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Industrial Railway Record 117

The Royal Gunpowder Factory, Waltham Abbey

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INDEX AND BINDING FOR VOLUMES 9 AND 10

Arrangements are being made for the binding of Volume 9 of the Industrial Railway Record, which consists of Records 94 to 105. An index for these issues has been prepared, and will be included with the binding; the index will also be available separately for those not wishing to have their Records bound. The Society hopes to announce further details as soon as possible.

This issue of the Record, No.117, completes Volume 10. Members will be informed of the binding and index arrangements for this volume in due course.

THE RAILWAYS OF THE ROYAL GUNPOWDER FACTORY, WALTHAM ABBEY

J.M. JENKINS

Introduction

Although employed for many years in the Government Research Establishment at Waltham Abbey, Essex, I successfully managed to ignore the remains of the narrow gauge railway system which operated in the Royal Gunpowder Factory (RGPF), before the site became the Royal Armament Research and Development Establishment (RARDE). When I paid a visit in late 1985 to the North Woolwich Railway Museum, one of the exhibits was a map entitled *Railways from Tottenham to Cheshunt* compiled by D.J. Taylor of the Great Eastern Railway Society in 1977. This map showed that there was a standard gauge connection from the Great Eastern main line at Brimsdown, through the Royal Small Arms Factory at Enfield, to the narrow gauge railway system in the Royal Gunpowder Factory. The transfer sidings between the standard and narrow gauge railways were located adjacent to a river wharf, on the boundary between the two factories.

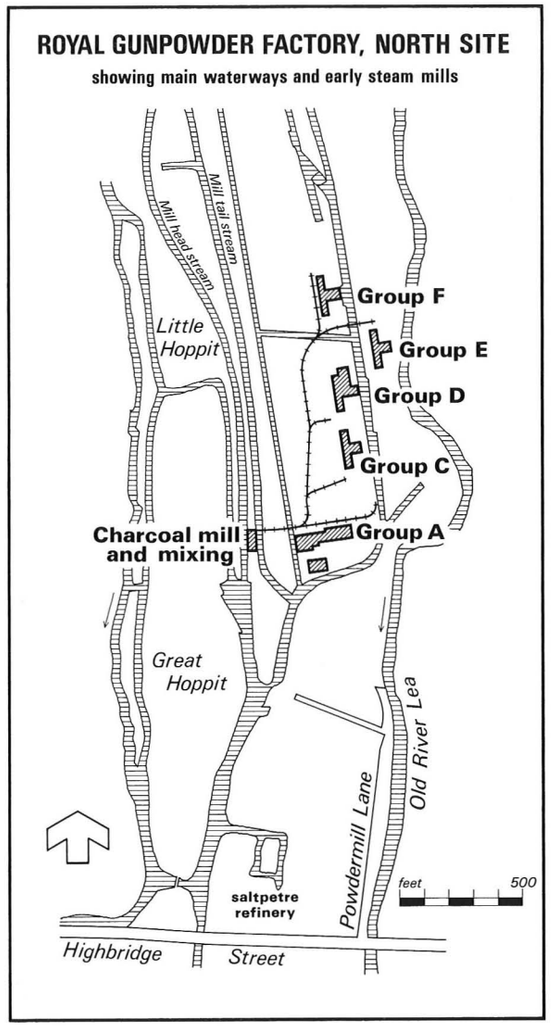
My interest was aroused in the internal railways of the Royal Gunpowder Factory and the object of this account is to record how its rail system grew during the period 1857–1943, and to describe some of its more unusual features, many of which were determined by the dangerous nature of the products transported and the presence of an extensive waterway system throughout the factory site.

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, and a map of this area is given to assist readers with the geography of the Establishment in its early days. The layout of the whole Factory can be seen from the 1923 map which is shown later.

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 as essential as they provided a rapid and cheap form of transportation of raw materials and finished goods, both within factories and onward to customers. Collieries, iron and other works were very dependent 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.

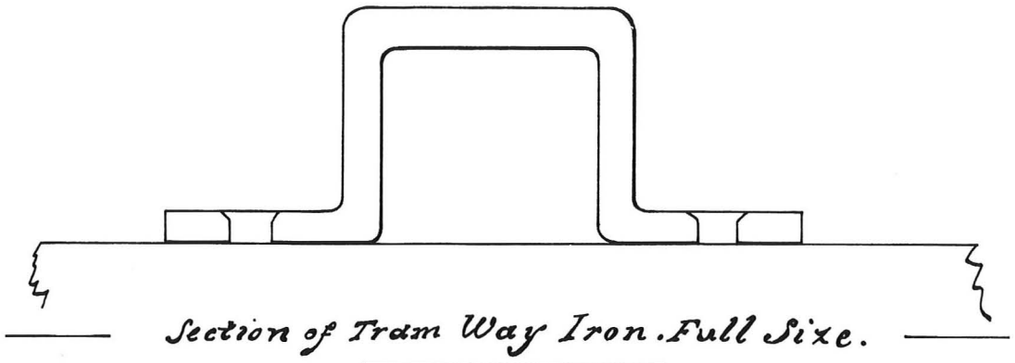


The earliest reference found so far to any sort of tramway or railway is on a plan dated 19th January 1856, in the RARDE Waltham Abbey Historical Collection. It shows 'the dimensions and position of the proposed new buildings at Waltham Abbey'. This plan is of the new steam powered gunpowder mill which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

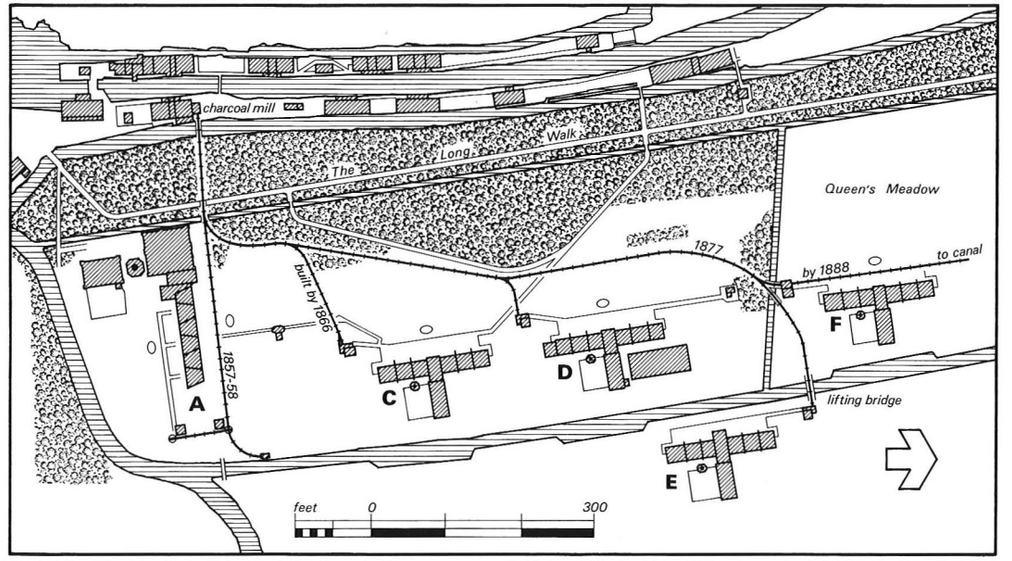
At this point it is necessary to discuss the use of the terms *tramways* and *railways.* On the early maps and drawings which show any form of railway the terms *tramway* and *railway* were used indiscriminately for what was a manually propelled system. An 1888 map refers to both tramways and railways,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

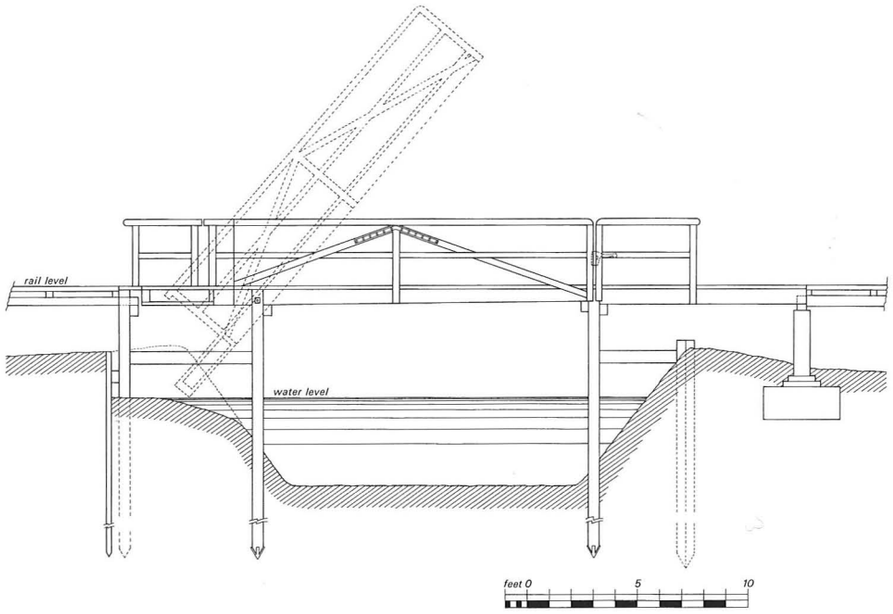
The original tramway which connected the charcoal mill and gunpowder mixing house to the new steam incorporating mill was only about 600 feet long, and its function would probably be to convey the loosely mixed ingredients of gunpowder (charcoal, saltpetre, and sulphur) rapidly and safely from the mixing house to the incorporating mill. There the mixture or 'green charge' would



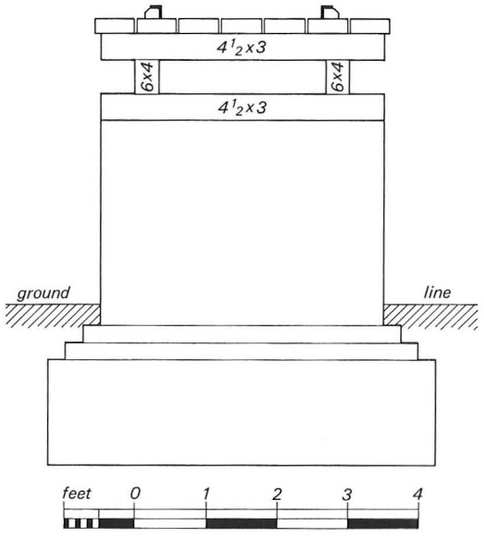
be subjected to heavy rolling for several hours to give a homogeneous mix in the form of a hard cake known as 'mill cake'. The mill cake was then broken up carefully and placed into wooden tubs, which were stored in small magazines, prior to the next stage in the manufacturing process. Almost certainly, 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 1866, 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





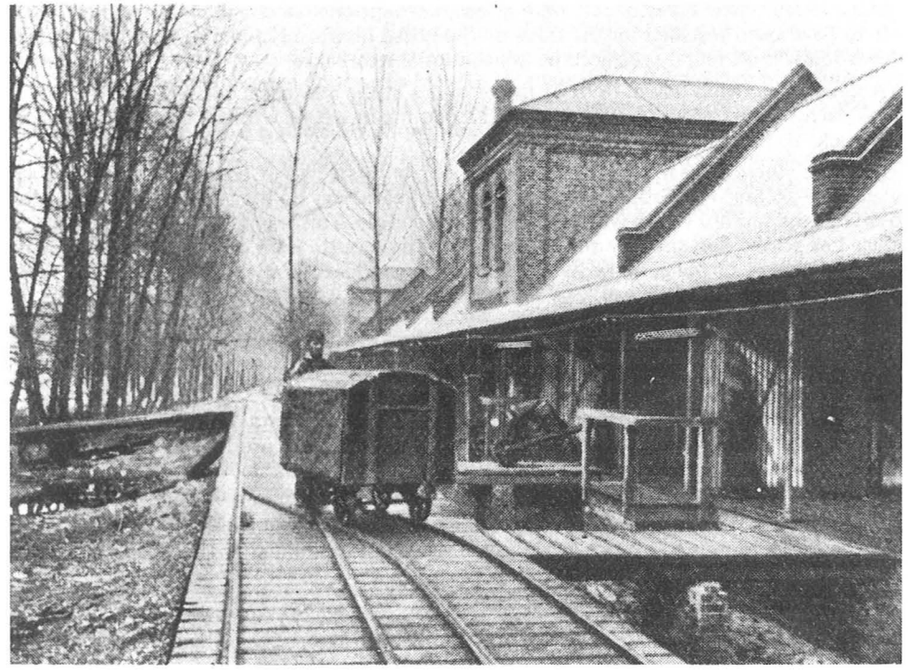
The lifting bridge, from a drawing of 1877. This bridge was on the tramway extension to the Group E gunpowder mills.



Metal-clad wooden rails; a detail from a photograph taken in 1892 at the Group G gunpowder mills. *(RARDE)*

Left:

The construction of the tramway platform, from the 1877 tramway extension drawing. The wooden rails are spaced at 2ft 6in centres giving a gauge of 2ft 3in between the inside faces.



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 2ft 3in.*

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 gauge of the tramway was 2ft 3in, and that the platform upon which it sat was 4ft 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.

