THE RAILWAYS

OF THE

ROYAL GUNPOWDER

FACTORY

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The Royal Gunpowder Factory, Waltham Abbey

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One of the exhibits in the North Woolwich Railway Museum one of the exhibits was a map entitled Railways from Tottenham to Chesthunt compiled by D.J. Taylor of the Great Eastern Railway Society in 1977. This map showef that there was a standard gouge connection from the Great Eastern main line Brimsdown,through the Royal Small Arms Factory at Enfield,to the narror gauge railway system in the Royal Gunpowder Factory. The transfer sidings between the standard and narror gauge railways were located adjacent to a river wharf,on the boundary between the two factories.

Waltham Abbey is situated close to the River Lea,which here forms two separate channels; the River Lea Navigation and the 'Old' River Lea. The Gunpowder Factory,and more recently the Research Establishment,occupy a long site between the town and the River Lea Navigation. The Factory is divided into two separate areas known as the North Site and the South Site. The early operations were concentrated in what is now the North Site.

THE EARLY TRAMWAYS.

The origins of the Royal.Gunpowder Factory stretch back to at least the mid 17th century. Until the second half of the 19th century,its sole product was gunpowder in its various forms; as an explosive or as a propellant for guns of all types and for rockets. In all this time,the transportation throughout the factory relied entirely on the waterways and hand carriage. In other industries,the development of tramways and railways was seen essential as they provided a rapid and cheat form of transportation of raw materials and finished goods,both within factories and onward to customers. Collieries,iron and other works were very depedendent on railways of some form or other from the late 18th century. The Royal Arsenal at Woolwich,which was under the same management as the Royal Gunpowder Factory (The Director General of Ordnance Factories), had iron railways from 1824. It would appear that the Royal Gunpowder Factory was reluctant to adopt a rail system,presumably because the existing waterway network was adequate to cope with the amount of production.

The development which appears to have precipitated the installation of a railway was the building of a new steam powered gunpowder mill on the North Site in 1856-7. Up until this date,all the mills at the Royal Gunpowder Factory had been water powered. The decision to install steam power may have been associated with the increase in demand for gunpowder caused by the Crimean War,which started in March 1854,and the consequent expansion of the Woolwich Arsenal.

The earliest reference found so far to any sort of tramway or railway is on a plan dated 19th January 1856,in the RARDE Waltham Abbey Historical Collection. It shows 'the dimensions and position of the proposed new buildings at Waltham Abbey'. This plan

is of the new steam powered gunpowder mill which was later called the Group A mill. It depicts a raised tramway down the north side of the building,with two turntables at its eastern end adjacent to two magazines. Furthermore,the plan shows the cross section of the rail described as 'tramway iron' at full sixe. Such bridge rails,as they were called,were not uncommon at this time. No further reference has been found to this type of rail being used at the factory so perhaps it was never laid,or for some reason was replaced soon after laying. Other features depicted on the plan are the gunpowder mixing house at the start of the tramway,and the side view of the tramway platform over the mill tail stream. The drawing also indicates why this tramway and later ones were on raised platforms; a detail shows that the flood level was one foot above the ground level in the vicinity of the new mill.

THE EARLY TRAMWAYS.

The first stone of the new steam mill was laid on the 1st March 1856 so it can be assumed that the tramway did not operate before 1857 or even 1858. The earliest map which shows the tramway was drawn in February 1859.

At this point it is necessary to discuss the use of the terms tramways and railways. On the early maps and drawings which show any form of railway the terms tramway and railway were used indiscriminately for what was a manually propelled system. An 1888 map refers to both tramways and railways,but the distinction between the two is not clear. By World War 1 usage will be adopted throughout this account.

The original tramway which connected the charcoal mill and gunpowder mixing house to the new steam incorporating mill was only about 600 feet long,and its function would probably be to convey the loosely mixed ingredients of gunpowder (charcoal,saltpetre,and sulphur) rapidly and safely from the mixing house to the incorporating mill. There the mixture or 'green charge' would be subjected to heavy rolling for several hours to give a homogeneous mix in the form of a hard cake known as 'mill cake'. The mill cake was then broken up carefully and placed into wooden tubs,which were stored in small magazines,prior to the next stage in the manufacturing process. Almost certainly,the tramway was also used to transport the mill cake to the two small magazines associated with the Group A Mill. On a map dated 1886,the relationship between the magazines,the steam driven incorporating mill,and the mixing house are clearly seen. This map also shows that the tramway ran on a platform for its whole length and that the wagons or trucks were turned by small turntables; these two features were to persist in the rail system of Waltham Abbey for many years. The 1866 map also reveals that a branch line had been built,which extended the tramway from the mixing house to the new Group C steam operated mill built in 1861.

In May 1861,there was an explosion in the Group A Mills and a report,with sketch,appeared in the Illustrated London News of 8th June 1861. The engraving shows a round-topped truck which was probably of the type used on the tramway. It is very similar in outline to that shown in a Strand Magazine photograph of 1895. The latter illustration also serves to give an impression of the tramway on a platform outside an incorporating mill.

During the period 1857-88,the number of steam

incorporating mills was increased and the tramway was extended to join them. A novel feature of the tramway system at this time was the use of a lifting bridge over the canal which ran between the Group C,D and F Mills and the Group E Mills. On a plan dated 1877,showing the extension of the track on its platform to the new Group E Mills,is a drawing of the bridge over the canal. The bridge opened in the fashion of a drawbridge.

Part of the lifting bridge drawing gives details of the construction of the tramway platform. Close inspection indicates that the rails were wooden battens with the upper and inside surfaces protected by metal cladding of right angular cross section. Such rails can be seen in a photograph dated 1892 of the tramway outside the Group G Mill. The practice of armouring wooden rails with iron or other metal was adopted possibly as early as 1716 in colliery tramways,but must have been unusual in the late 19th century. The drawing also indicates that the gage of the tramway was 2-ft 3-in,and that the platform upon which it sat was f-ft wide.

By 1888,the tramway linked the gunpowder mixing house with the Group A,C,D,E and F Incorporating Mills,and extended to the new canal cut,which terminated by the Group F Mill and its associated magazine. A drawing of the tramway bridge over Cobbins Brook dated August 1888 shows that solid metal rails of conventional cross section were being employed here. They were probably of steel by this time as steel rails became readily available in the 1860's. Thus in the 1880's and 1890's at least two types of rail were in use,conventional steel and clad wood. The latter appears to have been reserved for the track on the raised platforms,and photographs indicate that the clad wood was ultimately replaced by conventional steel rails.

A detailed drawing dated 1879 of the terminus at the

new canal cut shows that a run round loop was necessary to allow trucks to stand outside the magazine without interrupting the return flow of trucks to the mills and mixing house.

By 1888,there appear to have been two new rail systems not connected with that already described; one to link the Group H press house with magazines on the canal,and the other on the South Site of the factory which was described as a tramway. This tramway ran from a wharf on the old River Lea to the gun shed by the proof butts. These butts were part of the firing range used to assess the quality of the gunpowder and guncotton produced in the factory. The total length of rail system,including this tramway,was still not more than a mile.

THE ADVENT OF CORDITE MANUFACTURE.

The factory began manufacturing the new explosive,guncotton,in the early 1870's. The first expansion of the factory took place in 1885 when the North Site production of guncotton was found to be inadequate,but there was no significant extension of the railway system until the beginning of cordite manufacture at the factory in the 1890's.

Guncotton,or nitrocellulose,is manufactured by treating cotton with a mixture of nitric and sulphuric acids. Cordite is an explosive manufactured by the combination of guncotton with nitroglycerine,using acetone as a solvent. The main changes at Waltham Abbey consisted of the building of the guncotton works south of Cobbins Brook,the Quinton Hill nitroglycerine factory,the cordite blending houses and the cordite drying stoves on the South Site. Following an explosion in the South Site nitroglycerine factory on the 7th May 1894,there was a Committee of Inquiry into the accident,and Appendix 1 of that Committee's Report shows the extent of the South Site tramway at that time. This tramway is also clearly shown on the Ordnance Survey map of 1897.

During this period,another nitroglycerine factory was established on the North Site,and many of the existing steam powered gunpowder mills were converted to the manufacture of cordite. By 1911,the length of the tramway lines had increased substantially,although there were still many areas not served by them.

On the South Site,there were connections between the mills on Lower Island Way,the guncotton works by Cobbins Brook,the nitroglycerine factory,and the cordite blending houses and magazines. There were no rail connections,however,amongst the thirty or so cordite tray stoves which removed the solvent used in the manufacture of cordite stick. The whole of the cordite

tray stove complex was served by a system of canals off the River Lea. The internal transportation on the North Site was also still very dependent on the waterways. There was no rail link between the nitroglycerine factory and the cordite stoves in Edmondsey Mead at the very north of the North Site was also still very dependent on the waterways. There was no rail link between the nitroglycerine factory and the cordite stoves in Edmondsey Mead and the newly converted cordite factory based on the Group A to F Mills and press houses.

Tramway connections were established between these mills and the new cordite reel drying stoves and magazine built in 1904 on Great Hoppit Island. The original tramway between the gunpowder mixing house and the Group A Incorporating Mill had been severed by 1897,but the eastern part was used to provide the link between the Group A to F Mills and new facilities on Great Hoppit Island. Although the extent of the track increased very substantially during the period prior to World War 1,there appears to have been very little change in the operation of the tramway. The trucks continued to be manually propelled and as yet no evidence has been found of trucks being towed by horses or by any other means,except during the construction of the South Site cordite stove complex. A photograph taken at this time clearly shows that horse-drawn tip wagons were used,possibly on temporary track as the project involved the excavation of a canal network.

The factory rules of 1914 emphasise the need to keep the trucks clean and for good house-keeping. The trucks were to be pushed,not pulled,and workmen were instructed not to go faster than a walk. The rules also indicate that there were different trucks for different purposes,and that great care had to be taken with trucks

containing dry guncotton or cordite paste. If trucks containing these materials were derailed then 'the assistant foreman or superior authority...to be informed at once to superintend'. The dry guncotton or paste had to be removed from the derailed truck before re-railing was attempted. Derailment seems to have been a problem at times. In 1891 a memorandum to the Superintendent of the factory stated that 'the turntables on the 18in gauge tram line are very unsatisfactory. They continually throw the trucks off line,they jolt them in a very violent manner,and the catch is liable to catch the trucks. They also harbour water and in wet weather splash most disagreebly.' The Superintendent took note and instructed that the turntables be replaced with others of improved design.

The reference to 18in gauge in the 1891 memorandum is interesting,as it shows that the 2ft 3in gauge of the early gunpowder mill tramways was not used in later developments. Possibly the narrower gauge was introduced at the same time as the factory extensions associated with cordite manufacture. Problems with the tramways were experienced in this period,such as rails being laid in the wrong direction in part of the cordite factory,and there was some discussion as to whether rails in the cordite re-reeling house should be of brass rather than steel for reasons of safety. The Superintendent supported the use of brass rails,but the Director General of Ordnance Factories considered them unnecessary. The Superintendent then issued an instruction to the Building Works Department stating that 'scraps of cordite fire under the trucks when steel rails are used...If such an accident were to happen inside a house which is full of dry cordite,the consequences might be serious. It would be better to use wooden rails if not brass.' Wooden rails were employed and the remains of such rails laid in WW2 could still be found in the Establishment in 1989.

The Superintendent and the Director General of Ordnance Factories also had differences of opinion on the safety or otherwise of moving 75 pound lots of mixed guncotton and nitroglycerine by railway truck or by hand barrow down a steep incline. The director General thought it was more dangerous in a truck,and two men should carry the box on a light stretcher,one at a time. The Superintendent of the factory noted the Director General's comments and presumably acted upon them. Such were some of the problems of senior management at that time.

The construction of the track appears to have been of two types at the end of this period. The track on the ground consisted of steel rails with a weight of 20 pounds per yard,held together by pressed steel sleepers. On the elevated wooden platforms,similar steel rail was pinned or spiked directly to the platform,this form of track construction having replaced the earlier system of metal-clad wooden battens.

THE NARROW GAUGE RAILWAY 1916-17.

During WW1,major changes in the rail system took place with the building of a narrow gauge railway,suitable for lightweight locomotives,and interchange sidings with the standard gauge railway adjacent to the Royal Small Arms Factory. The construction of the narrow gauge railway between the Royal Gunpowder Factory's North and South Sites was a major undertaking requiring some unusual engineering features.

The new railway was planned in 1915-16 and appears to have been constructed mainly in 1916. The line was 1 5/8 miles long and started south of the cordite reel store on Great Hoppit Island. It ran a meandering course over the canal at the end of the Island,under the main Waltham Abbey to Waltham Cross Road,over the old River Lea,then down Lower Island Way over Cobbins Brook,through the main body of the cordite factory,to a coal siding and interchange siding with the Royal Small Arms Factory standard gauge railway on the south west edge of the factory.

The map of the narrow gauge system indicates that the points were numbered,and it is assumed that the 'mainline' followed the lowest numbers,from 1 (by the North Site locomotive shed) to 43 (acetone factory). It is unlikely that locomotives could use all this track but it is assumed that they ran along the 'mainline' from Great Hoppit Island to the Royal Small Arms Factory interchange sidings. The railway was 18in throughout,and those parts which were intended for locomotive haulage had heavier rail (30 pounds per yard),compared with 25 feet for those parts which were not used by locomotives.

The first noteworthy feature of the new railway,travelling from north to south,was the two road

engine shed located on Great Hoppit Island. There were new sidings by the shed,presumably to make up and break down trains of trucks for the South Site. How much further north beyond the shed the locomotives worked is not known. From the vicinity of the engine shed the line went due south,then swung round to the east on the swing bridge over the canal.

The swing bridge at Great Hoppit Island was necessary to allow water traffic access to the factory. The bridge was 76 feet long and split approximately half way along its length; the eastern portion being fixed,the other rotating about a turntable on the west bank of the canal. The two portions met at a concrete pier approximately in the middle of the canal. The swing span was operated by hand from the western bank. On the fixed span was a signal connected to the locking mechanism,so that if the swing span was not locked properly into position,the signal would remain at danger. It was impossible to move the bridge without operating the signal.

The bridge was constructed from steel lattice work with a wooden decking which carried the rails. Drawings of the bridge show the details of construction and the locking mechanism.

After the swing bridge,the track headed south through a 64 feet radius curve between existing buildings,then dropped on a gradient of 1 in 60 to go under the main road that ran from Waltham Abbey to Waltham Cross. The gradient down to the tunnel was the most severe on the whole railway. The construction of the tunnel under the main road was no mean feat as it ran parallel to and alongside the river. A coffer dam had to be built in the river leaving a passage just wide enough to allow boat traffic to pass,and to permit work on the relocation of the town sewer and gas main which went under the river at this point. The tunnel and its approaches were

concrete lined to make them water tight,as the track level at its lowest point was 3 feet below the normal water level of the river. The proximity of the railway to the river in the tunnel and the approach cuttings can be seen from the photograph and drawing.

