

The Tramway at the Chilworth Gunpowder Works

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In 1885 a German company took over the Chilworth gunpowder mills near Guildford and installed a narrow-gauge tramway, which operated until the works closed in 1920. The tramway was extended several times in order to service new sections of the factory which were built for the manufacture of a different form of gunpowder and the modern propellant cordite. Information, deduced from documentary sources and physical remains, is presented on the layout of the tramway, the track, the bridges and the trams. The most striking surviving feature is a swingbridge, which carried a branch of the tramway across the millstream and thence to the local railway station.

Introduction

The Chilworth gunpowder mills, in the Tillingbourne valley 4km south-east of Guildford in Surrey, were established by the East India Company in 1626. They worked continuously for nearly 300 years before closing at the end of the First World War. The general history of the site during this period is well documented (VCH; Warner 1975, 1976; Crocker 1984, 1985) but no detailed account has been given previously of the tramway which serviced it during its later years. The trams were manually operated and the track is of particular interest because much of it was installed by a German company, the *Vereinigte Rheinisch-Westphälische Pulverfabriken*, which took over the Chilworth company in 1885. Consequently it is probably the earliest metric gauge tramway in Britain. It linked together a large number of buildings and in order to explain its features it is convenient to describe first the different manufacturing processes carried out on the site.

Traditionally gunpowder was made from a mixture of saltpetre, sulphur and charcoal. The main processes were refining and grinding the separate raw materials, thoroughly mixing and pressing them into a moist cake using stone or iron edge-runners in an incorporating mill, further compression of this cake into sheets using a hydraulic press, breaking these sheets and granulating the pieces in a corning mill, removing any fine powder in a dusting house, polishing the grains in a glazing house and finally drying the resulting black powder in a stove. This powder was then stored in the factory magazine before being transported to large magazines on, for example, the Thames estuary.

When used in the big guns developed in the 19th century the traditional black powder produced large amounts of smoke. There was therefore a great need for an alternative 'smokeless powder' and a successful one was developed by the above German company in the early 1880s. This was known as brown or cocoa powder and contained charcoal produced from rye straw rather than wood (Wardell 1888, 21). The British Government arranged for this brown powder, which was usually compressed into hexagonal blocks and then known as prismatic powder, to be manufactured at Chilworth. As a result many new buildings and the tramway were constructed and soon additional land was leased and the works extended (Crocker 1984).

In 1888 the new propellant cordite, a uniform colloidal mixture of nitrocellulose and nitroglycerine, with mineral jelly as a stabiliser, was developed. This is truly smokeless and the Chilworth company soon established a factory for its manufacture. The main processes were drying the nitrocellulose, which for safety reasons was brought to the factory wet, pasting it with the nitroglycerine, incorporating the paste with the mineral jelly and a quantity of acetone, pressing the resulting dough through dies, to produce the cords after which cordite is named, cutting the larger diameter cords into lengths and reeling the

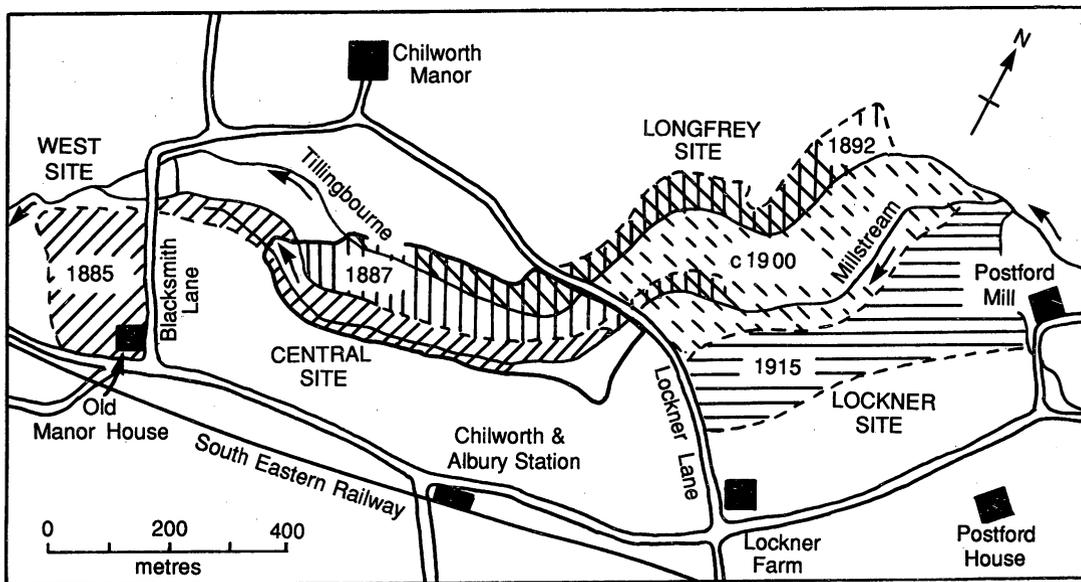


Fig 1 Outline site plan and phases in the development of the Chilworth Gunpowder Works between 1885 and 1915. For convenience the works is divided into four sites: West, Central, Longfrey and Lockner. The area occupied in 1885 by the black powder factory, on the West Site and part of the Central Site, is indicated by acute diagonal shading. By 1887 this had been extended, as shown by vertical shading, both on the Central Site and part of the Longfrey Site, in order to produce brown powder. By 1892 part of these extensions was occupied by a cordite factory indicated by obtuse diagonal shading. This factory was extended on the Longfrey Site in about 1900 as shown by broken obtuse shading. Finally in 1915 the Admiralty built another cordite factory, shown by horizontal shading, on the Lockner Site. The part of the Central Site which is scheduled as an Ancient Monument is enclosed by a bold line.

smaller ones, recovering about half of the acetone by heating the cords in a stove, drying them in another stove, blending, to ensure consistency, and finally packing and storing (War Office 1925). During the Boer War (1899–1902) it was found that the Mark I cordite described above eroded rifled guns and a new Mark II version with less nitroglycerine was developed. The Chilworth cordite factory was extended at this time. The final stage of development at Chilworth was during the First World War when the Admiralty built a second cordite factory adjacent to the existing works. However after the war the demand for gunpowder and cordite declined dramatically and the Chilworth factory closed in 1920 (Crocker 1984).

