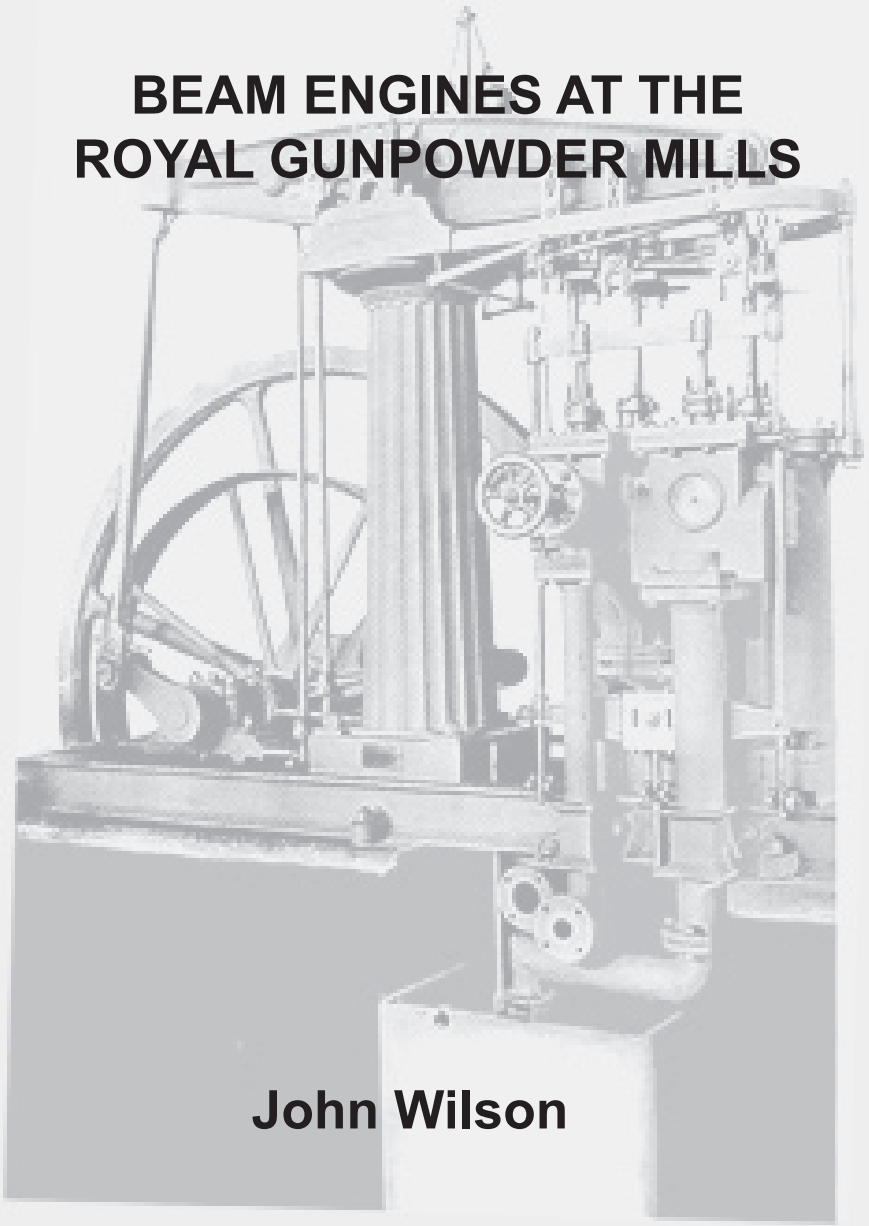
WAS c 1857

Freids Boffets

ROYAL
GUNPOWDER
MILLS
WALTHAM ABBEY

Published by the Friends Association of the
Royal Gunpowder Mills, Waltham Abbey
June 2006

BEAM ENGINES AT THE ROYAL GUNPOWDER MILLS



John Wilson

CONTENTS

ILLUSTRATIONS

The Author

John Wilson is an Electromechanical engineer with a wealth of experience in plant and machine tool maintenance . Taking early retirement in 2000 he joined the Royal Gunpowder Mills as a volunteer and has carried out much work on the site's industrial light railway.
He also acts as a guide and driver on the Landtrain tours and carries out numerous small jobs of engineering maintenance on the site.
As well as his interest in all things mechanical he is also very interested in the wildlife aspect of the site and a keen photographer.

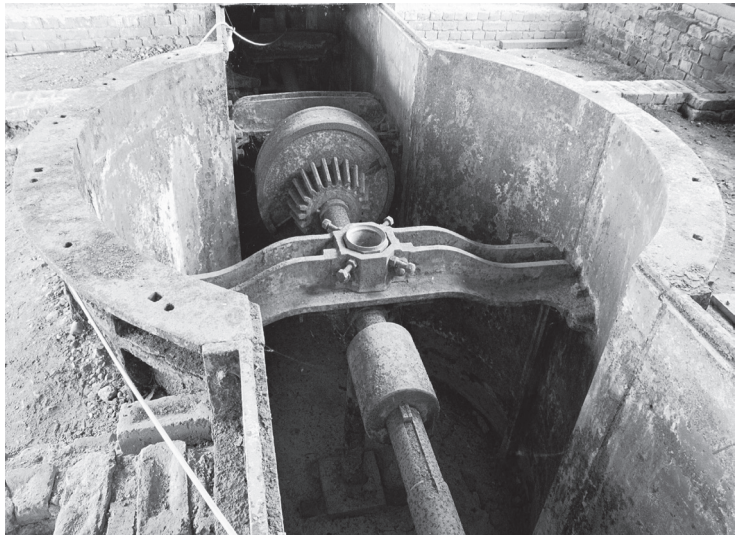
Other booklets published by the 'Friends Association are:

"The Listed Buildings at the Royal Gunpowder Mills Waltham Abbey"
by Les Tucker

"Woodland Trees of the Royal Gunpowder Mills Waltham Abbey"
by Norman Paul

GROUP C MILL (Building L157)

BEAM ENGINE PIT



EXCAVATION SHOWING THE UNDER-FLOOR SHAFT AND GEARING

INTRODUCTION

A crucial stage in the manufacture of gunpowder involves the grinding of the three constituents; Saltpetre, Sulphur and Charcoal. This was carried out in an Incorporating Mill where the rough mixture was ground exceedingly fine using Edge Runner millstones.

In the earliest days the mills were powered by water wheels but, as the demand for gunpowder grew and more mills were required the natural water supply was limited. A series of steam powered mills were then built to accommodate the demand and had the added benefit that production was no longer dependent on the vagaries of water supply, especially in dry summers.

Steam raised by coal fired boilers powered a Beam Engine situated in a central tower with under floor shaft and gearing to a series of bay housing the Incorporating Mills.

With the demise of gunpowder the buildings were converted for the manufacture of cordite. Initially that machinery was powered by beam engines but was eventually replaced by electrical power.

The beam engines were taken out and only the engine room pit foundations and the original under floor shaft and gearing remain.

This booklet details, as far as is possible, the use of beam engines at the Royal Gunpowder Mills at Waltham Abbey.

STEAM POWERED INCORPORATING MILLS
Built 1867 - 1888

Group A Mills

In March 1856 the foundation stone for the first steam powered gunpowder incorporating mill in the world, was laid at the Royal Gunpowder Mills, Waltham Abbey. In 1857 the mill was put into operation and was designated Group A Mill.

The drawing shows the layout of the Group A mill with a machine shop at the western end, the engine house in the centre and the six incorporating mills extending to the east.

The Beam Engine was a 30hp. compound beam engine ordered from Benjamin Hick & Son of Bolton, to a James Watt design. The original plan was to have two drive shafts running from the engine house, each driving three sets of two edge runners, but for some reason this was changed to a single shaft, driving all six sets.

There were problems with the design of Group A right from the start; the main ones being the 129ft. drive shaft that took the power from the engine to the six pairs of edge runners, and the decision to build the boiler house so far from the engine house.

Therefore when there was a serious explosion in the Group A mill in June 1861, it was decided not to repair the mill, but build all future mills to the “T” shape lay-out of the Group C mill which was nearing completion.

Group B Mill

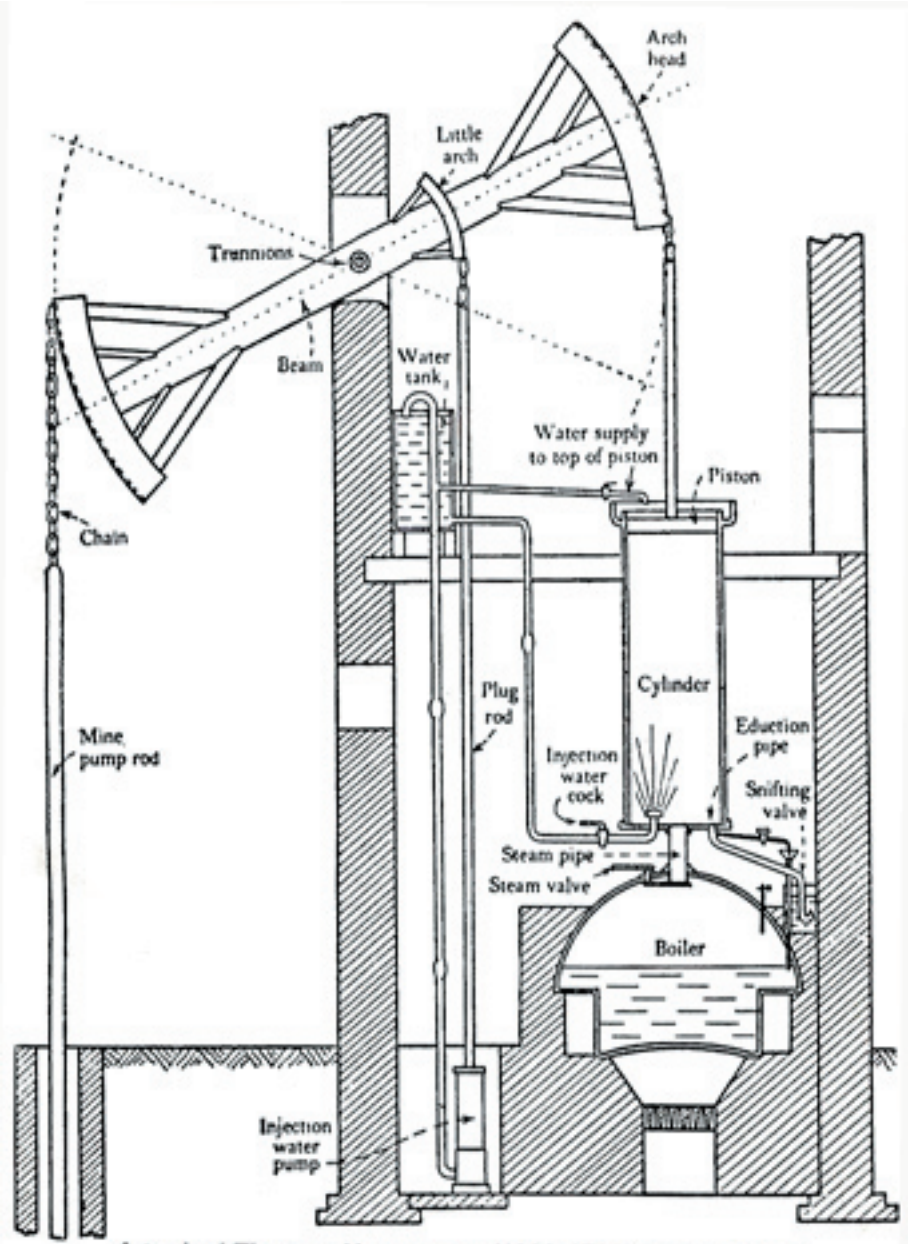
Group B Mill was built towards the end of the 1850’s and was a throw back to water power, with a central waterwheel and one pair of edge runner on each side. But to allow for drought, a small steam engine of unknown type was placed next to the water wheel to take over when needed. The Mill was located on the western side of the site, but its exact location isn’t clear.

