the damage from any explosions. The remains are in a ruinous state and many features are hidden for much of the year by

vegetation. The most striking feature is the range of six incorporating mills, built in 1885, which formerly housed sets of iron edge runners turning on bedstones, under which the ingredients were crushed and ground together. There are also numerous stone edge runners from an earlier phase, lying on the ground and erected along the path, and derelict waterwheel pits and watercourses. There are remains of engine beds, from the steam engines which replaced some of the waterwheels in the nineteenth century, traces of sleepers from the works tramway and the remains of a swing bridge which allowed the passage of punts along the mill stream.

One of the markets for gunpowder was in the fireworks industry, which consisted in the nineteenth century of a considerable number of firms in London, particularly east London and districts south of the Thames. Those in what was then Surrey included Drewett's, Darby's and Madam Cotton's in Lambeth, Brock's at Sutton and Paine's at Mitcham.

Schermuly Pistol Rocket Apparatus

Another industry related to the manufacture of explosives, and one which also used gunpowder in some of its products, was the SPRA (Schermuly Pistol Rocket Apparatus) Works at Newdigate. William Schermuly, who was British, of Dutch Huguenot descent, was a former merchant seaman who, concerned with safety

at sea, formed a company in 1897 to manufacture the world's first viable ship's line-thrower to his own design. In 1921 he patented a greatly improved model which was pistol-launched and registered his new SPRA Company in 1926. The factory was at Cheam, where it became surrounded by suburban housing developments too close for safety. In 1933 therefore, by which time William had died and his son Conrad was running the business, the firm moved to rural Surrey. They expanded during the Second World War to produce a variety of specialised products, including target indicator bombs and illuminating flares, and continued to design and produce marine and aeronautical distress equipment. There was a corresponding reduction after the war and a further decrease in the workforce with the introduction of automated processes. At the peak of wartime production there were some 1,400 employees but by 1973, when the company was taken over by the Wilkinson Sword Group and amalgamated with Pains-Wessex, there were only 350. The Newdigate works closed in 1981 and production moved to Pains-Wessex's factory at Salisbury.

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Papermaking

The techniques of making paper were developed originally in China and India and reached Europe through the Arab world and Spain. The first British paper mill was established at Hertford in about 1488 but was short-lived and it took another century before a successful papermaking operation was commenced at Dartford in Kent. Many paper mills then opened in the Home Counties and according to John Aubrey, writing in the 1660s, the first in Surrey started in the reign of James I (1603-25) in the neighbourhood of Godalming. However, the earliest Surrey paper mill for which documentary information is available was established at Stoke, near Guildford, shortly before 1635. The number gradually increased and, in all, 24 paper mill sites are known in the modern county.

Traditionally paper was made from fermented rags, beaten in water to form a pulp, known as stuff, which was placed in a vat. The papermaker, called the vatman, then dipped his mould, which was a rectangular wooden frame supporting a fine wire mesh, into the vat and lifted it out covered with a layer of very wet paper. A colleague, called the coucher, then placed this wet sheet of paper on a piece of felt and covered it with another felt. This operation was repeated until a multiple sandwich containing 144 sheets of paper, known as a post, was constructed. This was then placed in a press to remove most of the water and the sheets of paper were hung up to dry on ropes in a shuttered loft.

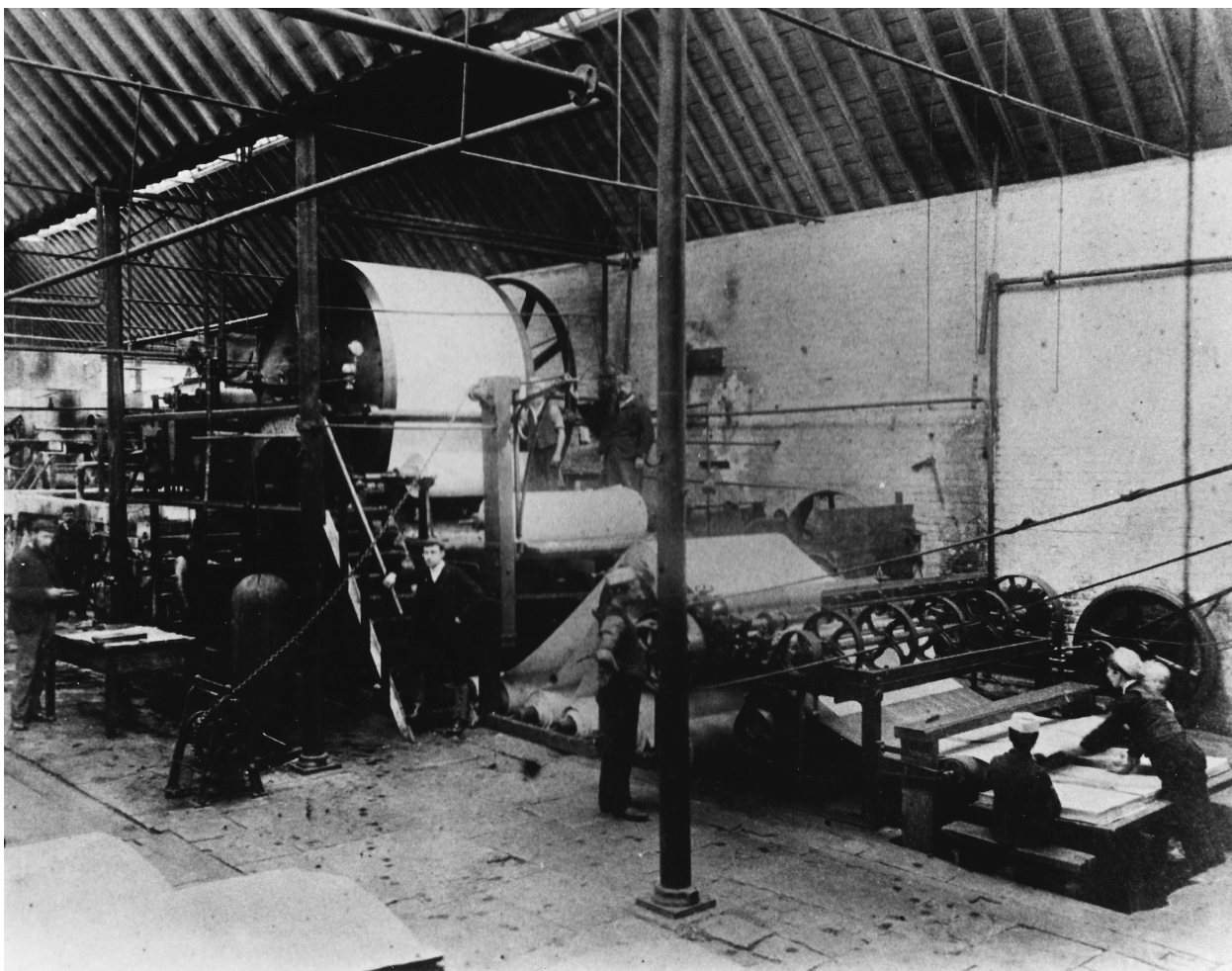
When dry, the paper was pressed again and parcelled into reams containing 480 sheets. Crucial factors in the manufacture of paper were the availability of good quality rags, clean water to make the stuff, water power to drive the beating engines, skilled craftsmen and a nearby market for the finished paper. Sites some 15 to 30 miles from London tended to satisfy these requirements.

At the end of the eighteenth century there were several major developments in papermaking techniques. First, the discovery of chlorine enabled coloured stuff to be bleached so that there was less dependence on clean water. Second, steam engines were introduced to power the beating engines so that water power was no longer necessary. Finally the papermaking machine was invented and this enabled continuous rolls of paper, rather than individual sheets, to be made. These developments resulted in large mills being built nearer to London. Some of the Surrey mills were able to expand to meet the challenge and two new mills, Esher and Woking, were established. However many of the other mills were forced to close.

In the 1860s rags started to be replaced by new raw materials, esparto grass and wood pulp. These came from overseas and the major, paper-making firms built new large mills on the coast, especially in Kent, which had a long papermaking tradition. The remaining Surrey mills tried to specialise but the number declined and the last mill, Catteshall at Godalming, closed in 1928.

Much is known about Surrey papermaking families, many of whom were active for several generations. A good example is the Simmons family who started to make paper at Sickle Mill, Haslemere, in 1735 and later acquired the neighbouring Pitfold Mill and New Mill. For 115 years four generations of the family worked these mills, which finally closed for papermaking in 1870. James Simmons III, who kept a diary from 1831 until shortly before he died in 1868, recorded the day-to-day operation of the mill. He discussed the difficulties of obtaining rags and selling paper and described accidents, including one in which a young apprentice lost an arm. He also anguished over major decisions, such as belatedly acquiring a second-hand papermaking machine in 1840 and installing a new steam engine in 1853-54.

Ewell paper mill was operated from 1733 to 1795 by William Jubb senior, who died young in 1739, by his widow Sarah, her second husband William Wells and finally by William Jubb junior. This mill was insured with the Hand-in-Hand Company and a new policy was taken out regularly every seven years. The insurance registers therefore provide a fascinating account of the development of the mill over this period.



Woking paper mill c. 1892, showing a cutting machine (right) and papermaking machine in the background.

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At Catteshall, the Sweetapple family were at first corn-millers with a tenant papermaker. They were Quakers and the 'Sufferings Books' kept by the Society of Friends reveal that when they refused to pay their military and church taxes, some of their property, including reams of paper, was confiscated. Like many other papermakers they became bankrupt and themselves became tenants of the mill, before becoming bankrupt a second time.

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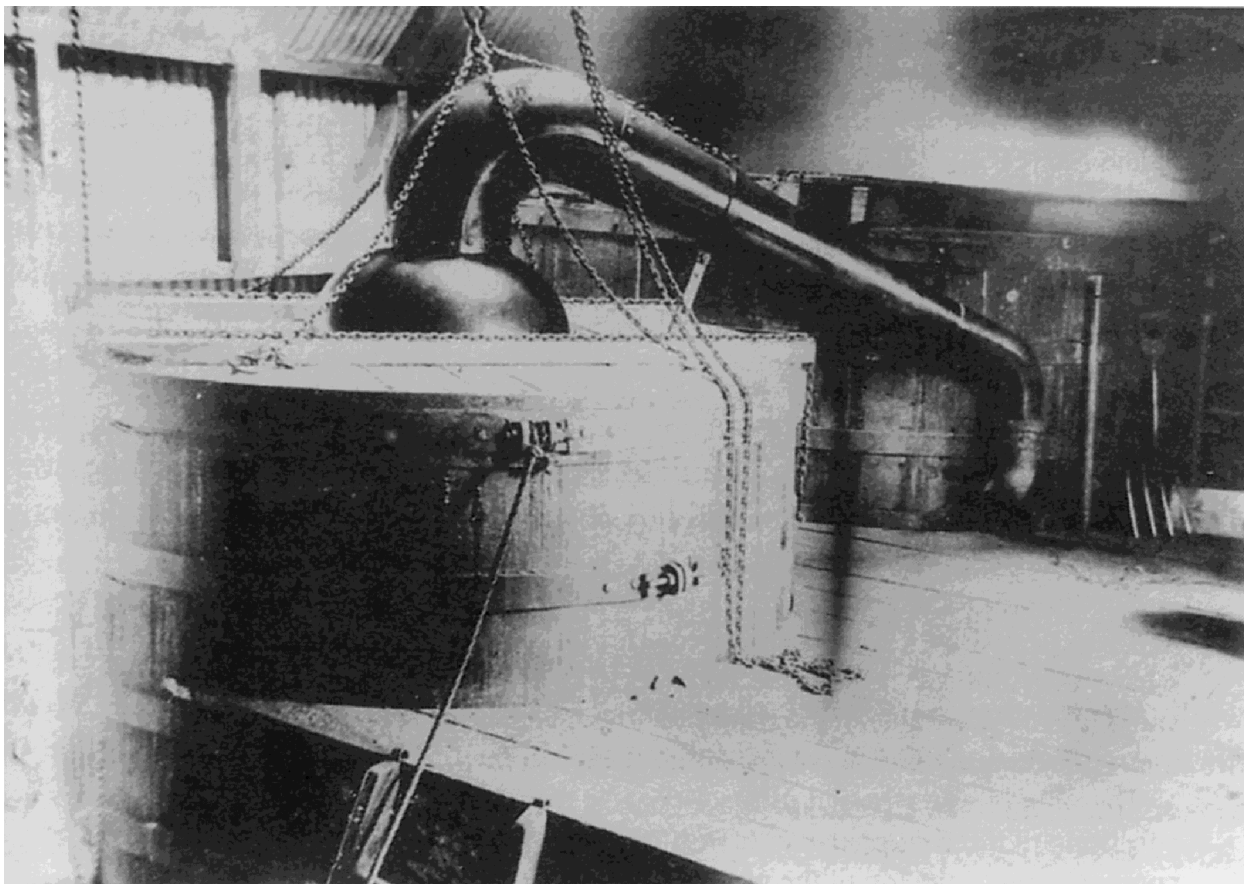
The Ball family, who were papermakers at Stoke, Chilworth, Albury Park and Postford mills, specialised in making banknote paper and in 1794 even made paper for forged assignats, paper currency issued in France. The French royal family hoped that the forgeries would help to undermine the Revolutionary government.

A few of the buildings which housed these paper mills survive more-or-less intact. The best example is Sickle Mill in Haslemere which largely retains its 18th century form. Good Victorian examples are Catteshall Mill, Woking Mill and a small building at Stoke Mill. Fortunately however many of the early mills were picturesque and artists have left us with useful representa-

tions. We are less fortunate with surviving equipment. The only well-identified mould is one used by James Simmons III at Sickle Mill in 1812 and the only surviving part of a papermaking machine is a cylinder from Chilworth, now used as a heavy roller by the neighbouring Blackheath Cricket Club. However many examples of sheets of paper made in Surrey mills have been recognised from the watermarks they contain. These were produced from wire motifs fixed to the mould or one of the rolls on the papermaking machine. More Surrey watermarks are continually being found and readers are encouraged to note them when they are studying historic documents and to report their discoveries to the Surrey Industrial History Group.

Essential oils

'Although the cultivation of medicinal plants is carried on in various parts of England, yet more land is employed in this way in Surrey than in any other county'. This quotation, from *The Pharmaceutical Journal and Transactions* of 1850-51, refers of course to historic Surrey and most of the essential oil industry was carried on in the area around Mitcham which is now in Greater London.



Essential-oil still at Westcott, Dorking. *Katherine Lane Collection.*

In the past, herbs and other plants were vital raw material for chemists and druggists as well as for perfumiers. Lavender had been grown in Mitcham from the fourteenth century and for much of the nineteenth century the herbal industry was of paramount importance to the district. Large areas were taken up by physic gardens where herbs such as lavender, wormwood, chamomile, aniseed, rhubarb, liquorice and peppermint were cultivated and there were many distilleries where lavender and other oils were manufactured. Perhaps the most well-known firm growing and distilling herbs was Potter and Moore, which was established in Mitcham in 1749 and continued for over 200 years. Mitcham mints were also renowned, the oil being obtained from the distillation of locally-grown peppermint.

As the value of land in South London rose and other industries came into the area, the growing of herbs moved further out, to Carshalton, Wallington, North Cheam and Beddington, but much of the distillation continued to be carried out at Mitcham until the middle of the twentieth century. In the area covered by the present book, there were many examples of herb growing and essential oil extraction, although they never reached the size of the operations nearer London.

The growing of mint is recorded in local names, such as Mint Farm and Mint Road at Banstead and Mint

Lane and 'The Mint' public house at Margery near Reigate. Lavender and mint were grown and distilled by W J Machell of Drift Bridge Farm until the middle of the twentieth century.

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The Reigate sewage farm at Earlswood had three or four acres of peppermint in 1911 which was sent to Mitcham to be distilled. The Woodhouse estate at Holmbury St Mary was built during the 1920s on the site of lavender fields and a distillery owned by the Lomax family.

An essential oil distillery operated from the mid-nineteenth century until its closure around 1905 in Pырford Road, West Byfleet. The road names Lavender Park Road and Rosemount Avenue are reminders of the plants grown to produce the lavender oil and rose water. In Westfield, Woking, a liquorice factory was operated by Messrs Woodward & Co in an old cottage in Highlands Lane, now known as Walnut Tree Cottage.

In Shere, lavender, chamomile and mint were grown by B Colebrook and Sons at The Flower Farm. The herbs were distilled at High House, Shere from 1925 until 1939 when the land was needed for food crops. A pre-war advertisement states that Colebrooks made lavender perfume and violet perfume with the brand name 'Essira', which is the Domesday name for Shere.

Mint and lavender were grown at Highlands Farm, Leatherhead, and taken to Mitcham for distillation, although there are also reports of lavender from Carshalton being sent to Leatherhead to be distilled.

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Nonsuch Court Farm, in what is now Nonsuch Court Avenue in Ewell, was rented by Mr Edward Martin, who grew peppermint and lavender and distilled them on the farm. Peppermint was also grown on Warren Farm, south-east of Nonsuch Park and this was probably also distilled at Nonsuch Court Farm.

In about 1893 plants were taken from Nonsuch to start the industry at Westcott, near Dorking. Here the farms consisted of Milton Farm, Westcott Hill Farm, Florence Farm and Squires Farm, with a few acres near the sewage works. These farms were leased from Mr Robert Barclay of Bury Hill House to Henry Herbert Chalke and James Kent who combined the growing of herbal crops with general farming. A description of the Westcott operation was written down by Mr S H Chalke, the son of the original partner, and extracts from his account are printed here by kind permission of his daughter, Mrs Katherine Lane:

At Westcott, both lavender and peppermint were raised from cuttings which were planted out in rows 3 feet apart. The crop was taken off from the third to about the sixth year after which the plants were dug up. The plants were planted with a dibber and the harvesting was also by hand using a small sickle known as a 'mint hook'. A handful of mint was cut and laid on the ground after which it was turned in the sun to dry for a few days before it was finally tied up in rush mats to be carted away to the distillery. Harvesting took place from about the end of July, through August until September. Much extra labour was needed for the harvest. Often children would be kept from school and itinerant workers were used on their way to Kent for the hop picking.

For the first few years the Westcott crops were taken by wagon to Mitcham but this was found to be too costly. Also the crops tended to overheat whilst being transported so that the yield of oil was less than that obtained if distillation had taken place as soon as possible after harvesting.

By 1898 the distillery at Westcott was in operation, housed in a corrugated iron building off Milton Street in a small wood marked 'Osier Plantation' on the Ordnance Survey map. The stream from Logmore was dammed to produce a pond from which the large quantities of water needed for the distillation

process could be drawn. Water from the pond flowed into a brick pit from where it was pumped to a large tank in the roof of the distillery before it was fed either into the still or condensing vat.

The mint was pitchforked on to staging at the top of the building from where it was loaded on to the first of four steel grids. These grids were put into the still using a hoist running on an RSJ above. Then the still head was hoisted on and the joints between the head and the still and the head and the condensing coil were 'luted' down with a paste consisting of whiting and linseed Meal mixed with water.

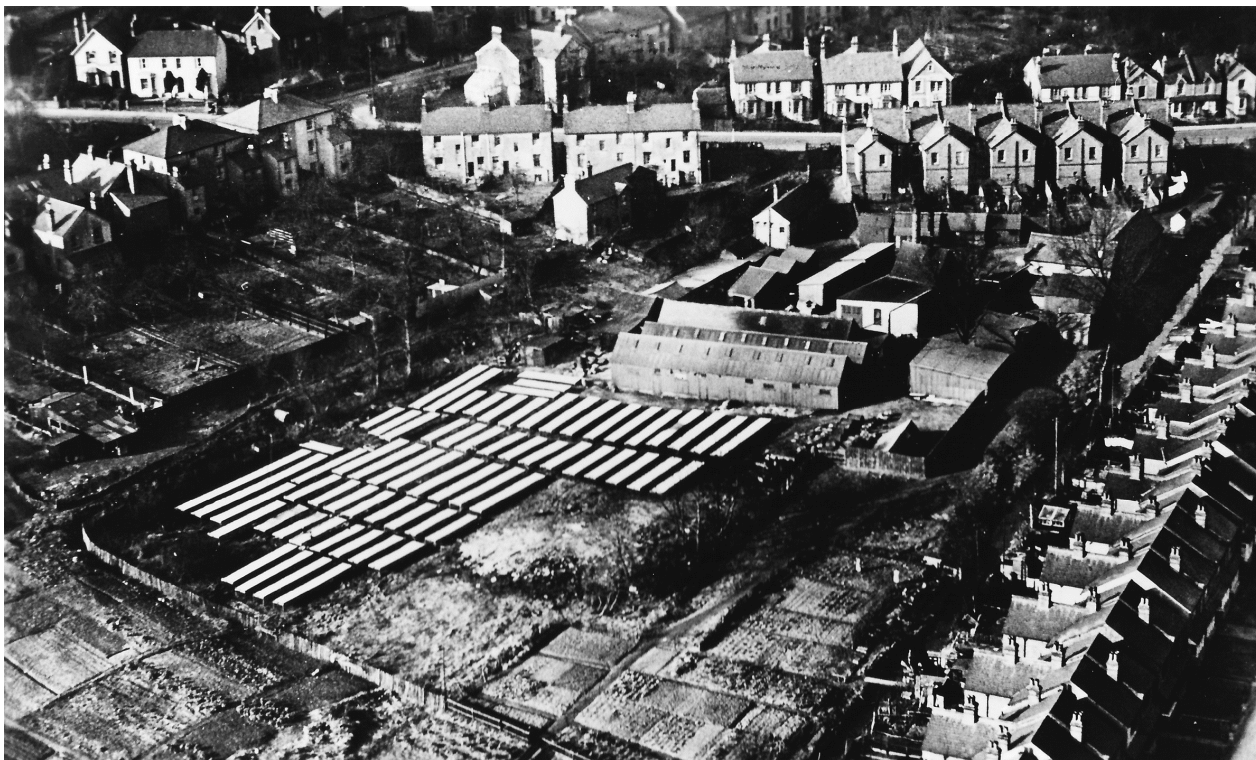
The still was then filled with hot water from the boiler to the top of the condenser and was heated by steam passing through a flat coil in its base. The steam and oil passed over the still head to be condensed in a spiral coil within the condensing vat. This coil was made of pure tin built into a vat about 11 feet (3.4 m) in diameter and 10 feet high which was kept full of cold water.

The oil and water passed into a separator made entirely from sheet copper and consisting of three compartments with copper tubes connecting the bottom of each compartment to the top of the next. The oil floated to the top of the compartments, most in the first, and from these it was filtered in a tinsplate drum 3 feet high and 2 feet diameter in which any solid matter and residual water were removed by filter paper in a cone of perforated zinc. The oil from the filter tank was drawn off through a tap into Winchester quart bottles for sale.