A form of single line working control was in operation through the tunnel. A rope ring served as the token,and no train could proceed into the tunnel unless the driver was carrying the ring. It was kept on a peg at either end of the tunnel,with a notice stating:

'Danger,it is dangerous for any person to enter the tunnel unless he takes the ring which is kept on one of the posts at the end of the tunnel. Any person wishing to take a vehicle through must (if the ring is not at the near end of the tunnel) cross to the far end of the tunnel and bring back the ring:
By Order'

South of the tunnel,the railway crossed the old River Lea at Lovatt's Mead by another swing bridge of steel lattice construction similar to the one already described,excepting that this bridge pivoted about the centre of the river. The signal for this bridge was on the northern bank. From Lovatt's Mead Bridge,the line continued down Lower Island Way and eventually linked up with the South Site railway system. A further swing bridge went over Cobbins Brook. This one was similar to the one at Great Hoppit Island in that it rotated about a shore-based pivot,but its construction was different from the other two. It was an older bridge which was reconstructed,presumably to strengthen it,towards the end of WW1.

The mainline of the railway passed in to the South Site and through the cordite blending house area,then swung over the internal canals to the acetone recovery plant

and standard gauge sidings of the RSAF.

In the interchange area,the narrow gauge railway ran south of and parallel to the standard gauge siding,which occupied the water front wharf on the old River Lea,and terminated by the acetone recovery plant. Cordite was transferred by hand from the narrow gauge wagons to standard gauge vehicles on the paralle track. The standard gauge railway also served an automatic coal chute on the wharf,a boiler house,and the alcohol drum dump. The coal chute was presumably used to load boats which then took coal into the factory via the waterway system.

At this point it is appropriate to say a few words about the railway of the RSAF. This factory was established in 1804,but no railway sidings appear on the Ordnance Survey maps up to and including the edition of 1897. The standard gauge interchange sidings on the boundary between the two factories do not appear on the Royal Gunpowder Factory maps before 1916,although this does not necessarily mean that they did not exist until that year. The RSAF was considerably extended following sanction received in October 1914,and improvements made during the first two years of the War appear to have included the provision of the railway siding from the main Cambridge line of the Great Eastern Railway. The branch,which joined the main line at the north end of Brimsdown station,also gave access to Brimsdown Power Station by 1924. Incoming stores intended exclusively for the RGPF were diverted to a separate delivery point within the RSAF,ultimately passing on to the Gunpowder Factory's narrow gauge railway via the interchange sidings.

The first locomotive known to have been employed at the RSAF was a Muir-Hill petrol tractor of 1925 (works number A,120). It has not been possible to discover how the internal rail traffic was worked before this locomotive was obtained. Either the GER shunted the traffic with its own locomotives,or more likely a system of horse and/or capstan haulage was employed. It is unlikely that steam locomotives were allowed near the interchange area,in view of the amount of explosives handled and the presence nearby of a plant producing acetone,an inflammable solvent.

The RSAF and the RGPF were under common administration for the first two years of the War. The former came under the Ministry of Munitions,Director-General of Munitions Supply in August 1915,control passing to the Director-General of Ordnance Supplies in January 1916. In December 1917 the separation of the two establishments was completed when the Royal Gunpowder Factory finance and accounts were transferred from Enfield to Waltham Abbey.

Towards the end of WW1,plans for extensions to the Royal Gunpowder Factory railway were drawn up. The major one was to run from north of the nitroglycerine factory on the North Site (the CE clearing house ('Composition Exploding') to a junction by the Edmondsey boiler house; the eastern branch was to go to the CE stove,then south over the old River Lea to the Experimental House.
The western branch was planned to run almost due south to the CE packing house and magazine,then south-east alongside the Long Walk,past the gunpowder mills,and sharply west to join the existing railway. This extension would have nearly doubled the length of the railway. From a map dated 1923,it would appear that this scheme was not carried out and neither were any other major additions made between 1917 and 1923.

The 1923 map does not show that some of the proposed assembly sidings were built just north of the engine shed on the North Site.

Post World War 1.

The factory continued to expand after WW1,and the manufacture of TNT and RDX was commenced. This development and that immediately prior to WW2 caused little extension to the overall length of the railway system,but a greater proportion of the traffic was worked by locomotives. The track length suitable for locomotive haulage was 3½ miles by 1940. Also the minimum radius had been increased to 35ft and the maximum gradient was 1 in 30. The figures for maximum gradient quoted at this time are significantly different to those previously cited in the gradient profile through the road tunnel. In view of the length of track available for locomotive haulage,it is unlokely that the battery locomotives,which were in use by 1940,would be restricted to one site. Presumably,the gradients had been eased in the years between the Wars as a matter of policy to permit easier working of the rail system.

The factory began to run down in 1943,and manufacture of explosives ceased by October of that year. Operation continued as a Government Research Establishment,although the title 'Royal Gun Powder Factory' continued to be used until July 1945. By 1952,the railway link connecting the North and South Sites had been dismantled,but some of the railway and the electric 'tractors' were still in use in 1954.

LOCOMOTIVES AND ROLLING STOCK.

The changes in the Waltham Abbey railway system,which took place in 1916,involved the use of mechanical haulage for the first time. The motive power was provided by four locomotives built by Ruston Proctor & Co Ltd of Lincoln. These were oil-fuelled machines of the maker's 'ZLH' type numbered 51697,51707,51901 and 51927,which were delivered over the period from 30th January 1917 to 29th October 1917. They had 10hp single-cylinder water-cooled engines. These were started on petrol and then ran on paraffin once warmed up. Such engines were considered to be a low fire risk compared with conventional steam locomotives.

It is believed that Ruston Proctor's 'ZLH' type was bases on a design produced by the Deutz Company in Germany,shortly before the War. Whether the engine resembled a Deutz design or not,the outline of the locomotive certainly did,and a detailed description appeared in the magazine Engineering of 30th November 1917. Each locomotive weighed 4½ tons,and measured 11ft 6in long by 3ft 6in wide by 6ft high,the drawbar pull was 800 pounds. Two speeds were provided,3mph and 6mph in forward and reverse,and the builders claimed that the locomotives could be safely handled by relatively unskilled labour (including women!). Several photographs exist of these locomotives in service of the RGF,and it is interesting to note that in all cases they are being driven by women.

It is not known whether these locomotives carried any names or identifying numbers while in service at Waltham Abbey; certainly none are visible in the photographs. Similar Ruston Proctor locomitives were used at the Royal Naval Cordite Factory at Poole,Dorset (2ft 6in gauge) and at the various explosive factories near Davington,Kent (3ft 3in gauge). These broader gauge

locomotives had inside frames,unlike the RGPF locomotives which,being 18in gauge,had outside frames. Two examples of the inside frame type are preserved; one of 2ft 6in gauge (52124) at the Museum of Lincolnshire Life,Lincoln,and one of 3ft 3in gauge (believed to be 50823) at the Narrow Gauge Railway Centre of North Wales,Gloddfa Ganol,Blaenau Ffestiniog.

No record has been found of any other oil powered locomotives at the RGPF,nor is it possible to say with certainty how long the Rustons continued in use. The only evidence concerning disposals indicates that one of the Rustons continued in use. The only evidence concerning disposals indicates that one of the Rustons continued in use. The only evidence concerning disposals indicates that one of the Rustons found a later home in North Wales. An advertisement in the Machinery Market of 6th October 1933 stated that Harry Gardam & Co Ltd,dealers of Staines,Middlesex had for disposal a 2ft gauge Ruston oil locomotive. This was acquired towards the end of 1934 by the Oakeley Slate Quarries of Blaenau Ffestiniog,and correspondence in Oakeley records indicates that the locomotive was 51901. The alteration of the gauge to 2ft raises the question of whether the 18 gauge locomotives were built with the frames spaced to accommodate 2ft gauge wheels,in which case the alteration would be a fairly simple matter. Correspondence between Gardam and Ruston8s revealed that the locomotive in question was built in 1925; possibly this can be taken as the date when the gauge was altered rather than the true building date. This might indicate that Ruston 51901,at least,was disposed of by the RGPF in or by 1925. In addition to the four Ruston locomotives,there were during the WW1 period an unknown number of small battery powered tractors. A photograph taken in 1917 shows a locomotive with two battery boxes and a central driving position,carrying a label EDISON STORAGE

BATTERY on the front. No documention has been found relating to this locomotive which might enable the builder to be identified,however it was possibly an 'Edison-Automatic' product. A range of industrial electric vehicles were available under this name by 1919,having batteries by Edison,and mechanical parts manufactured by the Automatic Transportation Company of Buffalo,New York,USA. The batteries could have been made either Britain or the USA,since in 1913 Edison Accumulators Ltd was formed in Britain as a branch of the parent company in the USA.

ROYAL GUNPOWDER FACTORY.

In the RARDE historical collection is a catalogue of H.C Slingsby Ltd,truck builders of London,which was reputedly used when equipment was being ordered during WW1. Under the heading 'Slingsby-Automatic Electric Trucks' this catalogue illustrated a battery locomotive resembling the one photographed at the RGPF. These locomotives were apparently available for gauges between 18in and 3ft,and were fitted with 48 volt 'Automatic' type motor. Since vehicles of Edison-Automatic make were available at around this time,it seems likely that the catalogue locomotive is one of their products marketed under Slingsby's name. The existence of the Slingsby catalogue at Waltham Abbey is of course no guarantee that Slingsby's that Slingsby supplied the locomotive in the 1917 photograph; however the Automatic Transporation Company's apparent link with both Edison and Slingsby does suggest that they may have been the actual builder.

Another early electric 'locomotive' at the factory remains to be described. This was built by British Electric Vehicles Ltd of Southport,and was a motorised flat platform truck of their 'Giant' type. This type of truck was originally designed for road use,and although the one built for Waltham Abbey is believed to have been a rail-mounted version,this can not now be confirmed. The chassis number was 59 and the date was July 1918. This vehicle had a payload of up to 4000 pounds,officially described as 1 ton,and the delivery details are enigmatically given as 'Government Cartridge Factory,No.3 Blackpole,Waltham Abbey,Essex'. It has not been possible to find a picture of this vehicle,and its ultimate fate is unknown.

There is no mystery about a batch of battery powered rail tractors purchased in 1937. They were five in number and came from Wingrove & Rogers Ltd in 1926

and continued to use the 'BEV' trademark. These five locomotives carried serial numbers 1043 to 1047 and were of the maker's type W117,being 4-wheel battery locomotives with outside frames and shaft drive to each axle. The weight in working order was 2½ tons and the maximum load hauled was 10 to 15 tons. Full length canopies were fitted,and delivery took place in July and August 1937.

When further battery locomotives were required after the outbreak of WW2,the RGPF turned to Greenwood & Batley Ltd of Leeds. Ten locomotives were acquired,via the Ministry of Supply,in two batches. The first six carried maker's numbers 1668 to 1673 and were ordered in December 1939 for delivery commencing 19th April 1940. A further batch of four locomotives which displayed numbers 1851,1852,1861 and 1862 were ordered in November 1941 and delivered in November 1942. All ten of these tractors weighed 45cwt each,had a drawbar pull of 360 pounds at 4½mph and could haul about 5 tons. They were 85in long by 36½in wide and 75in high. Power was provided by a 5hp 40volt motor which ran off NIFE batteries. Basic weather protection was fitted in the form of a full length canopy and end screens,and two seats were provided.
These odd-looking battery tractors were re-charged in what used to be the North Site locomotive shed and probably the two charging stations on the South Site; one in the guncotton factory and the other on Quinton Hill. These tractors were still in use long after the factory ceased production and had become a Govenment research establishment. At least three of them were in existance as late as 1958.

No details of the early cordite and guncotton trucks have been found to date. It is known that some of them were made in the Royal Carriage Department at Woolwich Arsenal for a cost of £40 each. According to an order dated 1892 there were then at least four different types,namely trucks without brakes,trucks for carrying cordite reels,trucks for cordite boxes,and trucks for cordite trays. Further types followed as a later specification book lists trucks for cannon cordite to two different drawings,trucks for wet guncotton,and trucks for new rifle cordite.

From the photographs of the Ruston locomotives taken in 1917,it appears that the trains pulled by these consisted mainly of round topped trucks filled with what were presumably trays of cordite. Resembling the bogie vans on the 18in gauge railway at Woolwich Arsenal,these trucks were 12 feet long,had two four-wheeled bogies,and weighed two tons fully loaded. trains were normally restricted to a maximum of six trucks,although the Ruston locomotives had been found capable of hauling nine. The locomotives were also used to haul a wide variety of other loads,including acid retorts,basket of laundry,and possibly guncotton.

In addition to the larger round topped trucks,there were smaller four-wheeled gable-topped trucks. These seem to have been hand propelled and were restricted to the process areas for transporting items such as cordite paste. The weight of composition carried in these hand propelled trucks varied depending upon the nature of the load but it was substantial,considering that it was explosive. For example,the cordite trucks carried 1,000 pounds of wet guncotton in 40 tins,or 640 pounds of dry guncotton in 16 bags. No drawings of these or any other trucks have yet been found but a specification does exist. This specification is for the supply of 19 trucks to no less than 7 different drawings.

Trucks for wet guncotton were purchased to 'Specification 765' in 1938 from the Cambrian Wagon Works of Cardiff,and trucks for cordite were purchased in 1939 from Hudson of Leeds. It is interesting that these specifications refer to the same drawings as those in the 1914 order.

OPERATION.

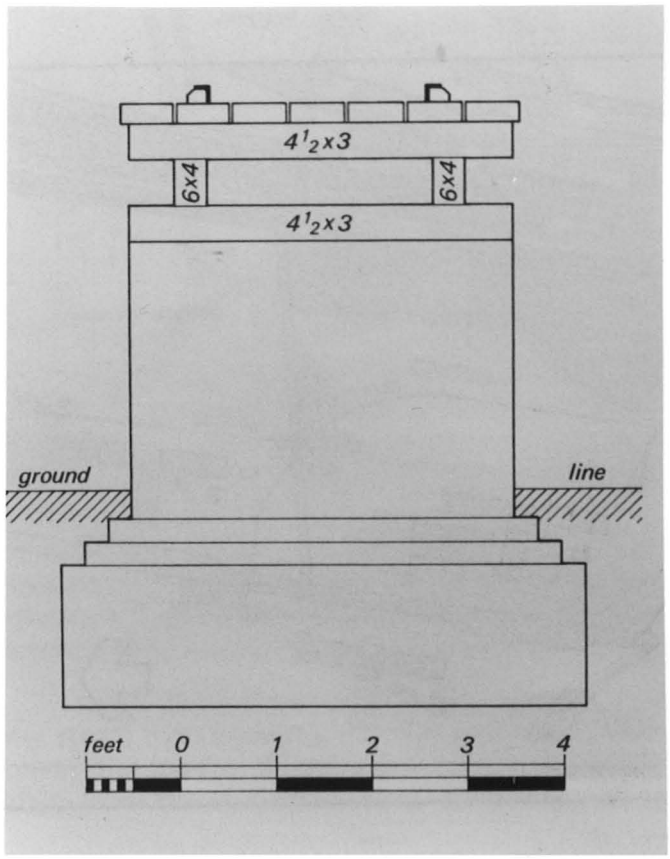
There is very little information in existence on the operation of the railway. It is apparent that there were running orders and traffic rules from amendents to a 1914 Royal Gunpowder Factory Rule Book,which are undated but presumably post January 1917,since locomotives are referred to. An appended note on Running Order 14 states: 'Substitute for first para "Engine and Tractor drivers are strictly forbidden to allow any persons to ride on their locos,except Brakesmen or Pintsmen,Traffic staff,and others provided with engine passes" '. This implies that the train crews were responsible for the operation of the points once the train was dispatched. The same Rule Book has an addition,but no more,to the Traffic Rules. It refers to Traffic Rule No.2 and states 'Add para. "Where tractor trains or specials are to proceed beyond Lower Island Lock,the Traffic Controller (Lower) must be informed and he will inform Traffic Controller (Upper). Such trains will run in the intervals between the regular trains" '. This fragment clearly indicates that there was a system of control operated jointly for the North and South Sites,and that there was a timetable of some sort for the trains. In the same Rule Book,there is a short section of 'Rules for the Protection of the Railway' which was added after the first publication of the Book.