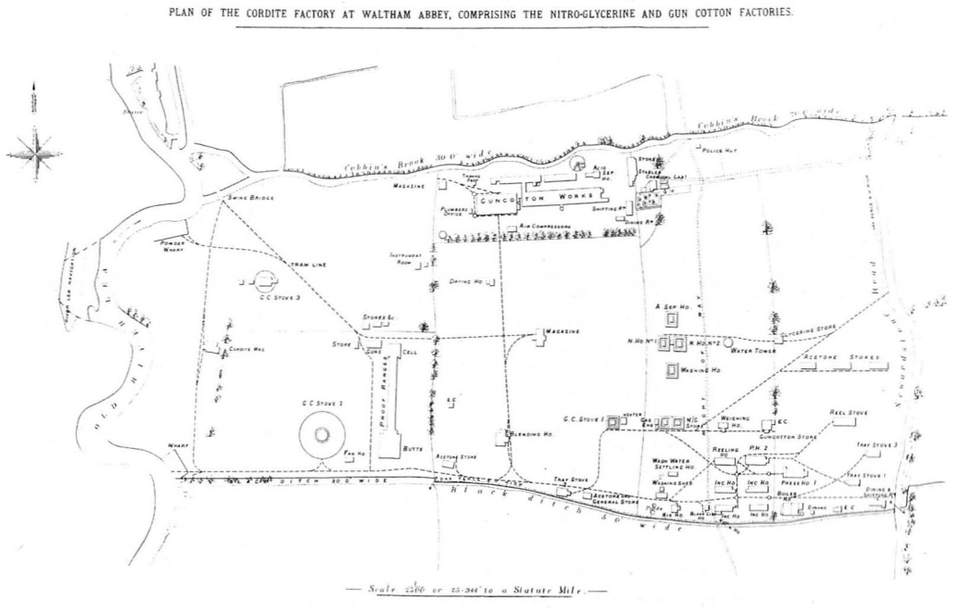
A detailed drawing dated 1879 of the terminus at the new canal cut shows that a run round loop was necessary to allow trucks to stand outside the magazine without interrupting the return flow of trucks to the mills and mixing house.

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 nitro-



The extent of the South Site tramways in 1894 is shown by this plan, which accompanied a report on the Quinton Hill nitroglycerine explosion of 7th May 1894. *(RARDE)*

glycerine, 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 I 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, and no railway between 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.

Horse-drawn tip wagons in use during the construction of the South Site cordite stove complex in the 1890's. *(RARDE)*

The factory rules of 1914 emphasise the need to keep the trucks clean and for good housekeeping. 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 disagreeably.' 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 World War 2 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.

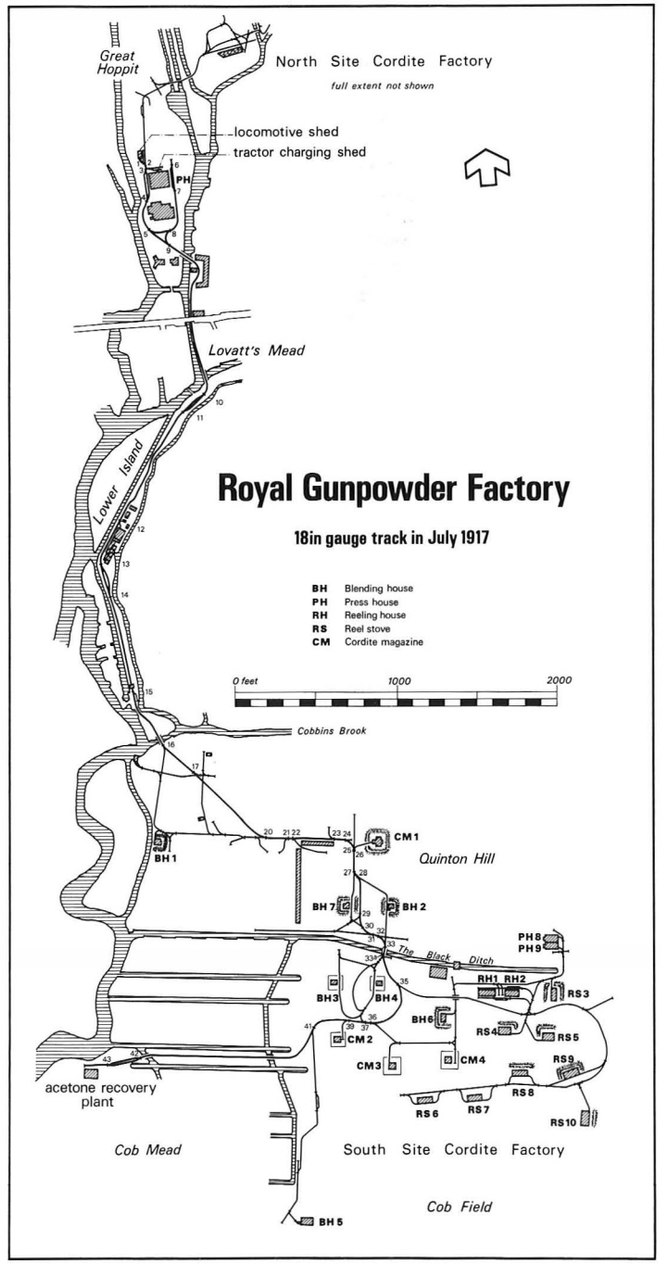
The construction of the track appears to have been of two types at the end of this period. The track on the ground consisted of steel rails with a weight of 20 pounds per yard, held together by pressed steel sleepers. On the elevated wooden platforms, similar steel rail was pinned or spiked directly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

The Narrow Gauge Railway 1916-1917

During World War 1, 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 1⅝ 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



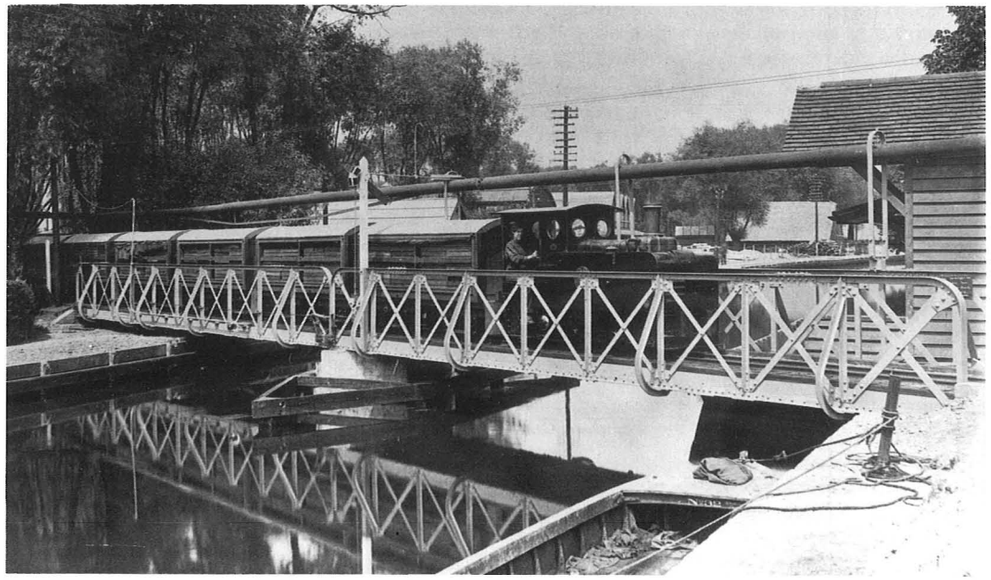
shed) to 43 (acetone factory). It is unlikely that locomotives could use all this track but it is assumed that they ran along the 'mainline' from Great Hoppit Island to the Royal Small Arms Factory interchange sidings. The railway was 18in gauge throughout, and those parts which were intended for locomotive haulage had heavier rail (30 pounds per yard), some of which was laid on lateral wooden sleepers. The minimum radius of curvature was 30 feet, 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.

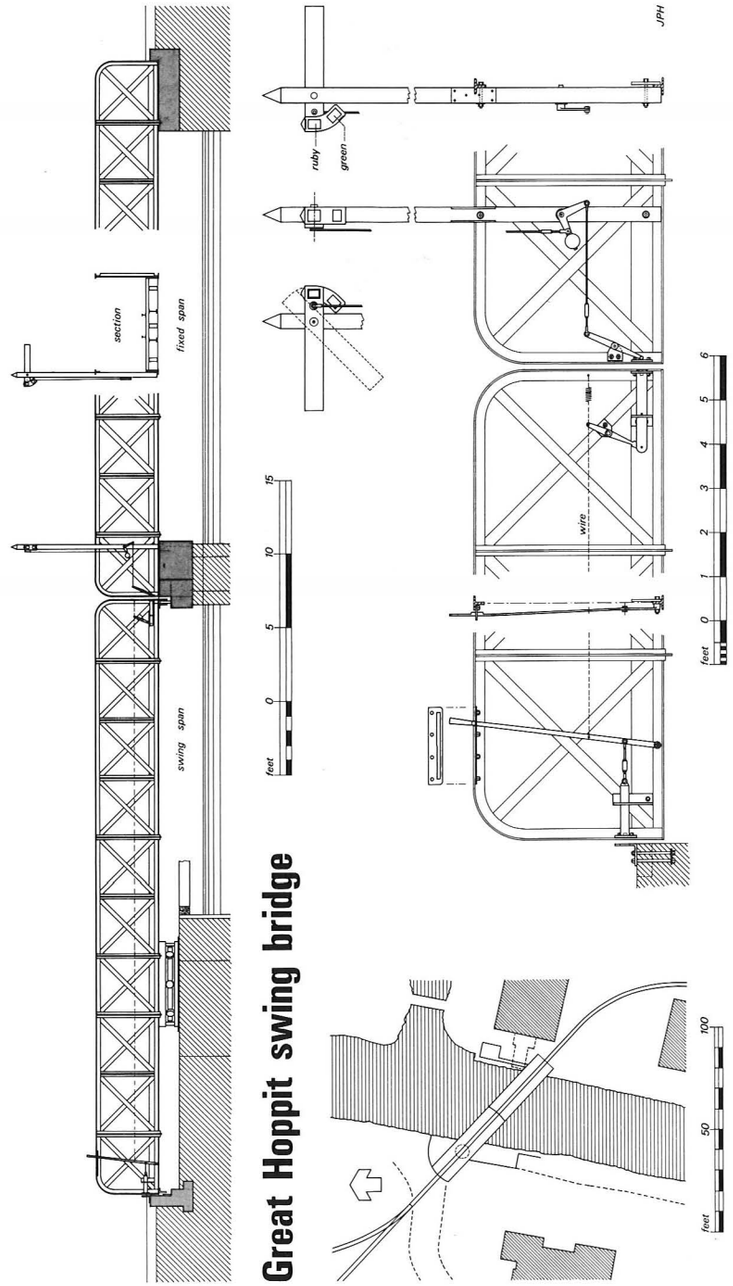
The swing bridge at Great Hoppit Island was necessary to allow water traffic access to the factory. The bridge was 76 feet long and split approximately half way along its length; the eastern portion being fixed, the other rotating about a turntable on the west bank of the canal. The two portions met 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

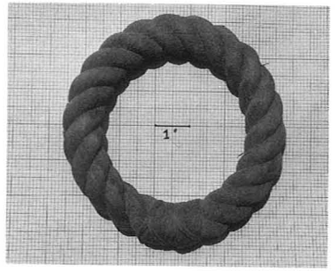


The swing bridge at Great Hoppit Island in 1917, with a train crossing hauled by one of the Ruston locomotives. The camera is pointing north. (RARDE)



The drawing of Great Hoppit swing bridge is based on 'Drawing No.E 120' dated 7th February 1917 (WASC 901/282), which details the locking mechanism and signal. The photograph on page 394 shows a few details which do not appear on the drawing, notably the curved stays which support the bridge sides, and the electric light mounted at deck level on the opening span, presumably for the benefit of boat traffic. Also missing on the drawing is a steam line, which was carried in brackets along the north side of the bridge and supported by truss rods across the opening span.

