WASS 2084

History of
Quinton Hill
Nitroglycerine Plant
27-3-1991

Quinton Hill Nitroglycerine Plant

The Buildings and Plant were erected in 1891 to designs which were basically the same as those of the Nobel plant at Ardeer. Two nitration houses were built on the summit of the Hill, adjacent to one another, but separated by traverses. Only one house would be used at a time allowing maintenance work to be carried out in the other. The two houses shared a Charge House on top of the traverses. After nitration of the glycerine, the nitroglycerine (NG) charge of about 750 lb was separated from the spent acid, using a stoneware cock. The NG was run downhill to the south in lead-lined gutters to the Washing House, where two batches could be washed at a time, 3 times with soda solution, once with water. The waste acid was run off northwards to an After Separation House, where it was kept for a time to enable any further NG to collect on the surface where it could be skimmed off and taken by hand to the Washing House. The waste acid was then run back towards Cobbins Brook.

The washed NG, after testing with litmus paper for free acid, was then run down to the NG Store, and the wash waters to a Wash Water Settling House. The NG Store was adjacent to, but separated from, a building intended to be used as a Dry Guncotton Store. All the Buildings, except the After Separating House and Wash Water Settling House, had high earth and rubble filled brick traverses similar to those used to surround gunpowder buildings.

The Dry Guncotton Store was never used as such, and in 1894 it was being converted to an additional NG Store. The procedure adopted at the time for the making of cordite paste was for processmen to bring weighed quantities of dry guncotton in a rubber bag to the NG Store where a measured quantity of NG, tested for stability by the Abel Heat Test, was added, the "poured-on cotton" then being taken to a mixing house where blending was carried out by hand before the paste was taken to the Cordite Incorporating Houses.

At 4.8 pm on Monday 7 May 1894, there was an explosion in the plant. Both the Washing House and NG Store blew up. Four men were killed; the processman working in the Washing House together with the Chemist-in-Charge and Foreman of the NG plant, and the Foreman plumber who were apparently approaching the Wash House entrance at the time. The NG Store was locked and unoccupied. Other buildings in the area were extensively damaged, particularly No 2 Nitration House where a nitration was in process. The Chemist-in-Charge of the Guncotton Factory, despite being injured, entered the Nitration House and with the two processmen working in the building, saw the charge safely drowned before seeking medical attention.

At the Court of Inquiry, no definite cause of the explosions was found, but there were many suggestions and recommendations made. Despite the evidence of the only eyewitness prepared to say which house blew up first (from the Proof Butts he was convinced the NG Store blew up first), the Inquiry came to the more logical conclusion that the Wash House was the first to explode, and the store followed, the probable cause being the building collapsing in the blast. A carpenter and boy working on the new guttering to the Dry Guncotton Store being converted were between the two buildings and had miraculous escapes, suffering no more than ear damage and bruises respectively.

A number of practices were changed after the explosion. The general public had been allowed to walk in the area on Sundays, without adequate supervision to ensure they did not smoke, and with the possibility that non-safety matches could be dropped on the ground; this access to the area was immediately stopped. Processmen changed their normal boots for those without iron nails in the Shifting Room, then walked to the process buildings along gritty paths to the process buildings, without putting on overshoes; this again was altered so that boots were changed on entry to the process building.

The plant was rebuilt quickly on the same site, although the Court of Inquiry recommended any NG plant should be placed in a position more remote from both the Guncotton and Cordite Factories then in use. Storage of NG was frowned upon, and in the new process, washed NG was "poured-on guncotton" as quickly as possible, and stored in this way. If a sample withdrawn failed the Abel Heat Test, the "poured-on cotton" was destroyed as soon as possible before being worked further. The brick revetted traverses had come in for criticism; despite this type of traverse having contained explosions of gunpowder in the past, the traverses around both buildings destroyed in the explosions had disintegrated and added to the debris distributed around the site. Earth traverses at Ardeer, however, had survived previous explosions there. The new Washing House and Pouring-on Houses were therefore built with earth traverses, and no further brick traverses were constructed. By the autumn of 1894, the NG Factory was back in production.

In 1898, following the Court of Inquiry's recommendation, a new NG Plant was erected at Edmonsey to serve the new Cordite Factory built on the North Site. Several Gunpowder Buildings were altered to Cordite Incorporating or Press Houses. Guncotton continued to be made on the South Site, conveyed by boat to the Grand Magazine at the extreme north end of the site where it was stored wet, dried in several stoves on the North Site, and processed. The cordite was then usually transported back to the Water Stoves on the South Site for drying. The smaller cordite factory on the South Site was used and extended during the First World War.