The four rules stated were to prevent obstructions on the railway. There were more extensive rules for the operation of the hand trucks,as already mentioned,and

there were special rules also for the working of the trucks which were part of the process methods for the manufacture of the cordite. No truck was allowed to stop outside a building in which explosives or propellants were being processed. Red signals were raised during the processing to warn the truck operators. Even so,a truck containing 640 pounds of dry guncotton exploded in 1940,killing the two men who were pushing it. The explosion of the truck was caused by a nearby cordite mixing house exploding.

ROYAL GUNPOWDER FACTORY.
CONSTRUCTION OF THE TRAMWAY PLATFORM.

From the 1877 tramway extension drawing. The wooden rails are spaced at 2ft 6in centre giving a gauge of 2ft 3in between the inside faces.



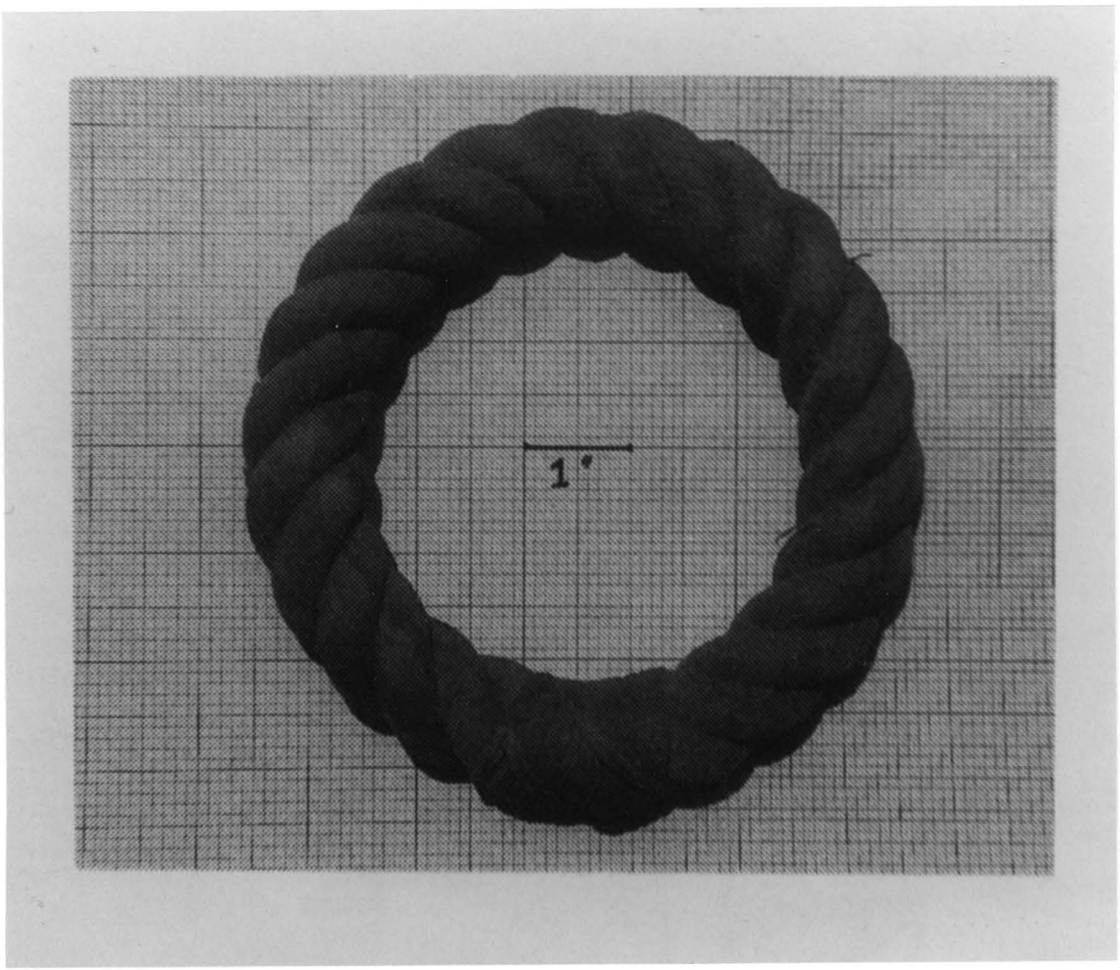
ROYAL GUNPOWDER FACTORY.

ROYAL GUNPOWDER FACTORY.

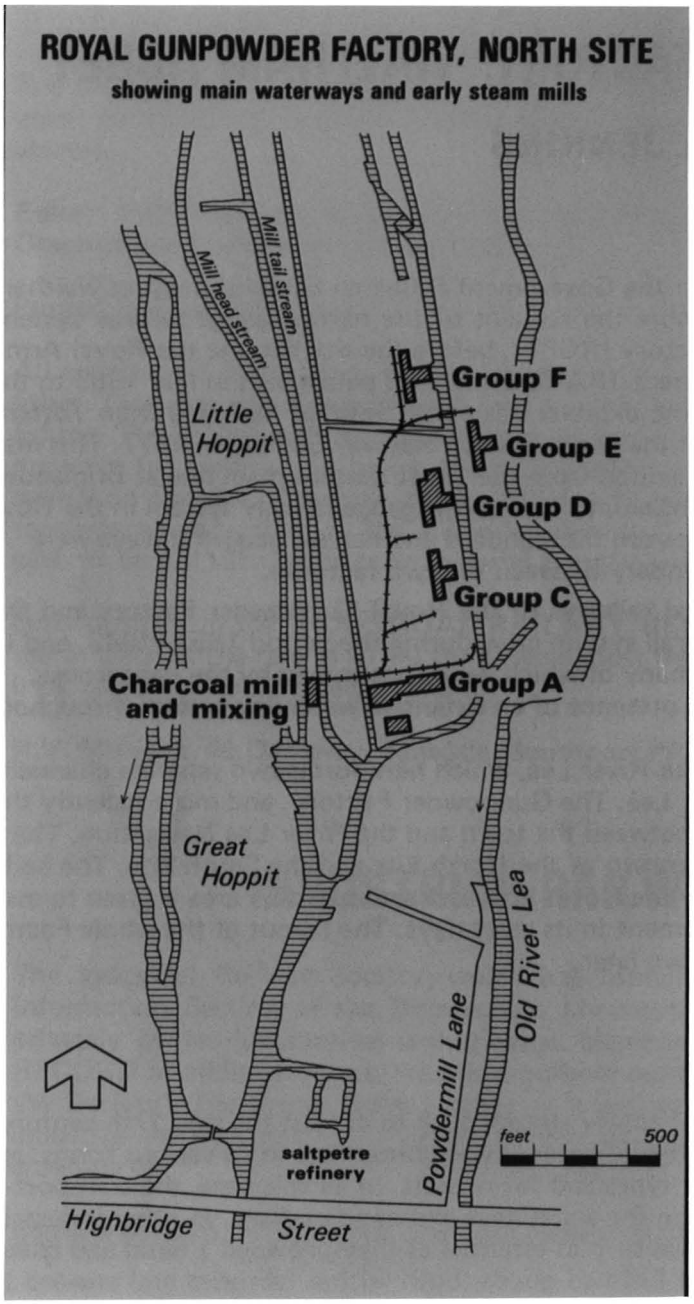
A photograph taken in 1917 showing a train travelling south,with the road tunnel in the background. The railway was 3-ft below the river level where it passed under Highbridge Street,and the substantial wall separating the railway and river is apparent. The locomotive is one of the 1917 Ruston Proctor petrol-paraffin tractors.

ROYAL GUNPOWDER FACTORY.
'SINGLE LINE TOKEN'.

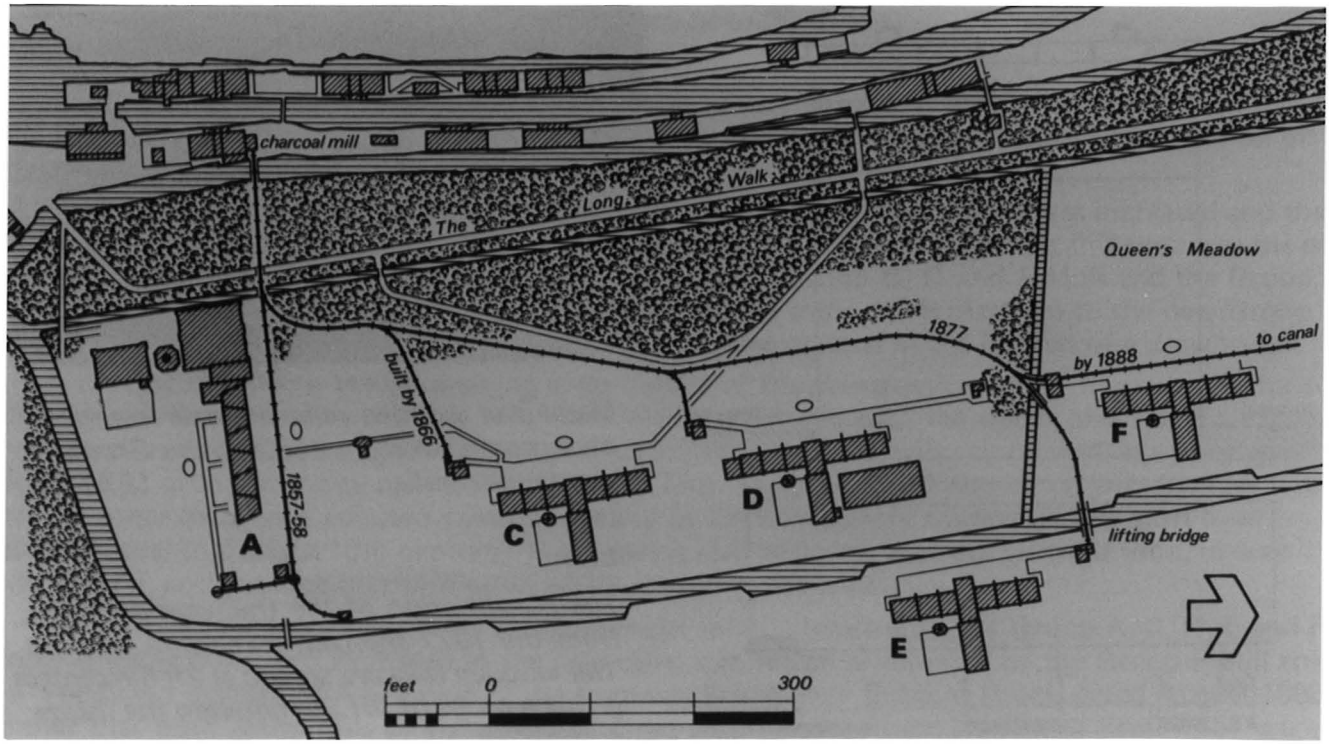
This rope ring served as a 'single line token' for the railway tunnel below Highbridge Street.
The single-line working control was in operation through the tunnel. A rope ring served as the token,and no train could proceed into the tunnel unless the driver was carrying the ring. It was kept on a peg at either end of the tunnel.



ROYAL GUNPOWDER FACTORY,NORTH SITE.

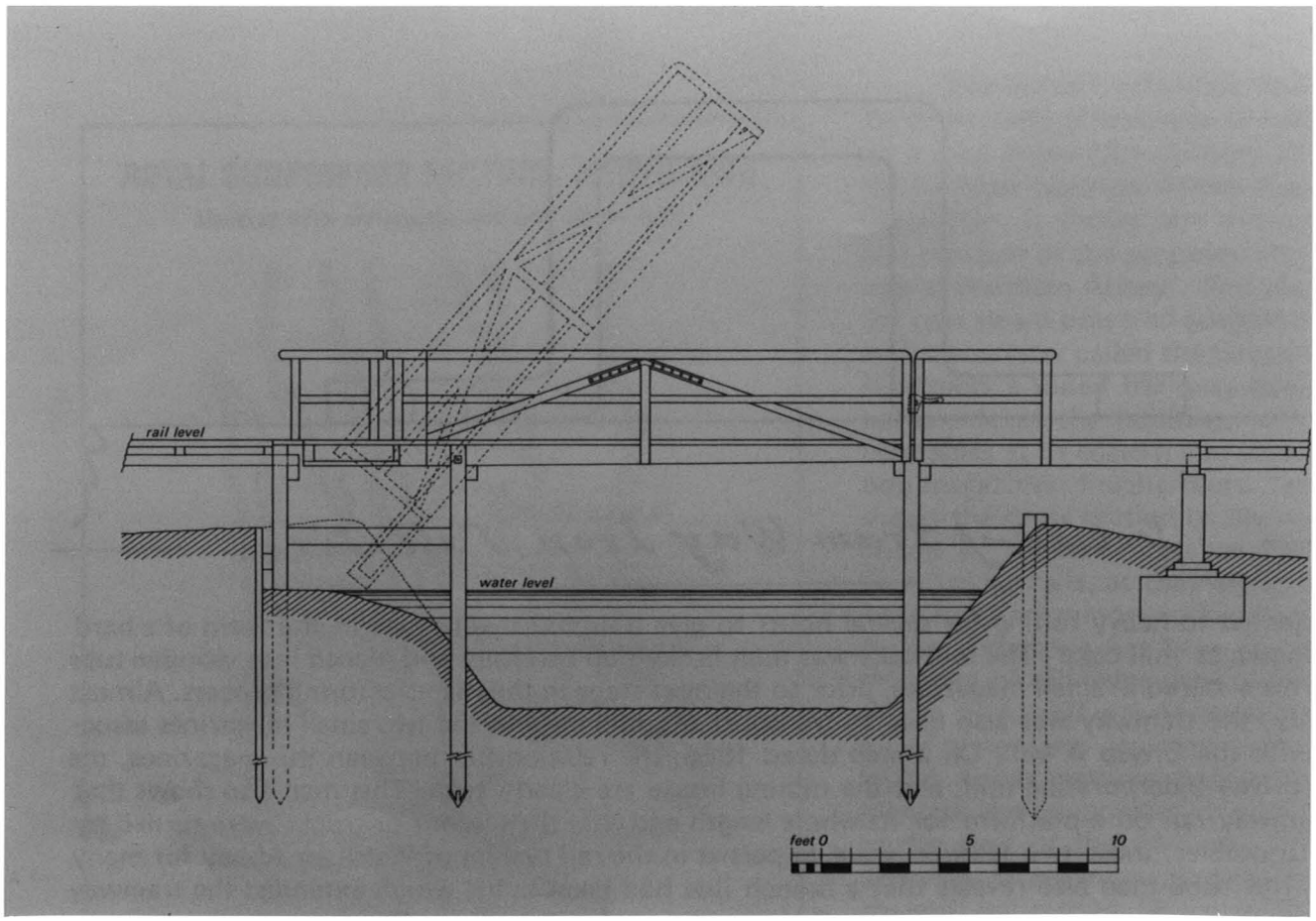


ROYAL GUNPOWDER FACTORY.
THE LONG WALK AND INCORPORATING MILLS.



ROYAL GUNPOWDER FACTORY.