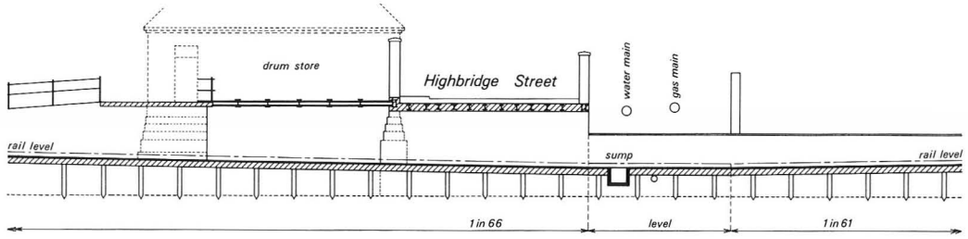
A photograph taken in 1917 showing a train travelling south, with the road tunnel in the background. The railway was 3ft below the river level where it passed under Highbridge Street, and the substantial wall separating the railway and river is apparent. The locomotive is one of the 1917 Ruston Proctor petrol-paraffin tractors. When this photograph appeared in a Ruston Hornsby publicity handbook, the gauge of the railway was wrongly given as 2ft. *(RARDE)*



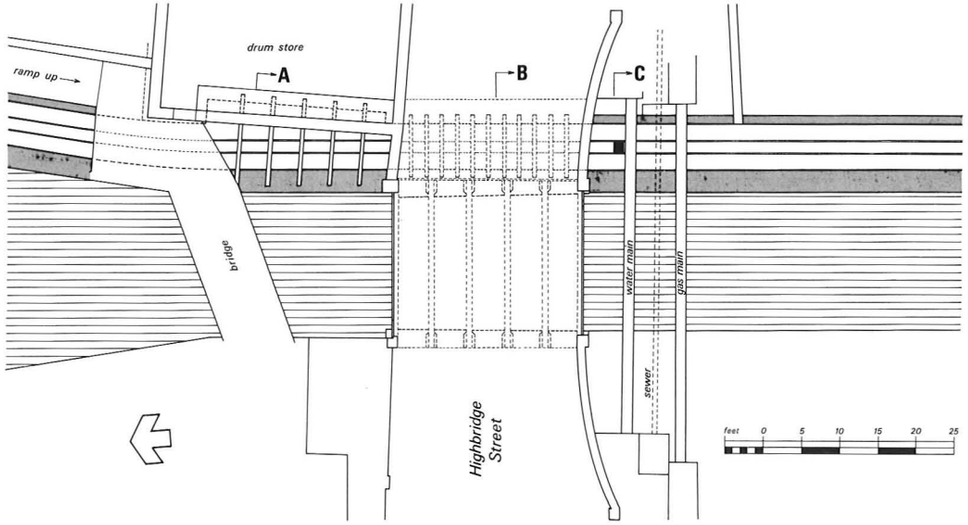
This rope ring, now preserved in the RARDE historical collection, served as a 'single line token' for the railway tunnel beneath Highbridge Street. *(J.M. Jenkins)*

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.

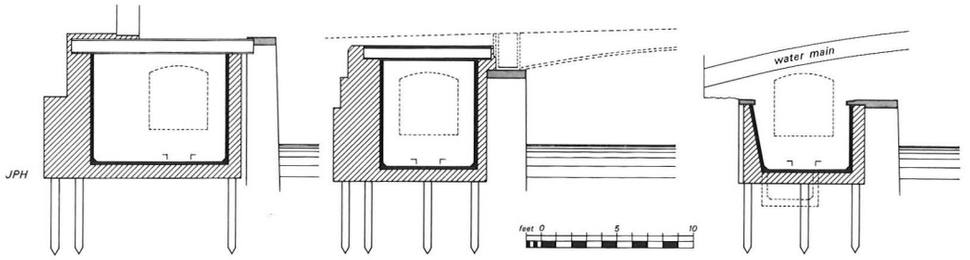
Section on tunnel centre line



Plan of tunnel and river bridge



Sections A B C



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:

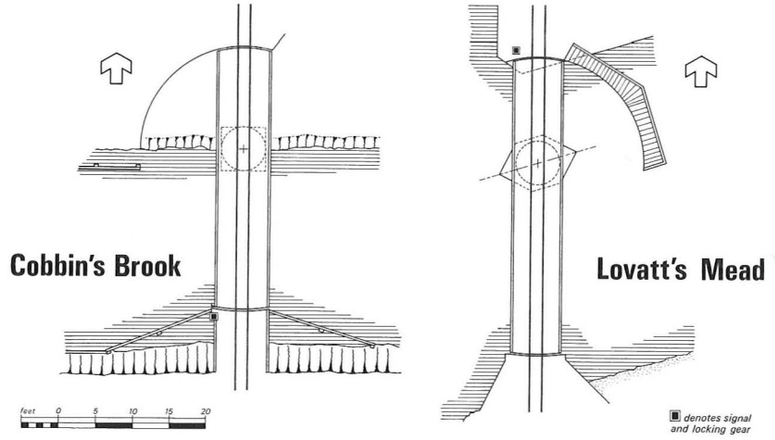
'Danger, it is dangerous for any person to enter the tunnel unless he takes the ring which is kept on one of the posts at the end of the tunnel. Any person wishing to take a vehicle through must (if the ring is not at the near end of the tunnel) cross to the far end of the tunnel and bring back the ring: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

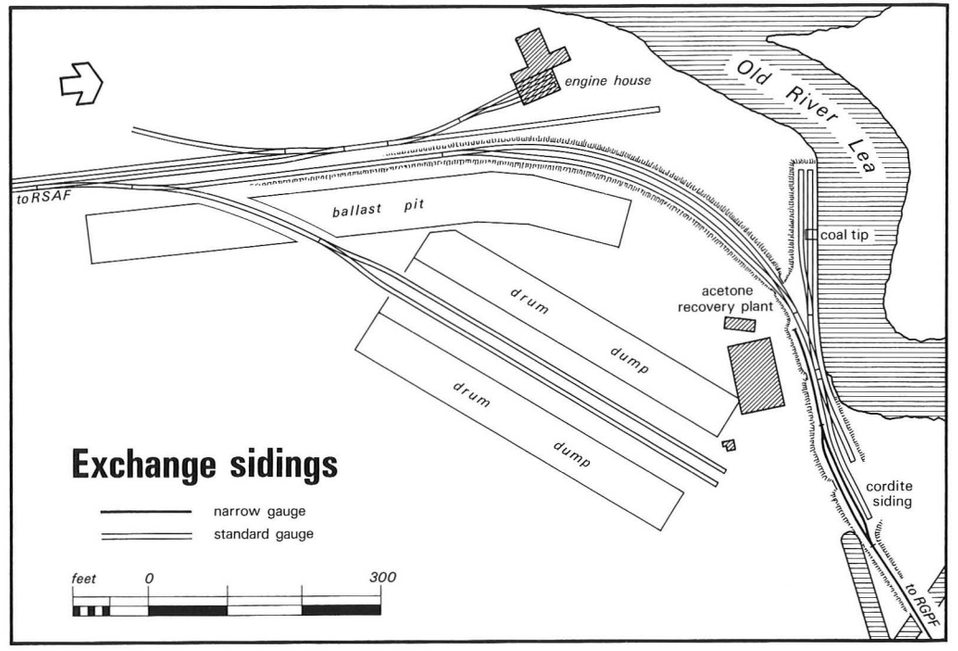
South of the tunnel, the railway crossed the old River Lea at Lovatt's Mead by another swing bridge of steel lattice construction similar to the one already described, excepting that this bridge pivoted about the centre of the river. The signal for this bridge was on the northern bank. From Lovatt's 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 World War 1.

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 Royal Small Arms Factory Railway.

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 parallel 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 Royal Small Arms Factory. 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 Royal Small Arms Factory 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





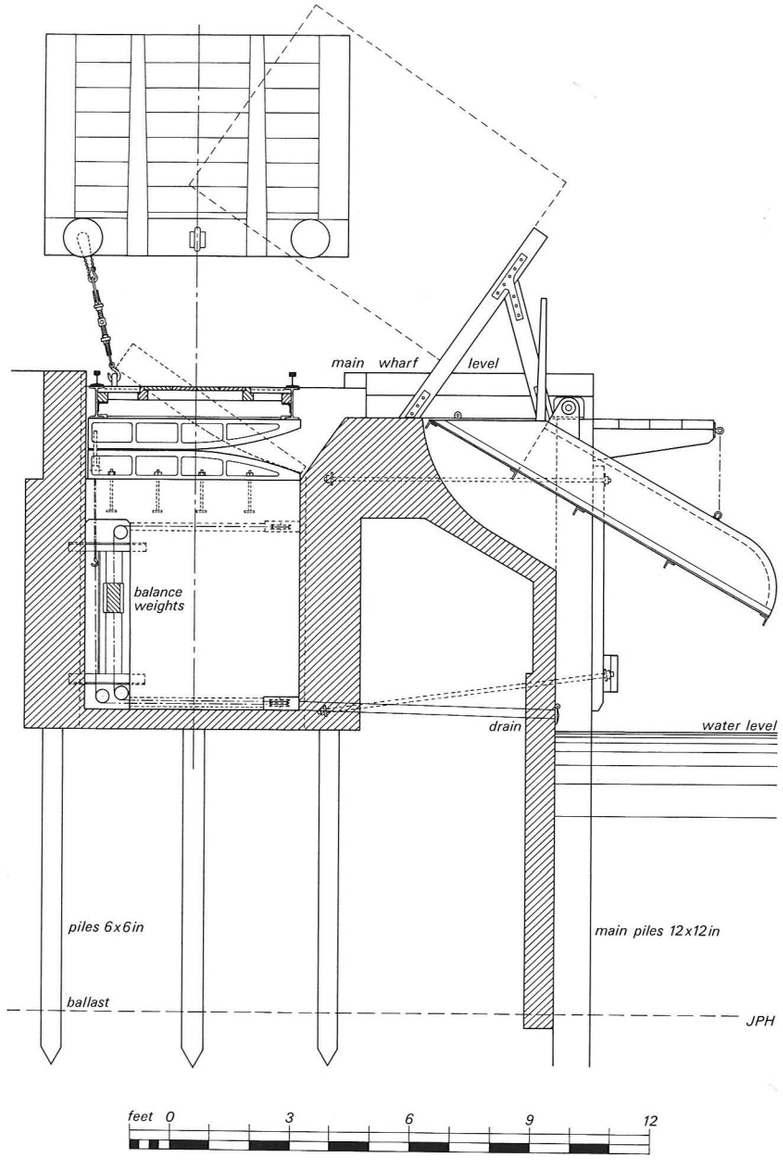
the railway siding from the main Cambridge line of the Great Eastern Railway. The branch, which joined the main line at the north end of Brimsdown station, also gave access to Brimsdown power station by 1924. Incoming stores intended exclusively for the Royal Gunpowder Factory were diverted to a separate delivery point within the Royal Small Arms Factory, 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 Royal Small Arms Factory 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 Royal Small Arms Factory and the Royal Gunpowder Factory 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 World War 1, 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) 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.

* CE is the abbreviation for an explosive known as 'Composition Exploding'.



The coal tip at the river wharf, adjacent to the Royal Small Arms Factory. Coal was loaded from standard gauge wagons into boats, which then distributed the coal to points served by water within the Royal Gunpowder Factory.

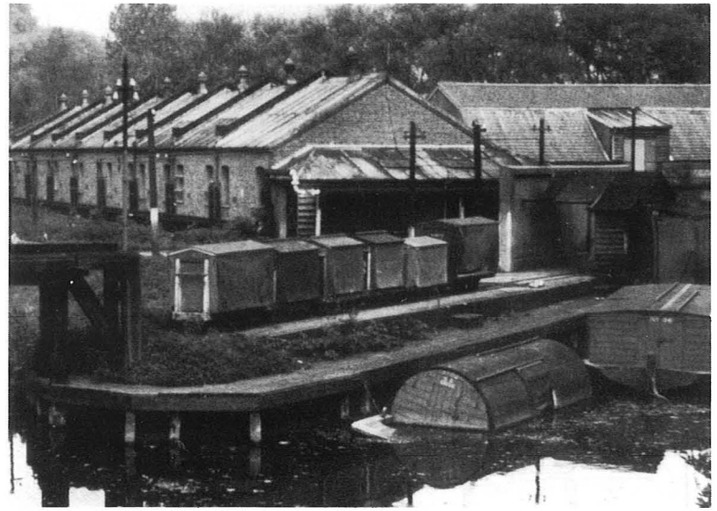
The western branch was planned to run almost due south to the CE packing house and magazine, then south-east alongside the Long Walk, past the gunpowder mills, and sharply west to join the existing railway. This extension would have nearly doubled the length of the railway. From a map dated 1923, it 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 show that some of the proposed assembly sidings were built just north of the engine shed on the North Site.