Tramways were introduced at many gunpowder mills during the 19th century. The early water- and animal-powered mills were usually small as the different manufacturing processes were carried out in the same or neighbouring buildings. It was therefore easy to manhandle the partially produced gunpowder from one building to the next using, for example, wheelbarrows. However this also meant that a fire or explosion in one building would probably be communicated to others. Gradually therefore, especially as a result of the Explosives Act of 1875 (Crocker 1986), sites became larger with well-separated buildings. This, in turn, made moving powder more difficult so, where possible, water transport was introduced, particularly punts on millstreams. Often however horse-drawn carts were needed as well. The introduction of steam-powered mills also meant that substantial quantities of coal had to be delivered to sites. Tramways were therefore built at many works. They provided an ideal solution both for internal transport, as they could be used to link all of the buildings, and for external links to rivers, navigations, canals and railways.

An outline map of the Chilworth works, part of which is scheduled as an ancient monument, is given in fig 1. This indicates its location relative to Chilworth & Albury Station, Blacksmith and Lockner Lanes, both of which cross the site, and other landmarks. The map also shows the site's main watercourses, the Tillingbourne and the millstream. The latter powered several waterwheels and turbines, which were rated at about 100 hp, but there were also steam engines generating about 1000 hp. For convenience the works is divided on the map into four sections labelled the West, Central, Longfrey and Lockner Sites. Stages in the development of the mills between 1885 and 1920 are also shown by different types of shading (Crocker 1984).

The Layout

The earliest evidence of the tramway at Chilworth is contained in an encyclopaedia illustration (Wyman 1888) which probably represents the works in 1887. It shows the site looking down from St Martha's Hill, which is immediately to the north. A drawing based on this illustration is reproduced in two sections in fig 2. The chimney stack at the right, on the West Site beyond Blacksmith Lane, is at the charcoal house. The saltpetre and sulphur houses, the cooperage and the factory magazine are nearby. The second tall chimney is at steam powered incorporating mills installed in the 1860s on the Central Site. Between these two chimneys are most of the black powder manufacturing buildings which were powered by water, one of the waterwheels being clearly visible. The chimney stack at the left, near Lockner Lane, is at the large brown powder incorporating mills. These steam powered mills were built in 1885, together with many of the other structures at this the eastern end of the Central Site (Crocker 1984, 1985).

Most of the buildings in fig 2 are linked by a continuous line which closely follows the route of the tramway marked on the 1896 1/2500 OS map. The only exception is the track to the factory magazine and this, as explained below, was probably removed before the 1896 map was produced. The sketch map of fig 3 provides an interpretation of the layout, with north now shown conventionally at the top of the diagram. This layout is also consistent with routes marked on an undated 1/2500 plan of the site probably prepared in 1888, when an application was made to extend the brown powder mills up the valley on to the Longfrey site (Plan c1888). Although these routes are not labelled on the map and could have been footpaths, it seems very likely that they represent the tramway. If this is correct the first phase of the tramway, probably built in 1885, was approximately 2.6km long. There was a weighbridge just east of Blacksmith Lane, presumably one of three 10 ton weighbridges owned by the Company in 1909 (Hodgetts 1909, 345).

Under an agreement dated 31 December 1888 the Chilworth Gunpowder Company held a tramway siding at Chilworth & Albury station on the South Eastern Railway (Albury Estate 1922, 47). This was for bringing coal for steam-powered mills and charcoal burning to the works, gunpowder being taken from the site by covered wagons to Stonebridge Wharf, on the Godalming Navigation at Shalford. As shown in fig 3 the siding was linked to the Central Site by a branch of the tramway which crossed the Dorking Road and headed north-east for about 300 metres before crossing the millstream to reach the manufacturing area. The annual rent to the railway company, which became the South Eastern & Chatham in 1899 (Simmons 1961, 252), was £1 (Albury Estate 1922, 47). The detailed layout of the sidings, which were to the west of the station, are shown in fig 4 (SER 1895). Originally there was one short length of railway siding and the tramway terminated behind the terrace of cottages at the point marked A. Later the sidings were extended and the tramway shortened to B. On the north side of the road there was a second weighbridge, described as a '10 tons Avery' (Albury Estate 1922, 47), and the 1896 1/2500 OS map shows the track passing on either side of the weigh office. The railway station, the public house, known as the Percy Arms after the Duke of Northumberland who owned the site, the row of cottages and an approaching train are shown near the top