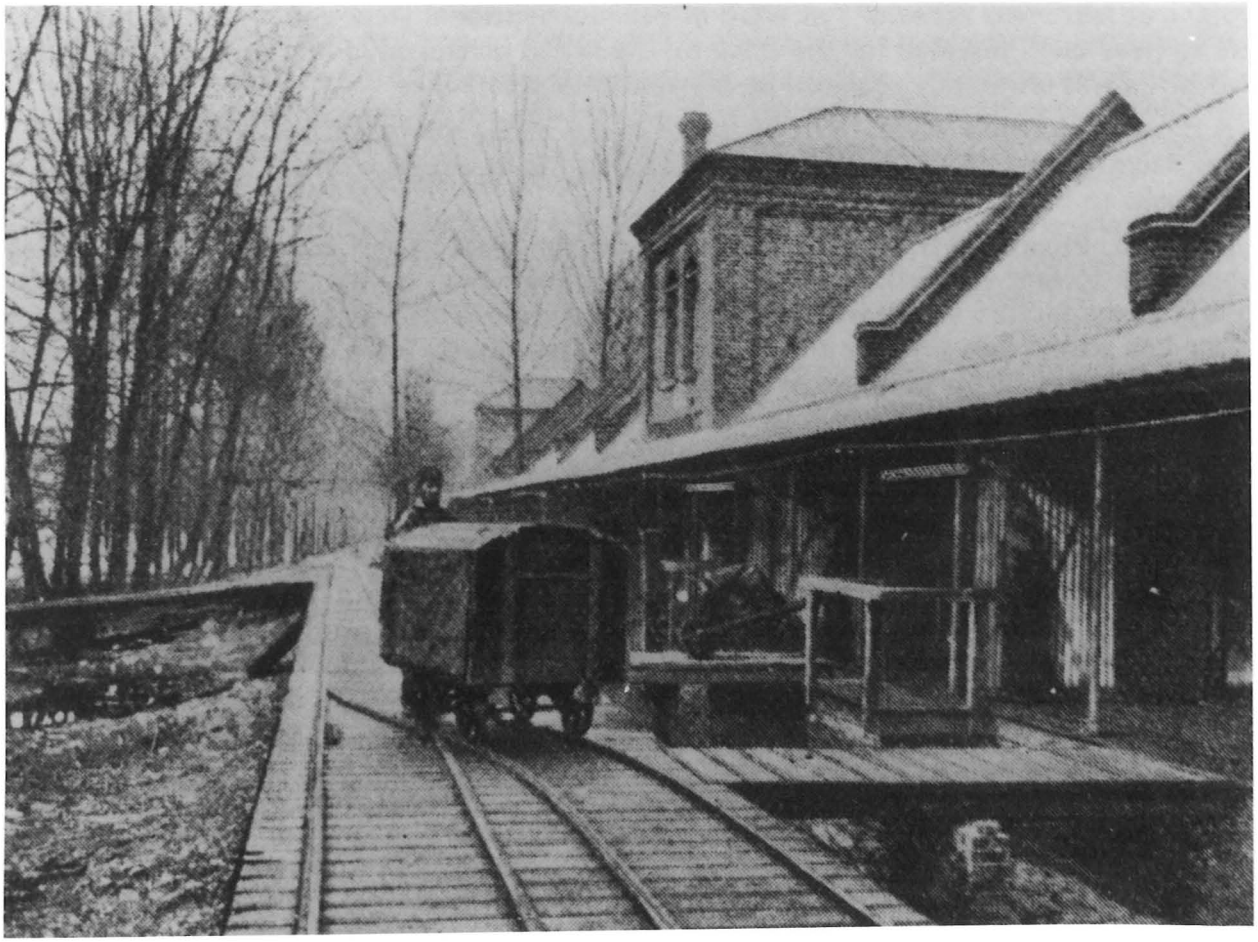
The lifting bridge,from a drawing of 1877. This bridge was on the tramway extension to the Group E gunpowder mills.



ROYAL GUNPOWDER FACTORY.
METAL-CLAD WOODEN RAILS.
Detail from a photograph taken in 1892 at the Group G Gunpowder Mills.

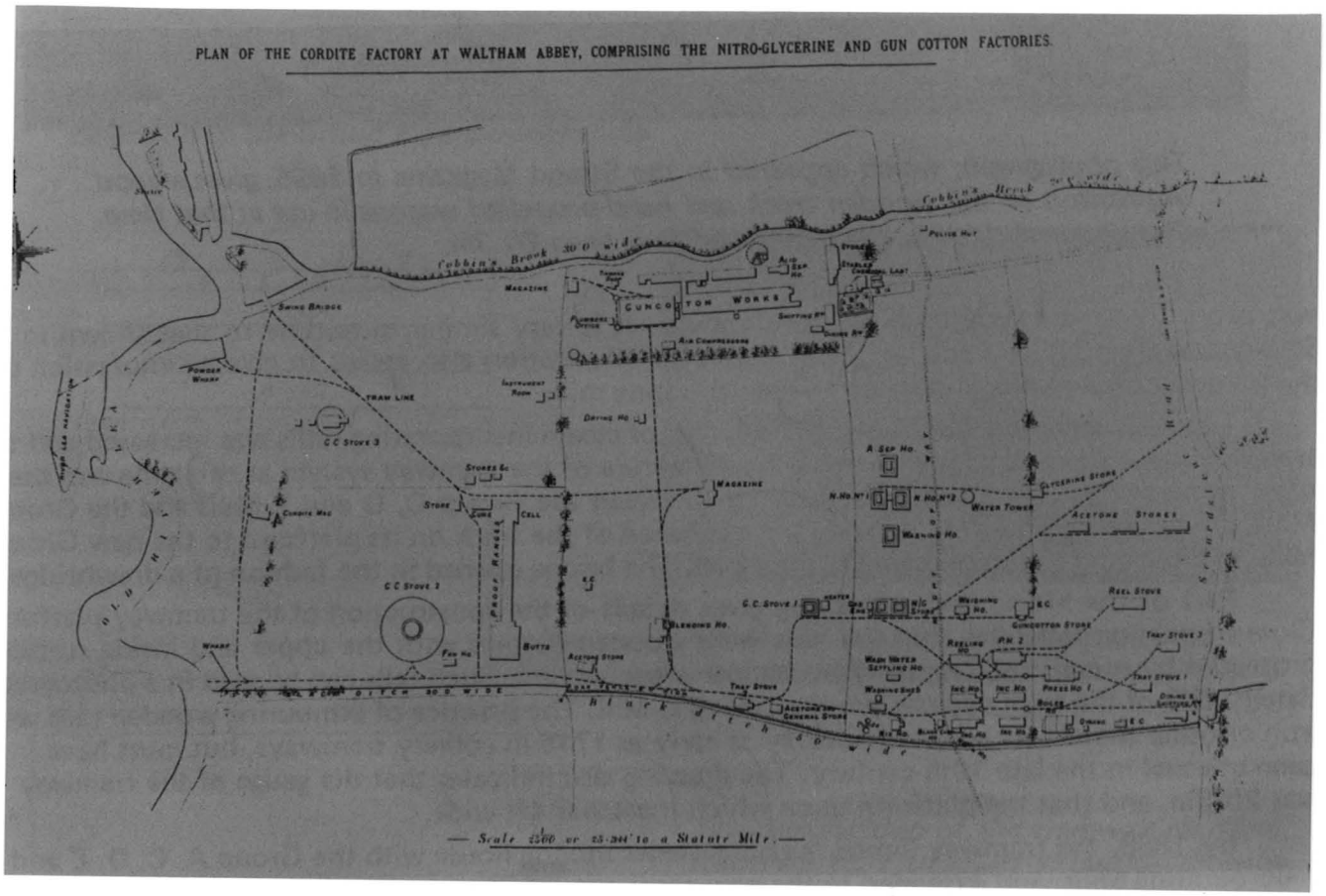
ROYAL GUNPOWDER FACTORY.

This photograph,which appeared in the Strand Magazine in 1895,gives a good impression of the wooden track and hand-propelled wagons in use at that time.
The gauge of this track is thought to have been 2-ft 3-in.



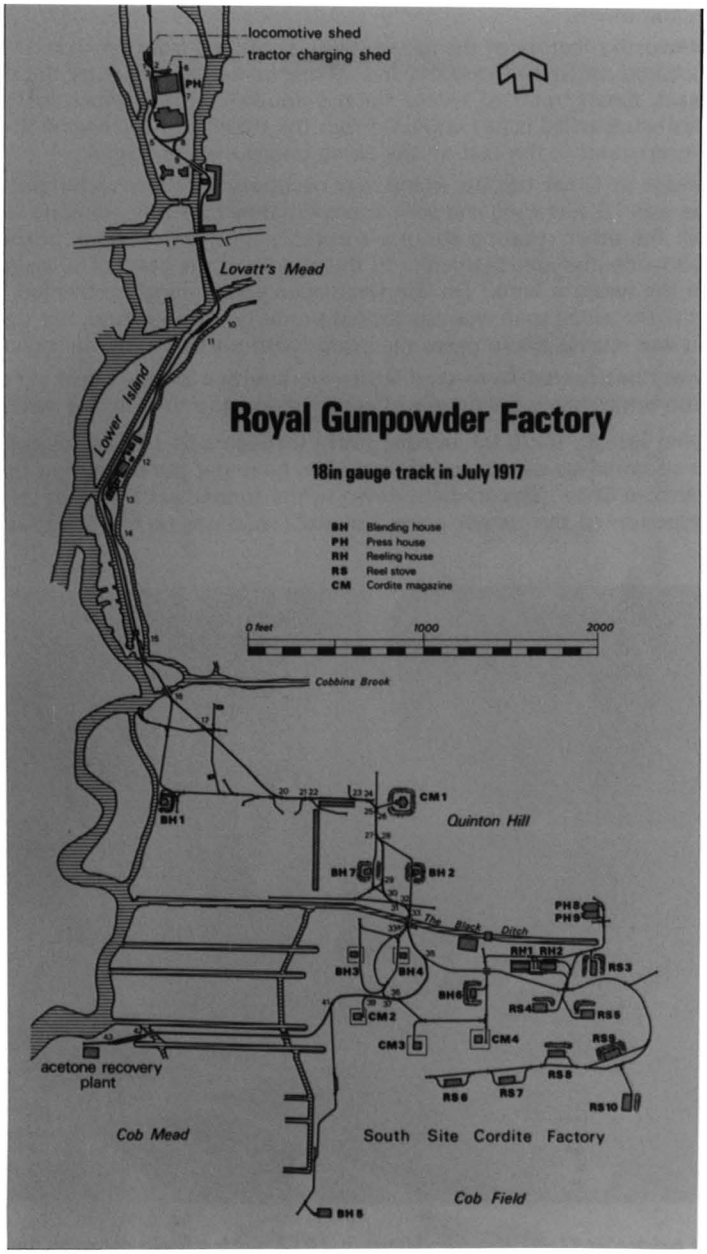
ROYAL GUNPOWDER FACTORY.

The extent of the South Side tramways in 1894 shown by this plan, which accompanied a report on the Quinton Hill nitroglycerine explosion of 7th May 1894.



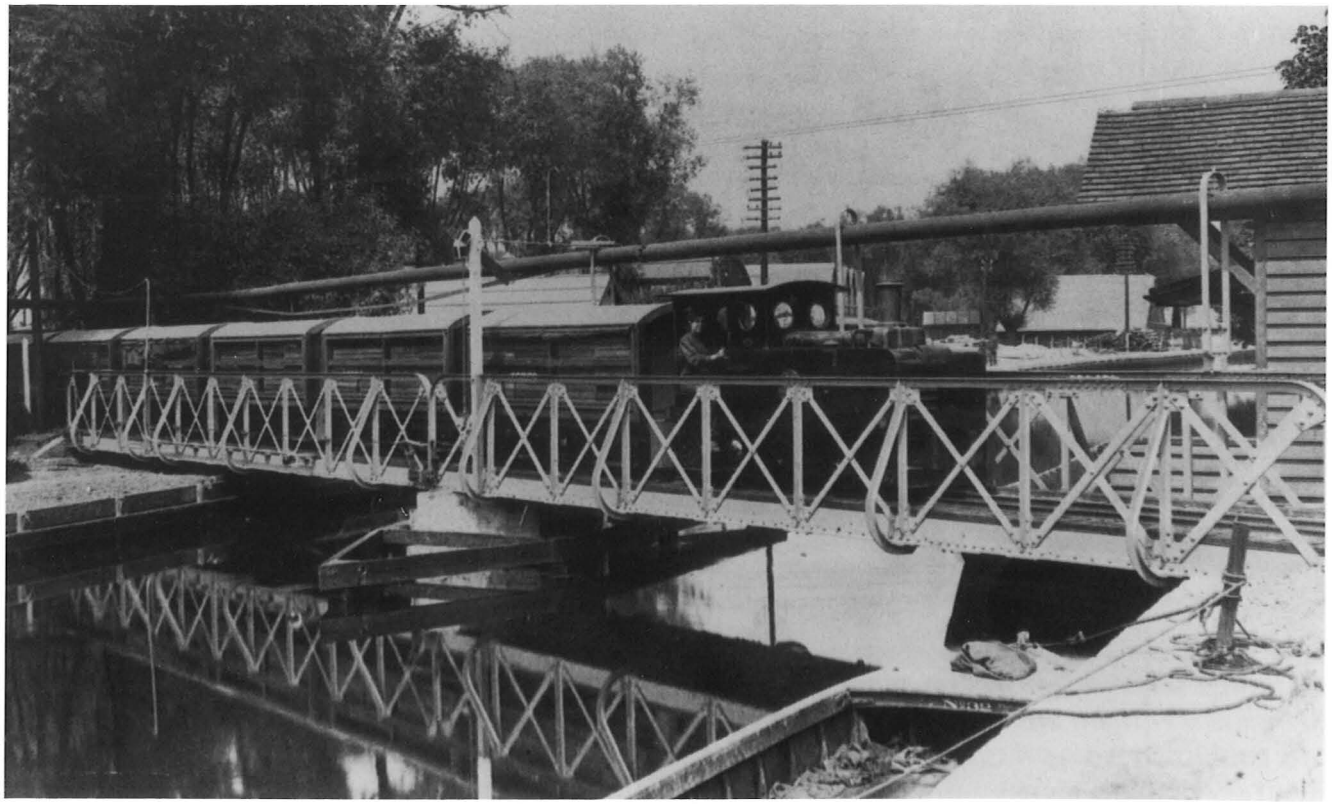
ROYAL GUNPOWDER FACTORY.
Horse-drawn tip wagons in use during the construction of the South Site cordite stove complex in the 1890's.

THE ROYAL GUNPOWDER FACTORY.
18-inch GAUGE TRACK,IN JULY 1917.