Group C Mill

Group C was the first of the new “T” shape mills, with the engine house and boiler house in the centre and two sets of edge runners to each side. This plan was changed to three sets of edge runners each side and proved very successful.

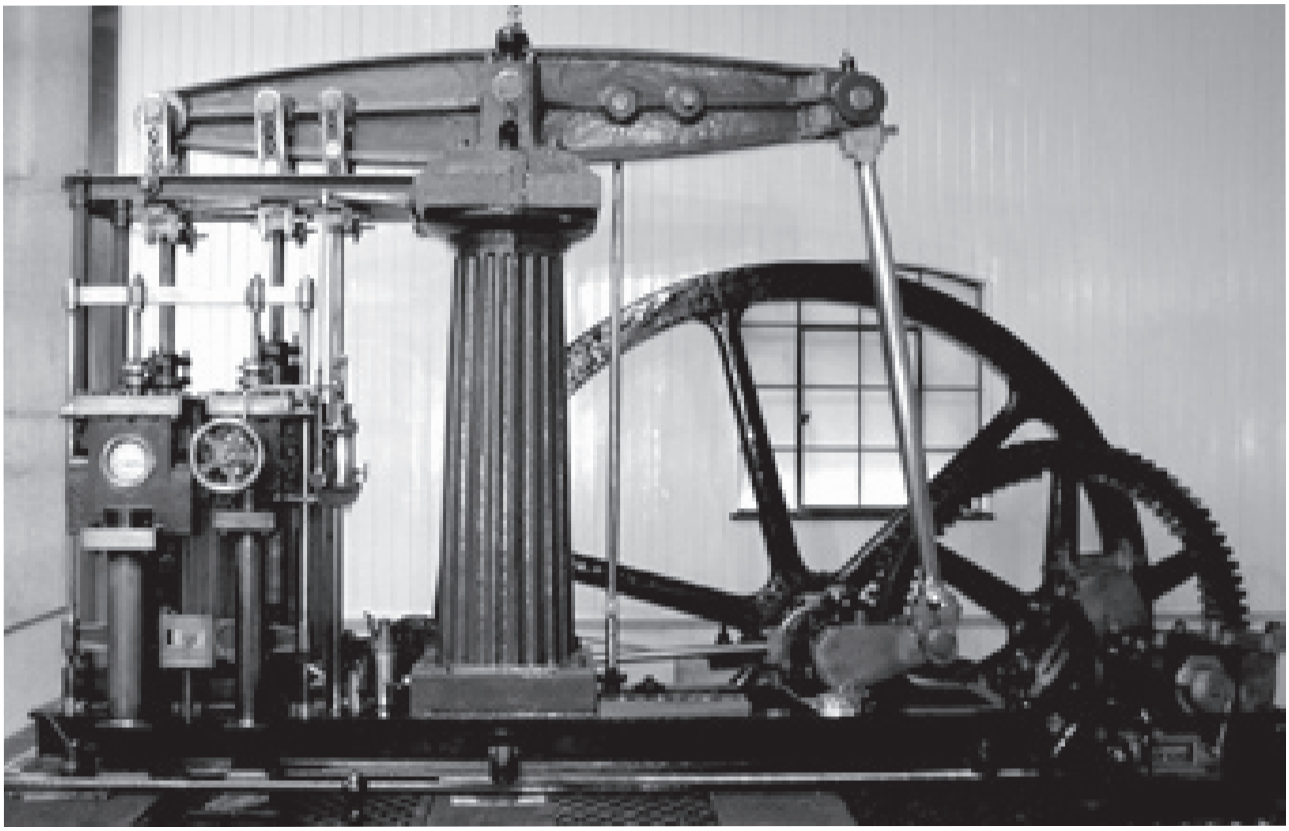
Group D, F & G Mills

Group D Mill was built in 1867, Group F in 1878 & Group G in 1888/9 and if you look at each of these buildings, you will see their common heritage.



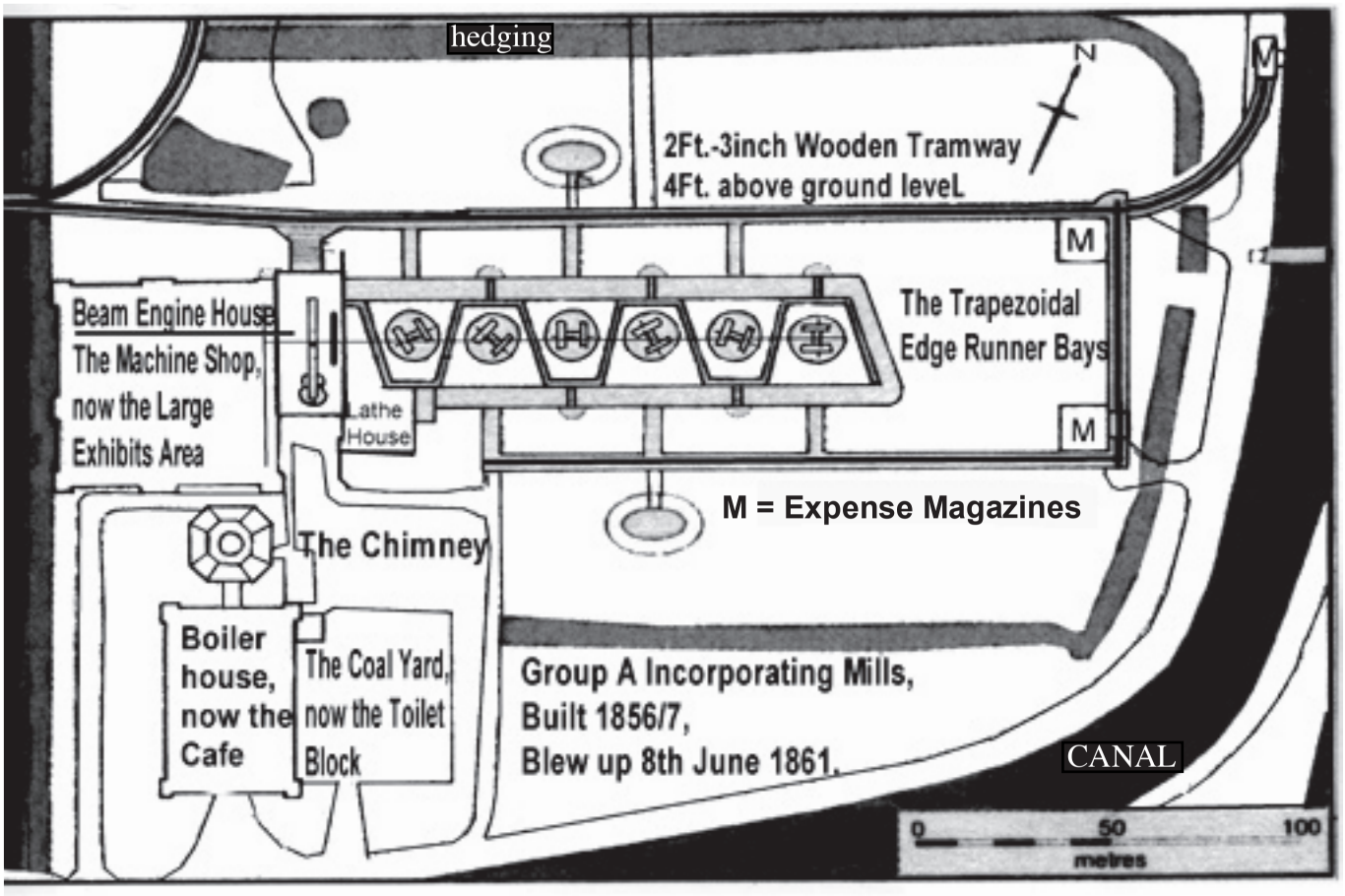
A typical Thomas Newcomen (1663-1729) beam engine of around 1712. Note the chains connecting the piston & pump rods to the beam.