Both the Quinton Hill and Edmonsey Plants continued in production, without any major mishap until 1901. After separation, a minor explosion occurred in the earthenware cock in Quinton Hill No 2 Nitration House. Little damage was done, but this led to alternative separation techniques being sought. The Superintendent, Nathan, and others patented the process whereby, after nitration was complete, extra waste acid was added to the nitration vessel, and the NG floated off the top over a weir to the Washing House. The new process was installed in No 1 Nitration House, Quinton Hill, and worked successfully in 1903.

By this time, a change was made in the cordite. The old Mark I Cordite, containing 58% NG, 37% guncotton and 5% mineral jelly, proved to be very "hot" in its burning, leading to erosion of gun barrels. A change was made to Cordite MD which contained 30% NG, 65% guncotton and 5% mineral jelly. The reduced demand for NG enabled the Quinton Hill Plant to be put in reserve in August 1903. About this time, a renumbering of the Nitration Houses occurred; Edmonsey Nitration House became Nitration House No 1, and the No 1 and 2 Nitration Houses at Quinton Hill became Nitration Houses Nos 2 and 3 respectively.

Between April ad December 1904, No 2 Nitration House was reactivated whilst new, larger capacity nitration plant of the Nathan design was installed in No 1 Nitration House at Edmonsey. On recommissioning the Edmonsey Plant, the Quinton Hill Plant reverted to reserve in January 1905. During 1907-8, No 3 Nitration House, which still contained the old Nobel design of plant was demolished, together with the After Separation House, a feature of the Nathan process being that, if 5% of water was added to the spent acid, no further NG separated out.

Despite the increased production during 1914-18, the Quinton Hill plant was never brought back into use. Before 1939, a new reserve plant at New Hill was constructed, but despite two explosions in January and April 1940 involving mixing houses at Edmonsey, the New Hill plant was never used.

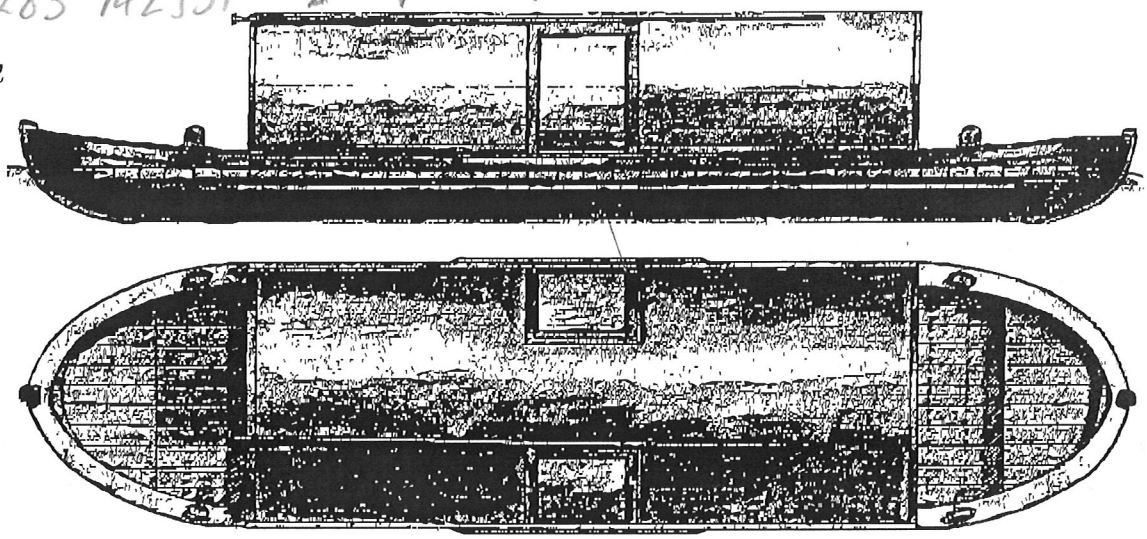
During 1939-43, the Quinton Hill Plant, which was showing cracks in the brick traverse, was subject to the growth of a legend that, in the explosion of 1894, there was a spillage of NG, and that it was therefore dangerous to approach the Building. However, from the history of the Plant, this legend has very little basis. At the time of writing, Nitration House No 2 is still relatively sound in main timbers, but the brick traverses, especially on the external sides, are cracking and crumbling badly probably through subsidence in the clay subsoil. The Charge House is badly decayed as well, and to a casual observer, the absence of No 3 Nitration House would lead one to accept the legend until the true history

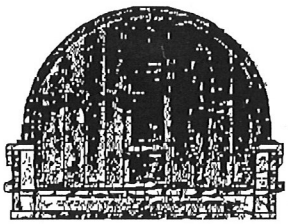
is explored. The empty well for the After Separating House is still visible, and the Washing House built in 1894 is still in place, but badly overgrown, as is the "pouring-on" and junction houses built subsequent to the 1894 explosion.