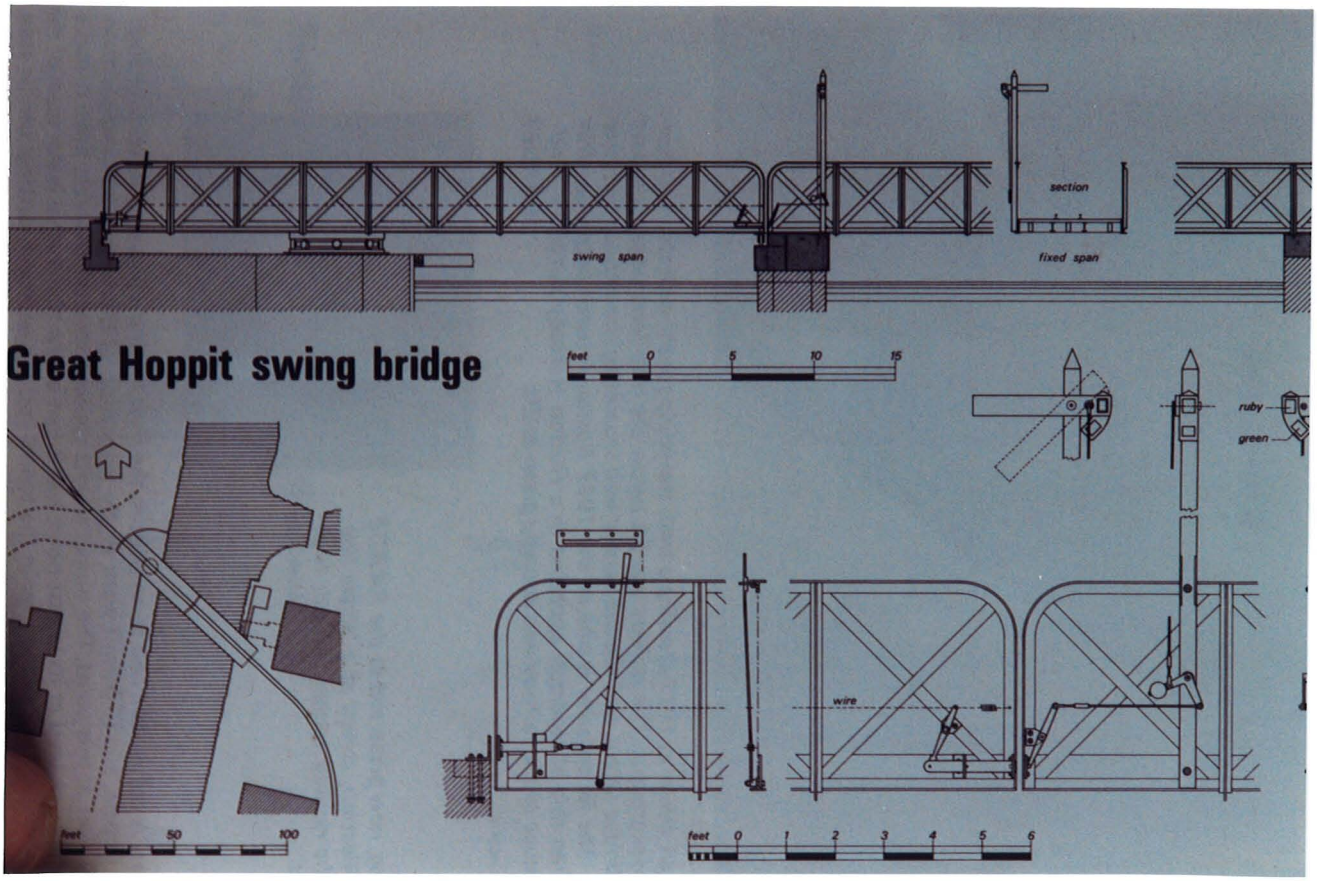


ROYAL GUNPOWDER FACTORY.

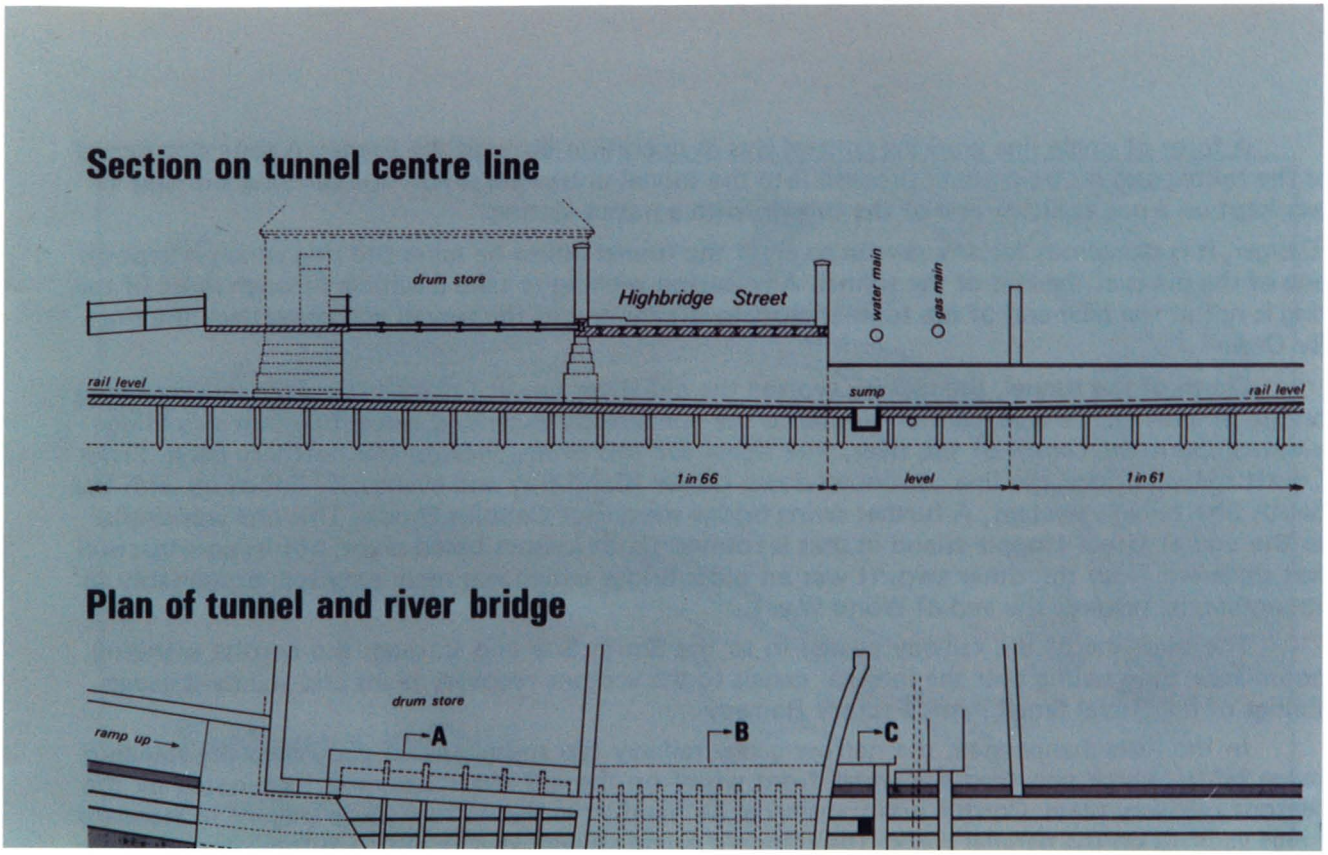
The swing bridge at Great Hoppit Island in 1917, with a train crossing hauled by one of the Ruston locomotives. The camera is pointing north.



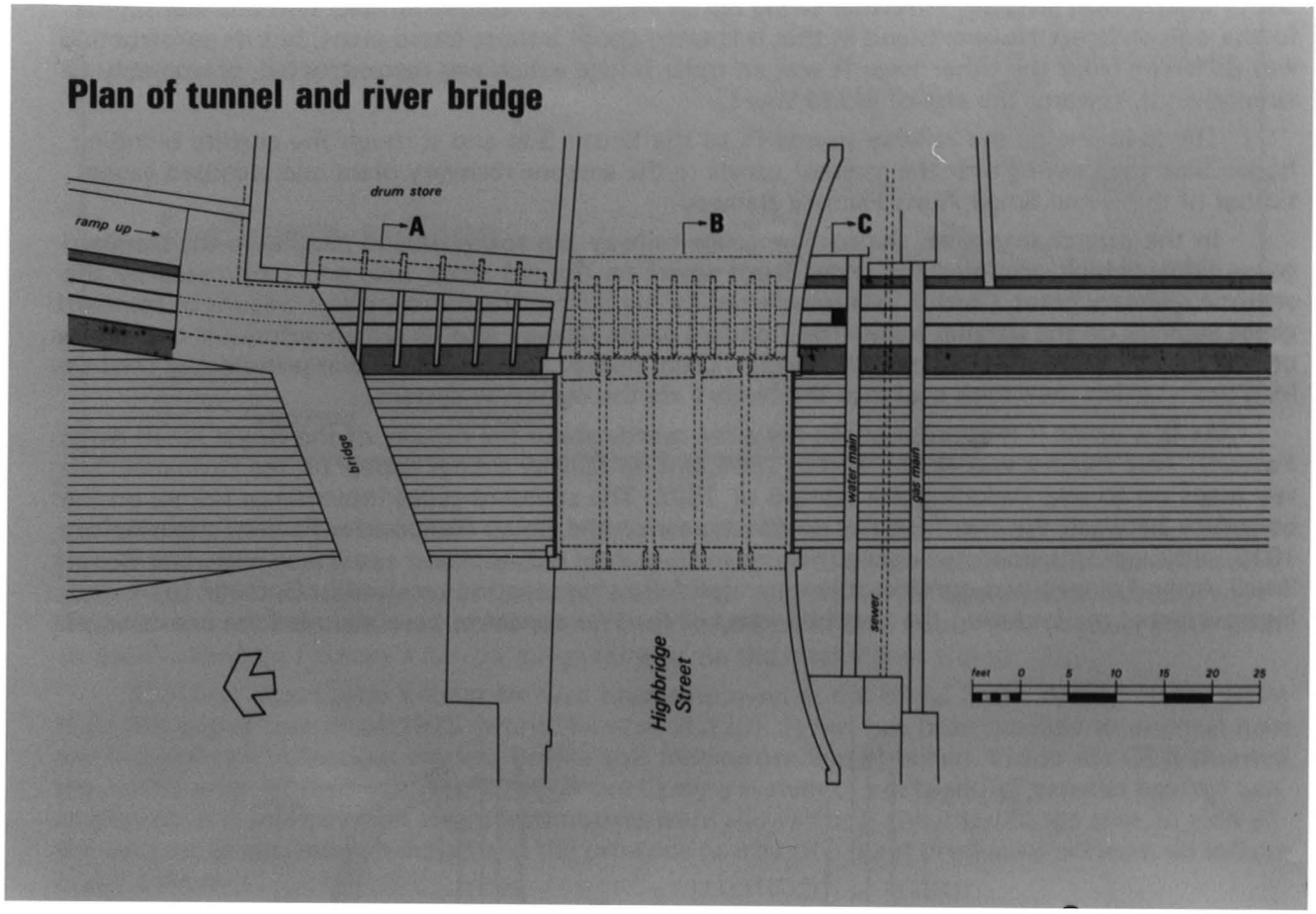
THE ROYAL GUNPOWDER FACTORY.
GREAT HOPPIT SWING BRIDGE.



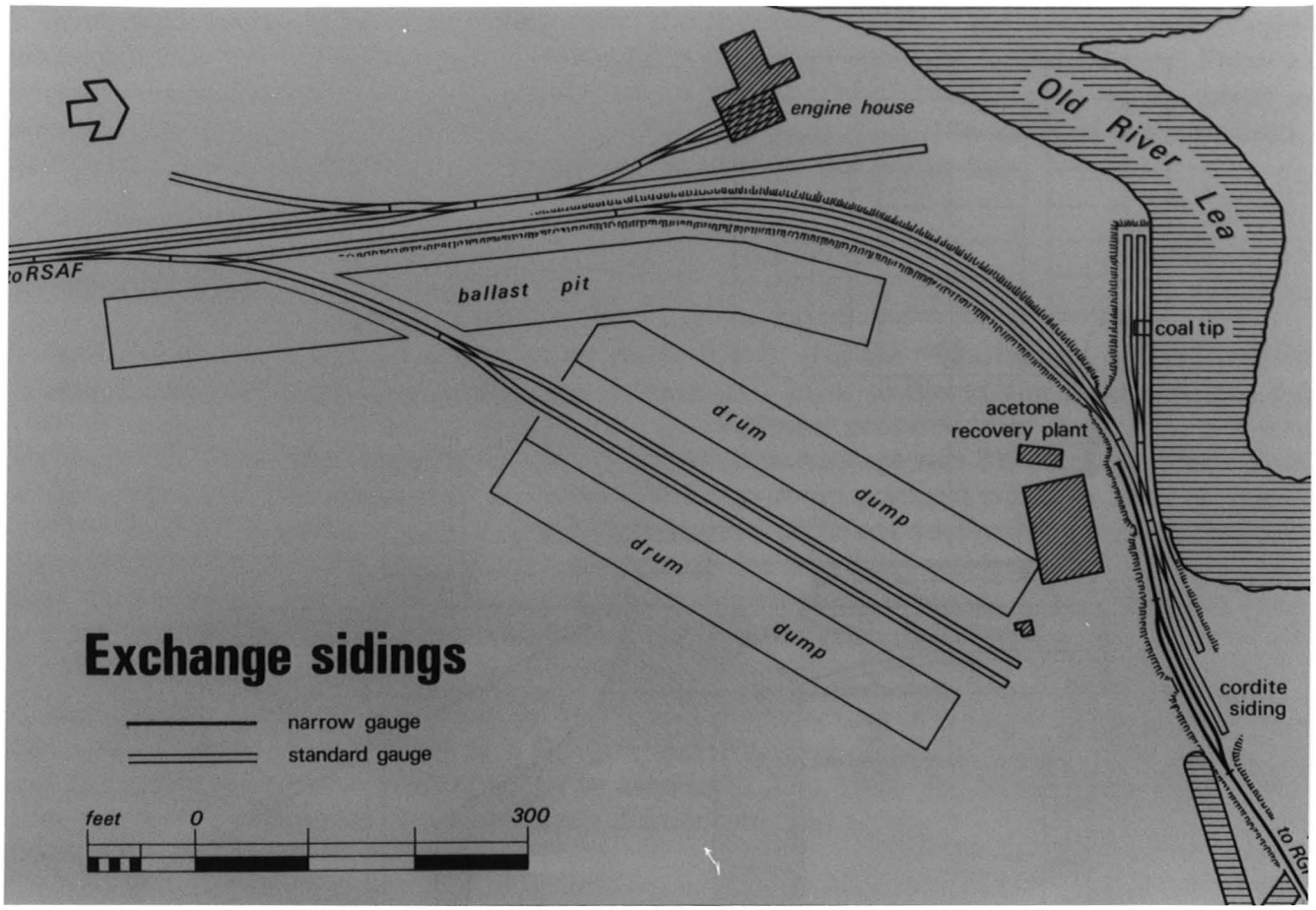
ROYAL GUNPOWDER FACTORY.
Section on tunnel centre line.