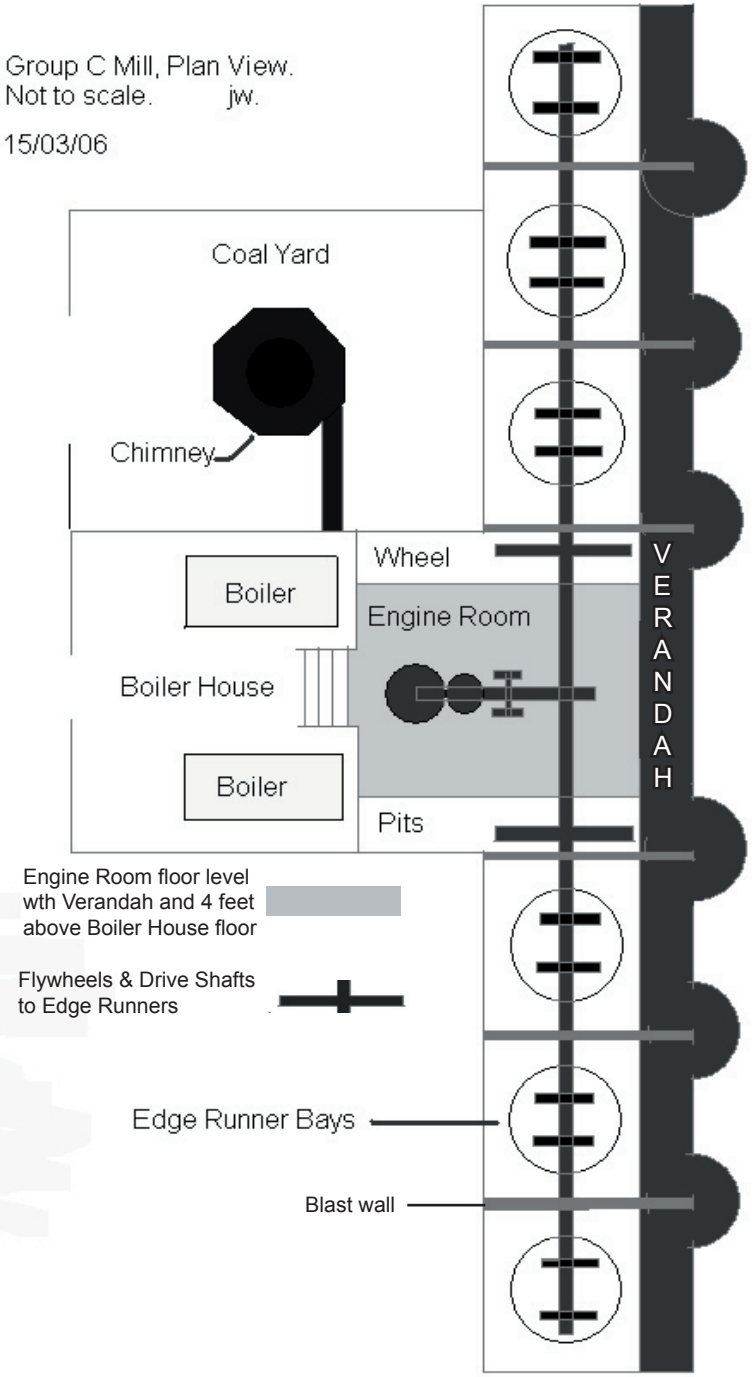
[10]



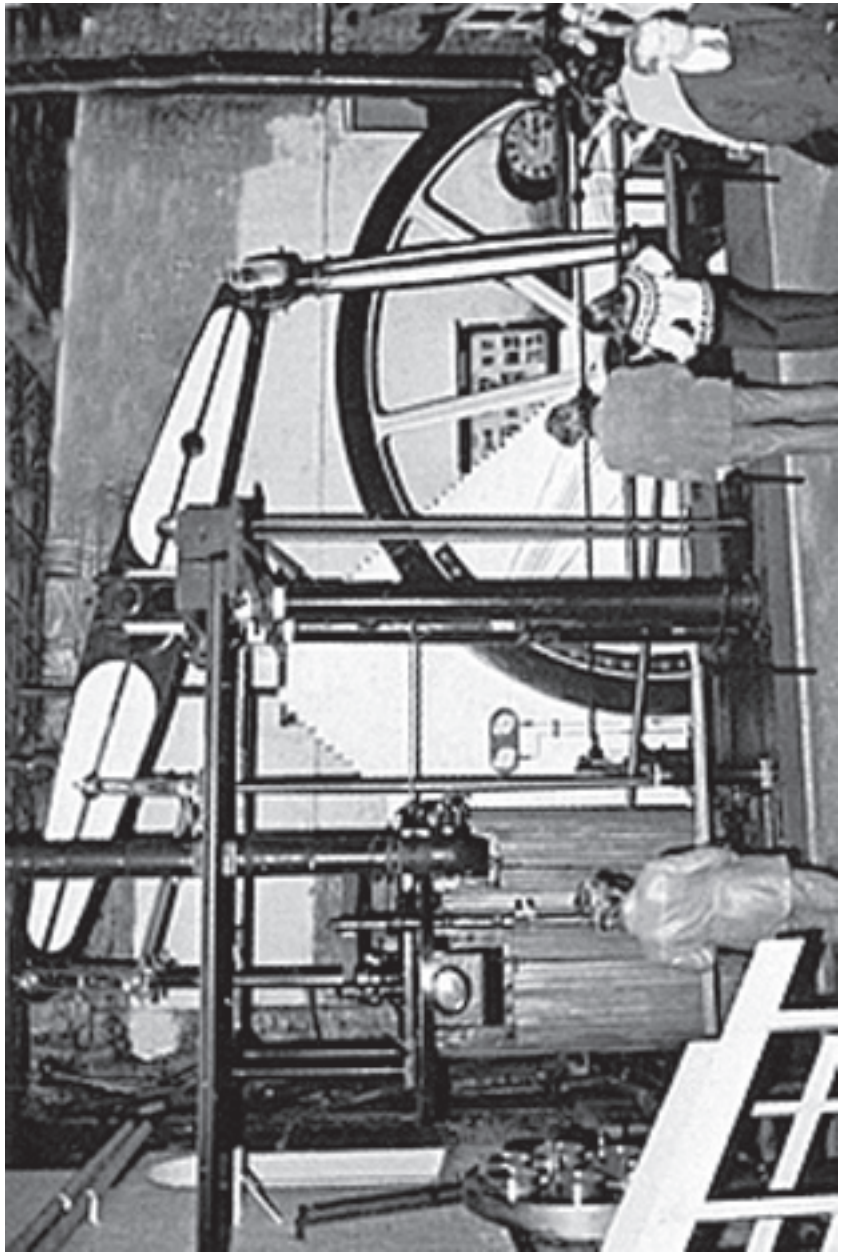
THE BEAM ENGINE AT BREDGAR IN KENT

[3]





[4]



THE KEW ENGINE

[9]

time, allows the piston to be connected directly to the beam and in turn allows the use of a power stroke in both directions.
In 1778 he built his first rotative beam engine for which he had also designed the Watt governor, a device that controls the speed of the engine automatically.
It should be noted that this engine still got its power by condensing steam, so was still an atmospheric engine, as boilers of the day were not safe above 2 or 3 psi.

It would not be until the start of the 1800's that boilers were built that were safe at 50 psi or more. Then engines could become truly steam powered.
In 1779 he went into partnership with another great engineer, Matthew Boulton at the Soho Works, Birmingham and between 1779 and 1800 is credited with building or licensing to be built some 450 engines.
So without James Watt there might never have been rotative beam engines.

The End of the Beam Engine

With the introduction of Cordite as the principle military propellant in the 1890s, gunpowder production reduced dramatically, as did the need for the large edge runner sets in the C, D, E, F and G mills, so the machinery was removed, the under floor drive shafts were buried, or where possible removed, and new machinery installed driven by overhead line shafts, with belts running to each new machine, but retaining the beam engines as the power source.
The little gunpowder that was still produced at Waltham Abbey, was made in the group B mill, which was primarily water powered.
Over the next decade or so, the beam engines were scrapped, being replaced by 30vdc electric motors as the primary drive.
The electric motors took their power from the power house that was built to generate electricity for the north site. It is not known when mains electricity replaced the 30vdc supply, but I would think that this would have happened some time after WW1.
Gunpowder production at Waltham Abbey finally ceased due to lack of demand and damage to the remaining mill, caused by a German land mine, dropped on the site during WWII, with the mill finally being demolished in the 1950s.

Group E Mill

Group E Mill is interesting in that it started life in 1870 as an engine house, boiler house, hydraulic accumulator tower and press house complex, to make pellet powder for large calibre guns, but within a few years was redundant as pellet powder fell out of favour.
In 1877 it was rebuilt as the Group E Mill but still retained the original engine house, accumulator tower and boiler house, which leaves us with a puzzle as to what type of engine was used; as the accumulator tower became the engine house which was too small to house a 30hp beam engine. It is possible that some type of horizontal engine was used instead.

The Beam Engines

The first engine supplied by Benjamin Hick & Son was a 30hp. twin cylinder compound beam engine to the James Watt design.
It had an 18ft. (5.5m) diameter flywheel mounted on the edge runner side of the engine, with a power take off shaft on the machine shop side to power the machine tools via a line shaft.
It isn't clear if the engines used in the Group C, D, F & G mills were identical to the Group A engine or indeed to each other, as records are not available. However they were all two cylinder compound engines and from the Group C mill onwards had two flywheels of 14ft. (4.2m) diameter, one each side of the engine.

Why Two Flywheels?

With a drive shaft running out from each side of the engine, each shaft driving three pairs of edge runners via individual clutches, two flywheels would give better balance to the engine and it made sense to make it possible to disconnect each shaft from the engine in the event of an explosion or breakdown in an edge runner bay, thus allowing the engine and three opposite bays to be kept in production.

What is meant by "Twin Cylinder Compound"?

The engines had two cylinders, one of around 12" (305mm) diameter, working at around 100psi (the high pressure cylinder), the other cylinder of about 24" (610mm) diameter and working at about 50psi (the low pressure cylinder).
Steam enters the high pressure cylinder where it drives the piston to the end of its stroke. On the exhaust stroke the steam is transferred to the larger low pressure cylinder, where it does more useful work. From the low pressure cylinder the steam goes into the condenser, where it is turned back to water, ready to be re-used in the boilers.

The condenser also creates a vacuum below the low pressure piston (on its exhaust stroke) giving extra power to the stroke and helping to make the engine more efficient.
Steam was produced by two Lancashire steam boilers and I suspect that one boiler would have been in steam, while the other was being cleaned, an important task on coal fired boilers, if they were to maintain good steaming.
There are no photos available of the boilers or engines, though we do have a photo of the boiler house crew. However two photos, one taken at Kew Bridge Steam Museum & one at Bredgar & Wormshill railway, of similar engines, give some idea of the type used.
The engines would have run at about 18 rpm and the edge runner mills were geared down to 8 rpm.

Why did the engine only run at 18 rpm?

Even the smallest of beam engines were still large and heavy machines. A small beam might weigh 5 or more tons. Some of the bigger engines had beams of 40 or 50 tons. A flywheel could weigh anything from 2 tons (for a very small engine) up to 50 tons for a very large engine, so there is a lot of weight to get moving and to stop.
Imagine a beam rocking as the engine runs. The beam has to swing through an arc as the piston goes up and down, so at each end of the pistons stroke the beam has to be stopped and reversed. Even with a small beam of a few tons, this puts considerable strain on the piston and connecting rods.

The flywheel on a beam engine is made in segments; in the early days held together with iron wedges and later by bolts, but no matter which method was used, if the engine was run too fast, the flywheel would break up (the bursting speed) as centrifugal force broke the wedges or bolts, so the two factors of mass (the weight of the beam) and centrifugal force working on the flywheel limit the speed of any beam engine.