The distillation process took six hours after which the luting was scraped out, the grids lifted out and the spent mint carted away and ploughed into the fields with the manure.

When both partners in the firm of Kent and Chalke retired in 1907 the farms and distillery were taken over by John Jakson & Co who removed the distillery plant to their Mitcham Road, Croydon works in 1915. The growing of herbs for essential oil production in Westcott ceased altogether before the end of the First World War.

It is interesting to note that Mrs Lane still has a bottle of peppermint oil distilled at Westcott in 1907, two drops of which are used every year to produce peppermints which are eaten after the family Christmas lunch.



The British Wax Refining Company works at Redhill in the 1930s. *British Wax Refining Company.*

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Soap, tallow and wax

Soap, tallow and wax manufacture are closely related industries. Tallow, derived from animal fat, usually from sheep and cattle, has been used from time immemorial for the production of candles. These were usually prepared either by dipping or forming in moulds. Candle making was originally a cottage industry and it was not until the nineteenth century that any industrialisation occurred. Historically the best candles were prepared from beeswax. Other sources of wax are spermaceti from sperm-whale oil, lanolin from wool-fat and plant waxes, such as Carnauba wax from the wax palm *Copernicia cerifera*. In the twentieth century, high boiling fractions of natural petroleum oils have been used to yield a range of waxes. Hydrolysis of tallow and related oils with alkali produces traditional soap.

The Old Soaphouse at West Horsley, whose name probably dates from the seventeenth or eighteenth century, is a reminder that soap making was once a cottage industry. Besides the house name, evidence has been found there for the storage of chemicals, most probably potassium carbonate, an alkali to hydrolyse tallow or lanolin from the local wool industry, and soapwort (*Saponaria officinalis*) has been found growing in the district only around this particular house.

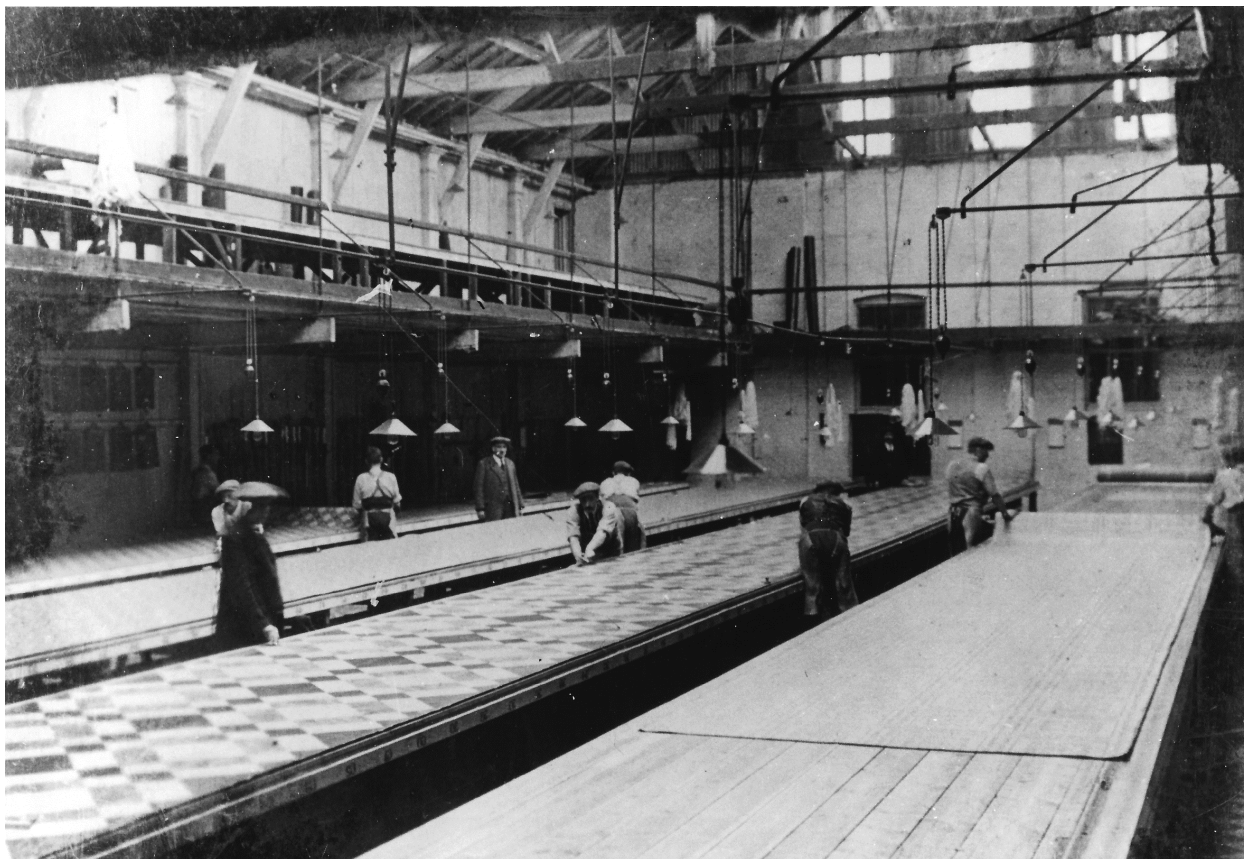
Industrial wax refining and bleaching, tallow and wax candle making and soap manufacture were carried on near the larger towns. In historic Surrey important centres of manufacture were Barnes, Battersea,

Camberwell, Croydon, Kingston upon Thames, Putney, Surbiton and West Molesey, no doubt originally to supply the demands of London. In modern Surrey, trade directories record soap manufacturing by J C Sowerbutts & Co Ltd in Woking High Street in 1891 and by the White Tulip Soap Co, Victoria Road, Horley, between 1905 and 1927. Soap was made at the Old Brown Windsor Soap Works by the Paris family at Woodhaw, Egham, but manufacture ceased and details of the process were lost when the widow of Mr Paris died in about 1851. Remains of the firm's wharf can still be seen at the Thames near The Glanty, where the M25 motorway crosses over the A30.

The modern soap and detergent industry has been represented in Surrey by the American company of Proctor & Gamble. In the 1980s this company bought up the research laboratories of Richardson Vicks at Rusham Park, Egham, which had previously been occupied by Shell Chemicals.

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W G Smith made candles in works opposite the police station in Staines from the 1860s until 9 April 1924. The exact date of the making of the last candle is well recorded because on that day the factory was destroyed by fire. During the blaze, so much molten wax ran down the road that even today wax can be found in nearby drains.



Workers trimming linoleum at the Linoleum Manufacturing Company, Staines. *Spelthorne Museum*.

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Candles were also manufactured in two factories in Dorking, perhaps linked to the tallow chandler James Letford of Mickleham, who appears in trade directories in 1858, 1887 and 1891. Another Surrey tallow chandler was Searle & Son, in the High Street, Epsom, who is recorded in directories of 1887 and 1891.

Wax refining has been undertaken in Redhill since 1914. The British Wax Refining Co started in Chapel Road but soon moved to a site in St John's Road, Earlswood, where trays of wax were spread out in the surrounding field to be bleached naturally by the sun. The factory occupied the same premises, using much of the original equipment in the purification process, until it burned down in the 1990s and moved within the district. The modern industry is based mainly on beeswax from Ethiopia, Carnauba wax from Brazil and paraffin wax from Nigeria and the Persian Gulf. The product is used in the pharmaceutical industry and for cosmetics and polishes, and much of it is exported.

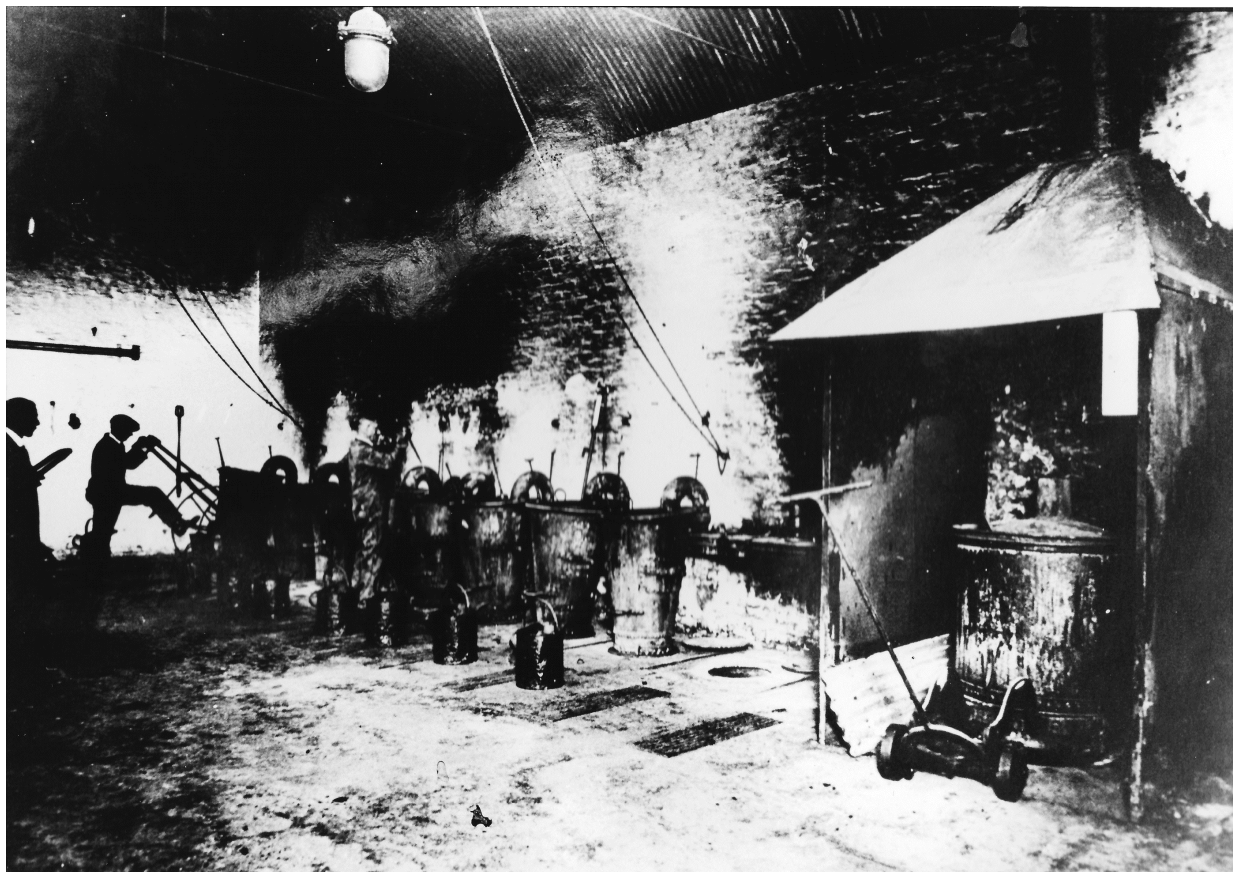
From 1960 to 1994 Johnson Wax Ltd manufactured polish at its factory in Frimley Green Road, Frimley. Its research laboratories at Milton Park, Egham, were previously occupied by the British Leather Manufacturers Research Association and had originally been the home of the De Worms family.

Floorcloth, linoleum, paint and varnish

Coated fabrics, in the form of oilcloths, were made in England in the seventeenth century and are recorded in use as floor coverings by 1722. Sail-makers' canvas, which could be made very wide, provided a good base, so the early manufacturers established themselves in seaports. Lancaster and Kirkcaldy remained major centres of floorcloth and then linoleum production in Britain. Paints, indiarubber and various mixtures — a method of 1763 used rosin tar, Spanish brown, beeswax and linseed oil — were used to impregnate and coat the fabric base and decorative designs were applied to the surface.

Several floorcloth weavers, a floorcloth starcher and a floorcloth factor are recorded in the 1841 census in Farnham, as are several canvas weavers, a sail cloth weaver and a sack weaver. The production of canvas in Farnham may have been primarily for making 'pockets' for packaging in the hop trade.

The superior product linoleum was invented by Frederick Walton, a Yorkshireman and son of an inventor and manufacturer, who patented a process of oxidising linseed oil (*linum oleum* in Latin), causing it to be



Varnish works at Mitcham. *Wandle Industrial Museum.*

come solid. A mixture of oils and rosins was processed to form linoleum cement and mixed with wood flour, ground cork and chalk, and then coloured with pigments. Walton's method used machinery to produce the designs and these went right through the thickness of the material instead of lying on the surface as in earlier floorcloths.

In 1864 Walton founded the Linoleum Manufacturing Company to exploit his invention and bought the disused Hale Mill at Staines, which had previously been occupied by a calico printing works, to set up an extensive factory which employed thousands of people. After a shaky start the business succeeded so well that 'lino' took the name of Staines across the world, as it was used in transatlantic liners. The market became so large that by 1888 there were some twenty manufacturers in Great Britain. Others included Barry, Ostlere & Co in Kirkcaldy and Williamsons of Lancaster, whose chairman Mr Williamson, later Lord Ashton, was known as the 'Lino King'.

The Staines Company enjoyed its peak from the First World War until 1930 when it became part of the Barry (Staines) group. After the Second World War the development of vinyl floorings caused a decline and the works closed in 1973. The site then became the Staines Central Trading Estate, on which many of the lino company's buildings were retained and re-occupied, but in the 1990s this is giving way to office development.

Linoleum was also produced at Addlestone, by the Addlestone Linoleum Company, and in the historic county of Surrey at Mitcham, where the industry was closely associated with the manufacture of varnish. Harlands, who were varnish and colour manufacturers in London in the early nineteenth century, established works in Mitcham by the 1840s and several other firms were attracted to the district. In 1965 there were fifteen firms making paint, varnish, polishes and synthetic resins in Mitcham but the industry declined in the 1980s.

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The Copal Varnish Company established a factory in 1875-76 on the site of the West Surrey Chemical Works at Yardmead, in what is now the borough of Runnymede. In 1886 Randall Bros of Bankside, near London Bridge, bought the site and moved their business there. Randalls had started making colours for printing inks and paints in 1855. They derived the trade name 'Paripan' from 'Paris White Japan', the name of one of their enamels, and in 1919 became a public company under the name of Paripan Ltd. Paint and varnish manufacture continued until 1962 when the company merged with Carson's Paints of Battersea. Production was later moved away and in 1973 the buildings were demolished.

Some other chemical industries

Charcoal has been mentioned in connection with fuel for the Wealden iron and glass industries and as an ingredient of gunpowder. The only known attempt in Surrey to make by-products from charcoal burning was at Rushetts Farm, Bramley, where naphtha and acetic acid were produced from up to 2,000 tons of wood each year. The 1871 census records John and George Glazier as labourers at the naphtha works. It is interesting that the census gives their place of birth as Fernhurst in Sussex, where charcoal for the Waltham Abbey gunpowder factory was made in the nineteenth century.

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Vegetable oils, such as rape and linseed, were refined at Ham Haw mill, also known as Weybridge mill and in the 1930s as Whittet's mill, which stood beside Thames Lock on the Wey Navigation. The mill had originally been a water-powered corn mill and had been used as an iron mill, paper mill and brass works before its last phase as a seed-crushing mill and vegetable oil refinery. There were many disputes with the Navigation authority about flooding and the amount of water used by the mill interfering with the operation of the lock. Then on Christmas Eve 1877 there was a disastrous fire in which the River Wey itself caught alight. By 1975 the premises were used only for the refining of vegetable oils and the recovery of solvents from other companies' waste products, which caused problems with effluents and atmospheric pollution. The mill's final industrial use was as a solvent distribution depot.

In north-west Surrey, the Jenolite company made the anti-rust compound 'Jenolite' in the small Rusham Road Factory Estate in Egham, on a site previously occupied by the American boiler maker Foster Wheeler Ltd. The buildings were demolished in 1995. The British Fine Colour Company made pigments and dry colours in Staines at a site still known as the Staines Oast House, although its use for hop-drying

ceased in 1903; in 1970 an employee celebrated 50 years with the company. Until the 1980s there was a factory boiling down bones to make glue at Town Lane, Stanwell, whose stench notoriously disturbed a royal visit to nearby Ashford Hospital in the 1940s.

In east Surrey, a Swiss company, Givaudan & Co, has manufactured synthetic aromatic chemicals and perfumes at Whyteleafe since 1950, and the Nutfield Manufacturing Company — known locally as the 'acid works' — made hydrofluoric acid and other fluorine compounds at their King's Mill works at South Nutfield, Redhill. The factory was established on the site of a former brick and tile works in 1925 by chemical manufacturers from Sheffield and operated until 1984.

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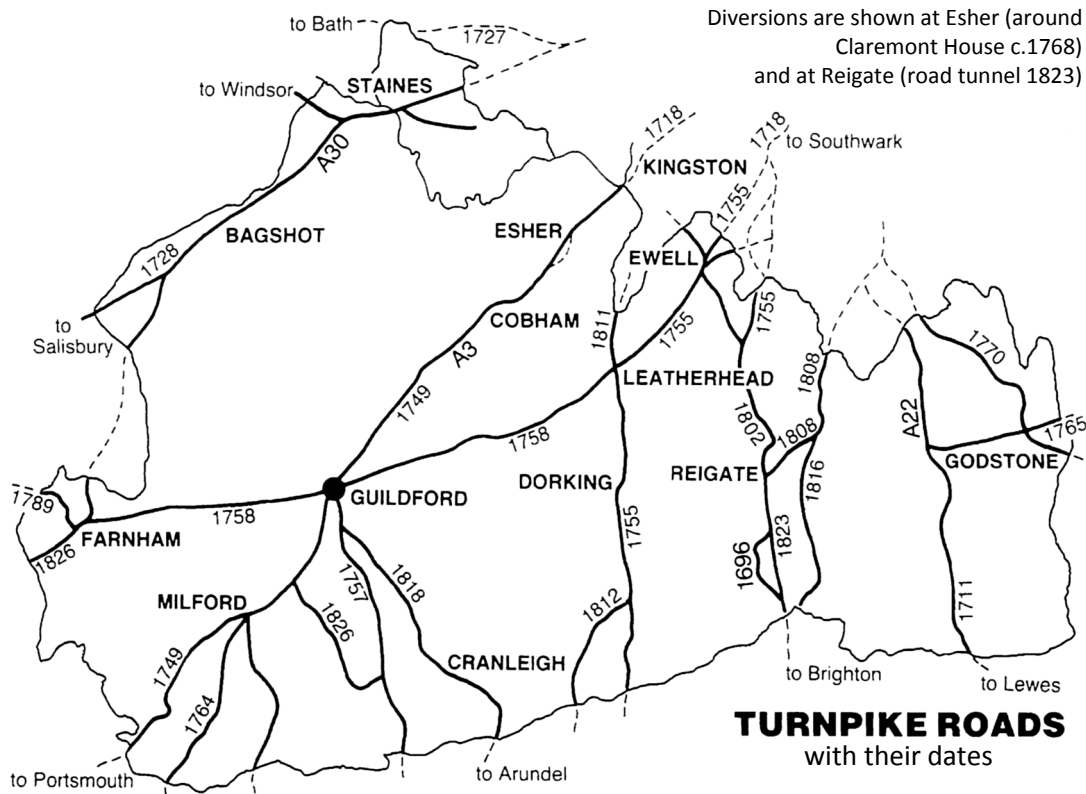
Petrochemicals

The scale of operation of petrochemicals and oil refining is so great that their pilot plants at the British Petroleum Research Centre in Sunbury and Shell Chemicals Company laboratories at Rusham Park, Egham, were far larger than the full-scale plants of other industries. The BP Research Centre was started by Dr Dunstan in a very small way during the First World War, in a dilapidated mansion called Meadhurst. It was only concerned with oil production and refining until after the Second World War by which time there were nearly 500 employees in much newer and larger premises. Petrochemicals were then produced in pilot plants and staff numbers rose to 2000. More recently the number of employees has been reduced though the site is still the main research and development centre of the company. The Shell laboratories were located at Egham for some 20 years until 1975.

Oil exploration has been carried out in the Warlingham and Godstone areas in east Surrey. Oil pipelines cross the county and a new one for Gatwick Airport is being constructed in the late 1990s.

Chapter 7

TRANSPORT



Corresponding modern roads (many altered from the 1930s onwards) are indicated by route numbers

The main historic roads, waterways and railways through Surrey are shown on the accompanying maps. The influence of London on transport in the county is clearly shown by the pattern of radiating routes.

Roads and Bridges

Early inhabitants moved about Surrey by using the river valleys but there was a need for a cross-country land route from east to west. Archaeological finds show that the Ho's Back ridge was in use in prehistoric times, but there is little evidence for a continuous early trackway on the North Downs east of Guildford. Here the early routes probably ran north-eastward along the gravel at the edge of the chalk, past what became the spring-line settlements of Leatherhead, Epsom and Croydon.

The Romans created a system of engineered roads with stone surfaces and side ditches for drainage. Four such roads radiated from London through Surrey, the most important being Stane Street, which ran to Chichester, the only Roman city in Sussex. The road can be followed today as a footpath from Epsom to

Burford Bridge, in Redlands Wood beyond Dorking and as the A29 through Ockley.

After the break-up of the Roman empire, its road system collapsed. Attempts were made to keep the old major routes open by various means, from conscript labour to individual enterprise. In the thirteenth century, Thomas de Oxenford built a causeway between Staines Bridge and Egham Hill to keep his woolpacks dry. There is still a road sign at Runnymede saying

EGHAM 2½ except at high water STAINES

Small communities were unable to repair the damage caused by traffic passing through their area along major routes. The solution was toll roads called turnpikes. The first turnpikes were run by local justices of the peace, for example the 1696 Reigate to Crawley road, then intended for saddle horses only. But main routes were soon 'privatised' and run by trusts set up by local magnates, who used the toll income to repair and maintain the roads. In the nineteenth century, the turnpikes were ruined by competition from canals and railways, and responsibility for the upkeep of roads passed to local government.

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Winterton toll house survives on the Petworth turnpike (now the A283) just north of Chiddingfold. Its board, painted with a list of the tolls charged, is in the Haslemere Museum. At Egham and Colnbrook are two of the water pumps put up on the Bath road in 1837 to 'lay the dust' raised by wheels crushing the loose stone surface. Tared surfaces came in with the twentieth century. The most enduring remains of the turnpikes are the milestones, of which long series can still be seen on the roads out of Godalming and along the old A3, the A30, the A246 and the A23. They show the mileage to the next town in each direction and also to the towns at the end of that turnpike. In 1823 the Brighton turnpike was straightened down Reigate Hill and the first road tunnel in Europe was cut. This now forms a pedestrian way in the town centre. At the entrance to Winkworth Arboretum on the B2130 is an elegant iron milepost, one of a set cast in Guildford and put up in 1826 on the last Surrey turnpike.