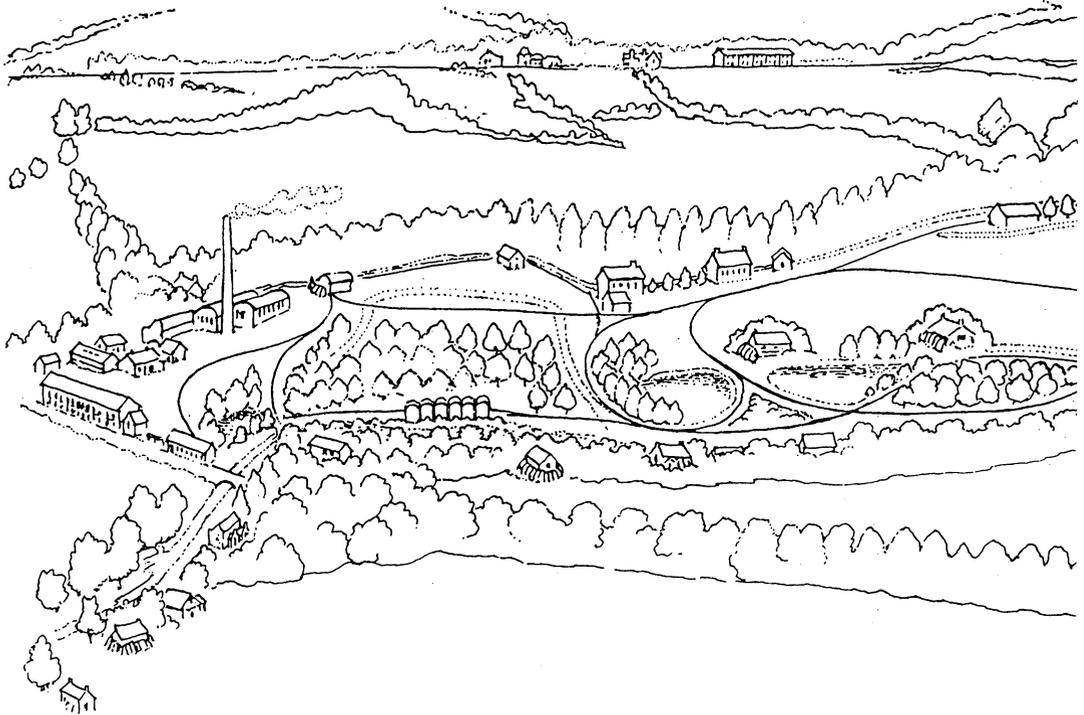
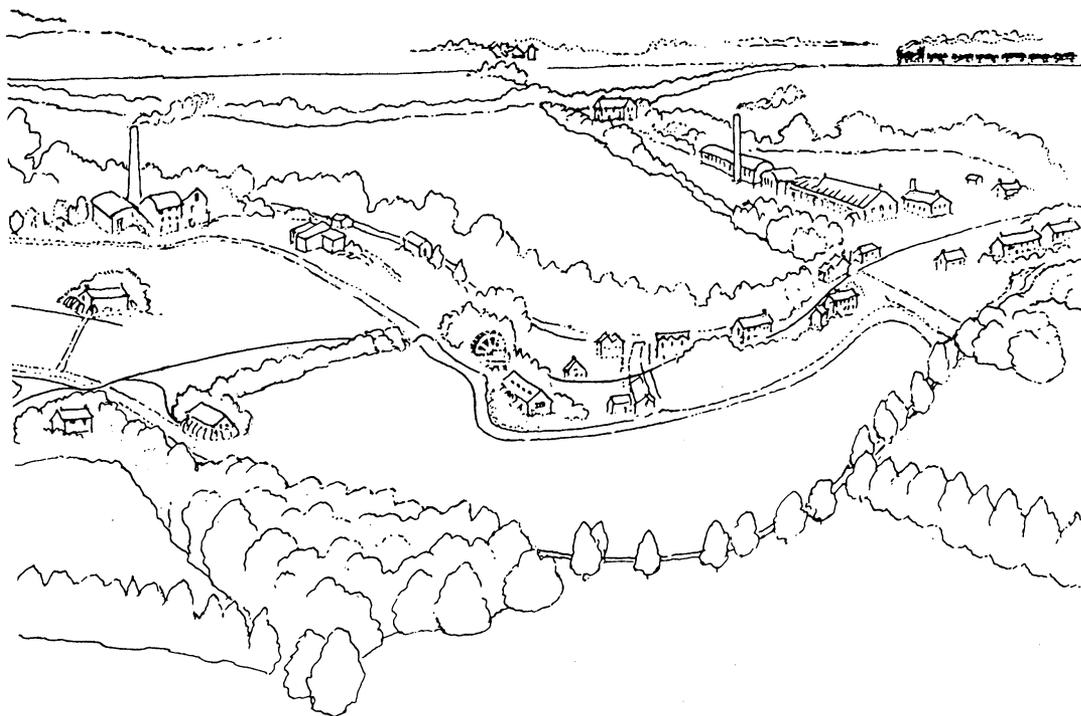


Fig 2 The Chilworth Gunpowder Works in about 1887 looking south from St Martha's Hill. The drawing is based on an illustration in Wyman's *Commerical Encyclopaedia* for 1888 and is reproduced here in two sections showing the east end of the works above and the west end opposite. Many of the buildings are joined by a continuous line representing the tramway. (Courtesy Rowena Oliver)

of the 1887 view of the site in fig 2, but the tramway branch had not been built at that time.

The bridge which carried the station tramway across the millstream appears to have been identical to a second bridge which took another branch to the factory magazine and charcoal house on the West Site and therefore crossed Blacksmith Lane. It is assumed that the two branches were built at the same time and both are certainly present on the 1896 1/2500 OS map. The route of the magazine branch, which would have succeeded the possible earlier route farther to the north, is shown in fig 3. Some other minor changes to the layout shown on the 1896 map are also indicated in figs 3 and 4.

The four buildings at the bottom left hand corner of fig 2, on the Longfrey Site, were brown powder magazines. Not shown are four more magazines farther up the valley and a second range of brown powder incorporating mills adjacent to the mill stream opposite. The view from St Martha's (Wyman 1888) and the 1/2500 plan of about 1888 do not indicate extensions of the tramway to these buildings. However it is likely that these were laid in 1888/9 at the same time as the railway and factory magazine branches. Certainly tramlines are shown servicing these buildings on the 1896 1/2500 OS map but in 1892 their use had been changed from brown powder to cordite manufacture. The routes of these extensions are shown on the sketch plan of fig 5. One follows the left bank of the Tillingbourne and had several fixed bridges crossing the stream. The other follows the right bank of the millstream. Thus the second phase of tramway construction, involving



about 1.9km of track, appears to have consisted of extensions to the railway station, the factory magazine and the new brown powder factory.

When the cordite factory on the Longfrey Site was enlarged in about 1900, the tramway along the right bank of the millstream was extended to service five new brick buildings. These included a press house and two stoves with chimneys, which survive intact. In addition a branch to the Longfrey magazine line was constructed across the bed of the valley to a new kneading house. These extensions which are marked as 'Tramline' on an undated 1/2500 plan of 'Chilworth Gunpowder Mills: Smokeless Powder' (Plan c1900) are shown on fig 5. The third phase of tramway construction, involving about 0.7km of track, was therefore the Longfrey cordite extension.

The above lines together with some minor additions, which are also shown on figs 3 and 5, have a total length of about 5.2km or 3.3 miles. It should be noted that a statement (Hodgetts 1909, 345) that the Company owned about 5 miles of tramway included both the Chilworth factory and a second works at Fernilee in Derbyshire. Similarly a third 10 ton weighbridge (Hodgetts 1909, 345) was presumably at Fernilee.