The Gunpowder Mills engines were not very powerful if they only produced 30HP. In the days of the beam engine, horsepower was calculated by the diameter and stroke of the steam cylinder and piston much as cars were taxed prior to about 1960, so a 1 litre car engine was taxed as 10 horsepower, and just as a 1 litre engine produces a lot more than 10 horsepower (anything up to 50 or more brake horsepower), so our beam engines would have produces a lot more than 30 horsepower, though what that figure would be, we do not know.

The Kew & Bredgar Engines

The Kew engine is an Easton & Amos engine built in Southwark, London, in 1863 and is slightly bigger than ours would have been. It has an 18ft. (5.5m) diameter flywheel with a weight of 10tons and produces 60hp at 18rpm. It was built to pump water in Cliftonville, Northampton and was taken out of service in the 1950's, a working life of some 87 years.

The Bredgar engine is slightly smaller than ours, driving a single flywheel of 10 feet diameter and was used to pump water for the Mid Kent Water Company from 1870 to 1950 (a life of 80 years) and was built by Thomas Horn of Westminster to a James Watt design.
In all other respects both engines are identical to the type used at the mills.
Apart from the Beam Engines, there were a number of other types of steam engine at the mills. These drove the drying stove fans, the Acid Factory machinery, and the generators in the Power House in the days before mains electricity came to the Gunpowder Mills. What type of engine these would have been, we do not know, as no records have been found (so far).

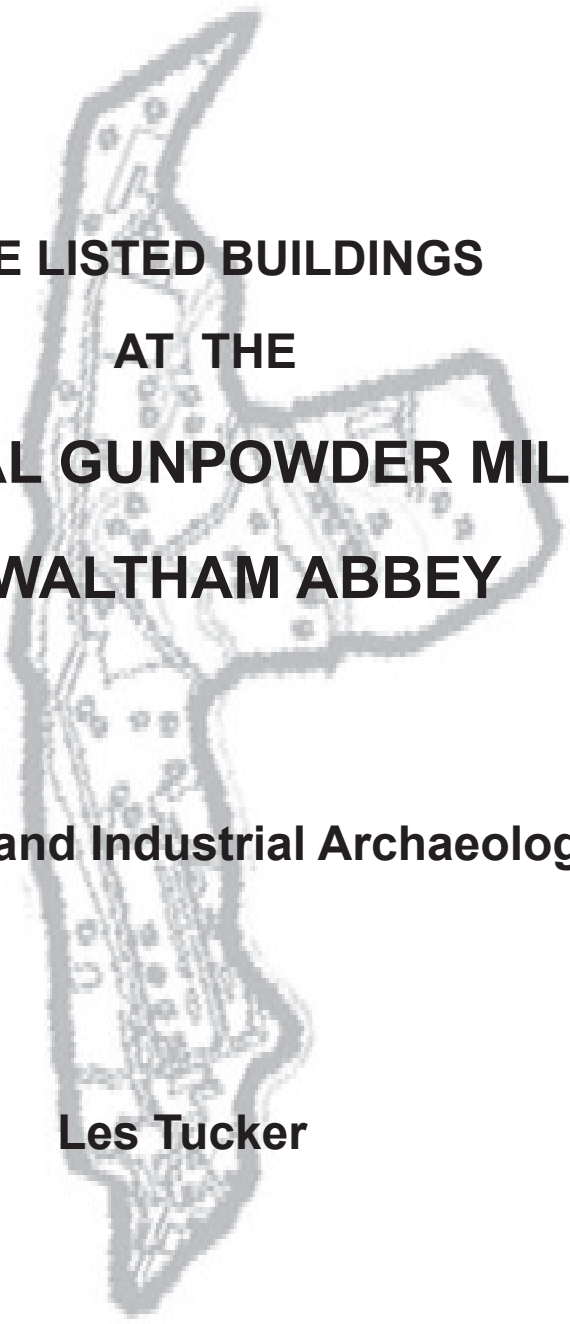
James Watt

You may have noted James Watts (1736-1819) name being mentioned in the text. This is because he was the man who made rotative beam engines possible.
Until 1769 beam engines were built to the Thomas Newcomen (1663-1729) design mainly for pumping water.
They were single acting atmospheric engines, in other words the power stroke only worked downwards, there was no upwards power stroke.
The piston rod was not connected directly to the beam, chain being the normal means of connection, so the working stroke was as follows:
Steam injected into bottom of cylinder and condensed into water. This causes a vacuum, so the piston is pushed to the bottom of the cylinder by atmospheric pressure. The chain on the piston rod pulls down the beam making the pump rod lift and do useful work. Because the pump rod is heavier than the piston, when the vacuum is released, the pump rod pulls the beam down, raising the piston, ready for the next stroke.
James Watt recognised the inherent inefficiency of this and his first patent of 1769 was for a separate steam condenser, so that the cylinder did not have to be repeatedly heated and cooled on each stroke.
In the 1770s he invented the parallel link motion, which, for the first

ROYAL
GUNPOWDER
MILLS
WALTHAM ABBEY

Published by the Friends Association of the
Royal Gunpowder Mills, Waltham Abbey
March 2002
reprinted January 2005

THE LISTED BUILDINGS AT THE ROYAL GUNPOWDER MILLS WALTHAM ABBEY



History and Industrial Archaeology

Les Tucker

CONTENTS

A221 The Lodge Built early 19th century

Situated on the eastern boundary flanked by the River Lea. Built of yellow brick with a slate roof it is redolent of military quarters seen in the older parts of garrison towns such as Aldershot. There were various alterations and extensions, e.g. the front entrance porch was added around the middle of the 19th century. Continuing the theme of power, if the buildings above represented the technical the Lodge represents the administrative. It was the senior officer’s residence, ranging from; Clerk of Cheques in 1821, Captain Instructor in 1859, Staff Officer in 1897 and becoming the Director’s residence after WWII when the site became a research establishment.
Of archaeological interest in the spacious gardens is what now appears to be an almost surreal sight in a domestic setting - a WWII brick built octagonal gun site with indented circular base plate marking in the concrete, probably indicating that staple of British light anti aircraft defence - a 40 mm Bofors quick firing gun.

The technical history of the Waltham Abbey Mills is not only about explosives but also the spectrum of the other technologies involved in their manufacture. The power buildings reflect the trends in power technology in the wider industrial world, from water through steam to electricity and, in particular, the remote accumulator tower is a reminder of the importance of hydraulic power in a wide range of applications and of the Mills’ position as a unique surviving example of the application of this power in a unique context.

From the 1860's advances in metallurgy - new steels, alloys etc. and in engineering techniques, enabled manufacturers to produce increasingly large guns which required larger charges. This however created a paradox in that the higher explosive force of pressed gunpowder in this quantity brought an increased risk of damage to the gun. A larger powder grain size was needed to enable better control and to slow the rate of burning. For this purpose, powders derived directly from presscake were developed - pellet and pebble powders up to 2" square for the largest guns. This led to the need for more powerful pressing facilities and the hydraulic story at Waltham Abbey entered a further phase of development. In the 1850's a Newcastle solicitor, William Armstrong, had demonstrated the effectiveness of his steam powered hydraulic system with weight loaded accumulator tower, comprising a vertical cylinder and ram with a cylindrical weight case. In 1869 the system was adopted for the L149 Group E built to serve a press house producing pellet powders.

The accelerating pace of armaments development brought still increasing demand for press facilities and raised the problem of the safety hazard of separate steam engines being distributed around the site - not an economic use. Again, hydraulics provided the answer. Armstrong had further demonstrated the ability of the accumulator tower system to act as a centralised storage and distribution source powered by one steam engine with a supply of pressurised water by a system of pipes to wherever required. In addition, separate remote accumulator towers could be incorporated, linked to the central point to store, regulate and boost supply. In 1879 the L149 steam facility was converted to gunpowder incorporation but the accumulator tower retained as the nucleus of a centralised hydraulic distribution system to serve new press houses producing pebble powders. At the same time L136 was built as a supporting remote accumulator tower.

Large charge technology progressed further with the introduction of prismatic powders, based on earlier American studies. These were pressed hexagonal shaped prisms about 1" high perforated with holes to facilitate gas transmission on burning. Further press houses, termed moulding houses, were built to produce these grades and the L149 and L136 hydraulic system was extended to power them. Moulded prismatic powders represented the peak of gunpowder development and pressing or moulding was the fulcrum of their manufacture. In turn, therefore, hydraulic technology, as represented by these surviving accumulator towers occupies a key position in the progress of the technology of the Mills.

INTRODUCTION

Although records show that gunpowder was manufactured at Waltham Abbey in the mid 17th century none of the earliest buildings have survived. All of the 250 extant buildings and structures date from the long period of government ownership from 1787 to 1991.

After closure as a government research establishment the site was extensively surveyed by The Royal Commission on the Historical Monuments of England (now English Heritage) which declared a large part of the site a Scheduled Ancient Monument.

Within the site boundary there are 21 buildings listed by English Heritage as of historical importance and these are detailed in this publication.

Les Tucker
Friends Association

Historical Dates

1662	First reference to Gunpowder Mills at Waltham Abbey.
1787	Purchase of the Gunpowder Mills by the Government.
1863	Guncotton manufacture.
1891	Expansion by purchase of the South Site Start of Cordite production.
1945	Royal Gunpowder Factory closed Site converted to a Research & Development Establishment
1984	South Site privatised as part of new Royal Ordnance plc. North Site retained by MoD as Research Establishment.
1991	Site closure after 204 years of government ownership
2001	Site opened to the public as a major interpretative centre and visitor attraction.

Chapter 1

THE STEAM POWERED INCORPORATING MILLS

In 1787 the Government, prompted by considerations of security of supply, control of output and quality of gunpowder, purchased the privately owned gunpowder mills on the Millhead Stream from the Walton family. At that time the mills were water powered. A canal system provided both water to drive the mills and a means of transport around the site.

The Crimean War 1854-56 revealed major deficiencies in British military supply of materiel and this, together with fears by Lord Palmerston's Defence Committee of French invasion, prompted authorisation of significant military expenditure. At Waltham Abbey this was reflected in the building of the steam powered incorporating mills, termed Group A in 1857, followed by Group B in 1859. Group A and B mills have since been demolished.