Private enterprise erected columns showing off-turnpike distances, like the 'White Lady' on the old A3 near Sandown Park, Esher, which dates from 1767.

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Another, from about 1820, stands in the centre of Cranleigh¹ and a three-armed signpost in Albury was elaborately carved from a local oak in the nineteenth century. At several places in Surrey are large stone multiple water troughs set up by the Metropolitan Drinking Fountain and Cattle Trough Association, often sponsored by a local worthy.

The Mickleham bypass, begun in 1935, was one of the first to have dual carriageways with separated cycle tracks and footpaths. A stone cairn at the Leatherhead end of that road records the building, opening (and re-opening) of Young Street, constructed by Canadian sappers in 1941 to bypass the narrow crossroads in Leatherhead. The Wapses Lodge roundabout on the Caterham bypass, opened in 1939, was the first in Britain to have pedestrian subways leading to and from an open central space below road level.

Inscribed stones or iron posts mark some of the points where roads cross county or parish boundaries, like the London Stone and the Three Counties post south-west of Staines. An unusual large example is the Basing Stone at the junction of the A30 and the A325. There is a continuous series of boundary mark-



Winterton toll house on the Petworth Road, Chiddingfold.

ers around the Metropolitan Police District, as it was in 1861. The City of London had been allowed to charge a tax on coal, and later wine, brought into the area, initially to pay for reconstruction after the Great Fire of 1666. The boundary was marked by cast-iron columns, carrying the City shield and the number of the Act, alongside every road, river, canal and path. There are several close together on Ashted Common and at Mogador. In addition, there are taller obelisk markers on railway embankments, for example at Staines and Whyteleafe.²

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With the development of coach travel and communications, there was a demand for accommodation, refreshment and change of horses. This was met by public inns with an enclosed yard, entered through an arched doorway high enough to take a loaded coach and team. The Talbot at Ripley still has its enormous

yard door in position and the front of the Angel in Guildford High Street still boldly declares POSTING HOUSE LIVERY STABLES. In the centre of Dorking, several of the roads and paths have their pavements protected by cast-iron bollards, railings and lamp standards cast between 1882 and 1913. At the main road junction is a public pump with an iron fingerpost above it with hands pointing to Horsham and Guildford. Roads are also used as routes for piped public utilities like gas and water supply and disposal. Fifty years ago, main roads could be identified by telephone poles.

The Romans bridged the Thames at London and Staines. A stone bridge was completed at London in 1209 and by then there were bridges at Kingston and Staines, probably mainly of wood. The Wey was bridged at Farnham and Guildford before 1220, possibly in stone. Those bridges have been destroyed but similar, though smaller, ones remain on the Wey, for instance the two bridges at Eashing (see photo page 57). They were probably built to help Waverley Abbey's farming and trade in wool on both banks of the river. The River Mole was bridged at Cobham and Leatherhead in the early Middle Ages and the medieval stone bridge piers at Leatherhead still remain, incorporated into the rebuilding in brick in 1782.

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The brick approaches to the 1750 wooden bridge at Walton-on-Thames, which was painted by Canaletto and Turner, survive, but the replacement iron bridges of 1780 and 1863 have gone. Chertsey bridge was built by James Paine between 1780 and 1785, and Staines bridge was rebuilt by John and George Rennie in 1829-32. On Staines moor is a composite bridge allowing cattle to graze widely on the common. It comprises a brick bridge over the Wraysbury river, another brick bridge over the railway line to Windsor and a steel girder bridge over the Staines West railway line. At Gosden Common near Bramley is a road bridge across both a railway line and a canal, both now disused. Four bridges in Surrey were designed by the architect Sir Edwin Lutyens in the 1930s. One carries the old Guildford bypass over the romantically-named 'Pilgrims' Way' path near Compton; two, over the Thames and Ember, are at East Molesey; Runnymede bridge, carrying the A30, was not built until long after Lutyens' death, and his design had to be revised.

Roads and bridges are fundamental to the movement of people. Surrey was particularly in the forefront of road developments in the 1930s and more recently the London orbital motorway, the M25, has been built cutting through Surrey along the line of the North Downs. Perhaps the most striking thing is the survival of so much of the structures of previous cen-



City of London coal tax post, Mogador.

turies, despite the spread of towns, the extension of road-building and the enormous increase in traffic loads.

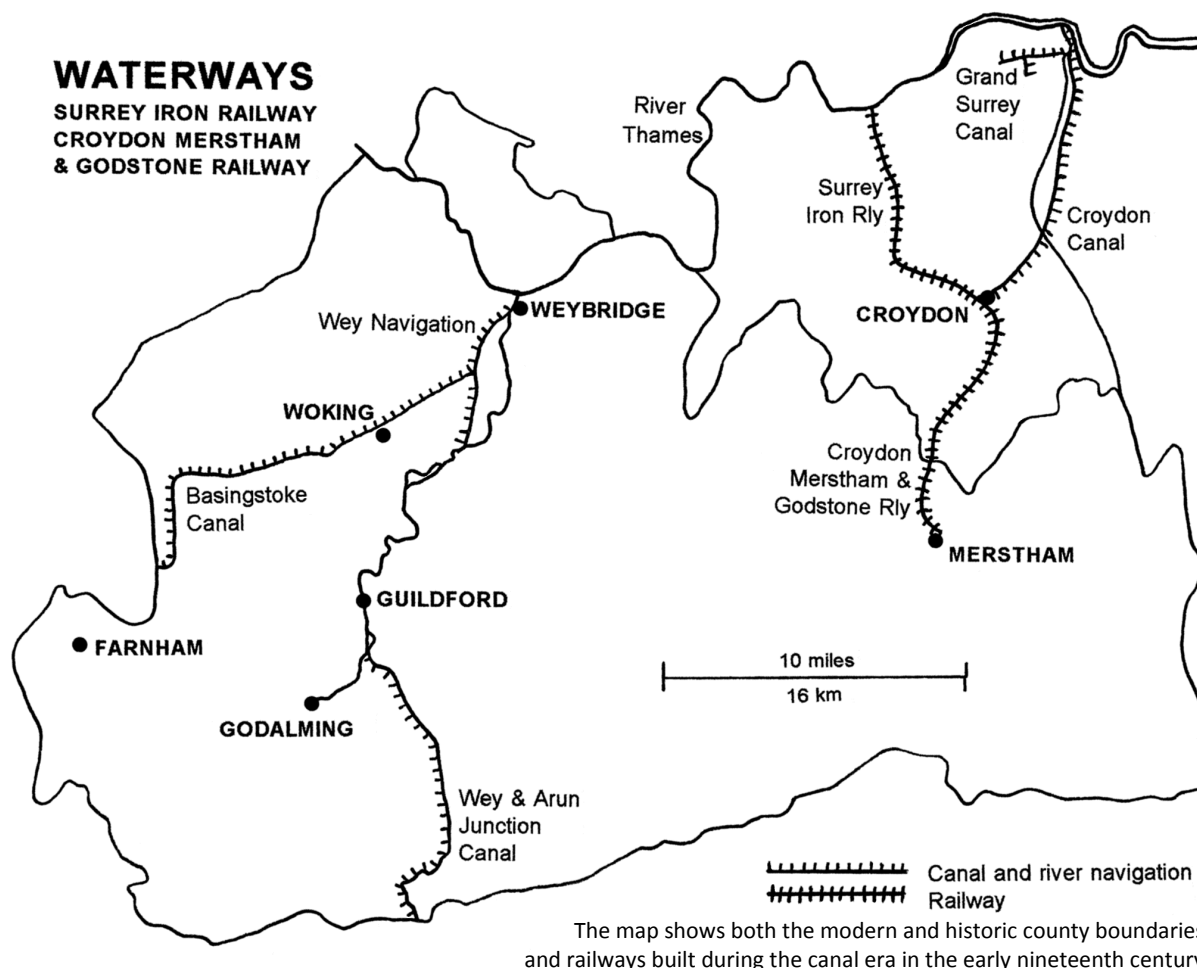
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Waterways

THE THAMES

The River Thames forms the northern boundary of the ancient county of Surrey and has probably been used for navigation continuously since prehistoric times. The City of London claimed a general jurisdiction over the whole river by virtue of a charter granted by Richard I in 1297. In fact, the charter merely states the importance of the river to the well-being of the city, that the king's keeper of the Tower of London should not exact tolls from river traffic and that various weirs for catching fish should be removed.

For reasons that are unclear, and have been much debated, the effective jurisdiction of the City of London extended to the boundary of the former county of Middlesex just above Staines, where a boundary stone remains. It therefore covered almost the whole of the Surrey section of the Thames. Until 1770, the City's control of the river was in practice minimal. There were no locks on its section and no tolls were charged for the use of the river, although riparian landowners charged for each horse using the tow-



path, such as it was. Up to a dozen horses might be needed to haul one of the larger barges, of about 150 tonnes, against the current. To manage the river the City set up a navigation committee and then obtained parliamentary powers to enable it to purchase the various towpath toll gates and charge a tonnage toll in lieu. It also set out to remove the worst shoals. It was realised, however, that the formation of a reliable navigation would require the construction of weirs and locks. There was opposition to this but in 1810 the necessary powers were obtained. Between then and 1830 locks measuring 150 by 20 feet (45 x 6 metres) were built at the six places where they exist today: Bell Weir, Egham; Penton Hook, Laleham; Chertsey, Shepperton and Sunbury in Surrey; and at Teddington, now in Greater London.

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Despite the difficulties of navigation before the building of the locks, one cannot underestimate the importance of the river to the trade of the towns and villages on or near its banks. There are, however, few tangible remains of the commercial use of the non-tidal river. Traffic declined fairly rapidly after railways were built in the area and the Thames Conservancy, which became the navigation authority in 1857, soon found that pleasure traffic was of prime importance.

The locks have been rebuilt at various times and, while they are quite usable by barges, their neat lawns and flower beds seem far removed from industrial history.

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THE WEY

The only navigation entirely in Surrey is that of the River Wey, comprising the Wey Navigation from the Thames to Guildford, opened in 1653, and its extension the Godalming Navigation, which was a separate enterprise and opened in 1763. In 1651 Sir Richard Weston of Sutton Place near Guildford, despite being a Roman Catholic and perhaps a Royalist, obtained with the aid of James Pitson, a major in Cromwell's army, what was later described as a 'pretended act of parliament passed during the late usurpation' to make the river navigable to Guildford. The navigation took the remarkably short time of two years to construct.

The Wey may be considered to be the second river in the country to have been successfully canalised, work on the Warwickshire Avon having probably been completed just before the Civil War. It presented particular difficulty as it was a fairly small winding stream. To deepen a river by hand digging is very difficult and



Hampton Court Bridge, architect Sir Edwin Lutyens, under construction by Surrey County Council. The bridge opened in 1933. *Surrey History Centre.*

was usually confined to the removal of local shoals, but the excavation of a trench on dry land is straightforward, provided there are sufficient labourers. Sir Richard Weston's unknown engineer therefore decided to avoid much of the shallow tortuous course so over half the navigation consists of artificial cuts. Sir Richard died before the work was completed and there were disputes between his heirs and those who had contributed to the cost and also, after the Restoration, between the proprietors and the riparian landowners who claimed that their land had been taken illegally. Much of the evidence in the resulting court cases has survived.

The line of the navigation is almost certainly the same today as it was when first built. Some features can be identified from evidence in the litigation records and there is also physical evidence, for example from bridges over the artificial cuts, which bear various dates in the eighteenth century. These bridges, consisting of brick abutments and timber beams (now replaced by steel) presumably replaced original bridges which had been built entirely of timber. If the cuts had been made as eighteenth century improvements, all the bridges on any one of them would be of the same date.

Ten locks were needed to overcome the 20 metres (70 foot) rise from the Thames to Guildford and there are also flood locks at the heads of the two longest cuts. The locks have been rebuilt, some in brick but most in concrete, but several survived until the 1960s in a form which was probably similar to the original. They were then turf-sided, but the irregular height of the timber and the fact that part of one wall of Trigg's Lock was made of timber to the full height suggest that the locks may have been built, or possibly rebuilt, as timber-sided rectangular chambers. As timber rots more rapidly if it is damp but exposed to the air than if it is permanently under water, the upper parts would tend to collapse, leaving sloping earth sides which would become covered with grass.

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The locks would take barges about 70 feet long by 14 feet wide (21.5 x 1.3 metres). The paddles for filling and emptying the locks were lifted directly without the usual rack-and-pinion gearing, or shifted with a hand spike. Such paddles remain in use at the two flood locks. The later Godalming Navigation had four locks with conventional brick chambers.



Eashing south bridge, over the millstream, one of a series of medieval bridges on the River Wey, c.1900. *Museum of Farnham, John Henry Knight Collection.*

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The principle of using extensive artificial cuts was adopted on many other navigations, sometimes, as on the Kennet, after an attempt to make the natural river navigable had failed, and elsewhere to improve an existing navigation. As the first navigation of its type in the country, the Wey Navigation is of national importance.

The Wey Navigation carried hardwood, gunpowder and agricultural produce downstream and coal, manure and domestic supplies up. Later it brought imported softwood upstream and imported grain for milling. Commercial traffic on the Godalming Navigation virtually ceased by 1930, apart from coal to the Vulcanised Fibre Works at Shalford and timber to Moon's timber yards just above Guildford Town Bridge. On the Wey Navigation, traffic declined in the late nineteenth century but revived somewhat from about 1910. Grain traffic on the lowest mile-and-a-half to Coxes Lock mill only finally ended in 1983 when the mill closed.

The Navigation was owned by the Portmore and Langton families for about 150 years. Latterly it belonged to the Stevens family who were associated with it for four generations and in 1969 gave it to the National Trust.

THE BASINGSTOKE CANAL

Two canals were constructed in what is now the county of Surrey, neither of which was intended primarily for the county's own trade. The Basingstoke Canal was the first canal, as distinct from river navigation, intended to serve a purely agricultural region and nobody knew whether it would be financially viable. The Act to authorise its construction was passed in 1778 but war with the American colonies made it impossible to raise the capital for some years and it was not until 1788 that work actually began. It was completed in 1794. It transpired that the traffic was quite insufficient to provide an adequate return on the investment. At best the net annual revenue was only about 12 per cent of the capital and, as the cost of construction had exceeded the estimate by 50 per cent, even this revenue could only service loans raised to complete the work. The shareholders never received a dividend.

The obvious route for a canal to Basingstoke is up the Loddon valley from the Thames and it was probably the poor state of the navigation of the river that led to the adoption of the more difficult route so as to reach the Thames farther downstream. Much of the line is on Bagshot Sands, an area of little use for agriculture which can have been expected to contribute very little trade. The only town near the line was Farnham, an agricultural centre not dissimilar to Basing-



The aqueduct carrying the Basingstoke Canal over the A331 Blackwater Valley road opened in the 1990s.

stoke. It is surprising that a branch to Farnham was not planned, although lack of money may well have prevented it from being built, even though it would have been on one level and cheap to construct. Farnham was thus served by a wharf some 4 miles (6 km) from the town on the Bagshot road, now the A325, and actually in Hampshire.

The canal enters Surrey in the middle of Ash embankment at the point where a large aqueduct was built in 1995 to allow the new Blackwater Valley road to pass underneath. The embankment is about 6 metres high and 1.5 km long. On leaving it, the canal turns northward to Frimley Green before resuming its easterly line to the Wey at New Haw. To leave the Blackwater valley it was necessary to dig a cutting almost 1 km long. While this is not as deep as is sometimes stated, being about 9 metres at the most, it was a considerable undertaking. It may have given the name to the district of Deepcut although, since this does not appear on the first edition Ordnance Survey map, it may come from the later and much deeper railway cutting. It is not clear why this route was chosen, as a line of similar length to the south of the high ground would have avoided a cutting and perhaps enabled the height of Ash embankment to be reduced. An unusual feature of the canal is that where it crosses minor side valleys it widens to form small lakes — as the land was of so little value it was not worth embanking the canal on the uphill side and providing a culvert to drain the hollow. Twenty-nine locks were required, of which 28 are in Surrey. These were designed to accommodate 70 foot Wey barges.

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The building of the London and Southampton Railway in 1838 required the construction of an aqueduct to carry the canal over the railway at Frimley Green. The present structure, however, dates from 1902 when the section of the railway was enlarged to four tracks. The Acts for the construction of the railway included various clauses to protect the canal. If the railway encroached on a pound between locks it had to enlarge the pound on the opposite side, as between locks 24 and 25, below Curzon Bridge. To avoid horses being frightened by the locomotives, the canal had to be screened from the railway by a hedge or bank and where the two were very close there had to be a wall at least 6 feet (1.8 metres) high. Part of this wall still stands by lock 25.

The opening of the railway reduced the already poor traffic on the canal. The construction of Aldershot Camp after the Crimean War boosted trade temporarily, as did military traffic during the First World War. After that, traffic was essentially confined to the section from the Wey to Woking and the final load of timber was delivered to Woking in 1949. The canal became steadily more derelict until it was bought by the two county councils and restored for pleasure traffic in the 1980s.

THE WEY AND ARUN CANAL

The other canal in Surrey was even less successful. The Wey and Arun Junction Canal ran from the Wey at Shalford to the Arun near Wisborough Green in Sussex. It was built between 1813 and 1816 as part of



Gosden Common aqueduct carrying the Wey and Arun Canal over the Bramley Brook.

an inland route from London to Portsmouth. Shipping from London to south coast ports was always liable to delays from unfavourable winds and was subject to loss from enemy action during the Napoleonic Wars. Peace and the development of the steamship meant that the canal failed to compete with the sea passage for through traffic and the only trade was that of the local agricultural area. As the cost of construction only slightly exceeded the estimate, the shareholders did receive a regular dividend for some years but this was only £1 for a share of £110. Over a quarter of the shares were held by the third Earl of Egremont, who was almost certainly more concerned with the improvement of agriculture in his part of Sussex than with a direct return on his capital. Traffic from Surrey must have been very light as there are no towns near the route but only the villages of Bramley, Cranleigh and Alfold. Even today, apart from Cranleigh, there is little development in the area. Construction of railways in the district, particularly that from Horsham to Guildford, reduced the already small trade and the canal was abandoned in 1871.

No substantial engineering works were required on the canal. There were 23 locks, of which 15 were in Surrey, and two small aqueducts. The locks in Surrey have almost entirely disappeared although Gosden aqueduct still stands. The locks were narrower than those on the Wey, being designed for Arun barges of about 11 foot (3.4 metre) beam. The summit was supplied with water from a reservoir, Vachery Pond,

which still exists, but the water supply was inadequate in many summers, even for the limited trade which existed.

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THE CROYDON CANAL

The Croydon Canal, built to link that town with the Thames, while not lying within the present county played a part in its trade. Opened in 1809, it competed with the Surrey Iron Railway, completed six years earlier. There was hardly enough traffic for one route to the Thames and the canal was closed in 1836 so that much of its line could be used for the construction of the London and Croydon Railway. It was the first complete public canal to be closed.

BOAT-BUILDING

Barges were built and repaired at a number of places on the various navigations. There were many boatyards on the Thames, such as Tom Taylor's, Biffen's, Tims, Harris's and Bates boatyards in the stretch of the river now in Runnymede. Away from the Thames, a yard that functioned until the Second World War was at Ash Vale on the Basingstoke Canal. The last barge to be built there was launched in 1939 and repairs were carried out until 1946. There was a dry dock beside Frimley top lock which was filled in during 1939 but has been rebuilt for use by pleasure craft. Nothing remains of the Ash Vale boatyard but



A William Stevens barge passing through Thames Lock, Weybridge.

that on the Wey at Dapdune Wharf, Guildford, is in use for pleasure craft. The National Trust has mounted an exhibition on the site to display and explain the historical features and this received the SIHG Conservation Award in 1998.

Railways

The story of railways in Surrey begins in the era of the Surrey Iron Railway and its extension, the Croydon, Merstham & Godstone Railway.³ The Surrey Iron Railway, which operated from 1802 to 1846, was the world's first public railway and the first to be sanctioned by an Act of Parliament. It was horse-drawn and unlike previous lines in the north of England, which had been dedicated to single industrial use, the SIR was open to anyone for the carriage of goods. The line ran for 8¼ miles (13 km) along the Wandle valley from Wandsworth to West Croydon, with a 14 mile branch from Mitcham to Hackbridge. The CM & GR, which operated from 1803 to 1839, ran for ten miles from Croydon to the stone quarries at Merstham but plans to continue it further came to nothing.

The gauge of the line was 4 feet 2 inches and the 3 foot (0.92 metres) long L-shaped rails were laid on stone sleeper blocks; examples of both rails and blocks are still to be found in the district. The main traffic was always stone going out from quarries, supplemented by general traffic for the industries along the River Wandle. The SIR and CM & GR each had a short life, overtaken by the introduction of steam haulage. Parts of the trackbed were incorporated into subsequent lines and the alignment by Mitcham station still forms the modern route into Waterloo.