There is therefore no reason to suppose these buildings cannot be safely cleared, subject to the normal decontamination procedures, if the site is required for new process buildings.

I acknowledge the considerable assistance given by Mr M McLaren, Mr J Bird and their colleagues.

For nearly 300 years, a network of canals helped to supply Britain's armed forces with explosives. September's WW contained an introductory item on the Royal Gunpowder Mills. Now Christine Richardson takes a detailed look at the waterways of a secret, and sometimes lethal, site



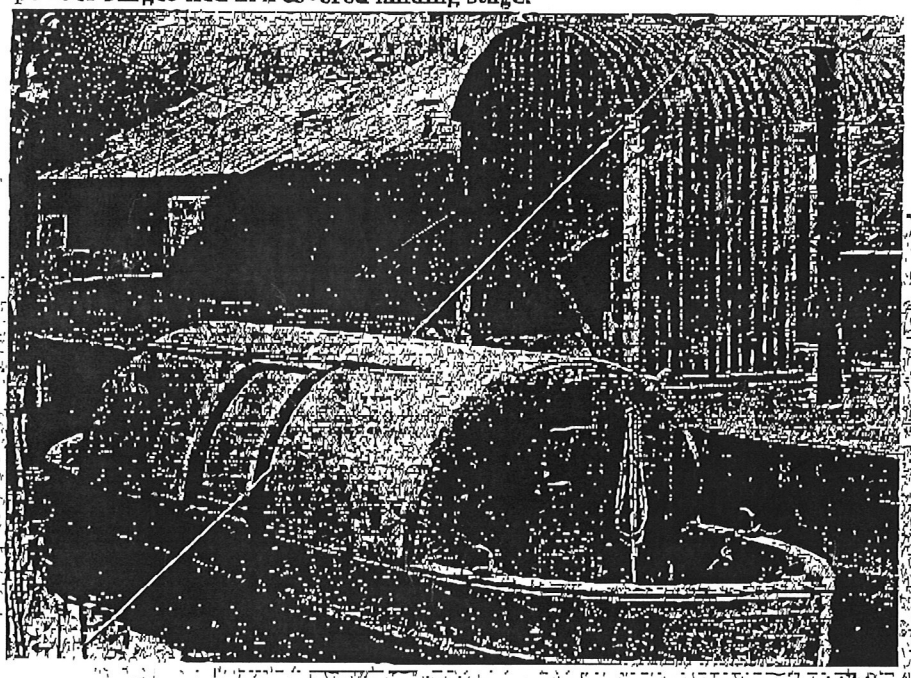


● One of the special barrel-roofed boats used on internal traffic.

Edward Paget-Tomlinson

MENACING *waterways*

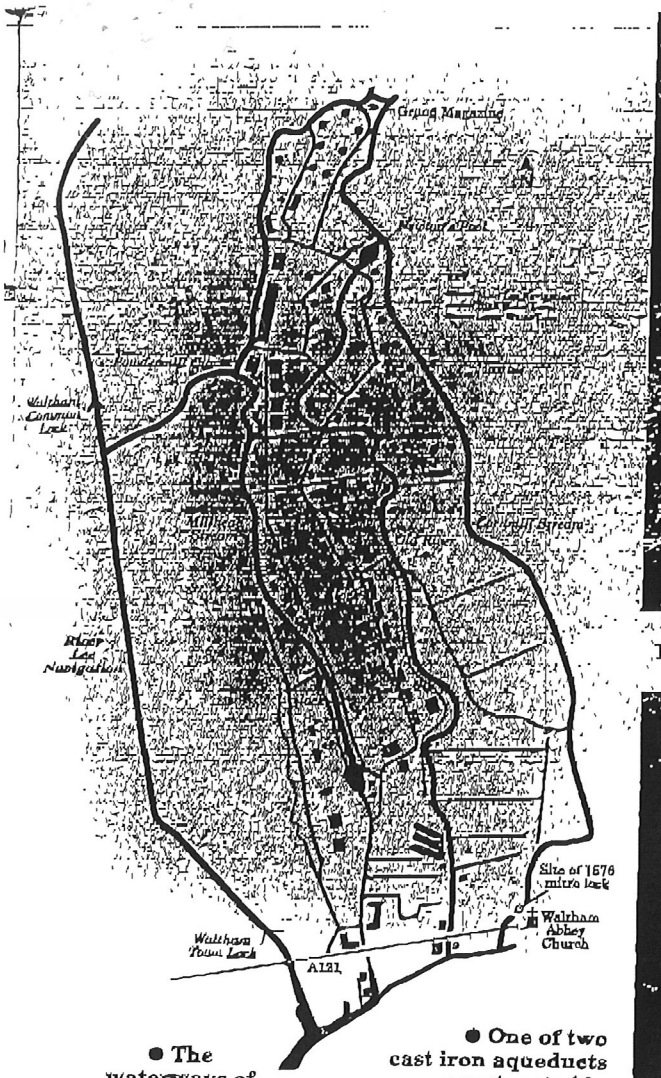
● Taken on 10th May 1904, this archive photograph shows one of the typical internal powder barges tied at a covered landing stage.