Group D Mills (L153) - pictured in late 1980's

The succeeding Groups built - from C in 1861 to G in 1888 and the Group A engine and boiler houses comprise the listed steam incorporating mills - summarised below:

GROUP	A	B	C	D	E	F	G
Build Date	1857[1]	1859	1861	1867	1877[2]	1878	1888
Grade	2*	-	1	2*	2*	2	2*
Bldg No.	-	-	L157	L153	L149	L145	L148

([1] only Engine (L168) & Boiler (L176) houses remain)

([2] central part 1869 originally for pellet powder)

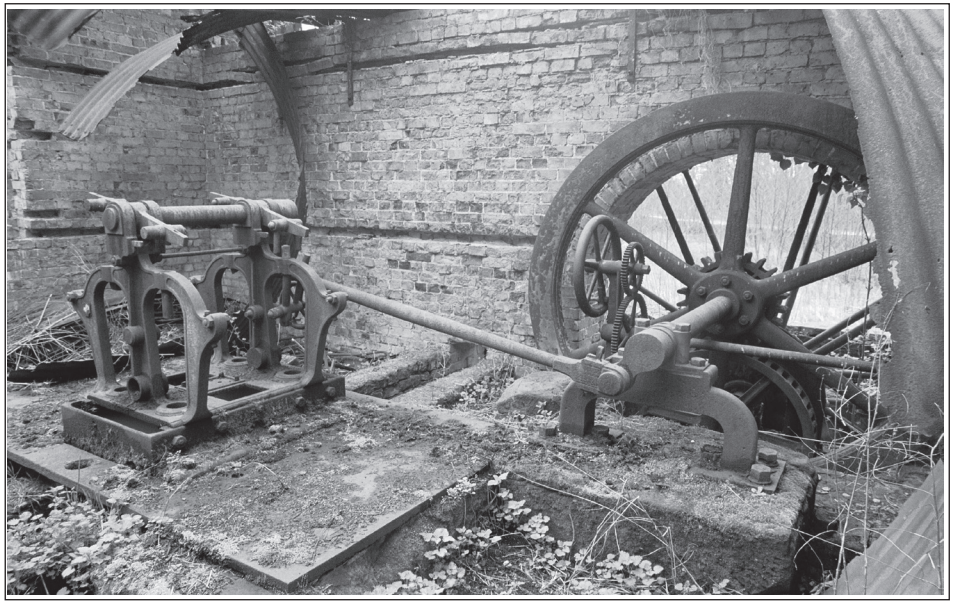
The steam mills represented a fundamental move away from the water powered Millhead:

1) In location - built on open land between the Millhead Stream and the Old River Lea.
2) In adoption of newer technology - replacement of water power by steam.
3) in scale - scale of buildings far beyond the timber structures of the Millhead.
4) In output - the steam mills represented a move to a fully industrialised basis.

HYDRAULIC POWER

The history of gunpowder manufacture is one of a constant quest for improvement with progressive development and addition of manufacturing processes. Pressing was introduced at a comparatively late stage - around 1780. Relatively loose structure millcake from the incorporator was pressed to increase the density of the material. This made the material less moisture absorbing in storage, more resistant to break up on transport and increased the explosive power of the material.

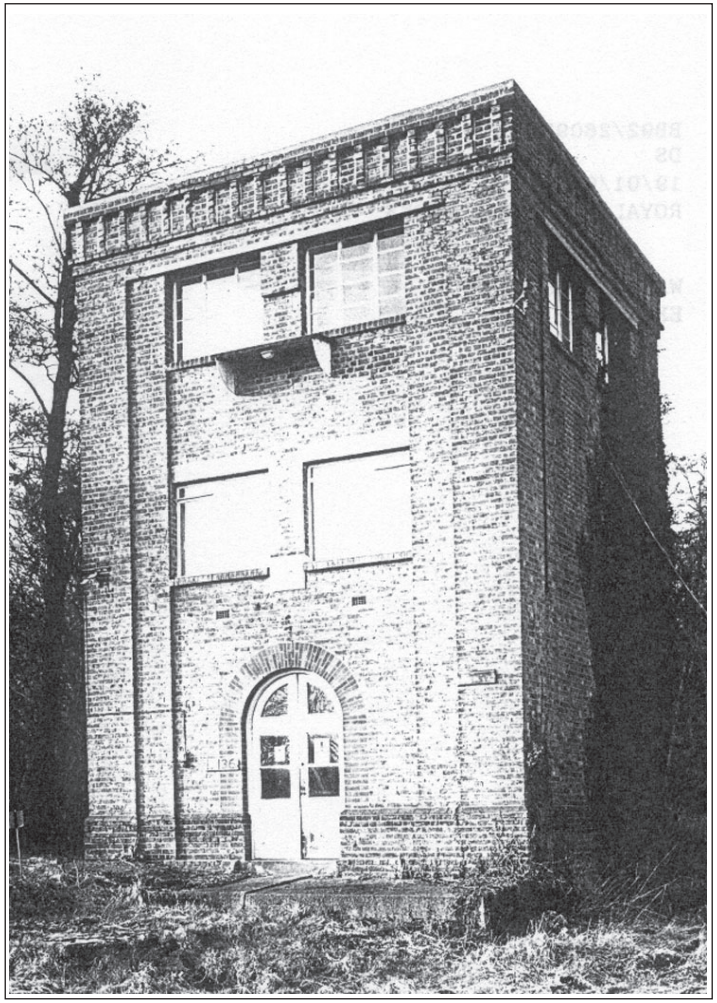
Presses were initially hand operated screw presses as used in a range of other applications; e.g. vegetable oil extraction. In 1795 Joseph Bramah patented an hydraulic press incorporating a hand driven water pump. The Bramah press produced an higher pressure than the screw presses and, important for safety reasons, could be operated remotely. In 1812 when an explosion in a screw press occurred the Bramah press was introduced at the Mills and a new power technology had arrived. Around 40 years later hydraulic technology took another step forward by an unique synergy. The existing Bramah presses used hand leverage to operate the water pump but in the early 1850's in 2 Press Houses (one of which still survives) the power of a water wheel was used to activate the hydraulic pump. Water power had come full circle.



Existing gearing from waterwheel to hydraulic pump

L136 Remote Accumulator Tower Built 1879

The Accumulator Tower is now a nature observation point situated just south of a lock linking the high and low level water systems at the north end of the area noted as ‘Magazine Land’ in the Mills guide.



The tower represents the large scale application of hydraulic power to the pressing operation in gunpowder manufacture and the culmination of a century of progressive development of the application of this important, but comparatively lesser known, power source. To place it in context therefore a brief synopsis of this history follows:

Group A Incorporating Mills 1857

Group A consisted of a central engine house containing a 30hp compound beam engine, a boiler house and 6 incorporating mills in bays. The incorporating bays were destroyed by an explosion in 1861 and not rebuilt. The approach employed shared some general characteristics with the later steam mills - underfloor drive from engine house, very thick mill partition walls (3 ft thick brick) and bay sides constructed of light material. Group A was corrugated iron and glass but later walls were cloth felt on timber to provide a path of least resistance for any blast away from machinery. The Group A bays were interlocking trapezoidal shaped. This was not followed in later Groups.

In 1898 a cordite reeling house was built on the Group A site. After WWII until 1952 this building was connected with the development of plastic propellant and storage of rocket motor cases. The shape of the Group A mills roof gable can still be seen on the eastern end of the L168 Engine House.

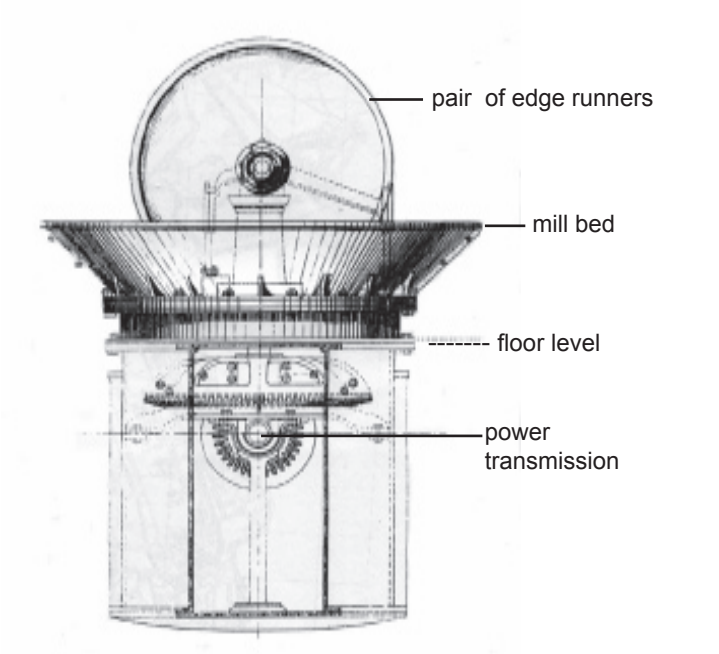
Group B Incorporating Mills 1859

In design terms this Group represented a discontinuity from Group A to Group C in that the main power source was water with a steam engine only as a reserve. The Group B mills have been demolished.

Group C Incorporating Mills 1861

This mill building is of a T shape with a central engine tower, originally housing a steam beam engine and a boiler house at the east end to the rear which contained two Lancashire boilers. To the north and south of the central tower are two sets of bays which held a total of 6 incorporating mills - 3 bays on each side. Each mill comprised a pair of vertically mounted cast iron edge runners, weighing about 4 tons, revolving on a circular iron bed.
(N.B. Earlier mills had stone runners, some of which can still be seen on the site)
Yellow brick laid in English bond was used to construct the engine house, boiler house and partition walls separating the bays. The partition walls are 0.68 metres (27 inches) thick.
The front and rear walls of each bay were of a light felt on wood and the roofs were of composite timber/iron construction. To the west side an open timber verandah allowed loading of materials from the narrow gauge railway. After 1945 when the site became a research station the buildings were converted into laboratories and the verandah was closed in, as shown on the previous photograph of L153.
The boiler house roof reflected contemporary application of wrought iron tension rods with cast iron compression members.
The possibility of accident was inescapable. The design of the light construction front and rear walls and roof of the bays was to channel any explosion to the outside, avoiding transmission to adjoining mills. These walls were relatively easy and economic to repair whilst the strong partition walls provided protection and minimised damage to adjoining bays.
The power transmission from the engine reflected an approach similar to that employed in the textile mills of the time with an horizontal drive shaft in an under floor shaft alley, thus avoiding damage from the ever present risk of fire. The alley in Group C was lined with

cast iron plates bolted together with a top plate forming the mill floor above. The drive was taken from the engine via a connecting rod to a crank on the drive shaft, flanked by a pair of flywheels. Each mill has an horizontal bevel gear wheel with drive being transmitted via a pinion wheel. Motion from the drive shaft was transmitted via a friction clutch engaged by a remote control rod. From the bevel wheel a vertical shaft passed to an horizontal spindle on the edge runners.

