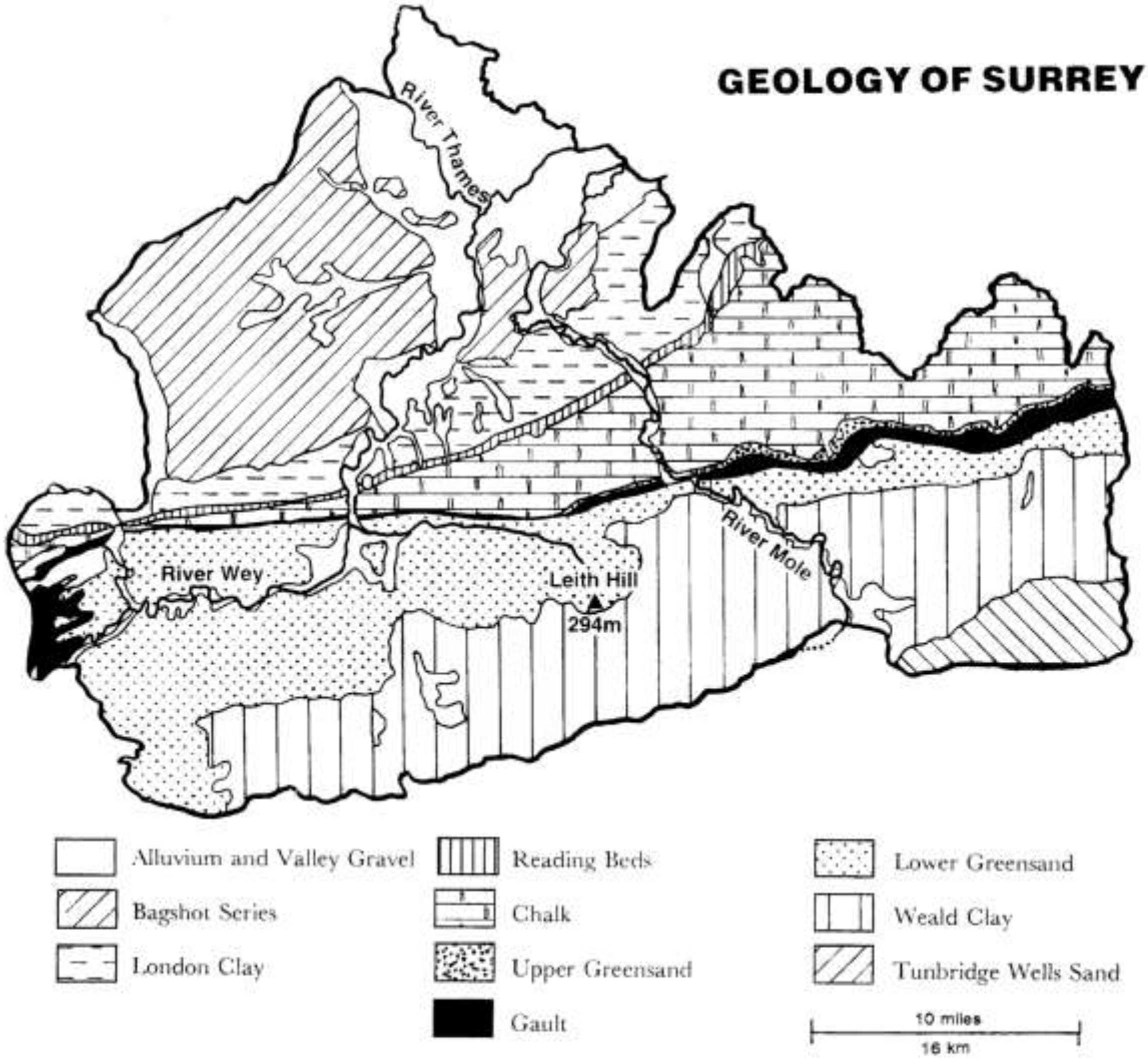
[Page 4]

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.

[Page 5]

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.

[Page 6]

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.

[Page 7]

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.

[Page 8]

LIMEKILMS

Farmers on clay soils even back to the sixteenth century would have their own small limekilns. The name Firsfreld 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.