By 1662 there was more gunpowder being made at Waltham Abbey "than in all England besides". The river Lee had made such developments possible – providing water transport for the supply of raw-materials, and the relatively safe distribution of finished products. Via the Lee and the Thames, gunpowder was carried by boats to the Royal Arsenal at Woolwich, and the great magazines at Purfleet.

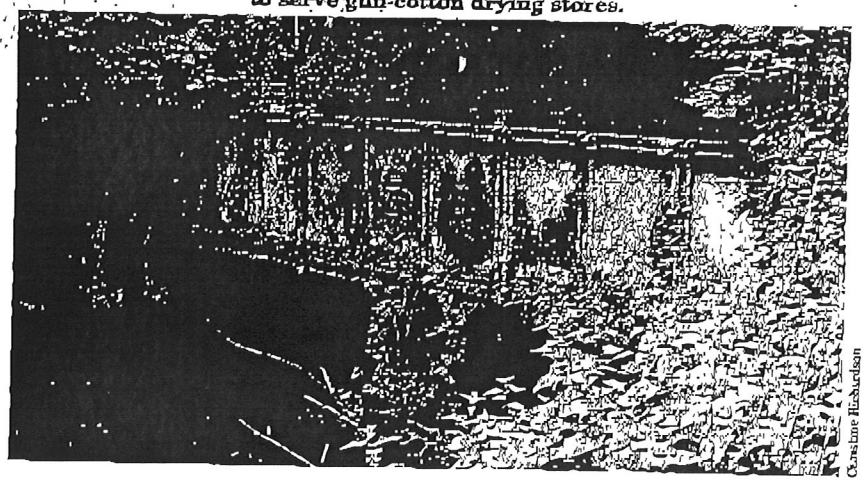
Historically, most armaments production took place in the south-east of England because the threat was from continental Europe. To the north-east of London the Waltham Abbey site was admirably placed and in 1787 it was taken into Government ownership and given the title Royal.

For safety reasons the production buildings were spread far apart and the least risky way of moving items



● The waterways of Waltham Abbey c.1945.

● Footbridges of this unusual shape were typical of those across the Royal Gunpowder Mills' waterways. This one crosses a canal dug in 1903 to serve gun-cotton drying stores.



● One of two cast iron aqueducts constructed in 1878–9 carrying the royal cipher 'VR'.

Caroline Richardson

between them was by water. Therefore, a network of canals was created, crossing the area and linking with three ancient main channels, which also provided water-power for the gunpowder mills. Of those three main channels, two already had a significant past. The Old River Lee had been the through-route for navigation, with a type of flash-lock at what is now known as Newton's Pool. This caused the usual clashes between boatmen and millers, as a result of which the Cornmill Stream was improved to navigable standard and a pound-lock built to drop boats down to the old river. Not just any lock – the first one in Britain with mitred-gates at both ends, completed in 1576. Riots destroyed it in 1592, and it is thought that no trace remains. In 1767 Smeaton moved the Lee through-navigation to the west – and left the old by-passed channels to form the outline of the gunpowder mills' waterways.