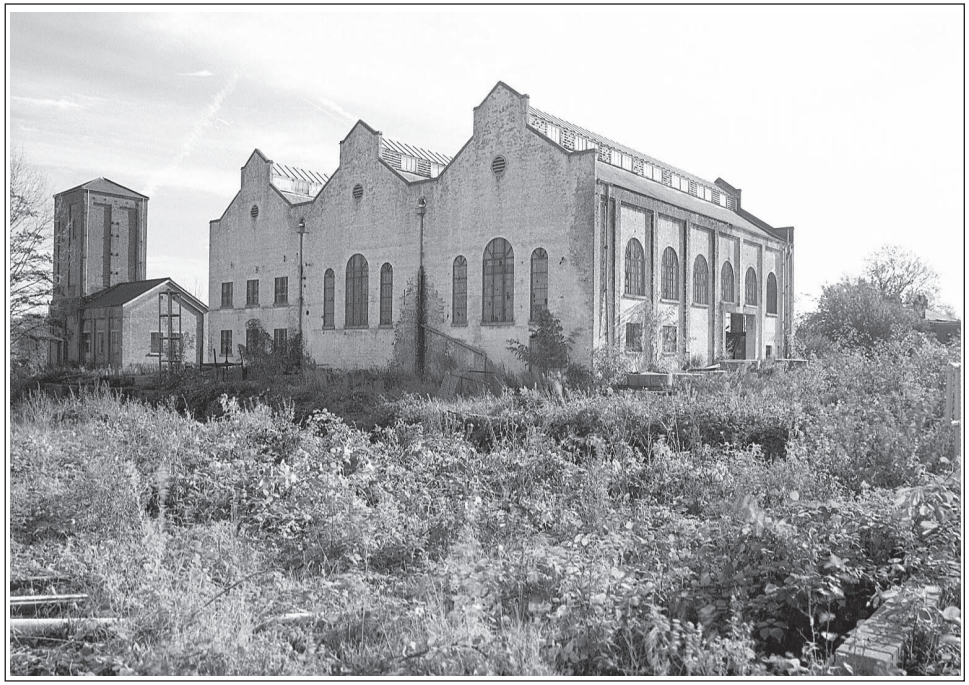


The use of underfloor transmission had 2 major advantages - it separated two 'alien' systems - metal drive gear and gearing, associated with heat and possible sparks, from the explosive powder dust laden atmosphere of the mill rooms and it lessened the risk of a machine part breaking or becoming detached and falling onto the mill bedplate. In addition, in the event of an accident, the drive machinery was protected and therefore reusable without expensive repair.

Architecturally, full advantage was taken of the tall central engine tower and boiler house to design buildings beyond the strictly utilitarian. They were of Italianate style with characteristic round arch openings. The engine and boiler houses had dentil cornices and chamfered brick plinths and the boiler house had brick bay dividing pilasters. Overall there is an impression of careful design and construction with the style of the central buildings offsetting the necessarily functional incorporating bays.

L177 Dynamo House Built 1902

As could be expected, electricity was first employed at the Mills, in the late 1880's, for lighting rather than motive power. The fundamental move from steam to electricity for production power occurred from around the beginning of the 20th century. A power house was constructed on the South Site in 1905 and the main power house (A210), with 3 Bruce Peebles generators, which is a prominent feature of the North Site, was built around 1908.



The 'Powerhouse' complex - main boiler houses on the right.

The Dynamo House, also termed the Switchboard House, abuts on to the east side of the L176 Boiler House. It had 2 dynamos and an accumulator shelf and its function appears to relate to a change from steam to electrical power supply to a building on the original Group A Site which had become a cordite reeling house. Originally a 30v DC supply was used to power cordite machinery. With the introduction of mains electricity to the area the Dynamo House was subsequently used as a general machine shop but the main boiler houses continued to raise steam for heating and processes around the site.

L176 Boiler House Built 1857

This is situated immediately south of the L168 Engine House and supplied steam for the Group A engine. As part of the original steam complex it is Grade 2* listed.

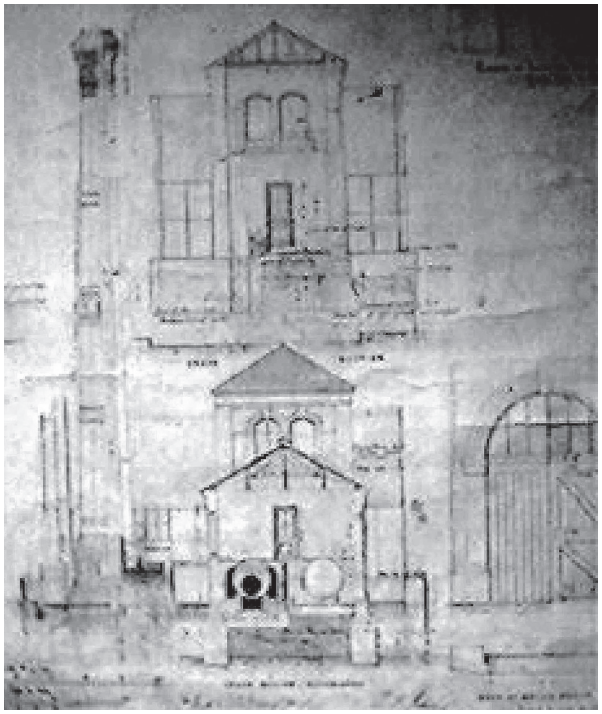
The roof trusses are of iron with decorative cast iron compression members. There is a record of installation of new boilers in 1902 but, since the Group A Incorporating building was not rebuilt after the 1861 explosion, it is not clear what these were used for. During the time of the site's history as a research establishment the boilers had disappeared and the building was the 'Rigger's Shop' and store.

L176 has now been renovated and houses the site's cafe and restaurant facility. Whilst the major structural features have been retained the original large wooden sliding doors on the north side have been replaced with a glass panelled entrance for the cafe.

Groups D, E,F,G Incorporating Mills 1867 - 1888

Developments in armaments and metals technology led to a steady growth in size of guns and volumes of gunpowder required. In response, these further groups of mills were built. In an expression of confidence in the validity of Group C the design and architecture of D, F and G closely followed it and also E after modification. The Grade I listing of Group C reflects its status as the design template for the later development.

D, F and G differed only in detail from C. For example, some red brick was used in construction rather than the same yellow brick as the main structure. Group E had originally been constructed in 1869 for the manufacture of the new pellet powders with an hydraulic accumulator tower in addition to engine and boiler house, but was converted to gunpowder production in 1877 with the accumulator tower retained to service a central hydraulic system. The general style and layout of the other Groups was followed.



part of engineering drawing ca. 1880 showing end view of boiler house with central tower behind.

Full original drawing is held in the Site archives.

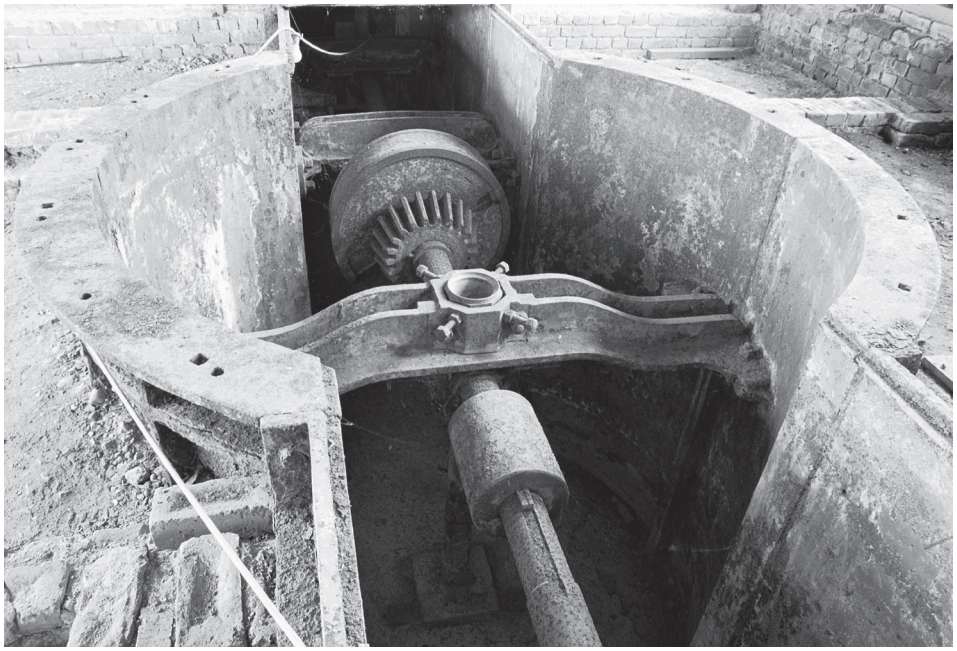
D, F and G were ranged in line alongside C, bordering Queens Mead and E faces them across the Middle Stream Canal.
By 1888 Waltham Abbey had 40 steam powered incorporating mills. It was estimated that steam driven runners were about 30% more productive than water driven.

THE INTRODUCTION OF CORDITE

Towards the end of the 19th Century gunpowder was supplanted as a service propellant by the chemically based cordite and, over a very short timescale the mills were converted to the production of this more powerful propellant. Groups C and D were converted to cordite presshouses and E, F and G to cordite incorporation. This involved the removal of the gunpowder edge runners and the covering over of the underfloor transmission train.

Cordite is a mixture of Nitrocellulose (Guncotton) and Nitroglycerine. The nitroglycerine is absorbed into the nitrocellulose to form a stiff dough using a mixing incorporater based on those used in the bread making industry. The resultant dough was forced through a die into long cords - hence the name Cordite.

Steam continued to be the power source but the drive was converted to an overhead shaft with drive belts to the cordite 'dough' incorporators.



In L157 the floors have been excavated to reveal the, still extant, drive shaft and gearing although the Beam Engine and Steam Boilers were removed when the factory ceased all production in 1945.

first application of steam power at the Mills in the mid 19th century - the Group A incorporating mills which were demolished by explosion in 1861 and not rebuilt. The Engine House survived and its Grade 2* status reflects its position as the earliest surviving steam related building on the site. The steam powered engine was a 30hp 6 ′ stroke compound beam engine supplied by Benjamin Hick & Son, Soho Ironworks, Bolton. Initiating the practice continued in incorporating mills Groups C to G, power was transmitted to the six mills of Group A via an underfloor cast iron lined drive shaft alley.