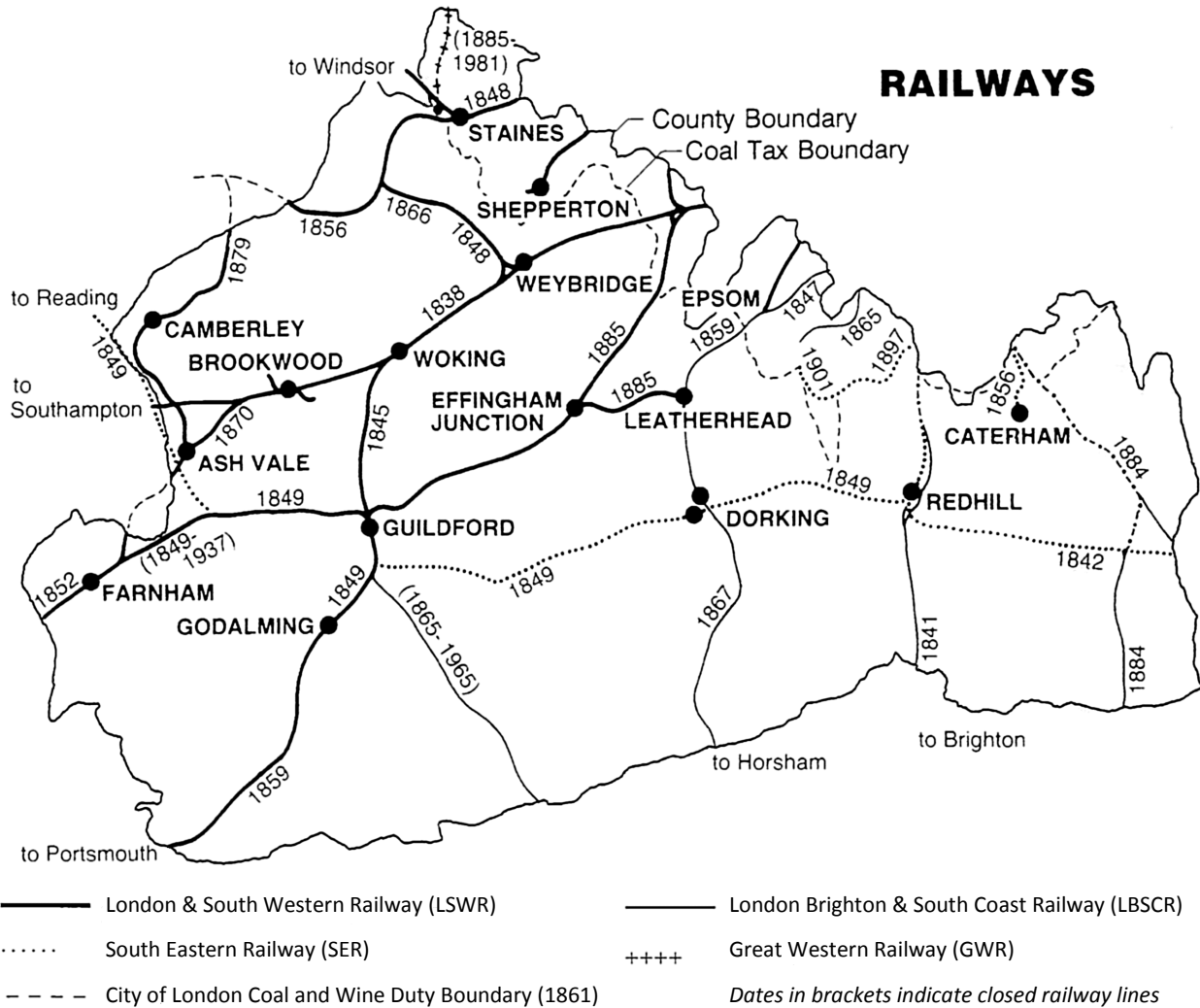
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The next stage in Surrey's railway history was the building of the early formative lines and their amalgamation under larger companies, all part of the opening up of routes to the coast and the development of suburban lines.

The major railway companies operating in Surrey were:

- ◇ The London & South Western (L & SWR) — mainly in the north and west of the county;
- ◇ The London, Brighton & South Coast (LB & SCR) — running north-south in the centre and east;

RAILWAYS



◇ The South Eastern Railway (SER) — operating an east-west route. This eventually united with the London, Chatham & Dover Railway within a single management committee to become the South Eastern & Chatham (SE & CR). However, the two companies remained financially independent.

All these companies became part of the Southern Railway in 1923 and of British Railways following nationalisation in 1947.

In west Surrey, the first line was from London to Southampton, proposed in 1830, authorised by Parliament in 1834, opened to Woking Common in 1838 and to its terminus in 1840. By then the London & Southampton Railway Company had plans to extend its lines to Bath and Bristol and beyond and had become the LSWR in 1839.

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Early plans to link Woking Common with Guildford included the Guildford Junction Railway's scheme to use the 'Prosser Patent Principle', whereby the train would run on wooden flangeless wheels kept on the flat wooden rails by angular guide wheels. This idea was dropped and the LSWR completed the line in 1845 with iron rails and earthworks and bridges wide

enough for doubling, which was done within two years. Woking Common was now a junction and the station was enlarged to handle the extra traffic.

The dash for Portsmouth was now on. The L & SWR served the city by a roundabout route across the harbour from Gosport but a more direct line was needed. By 1845 there were four lines heading towards Portsmouth: the Guildford branch from Woking, the existing Gosport branch, the Brighton & Chichester, linking up with the London & Brighton and the Croydon Railway extension from Epsom.

There were several schemes, using different routes, including one which never came to fruition for an atmospheric railway — trains sucked along by a vacuum created by a stationary steam engine — from Epsom. A Portsmouth Direct Bill was passed in 1846 but such was the rivalry, and the desire of the different companies to defend their preserves, that it was not until January 1859 that a direct route from London to Portsmouth was opened. This went through Godalming and covered a distance of 74 miles (118 km) from London instead of the 94 miles via Gosport or 95 miles via Brighton. After some early difficulties it became one of the L & SWR main lines.



The trackbed of the former Guildford to Horsham railway line running through the former Bramley and Wonersh station. The line forms part of the Downs Link long-distance footpath.

The 1840s saw the opening of L & SWR branch lines from Guildford to Farnham and from Weybridge to Chertsey and the building of a branch from Richmond to Windsor by the Windsor, Staines & South Western Railway. This company had been formed by the amalgamation of the Staines & Richmond Junction Railway with the Windsor, Slough & Staines Atmospheric Railway Company, which itself had failed in an attempt to get a Bill through Parliament in 1846. The Richmond to Windsor line was absorbed into the L & SWR in June 1850.

In 1849 an east-west route across the county was provided by the Reading, Guildford & Reigate Railway Company, incorporated in 1846. At Reigate Junction, as Redhill was then known, this connected with the LB & SCR line from London to Brighton and with the South East & Dover Railway line to Tonbridge and Ashford. The line was bought out in 1852 by the SER which thereby achieved its aim of linking the Channel ports with the Great Western Railway and with the industries of the Midlands and South Wales.

A network of branch lines continued to grow as suburban development spread. In north-west Surrey, lines opened to Hampton Court in 1849, Kingston and Hampton Wick in 1863, and from Ascot to Bagshot, Camberley, Frimley and Ash Vale in 1876. The Great Western Railway crept into what became part of modern Surrey with a line from West Drayton to Staines West, opened in 1884. Moving to the joint

territory of the L & SWR and the London Brighton & South Coast Railway, lines reached Sutton and Epsom in 1847, Leatherhead in 1859, Dorking on the Horsham in 1867 and Effingham junction in 1885. As early as 1846 proposals were made for a line from Guildford to Horsham, but these were dropped and resurrected in the 1860s. The line was opened from Stammerham Junction to Peasmarsh Junction near Guildford in 1865 and closed to passengers after exactly one hundred years.

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There were two interesting developments on the L & SWR line west of Woking, one serving a cemetery and one a rifle range.

London's graveyards were full and further burials were banned in 1850. The London Necropolis and National Mausoleum Company was authorised in 1852 to buy a large area of Woking Common on which to develop a vast cemetery. In practice most of the land was later sold at great profit for the development of the modern town of Woking but 400 acres were used for the cemetery and in 1854 a regular train service began from a private terminus outside Waterloo Station in London.

In 1863 negotiations took place between the L & SWR and the Necropolis Company for the building of a main line station at 'Necropolis Junction'. The Necropolis Company provided the land and built the station



The 1937 signal box at Woking Station.

master's house and an approach road, and the L & SWR built the station, goods yard and siding (in fact a run-round loop) into the cemetery. Brookwood station was opened in June 1864, enlarged in 1890 and virtually rebuilt in 1903 when two extra tracks were laid.

The fares, set by the Act authorising the building of the Necropolis, were unchanged for 87 years, being fixed at a maximum of 6s (30p) for mourners and attendants first class, 3s 6d (17½p) second class and is 6d third class. Coffins were charged single fares of 2s 6d for a pauper, 5s for an artisan and £1 for all others. Stories abound of non-funeral parties, golfers and others, travelling on the train suitably dressed in order to obtain the benefit of the specially reduced fares.

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The L & SWR line between Woking and Pirbright Junction also saw the building, in 1890, of a branch line to serve the National Rifle Association's ranges at Bisley Camp. The 1¼ miles long line was built in four months with the aid of the Royal Engineers from Aldershot and was only open for one month each year during the Bisley meeting in July. The branch left the main line at Brookwood station, ran parallel to the main line for a few hundred yards, and then crossed the Pirbright road and the Basingstoke Canal before continuing to Bisley Camp station. During the 1914-18

war, the line was temporarily extended to Pirbright, Deepcut and Blackdown camps. In 1941 it was again extended to Pirbright camp but removed in 1950. The Bisley branch was closed and the track lifted in 1952.

Another special development was in the Epsom area where, at the end of the nineteenth century, London County Council was building a range of hospitals for the mentally ill and handicapped. In 1905 Longrove hospital was under construction and the contractor built a light railway from exchange sidings at Ewell, which became Ewell West station, to carry materials to the site. The hospital was finished in 1907 and the LCC took over the railway, then constructed the Horton Light Railway and other branches expressly to serve the power house and pumping works. West Park hospital was built during the years 1915-24 and the railway was again used to carry construction materials. The railway, steam-hauled throughout its life, continued in operation, carrying materials and supplies until 1950, when the newly created Regional Hospital Board took over the site and closed the line down, scrapping track, locomotives and rolling stock.

As in west Surrey, with the building of the direct line to Portsmouth, company rivalry dogged developments in the east, where the LB & SCR and the SER were in constant dispute. One of the biggest battles was over the branch line to Caterham which opened in 1856, for although the line was in SER territory



Guildford Station roundhouse before its closure in 1967. *Tony Martin Collection.*

there was no right to stop at Godstone Road on the LB & SCR owned section, and in any case the station had been closed since 1847. Continuing disputes led to the financial breakdown of the small company in 1859. The SER took the line over but passengers had continued trouble which only ceased after letters and articles were printed in *The Times*. Later the quarrels abated and a joint line from South Croydon junction to East Grinstead was authorised in 1878, opened in 1884 and later extended south to Lewes.

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Besides the growing commuter suburbs, Epsom races created a large local demand for rail travel. These demands were served by the Banstead & Epsom Downs Company line, taken over before its completion in 1865 by the LB & SCR, and by the Chipstead Valley Railway line which ran from Caterham Junction (Purley), turned south-east, passed back under the main line and ran west towards Tadworth and Tattenham Corner, which it reached in 1901. In 1951 it was reported that over 40,000 racegoers travelled to the Derby by this line.

The major railway companies, into which many smaller ones had been absorbed, were themselves amalgamated to form the Southern Railway in the grouping which occurred in 1923. The Southern was the smallest of the groups formed in that year but in many ways it was one of the more efficient and successful ones. All the lines in Surrey were incorporated into the Southern and benefited from the electrification

policy of the new company, the only one to opt for third rail in preference to overhead power lines. Both the LB & SCR and the L & SWR had electrified some of their suburban services earlier in the century and many of the remaining Surrey lines were electrified by the end of the 1920s. The line from Raynes Park to Epsom and Dorking was converted in 1925, Sutton to Epsom Downs in 1928 and Streatham to Mitcham, Sutton and Epsom in 1929. The major exception was the main line from Hampton Court Junction through Woking to Guildford and beyond, which was not converted until 1937. The Dorking to Horsham line was electrified in 1938 and that from Ash Vale to Guildford in 1939. The Second World War delayed the completion of electrification until 1956 when the Oxted line was converted.

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The only new line constructed in the county under the Southern was an incomplete commuter line on the Leatherhead and Dorking route from a point south of Motspur Park through Tolworth towards Leatherhead, which never got beyond Chessington South owing to the outbreak of war in 1939. The growth of passenger traffic had been colossal during the century, greatly increasing during the period of the Southern Railway. On the whole of the Southern in 1923 there were 198 million passenger journeys, 208 million in 1932 and 237 million by 1938.

The 1947 Transport Act was a watershed in railway operation. Much had to be done by the newly nation-

alised industry to repair the neglect of the war years and a major re-signalling programme was instigated in the Southern Region in 1965. For example, the Southampton main line was converted to multiple-aspect colour light signalling in 1966 and the Portsmouth Direct line in 1974. Now with a return to private ownership, what will this major change bring to Surrey railways?

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Aviation

Surrey was at the forefront of heavier-than-air flying in the early years of the twentieth century and in the middle years of the development of civil airports, and was prominent in aircraft manufacture throughout the period. But before this time, from as early as 1785, lighter-than-air craft, first balloons and then airships, had taken to the air above the county.

On 1 May 1785, only 18 months after the first manned balloon ascent in Paris, James Sadler, who had become the first British airman, made his third ascent in a hydrogen-filled balloon from Hurst Park. Other ballooning sites in historic Surrey from this period up to the 1920s included St George's Circus, Southwark, the Ranelagh Club at Barnes Common, Vauxhall Gardens, the Crystal Palace, Roehampton, Battersea Park and Wandsworth and Mitcham Gas Works.

The first successful cross-country flight by a powered lighter-than-air craft was on 22 October 1902 from the Crystal Palace to Eastcote in Middlesex. An historic flight by the airship 'Nulli Secundus' of the Military Balloon Section, from Aldershot over London to the Crystal Palace, took place on 5 October 1907. The craft was commanded by Colonel John E Capper and his crew was S F Cody, who was still an American citizen at that time. By the time the airship was forced to land by adverse headwinds, it had covered over fifty miles and had been in the air for 3 hours 20 minutes. This was an important event for it stimulated British efforts to catch up on the lead taken by France and Germany.

The first sustained flight in Britain in a heavier-than-air machine was made by Cody at Farnborough, just across the county boundary in Hampshire, on 16 October 1908. Cody flew some 1390 feet in a bi-plane of his own design and construction.

AIRFIELDS

Brooklands

In June 1908 A V Roe, experimenting within the motor-racing track built the year before at Brooklands, came off the banking, became airborne and flew along the finishing straight for some 100 yards, but

there were no officials on hand to record the event and it was never recognised as a powered and controlled flight.

Brooklands became the Mecca for a new breed of fliers and up to the outbreak of war in 1914 saw the establishment of ten flying schools which between them trained over 300 pilots, more than any other field in the country. Famous names from the period include the Frenchmen, Blériot, Paulhan and Pégoud (the first to loop-the-loop in Britain, at Brooklands in 1913); Alliott Verdon Roe, Pixton, Grahame-White, Pemberton Billing, Tom Sopwith and the Australian Harry Hawker.

The next two decades saw the development of club flying and air races. The King's Cup was flown from Brooklands on several occasions and pilots like Tommy Rose and Chris Staniland thrilled the crowds with stunt flying. During the First World War the airfield had been taken over by the government, as it was again in 1939 when it was handed over to Vickers. This time at the end of hostilities in 1945, neither the race track nor the airfield was to return to civilian use.

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Croydon and Gatwick airports

Neither of these major sites is in modern Surrey but both were in the county during their formative years.

Croydon emerged out of the war-time flying fields at Beddington and Waddon. In March 1920 it was designated 'The Official Air Terminus and Customs Airport for London' and the first commercial flight, to Le Bourget, Paris, took place. The new airport buildings along Purley Way were opened in 1928 and a number survive, including hangars and Airport House and the control tower, which has been refurbished as offices and a restaurant with a small historical display. The Aerodrome hotel of the same period is a Post House hotel in the 1990s.

Long-range flights to the Empire by Imperial Airways and continually-growing services to Europe by British and continental airlines operated up to the outbreak of war in 1939. Croydon was also famous for many record-breaking flights in light aircraft by pilots who included Alan Cobham, Charles Lindbergh, Bert Hinkler, Charles Kingsford-Smith, Jim Mollison and two women, Amy Johnson and Jean Batten.

During the Second World War Croydon was a fighter base. It re-opened after the war but its grass runways were too short and could not cope with the weight of the new civil airliners. Traffic was transferred first to Northolt and then to the new airport at Heathrow; Croydon Airport closed, and much of the land was used for housing.



The 'Beehive' terminal building at Gatwick Airport nearing completion in 1936. *John King Collection.*

Gatwick Airport was developed first by Morris Jackaman and then by Marcel Desouter from a flying club which operated in a field next to the racecourse in the early 1930s. Lack of finance, the boggy nature of the land and the intransigence of the Southern Railway, together with the demands of the Air Ministry, caused continual difficulties. The new terminal, south of the site of the modern one, was opened with much dash and ceremony in June 1936.

It was — and still is — famous for the innovative design of the building, the 'Beehive', connected by a tunnel to its own station on the Southern Railway main line from London to Brighton, and to the aircraft by means of telescopic covered walkways, the precursor of all modern airport design. The Beehive still stands and has been refurbished with many of its original features retained.

Like Croydon, Gatwick became an RAF station during the Second World War, with both fighter and army co-operation squadrons operating from the grass field. This still suffered intermittently from flooding from the River Mole, and the problem was not solved until the new post-war airport with concrete runways was built.

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Other early airfields

Other early flying fields in Surrey were at Beddington, Waddon, Addington south of Croydon, and at Fair Oaks near Chobham, and there were short-lived sites at Hook, Chessington and Warlingham. Fair Oaks survives for light civil flying.

Redhill was developed by the British Air Transport Company in 1934 as a Flying Training School, having moved from Addington. The company gained a con-

tract to train Imperial Airways engineers and for basic flying training. Redhill Flying Club was formed in March 1937 and took part in the National Civil Air Guard scheme. In July 1937 the No 15 Elementary and Reserve Flying Training School of the RAF opened. In the 1990s Redhill is the base for Bristow Helicopters and several flying clubs for light aircraft.

Kenley was associated with air defence between the wars and became a major base for Fighter Command during the Battle of Britain.

Dunsfold was built in 1942 by the Canadians as an advanced landing base for Fighter Command. After the war, Skyways, which became the largest charter company in Europe, took over Dunsfold but ran into financial problems in 1950 and was wound up.

Wisley, across the A3 from Brooklands, was created in 1943 to increase test facilities for Vickers and was fully operational the next year, though the site was not fully developed with a 6700 feet (2 km) runway and night flying facilities until 1953. The airfield closed down in May 1972 and proposals to re-open it for light aircraft in the 1980s came to nothing.

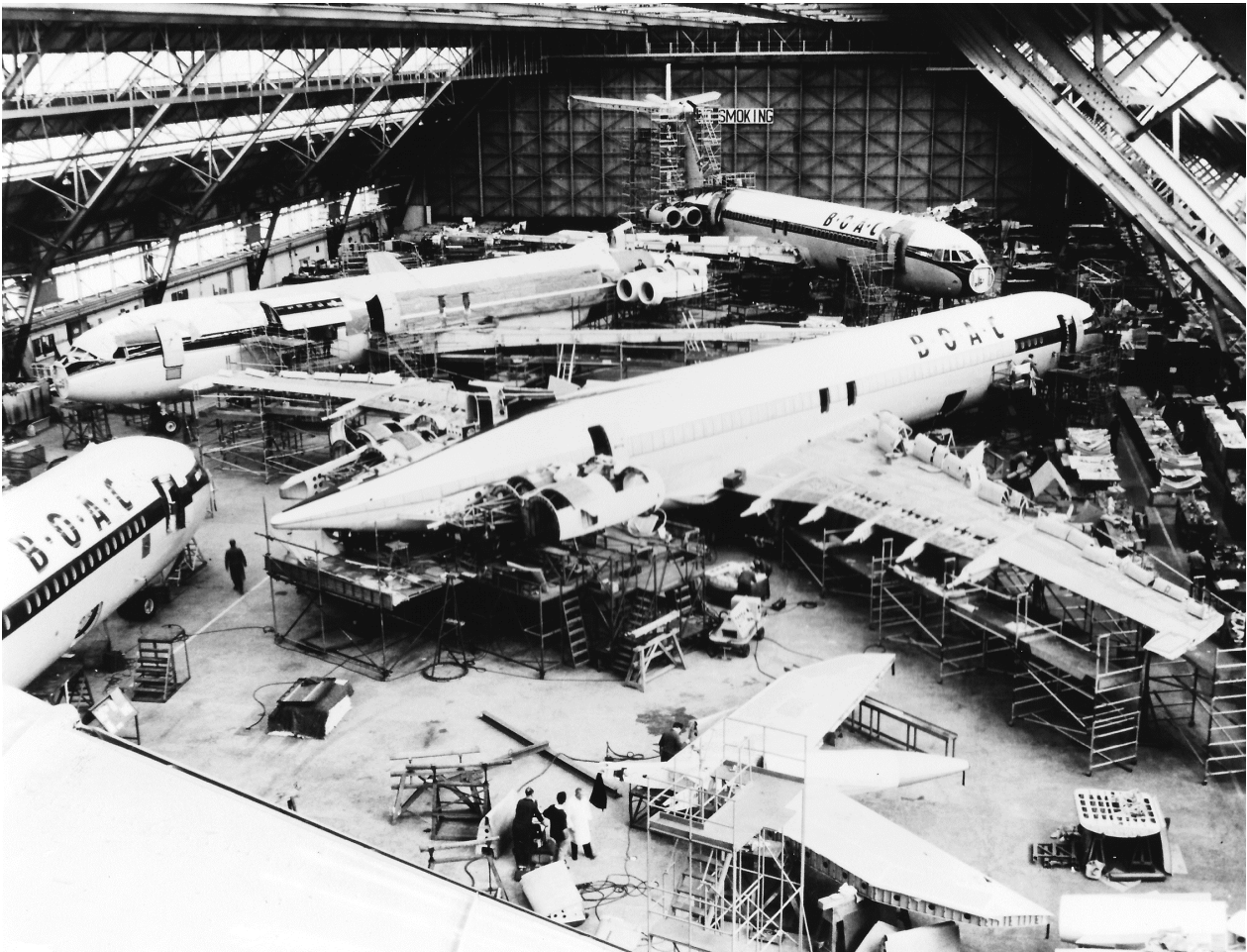
Also in 1943 a small second-line advanced landing ground was set up at Horne, near Redhill. It did not survive after the war.

Notes

1. Budgen, C, 'The Bramley and Rudgwick Turnpike Trust', *Surrey Archaeological Collections*, 81 (1991-92), 97-102
2. The City of London coal and wine duty boundary is shown on the map of railways on page 61.
3. The SIR and CM&GR are shown on the map on page 55.

Chapter 8

ENGINEERING



BAC VC 10s and Super VC 10s in production at Weybridge for BOAC and BUA in 1964. *Brooklands Museum.*

In parallel with the development of air transport, Surrey has had a long and important involvement in the aircraft industry which still continues today, albeit in a much reduced form. With its proximity to London, the county was also prominent in the pioneering stage of motoring and the design of early cars. Motor vehicle manufacturing has remained an important industry among a wide range of specialised engineering works, many of which have manufactured parts for aircraft and vehicles. Other industries include the manufacture of dry-cleaning machinery at Leatherhead; industrial knitting machinery at the Gillett Works, Bookham; machine tools at the Dorking Foundry; vacuum cleaners at the Goblin Works, Ashted; Drummond lathes and Webber stationary engines at Guildford; and printers' compositing machines at the Monotype Corporation's works at Salfords near Redhill.