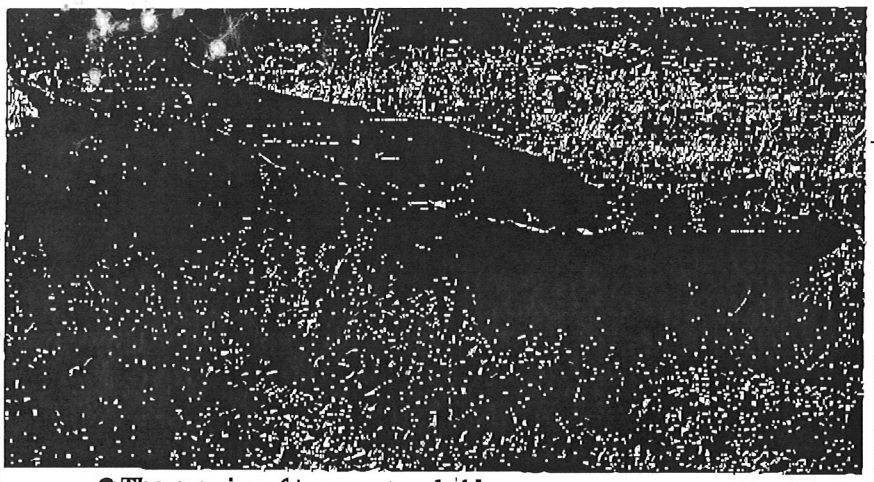
The aftermath of the French Revolution led England into an almost continuous period of warfare, culminating in the battles against Napoleon. War meant that bulk supplies of munitions were needed, so many new buildings were added at Waltham Abbey, and the canal system was enlarged considerably. Charcoal – one of gunpowder's three components – was brought by boat from Fernhurst in Sussex, and Faversham, Kent. Of the other two raw materials tons of saltpetre came up the rivers Thames and Lee from Bengal. Together with sulphur they were taken to the various production buildings via the site's canals. Damp gunpowder from Royal Navy ships was also carried, to be dried in steam-stoves.

By this time the production systems had evolved from south to north, with the finished gunpowder being stored in the Grand Magazine. From there it was loaded in to spritsail barges which used the Powdermill Cut to reach the Lee Navigation.

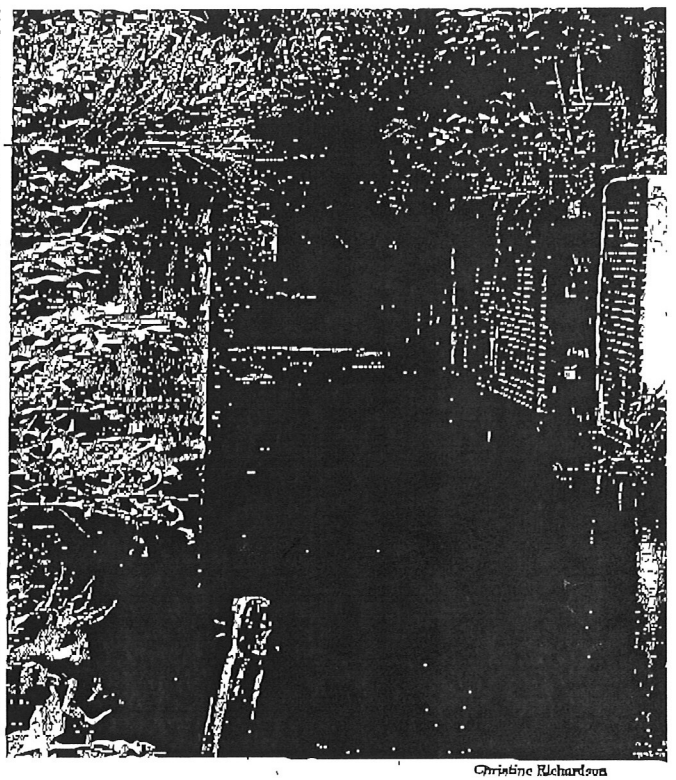
The peak of production during the Napoleonic Wars was in 1813, when 250 men were employed, and the canals were used by 9 powder-boats, 5 barges, 2 ballast-barges, and 6 punts. But demand for armaments slumped with Napoleon's final defeat at Waterloo and by 1822 the workforce was only 34. However, various conflicts in Britain's growing Empire meant that bulk production of explosives was often required. More canals were gradually added to the network, with waterways on two levels linked by locks. Two cast-iron aqueducts carried one canal over the Old River Lee, both marked with the Royal VR cipher, and the dates 1878–9. A distinctive style of footbridge was built. They were a semi-circular shape and made of an open grid of wrought-iron. At each side were boot-scrapers to prevent grit being trodden onto the bridge that might fall on to passing explosives boats. Such detritus in gunpowder's raw materials could cause an explosion during the grinding processes.