The fourth and final phase of constructing the tramway was when the Admiralty cordite factory was built in 1915. The only known layout of this track is on the proposed plan of the new works submitted to the Duke of Northumberland as landowner (Plan 1915). The route, which was labelled 'Tram', is indicated in fig 5 to the south-east of the millstream on the Lockner Site. It did not connect with the earlier tramway and it seems likely that it was built to an imperial rather than a metric gauge. In practice the new cordite buildings were constructed in slightly different places from those shown on the 1915 plan and no doubt the tramway also departed a little from the route shown in fig 5. It is interesting however that, unlike most of the earlier tracks, it linked the various buildings in a logical sequence as defined by the manufacturing process described above in the Introduction. It

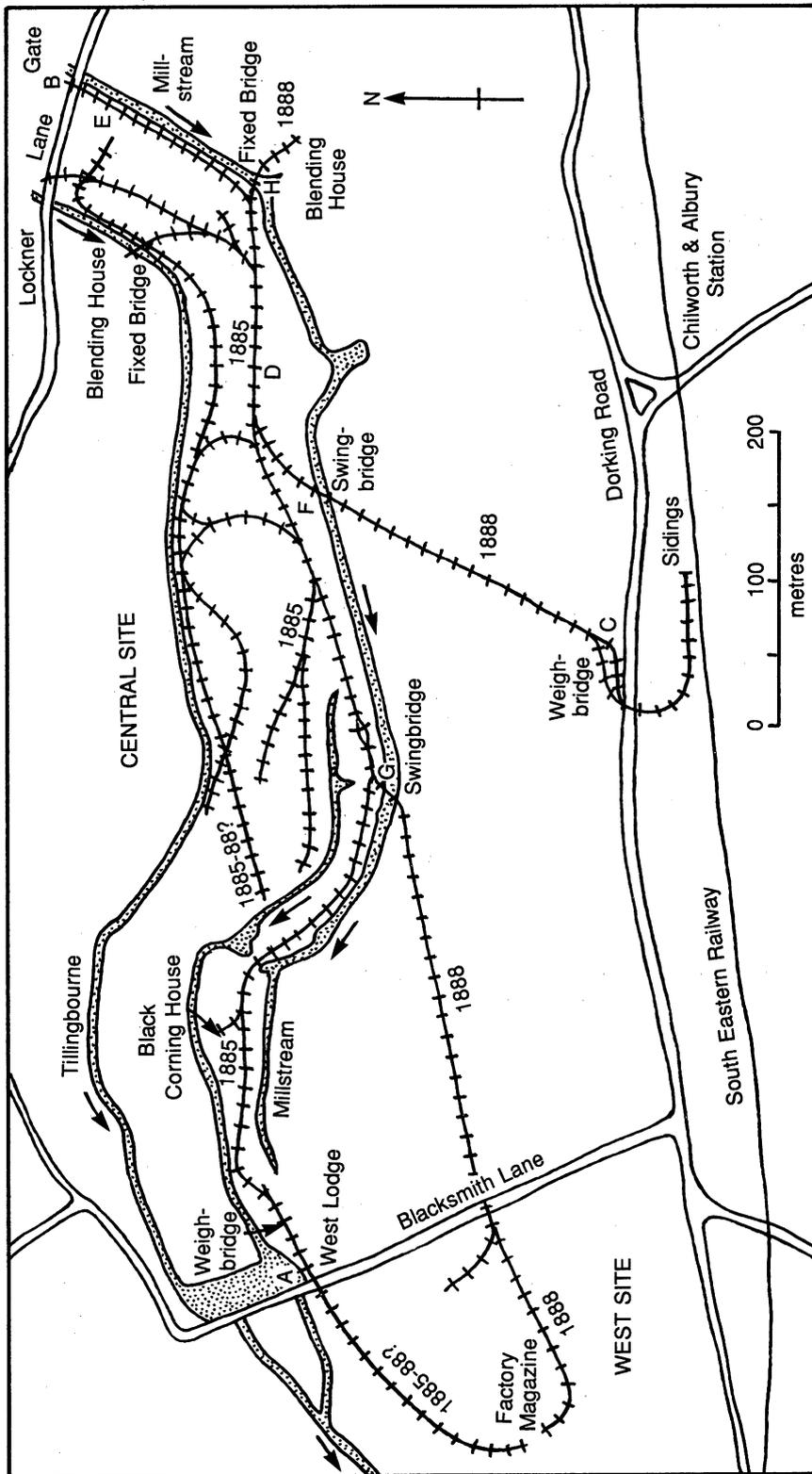


Fig 3 Layout of the tramway on the Central Site, together with the branches to Chilworth & Albury railway station and to the factory magazine on the West Site. The track was first laid in 1885 and the dates of later changes are as indicated. The letters A-H are defined in the section on Remains.

was about 1.5km long. Unfortunately for security reasons all information about the works was removed from the 1916 1/2500 OS map.

The tramway is shown as being entirely single track on the 1896 1/2500 OS map apart from three passing places at the station weighbridge, the western swingbridge and the eastern entrance to the Longfrey Site (see figs 3-5). There were of course many branches, spurs and loops but, if the available maps are accurate, tram pushers could in several places find themselves 200 m from a passing place. Finally, the tramway gradients which have been surveyed in detail for part of the site by students of the University of Surrey, were not too demanding. Most were less than 1% but the branch to the railway station was steeper, averaging about 3.5% overall but approaching 5% at the works end. However as this was only used for incoming coal and not outgoing gunpowder, only empty trams had to be pushed uphill. The only other relatively steep section, again about 5%, was near the blending house at the south-east end of the Central Site (see fig 3), but again it was not used for full coal trams.