Village smithies and forges and foundries in several towns, such as Filmer and Mason's in Guildford and the Chertsey and Dorking Foundries, continued to

supply local needs well into the twentieth century. Of special note among foundries was Burton's at Thames Ditton, which sent monumental statuary all over the Empire, while Rowhurst Forge, Leatherhead, established in the 1930s, has been influential in reviving the art of the blacksmith.

Aircraft manufacture

The Brooklands site at Weybridge had a major involvement in aircraft construction from the early days. Vickers, who took over and extended the Itala motor works in 1915, Martin and Handasyde, Avro, Sopwith, Blériot and the British and Colonial aircraft company, all operated there during the First World War. Some 20,000 aircraft were flown out during that war, including Sopwith aircraft, the Vickers Gunbus, and over 1600 S.E.5s, built by Vickers and other makers at Brooklands under contract from the Royal Aircraft Factory at Farnborough. Martinsyde (the renamed Martin and Handasyde), had opened up

a new factory on the site of the Oriental Institute in Woking and Louis Blériot set up a factory at Addlestone to build French Spad fighters. Both of these firms, like Sopwith, sent their aircraft to Brooklands for flight testing as they had no airfield of their own.

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Vickers began to specialise in building large military aircraft. The Vimy bomber came just too late to fly offensively in the First World War but made historic flights across the Atlantic with Alcock and Brown in June 1919 and to Australia with Ross and Keith Smith in December of the same year.

During the 1920s and 1930s, Vickers produced the Virginia and Victoria biplane bombers and transports, the Vildebeest torpedo bomber and then the Wellesley long-distance aircraft, using Barnes Wallis's geodetic construction, and just before the Second World War the Wellington, of which 11,461 were ultimately built. Not a single flying example remains but a static model is being completed from the wreck salvaged from Loch Ness, fittingly at the Brooklands Museum.

After the war, Vickers built the Viking, Vanguard, Viscount and VC 10 airliners and the first of the V-bombers, the Valiant. The Viscount, the world's first prop jet airliner, outsold any other of its type. It was operated by over 60 different civil and government organisations in 40 countries and many remain in service today. After the company became part of the British Aircraft Corporation, and then British Aerospace, it produced parts for the BAC111 jet liner and Concorde and built the ill-fated supersonic TSR2 strike aircraft. Although aircraft made their first flight from the new concrete runway at Brooklands, it was only a short 'hop' to Wisley where all the post-war development flying for the Viking, Viscount, Vanguard, VC 10 and most of that for the BAC111 took place. The factory was closed in the 1980s and the site redeveloped, though some of the original buildings have been retained as part of the Brooklands flying and motor-racing museum.

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Tom Sopwith took over the skating rink in Canbury Park Road, Kingston upon Thames, in 1912 and started building the first of a long line of successful military aircraft, including the Tabloid, Pup, Strutter and Camel. All had to be taken by road to Brooklands for final assembly and flight testing. A seaplane version of the Tabloid won the Schneider Trophy for Britain in 1914 at Monaco. In 1917 the government, concerned with the increasing need for aircraft to pursue the war in the air, announced plans to build a number of national aircraft factories, financed by the government but managed by the aircraft manufacturers.

One of these was built at Richmond Road, Ham. Sopwith had misgivings about the viability of the scheme, so was instead offered a lease on the site which he took up. On the two Kingston sites, with the help of a number of sub-contractors, over 16,000 Sopwith aircraft were built during the First World War. The two factories employed 3500 people, including 1000 women, by the end of the war.

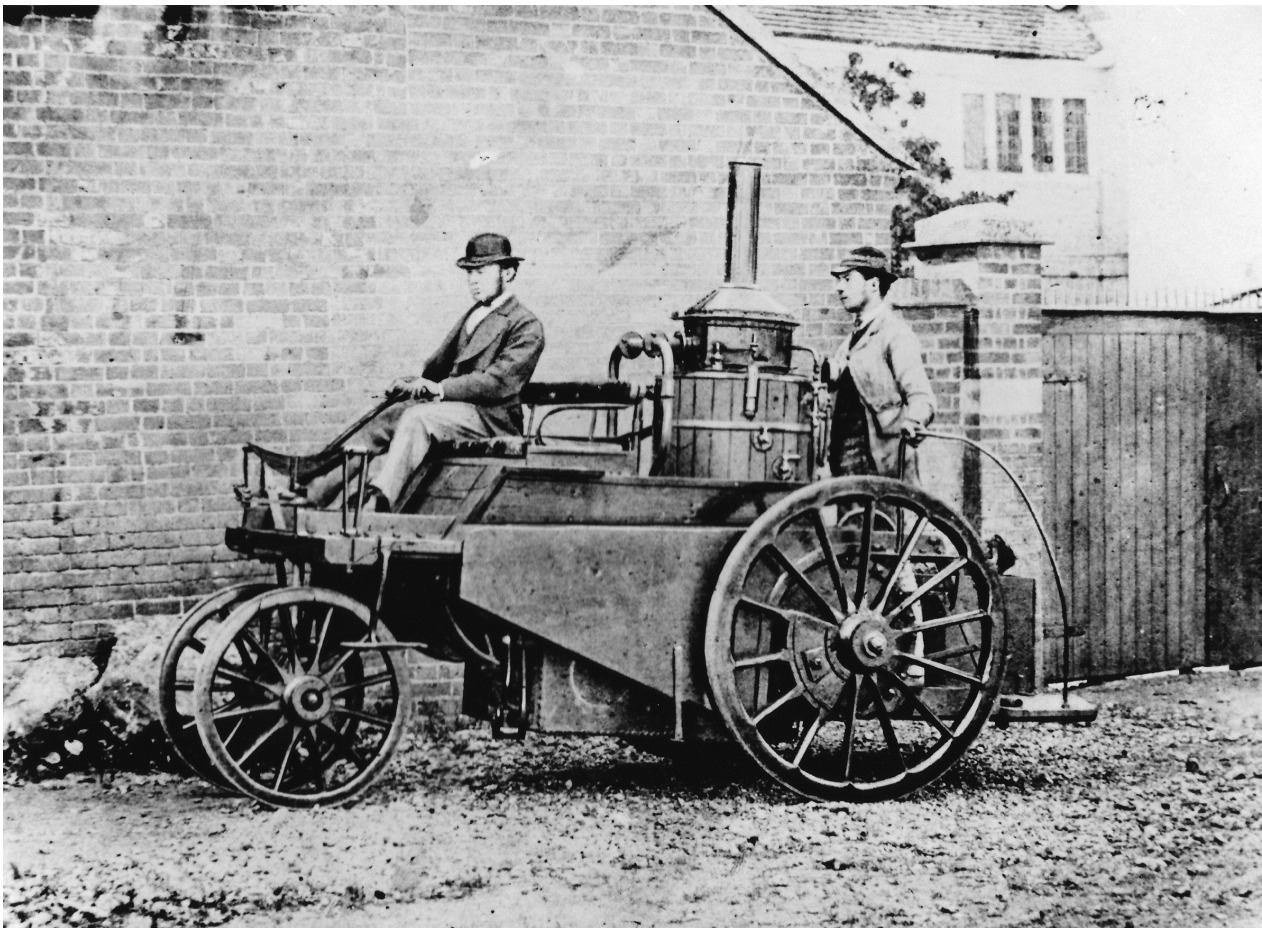
In 1920 the Sopwith Company was forced into liquidation by an enormous claim by the government for excess war profits. A new diversified company was immediately created, the Hawker Engineering Company. Harry Hawker, who had joined Sopwith in 1912, was tragically killed in a flying accident the next year but the company bearing his name went on to build fine military aircraft, first under W G Carter as chief designer and then the legendary Sydney Camm. Planes such as the Horsley, Hart, Fury, Nimrod, Osprey, Demon and Audax led up to the RAF's first monoplane fighter, the Hurricane, which made its maiden flight from Brooklands in November 1935. A total of 9,997 Hurricanes were built by Hawkers, and a further 4,129 by other companies.

After the Hurricane came the Typhoon and Tempest, followed at the end of the Second World War by the Sea Fury, the fastest piston-engined fighter built anywhere in the world. The jet age came in 1949 with the P1040 and the Sea Hawk, followed by the P1052, the Hunter, the Harrier in 1971 and then another Hawk. The last two are still in service in the 1990s in many parts of the world, the Harrier being famous as the world's first vertical short take-off and landing aircraft and the Hawk as the Red Arrows' display team machine. In 1950 Dunsfold airfield was leased to provide final assembly and flight test facilities to replace those at Langley, Buckinghamshire, and Farnborough. In 1963 the company became part of the Hawker-Siddeley Group and more recently of British Aerospace.

The Kingston factory was closed and the site cleared by February 1994, leaving Dunsfold as the sole remaining aircraft assembly and flight testing site in Surrey.¹ Harriers and Hawks are completed there from assemblies made largely at Blackburn Aircraft at Beverley in Yorkshire.

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The National Aircraft factory No 1 was built at Waddon to construct de Havilland designs. Completed in June 1918, it came too late to have any serious effect on the outcome of the First World War, but contracts placed were fulfilled and when 1,500 employees were dismissed in January 1919 there was severe industrial unrest. In 1920 the business was taken over by the Aircraft Disposal Company and the site became a



John Henry Knight's 'steamer' outside the gates of Weybourne House, Farnham.
John Henry Knight Collection, Museum of Farnham.

huge sale depot where parts, engines and complete planes were available at knock-down prices. When Croydon airport was opened many of the factory hangers on the north side continued to produce light aircraft, first by Marcel Desouter, who subsequently became associated with the development of Gatwick airport, then by the Redwing Company, and later by the General Aircraft Company.

A number of component factories developed, particularly around Brooklands; the propeller factory of Langs and the Clerget engine factory of Gordon Watney & Company, both at Addlestone, are typical. Engine manufacture, except by sub-contractors during the war years, was limited to Blackburnes of Bookham, who produced a number of designs for light aircraft in the 1920s and 1930s.

Motor vehicle manufacture

The genesis of the motor vehicle in Surrey lies in the 1868 road steam vehicle of John Henry Knight of Farnham. Knight was well-to-do, trained as an engineer and was an enthusiast for harnessing the power of steam to road-going transport. Though his vehicle was clumsy and disaster prone, it seemed to prove that road vehicles not powered by horses or pedal

power were a possibility despite the restrictions of the law. However, Knight's next vehicle, his most important one, resulted from his dabbling with a gas engine, his *Trusty*. The result was initially a three-wheeler with tiller steering and powered by the *Trusty* engine. It was probably the fourth native British car made and it is still preserved in the National Motor Museum at Beaulieu. It may be that Knight's real importance subsequently was as a catalyst, acting upon his friend, Sir David Salmons (of Tunbridge Wells) in agitating for a greater acceptability of the motor car by the aristocracy and the legal bureaucracy. With his own leanings towards the privileged classes, Knight could not possibly envisage the coming days of motoring for the masses.

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Surrey had acquired a bad reputation for its persecution of the motorist — as the early motorist saw it — after the appointment of Captain H M Sant as Chief Constable in September 1898. The first skirmishes involved motorists against the police for their oppressive tactics against speedsters, and the Self Propelled Traffic Association was formed in December 1895 to repeal the Locomotives on Highways Act which restricted vehicle speeds to 4 mph in the country and 2 mph in towns. In 1896 Parliament duly passed the

'Emancipation Act', liberating motorists from the demands of that earlier Act. In 1898 the SPTA was swallowed up in the Automobile Club of Great Britain and Ireland which eventually turned into the RAC. However the speed limit was only 20 mph in 1905 when the Automobile Association was born from the need to warn motorists of police speed traps. Needing little encouragement to pursue the well-to-do, Sant's policemen set up road traps which made Cobham, Wisley and Godalming notorious amongst car and motorcycle owners. *The Diary of the Bow-Wows Motor Cycle Club, 1914*, relates how the motorists 'proceeded quietly to Godalming where a halt was called to see everyone safely through the trap which was observed to be working with its usual weekend vigour ... The ride from Guildford to the 'Hut' [The Wisley Hut Hotel, demolished during widening of the A3] was remarkable for the feeling of 'trap-funk' which existed'.

The Government reluctantly allowed the motors to flourish, the better to tax the owners and thus improve the state of the roads, but the greatest impetus for change in Surrey, and the event which had the most far-reaching consequences for the County, was the coming of Brooklands Race Track in 1907.

Financed by Hugh Locke-King and sited on his own land near Weybridge, the track was inspired by his exasperation at the failures of British racing cars to win road races on the continent. Brooklands offered a safe haven where cars and public were in little danger from each other, but it spearheaded the thrust of the car and of car racing into what was then the countryside. Car manufacture, pushed outwards in a south-westerly direction from the London suburbs, encouraged the entrepreneurs to produce more vehicles in obscure places, for example Blackburne motorcycle engines at Tongham near Farnham. Component factories have flourished along country lanes — crankshafts at Elstead; gauges at Bramley; special van bodies in Godalming; bespoke car and coach bodies at Wrecclesham.



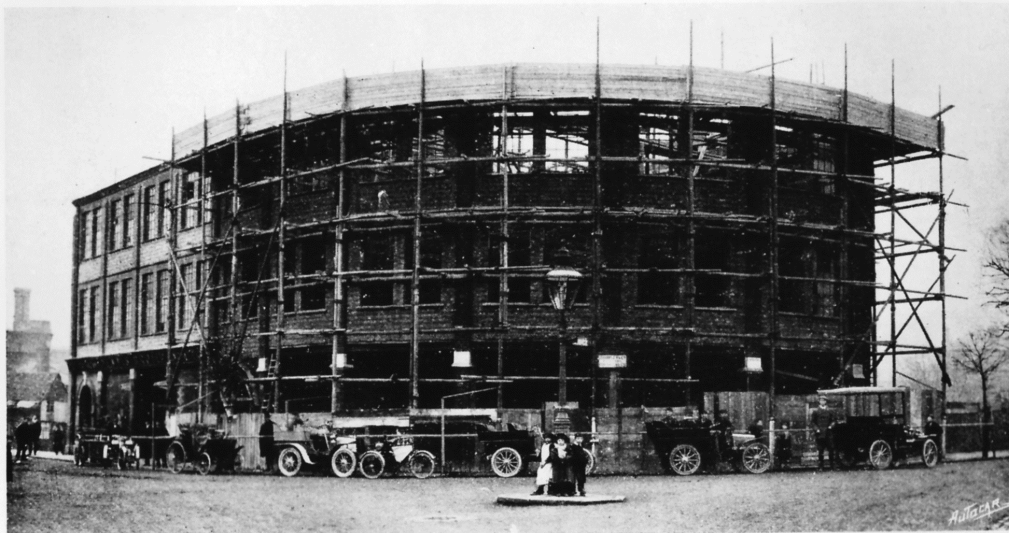
A mechanic at work in Thomson and Taylor's premises at Brooklands race track. *Brooklands Museum*.

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Everywhere wayside garages sprang up, offering petrol and accessories and specialised servicing to the motorist. An interesting example might be Puttocks who originally came to Guildford in 1814 to set up a livery stable but turned over their business to the motor vehicle industry in 1903. Since then they claim to have offered the first motor car for hire (1905), the first taxi (1908), the first charabanc (1910), and the first Mercedes car dealership in Surrey. In 1911 Puttocks built a new garage in Guildford High Street and had the first pump in Guildford maintaining a virtual 24 hour service. Often such garages were sited on the more important roads into and out of towns, such as RKG on the Epsom Road out of Guildford, Martin's on the A281 from Guildford to Horsham, and also

DENNIS BROTHERS, Limited.

A new additional Factory now being erected which, when completed, will be employing upwards of four hundred workpeople.



To enable us to cope with the increasing demand for DENNIS MOTORS.

Factory : Guildford.

Head Offices : Guildford.

Dennis Brothers' purpose-built car factory in Onslow Street, Guildford, nearing completion in 1901.
Surrey History Centre.

Warn's of Shalford (1908) further along on the same road. Many of them have been selling cars for a long time, for example Grays of Guildford since 1904. Some of them, for example Thomson and Taylor of Cobham — used by Malcolm Campbell for his Bluebird cars and boats from 1930 — or Jarvis of Wimbledon, who built the Jappic car in 1925 for record breaking, became heavily involved in attempts on the land speed record. A further 'spin-off' was the number of famous drivers and mechanics who came to live in Surrey, such as Malcolm Campbell and his son Donald, Leo Villa their mechanic, and famous Brooklands divers Parry Thomas and Sammy Davis.

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The oldest motor vehicle manufacturer in the county, one which is still making vehicles today, is Dennis Specialist Vehicles, originally Dennis Bros of Guildford. After making bicycles, motorised tricycles and cars, this firm progressed to fire engines, lawn mowers, rubbish collectors, aeroplane towing trucks, buses and coaches. Dennis Bros, bought up White and

Poppe of Coventry to acquire their expertise in making engines and encouraged their workers to move to Guildford. Consequently they needed housing, so the firm founded Dennisville to build its own housing, thus adding to the spreading Guildford environment. One of the earliest Dennis production factory buildings, known as Rodboro Buildings in Guildford, is one of the oldest purpose-built car factories in the world, and is said to be the oldest multi-storey one. Plans to demolish the building to improve the traffic flow in the town were not carried out and it has been adapted for recreational use as a spacious and interesting public house.

Another specialist product from the early years of the motor car era was made by the firm of F G Barnes of Godalming, one of the pioneers in attempting to solve the problems of road maintenance created by the new traffic. They were probably the first after the turn of the century to produce a tar-spraying machine for roads.

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As the twentieth century progressed, an economy based on the living horse gave way to one based on mechanical horsepower. The result was that thousands of people had to learn new skills and find re-employment. Car manufacture boomed. The largest employers have probably been Dennis Bros at Guildford and Lagonda at Staines but many different makes of cars and motorcycles have been attempted. Some of them have become famous, such as the Trojan of Croydon, AC and Panther of Thames Ditton, and Invicta of Virginia Water and Cobham, but many have remained obscure, such as the delightfully named Humming Bird of Dorking, the Carlette of Weybridge and the Zendik of Kingston upon Thames. Over 130 makes of car and over 40 makes of motorcycles have been produced, some of them perhaps in small numbers. One of the most consistently produced types of vehicle was the cycle car, whose openness to the skies and cheapness of production appealed to the mechanically minded from 1913 onwards, when the first race for them was held at Brooklands. Each of the World Wars brought promising productions to a halt but so too did such threats to commercial prosperity as the coming of quality mass motoring production (via Ford, Morris and Austin) and the Great Depression of the 1930s.

The post-war flooding of the British market by the Pacific Rim countries, notably Japan, has hit the whole of British car production, yet has hardly touched an astoundingly successful aspect of Surrey's motor activity — the production of very fast cars either for road use: the Cooper, Panther, AC, Caterham 7 — or for specialised track racing, such as McLaren at Woking and Tyrrell at Ockham.

The Ken Tyrrell Racing Team successfully took part in F2, F3 and saloon car racing and moved into Formula One racing in 1968, with engines supplied by Cosworth. The team became famous with the emergence of Jacky Stewart, who won the World Championship three times with cars of his own design. Other famous drivers in the Tyrrell team have included Jody Scheckter, Ronnie Peterson and Jean Alesi. In 1996 Salo, Katayama and Dr Harvey Postlethwaite were designing cars for the team.

Notes

1. As this book went to press it was announced that Dunsfold was to close as an airfield and manufacturing site.

Chapter 9

UTILITIES



One of the twin, back-to-back Staines reservoirs of the West Middlesex Water Company, photographed with the water down in 1998.

The provision of safe and adequate water supplies, of sanitation, energy for lighting and power, and increasingly sophisticated means of communications, have all given rise to major industrial undertakings from the nineteenth century onwards.¹ Besides the basic water, sewerage, gas, electricity, signalling and telecommunications industries discussed below, Surrey has a significant connection with the postal service in that the architect John Wornham Penfold, designer of the hexagonal 'Penfold' pillar box, was born in Haslemere and remained closely associated with the town.² In a more specialised field, the Royal Greenwich Observatory had an outpost at Abinger from 1924 to 1957 to avoid interference with magnetic signals.³

Water supply

Surrey largely depends for its water supply on two great water-bearing strata, the Chalk and the Lower Greensand, which traverse the county from east to west. A line of springs issuing at the outcrop of the Chalk from beneath the overlying tertiary beds gave rise to a chain of towns and villages from Guildford through the Clandons, Horsleys, Bookhams, Fetcham,

Leatherhead and Epsom as far as Sutton and Croydon. Other early spring-fed settlements are the British camp on St George's Hill, south of Weybridge, and Waverley Abbey, where a Lower Greensand spring provided a supply in 1179.

Wells are more reliable than naturally occurring springs as they can be extended below the range of variation of the water table and can penetrate relatively impermeable strata, such as the Gault Clay, to reach aquifers beneath. The depth of wells in Surrey varies considerably. Most Greensand wells are less than 60 metres deep, but those in chalk are often much more — for example 155 metres at Polesden Lacey. The yield of wells is sometimes increased by driving 'headings' — horizontal adits — to intercept water-bearing fissures, particularly in the chalk. Notable examples include Woking Waterworks' 40 metres-deep well at West Horsley which has headings extending 183 and 400 metres, and the Banstead Hospital (now HM Prisons) wells which are 90 and 116 metres deep and have galleries totalling 150 metres. Haslemere Waterworks, whose 32 metres well is in the Lower Greensand, has an easterly heading 167 metres long.