Post World War 1

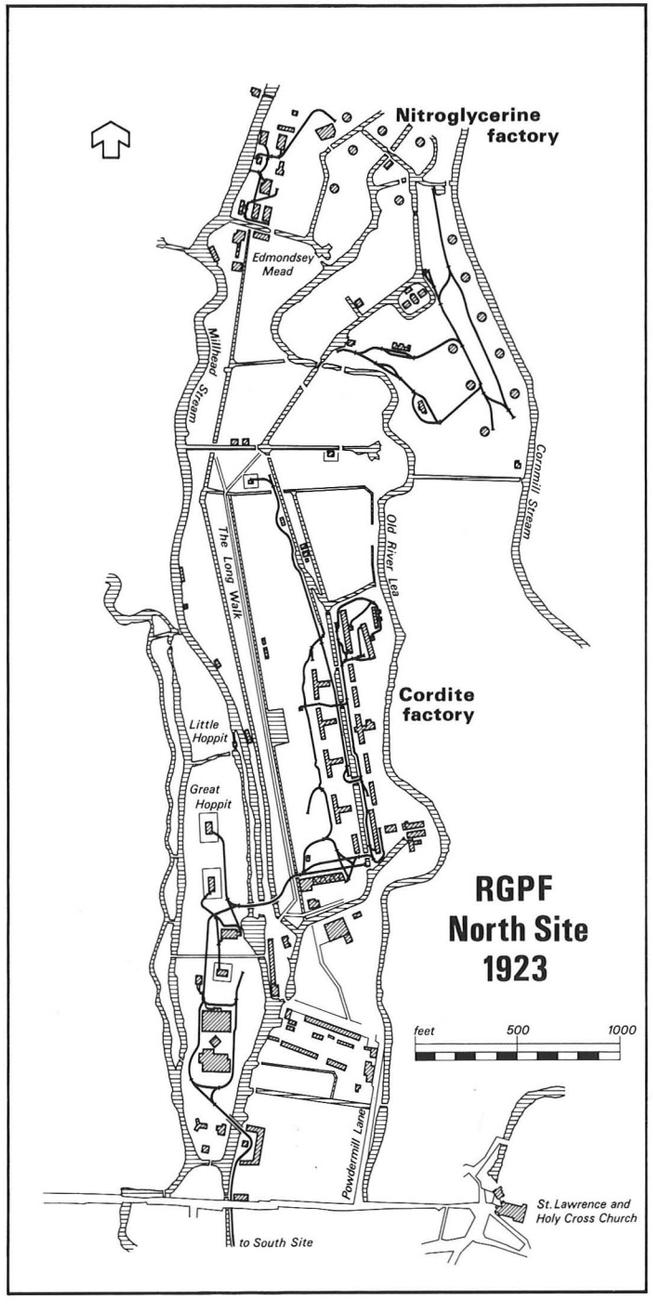
The factory continued to expand after World War 1, and the manufacture of TNT and RDX* was commenced. This development and that immediately prior to World War 2 caused little extension to the overall length of the railway system, but a greater proportion of the traffic was worked by locomotives. The 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 unlikely 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.

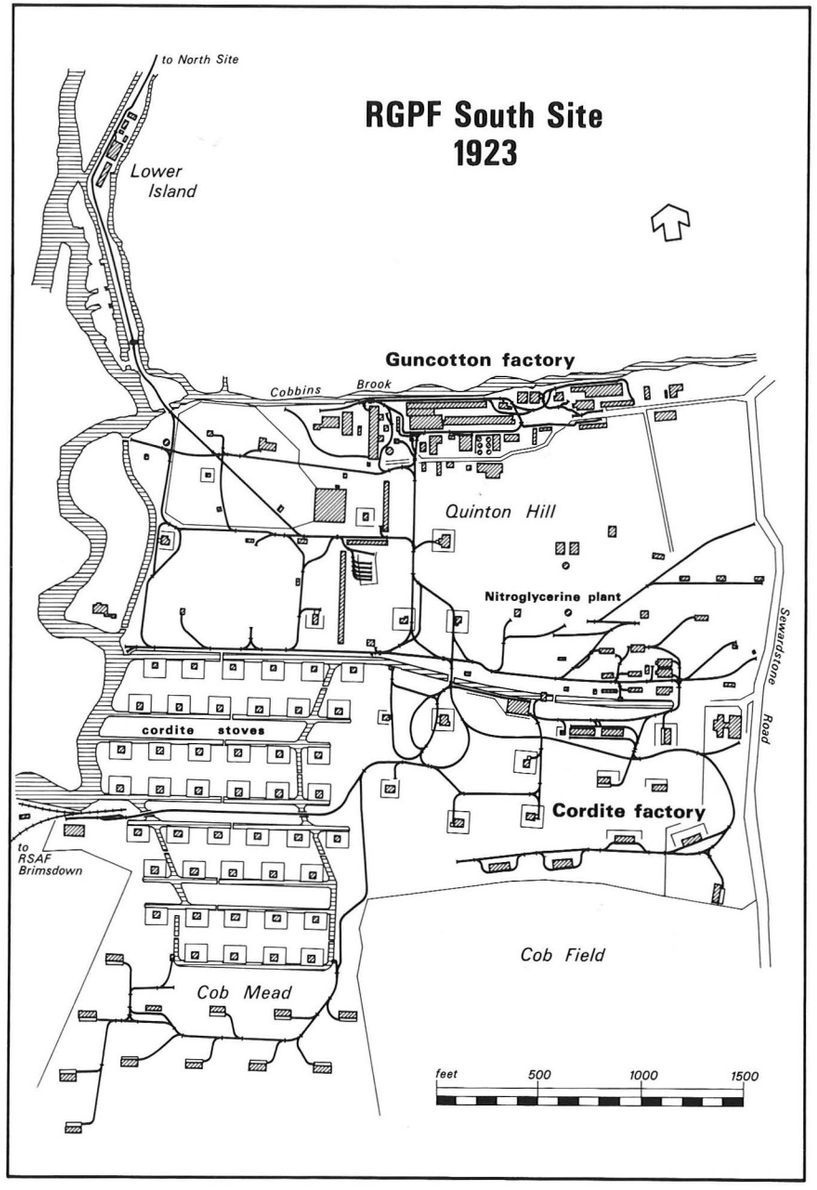
The factory began to run down in 1943, and manufacture of explosives ceased by October of that year. Operation continued as a Government Research Establishment, although the title 'Royal Gunpowder Factory' continued to be used until July 1945. By 1952, the railway link connecting the North and South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

* RDX is the abbreviation for an explosive known as 'Research Department Explosive X'.



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

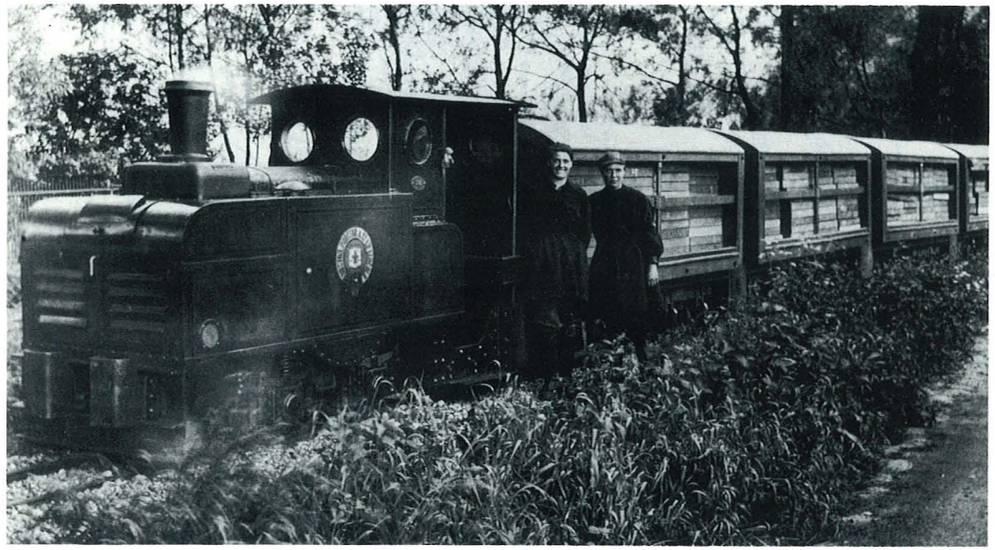

Nitroglycerine factory
Edmondsey Mead
Millhead Stream
Gunmill Stream
The Long Walk
Old River Lea
Cordite factory
Little Hoppit
Great Hoppit
RGPF North Site 1923
feet 500 1000
Powdermill Lane
St. Lawrence and Holy Cross Church
to South Site


to North Site
RGPF South Site 1923
Lower Island
Guncotton factory
Cobbins Brook
Quinton Hill
Nitroglycerine plant
Stewardstone Road
cordite stoves
Cordite factory
to RSAF Brimsdown
Cob Field
Cob Mead
feet 500 1000 1500

Locomotives and Rolling Stock

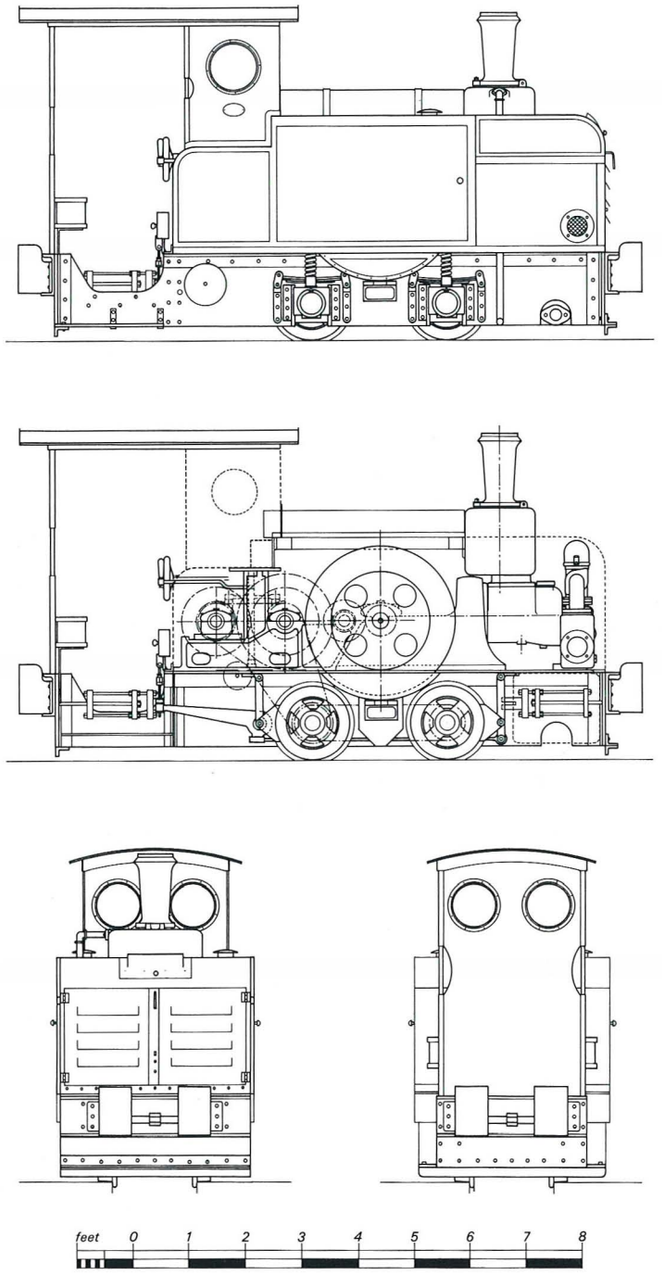
The changes in the Waltham Abbey railway system, which took place in 1916, involved the use of mechanical haulage for the first time. The motive power was provided by four locomotives built by Ruston Proctor & Co Ltd of Lincoln. These were oil-fuelled machines of the maker's 'ZLH' type, numbered 51697, 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.

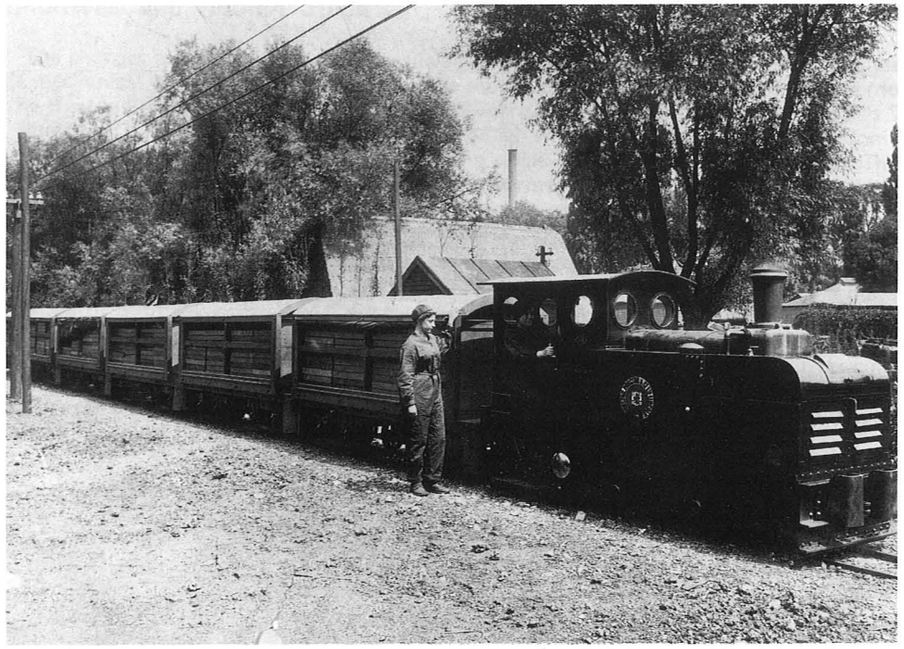
It is believed that Ruston Proctor's 'ZLH' type was based on a design produced by the Deutz Company in Germany, shortly before the War. Whether the *engine* resembled a Deutz design or not, the outline of the locomotive certainly did, and a detailed description appeared in the magazine *Engineering* 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 at the Royal Gunpowder Factory, and it is interesting to note that in all cases they are being driven by women.