In 1869 there were 15 covered boats on the system, varying in length between 21ft and 30ft, and 5ft 11ins to 8ft 6ins beam – used to carry dangerous cargoes. Their barrel-shaped roofs were designed to stop explosive dust settling on them, and phosphor bronze nails and fittings were used to prevent sparks. There were also 16 open boats for general errands, carrying charcoal, timber, stores, and acting as ferries.

By now the spritsail barges were carrying over 40,000 barrels of gunpowder from the site every year. →



● The remains of two punt-ended barges. Christine Richardson



● The substantially intact remains of a lock on Millhead Stream built in 1896 between the upper and lower systems when the change from gunpowder to cordite production generated extra barge traffic.

Christine Richardson

MENACING *waterways* *continued*

But evermore larger guns needed more efficient explosives and soon nitroglycerin was added to the dangerous products at Waltham Abbey. This required the on-site boats to carry acids and chemicals – supplied, stored and moved in dark-green glass carboys, covered in wicker. However, nitroglycerin is so volatile that even water-transport was not smooth enough; instead it was moved between processing buildings by gravity – slow-flowing along pipes and gutters.

Such volatility meant that nitroglycerin could not be safely used as an armament. Instead, after 1890, it was mixed with other elements to form cordite, a chillingly efficient explosive. As the products became more effective so did the carrying of them on the canals. By now the boats on the internal network had evolved into two types, both carvel-built in timber, double-ended and capable of holding a 5 ton cargo. (For a more detailed description see 'Royal Gunpowder', September 1998 *WW*.)

The boatmen pulled or poled their craft through a pretty, thickly wooded landscape. Before electricity was available they worked daylight hours only, as few of the buildings could have flames to provide artificial light. With structures spread thinly amongst 400 acres there was nothing fearful to see, only the knowledge that some buildings had floors covered with leather hides, nailed down with copper nails, and kept moist all the time to stop explosive dust spreading. Those producing cordite and nitroglycerin had floors of lead sheet, so that the dust could be seen and cleared up.

Boat crews were never hurried – it was policy that no one on the site was pushed to do a certain amount of work in a day. People under pressure make mistakes. Nevertheless, at times of war when production targets were high there were tragedies at Waltham Abbey's Royal Gunpowder Mills. On 7th May 1894 one building exploded. The design of the area, and the blast-walls, should have contained the damage – but it did not. Three other buildings, also containing explosives, were completely destroyed. The blast was heard 12 miles away in Hyde Park, where people thought it was a gun-salute for the Queen. The trees were supposed to help contain a blast but they proved totally ineffectual. Seven men died – one was blown into a canal, five of the others over the river to the Essex marshes. Understandably the failure of the blast containment system caused considerable alarm amongst the workforce.

Unhappily, that was not the only catastrophe on the site. In 1902 there was a similar explosion, and twice in 1940 when the production pressures of World War II resulted in the devastation of cordite mixing-houses. But heavy workloads did not always result in mistakes. In 1917, the horrendous demands of the First World War caused the workforce to be increased to an all-time peak of 5,000 – the majority women working shifts to secure continuous production. Explosives manufacture ceased in 1943, with production switched to areas of Britain out of the reach of enemy bombers. Many of the canals were infilled in the 1950s, but traces remain. The timber piling of their banks can be found, and the clay linings still retain any dampness, with marsh plants thriving.

The remaining waterways were put to non-navigable use in the 1960s during the research and development of non-nuclear explosives of every kind. Newton's Pool, the site of the 16th century flash-lock, now saw flashes of another kind when it was used to test the underwater effectiveness of new explosives – the results of which were recorded by high-speed cameras capable of 1,200,000 exposures per second.

The final closure of the Waltham Abbey site was on 30th June 1991. Since then the Ministry of Defence has carried out a decontamination programme, including the removal of dangerous materials from the canals – a task done without damaging the clay-puddle. The canal system survives partly as open waterways, partly as earthwork features, whilst others have been infilled and lost. But the Old River Lee still flows through the centre.

Now the site is being prepared for public access. The northern half is still thickly wooded and is an SSSI. The largest heronry in south-east England thrives among the willow, alder, and black dogwood originally planted for charcoal production.

The Royal Gunpowder Mills at Waltham Abbey will be ready for public visits from the year 2000. A number of sunken powder-boats and barges are in the remaining waterways, their removal a future task when funding and manpower are available. And, in the long-term, boats may once again cruise the canal network – this time carrying visitors, not highly dangerous explosives.