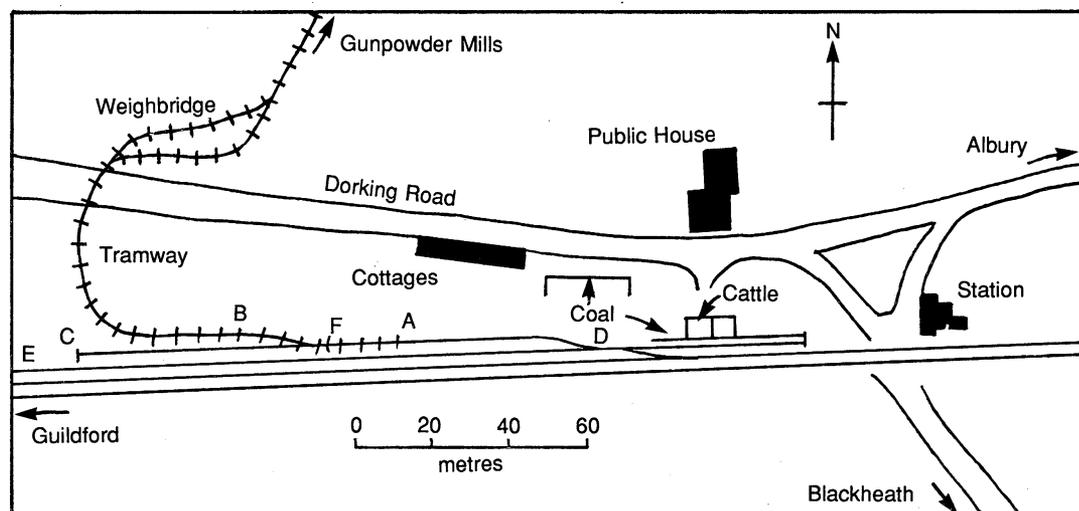


Fig 4 Layout of the Gunpowder Company's sidings at Chilworth & Albury railway station. Originally the tramway terminated at A but it was shortened to B when the railway sidings were extended by the tracks CD and EF.

The Track

Much of the Chilworth gunpowder site is built on low-lying ground between two millstreams on either side of the valley. That along the north side is now known as the Tillingbourne but originally the river flowed down the centre of the valley between the two streams. Consequently this land is very damp and the tramway follows for much of its route the embankments of the two artificial watercourses. Elsewhere new low embankments were constructed but no cuttings were necessary. Where the cordite branch crossed Lockner Lane granite sets were used to outline the track but recent road resurfacing has covered these. A similar arrangement was probably used at other road crossings. The track was laid on timber sleepers, some of which survive. These are about 1.35m long, 0.15m wide, 0.08m deep and 0.85m between centres. Some of them have iron nails and others brass studs in their upper surfaces.

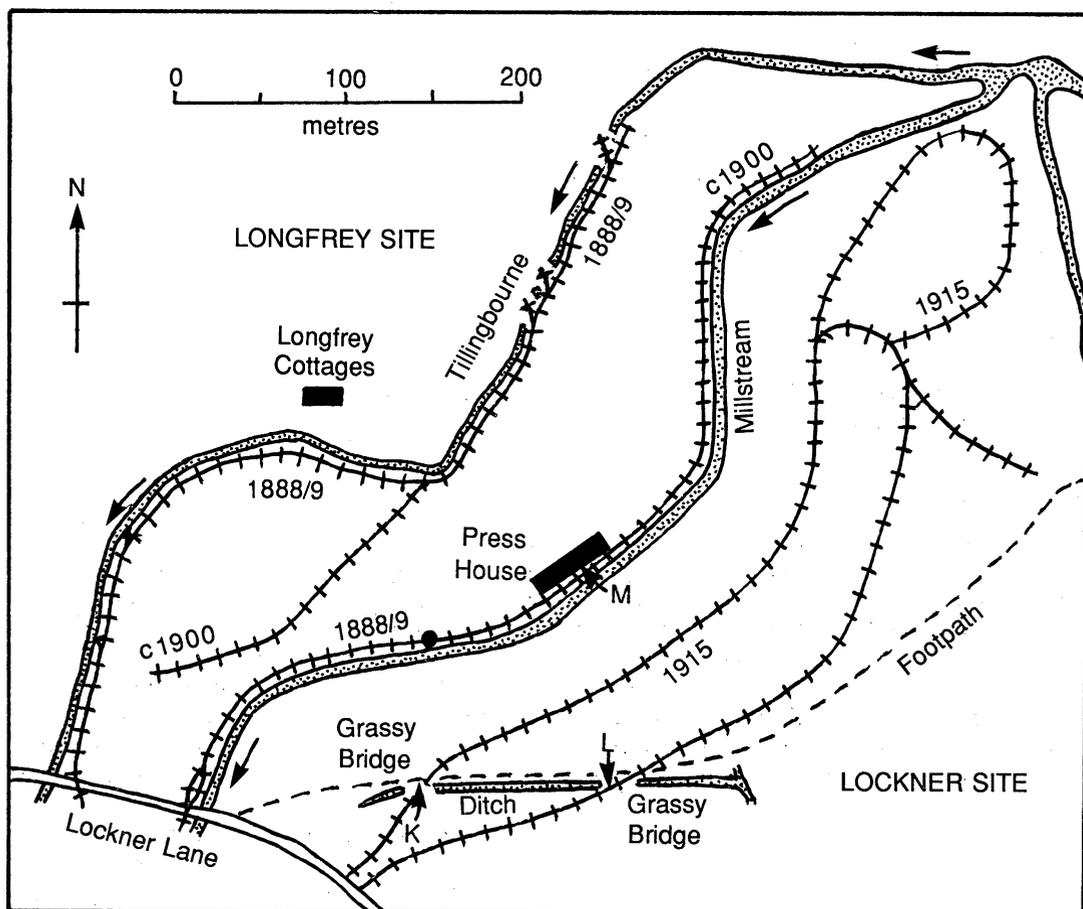


Fig 5. Layout of the tramways on the Longfrey Site, which was developed in 1887 for brown powder but rebuilt in 1892 and then extended in about 1900 for cordite, and on the Lockner Site, which was opened in 1915 as an Admiralty cordite factory. The letters K-M are defined in the section on Remains.