One of the Ruston Proctor petrol-paraffin locomotives poses for the camera with its crew. The bogie wagons are loaded with trays of cordite. *(RARDE)*

The drawing on the opposite page shows the 18in gauge version of the Ruston Proctor 'ZLH' Class locomotive. Drawing by Peter Holmes, based on a sectional view which appeared in Ruston Hornsby Publication No.3776. The Ruston Oil Loco, *with additional details from Ruston drawings 19-1015 and 19-1016 supplied by courtesy of R.E. Hooley. It is not known whether all four of the Waltham Abbey locomotives were identical.*





One of the Ruston Proctor locomotives with cordite wagons, at the north end of the new railway on Great Hoppit Island. This is the same train as that which appears on pages 394 and 396. *(Collection R.E. Hooley)*

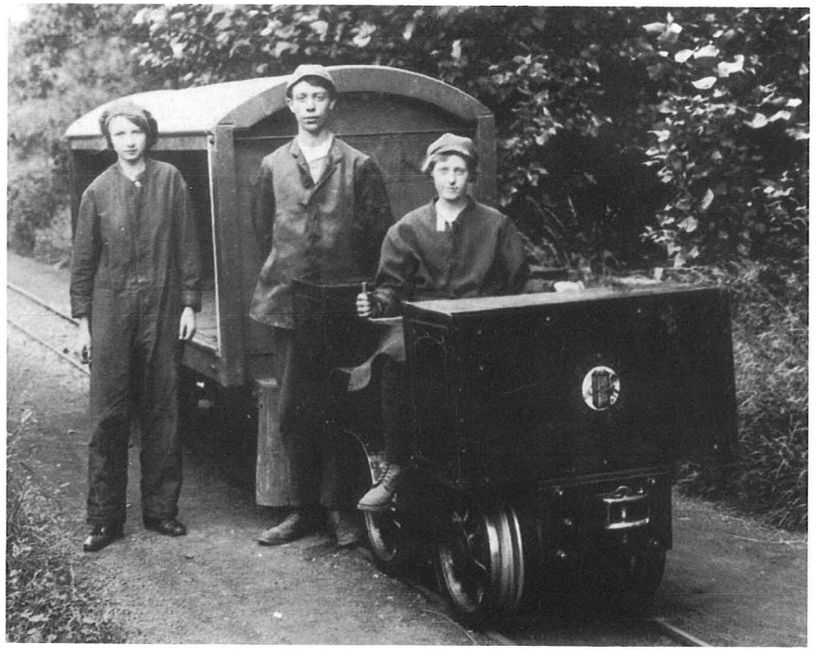
It is not known whether these locomotives carried any names or identifying numbers while in service at Waltham Abbey; certainly none are visible in the photographs. Similar Ruston Proctor locomotives were used at the Royal Naval Cordite Factory at Poole, Dorset (2ft 6in gauge) and at the various explosives factories near Davington, Kent (3ft 3in gauge). These broader gauge locomotives had inside frames, unlike the Royal Gunpowder Factory locomotives which, being 18in gauge, had outside frames. Two examples of the *inside* framed 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 Royal Gunpowder Factory, 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 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 18in 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 Ruston's 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 Royal Gunpowder Factory in or by 1925.

In addition to the four Ruston locomotives, there were during the World War 1 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 documentation 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 in 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.

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 World War 1. Under the heading 'Slingsby-Automatic Electric Trucks' this catalogue illustrates a battery locomotive resembling the one photographed at the Royal Gunpowder Factory. These locomotives were apparently available for gauges between 18in and 3ft, and were fitted with a 48volt '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 supplied the locomotive in the 1917 photograph; however the Automatic Transportation 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'

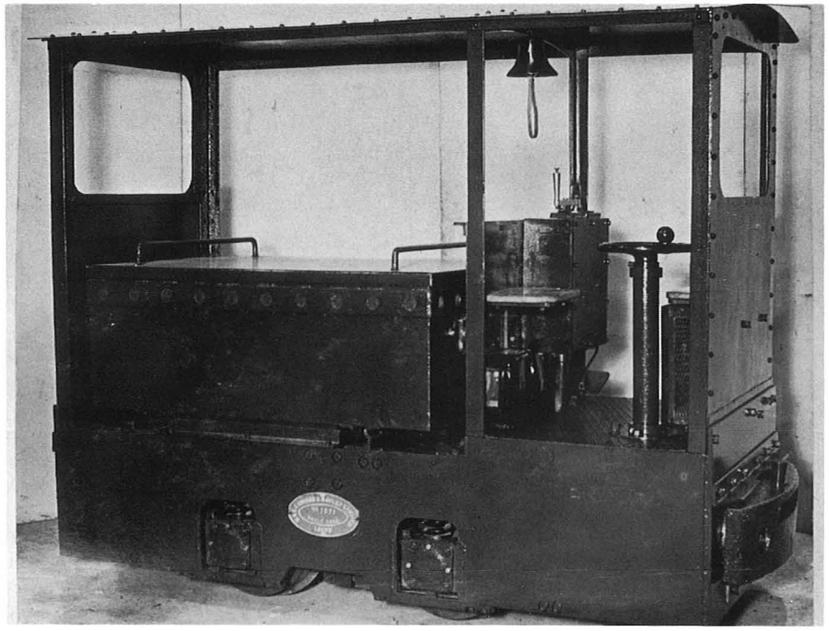


The early battery locomotive, photographed in July 1917. The battery box carries the name EDISON STORAGE BATTERY. *(RARDE)*

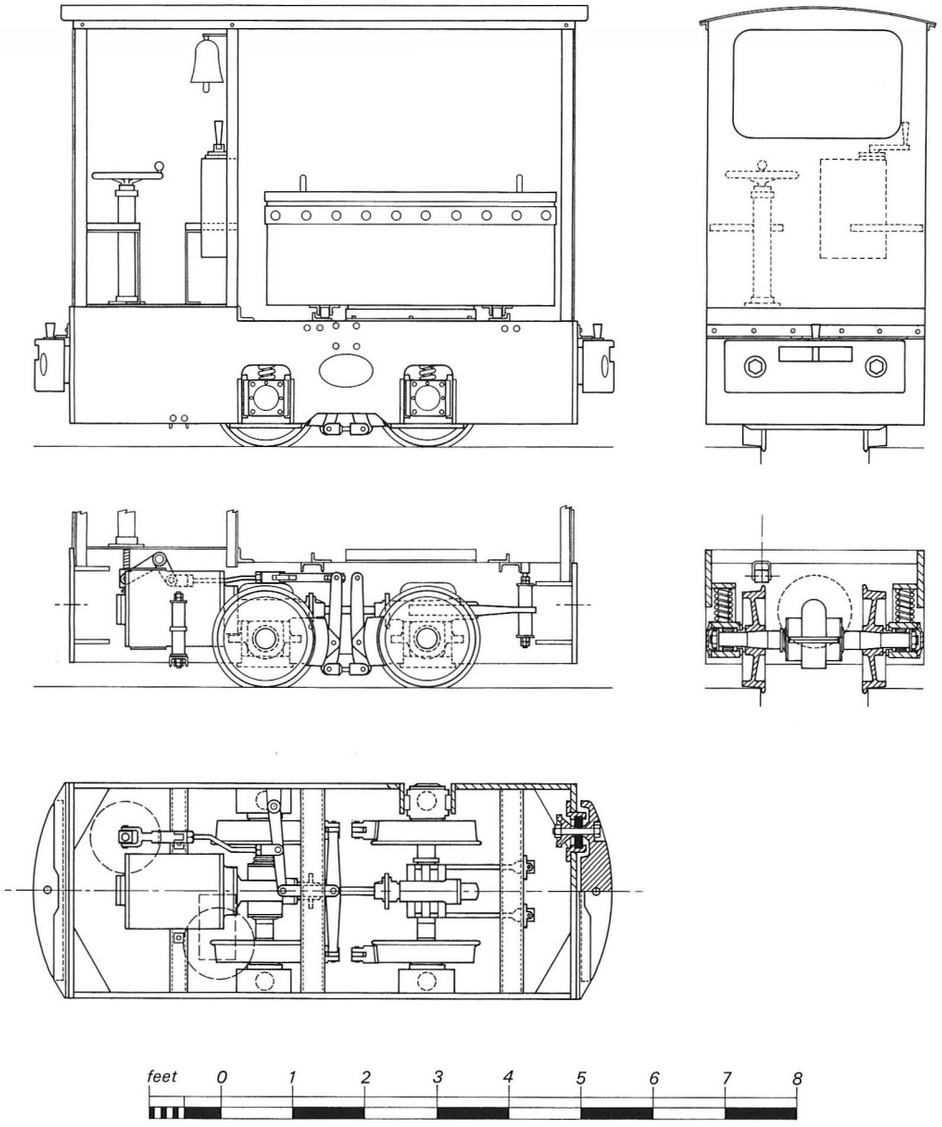
type. This type of truck was originally designed for road use, and although the one built for Waltham Abbey is believed to have been a rail-mounted version, this can not now be confirmed. The chassis number was 59 and the date was July 1918. This vehicle had a payload of up to 4000 pounds, officially 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 of Liverpool, a firm who had acquired the goodwill of British Electric Vehicles 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 World War 2, the Royal Gunpowder Factory 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.



Official maker's photograph of Greenwood & Batley 'tractor' number 1671, built in 1940. *(Collection A.J. Booth)*



The above drawing shows a Greenwood & Batley 'tractor' of the second batch, built in 1942. The four 1942 locomotives differed slightly in detail from the six built in 1940, mainly in the buffer and end beam arrangement. Drawing by Peter Holmes, based on Greenwood & Batley outline drawing number T.1868, by courtesy of the Hunslet Engine Co Ltd.

These odd-looking battery tractors were re-charged in what used to be the North Site locomotive shed and probably in 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 had ceased production and had become a Government research establishment. At least three of them were in existence as late as 1958.

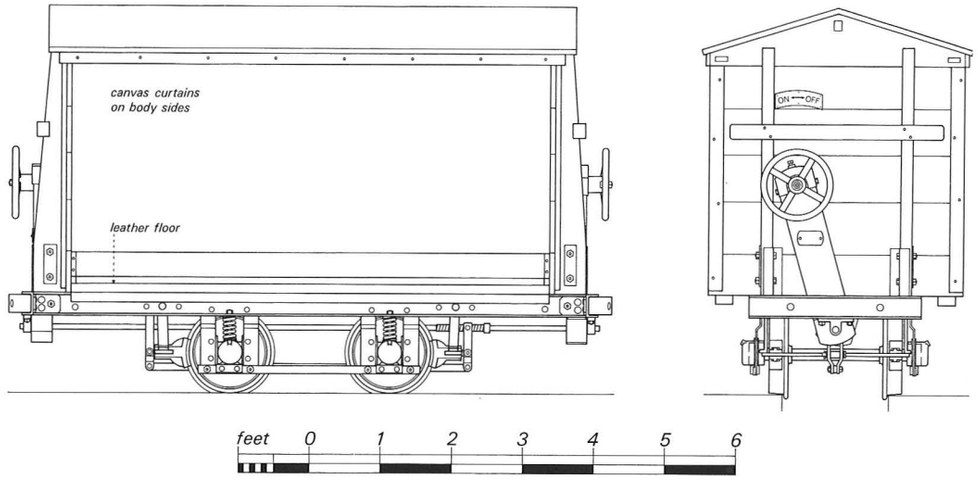
No details of the early cordite and guncotton trucks have been found to date. It is known that some of them were made in the Royal Carriage Department at Woolwich Arsenal for a cost of £40 each. According to an order dated 1892 there were then at least four different types, namely trucks without brakes, 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, baskets 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 1000 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.

Hand-propelled wagons with peaked roofs, probably photographed during World War 1. These smaller wagons were used within the process areas. (RARDE)



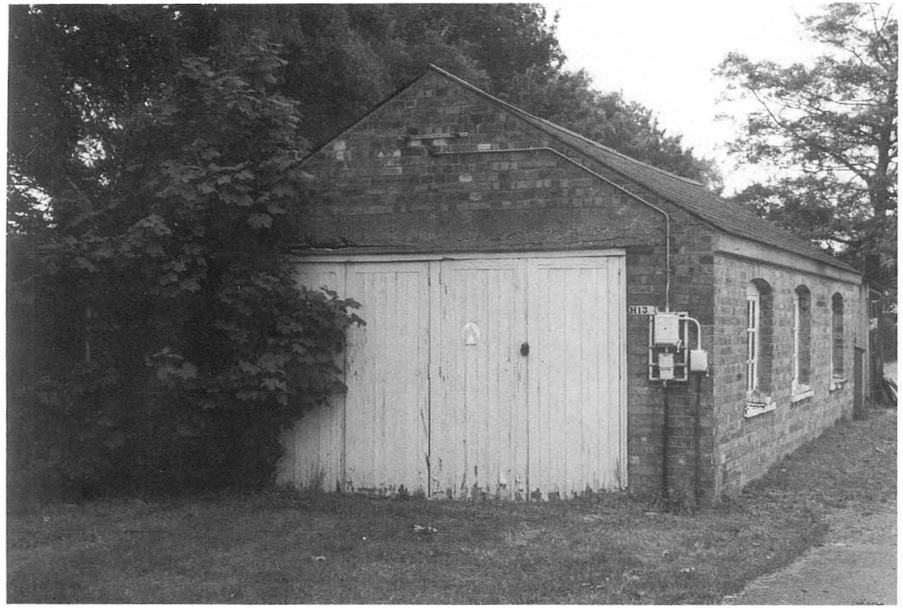
The above drawing shows a cordite paste wagon built by R. Hudson Ltd, possibly one of the batch supplied in 1939. Drawing by Peter Holmes, based on measurements taken by J.M. Jenkins from the surviving wagon.