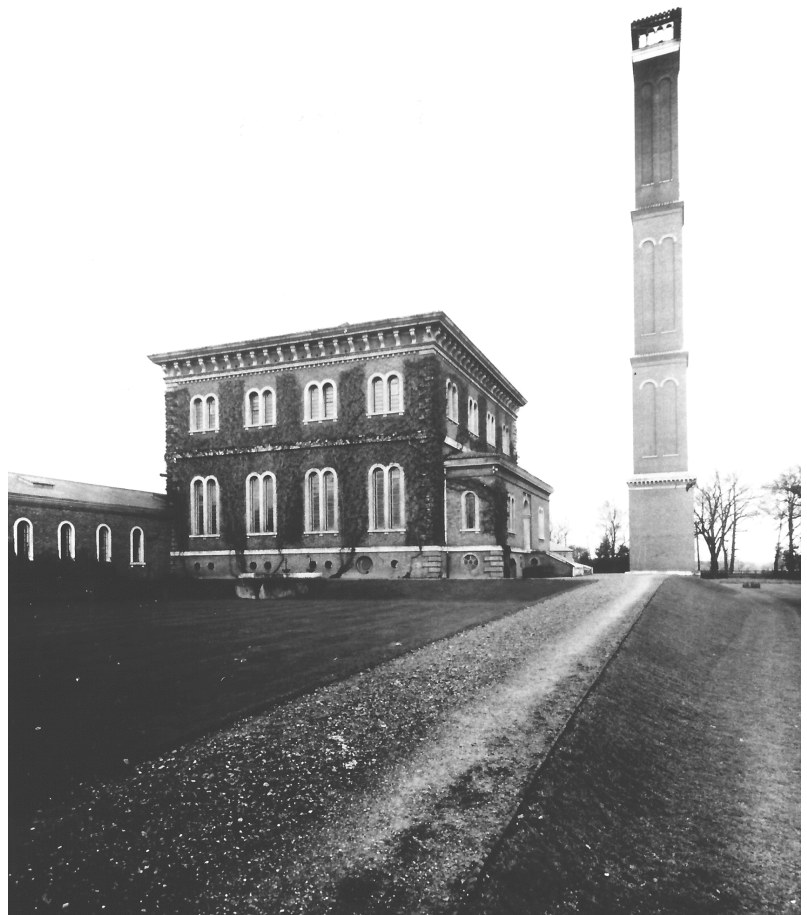
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Well-sinking is a hazardous craft akin to mining. In loose or saturated strata, lining or 'steining' is provided to support the sides. This is commonly constructed of brickwork placed on a curb which, by its own weight, forces itself down the shaft, or of cast iron sections bolted together. Forced ventilation by bellows or fan is commonly needed.

By 1880 there were over 200 Lower Greensand wells, located in a broad sweep from Thursley and Farnham in the west to Bletchingley in the east, and over 100 chalk wells from Guildford to Chelsham and Warlingham. Wells were deepened by boring, initially by chiselling and bailer action and later by rotary drilling. In the nineteenth century the provision of boreholes in Surrey was largely by private firms but by the turn of the century the county was becoming a principal supplier of deep-seated water. Bore-hole sources over 245 metres deep were in use at Chertsey Brewery, Caterham Waterworks and East Horsley as well as one of 365 metres at Dunsfold and one of 484 m at Ottershaw Park at Chertsey. Significant among private suppliers were hospitals and institutions, such as Holloway Sanatorium at Virginia Water and Brookwood Asylum at Woking, and commercial undertakings such as laundries and breweries.

Surface supplies have been used in some parts of the county. In the Wey valley, a supply was taken by channels from the Abbey Stream to the twelfth century Newark Priory near Send. In the mid-seventeenth century, a piped water supply was taken from one of the ponds on the Tillingbourne to Wotton House and its gardens created by John Evelyn. Dorking was a leader in major pumped supplies in 1738 when the Pippbrook was impounded and 'water mills, works and engines' were installed. After more than a century the works were put up for sale with 'a six-foot overshoot wheel, 5 feet wide [with] universal joints, having an extra crank available in case of accident' as well as a 'three-barrel engine' or pump. Surface run-off from the greater part of the District of Tandridge is abstracted from the River Eden in Kent, stored in Bough Beech Reservoir and pumped back to serve the area east of Reigate and south to Horley and Gatwick.

An early distributed water supply was provided at Guildford in 1701 when William Yarnold received a grant from the corporation to erect a waterwheel and pumps to raise water from a well near the fulling mills on the River Wey to a reservoir at the foot of Pewley Hill. A company was formed of which the corporation held three-and-a-half of the eight shares and which it acquired in full in 1865. A new well was then sunk



The Hanworth Road works of the Metropolitan Water Board in March 1934. *Thames Water Utilities.*

which became contaminated from a fractured sewer, resulting in 264 cases of typhoid fever. Development continued however and in 1898 the water manager reported that power sources for the supply comprised gas and steam engines, water turbines and three waterwheels.

Guildford was not alone in having typhoid. The County Medical Officer's report of 1898 admitted that the only sanitary districts with no fatalities from the disease during the past three years had been Weybridge and Chertsey. Water

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supplies were not sufficiently safe until the mid-twentieth century when routine sterilization was adopted following a notorious outbreak of typhoid in Croydon in 1937.

Nevertheless, new water supplies were not always received with open arms. It was reported in 1905 that tenants of cottages at Weydon Mill were using river water in preference to that which came through the Farnham Water Company's mains; and when the South West Suburban Water Company proposed to



Interior of the Victoria Reservoir, Farnham, a typical covered reservoir. The photograph was taken during cleaning and renovation in 1999, 100 years after the reservoir was opened.

bring water to Windlesham in the 1890s, the parish responded unfavourably as they were content with their well supplies.⁴ After other unsuccessful moves in 1898, 1900 and 1905, when charges for water were the usual stumbling block, agreement was finally reached in 1910 to accept a mains supply. Again, when Woking Water and Gas Company proposed to lay mains in the parish of Ockham, the Parish Council and the Earl of Lovelace opposed the scheme on the grounds that the general health of the district had not suffered from the existing well supply.

The water companies had been the dominant suppliers since the eighteenth century. Until the Waterworks Clauses Act of 1847 they were authorised by their own special Acts to afford a supply and the new legislation standardised their powers and facilitated the setting up of new companies. At least 25 such companies have existed in the county at one time or another. Most sold out or were taken over for economic reasons or because of resource constraints so that the number was eventually reduced to four.

The sell-out might be controversial, as in the case of the Reigate Water Works Company, established in 1858, which sold its assets to East Surrey in 1896. Reigate Corporation, caught unawares by the deal, tried without success to delay the passage of the enabling Bill through the House of Commons. They also

failed to obtain the resignation of the Town Clerk for failing to inform them of the sale although he was a director of the Company himself. The Corporation then promoted its own Bill with the object of altering the proposed rates and charges, which they considered 'exorbitant to a degree'. This move attracted hostile comment in the press. Eventually a compromise was reached by which marginal differences in the charges for baths and additional water closets were reconciled and a number of public faces were saved.

The East Surrey Company was one of the four which has continued to the present day. Its records at the beginning of the twentieth century illustrate its activities. In 1900 there were 758 new consumers and 42 km of new mains, including a large arterial from Kenley to Merstham via Purley and the first borehole at Purley. The second borehole was ready in 1901 when there were 551 new consumers and 37 km of new mains, including the large main from Merstham to Nutfield.

The other three surviving companies are the South East, North Surrey and Sutton District water companies. Their combined supply areas, which exclude those covered by Thames Water, may represent the highest proportion of supply by commercial companies in any county in England and Wales.

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Besides securing its own supplies, Surrey has been involved in the supply of water to London. In the 1850s, the London water companies were forced to obtain their supplies from the Thames from further upstream, above the tidal range. The Lambeth Water Works Company inaugurated an intake, filters and pumping station at Seething Wells, Surbiton, in 1852 and the Chelsea Water Works Company followed suit in 1856. James Simpson, engineer to both companies, had developed the slow sand filter in 1827 for the Chelsea company and his design was adopted throughout the world. The Lambeth company installed two pairs of Woolf compound beam engines, the first to be used by a London waterworks, and these were followed in 1891 by a Worthington triple-expansion engine. In the 1870s both the Lambeth and Chelsea companies again moved upstream to construct new intakes and storage at Molesey.

Meanwhile the East London Water Works Company had built an intake on the left bank of the Thames at Sunbury and waterworks alongside Hanworth Road. Here, so much water was encountered in the excavations through the gravel that it was decided to collect it by a novel method. Perforated hollow iron piles were driven through the gravel into the underlying clay and connected there to a brick culvert. Water from the gravel passed through the piles and culvert to a well from which it was pumped, together with river water, to the filters.

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The Metropolitan Water Board was established in 1902. Increasing demand made storage necessary to balance periods of low river flow and a series of large reservoirs was built: Staines North and South, commissioned in 1904, Walton Knight and Walton Bessborough in 1907, Island Barn in 1911, Queen Mary in 1925, King George VI in 1947 and the Queen Elizabeth II reservoir in Elmbridge in 1962. As storage also purifies water, the Board decided to pass all London's Thames supplies through the reservoirs. These have earth embankments with central puddled clay cores keying into the underlying London Clay.

Sub-surface sources have continued to be developed. In west Surrey, in the area now supplied by South East Water, wells were sunk in 1963 at Tongham, which had been supplied by the Aldershot Water Company, and in 1970 at Tilford, previously fed by the Wey Valley Water Company. At Fetcham there is a group of ten artesian springs where water issues from the underlying Chalk and is pumped by the East Surrey Water Company to its Elmer Works at Leatherhead.

Surrey's Sewage and Refuse Disposal

Sewage in Surrey, as elsewhere in the country, had been allowed to run into open drains, leaky cesspits or straight into water courses until fairly recent times. The contents of privies and cesspits were simply dumped on to the land. This allowed plagues such as cholera to spread even in rural areas, as happened in 1848 in the village of Windlesham. The first attempts to improve the situation was by local authorities employing night-soil men to collect sewage and cart it to a dump outside the inhabited area. The irregularity of collection would have led to intolerable conditions were it not for influential residents, who unlike those of today lived in the centres of towns, insisting on the regular emptying of cesspits and collection of foul refuse. A parallel situation arose nationally in 1858 when the Houses of Parliament were so affected by the smell of the Thames that they speedily implemented a plan to convey London's sewage to treatment works prior to its discharge into the river. Sir Joseph Bazalgette, engineer to the Metropolitan Board of Works, built five main sewers, two of which ran south of the Thames, through areas then in Surrey and on into Kent, to the southern outfall works at Crossness.

Some of the old unhygienic practices of sewage disposal continued well into the twentieth century. In the 1930s some farms still had privies placed over streams. Even in 1945 at Stanwell, a village now on the border of Heathrow Airport, earth pails were still in use and were emptied on to the land. Some early small isolated sewage works, probably little better than cesspits, though long since disused, are marked on large-scale Ordnance Survey maps. One of these was in Windsor Great Park.

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Real improvement did not start until after the passing of the Public Health Acts in the 1870s. These divided the country into urban and rural sanitary authorities whose duty was to provide good water supplies and proper treatment of sewage. Even then progress was slow because of the difficulty of raising sufficient funds. Nevertheless the volume of sewage was increasing all the time, not only because of the increase in population but also because improving standards of living brought an increase in the use of water closets. Fortunately the general adoption of Thomas Crapper's 'Water Waste Preventor', now the universal type of lavatory cistern, prevented water closets being left to flush continuously and restricted the increase in the volume of sewage. The slow provision of public sewers led in some cases to developers providing their own, as in 1907 at the Ridgemoor Estate in Sunningdale, where however the sewers merely led to the nearest stream.

Some of the earliest sewers were built primarily as drains for surface water and were connected to take domestic sewage illegally, as at Dorking, and considerable pollution resulted. When purpose-built sewers were eventually constructed they made maximum use of gravity to convey the sewage to the treatment works, which were therefore built on the lowest available sites, usually near water courses. Where this was not possible, costly pumping arrangements had to be made to lift the sewage above the level of the treatment works. Sewers also required vents to remove toxic gases such as hydrogen sulphide and inflammable gases such as methane. Sewage vent pipes are widely distributed throughout the county and resemble tall lamp posts without their lamps. Decorative examples can be seen on the London Road at Sunningdale and around Leatherhead.

Sewage treatment plants were built in the county from the 1880s onwards, for example at Frimley in 1884, Woking in 1899 and Camberley in 1907. Dorking Rural Sanitary Authority's system, connected to a treatment works at Pixham, served 95 per cent of the town by 1892 but needed major reconstruction a year later. Lyne sewage treatment works, serving much of the present Borough of Runnymede, was built before the First World War and in 1925 Lightwater sewage works, which also served Bagshot, was completed.

Weybridge sewage works became well known to the public because it was situated beside Brooklands Race Track and featured in the film 'Those Magnificent Men in their Flying Machines', in which an unfortunate pilot crashes into the sludge beds. The works have since been moved to the other side of the railway viaduct.

Early sewage works were extended and modernised, in some cases also to handle refuse and recover waste products. From 1950 to the 1970s, for example, at the Leatherhead sewage works off Randalls Road, refuse was passed along conveyor belts and women, who travelled daily from London, were employed to remove salvageable items. The remainder was composted with sewage sludge, to produce a friable fertiliser for sale.

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Sewage treatment works also exist at Esher, Farnham, Guildford, Hersham, Horley, Merstham, North Camp, Reigate, Wisley and Worplesdon. Some of the county's sewage is however treated outside the county. The works at Staines (formerly in Middlesex), which had replaced direct discharge into the Thames in 1899, was closed in 1936 when the large Mogden Works in Isleworth was built to treat all the sewage of west Middlesex. Unfortunately for the local inhabit-

ants, the treated sludge from Mogden was pumped back to their district at Perry Oaks for final treatment and conversion to 'Morganite', a fertiliser which was sold to the public. Sales were eventually stopped because of the possibility of contamination with toxic metals. In the 1990s Perry Oaks is threatened with closure to make way for a fifth terminal at Heathrow Airport.

Sewage from parts of the Borough of Reigate and Banstead and from Tandridge District is treated outside the modern county at Beddington on a site which has been in use for over a century. Originally the sewage was merely allowed to flow over the ground, being partially purified as it went. Proper treatment plant was installed between 1902 and 1912 and in 1932 was extended to provide for the novel system of using the treated sewage as cooling water in a power station. Methane produced by the digestion of the sewage sludge was used to drive corporation vehicles. In 1966-69 the works were completely rebuilt.

Many of Surrey's disused sand, clay and chalk pits have been used for the disposal of refuse. Croydon Corporation began dumping in abandoned chalk pits at Merstham in the 1960s and in the following decade landfill became national policy and the scale of dumping greatly increased. A disused pit is lined with a plastic membrane to prevent foul water from contaminating the local water table. The refuse can be dumped and compressed down for many years during which water is collected for treatment and methane is tapped off through pipes and either flared off or burnt to produce electricity. When the pit is full it is earthed over and the land can be used for grazing. Numerous large pits have thus been filled in Surrey, leaving little evidence of the industries they once supported.

Gas

William Murdoch, gave the world's first demonstration of lighting by coal gas in 1792. He made the gas by heating coal in an iron retort and passed it through pipes to light his home at Redruth in Cornwall, where he was erecting steam engines for the firm of Boulton & Watt. Later he returned to their Soho Works in Birmingham and in 1801 lit the premises with gas to celebrate the Peace of Amiens. The next major developments were in the London area. In 1812 the Gas Light & Coke Company became the world's first company to supply gas for public use and built works in Horseferry Road, Westminster. In 1813 this supplied the world's first gas public lighting on Westminster Bridge, then on the boundary between Surrey and Middlesex.

The first gasworks in the historic county of Surrey was Munroe & Company's works at Bankside in 1814, and in 1833 the South Metropolitan Gas Light & Coke Company completed its first gasworks in the Old Kent Road adjoining the Grand Surrey Canal, which was used to bring in coal.

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The popularity of gas for both public and domestic lighting grew rapidly and by 1830 there were 200, and by 1850, 800 gasworks in Britain. At that time the main use for gas was for lighting, both public and domestic since, although the design of burners had improved, the production of light still depended upon the luminosity of a non-aerated flame which deposited soot on any surface it touched. The use of gas for other purposes, such as cooking and heating, was made possible by the development of a practical aerated flame by Bunsen in 1855.

The invention of the electric arc lamp with its greater brilliance for public lighting and of the electric incandescent filament lamp for domestic use began to threaten the dominance of gas lighting. The discovery of 'Limelight', produced by heating a refractory substance such as lime to incandescence, led many people to try to adapt this principle to gas lighting. The solution was eventually found by Welsbach, who used an aerated gas flame to heat a mantle containing a mixture of oxides of thorium and other rare earths, to incandescence. This timely invention saved the gas industry from a premature decline.

The growth in the number of gasworks in the early nineteenth century continued until almost every town, village and even some individual buildings had their own gasworks. Inevitably the smallest and least remote of these works were taken over and closed down by larger neighbours, as happened at Bagshot, Chertsey, Chobham, Redhill, Reigate, Sunbury, Sunningdale and Woking. Large isolated premises with their own mini-gasworks included the Royal Earlswood Hospital in Redhill, Holloway Sanatorium, the Wentworth Estate in Virginia Water and King Edward's School at Witley, where remains of the gas-producing plant survive today.

Because of its proximity to London, Surrey never had a major gasworks and drew some of its supplies from Croydon, Wandsworth and Hampton Wick. However there were medium-sized works at Cobham, Dorking, Egham, Camberley, Leatherhead and Walton & Weybridge. The Dorking Gas Light Company, for example, built its works in 1834 to supply public lighting, coal being delivered from Dorking Town station by horse and cart. The works was later extended and in 1928 the company amalgamated with the



Low-pressure storage gasholder at Oxted.

Redhill Gas Company to become the East Surrey Gas Company. Like nearly all gas companies in Surrey, this became part of the South Eastern Gas Board on the nationalisation of the industry in 1948. A new gasholder was built in the Dorking works in 1951 but coal gas production ceased in 1956.

In 1832 the Staines & Egham Gas Light & Coke Company built works on The Causeway at Egham, to become the first of the public utilities on this road, followed by water and electricity. It was later taken over by the Brentford Gas Company which in turn was bought up by The Gas Light & Coke Company. On nationalisation of the industry, this works became the only one in Surrey to become part of the North Thames Gas Board's area. In spite of all these changes in ownership, gas production not only survived but even steadily increased until the 1960s when the district changed to natural gas and production of coal gas ceased.

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The Leatherhead Gas and Lighting Company works opened in 1851 near the site of the future railway station. Coal was delivered by road from Epsom until the railway arrived in 1859. The Cobham Gas Light & Coke Company was bought up in 1912 and the Leatherhead Company itself was absorbed by the Wandsworth Gas Company in 1936. Gas was then supplied to the district from Wandsworth and the Leatherhead works closed in 1938.

On the nationalisation of the gas industry in 1948 there were still over a thousand gasworks in Britain, of which sixty were in the South Eastern Gas Board's



An illustration from *The Graphic* of 1881 showing Godalming's pioneer street lighting.

area which included Surrey, Sussex, Kent and south London. Most of these were closed down in a plan to concentrate production on only four or five sites, none of them in Surrey. The discovery of natural gas in the North Sea in 1960 then saved the gas industry from a steady decline in the face of competition from electricity and cheaper oil. Instead the industry has gone from strength to strength, becoming the nation's most popular fuel for heating and cooking.

The sites of the closed works have generally been redeveloped — Dorking's for example as a modern business park and Guildford's in the redevelopment of the town's riverside — but traces of the industry have not disappeared entirely as some of its most prominent features, gasholders, were retained for the storage of North Sea gas, as at Camberley, Chertsey, Dorking, Egham, Oxted and Whyteleafe. Gasholders, or gasometers as they are popularly known, store gas over

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water and rise and fall with the volume of gas in them, disappearing completely from view when empty. Dry gasholders on the other hand do not visibly change with the volume of gas but have an internal piston which rises and falls. Egham was the only gasworks in Surrey to have one of this type as well as the more common wet gasholders. It was so large that it became a local landmark from its erection in 1928 until 1985, when it was demolished, although the smaller wet gasholders were retained.

Other modern gas installations include valve stations, high pressure mains, whose positions can sometimes be seen from their small concrete marker posts, and at Mogador, north of Reigate, there is a pressure-reducing station for natural gas.

Electricity

Surrey has a particular claim to fame in that, fifty years after Faraday's discovery of electromagnetic induction in 1831, the first public electricity supply in Britain was provided at Godalming.

At the end of September 1881 the annual contract for lighting the town's streets by gas expired. As well as a tender for renewal of the contract from the Godalming Gas and Coke Company in the sum of £210 the Town Council received an offer from Messrs Calder & Barrett, electrical engineers and contractors of Westminster Bridge Road, London. A demonstration was given in which part of the town was lit by a single Siemens arc light and several Swan incandescent lamps, using electricity generated at the Westbrook Mill of R & J Pullman, leather dressers, on the River Wey. The equipment was inspected by the mayor and council on 28 September and on 30 September the council placed a contract with Calder & Barrett to light the town for a year from 1 October 1881 in the sum of £195.

ELECTRICITY GENERATING STATIONS IN SURREY						
Station	Position	Started	Closed	Installed capacity		Survival of building [†]
				Initial kW	Max kW	
Caterham	85 Croydon Rd	1903	1924	88	180	
Dorking	Station Rd	1904	1939	180	1,000	■
Egham	164 High St	1905	1912	*	*	■
Egham	The Causeway	1912	1924	188	680	
Epsom	Depot Rd	1902	1954	220	2,050	
Farnham	East St	1912	1954	180	530	
Godalming	Westbrook Mill	1881	1884	4.5	4.5	
Godalming	Borough Rd	1902	1949	380	600	■
Guildford	Onslow St	1896	1913	60	750	
Guildford	Onslow St (extn)	1913	1927	1,100	1,610	■
Guildford	Woodbridge Rd	1927	1968	7,500	11,250	
Hindhead	Tower Rd	1901	1953	38	925	■
Leatherhead	Bridge St	1902	1941	75	2,210	
Reigate	Wray Common Rd	1901	1936	230	2,742	■
Weybridge	Church Walk	1890	1896	70	70	■
Weybridge	Thames St	1902	1922	180	780	
Woking	Board School Rd	1890	1959	40	7,000	

Source: Garcke's Manual of Electrical Undertakings.
 *This station does not appear in the published statistics but a contemporary report states that the machinery is 'sufficient to light several hundred lamps' (Egham and Staines News, 1 April 1905).
 †In 1997.

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The scheme included three arc lights in the town and three in the mill and 27 Swan lamps in the town and seven at the mill. A Siemens alternator with a capacity of 4.5 kW was installed in the mill. Motive power was provided by first one, and later two, waterwheels which were provided by Pullmans in exchange for lighting the mill and mill house. The significance of this hydro-electric installation at Godalming lies in the fact that as well as providing street lighting and serving the mill, it was also intended to make the supply available to the public. The first public supply was taken from this system before the end of the year.

Problems arose with voltage drop in the conductors feeding the lamps in the town, and there were also difficulties with the waterwheels when the river was in flood. By the end of 1881 the generating plant had been moved to a shed at the back of the White Hart inn where it was driven by a steam engine.

In the following April Calder & Barrett withdrew and the Council entered into a contract with Messrs Siemens to light the Borough for 12 months. They improved and extended the installation but by 1884

Siemens declined to tender as the demand was insufficient for them to extend the system to a viable capacity. So from May 1884 the street lighting of Godalming reverted to gas, and the private electricity consumers lost their supply, although it appears that private generation continued at the mill.