In common with a large proportion of the Mills buildings, L168 passed through a variety of uses. Its last working function was, from the mid 1960's, as an experimental 'whisker' factory where hairlike strands of silicon carbide or nitride were produced to reinforce thermosetting resins or aluminium alloys to give high strength composite materials for weapons systems.

The Mechanics Shop is the single story western block of L168. Power for belt drives was supplied by a second motion shaft from the Engine House. The construction of the Shop reflected contemporary application of iron for fireproofing purposes, The roof, supported by cast iron pillars and beams, incorporated trusses of round and tee iron with decorative cast iron compression members. The Mechanics Shop was comprehensively fitted out to provide the most up to date engineering facility. A 4 ton crane, capable of lifting the heaviest edge runners was mounted on the centre pillar. Particularly impressive was an horizontal mill capable of turning the heavy mill runners (by this time iron had replaced stone in the latest mills) and bedplates. An 1859 drawing shows a Lathe House at the end of the Engine House abutting to the Group A Mills. A further undated drawing shows "Foundations for Edge Roller Turning Lathe by Smith, Beacock and Tannett, Victoria Foundry (Leeds)."

In 1858 Lammot du Pont, of what was to become the great American du Pont chemical dynasty, visited Waltham Abbey in the course of a fact finding tour of the European gunpowder industry. He appears to have been impressed, particularly by the younger Congreve's granulating machine and the Mechanics Shop facility. Within 2 months of return he had ordered construction of similar facilities at the du Pont Hagley Yard gunpowder factory (Hagley Yard is now a major museum of gunpowder).

L168 has been renovated and the Mechanics Shop currently houses the site's exhibition of the forms of transport used at the factory; including a powder boat, narrow gauge railway engine and a 1950's Foden lorry used to transport liquid nitroglycerine from Wales.

Chapter 5

THE POWER BUILDINGS

The theme of this final chapter on listed buildings is ‘Power’.
The buildings covered are:

L168 Engine House and Mechanics Shop - Listed Grade 2*
L176 Boiler House - Listed Grade 2*
L177 Dynamo House - Listed Grade 2*
L136 Remote Accumulator Tower - Listed Grade 2
A221 The Lodge - Listed Grade 2

Power has been fundamental to all human activity; agricultural, industrial, social and over the years the Mills reflected the various forms of power as they developed from water to steam to hydraulics to electricity.

L168 Engine House and Mechanics Shop Built 1857

In the 18th century the buildings of the Millhead ran almost entirely on water power with some use of horse power. The Engine House and Mechanics Shop, situated adjacent to the roundabout at the southern end of Long Walk, supplied power to

THE RESEARCH ESTABLISHMENT 1945 - 1991

The Royal Gunpowder Factory closed as a production site on 28th July 1945 but reopened two days later as an experimental outstation of the Armament Department at Woolwich. It later became a full research and development establishment and continued as such until final Government closure in 1991.

During this time the existing buildings were once again modified to become research laboratories and it is evident that, even then, the mills were considered to be important structures worthy of careful preservation. After removal of machinery the various building floors were relaid to accommodate laboratories and small scale process bays. A major addition to the mills was the closing in and weather proofing of the verandahs allowing safe egress of staff, equipment and materials between laboratories in each complex. This can be seen in the picture of the Group D mills (p 2). It was possible to walk from the Group D mills right through to Group F entirely under cover.

During this period very little new building was considered necessary with most of the original buildings re-used as a fitting tribute to the design and workmanship of the original builders.

The cumulative repetition of style and scale of these mills creates, overall, an impressive architectural grouping. There is a strong symmetry lending an impression of power and, at the same time, large scale efficient industrial organisation.

With the development of the Site as a major visitor attraction and educational resource many of the buildings will once again have a change of use. A major refurbishment and preservation programme has been carried out and, in time, it is hoped that all such buildings will once again be in use.

Chapter 2
THE "1787 GROUP"

The three buildings here are:

A200 Walton House	- Listed Grade 2
A201 Mixing House	- Listed Grade 2*
A202 Saltpetre Melting House	- Listed Grade 2*

The term "1787 Group" has been used since the three comprise a grouping on the Island site where the original composition or mixing house and material preparation date from the Walton mills when the Government took over in 1787. Walton House was the Government administration building. The Government paid £10,000 for the Mills, bringing to an end the train of Walton family ownership which had passed through successive generations from 1702 after purchase from the Hudsons.

Looking North to the Millhead with Walton House on the right

These are the only surviving 18th Century buildings and the oldest on the site. They are situated by the newest building, the Establishment Library, built in the mid 1960's which now houses the main Exhibition Centre.

The Government purchase had been made on the recommendation of Major, later Lt.General Sir William Congreve, at that time Deputy Comptroller of the Royal Laboratory at Woolwich and followed the previous Government purchase in 1760 of the Home Works at Faversham, also made on his recommendation. Congreve's recommendation was opposed to Pitt's view that Faversham should be 'privatised' on cost savings grounds and Congreve therefore had a deep vested interest in the success of both purchases. Immediately following transfer of ownership Congreve instituted an extensive programme of repair, refurbishment and new building. Many difficulties were encountered, particularly with water supply, and production did not recommence until 1789.

L167 Reel Drying Stove Grade 2 listed - built 1889

This building, built originally as a charcoal store for gunpowder lies to the south of the Group C steam mills.

H7 Reel Drying Stove Grade 2 listed - built 1904

This is now the entrance building to the Mills. It was built, along with a duplicate reel drying stove H8, to service the expanding cordite output of the Mills. It is set within a substantial earth traverse for blast deflection upwards in the event of explosion. A tramway system led into the building entering through vertical facing wall with concrete revetments. Experience of earlier incidents had led to the conclusion that such earthworks were superior as traverses to the solid mass concrete previously employed.

The tramways ran to loading porches. These drying stoves were 'Danger Buildings' and, to prevent dust and grit entering, the porches were protected by a red painted barrier board. On stepping over the barrier board anyone entering the building had to put on special leather overshoes.

The purpose of drying was to remove remaining moisture and to drive off the acetone solvent employed in the incorporation. This scarce and valuable product was therefore lost to the air in vapour form. At the Mills R. Robertson and W. Rintoul devised a method of acetone recovery in which the air and acetone vapour were drawn across a sodium bisulphite solution with which the acetone reacted to form an insoluble bisulphite compound from which the acetone could be recovered. The necessary plant was initiated in 1906. H7 would probably have included an acetone recovery system from this date.

Having introduced a major change in power technology in the mid 19th century, at the end of the century the Mills, over a very short space of time, managed a total change in the technology and nature of its main product; from a basis of natural ingredients (saltpetre, sulphur and charcoal) for gunpowder, to the chemical base nitroglycerine and nitrocellulose for cordite, with all the implications this carried. New unfamiliar plant, conversion of old plant and buildings, new manufacturing, materials handling, revised safety procedures, training of staff, new laboratory and testing procedures etc. - an impressive achievement.

The development of and introduction of cordite into service was meteoric. It removed entirely the need for the brown and moulded powders which a short time before had seem so advanced. By 1890 land south of the town had been purchased to allow for the necessary expansion with the Mark I cordite becoming the standard rifle propellant in 1891. By 1898 the North Site, in conjunction with the new South Site, was producing guncotton and nitroglycerine and the Mills had become, predominantly, a cordite factory.

During WWI Cordite RD (Research Department) B was developed using ether-alcohol solvent in place of the scarce acetone. Prior to WWI the Mills cordite output was 26 tons per week. Within a year of the start of the war this had risen to 140 tons and by 1916 to 200 tons. Important development work continued at the Mills after WWI. In 1933 Cordite W (Waltham) was developed with replacement of mineral jelly by 'carbamite', a more efficient stabiliser. Although earlier grades had been termed 'smokeless powders', pressure from the military for enhanced smokeless and flashless qualities had intensified. Following research at Woolwich, from 1928 the Mills had been evaluating compositions containing picrite (nitroguanidine) and by WWII a formulation including 55% picrite had almost completely eliminated flash and smoke.

LISTED CORDITE BUILDINGS AT WALTHAM ABBEY

As outlined above the change to cordite at the end of the 19th century involved substantial conversion of gunpowder buildings. In broad overview terms the cordite manufacturing process had elements similar to gunpowder - incorporation, pressing, drying, blending.

The listed buildings which performed updated cordite functions were:

INCORPORATION AND PRESSING

	Gunpowder	Cordite
L145 Group F	Incorporating	Incorporating
L148 Group G	Incorporating	Incorporating
L149 Group E	Incorporating	Incorporating
L153 Group D	Incorporating	Press House
L157 Group C	Incorporating	Press House

DRYING

After pressing, the cordite was moved to drying stoves, either wound on to reels for small diameter cords or the larger diameter cut to required lengths. Hot air, heated by steam pipes was blown around the buildings. After drying the reels were moved to a Reeling House for winding into 60 strand ropes to ensure an average uniform quality. Larger size cords were blended by hand.

The programme had cost (including the purchase of competing water users - corn mills at Cheshunt and Waltham Abbey) the considerable sum of £35,000 and represented a significant investment, reflecting the importance placed on providing a secure and controllable gunpowder source by the Government. It seems possible that the realisation that the Mills were going to need this order of expenditure to retain their dominant position was an influencing factor in the Waltons' willingness to sell.

At the end of 1787 James Wright was appointed 'Storekeeper - Head of Establishment' at a salary rising to £300 p.a. He was assisted by a Senior Administration Officer, termed 'Clerk of Cheques'. In 1788 William Newton was transferred from Faversham and appointed "Master Worker' at a salary reaching £130 p.a.

A200 Walton House - 1787

Management required premises to carry out their functions and house their staff and the building now termed Walton House was erected, probably on the site of an earlier structure. The original building was two-storeyed, of two bays by one bay, in red/brown brick of rectangular form in Flemish bond. The roof was hipped with pegged trusses (original carpenter's marks still visible). In the 19th century various extensions were added. In the early part of the century a third bay of two storeys was added on the north side then, from 1860 a two storeyed wing two by two bays and another two storeyed wing. These additions resulted in the building ultimately having a U shaped plan. There was a progression of official titles - Storekeepers Office, by 1865, Superintendents Office and by 1917 the Main Offices. In 1865 plans were drawn up for conversion to Master Worker's living quarters but it is not clear whether this ever took place. The shield on the frontage with animal head and winged angel appears to relate to previous owners rather than the Waltons. Perhaps, not surprisingly, in view of the large number of additions and the high water table, settlement has taken place. This is visible but to determine on which side is not as straightforward as it might appear. Certainly the north side has a considerable lean as evidenced by the sloping internal floors.