In general the rails were of iron but only a very small sample is known to survive. This is about 22mm long and weighs 140gm giving a linear density of about 6.4kg/m. The usual range of densities quoted for industrial narrow gauge railways is 6.9 to 45kg/m (Dean 1985, 27). The Chilworth rails were therefore very light which is not surprising as the trams were pushed by men and not hauled by horses or locomotives. The sample is 50mm high, its head is 25mm across and the shape of its cross-section, which is shown in fig 6, suggests that the Chilworth rails were imported from Germany (R A Symes-Schutzmann, pers comm). This is consistent with the surviving iron girders in the brown powder incorporating mills, which are clearly German as they bear the inscription 'Burbach 1884'. Iron rails were not permitted within 3 yards of a danger building, so that in places wooden rails were used. Some of these survive, for example outside the press house on the Longfrey cordite works (see fig 5). Elsewhere on the site it is claimed that brass rails were used but in some places the rails simply stopped before reaching the danger buildings. The most important aspect of the track however is its gauge which was 800mm, standard on the Continent but otherwise unknown in Britain (Members of Railway & Canal Hist Soc, pers comm). A detail of a photograph, taken in about 1913, of some workers grouped on the

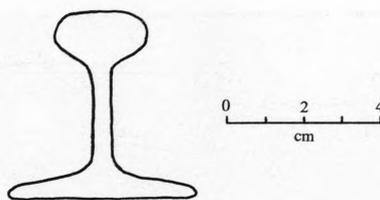


Fig 6 Cross-section of a tramway rail from the Chilworth Gunpowder Works, which has a characteristic German form. (Courtesy R A Symes-Schutzman)

tramway is shown in fig 7. This confirms that the gauge is indeed about 800mm and the sleepers about 1.35m long.

The bridges

Three tramway bridges crossed the millstream. The most interesting of these is the swingbridge which was built in 1888 to link the tramway to Chilworth & Albury Station on the South Eastern Railway (see fig 3). It survives substantially intact, as shown in the photograph of fig 8, and measured drawings are given in figs 9 and 10. This bridge crossed the stream at an angle of about 50° , as shown in the plan of fig 9, on the alignment of the straight track to the railway sidings. It consisted of a fixed timber section at the north end and a swinging iron section at the south. When opened it provided a passageway of about 2.0m, large enough to allow the punts, which carried gunpowder along the watercourse, to pass through. A photograph of these punts (Crocker 1984, 19) suggests that they were about 1.5m wide.

The timber section of the bridge consists of two trestles supporting two beams, 8.58m long and 0.60m apart, which extend some 3.0m on to the north bank (see fig 9). All of this timber is 0.20m square so that the rails of the 800mm gauge track lay directly above the centres of the beams. The section ends with a trestle near the middle of the millstream and parallel to the banks. This means that it makes an angle of 50° with the main beams. The other trestle is near the north bank, making an angle of 20° with the bank and 70° with the beams. This rather odd arrangement could suggest that the carpenters had some problems with the oblique crossing. This is partially confirmed by some unused depressions at the ends of the lintel again cut at an angle of about 70° . As shown in figs 10(a) and (b), each trestle consists of four pieces of timber: a submerged sill, two splayed legs and a lintel. They were built using mortise and tenon joints fixed with pairs of 25mm dowels. Carpenters marks are visible on some of the joints (eg //, //; ///, ///). The two long beams are laid in grooves 35mm deep cut into the tops of the lintels. Nails in the upper surfaces of these beams suggest that they were covered with planking 75mm thick.

The iron section of the bridge pivoted about a vertical iron post, 0.16m in diameter, built into a concrete platform on the south bank of the millstream. It is 0.90m wide and consists of two iron beams 0.25m deep and with inward facing 75mm flanges at top and bottom. One of the beams is 5.81m long and the other 6.54m, the difference accommodating the oblique crossing. They are joined near their ends by cross-members of the same section, but the bearing plate at the pivot is missing. Bolts projecting 65mm from the outer sides of the beams suggest that they were clad with timber, which would have been used to fix the planking on top of the beams. This was probably about 1.35m wide, matching the sleepers of the fixed track. Figure 10(c) shows the resulting cross-section of this part of the bridge, the iron rails being immediately above the iron girders. The pivot is 2.47m from the south end and is not therefore at the geometrical centre of the bridge. This is normal



Fig 7 Detail of a photograph of gunpowder workers at Chilworth in about 1913 grouped together on part of the tramway. (Courtesy Ron Puddick)



Fig 8 Photograph, taken in 1983 looking upstream, of the tramway swingbridge linking the works to Chilworth & Albury railway station. The fixed timber section is on the left and the swinging iron section on the right. See figs 9 and 10 for a plan and elevations.