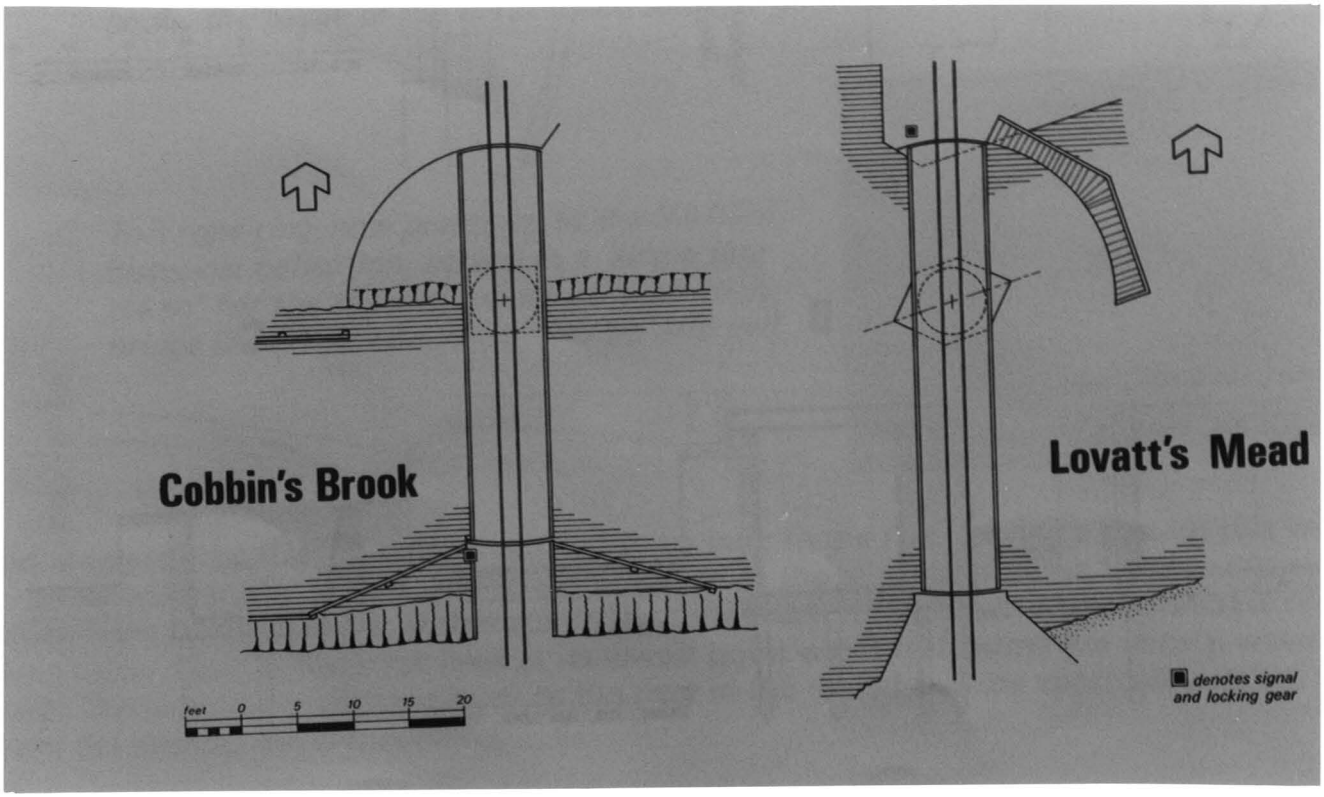
THE ROYAL GUNPOWDER FACTORY.
PLAN OF TUNNEL AND RIVER BRIDGE.



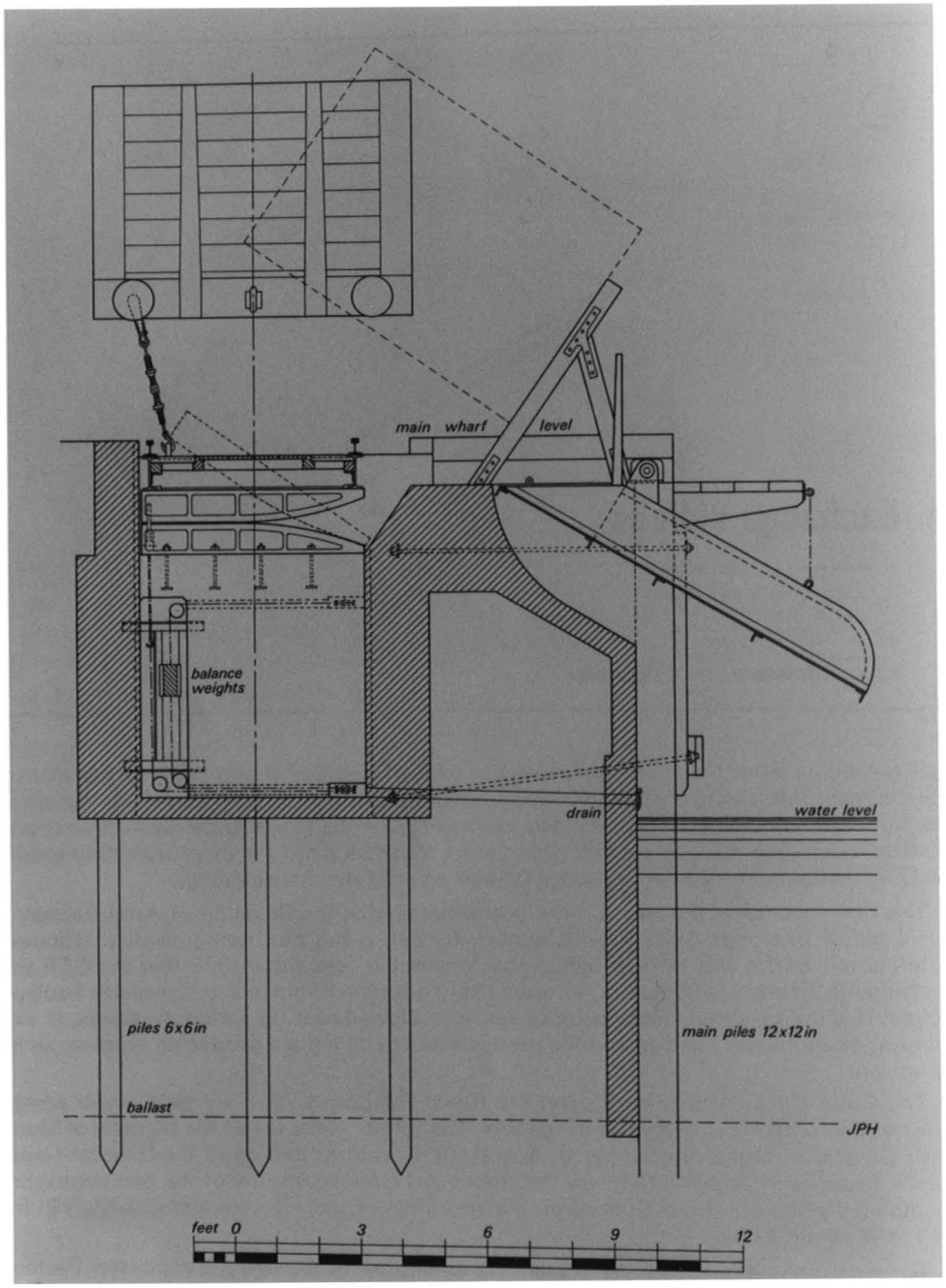
ROYAL GUNPOWDER FACTORY.
EXCHANGE SIDINGS.



THE ROYAL GUNPOWDER FACTORY.
COBBINS BROOK AND LOVATT'S MEAD.

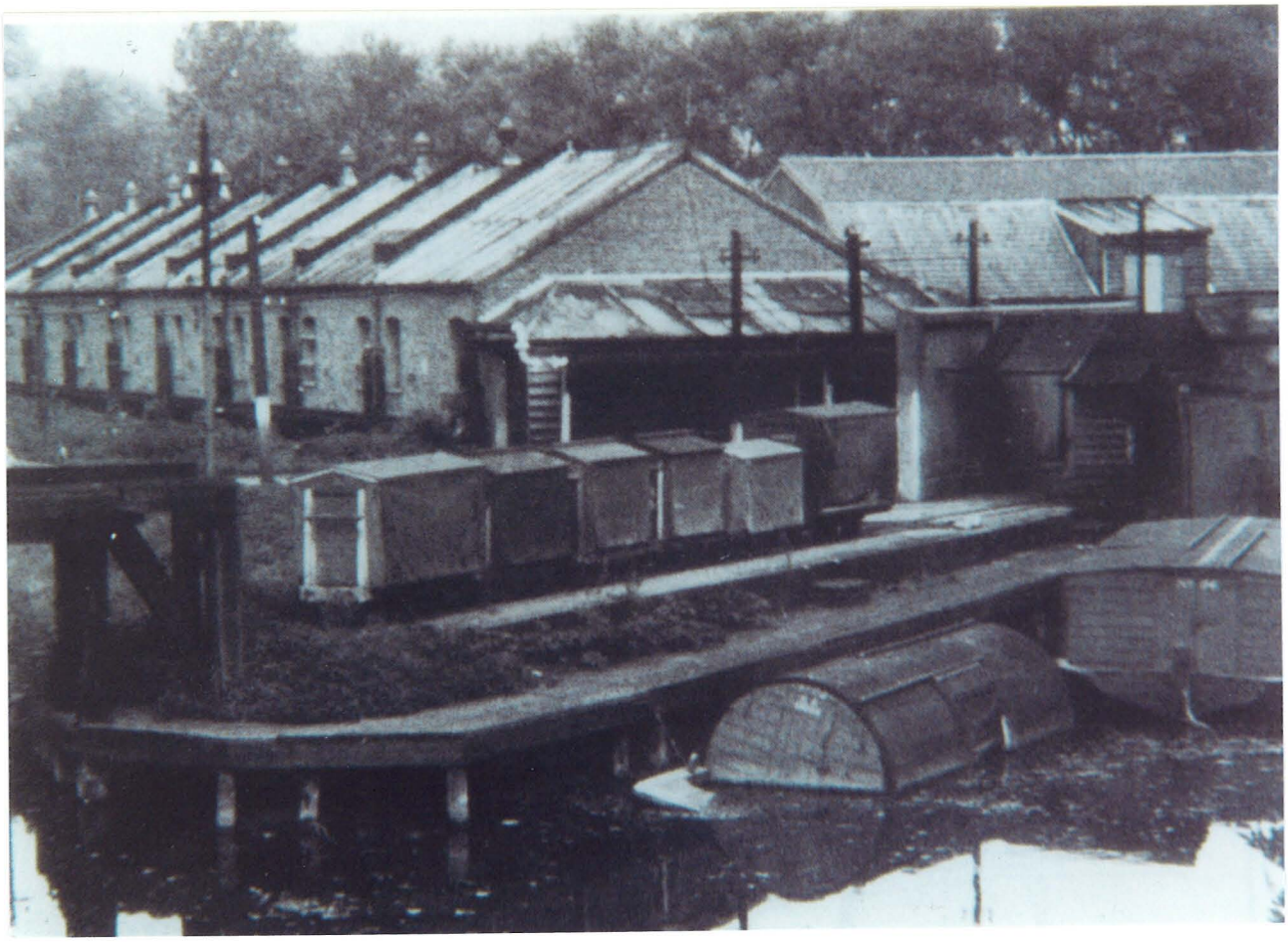


THE ROYAL GUNPOWDER FACTORY.
COAL TIP AT THE RIVER WHARF.

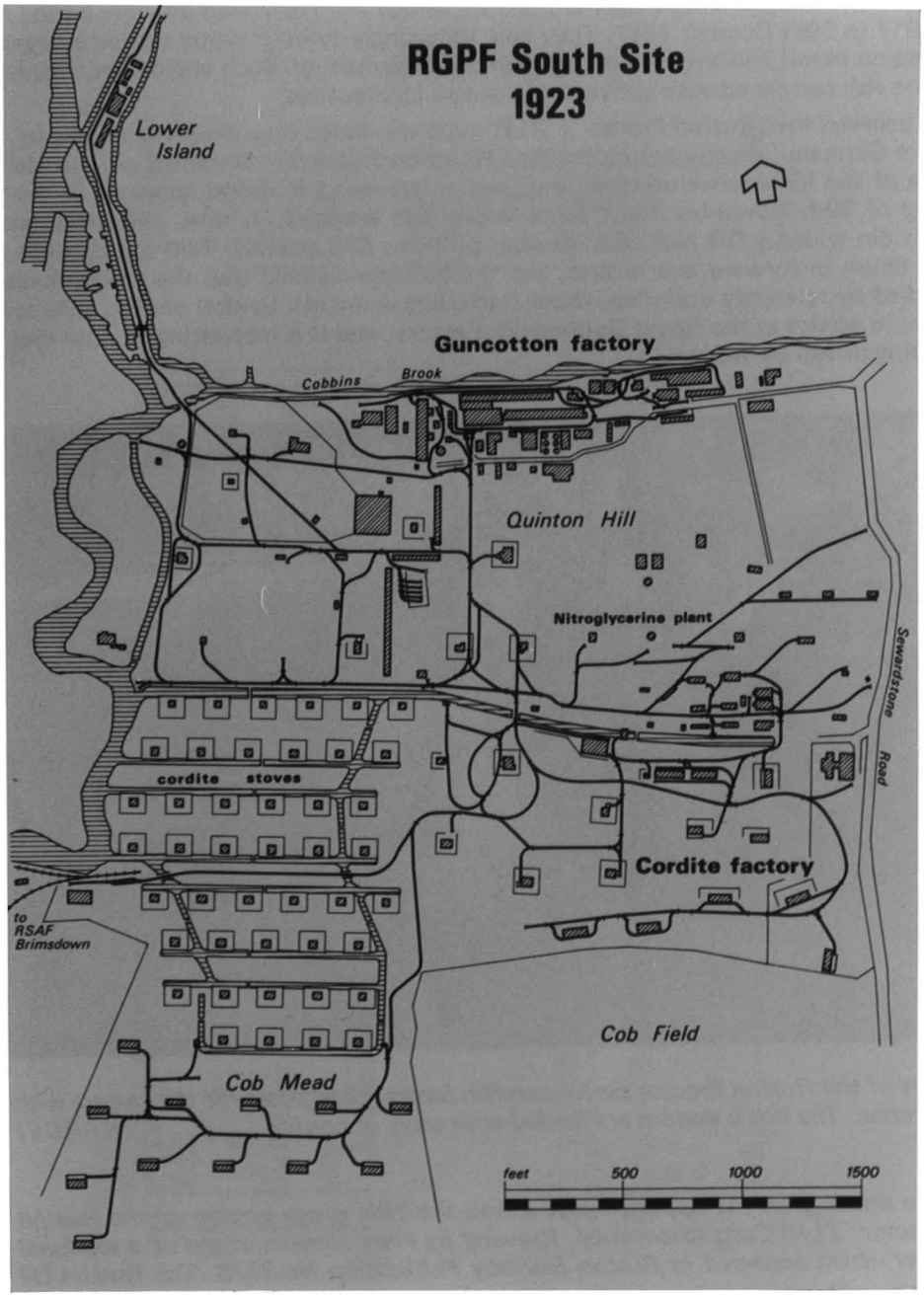


ROYAL GUNPOWDER FACTORY.