[Page 9]

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 l887. The Dietzch 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 Dietzch kilns. The two towers are connected by remains of a chalk-loading gantry.

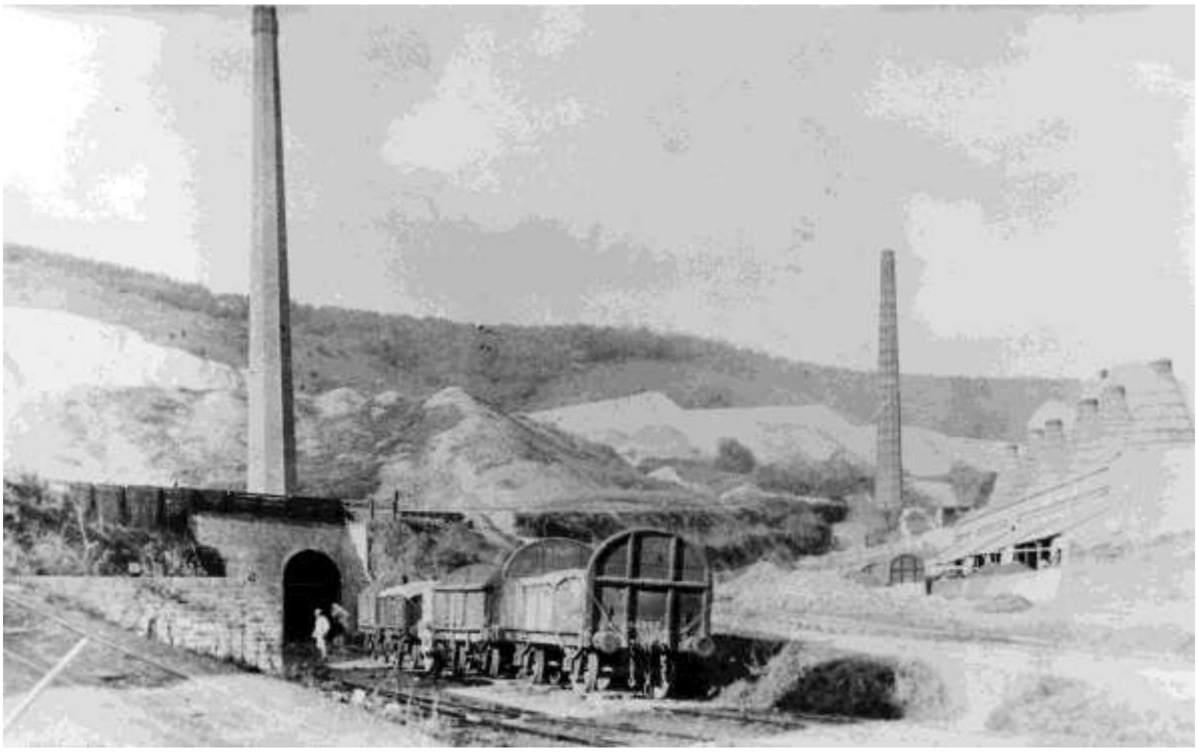
Another solution was devised by Alfred Bishop, manager of the Brockham works, who patented the Brockham Kiln in 1889. He reasoned that the lime-burning process would be improved if additional fuel in the form of small coal was shovelled directly into the burning zone continuously. This was done through 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 l960s. In the l990s 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 l990s.

[Page 10]

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 l990s. It served the Oxted kilns themselves until the l960s. It was then used to hydrate burnt lime brought in bulk containers from elsewhere but was demolished in l998.

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.

[Page 11]

0THER 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.

[Page 12]

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 l805 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.

[Page 13]

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 reworked 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 Ful1er'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 Second World War, particularly in later years for stone to be crushed for road rnetalling, but after the war the workings were abandoned.

[Page 14]

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.

[Page 15]

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 *ad*sorption — 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 *ab*sorption 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.

[Page 16]

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 Godstene 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, Cockle Works west of Nutfield and Park Works on the north side of the village. Perhaps Cawley'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 Cockle 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.

[Page 17]

'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.

[Page 18]

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.