In the year after the Godalming project began, the Electric Lighting Act, 1882, was passed. This enabled the Board of Trade to authorise the supply of electricity by any local authority, company or person and to grant powers to install a system of supply, including powers to break up streets. Licences, which could not be granted without the consent of the local authority, were to be for periods not exceeding seven years, although they could be renewed. Alternatively the Board of Trade could grant a Provisional Order for an undertaking, although the Act gave local authorities the right to take over the assets of companies after a period of 21 years. Overhead lines could only be erected with the consent of the local authority. Because of the right to buy by local authorities, who would pay for the plant but not the business, there was little enthusiasm for starting undertakings. How-



The Electric Theatre, Guildford, formerly the 1913 electricity works.

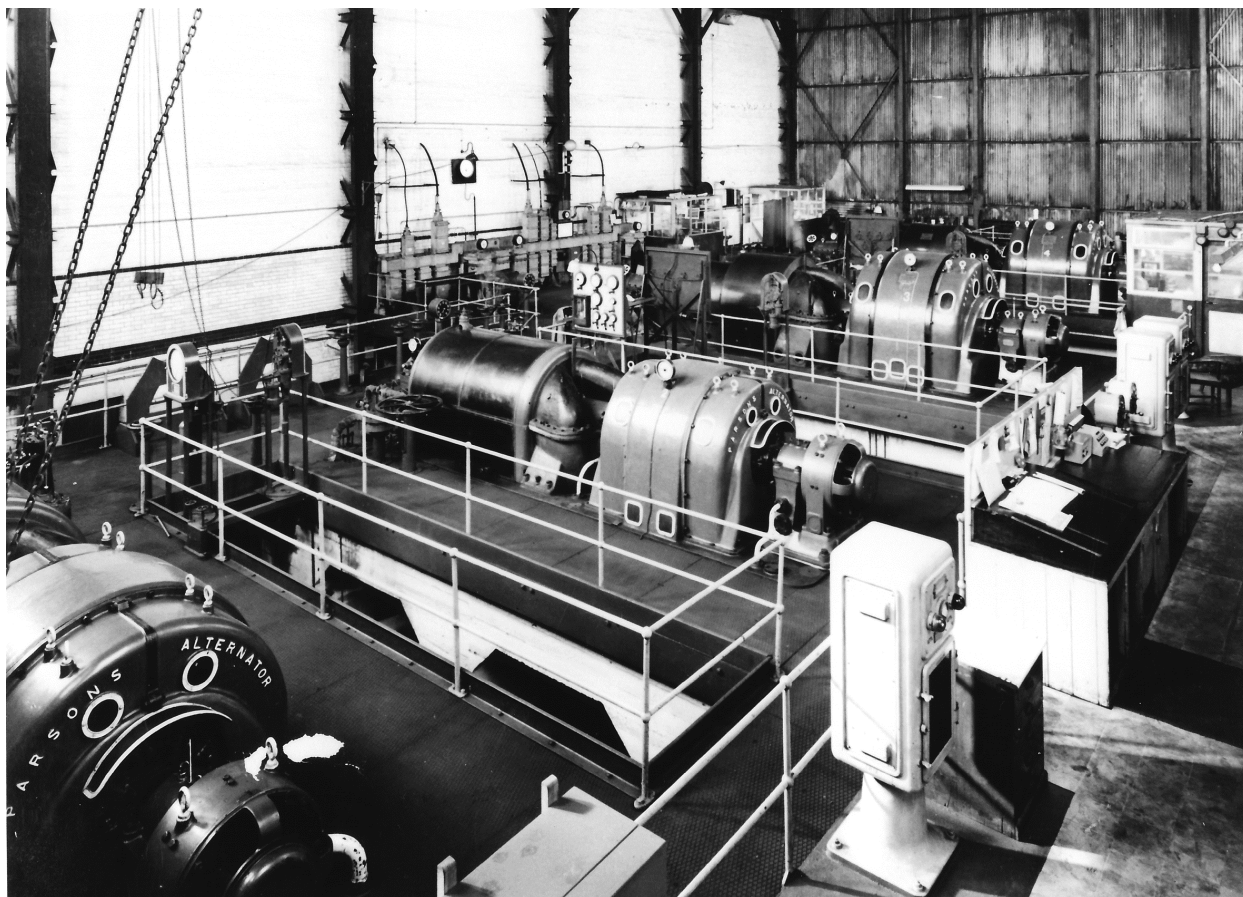
ever, the Electric Lighting Act of 1888 extended the period after which the purchase right could be exercised to 42 years and required the undertaking to be valued as a going concern. Consent was now required from the Board of Trade for the erection of overhead lines. These provisions and the increased availability of incandescent filament lamps resulted in a number of applications for Provisional Orders by local authorities and private companies. Many were cancelled or transferred while finances were sorted out before any electricity was supplied. Each of the early undertakings built small generating stations with a capacity to supply only those consumers in their immediate vicinity. Plant was extended as demand increased and as provisional orders were received from a wider area.

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The supply voltage varied from undertaking to undertaking, with some generating direct current (DC) and others alternating current (AC). A DC system could be operated in two shifts, with the station batteries maintaining the night load. In AC generation, the use of transformers allowed higher voltage distribution so that the station could be further from the load. Most early stations were steam-driven by reciprocating engines, but many of the smaller ones converted to diesel plant before they eventually closed down. Some stations, including Farnham and Egham, were diesel-driven from the start.

After the demise of its pioneering scheme in 1884, Godalming was without a public supply until a station was opened in Borough Road by the Urban Electricity Supply Company in 1902. This station had steam-driven dynamos giving an output of 380 kW in its early years but, interestingly, in 1922 a 20 kW water-driven set was added so that once more the Wey at Godalming was producing electricity.

Weybridge also has a claim to distinction as the first town in England to be wholly lit by electricity using incandescent lamps. Its generating station, built in 1890 adjacent to the River Wey in Church Walk, contained a water-tube boiler and duplicate steam-driven 35 kW alternators generating at 1,000 volts. Power was distributed throughout the town using about 6 miles of overhead lines supplying 111 incandescent filament street lamps as well as a number of private consumers. The plant closed down in 1896. Problems were caused mainly by objections to the overhead lines and the decision of the newly-formed Weybridge Urban District Council to enter into a contract with the Walton-on-Thames Gas Co Ltd for street lighting in Weybridge. Part of the generating station in Church Walk was converted to cottages in 1898 and the building still survives in the 1990s. Electricity generation returned to the town in 1902 when the Urban Electricity Supply Company Ltd opened a new station in Thames Street. This was in operation until 1922, by which time a bulk supply was available from Twickenham and the Weybridge station was demolished.



Interior of the power station in Woodbridge Road, Guildford. *Amberley Museum.*

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Another station which came into operation in 1890 was in Board School Road, Woking. This had duplicate 20 kW AC machines which only operated from sunset to sunrise. Its capacity increased until it closed in 1959 with 7,000 kW of plant; it was always steam-driven but the final machines were all turbo-alternators.

Guildford's first station was built in 1896 at the old militia barracks in Onslow Street by the Guildford Electric Supply Company with an initial installed capacity of 60 kW. An extension was built adjacent to the works in 1913. The system became unreliable and, after pressure from local businesses, in 1921 the company was taken over by the town Corporation. A completely new station was built in Woodbridge Road and was in service by 1927. This had turbo-alternators and an eventual installed capacity of 11,250 kW, although the building was designed to be extended to have an ultimate capacity of 42,000 kW. This station operated until 1968 after which it was demolished. The 1913 building, with the legend '1913 ELECTRICITY WORKS' on the wall facing the River Wey, was converted to a theatre — named the 'Electric Theatre' — by Guildford Borough Council in the 1990s.

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The new Guildford generating station was the largest in the modern county and the last to be available to generate. Other larger stations at Kingston and Croydon, both in historic Surrey, have now been closed for some years and have been demolished.

The increased demand for electricity caused by the First World War highlighted the deficiencies of a number of undertakings, and soon afterwards the Electricity Supply Act (1919) was passed. This established the appointment of Electricity Commissioners with the duty of 'promoting, regulating and supervising the supply of electricity'. The commissioners established Electricity Districts and hoped to set up regional schemes for centralising generation in a relatively small number of larger stations owned by joint Electricity Authorities (JEAs). The London and Home Counties JEA, set up in 1925, included a large part of Surrey. The scheme had only limited success however as the JEAs had no compulsory powers.

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By the 1920s there was pressure to establish a transmission network for the whole country to concentrate generation at the most efficient stations and, at the same time, improve the security of supply. In 1925 the government set up the Weir Committee to review the national problems of the supply of electrical energy. This committee proposed the establishment of an

independent body, the Central Electricity Board (CEB), with the duty of constructing a 'gridiron' of transmission lines, which became known as the National Grid. This interconnected selected power stations and the various distribution systems. The stations were operated by their existing undertakings but under the control of the CEB, which purchased the electricity generated in the selected stations and sold it to authorised suppliers. It was suggested that about 430 non-selected stations would close. The committee's recommendations were incorporated in the Electricity (Supply) Act of 1926. Basically, the scheme enabled power stations to be interconnected with 132 kV ring mains, while transforming stations fed lower voltage (66 kV and 33 kV) secondary systems.

Surrey was part of the South East England Electricity Scheme, initially with two 33 kV rings, one connecting Croydon with Epsom, Leatherhead Dorking and Reigate, and the other connecting Guildford with Woking, Godalming, Farnham, Hindhead and Aldershot. A 132 kV substation, Woking Grid, was established at West Byfleet in 1932 with 132 kV connections to Luton via Willesden and to Wimbledon via Uxbridge. At the same time a 132 kV substation was put in service at Croydon on the Wimbledon-Northfleet line. The security of the Epsom ring was improved in 1937 when a 132 kV substation was built at Leatherhead in the Woking-Wimbledon line.

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Before the CEB system was in place, a few small power stations had closed when bulk supplies had been obtained from neighbouring undertakings, such as at Egham, Weybridge and Caterham. However, once the grid system was established most of the tiny stations began to run down and none has operated since the 1970s. Some undertakings, such as those supplying the Camberley and Horley areas, never generated their own power but bought it in bulk from the start.

The industry was nationalised in 1948, and the first post-vesting station in the country, at Kingston, was put into service in the same year.

By 1949 it was realised that the grid system of the 1930s would be inadequate, and in 1950 it was agreed to construct a 275 kV supergrid to be superimposed on the 132 kV system. Later, in 1962, plans were in hand for the 400 kV supergrid system, the first line being commissioned in 1963. The only substation with 275 kV or 400 kV connections in Surrey is one at West Weybridge which was put into service in 1957.

The Central Electricity Board set up its research laboratories at Leatherhead during the Second World War. The high voltage test line built by the Central Electricity Generating Board still remains and is now used by the National Grid Company. Following privatisation



High voltage electricity transmission lines at Weybridge.

the industry was split into a number of competing companies but the transmission system continued to be operated as an integrated network. Thus the power generation for public supply in Surrey started with a small hydro-electric station at Godalming, went through a period when most towns had their own small power stations which were gradually closed as the transmission facilities developed, until in the 1990s no electricity is generated closer than the Thames estuary.

Before public supplies became available, many factories and large houses had their own electricity generators, and in rural locations many kept their ment in operation well into the 20th century. For example Dennis Bros' motor works in Guildford had a power house built in 1915 containing four diesel-driven generators which was still operating sixty years later. In fact, another 'first' claimed for Surrey in the history of the use of electricity was at the Ferry Works, Thames Ditton, which is reputed to have been the first factory in the world entirely lit by electricity. It was occupied from 1880 by Willans & Robinson, whose high-speed steam engines were used for driving dynamos for early supply systems.



Chatley Heath semaphore tower, restored and re-opened in 1990, showing (a) the exterior and (b) the operations room.

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Communications

ADMIRALTY TELEGRAPHS

Communication lines between the Admiralty in London and the naval dockyard in Portsmouth ran through Surrey. Mechanical means of signalling, first by shutter telegraph and then by semaphore, were used in the first half of the nineteenth century.

The Shutter System

At the time of the Napoleonic Wars the Admiralty began to see a need for speedy communication with its naval bases around the east and south coasts of England. Following the development of the visual telegraph system by the Abbé Claude Chappe in France, a competition was held resulting in a network being built to the design of another cleric, the Reverend Lord George Murray.

The system between the Admiralty in London and Portsmouth dockyard came into operation in 1796. It employed a chain of ten huts sited at high points of mutual visibility. At each site there was a gantry above the hut supporting a series of six panels or

shutters that could be opened or closed by ropes or chains from inside the building, somewhat in the manner of venetian blinds. The pattern formed by a group of panels was used to represent a particular letter of the alphabet or a number, the changing patterns allowing messages to be sent along the chain of stations. A look-out with a telescope would watch to see what settings were being made by the neighbouring station, and call these to an operator who would set the same pattern to be repeated down the line.

Four such stations were established in the Surrey section of the route at Putney Heath, Cabbage Hill (Maiden Rushett), Blind Oak Gate on Netley Heath and Telegraph Hill, Hascombe. Nearer the coast a branch left the London to Portsmouth route for Plymouth.

Despite some limitations, such as mechanical problems, the misreading of some characters and the fact that it could only be used during daylight in periods of good visibility, the shutter system worked reasonably well until 1816, when hostilities ceased and it was dismantled.

The Semaphore System

Already in 1815 an Act had been passed for the establishment of a permanent system, and in 1818 surveying began for a new line which opened in 1822. This comprised fifteen stations which employed the semaphore principle of signalling as proposed by Admiral Sir Home Riggs Popham. They were brick-built, mostly single-storey houses but with some taller buildings and a few towers. Atop each building was a mast on which two arms were pivoted, one above the other, their positions representing characters as in naval hand-flag signalling. The masts were hollow and hexagonal in cross section, about 50 cm across and mostly about 9 metres high above the roof of the building. The arms were 2.5 metres long and 37 cm wide, pivoted at one end at points 3.7 metres up the mast and at its top. They could be 'parked' in the mast casing when not in use. In some cases the arms may originally have been moved by chains but by 1828 an arrangement of cranks, bevel gears and rods was employed at all sites. By means of a worm and pinion the cranks also drove pointers in the operations room to indicate to the operator the positions of the arms above. These mechanical parts were manufactured and maintained by Maudslay & Field.

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The semaphore line to Portsmouth ran a little to the west of the route of the earlier shutter system, with stations in Surrey at Putney Heath, Kingston Hill, Cooper's Hill (Hinchley Wood), Chatley Heath, Pewley Down (Guildford), Bannicle Hill near Witley and Haste Hill (Haslemere). Construction of a branch line was begun in 1825 to run between Chatley Heath and Plymouth. Stations were built at Worplesdon Glebe and at Poyle Hill on the Hog's Back near Tongham, but none were equipped, nor was the line completed, and the Plymouth branch was abandoned in 1831. Although never used 'in anger', the London-Portsmouth route continued in operation until 1847. It was then overtaken by the electric telegraph which had the distinct advantage of being able to operate by night or day, and in all weathers. Uniquely, one of the original semaphore stations remains at Chatley Heath and is open to the public. The tower building has been completely restored and preserved by Surrey County Council, with a fully operational semaphore signalling mechanism and descriptions and demonstrations of the shutter and semaphore systems. It received the SIHG Conservation Award in 1990. The houses at Cooper's Hill and Pewley Hill survive in private occupation.

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ELECTRIC TELEGRAPHS AND TELEPHONES

The first practicable electric telegraph system was introduced in 1837 by Cooke and Wheatstone, who used a system of pointers to send and display the letters

making up a message. It was adopted by the newly-developing railway companies and the first publicly available line opened in 1838 between Paddington and West Drayton on the Great Western Railway. At about the same time Samuel Morse invented his telegraphic code, which was to become the accepted standard. The telegraph network expanded so that all the towns in Surrey and most larger villages had a telegraph office, often at the local Post Office.

In the USA Alexander Graham Bell patented his telephone in 1876. Britain's first public telephone exchanges, where connections between subscribers were made manually, came to London three years later. Others followed throughout the country and were operated by seven main companies and the Post Office. The National Telephone Company was formed on the merger of six of those companies in 1885 and was itself taken over by the Post Office on 1 January 1912.

Connections

Early telegraph and telephone connections between subscribers and central exchanges or offices were made with bare copper wires, supported by wooden telegraph poles. The overhead wires ran beside railway lines and roads and presented many problems of maintenance and vulnerability in poor weather conditions. They were also unsightly and the poles were often difficult to place in densely populated areas. Reliable forms of insulation allowed the wires to be placed below ground and, in towns, they came to be accommodated in glazed earthenware ducts for much of their route, rising above ground only for local connection. Covers giving access to the ducts are to be seen everywhere on roads and footways throughout the county.

Because of the relatively high cost of burying copper wires in underground ducts, overhead lines continued to be used for connections between towns and cities, but various means were developed to permit a number of conversations to share one pair of wires. Later, multi-channel carrier systems employing radio techniques enabled many telephone conversations or telegraph messages to be grouped together and passed over one coaxial cable circuit. With repeater stations en route to provide signal amplification and correction, longer distance underground connections became more viable.

In the late 1940s, microwave radio allowed many carrier groups to be taken out of the ground and combined on to radio circuits with the capacity to carry hundreds of individual conversations. These systems required tall masts to permit the necessary line-of-sight linking between stations, and a network of these developed which continues to provide the means of distributing telephone, TV and data signals. A typical example of a microwave radio relay site is at Old Dean Common near Bagshot, with its massive lattice tower supporting the highly directional parabolic dish and horn aerials.

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Epsom Telephone Exchange

The development of the telephone service can be illustrated by the example of the Surrey town of Epsom, where the UK's first automatic public telephone exchange opened in 1912. The first public telephone service in the town had been set up in 1893 by the National Telephone Company, using a manual magneto system, initially of 100 line capacity. In 1905 the General Post Office (GPO) opened a rival exchange with a similar initial capacity, but employing central battery signalling (CBS).

On 1 January 1912, the Post Office took over the National Telephone Company to become the monopoly telephone service provider in Great Britain. The 'Ex-National Company' subscribers in Epsom were transferred to the GPO exchange, enduring duplicate sets of apparatus during the transition. All connections between subscribers had been effected manually by human operators but on 18 May the automatic exchange went into operation, replacing the manual system and serving 340 subscribers from the Post Office premises in Station Road (now Upper High Street).

The exchange equipment was two-wire Strowger type, initially of 500-line capacity but ultimately capable of handling 1,500 lines, which together with the subscribers' apparatus was supplied second-hand by the Automatic Electric Company of Chicago. It was installed by British Insulated & Helsby Cables Ltd, whose Automatic Telephone Manufacturing Company of Liverpool had recently been formed, with patent rights from the Chicago company to become the first manufacturer of automatic telephone equipment in the UK.

The system was seen as experimental, to allow GPO engineers to assess the operation of such features as public coinboxes, trunk connections, charge meters and subscribers' foibles. Epsom was chosen for the trial as it offered the most suitable conditions. It was near HQ, it already had direct connections to the manual exchanges at London Central, Croydon and Sutton and a 'long distance' line connection with Leatherhead and its manual exchange had the highest

percentage of local traffic of any London Post Office exchange. Epsom was also considered suitable for testing the economic 'break point', judged to shift from manual to automatic systems at about 500 lines, and was expected to show the effect on automatic switches when they were subjected to high rates of calls, such as would be experienced during the races, especially on Derby Day.

Epsom automatic exchange remained in operation for twenty years but, according to a policy of limiting automatic working to the area within 10 miles of Oxford Circus, on 20 July 1932 the Epsom system reverted to manual operation from new exchange premises which had been built in East Street. Thus it remained until 6 October 1965 when automation was restored with full Subscriber Trunk Dialling (STD) facilities, 999 emergency calls and the Speaking Clock, TIM. In the 1990s the system is mainly electronic and provides the full range of British Telecom services. Both of the original exchange sites in Epsom have been redeveloped.

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CABLE COMMUNICATIONS

The 1990s saw the introduction of cable communications in Surrey. By means of an underground network of copper, broadband coaxial and fibre-optic cables, as many as sixty TV channels together with fm radio and telephone services may be supplied to homes and businesses in an area. Familiar to many will be the roadside local distribution cabinets that have sprung up in the county over the past few years.

At the heart of the network is the main centre or 'head end' which is equipped to receive broadcasts from a number of sources, and to redistribute them. The centre will also house the control processing equipment and, possibly, local programme production facilities. There would also be a digital telephone exchange or switch for connecting local subscribers in the area, and equipment to link to the networks of other service providers.

In 1997, four companies held franchises to provide cable communications services to most of the county.

Notes

1. Information has been kindly provided by the East Surrey Water Company, Thames Water and British Telecom Archives.
2. Swanton, E W & Woods, P, *Bygone Haslemere* (1914), 279-82; Robinson, M, *Old Letter Boxes* (Shire, 1987), 9-11.
3. Tarplee, P, *Abinger and the Royal Greenwich Observatory* (SIHG, 1996).
4. Smith, E, *Edwardian Farnham* (1979), 98; Eedle, Marie de G, *A history of Bagshot and Windlesham*, 198.

Chapter 10

SURREY'S DEFENCES

Remains of defence works can be seen in Surrey, from prehistoric hill forts, through the castles still to be found in several towns, to the mobilisation centres of the 1890s and the camps, pillboxes, buffer depots and airfields of the twentieth century.

The London Mobilisation Centres

These were part of a line of defence to the south and east of London which was planned in response to public fear of invasion but was never completed. These may often be seen on Ordnance Survey maps marked as 'old fort' or 'fort dismantled' but they were not forts and are not all dismantled.

Although most European capital cities already had their ring of defensive forts around them, London did not see the need for this as it had always been assumed that the Royal Navy could adequately protect our shores. However, during the 1880s doubts began to be expressed about their ability to do this and Colonel (later General) Edward Hamley MP prepared a plan to defend the capital which was put before Parliament in 1889.

The scheme was for an entrenched line 72 miles long to have been dug by the London Volunteers once a warning was received. In preparation for this the government arranged for a series of storehouses, known as 'mobilisation centres', along the route of the line, to be built, and it is these which became known as forts. They may often be identified by street names such as Fort Road. These buildings were used as stores for tools and materials for digging the entrenchments as well as for storing munitions to be used by the troops who would man the defences. They were really magazines which had some potential for defensive use.

South of the Thames mobilisation centres were built from Guildford to Farningham, and north of the river from the estuary round to North Weald. It was felt that the way to London along the Thames was adequately guarded by permanent forts which had been built about 20 years earlier. There were nine 'forts' in Surrey, built between 1893 and 1902, from Henley Grove in the west, Pewley Hill, Denbies, Box Hill, Betchworth, Reigate, Alderstead and Foster Down to a pair of artillery magazines at Woldingham, one of which has a house built upon it. They were usually positioned so as to have a view suitable for infantry or artillery positions in the event of an attack from the south.