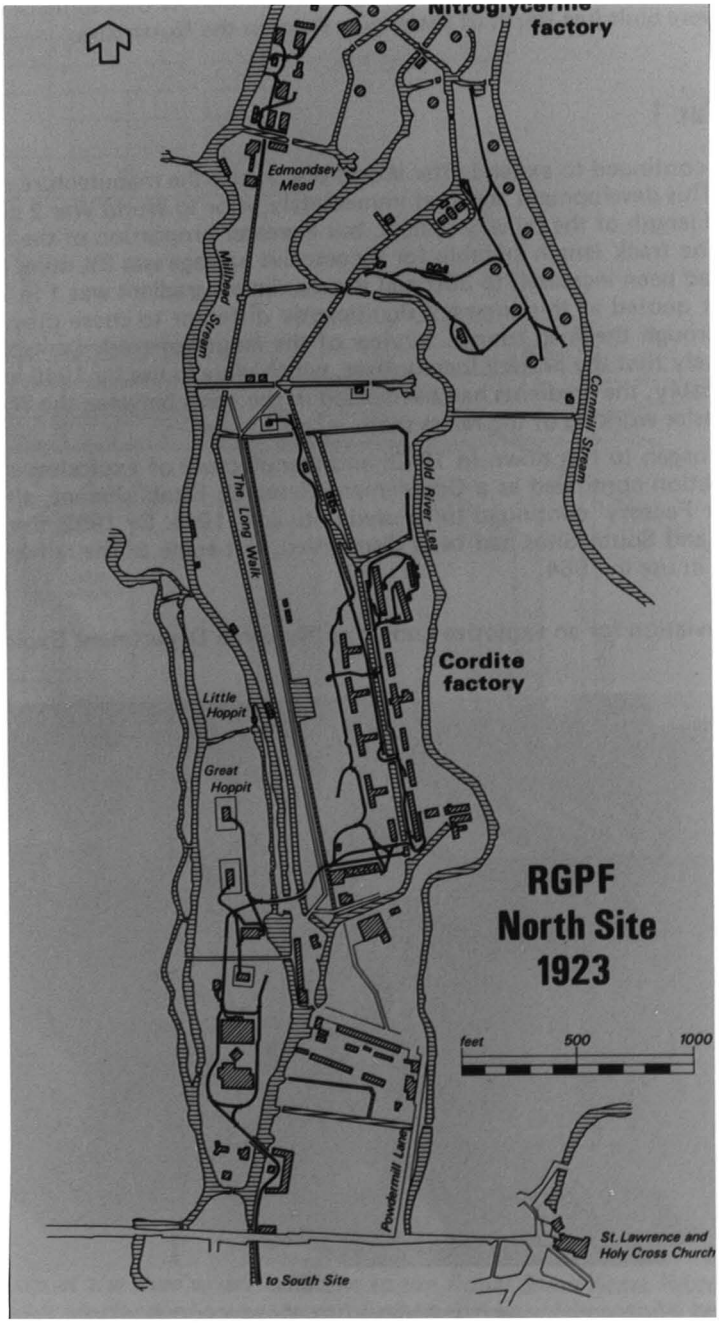
An undated photograph which is believed to show a corner of the North Site. Various types of covered wagons are visible.



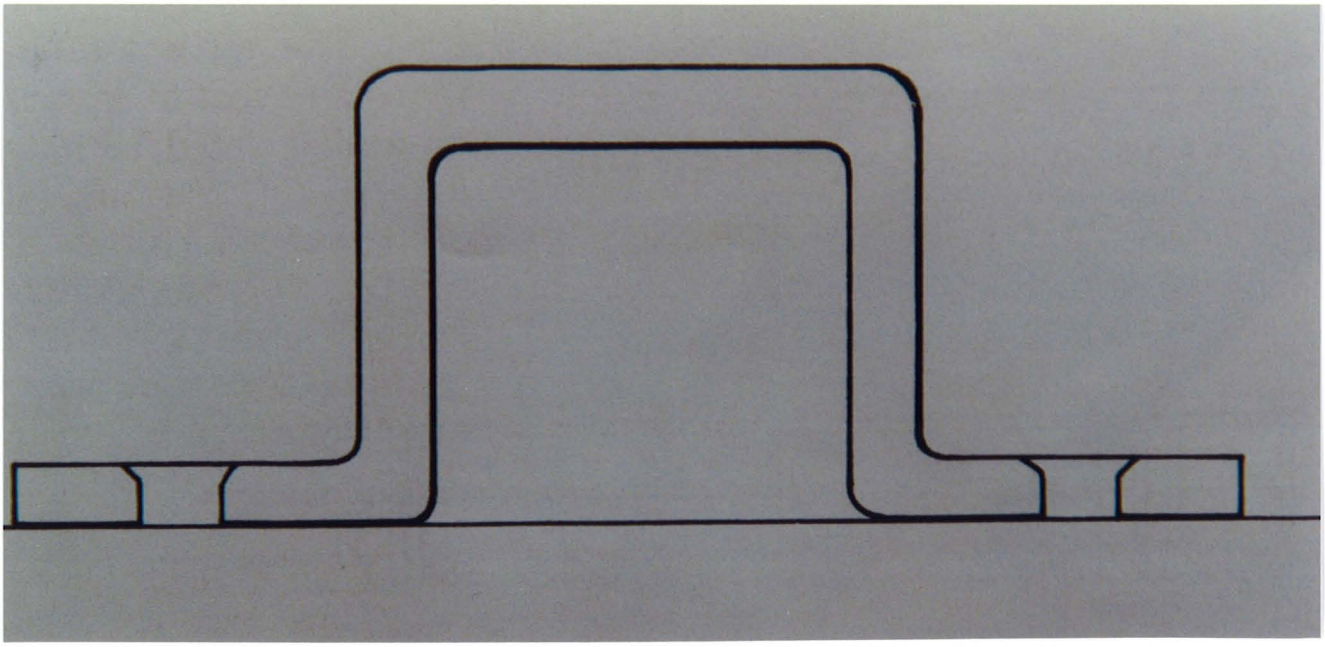
ROYAL GUNPOWDER FACTORY.
SOUTH SITE 1923.



ROYAL GUNPOWDER FACTORY.
NORTH SITE 1923.

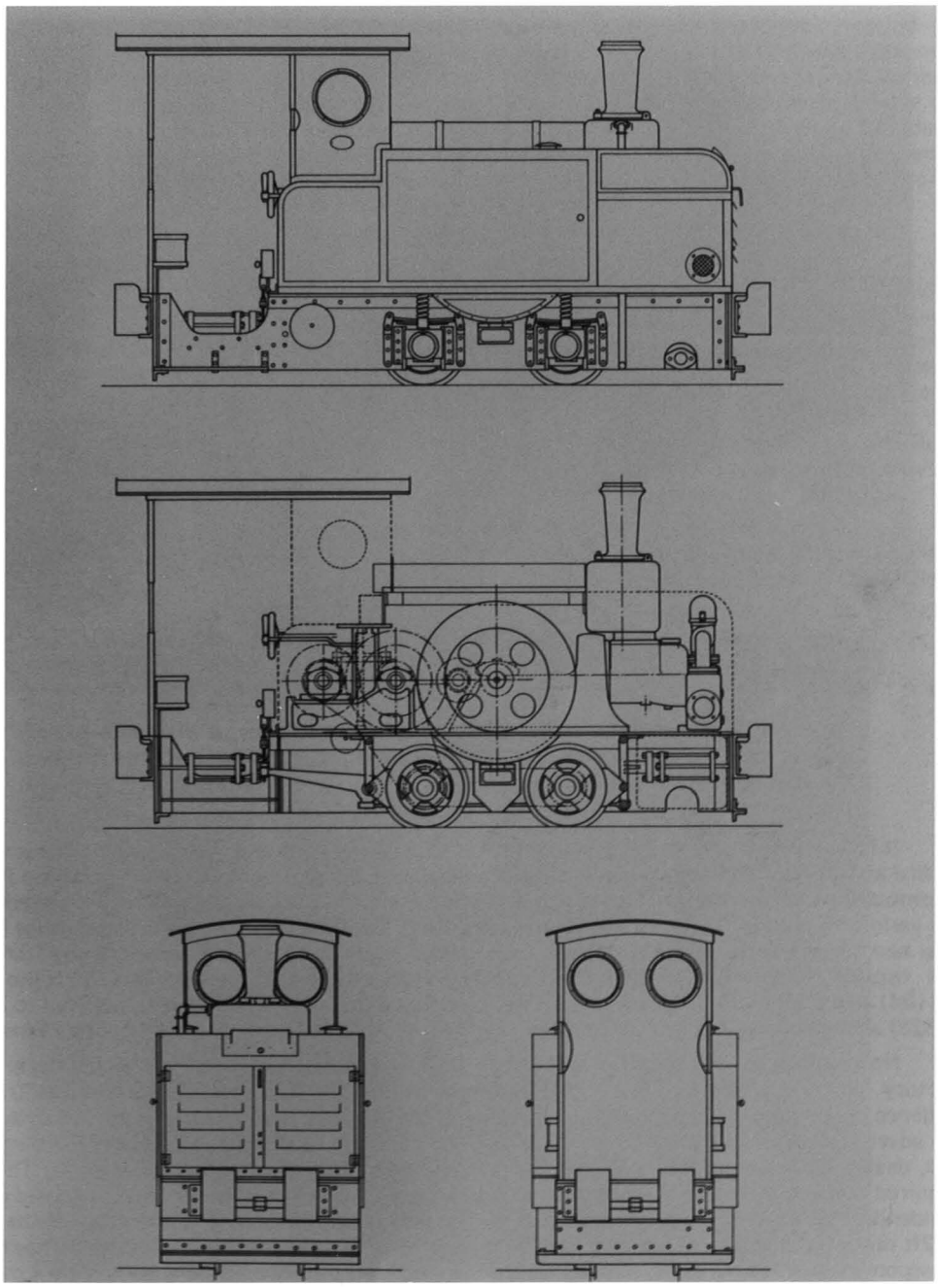


ROYAL GUNPOWDER FACTORY.
SECTION OF TRAM WAY-IRON.



THE ROYAL GUNPOWDER FACTORY.
ONE OF THE RUSTON PROCTOR PETROL-PARAFFIN LOCOMOTIVES,NOTE WOMEN CREW. THE BOGIE WAGGONS ARE LOADED WITH BAGS OF CORDITE.

THE ROYAL GUNPOWDER FACTORY.
18-inch GAUGE VERSION
OF THE
RUSTON PROCTOR 'ZLH' CLASS LOCOMOTIVE.

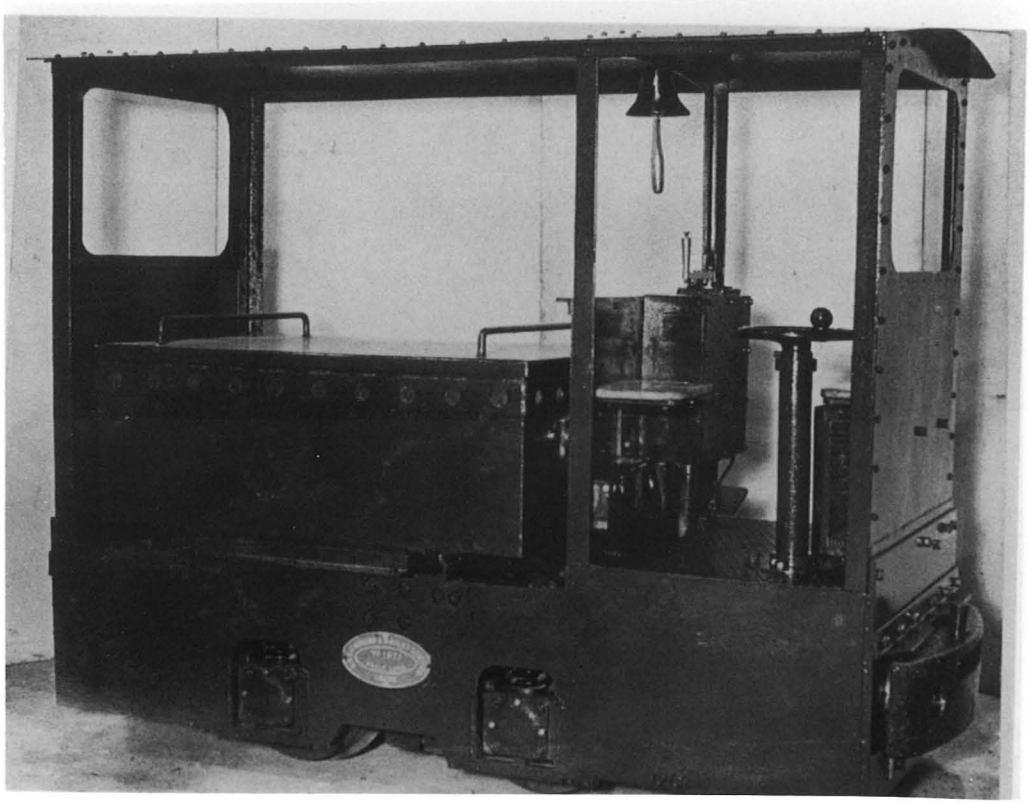


ROYAL GUNPOWDER FACTORY.
RUSTON PROCTOR PETROL PARAFFIN LOCOMOTIVE.
With its Female Crew WW1.

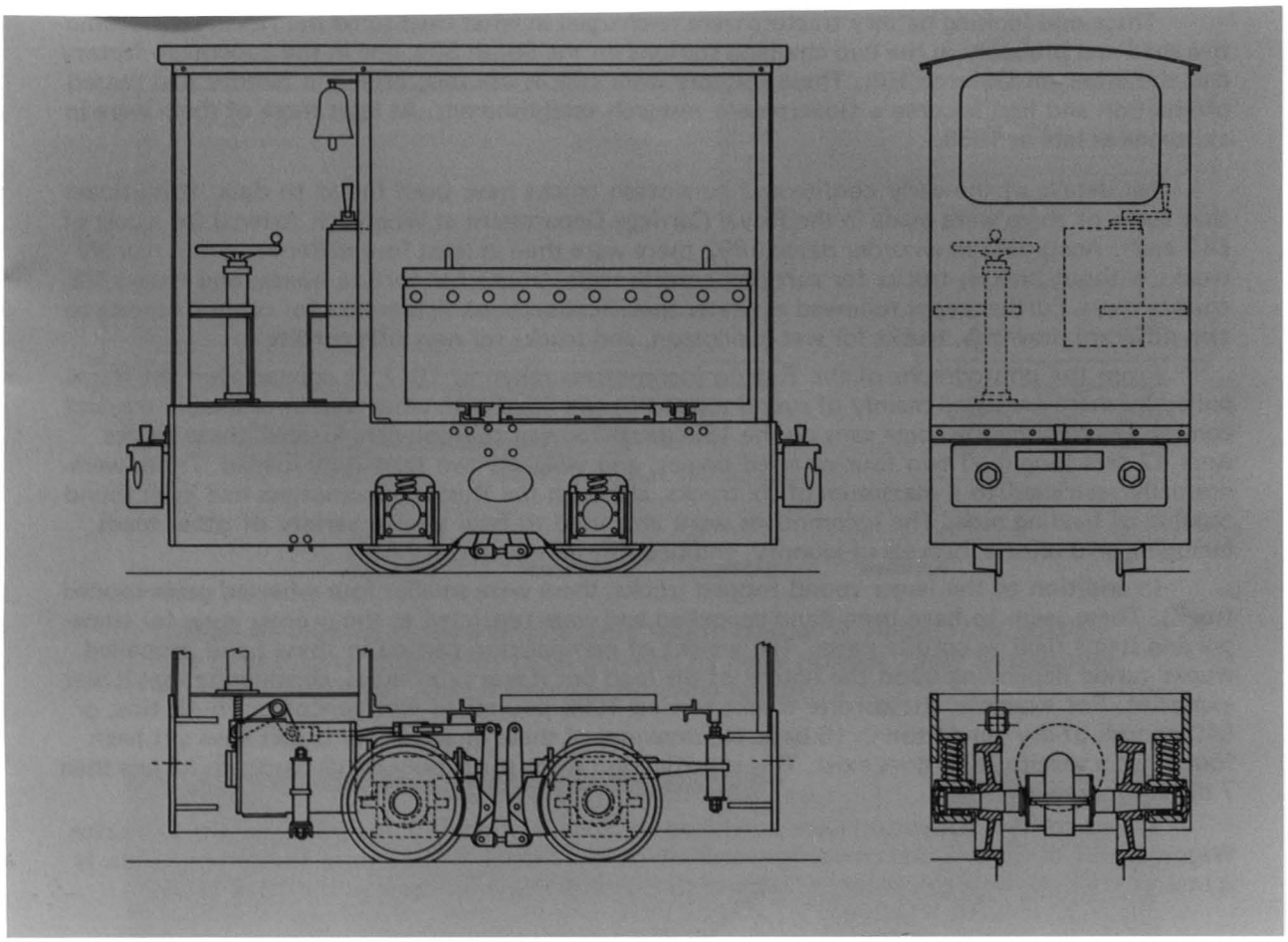
Weight of locomotive: 4½-tons.
Length: 11-ft 6-ins.
Width: 3-ft 6-ins.
Height: 6-feet.
Drawbar pull: 800-lbs.
Speeds: 3mph and 6mph in forwar and reverse.