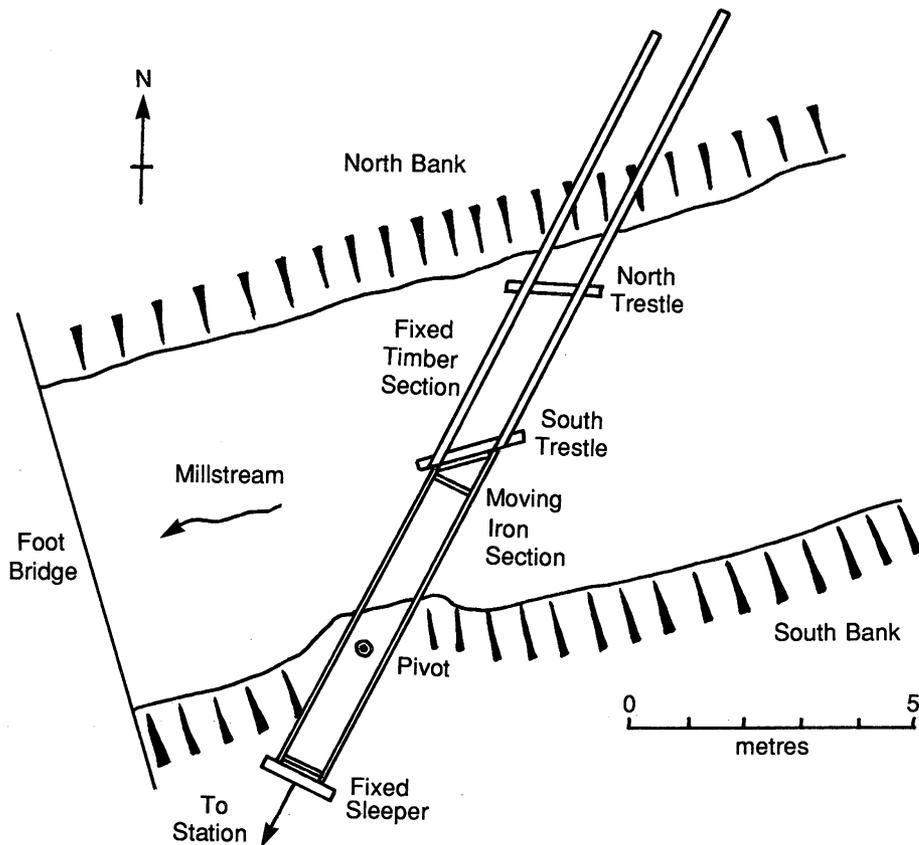


Fig 9 Plan, based on measurements taken in 1991, of the swingbridge illustrated in fig 8. It shows the fixed timber and rotating iron sections and the locations of the two timber trestles.

for swingbridges and a rough calculation indicates that in this case a large ballast of 200 to 300kg would have been needed at the bank end.

When the two parts of the bridge met, two projecting horizontal pieces of angle iron engaged, the one on the iron section sliding over and finally resting upon its mate on the timber section. These angle irons are fixed to the two meeting ends of the sections of the bridge by being shaped, bent and bolted to the outsides of the main beams. However the one on the timber section has sagged under the weight of the iron section, which is no longer supported at its pivot. Therefore the top surfaces of the iron beams are now lower than the corresponding surfaces of the timber beams, although originally they would have been level.

A second swingbridge about 200m to the west carried the branch of the tramway which led to the factory magazine and charcoal house on the West Site. Only the iron post of the pivot survives. This is on the north bank of the millstream and is again set into a concrete platform. It is undamaged and clearly identical to the pivot of the bridge described above. Therefore it is assumed that this bridge also dates from 1888. However it seems to have been dismantled before the works were closed as it is not mentioned in the sale particulars (Albury Estates 1922, 47). It is interesting that the two swing bridges had their pivots on opposite banks of the mill stream. This could have been related to the need to use the maximum depth of water for the punts or to restrictions in accommodating the swinging

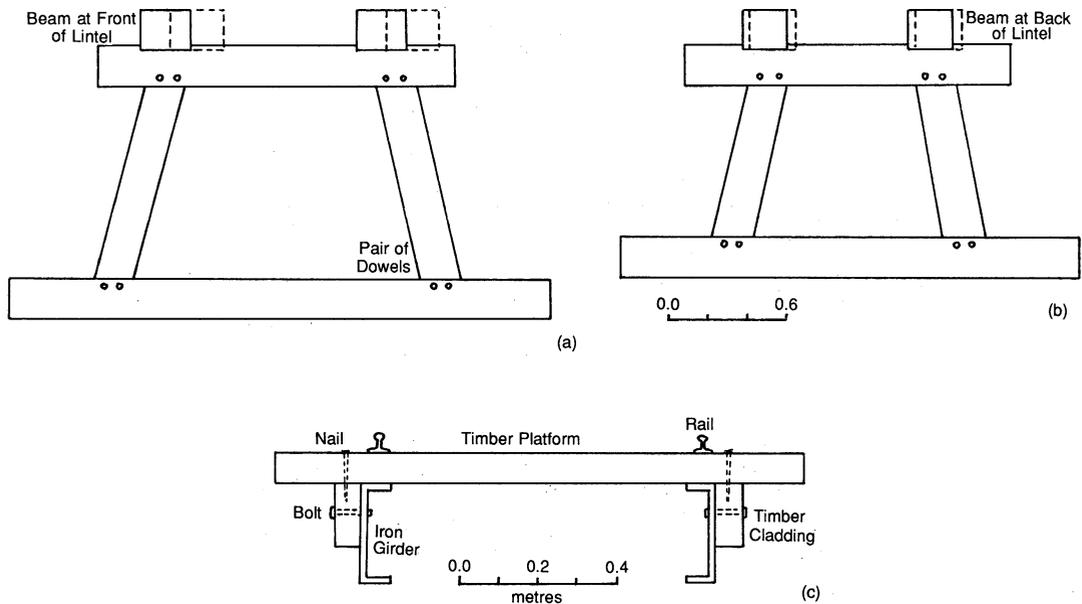


Fig 10 North elevations of (a) the south trestle and (b) the north trestle, with the beams they support, of the timber part of the swingbridge shown in fig 8 and, at twice the scale, a cross-section (c) of the iron part, with a reconstruction of its timber platform supporting the rails. Based on measurements made in 1991.

ends on the banks. However the arrangements are also consistent with the heavily loaded trams taking coal to the boiler and charcoal houses, crossing the iron sections before the wooden ones.

The third crossing was a fixed trestle bridge at the south-west end of the range of six brown-powder incorporating mills near Lockner Lane. This served a blending house in the bluebell wood on the south side of the stream (see fig 3). The single central trestle, with three vertical legs, survives together with one of the two timber beams. This is 11.00m long and has a 0.22m square cross section. The lintel of the trestle is 1.76m long, 0.18m wide and only 75mm deep. Marks on its upper surface indicate that the gap between the two beams was about 1.18m. Thus the full width of the bridge would have been at least 1.62m, much wider than was needed for the tramway. It seems likely therefore that it predates the tramway and the 1/2500 plan of the site which probably dates from about 1888 does indeed appear to show it without tramlines (Plan c1888).

Several fixed tramway bridges about 3.0m long also crossed the Tillingbourne stream which flows along the north side of the valley and other small bridges traversed drainage ditches at various parts of the site.