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)

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 amendments 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 Pointsmen, 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.



The former North Site locomotive shed photographed in 1987. (J.M. Jenkins)

Remains of the System

At the time of writing 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 reminder 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 World War 2. 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.

Wooden rails were still in position in 1987 in one of the former process buildings. (J.M. Jenkins)

18in gauge points found in 1987 on the North Site. (J.M. Jenkins)

Buffer stops adjacent to a disused canal wharf. (J.M. Jenkins)

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 World War 1; 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 Royal Small Arms Factory link with its coal chute dismantled? One of the difficulties is that most of the documents relating to the interesting World War 1 period of the railway now seem to have vanished, but we are fortunate that some of the drawings have survived.

Locomotive Summary

type	*builder*	*builder's number*	*delivered*	*class*	*disposal and notes*
4wPar	RP	51697	30. 1.1917	ZLH	S/S
4wPar	RP	51707	16. 3.1917	ZLH	S/S
4wPar	RP	51901	28. 9.1917	ZLH	(1)
4wPar	RP	51927	29.10.1917	ZLH	S/S
4wBE	?				(2)
4wBE	BEV	59	30. 7.1918	'Giant'	(3)
4wBE	WR	1043	31. 7.1937	W 117	S/S
4wBE	WR	1044	31. 7.1937	W 117	S/S
4wBE	WR	1045	31. 8.1937	W 117	S/S
4wBE	WR	1046	31. 8.1937	W 117	S/S
4wBE	WR	1047	31. 8.1937	W 117	S/S
4wBE	GB	1668	1940		(4)
4wBE	GB	1669	1940		(4)
4wBE	GB	1670	1940		(4)
4wBE	GB	1671	1940		(4)
4wBE	GB	1672	1940		(4)
4wBE	GB	1673	1940		(4)
4wBE	GB	1851	16.11.1942		(4)
4wBE	GB	1852	16.11.1942		(4)
4wBE	GB	1861	30.11.1942		(4)
4wBE	GB	1862	30.11.1942		(4)

All locomotives were 18in gauge, and all those which are identified were delivered new.

Notes

(1) To Oakeley Slate Quarries Ltd, Blaenau Ffestiniog, via H. Gardam & Co Ltd, Staines, Middlesex, 1934. This locomotive was rebuilt to 2ft gauge by 1933. It is not possible to say when it was disposed of by the Royal Gunpowder Factory, possibly Gardam did not acquire it directly.

(2) Batteries made by 'Edison', chassis possibly built by Automatic Transportation Company of Buffalo, USA. Disposal unknown.

(3) Not certain whether this was a road or rail vehicle. Disposal unknown.

(4) Three of these locomotives were still in existence in 1958, and at least one survived until 1962, out of use. Disposals not known, but presumed scrapped.

Abbreviations

RP	Ruston Proctor & Co Ltd, Lincoln
BEV	British Electric Vehicles Ltd, Southport
WR	Wingrove & Rogers Ltd, Liverpool (acquired goodwill of BEV in 1926).
GB	Greenwood & Batley Ltd, Leeds
Par	Paraffin engine
BE	Battery electric
S/S	Scrapped or sold, disposal unknown

Acknowledgements

Firstly I must thank Mr M. McLaren, also an employee of RARDE, who has considerable knowledge of the Royal Gunpowder Factory. He pointed out the location of maps, drawings and other records held by the Establishment and the Public Record Office. Without his assistance, it is doubtful whether this account would have been written. Dr D. Tod, also of RARDE, gave very valuable assistance with his considerable knowledge of narrow gauge railways. I must also acknowledge the staff of RARDE Waltham Abbey for their assistance and patience. Mr R.E. Hooley of Ruston Gas Turbines Ltd kindly provided photographs and drawings of the Ruston Proctor locomotives, and copies of contemporary literature. The Hunslet Engine Co Ltd of Leeds supplied details of the Greenwood and Batley locomotives and the drawing, while Adrian J. Booth provided additional information on these locomotives and the photograph. Frank Jux and Jim Peden provided details of the BEV and WR locomotives, and Gordon Green and Douglas Clayton of the IRS supplied further locomotive details. Lastly, but by no means least, I must thank my wife who tolerated a bedroom cluttered with boxes of drawings and maps for several months.

References

Winters W. *Centenary Memorial of the Royal Gunpowder Factory, Waltham Abbey.* 1887

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'WASC' denotes RARDE, Waltham Abbey, Special Collection. There are many separate references in this collection, which are too numerous to itemise.

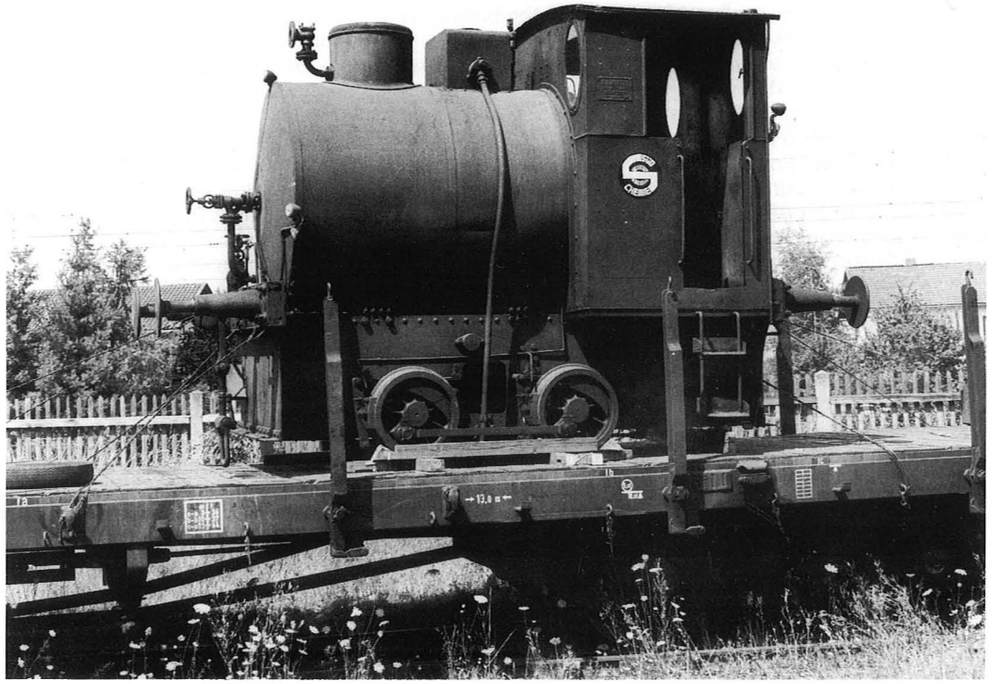
SOCIETY VISIT TO GERMANY

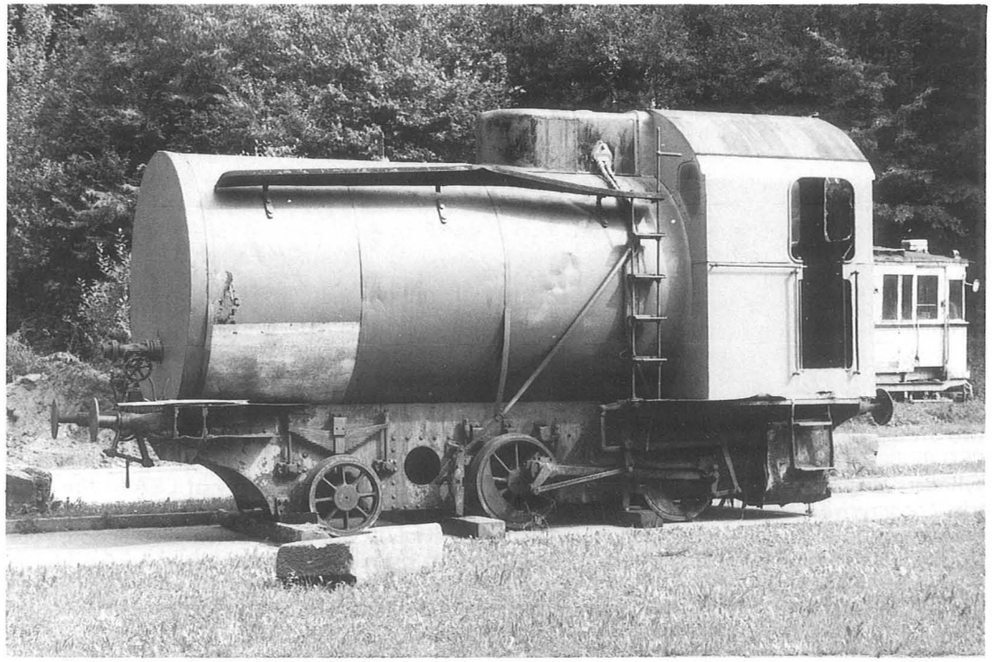
FRANK JONES

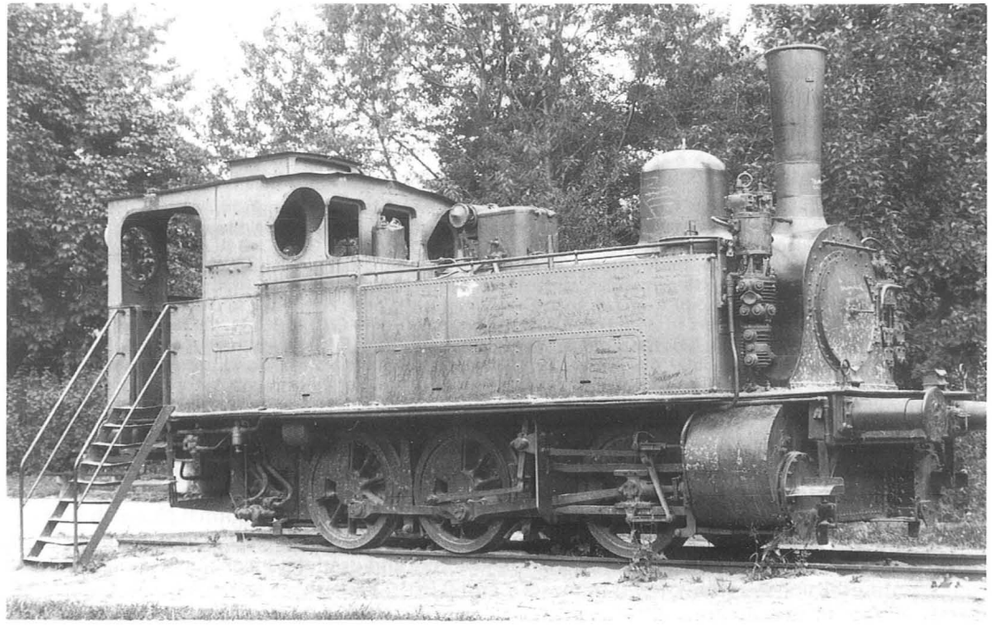
The three locomotives appearing in the photographs were seen on the Industrial Railway Society and Locomotive Club of Great Britain trip to Southern Germany during the August Bank Holiday in 1987. Details of the visit were given in *Bulletin* 444. The diminutive 0-4-0 fireless locomotive (Maffei 3884 of 1914) was in Nordlingen railway museum, but at 7.30pm decent pictures were not possible. Fortunately, Siggy Wieser of Dettingen, a precision model maker, kindly provided one taken in 1975 on the locomotive's arrival at the museum. With 300mm (11.8in) diameter cylinders and a working weight of 11 tonnes, it must surely be among the smallest of standard gauge fireless locomotives.

The 2-4-0 fireless Maffei 3859 of 1913 was photographed by me at the shambles of Marxzell. The wheel arrangement is very rare for a fireless locomotive but not unknown. Other examples were UNIQUE (Bagnall 2216 of 1924) on Bowater's railway at Sittingbourne and the only fireless locomotive (works number 1969) built by Avonside in 1925 for a 5ft 6in gauge railway in India.

Finally the 0-6-0 tank, Esslingen 4092 of 1922, was the former Esslingen works shunter. The firm is remembered more for its rack tank locomotives rather than industrial shunters. The locomotive was standing in a playground in Kornwestheim when I took the photograph.







LOCOMOTIVES OF THE MOUSEHOLD LIGHT RAILWAY

The brief history of the 3ft 6in gauge Mousehold Light Railway constructed on the outskirts of Norwich in 1918 was described by Chris Fisher in RECORD 76. The motive power used on the two mile journey to Norwich Thorpe station comprised two electrically powered wagons constructed at the Norwich Electric Tramways Company depot. These looked like 'open railway trucks but were fitted with a covered platform at each end, and had a tramway trolley-collector in the centre.' The lines within the factory were shunted by two secondhand steam locomotives. In 1921, the factory described as the Mousehold Heath Aircraft Acceptance Park was advertised for sale. Together with the various buildings, roads, and accommodation on offer was 'approximately 500 yards run of tramway lines serving all large sheds and shops.' Since the publication of the short article in 1978, further information has become available which throws a little more light on the identities of the obscure locomotives used on this railway. In particular, the publication *Surplus* contains numerous references.