THE ROYAL GUNPOWDER FACTORY.
ONE OF THE RUSTON PROCTOR LOCOMOTIVES WITH CORDITE WAGGONS,AT THE NORTH END OF THE NEW RAILWAY ON GREAT HOPPIT ISLAND.

THE ROYAL GUNPOWDER FACTORY.
GREEWOOD & BATLEY 'TRACTOR'.
No. 1671,BUILT IN 1940.



THE ROYAL GUNPOWDER FACTORY.
GREEWOOD & BATLEY 'TRACTOR'.
DRAWING SHOWS ONE OF THE SECOND BATCH
BUILT IN 1942.



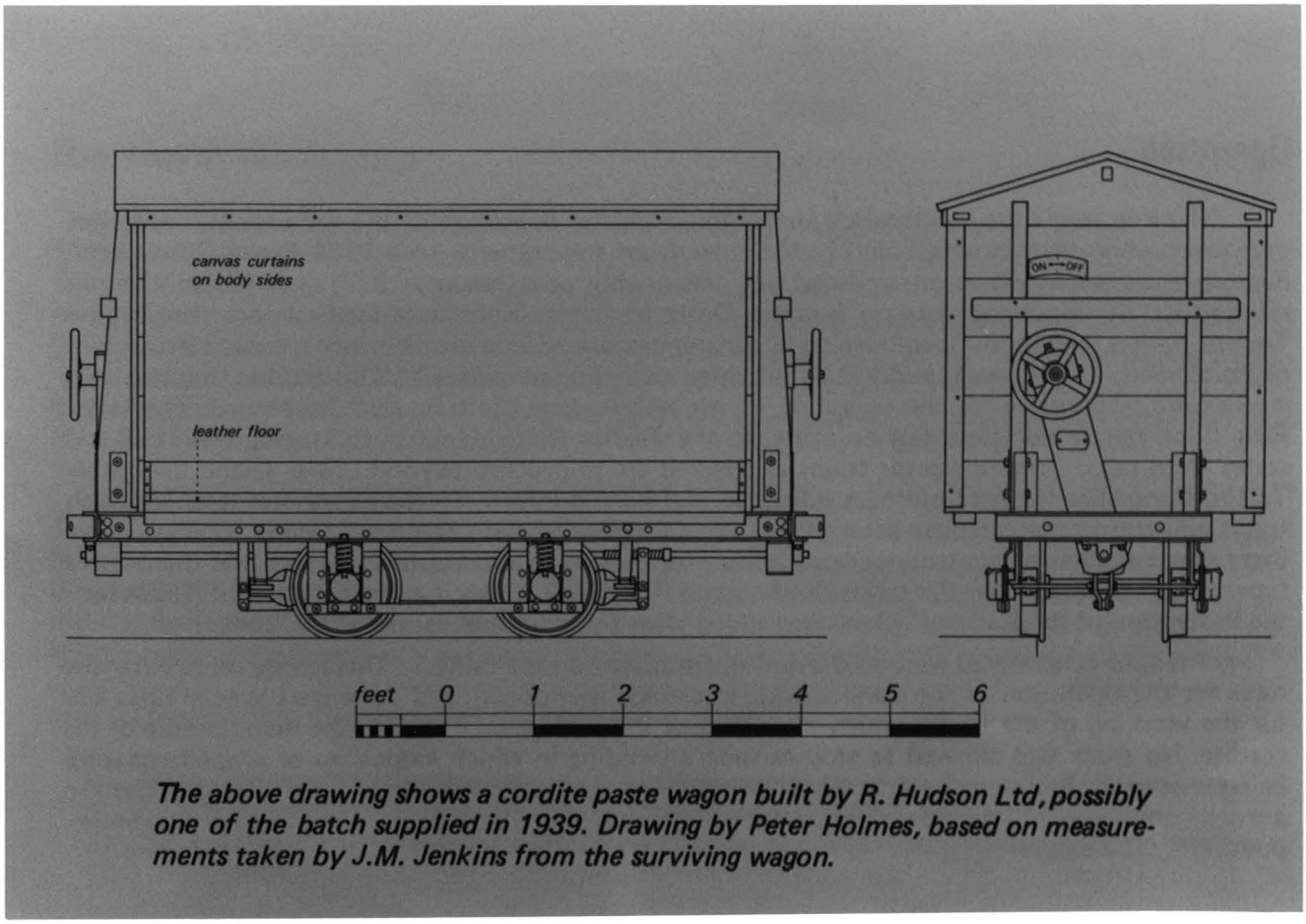
THE ROYAL GUNPOWDER FACTORY.
EARLY BATTERY LOCOMOTIVE?PHOTOGRAPHED IN JULY 1917. THE BATTERY BOX CARRIES THE NAME 'EDISON STORAGE BATTERY'.

THE ROYAL GUNPOWDER FACTORY.
HAND PROPELLED WAGGONS WITH PEAKED ROOFS WW1. THESE SMALLER WAGGONS WERE USED WITHIN THE PROCESS AREAS.

THE ROYAL GUNPOWDER FACTORY. HUDSON BUILT CORDITE PASTE WAGON RELIC OF THE ROYAL GUN POWDER FACTORY.

The most substantial relic of the Royal Gunpowder Factory railway is this Hudson-built cordite paste wagon, preserved on the RARDE North Site. (J.M. Jenkins)

THE ROYAL GUNPOWDER FACTORY.
CORDITE PASTE WAGON.
ONE OF A BATCH SUPPLIED IN 1939.



The above drawing shows a cordite paste wagon built by R. Hudson Ltd, possibly one of the batch supplied in 1939. Drawing by Peter Holmes, based on measurements taken by J.M. Jenkins from the surviving wagon.

REMAINS OF THE SYSTEM.

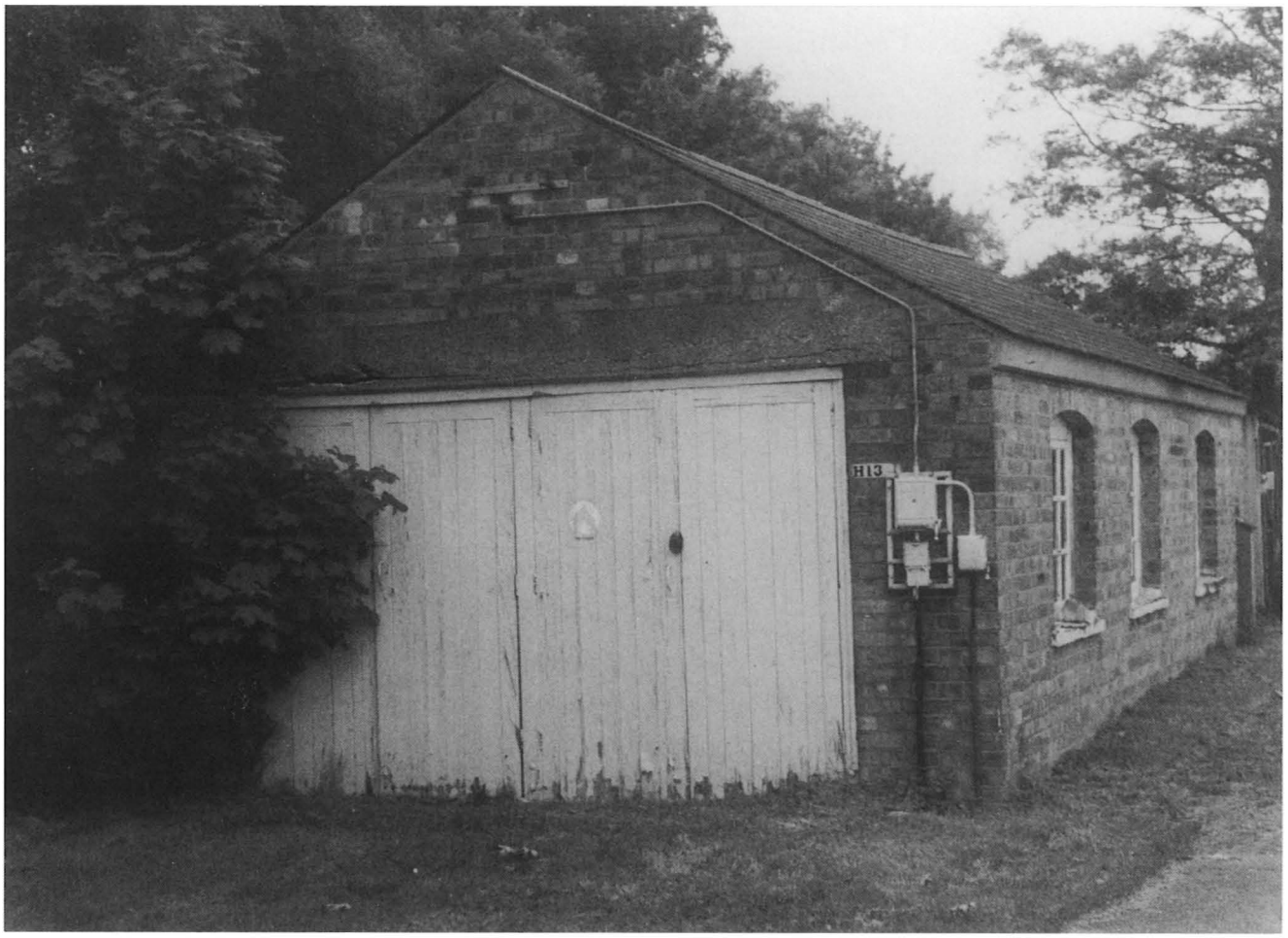
At the time of writing (June 1989) there are a small number of relics of the railway system left in the Establishment,and these are mainly on the North Site. A few short sections of track remain,and there is a buffer stop for the tramway system near to a loading dock by one of the disused canals. In addition,one example of a set of points has been found as have wooden rails. One 'ring' used for single line control through the tunnel remains as previously mentioned. As for the rolling stock,only one hand operated cordite paste truck is left. As can be seen from the photograph,it has been badly neglected of late. This truck was made by Hudsons of Leeds. It is situated on a short section of track which gives a clear impression of the steel sleepered track that was used for much of the rail system.

The engine shed built for the Ruston Proctor locomotives still survives as a metal rod store. The rails inside are embedded in the concrete floor. A remainder of railway days exists inside the building,in the form of a notice on how to charge the NIFE batteries,which powered the tractors used in WW2. The only relic of the Great Hoppit Island swing bridge is the concrete pier in the middle of the river,although the fixed span and signal were removed as recently as 1987. There is little trace of the tunnel that ran under the main road as it was sealed off when the road bridge was rebuilt in 1967. Some evidence of the railway cutting on the south side of the bridge can be seen by peering over the parapet of the new road bridge.

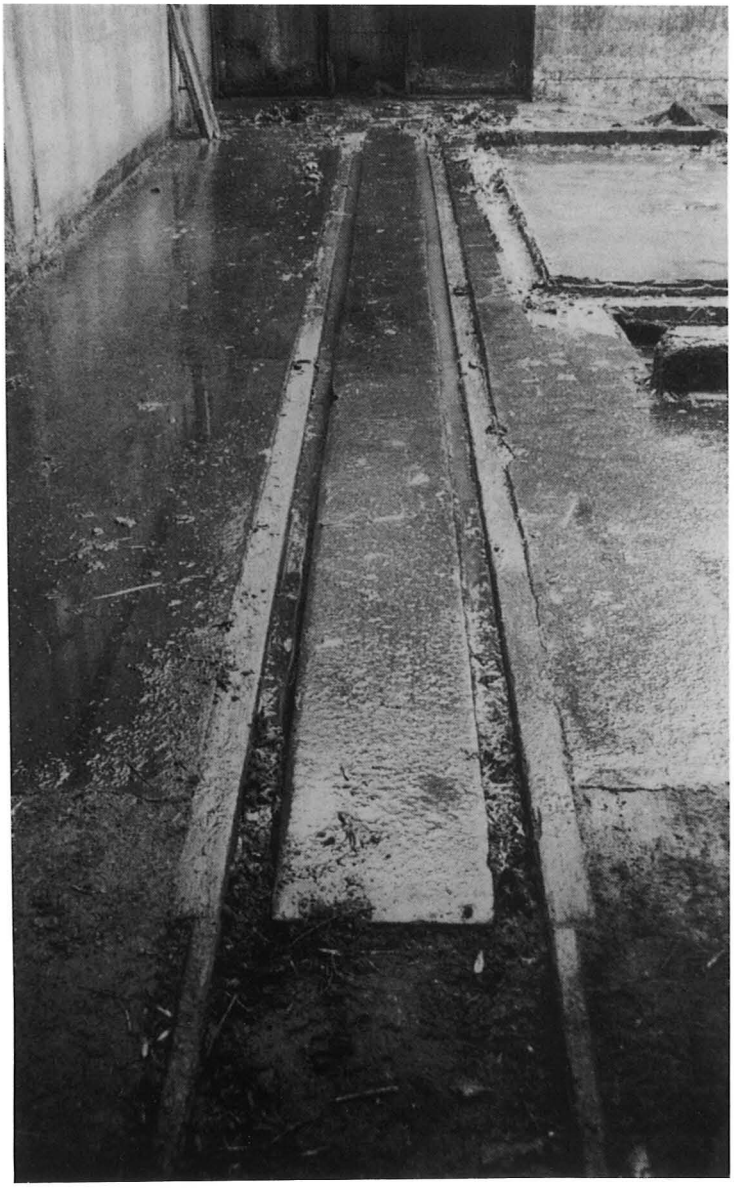
It is hoped that the few relics will be properly preserved along with the drawings and documents so far identified. Several questions remain to be answered,such as the constructional details of the early trucks,particularly the 8-wheel trucks of WW1; how long were the Ruston & Proctor locomotives used; what

was the origin of the 'Edison' battery tractor; what were the Traffic Rules and operating procedures,and when was the RSAF link with its coal chute dismantled? One of the difficulties is that most of the documents relating to the interesting WW1 period of the railway now seem to have vanished,but we are fortunate that some of the drawings have survived.

THE ROYAL GUNPOWDER FACTORY.
FORMER NORTH SITE LOCOMOTIVE SHED.
PHOTOGRAPHED IN 1987.



THE ROYAL GUNPOWDER FACTORY.
WOODEN RAILS WERE STILL IN POSITION
IN 1987 IN ONE OF THE FORMER PROCESS
BUILDINGS.



THE ROYAL GUNPOWDER FACTORY.
18-inch GAUGE POINTS
FOUND IN 1987 ON THE NORTH SITE.

THE ROYAL GUNPOWDER FACTORY.
BUFFER STOPS
ADJECENT TO A DISUED CANAL WHARF.