The trams

Unfortunately no illustrations of the trams used at Chilworth are known to survive. However in about 1912 a pressed-glass model of a tram was presented by the Company to Edward Puddick on completing 25 years of service at the mills. A photograph of this model, which is about 150mm long, is shown in fig 11. A mark pressed into its base shows

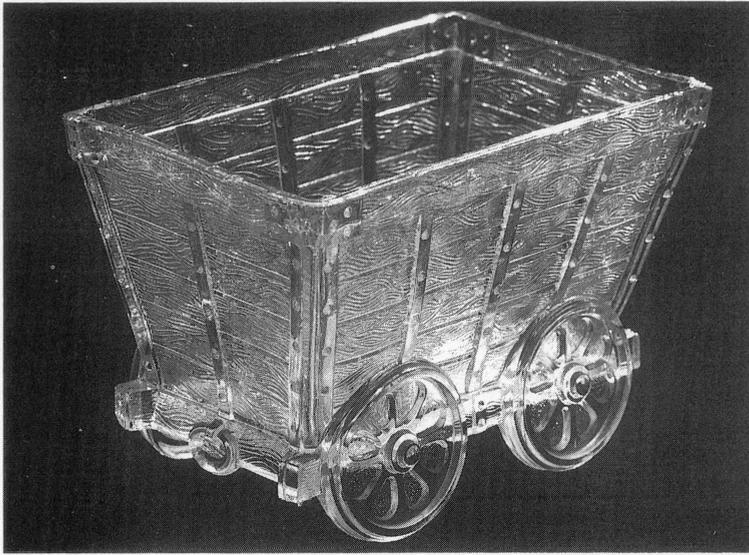


Fig 11 Photograph of a pressed-glass model of a tram, about 150mm long, presented to a worker at the Chilworth gunpowder works on completing 25 years of service. Therefore it is likely to be similar to at least some of the trams used at Chilworth, probably those for transporting coal and not gunpowder or cordite. (Courtesy Ron Puddick)

that the design was registered on 19th June 1880 by William Henry Heppel of the Newcastle Flint Glass Works, Forth Street, Newcastle upon Tyne (V&A 1984). It therefore seems reasonable to suppose that the tram was modelled on those used in the collieries of the North-East and in any case this registration date is five years before the tramway was constructed at Chilworth. Nevertheless, in order for it to be appropriate to present the model to a Chilworth worker it must have been similar to at least some of those used at the gunpowder works presumably those for carrying coal rather than gunpowder or cordite.

The coal trams, which were of wood and bound with steel, are said to have held 1 ton (Warner 1976, 157). This is consistent with the proportions of the glass model shown in fig 11, assuming 800mm for the gauge and about 1.3 for the specific gravity of coal. It is likely that the trams were wider than the 800mm gauge but no doubt passed easily through the surviving 1.44m wide gate leading to the Longfrey site (fig 3). Each tram was pushed by two men, who were able to take a ride on the downhill journey from the railway station when their tram was full of coal. The powder trams were of wood bound with brass. (Warner 1976, 157). In a 1916 booklet of 'Special Rules to be observed by every person employed at the Smokeless Powder Factory', rule 24 states 'All Tram Cars to be kept clean, and the sweepings to be put into the tubs provided for the purpose' (Home Office 1916, 6).

At 8.37 am on Tuesday 12 February 1901 a powder tram, standing outside the black corning house and containing about 200 lbs of gunpowder dust, exploded (Report 1901; *Surrey Adv* 1901; Warner 1976, 131-57). This caused the corning house, which was 200m east of Blacksmith Lane (fig 3) and which held about 500 lbs of powder, to explode. Six men were killed including Walter Abbot, William Marshall and William Prior, who were described as tram pushers. The subsequent enquiry revealed interesting information about the tramway. Thus the licence governing its construction stated that 'the rails within 3 yards of a danger building shall be of wood, brass or other suitable material'. However the Company had avoided this condition by terminating the tramway, with its iron rails, 5

yards from the corning house. Therefore the tram pushers, wearing hob-nailed boots, had to carry barrels containing between 70 and 80 lbs of gunpowder dust from the corning house to load on to the tram. It was assumed that one of the men doing this had slipped on icy ground, struck a spark with his boots on a rail or stone and ignited some powder dust on the outside of a barrel, thus causing the tram to explode. Part of the reason for concluding that the tram had exploded first was that one of its brass handles was carried over the corning house and found 330 yards away. If the corning house had exploded first the whole tram would have been blown in the opposite direction. In addition there was a very distinct depression in the ground at the spot where the tram had been standing and the rails were bent downwards (*Surrey Adv* 1901).

The Remains

The main features of the tramway which survive at the Chilworth gunpowder site will be summarized here with reference to fig 3 (A-H) and fig 5 (K-M). Well-trodden footpaths follow the route of the tramway from West Lodge A to the gate B on Lockner Lane and along the branch which leads to the Dorking Road at C. Elsewhere the route is indicated by low embankments. No iron rails are visible but sleepers survive near D and E, some at E having brass studs in their upper surfaces. The most striking feature is the east swingbridge F which crosses the millstream alongside a modern footbridge. Only the pivot survives of the west swingbridge G but there are more substantial remains of the fixed timber bridge H. There are also grassy bridges at K and L near the footpath which crosses the Lockner site. Clearance has revealed some timber rails in front of the press house M on the Longfrey site, which is private property.

It is interesting to compare the remains of the tramway at Chilworth with those at other gunpowder mill sites elsewhere in Britain. About 30 of these were operative during the late 19th and early 20th centuries (Crocker 1988) and probably over half had tramways. Some of these such as the one at Waltham Abbey in Essex were narrow gauge, like that at Chilworth, but others like those at Lowwood and Gatebeck in Cumbria were standard gauge. Many including Glyn Neath in Breconshire and Roslin in Midlothian were horse-drawn but others including Waltham Abbey had locomotives. No doubt some were man-powered like Chilworth but there is little evidence for this. The physical remains at most of these other sites are just as tenuous as those at Chilworth but some trams, or rather wagons, survive at Lowwood. However for some of the sites more photographic evidence of the tramways is available than at Chilworth. This is particularly true of Waltham Abbey and Glyn Neath. A detailed survey and analysis of the tramways at all these sites would be worthwhile.

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