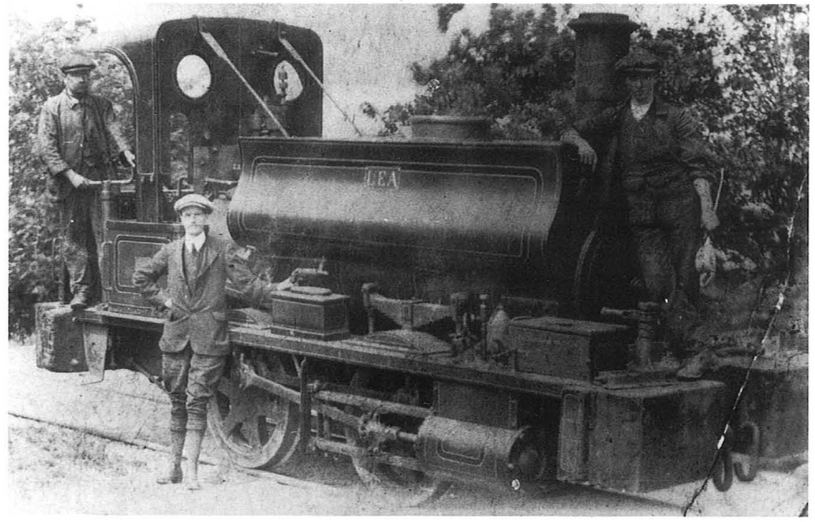
The two steam locomotives were advertised for sale on 15th November 1919 as one saddle tank locomotive and one side tank locomotive of 3ft 6in gauge, rebuilt by J.F. Wake, and it is presumed that these were the locomotives which worked at the Mousehold factory. On 15th May 1920, two 3ft 6in gauge locomotives, rebuilt by J.F. Wake, were advertised as available for puchase at the CSD 85 Barnbow Ordnance Factory, Leeds. The locomotives were recorded as having 9in x 14in cylinders *(sic)* and one was called LEA. Russell Wear has described the history of LEA in *The Industrial Locomotive No.28.* It was an 0-4-0 saddle tank with outside cylinders built by Barclays & Co (maker's number 272) in 1880. The locomotive had previously worked at B. Whitaker & Son, Pool Quarry, Pool-in-Wharfedale before moving to Mousehold, presumably via J.F. Wake. LEA evidently left Mousehold before November 1919 and was taken to Barnbow where it still remained in September 1922. The side tank locomotive has not been identified and was not advertised after May 1920.

The Railway is described by R.C. Anderson in *Tramways of East Anglia.* He records how the two electrically powered wagons 'were driven by crews trained from among sixteen volunteers who were paid a special bonus of 5s (25p) per week.' After the closure, the electrically powered wagons (described as Electric Rail Tractors) and trailers were offered for sale in *Surplus* on 15th August 1921. There were three electric rail tractors. Of these, one was new and carried no number. The other two had the same specification but were second hand. Number 10008 was described as in good condition and No.2 was in fair condition. The Railway therefore only put two of these units into service.

Surplus gave the following details of the new tractor:

> 'One Electric Rail Tractor, by Peckham Motor Truck and Wheel Co., Kingston, N.Y. Tramcar type of chassis built up of 3 in x ⅝in. W.I. bars, length overall, 24 ft., wheel base, 6 ft. 6 in., helical and laminated springs, two 38 B.H.P. Electric Motors, type G.E., 249 A., by B.T.H., U.S.A. Wood open type body fitted with covered over driving cab each end, body 16 ft. x 6ft. 6in. x 2 ft. high with drop sides, body 1¼ in. timber, floor boards, 1½ in. timber, 6 in. x 9 in. wood case over body from cab to cab carrying trolley pole, 6 ft. floor to casing, load approx. 5 tons. Tractors fitted 2 B.H.P. Controllers type B., 49 C.C., 2 B.T.H. Car switches, type M.S. 4, B.B., 2 B.T.H. Resistances Type, C.T., Form B., 1 B.T.H. Lightning Arrester. Type M., Form D. 2, 850 Volts, Gauge, 3 ft. 6 in. No number indicated. Condition : This is a new Tractor, but will probably need a light overhaul and minor adjustments before working.'

The Norwich trams all used Peckham trucks, the bodies being the products of Brush or English Electric, so the reference to Peckham probably only refers to the manufacture of the running gear. Peckham trucks were not at all 'normal' in this country, although many of the towns which were early in the field of electric traction used the 4 wheeled Peckham Cantilever truck. The Peckham trucks on which the electric rail tractors were built differed from the normal Norwich pattern of cantilevers in having a longer wheelbase than the 6ft norm. The Norwich Electric Tramways Company subsequently bought at least two of the tractors and used the mechanical and electrical equipment in the construction of two tramcars 7 and 9 in 1923. Perhaps the third was obtained for spares.



LEA arrived at Whitaker's Pool Quarry in 1910, possibly from Lancashire. It was pinch-barred up the 1 in 6 incline to the top level where both it and its predecessor worked. The livery at Pool was maroon with black lining. The photograph was taken at Far Row, the incline top, about 1913 and the driver Joe Roundhill is on the footplate. The line closed in 1915 due to the wartime slump and LEA moved on eventually reaching the Mousehold Light Railway.
(Courtesy J. Whitaker, collection F. Jones)

Some trailers and one flat top trolley were also advertised for sale in 1921. There were four trailers using Peckham running gear and these had a similar chassis to the electric rail tractors. Their dimensions were overall length 20ft 6in, wheelbase 6ft, a wooden open-type body 16ft x 6ft 6in x 2ft high and with drop sides. The platform at each end was 4ft 6in x 2ft with a hand brake column. All wheels were braked and there was a cow catcher at each end. Trailers Nos.1 and 4 had been used but the other two trailers had probably not entered service. The latter were described as having a new body and an overhauled and painted undercarriage. In addition, No.3 trailer was slightly smaller and had Baltimore Car Wheel Company running gear.

The editor is grateful to John Horne, Chris Fisher, and E.D. Chambers who provided the information for this article.

'The expense of drawing the ore and stone out of the mine depends much upon the length of the level and the depth of the shaft, but is always considerable when horses are employed. In Alston Moor it is usually drawn out at so much per shift, a shift containing six or eight waggons. A miner's waggon, calculated for an eight waggon shift, contains thirty kibbles, the capacity of each kibble being fourteen quarts, or thereabouts; a waggon, calculated for six waggon shifts, contains forty kibbles: the shifts in both cases being equal. The cost of a shift, in horse levels, varies from 3s 6d to 8s (17½ to 40p), inclusive of the cost for filling, driving, and emptying the waggons, no allowance being made for the difference of weight between the ore and the stone.' *(Extract from* A Treatise on a Section of the Strata from Newcastle-upon-Tyne to Cross Fell *by Westgarth Forster, 1883 — P. Holmes)*

MYSTERY CORNER

E.D. CHAMBERS

Only a cursory glance through the pages of the RECORD is enough to demonstrate the many varied situations where light railways have been employed. The postcard by B. Stone & Son shows work proceeding on clearing away the sand from the promenade after the sand storm of December 1929. The large building in the background is the Pier Hotel. Readers are invited to identify the location.

TRAMWAY ACCIDENT – 'From the *Mackay Mercury* of November 4, we learn that particulars to hand concerning the tramway accident at Plane Creek, which occurred last Wednesday week, show that the engine driver was under the influence of liquor, and drove the engine to which several trucks were attached, at a frightful rate. It being the last load of the cane from down the line, the occasion was being celebrated by indulgence in intoxicants, and the driver would not yield to the pleadings of the boy on the engine to drive slower. The boy had some difficulty in stopping the engine to open the gates, and when he got off to open them, the driver drove straight through and would not stop for the lad to get on again. The trucks became derailed and the driver was thrown to the ground, his head striking some part of the engine, and he was instantly killed. The engine afterwards ran off the line, and like many of the trucks, was damaged to considerable extent. The usual magisterial enquiry will be held.' *(This account of the accident was reported in* The Week (Australia) *on 17th November 1899. Plane Creek Mill at Sarina, some 730 miles north of Brisbane, still has a 2ft gauge tramway system.– John Browning)*

LETTERS

DANIEL ADAMSON & CO

Doug Clayton's account of Daniel Adamson's locomotive activities in RECORD 110 is a most useful addition to the published history of lesser builders. The device in front of the dome on OLDHAM and CHADDERTON is surely an external regulator, taking steam from the dome through the horizontal pipe (along which passes the regulator rod) and discharging to the dry pipe by the vertical one that supports it. The lubricator on top of the casing is the give-away, as this is typical of those used to lubricate certain designs of regulator. The absence of a rod on OLDHAM suggests that it was out of use at the time the photograph was taken. I note that Adamson's version of the Ramsbottom safety valve employed a compression spring, as did that adopted by F.W. Webb. Both men were Cheshire JPs, so there may be more than coincidence in this detail.

The Adamson disc wheel was in no way an ancestor of the Bulleid-Firth Brown wheel. It would have been heavier than a spoked wheel of equal strength, whereas the whole point of the BFB design is the use of thin, virtually corrugated sections to produce a wheel much lighter than the equivalent spoked one. The form of wheel used by Adamson, like his cylinder layout, is a throwback to Timothy Hackworth; Bulleid was treading new ground.

Frederick Beaumont's air locomotives and tramcars are a fascinating subject, details of which are reasonably plentiful but often contradictory or, as in the case of Major Hogg's description, hopelessly garbled. Beaumont was associated with torpedo research at Woolwich, thus being able to make use of the small compressor in the torpedo laboratory for his early experiments in compressed air traction. The building of a locomotive for use around the Arsenal perhaps legitimised this activity. His first locomotive was certainly of 18in gauge, but I suspect that there was a standard gauge one as well. I cannot accept that he started off with a four-cylinder engine of the form attributed to him. Not only is it a demonstrably unworkable system, but even by 1873 Beaumont's track record shows him to have been a sound and imaginative engineer, not the sort of abstract theorist who would have fallen into such an obvious trap. In fact the cylinder proportions quoted are those of the compressor used in his early experiments.

The reference to 'cylinders' that confused Major Hogg took some time to unravel, but it appears that Beaumont used this term for the air bottles which formed the reservoir of his first locomotive. They were coupled together in groups, one group at a time being run to exhaustion. The intention was that the last group served as a reserve capable of getting the locomotive, light, back to base from anywhere on the system. In practice, this elementary piece of management proved beyond the capabilities of certain drivers who became stranded. This in turn gave the locomotive a bad name which it did not deserve. Runs of more than six miles per charge were achieved in the right hands. The locomotive, or its standard gauge companion, is the one illustrated at the top of page 166, attached to one of the 18in passenger carriages. The translation from photograph to engraving is not good enough to enable much to be learnt of its layout.

Beaumont's early machinery was made by Greenwood & Batley, who were also involved in the Whitehead torpedo project, and they were to have built a tramcar embodying lessons learnt at Woolwich. Whether they did or not I have no idea, because Beaumont then transferred his allegiance to Daniel Adamson. It was undoubtedly Adamson's expertise in welded steel reservoirs that led to the change, but I believe that he also collaborated with Beaumont in the design of the unique drop-valve gear fitted to the high pressure cylinders of all subsequent Beaumont locomotives and tramcars.

The first of these were the two Manning Wardles, second generation experimental locomotives intended to gain further experience of the system in regular public service. According to Beaumont, Adamson supplied both the reservoirs and the engines for these locomotives, in which case one wonders why they were not built at Dukinfield. They undertook several trials and generally acquitted themselves well, being by a wide margin the most efficient compressed air locomotives ever built if judged on the basis of work output per cubic foot of air consumed. They appear to have been modified several times and probably account for many of the reservoirs in Adamson's list. An early account says that Manning Wardle 761—the larger, six-cylinder one—had a nominal storage capacity of 100cu ft and Manning Wardle 762 had 80cu ft. A few months later, 762 possessed a reservoir capacity of 97cu ft when tested at the North Metropolitan Tramways depot at Stratford. The lower illustration on page 166 shows 762 working between Stratford and Leytonstone.

The reservoirs listed have nominal capacities of 20cu ft (2344—47), 30cu ft (2006—7), 50cu ft (2682- 83); the rest are 40cu ft. It is possible that 2006—7 were made for a tramcar, but they could have been the original equipment for 762. Equally, I suspect that 761 started life with two 40cu ft reservoirs. Presumably both locomotives had two 40cu ft and one 20cu ft reservoirs latterly. A complication in working out what went where is that some time around the end of 1882, Frederick Beaumont parted company with the Beaumont Compressed Air Company. The latter, a get-rich-quick outfit apparently devoid of much technical skill, tried to sell Beaumont system equipment for a few years longer but succeeded only in discrediting it completely through incompetent design and handling. Their demise followed some disastrous trials at Antwerp when their car came a miserable last. The performance recorded by Beaumont's early locomotives would have won.