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All the forts still exist except that at Denbies which was demolished in 1970. All the centres had brick-built caretakers' cottages and stores, most of which remain. The easiest installation to see is that at Box Hill where the cottage and store form the National Trust café and information centre while the fort itself, together with appropriate interpretation boards, may be seen behind these. Reigate Fort is now cared for by the National Trust and is open to the public.

By 1905 the scheme was abandoned and the centres were sold, often to the original owners of the land, and they are re-used as stores, youth centres or homes, or are derelict.

Twentieth Century Defences

The most numerous defensive features date from the twentieth century and these are also the most obvious.

Dating from the First World War there are systems of training trenches such as that at Old Park, Caterham, though many others probably await recognition for what they are. Anti-aircraft emplacements and camps, such as Woodcote Park near Epsom, are easily confused with their counterparts from the second global conflict which were often in the same locations. A large example of the latter type, the Canadian Forestry Corps camp, was to be found in Windsor Great Park, complete with a fully operational sawmill which produced wooden huts for other camps at home and overseas. On this site, too, aircraft were assembled and flown from Smith's Lawn.

Among civilian establishments requisitioned for war service was the National Rifle Association camp at Bisley. This also served during the Second World War, when many more temporary camps were set up, many under canvas, as the build-up of forces for D-Day got into full swing. Then even some of the county's roads, for example Mickleham by-pass, were used as temporary vehicle parks. Other sites to be found gently decaying include ammunition dumps such as those at Ranmore Common and Leith Hill. Among the more unusual wartime uses of civilian sites — of which little evidence is left — was the utilisation of Wanborough Manor House near Guildford as a Special Operations Executive (SOE) training base for agents who went to the continent to help European resistance movements.



Anti-tank gun emplacement, Moor Park, Farnham.

As the time for the invasion of 'Fortress Europe' approached, once again the county took on a largely Canadian flavour as Canadians made up the majority of the troops based in this part of southern England. One of the largest camps, called Tweedsmuir, was set up on Thursley Common in the west of the county; its outline is still clearly visible. Just down the road at Elstead, a tank regiment was based with its vehicles secreted under the many trees around the village. Part of the headquarters occupied a house by the village green which is still marked with loopholes in the garden wall.

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Loopholes are to be found throughout the county, too, in some 2,000 pillboxes which are still extant in the 1990s. These, in a wide variety of designs and variants, lie largely on the GHQ Line which passes west to east through the county following any available defensive line. A particularly fine example of their use is around Sidlow Bridge, south of Reigate, where some eleven pillboxes cover the river crossing in two rows, the first close in and the second further back in the edge of surrounding woodland. Where existing defence lines were not to be found, anti-tank ditches were dug which have largely become invisible through agricultural activity and development but are occasionally mistaken for archaeological evidence of

earlier crop marks. At points where defence lines crossed roads and byways, concrete road blocks are often to be seen, though other obstacles such as lengths of steel rail have virtually disappeared.

Most of these works were to have been manned by regular troops but the Home Guard would also have played a part and evidence of their activities can occasionally be found in such things as mountings for their spigot mortars, the Blacker Bombard. An example at Farncombe, Godalming, is used to support a fence post. Auxiliary units, though ostensibly part of the Home Guard, were the British Resistance, and a number of their hideouts still exist, though often partly demolished as in the case of one behind the Rural Life Centre at Tilford. Other pillboxes were erected in rings around strategic sites such as army garrisons, camps and airfields; examples protecting airfields are still to be found at Redhill and Fair Oaks.

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Also of strategic importance were the many operations rooms for the RAF and command bunkers for the government or military planners. The former were sometimes located in town centres, as in the empty butcher's shop in Godstone Road, Caterham, while the command bunker below Wentworth golf course at Virginia Water has been re-used for storage.

The Cold War of the 1950s and 1960s led to the building of buffer depots, like those at Betchworth, Redhill and Shalford, to store a regularly changed emergency food supply around the county from which rationed supplies were to have been issued following a nuclear attack. Numerous new bunkers were also built beneath the county for various purposes, from regional government centres to fallout-monitoring posts. Despite the warming of East West relations, many remain although decommissioned. Nevertheless their locations are not generally known and, save the Royal Observer Corps posts, such as that at Clandon, will provide opportunities for research by future generations.

Airfields

During both World Wars, Surrey played a significant role in the defence of the country. Although during both conflicts civil and personal flying were severely restricted, technical developments in aircraft, engines, radio and navigation aids were accelerated as a result of wartime investment.

In 1914 Brooklands was the premier flying training field in the country, with ten schools turning out more trained pilots than any other airfield. At the outbreak of war, Hugh Locke-King, the owner and creator of Brooklands, immediately offered the site to the government. The War Office took over on 5 August and the Royal Flying Corps (RFC) designated Brooklands as an Aircraft Acceptance Park to receive new aircraft for military purposes.

The RFC at the outbreak of war had only five squadrons, with 125 planes and 1,100 officers and men. Official government policy was that there was no conceivable role for the aeroplane in war, and initially it was used only for reconnaissance and spotting for the artillery. By 1918 however, Britain was producing 3,500 planes a month, many of them either built at Brooklands or manufactured locally and flown from there.

Number 8 Squadron RFC was formed at Brooklands in January 1915 and completed training there before flying its B.E.2C aircraft out to France in April. A .303 Lewis gun was mounted in the nose cockpit of a Vickers Gunbus at Brooklands and is credited with shooting down its first German plane, a Taube mono-plane, over southern England on Christmas Day, 1914.

In late 1915, to counter the Zeppelin raids on London, a number of defence airfields were established. Those in Surrey were at Beddington by Croydon, the neighbouring field at Waddon, at Hurst Park racecourse, on Wimbledon Common and at Kenley by Warlingham.

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Kenley remained in RAF service up to 1965 as a fighter station. In the Second World War it played a major part in the Battle of Britain, as did the civilian aerodrome at Croydon which was taken over by Fighter Command. Gatwick did not have an active role during the Battle of Britain but was itself bombed several times, though without damage or casualties. Number 29 Army Co-operation Squadron arrived in September 1940, the first of many based there for the remainder of the war. Squadrons, including a Canadian one flying Mustangs, played a major role in the build-up to the invasion of France in 1944.

Croydon became a fighter base with Hurricane squadrons and was attacked a number of times by the Luftwaffe. Thursday 15 August 1940 was 'Black Thursday' when, at 6.15 in the evening, the airfield was heavily bombed, as were Kenley and Biggin Hill. Hurricanes of 111 Squadron shot down several Dorniers but damage to the airfield, and particularly to the adjoining industrial estate, was heavy, and some hundred casualties were reported. The press next day referred to 'scarred but cheerful Croydon'.

Several emergency and dispersal airfields were set up, usually without a permanent runway or buildings, at Horne, Fair Oaks, Lingfield, Egham, and again at Hurst Park. In 1942 the Canadians constructed an airfield at Dunsfold, where Mustangs and Mitchells, including a squadron of the Royal Dutch Naval Air Service, flew many sorties before and after D-Day over the English Channel and into France, afterwards continuing to provide support for the Arnhem and other campaigns.

Chapter 11

ENTERTAINMENT



A film crew at work at Nettlefold Studios, Walton-on-Thames, c. 1929, with the film director Walter Forde on the left. *Elmbridge Museum*.

Surrey's proximity to London has again been a factor in the development of the entertainment industry, in its relation to the London theatre, in the location of film studios and in the prominence of Epsom as an early spa town and centre of horse racing.

Theatre and cinema

The 20th century is one in which entertainment has become an expected 'right', due to everyone. Previously, a visit to the theatre, the most common way of passing the time, was a rare pleasure, until the public houses of London offered live entertainers to cajole customers within their doors and gradually turned into the music halls. The theatres which had been in the main line of descent from Shakespeare's 'Globe' continued to offer plays debating ideas and character, but it is this type of theatre that has suffered a disastrous decline. London theatres were hit badly by the fall in attendances but provincial theatres suffered from the spread of the cinemas during the 1930s and 1940s and, in turn, the cinemas were hurt by the universal spread of television so that few remained in our towns.

Theatres have been judged to be out of touch with the lives of the working and middle classes and their expensive salary bills have made them uneconomic for the entrepreneurs to persevere with them as audiences have declined. Cinemas were seen to have more opportunities to make profits, This resulted in a decimation of the number of buildings (mostly 19th century) offering live entertainment, jollity or ideas.

Guildford has had four professional theatres in its time — the Market Street Theatre, the Theatre Royal, Guildford Repertory Theatre and the Yvonne Arnaud, opened in 1965. The last was part of a remarkable phoenix-like resurgence of theatre building in Surrey which also accounted for the Redgrave in Farnham, the Thorndike in Leatherhead, the New Victoria in Woking, the Harlequin at Redhill, and the Playhouse at Epsom. Though the Guildford Theatre has fed the London West End with many successful 'home-grown' productions and despite the fact that a lot of stars live within Surrey, yet a bleak future seems to face the modern generation of theatres without sufficient audience support and financial backing from the Government.



Staines art deco film centre.

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Old industrial premises have sometimes been converted for use by theatres, particularly community theatres, though the professional Yvonne Arnaud has used the adjacent town mill first as workshops and then as an auditorium. The small Bellerby Theatre was created in the 1970s in a former iron works in Leapale Lane, Guildford, and the 1913 Guildford Electrical Supply Company building by the river was converted and extended to form the Electric Theatre in 1996. Both are among a variety of adapted premises used by the Guildford School of Acting, which in the 1990s is gaining a reputation for excellence.

Interestingly, it is possible to make out a case for Surrey as the original birthplace of the cinema. Eadward Muybridge (as he became later known) was born as Edward Muggerridge in Kingston upon Thames but emigrated to America in 1852 and became one of the most celebrated photographers there. Having accepted a large bet from the Governor of California, he started experiments to determine whether a running horse has all four legs off the ground at the same time by using 24 cameras each attached to a trip wire. Later he invented the zoopraxiscope to project these moving images on to a screen for an audience. In so doing he had laid the foundation of the cinema, a new method of entertaining people.¹

The earliest cradle of English film making was probably in Surrey. The location of film studios in Great

Britain was most frequently found in London and the Home Counties, often because of the availability of electricity but also because London offered a source of capital, actors, film stock and apparatus. In 1899 Cecil Hepworth, having searched the Thames Valley for a villa in grounds with power laid on, started making films in Hurst Grove, Walton-on-Thames, an ideal house in which he installed a generating set powered by a gas engine for his studio's needs. Many of his early short films were no more than exercises in trick photography but he soon turned to story films, including 'Alice in Wonderland' (made in 1903 in the gardens of Mount Felix) and 'Rescued by Rover' (1905, the best known of all his films) in which all the parts were played by Hepworth, his family and his dog. It is amusing to think that Weybridge and Walton-on-Thames served as a location for many Westerns made by Lewin Fitzhamon round about 1905. Many of the actors and actresses in his films went on to become the film stars of the 1920s and 1930s.

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After Hepworth became bankrupt in 1923, his studios were taken over by Nettlefolds who continued to produce films until the mid 1960s. Walton Studios has now become a shopping centre and the name 'Hepworth Way' commemorates the great days. However, the old powerhouse of the studios was turned into a public hall and survives as 'The Playhouse' in

Hurst Grove. In the historic county of Surrey, Croydon's contribution to the history of the cinema was also considerable. Like Walton, Croydon in those days was near enough to London but surrounded by interesting countryside. The Clarendon Company built their studio in Limes Road, Croydon, in 1904 and made one short comedy film per week in premises well in advance of their time — a large glass roof and sliding doors for the main stage, plus electric light! Although they made many historical and melodramatic films, the company failed after the First World War. The premises were taken over by other film companies — Harma and Associated Exhibitors Film Company — but eventually became the premises of an electrical engineer. The more famous firm of Cricks and Martin created elaborate studios in Waddon New Road, Croydon, in 1908 and made comic, industrial and educational films. By 1910 they employed more staff than any other film company in Great Britain. They used a lot of location shots and they also introduced the happy ending. Despite their actuality films and large spread of dramatic subjects, they folded in 1915 and although the Gaiety Company, who made comedy dramas and shorts, made a gallant attempt to continue, film making ceased there and the buildings became a garage.

In 1928 the Littleton Park Estate in Shepperton was bought by Sound City Films for use as film studios. By 1932 five films had been made including Alexander Korda's famous 'Sanders of the River' in which the tiny River Ash became a mighty river. By 1936 the studio had expanded to include seven sound stages, twelve cutting rooms, three viewing theatres and a building converted into a hotel. In 1946 the studios were taken over by British Lion under Korda; from then until 1970 there followed the most prosperous days of the studios and the British film industry. At Shepperton over 350 films were made, including 'The African Queen' 'The Third Man', 'The Wooden Horse', 'Cockleshell Heroes', and 'Oliver'. A decline in the studio's fortunes followed until the rock group The Who bought it and called it Rock City. In 1972, Spelthorne Council bought a large part of the site for housing but filming still continues by Lee International Studios, mostly for television, on the reduced site.

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After reaching its high point during the Second World War, film-going declined from the 1950s onwards and so cinema buildings started to disappear from our streets, although many of the premises still exist in a different role. As an example, Godalming has had three buildings serving as cinemas. The first, known popularly as 'Fudger's' after its proprietor, was little more than a corrugated iron shed. Although known in

its time as the Electric and the Empire Palace, it became used for commercial concerns, especially of a light engineering nature, and is empty at the time of writing. What opened as the Odeon Cinema in the 1930s became a food supermarket and the Regal, whose exterior, in keeping with the style of the old town, was stated to be approved by Lutyens,² ceased to show films in the 1970s. It became a bingo hall, lost money with the decline of this popular pastime, and has been demolished and the site used for a block of luxury flats. Staines has lost the Empire Cinema (which became a toy shop and a cobbler's), and the Majestic (demolished in 1961) but was lucky to retain the MGM Film Centre, with three screens. Ashford was unlucky to lose not only two cinemas but even its swimming pool. The same sort of story can be repeated in every town and city of this country. Mostly supermarkets have taken over; bingo has run its course too; at least Weybridge had a church converted from a cinema when The Odeon became St Martin de Porres Roman Catholic Church but this, in turn, closed when the new church of Christ the Prince Of Peace was built in 1988.

Now, under the influence of Hollywood, which always wants to try something new to rescue its position (whatever happened to ToddAO, 3-D films, Surround-Sound and SmellieVision?), the cinema seems to be making a comeback through the 'multiplex'. More small auditoria, and therefore more films offered to the public, but only one set of staff for the box-office and the projection box at the cost of at least twice the income. No wonder, then, that the cinema industry is making a profit at last.

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Horse racing

Surrey is well known for horse racing, perhaps best known for the races at Epsom, particularly the Derby and The Oaks. James I is said to have held the first horse races on Banstead Downs (as Epsom Downs were then known) when he was in residence at Non-such Palace. Before that the Downs were a popular location for foot races. In 1648 a meeting of Royalists was held on Banstead Downs under the pretence of a horse race meeting and during the Commonwealth horse racing on the Downs was a common enough event for it to be used as a cover for a secret gathering. Race meetings were attended by all social classes and large numbers of gypsies and vagrants traditionally congregated on Epsom Downs.

Epsom Races have been held annually since 1730 but their popularity really started in 1779 with 'The Oaks' race, which was named after the Earl of Derby's seat at Carshalton. 'The Derby' was first run in 1780. In



Gatwick racecourse. *John King Collection.*

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1828 Charles Buck, a Doncaster man, obtained permission to build a grandstand and this was the beginning of the various buildings which have developed on the Downs over the years. The meetings gave rise to a race horse breeding and training industry in and around Epsom and Headley.

Guildford races were held on Merrow Downs, on either side of Trodd's Lane on the site of the present golf course, from 1701 until the middle of the 19th century.

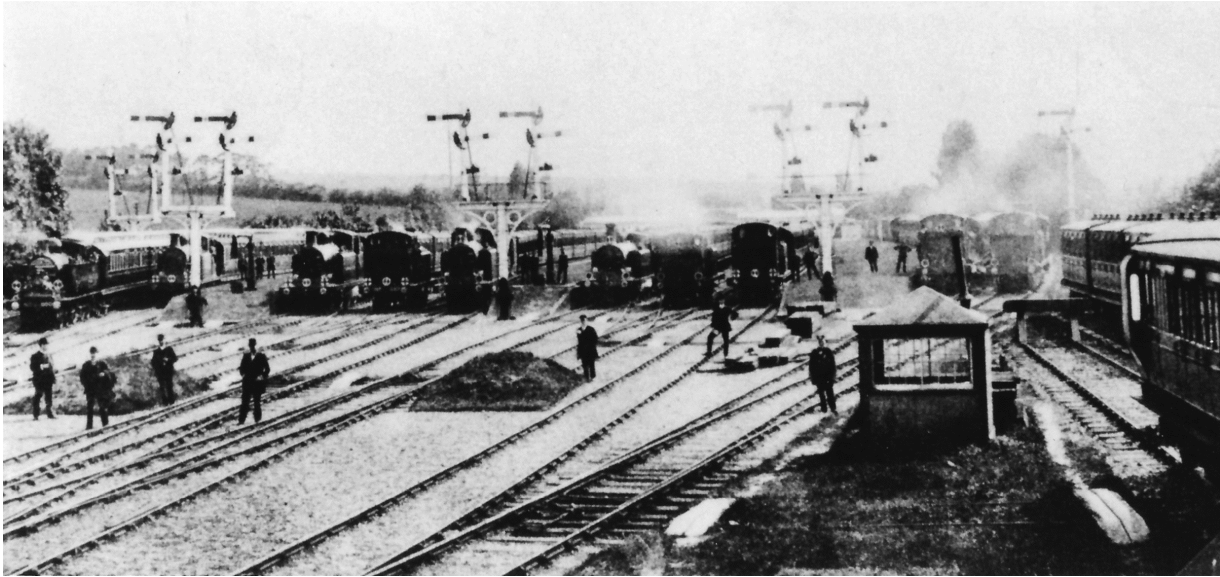
In the 18th century there was horse racing on The Tilt at Cobham but this had ceased by 1780. The nearby public house is still known as 'The Running Mare'.

Another early horse racing venue in the county was Egham where the sport first took place at Runnymede over two days in 1734 and 1735. In 1737-39 there were three-day meetings but an Act of Parliament in the following year, which restricted small race meetings, meant that racing did not return to Egham until 1770. The support was varied until 1849 when a Race Special train was run to the newly-opened LSWR station at Staines. Seven years later the railway arrived at Egham bringing even larger crowds, with an increased number of pickpockets and confidence tricksters. In 1884 the police refused to attend because of the unruly crowds and as it was considered impractical to run the races without police control the meeting was cancelled and there was no more racing at Egham.

There was a short-lived racecourse on Reigate Heath. Racing took place between 1834 and 1839 and an attempted revival in 1863 was unsuccessful.

When Croydon began to grow into a busy town its racecourse was moved in 1864 out to Stroud Green and a new railway station, Woodside, was built seven years later to serve the needs of the racegoers. This course was very successful but, as with Egham, with success came hooliganism. The course moved in 1891 to a site between Horley and Three Bridges and the London Brighton & South Coast Railway built a station, Gatwick Racecourse, to serve the racegoing public. The course was very popular, and during the First World War the Grand National was run there. The success of the racecourse helped to increase the use of the new airport which had been built nearby. In 1955 it was agreed that a new international airport would be built at Gatwick on the site of the racecourse and much of the old airport. No trace of the racecourse survives except its bandstand, which was re-erected in Crawley New Town. The new Gatwick Airport station was built on the site of the racecourse station. This area of former Surrey became part of West Sussex in 1974.

The first enclosed racecourse in Britain was built on part of Sandon farm, owned by J W Spicer of Esher Place. It opened in 1875 as Sandown Park. There are two courses here, one for flat racing and one for steeplechases.



Epsom Downs railway station in LB & SCR days

In 1877 the Kempton Park estate was for sale and S H Hyde, together with a few friends, formed a company to design, build and operate an enclosed racecourse similar to that at Sandown Park. The first meeting was held in the following year, and at the same time a railway station was opened on the Shepperton branch line near the grandstand. Traditionally, Kempton Park charged lower entrance fees than Sandown Park and the course became very popular. In 1932 the grandstand burnt down but was replaced in time for the next year's meeting. New stands and stables were built between 1975 and 1981. The course continues to flourish and is famous for the King George VI Steeplechase which is run on Boxing Day.

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Racing, together with other sports, had been taking place on the common meadow of Molesey Hurst from the 1730s. It is of interest to note that the first balloon ascent from Surrey was made there in 1785. In 1887 the Jockey Club closed the course as being unfit for racing. As an open racecourse it had produced little income but after the closure a group of investors bought the site and fenced it, intending that it should become a club for a variety of sports. Hurst Park racecourse opened in 1890 but in order to obtain a jockey Club licence the proprietors had to extend the course beyond the original Hurst grounds into East Molesey. Racing continued, with interruptions for both wars, until 1962 when the buildings were demolished and a housing estate was built on the site. The main grandstand was sold to Mansfield Town Football Club and the turf to Ascot.

Also in 1890 the racecourse at Lingfield Park was opened. This now has an 'all-weather' as well as a turf course, enabling racing to take place throughout the year.

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Hand-in-hand with a successful horse racing course there were always good rail facilities. Courses either had special stations built or had the local stations extended to cater for the race traffic. Epsom had two stations near the course, Epsom Downs and Tattenham Corner. The former station had nine platforms with sidings between the platform roads while the latter, built 36 years later in 1901, had six platforms as well as berthing sidings for 24 trains. Tattenham

Corner succeeded Epsom Downs as the terminal station for the royal train on Derby Day. Esher station had extra platforms with direct access to Sandown Park while Kempton Park station was built for use on race days only as it could only be used to gain access to or from the racecourse. The Hampton Court branch had additional berthing sidings to cater for race trains for Hunt Park and Lingfield station is close to Lingfield Park racecourse. Rail facilities have been drastically reduced in the age of the motor car and car parking space has been correspondingly increased.

Notes

1. Material relating to Eadweard Muybridge is held by Kingston upon Thames Museum. A new catalogue is in preparation in 1999.
2. Regal Cinema souvenir programme, 1933, in *Godalming 400* (Godalming 400 Committee, 1974, rep Godalming Trust).

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Abbreviations are given for Boroughs and Districts of the modern administrative county of Surrey,
corresponding to titles in the series of Industrial History Guides published by SIHG: El: Elmbridge; EE: Epsom & Ewell;
Gu: Guildford; MV: Mole Valley; RB: Reigate & Banstead; Ru: Runnymede; Sp: Spelthorne; SH: Surrey Heath; Ta: Tandridge;
Wa: Waverley; Wk: Woking, Places in Greater London have the abbreviation GL. [Original page numbers]

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