The purpose of heating the cylinders was to oppose adiabatic cooling which greatly reduces the work output from a given quantity of air. The tiny boilers contributed much to the total power output of a Beaumont locomotive. Even using moist air, ice would not build up in the cylinders because such a happening violates several physical laws. The air reaching the low pressure cylinders of a Beaumont engine had very low relative humidity, but other systems relied upon latent heat recovery from entrained water vapour to offset adiabatic cooling. Problems with ice aggregation occurred with poorly designed exhaust arrangements, the coherent ice coming from the humidity in the surrounding atmosphere.

Beaumont certainly intended to work the Channel Tunnel by compressed air, using huge express locomotives embodying principles successfully demonstrated by the two Manning Wardles. Compressed air would have been the only form of motive power capable of working such a tunnel in 1887, the date by which he expected to complete the first main bore.

Lastly, the reference to a Beaumont atmospheric locomotive on the London & Croydon Railway in the 1840's is a red herring. Atmospheric railways did not have locomotives, this being one of their great advantages, and in 1840 Frederick Beaumont was just seven years old. Another Beaumont *was* involved in railway promotion in South London, but he is not known to have been an engineer. I suspect that Major Hogg got out of his depth trying to separate railway history from attractive legend. For the record, the first full-size compressed air locomotive to run in Britain was demonstrated on the Eastern Counties Railway in 1852.

KENILWORTH — RODNEY WEAVER

An article on 'Platt's railway' by Mr W.W. Kempe of Platt Bros & Co Ltd appeared in the 8th April 1967 edition of *The Chronicle* newspaper. This gave a short history of the works railway at Oldham. It described the locomotives built by Adamson, which were named after wards in the Oldham area. The article commented how the locomotives had several features which departed from the then accepted practice. The wheels were cast iron with steel tyres. Despite the great size of the buffers, they were backed by India rubber cushions. The acutely sloping cylinders were easily accessible. Unfortunately this feature was the 'one weak point of the locomotives, since the cylinders frequently worked loose, being supported only by the smokebox.'

In 1907 one of the Adamson locomotives, GREENACRES reputedly built in 1873, had an unfortunate accident. It was on the Werneth—Middleton line of the Lancashire & Yorkshire Railway with its gradient of 1 in 27½. 'The old-type locomotive, GREENACRES, was taking its morning load of coke, pig iron, and steel rolls to the forge, with the engine first according to the rule. The brake failed to hold the engine and the train crashed through the stop-blocks and fell into Peel Street.' A dramatic photograph of the locomotive lying on its side in the street appeared. After that steam brakes were fitted to all Platt's locomotives, a heavy brake van was purchased from the L&YR, and hydraulic stop blocks were provided. The L&YR's breakdown crane retrieved the locomotive and wagons. GREENACRES was one of four Adamson locomotives which Platt Bros sold to the Government in 1916.

LLANBERIS — V.J. BRADLEY

The engraving on page 166 of RECORD 110 of the Beaumont compressed air locomotive No.2 was originally published in 1880. A later illustration of No.2 in service with the North Metropolitan Tramways, taking on air from a man hole in Stratford Broadway, shows a much larger machine with double-ended controls and an all-over roof. It no longer sports the City of London Arms, and it seems possible that the illustration in the RECORD may have included some guesswork.

There was a query on page 145 why CHADDERTON was at Tattenham Corner. I understand that all locomotives stored at that station in 1919 had come from France via the Richborough Port train ferry, so it would appear that CHADDERTON had spent some time in France, however briefly.

LLANDRE, DYFED — R.W. KIDNER

FLIMWELL CROSSWAYS

I suggest that the postcard in RECORD 111 shows work on an improvement to the A21 London — Hastings road (grid reference 312715) about 1938—39, either by the East Sussex County Council using direct labour or by a contractor. The arrangement appears to indicate that spoil was being dumped locally; the site is three miles from any railway. The gentleman directing traffic looks like an Automobile Association scout.

LONDON — DAVID COLE

KINMEL CAMP RAILWAY

I have in my possession a print of a LMSR survey of the 'Kinmel Park Camp Railway', dated 1923, which clearly shows that trains from the Camp ran direct on to the Foryd Pier Goods Branch, and had to set-back on to the Denbigh line, before they could proceed again towards Rhyl. This would explain the 7—10 minutes allowances in running times here referred to by Mr Chambers in his letter in RECORD 111. Pencil scribble on the map indicates an alteration to the layout, to permit through running without reversal, and I presume this was installed after the LMSR took the line over. The differences in running times from Foryd Junction to Rhyl doubtless paid regard to the 'standing start' made by the WD trains, compared with the 'pass at speed' nature of the Vale of Clwyd traffic.

LLANBERIS, GWYNEDD — VIC BRADLEY

THE CORKICKLE BRAKE

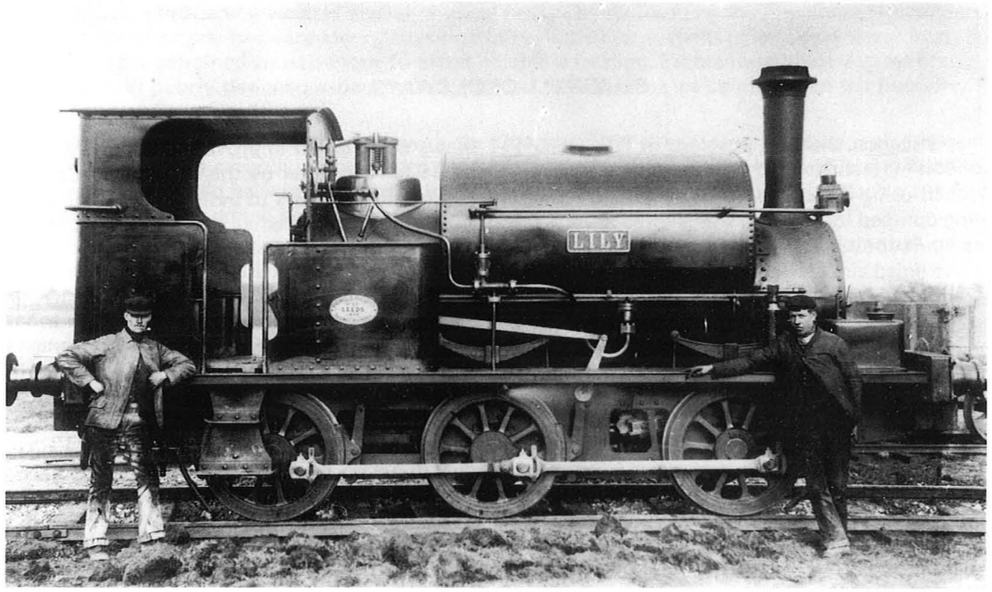
One small error crept into the article in RECORD 111. The 'new loco shed by 1974' was shown on the map astride the line leading to the loading point at the works. In fact, the shed was situated on a short siding off this line.

STAFFORD BOB YATE

HEVER CASTLE CONTRACT

I can supply some further information on the locomotives which worked on the Bott & Stennett Harrow & Uxbridge Railway contract. These were mentioned by Frank Smith in his article in RECORD 110. LUCERO was a 0-6-0 saddle tank built by Manning Wardle (works number 1098) in 1888. It came from T.A. Walker, Buenos Ayres about 1899. ANNIE was possibly Manning Wardle 1445 of 1899 and could have come from Holme & King. The other unidentified locomotives were INCE (Hunslet 425 of 1887), a 0-4-0 saddle tank received from Hall & Co or H.M. Nowell; GREENWICH (Manning Wardle 887 of 1883) from J. Mowlem and GORDON (Manning Wardle 684 of 1878) from H. Weldon. The latter two locomotives were 0-6-0 saddle tanks.

LONDON D. COLE



Another locomotive which worked on the Harrow & Uxbridge Railway contract was LILY (Hudswell Clarke 621 of 1902), photographed standing on temporary track at Rayners Lane. (G. Alliez, courtesy B.D. Stoyel)

BOOK REVIEWS

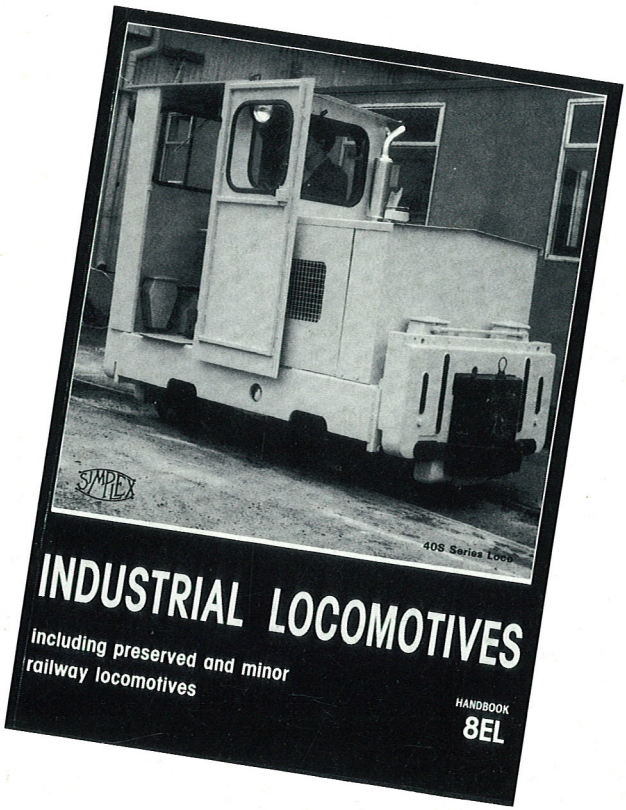
LESSER RAILWAYS OF BOWLAND FOREST AND CRAVEN COUNTRY *by Harold D. Bowtell. ISBN 0 9511108 8 8. 112 pages, 9½in x 6¼in, hard covers, 75 illustrations and 13 maps. Published in 1988 by Plateway Press, P.O Box 973, Brighton BN2 2TG. Price £12.95.*

Most readers will probably be familiar with Harold D. Bowtell's previous two books of reservoir railways. This latest publication by Plateway Press covers the area between the rivers Ribble and Lune, extending from the Lancaster to Carlisle mainline towards Skipton and Haworth. It describes about a dozen railway systems and depots, together with over 80 locomotives used to construct the reservoirs. Railways of 3ft gauge predominate but 2ft and standard gauge also appear. The book brings out very well the remote character of some of these locations, particularly at Stocks, and your reviewer was sufficiently encouraged to go and inspect the route of the former 4½ miles long branch to Jumbles Quarry. Some sodden sleepers marked the trackbed which led to an embankment near the Cross of Greet Bridge before the route headed off towards the quarry. On that grey morning, and after reading Harold's book, it was easy to imagine FYLDE (Peckett 1671 of 1924) or OGDEN (Bagnall 1761 of 1905) struggling up through the inhospitable terrain.

The book does not have an index although the chapters and listing of the locomotive information makes locating references relatively easy. A very interesting selection of photographs has been included but one suspects that the printer could have made a better job of reproducing them and the paper used is rather flimsy. The author has the reputation of being a precise and careful historian and this book confirms it. He has identified a lot of new information about the railway systems and locomotives, with many particulars of the internal combustion locomotives which others have tended to overlook. The book is a valuable addition to the literature on contractors' railways and is heartily recommended. *(C. Shepherd)*

RAIL FREIGHT—TODAY *by C.R. Anthony and B. Rogers. ISBN 0-86093-439-X. 120 pages, 273mm x 215mm, hard covers, 202 black and white photographs. Published in 1989 by Oxford Railway Publishing Co Ltd, Sparkford, near Yeovil, Somerset BA22 7JJ. Price £12.95.*

It is our usual practice to concentrate on reviews of books primarily concerned with industrial railways but it does no harm to have an occasional reminder that the future of the private sidings and the main railway system are closely linked. This book looks at the organisation of rail freight today from the BR side of the operation. It has separate chapters dealing with coal, oil, metals and automotive, minerals, construction, chemicals and Speedlink sub-sectors, together with Freightliners Ltd. The current arrangements are considered in the context of BR operations in the North East of England and Yorkshire. Seven private locomotives are illustrated. The book gives a useful insight into the modern methods of handling materials, which have all too often resulted in the disappearance of industrial locomotives at many locations. This still leaves some rather truncated private railways as we were reminded at the Society's recent AGM. It is interesting to read about the advantages of different loading methods. For example, the use of two front loading Michigan mechanical shovels at Seaham Colliery is almost as quick as loading from overhead screens. The book will appeal mainly to those with an interest in BR's freight operations and their impact on the remaining industrial railways in the north east. *(C. Shepherd)*



NOW AVAILABLE

The Industrial Railway Society is pleased to announce the publication of *Handbook 8EL* (Existing Locomotives). This lists all industrial, preserved and minor railway locomotives in the British Isles, and includes all amendments notified up to 1st January 1989. The book contains 303 pages of information plus 32 photographs.

8EL is available in softback or hardback, the price to members being £9.50 and £12.50 respectively, to non-members £12.95 and £15.95. These prices are inclusive of postage and packing. Orders should be sent to **S.C. Robinson, 47 Waverley Gardens, London NW10 7EE.** Cheques or postal orders should be made payable to the Industrial Railway Society.