Lt.General Sir William Congreve

When the mills were purchased the science of chemistry had barely started, control of the manufacturing process was loose and quality was a constant problem. Of particular importance was the need to secure not only better performance but greater uniformity. Congreve was a visionary who saw that the way forward lay in scrupulous attention to purity of ingredients, precise measurements, close study of each stage of the process to introduce improvements where possible. These considerations might now seem self evident but in that time needed strong direction and control to be achieved.

William Congreve was succeeded in 1814 by his son, also William, as Comptroller of the Royal Laboratory, including supervision of the Royal Gunpowder Factories, and continued the emphasis on quality, measurement and machinery improvement. He was responsible for the patenting in 1815 of important mixing and granulating machine designs.

A201 Mixing House 1787

The building of a new mixing house was an expression of Congreve's concern for purity of ingredients and for close control, establishing a milieu in which his precise instructions for proportions could be carried out. The process involves the mixing of the three ingredients of gunpowder - saltpetre, charcoal and sulphur, normally in the ratio of 75/15/10. Saltpetre and sulphur having been previously refined, all three ingredients were separately ground and sieved to provide the uniform consistency for the following process of incorporation into actual gunpowder.

The building is of red/brown brick in Flemish bond with a pyramid shaped roof. The roof trusses in the original part of the building are timber with a tie beam, king posts and struts. An addition to the north side at a lower roof level was made in the early 19th century and the south side also extended. The present flat roof link to building A202 was probably a replacement of this south extension. In common with other buildings A201 passed through a series of titles and functions; by the mid 19th century the original part was a Powder Store and the northern addition a Barrel Store. By 1886 the description was Storekeepers Office and Store, by 1908 Drawing Office with the flat roofed link a Laboratory Store and the northern extension a Visitors Danger Building Office. In 1830 the Board of Ordnance commissioned a study from Frederick Drayson of the operation of the Mills with a view to possible restructuring. His submission included a series of drawings of the buildings and processes.

At the same time it was hoped that guncotton could be granulated to provide a superior replacement for gunpowder but these hopes were not fulfilled. Guncotton was found to be too explosive in force and gunpowder continued its dominance. However, demand for a 'smokeless powder' continued.

Nitroglycerine (NG) - from 1863

Prepared by the action of nitric and sulphuric acids on glycerine this was first made by the Italian Sobrero in 1846. Although of much greater power than any other explosive of the time it was a sensitive and unpredictable liquid and in early manufacture many devastating accidents occurred. It was the Swedish chemist, Alfred Nobel, who 'tamed' NG by absorbing it into an inert clay (kieselguhr) which reduced its sensitivity. This he termed 'Dynamite' and the material came into widespread use.

Blasting Gelatine - from 1875

In 1875 Nobel introduced 'blasting gelatine' in which soluble NC was gelatinised by NG.

Smokeless Powders - from 1886

Poudre B 1886 In 1886 the French developed 'Poudre B' made by gelatinising guncotton with ether-alcohol and working the paste into a dry horn like material. Although not perfect it could be regarded as the first practicable smokeless powder.

Ballistite 1887 Nobel's blasting gelatine was too powerful for use as a military propellant but in 1887 he patented Ballistite as a propellant, it being a mixture of soluble NC, NG and camphor as plasticiser.

Cordite circa 1889 The French achievement had caused considerable interest, if not anxiety, in the British military and in 1888 an Explosives Committee was set up under Sir Frederick Abel to investigate the potential of NG based material as a service propellant. Within a year, in 1889, they had patented 'Cordite' with insoluble NC, NG and mineral jelly using acetone as solvent. This was termed Cordite Mark I and had a composition of NG 58%, NC 37%, Mineral Jelly 5%. The process involved forcing the material through a die while in a plastic state to produce strands or cords - hence the name Cordite. The patent process had passed through murky waters, including an action for infringement by Nobel - The Times termed it 'The Cordite Scandal" In 1901 Cordite MD (Modified) became the standard service propellant, practically reversing the previous composition to NG 30%, NC 65%, Mineral Jelly 5%, the purpose being to reduce barrel erosion.

Chapter 4
CORDITE BUILDINGS

This chapter deals with listed buildings associated with cordite production. A synopsis of the development of cordite production follows:

Pre cordite - Gunpowder The 19th century was an era of accelerating economic, manufacturing and trade activity with increasing rivalry between the Great Powers. Demand for gunpowder similarly increased in both the civil and military fields. In the military application, advances in metallurgy applied to iron and the new steels had enabled the manufacture of larger guns requiring not only larger charges but more specialised powders with a controlled rate of burning. This led to major developments in powder technology in the form of pellet or shaped powders, moulded prismatic powders and 'brown' powders. These new requirements resulted in a significant expansion of production facilities at the Mills in the late 1870's, together with new canal links. At that time it would have appeared that the natural based gunpowder would be the world explosive and military propellant for the foreseeable future. However, the new science of applied chemistry had already laid the foundations for massive change at the end of the century. Pressure for improvements in quality, performance and explosive power was constant. In the military sphere there was also growing demand for a 'smokeless powder' which led scientists to explore the possibility of replacing the natural based gunpowder with new chemically based materials.

Nitrocellulose NC - Guncotton - from 1863 The foundation of chemically based explosive manufacture is the process of nitration - the replacing of hydrogen in a molecule with an energetic nitro group. Around 1845 a Swiss chemist, Professor Schonbein of Basle, discovered a variety of nitrocellulose(NC) by the action of nitric and sulphuric acids on cotton and this was called Guncotton. Its explosive power was soon recognised but a series of explosions in many countries caused its manufacture to be dropped. Then, in 1865, Frederick Abel at Woolwich developed vital improvements making its manufacture and use practicable. He discovered that previous accidents were due to the imperfect washing of the material after nitration leading to severe instability and introduced a washing process which was put in place at the Mills. The civil explosives industry quickly 'cottoned on' to the commercial possibilities and many of the Waltham Abbey Mills processing improvements were widely disseminated throughout the industry. In the military the new material became widely used in torpedoes, mines and demolition charges. Guncotton continued as an important military explosive into WWII and in 1940 the Mills were producing 120 tons per week.

A202 Saltpetre Melting House (1787) A202 is immediately south of A201 and is linked to it by a flat roofed block. It is of red/brown brick in Flemish bond with a pyramid shaped roof with tie beam/king post roof trusses. A saltpetre boiling house was situated on the south side but was later replaced. Again a succession of titles/functions - Melting House, by 1827 Sulphur Mill, 1865 Washing Up House and Store, 1886 Master Worker's Office, Laboratory and 1908 Cordite Foremans Office.
In the 1960's a new Library building was erected to the south of A202 and both A201 and A202 were linked to form an overspill archive for scientific journals and photocopying facilities.

Saltpetre refining was a significant and expensive part of ingredient preparation. Increasing demands placed on it were reflected in new building. In 1806 a new refinery was built adjacent to the existing Walton plant at the junction with Highbridge Street and what is now Beaulieu Drive. In 1827 a major new refinery on the other, eastern side of Millhead was built and this survived until the end of gunpowder production.

The significance of the 1787 Group in the chronology of the Mills is; in physical terms as the oldest surviving buildings and the embodiment of structures of the 18th century gunpowder industry. Technically, they represented the start of a rationalised approach to manufacture introduced by William Congreve involving all stages of the process from purity of ingredients, precise measurements, close control, machinery improvement and economy of operation, progressively establishing the Mills over 200 years as leaders in their technology.

Chapter 3

EXPLOSIVE MAGAZINES

The phrase “powder magazine” tends to convey an image of a substantial building storing large quantities of gunpowder, or other explosives, often away from the site of manufacture. However a different type of magazine, of smaller size, performed a usual function within the manufacturing areas.

L 135 ‘Tray Magazine’ (1882) Grade 2 listed

BACKGROUND:

Increasing Government awareness of the need for better safety provision within the manufacturing process was reflected in legislation; Expense and Charge magazines were built in civil and governmental factories - Expense magazines for safe storage of product batches awaiting movement to further processing and the Charge magazines for enabling control of the quantities being worked on in the manufacturing area by providing separate storage for incoming material until it could be moved into processing within the permissible limits.

The listed magazines at Waltham Abbey include both ‘Expense’ and ‘Charge’ categories.

L 154 Expense Magazine Grade 2 - built 1864

Lying to the north of the Group C mills this again is one of the surviving gunpowder Expense magazines for storing material after incorporation. In common with other gunpowder buildings it made the transition to cordite and by 1917 was a store for cordite dough produced by incorporation, in the converted steam mills, of cordite paste - the process of incorporation involving absorption of nitroglycerine into nitrocellulose (guncotton).

L 165 Mineral Jelly Store Grade 2 - built 1917

Located at the south end of Queens Mead. Mineral Jelly (Vaseline) was added to cordite dough with the original intention of preventing gun barrel fouling by metallic deposits from shot but it was found to have an important stabilising effect on the cordite material. Reflecting the huge increase in demand for cordite in WWI it became necessary to build this dedicated store for mineral jelly.

L 170a Expense Magazine Grade 2 - built 1857

Lying to the east of the site of the first steam mills, Group A (see Part I) this is the earliest Expense magazine on the site. It stored material after incorporation in Group A to await onward transportation for breaking down, pressing etc. When the Group A mills were built a tramway link was established to bring material from the mixing house in the Millhead area. This involved raising on trestles to bring it up to the level of the incorporating mill floor which was raised to accomodate the underfloor drive gear. The tramway was extended to the Expense magazine which therefore has a raised door at the level of the tramway.

As in the technical field the Factory was in the forefront of safety development which fully reflected and, in some instances, was in advance of explosives legislation. The rush of the Industrial Revolution and beyond and the pressures of competition had meant that Victorian industry placed safety far down the list of priorities. The Mills attention to safety was part of the long climb to better and safer working conditions which took place in industry generally and continues today.

THE LISTED MAGAZINES

The buildings involved are:-

L 133 **L 135** **L 141**

L 154 **L 165** **L 170a** §

L 133 Magazine Grade 2 - built 1879

As the Mills expanded with increased steam production so magazines proliferated, particularly at the time of significant expansion in 1878 when new moulded powders were introduced. There is a particular concentration to the north of the steam complex (termed 'Magazine Land' in the guide to the Mills) and L 133 is within this complex. An essential component of the 1878 expansion was the extension of the high level canal system and along with this a lock was built immediately to the north of the magazines to provide a connection with the lower level system and thus with the magazines.
When the gunpowder incorporating mills were converted to cordite incorporation some magazines, including L 133, were utilised to act as Charge magazines for the cordite mills, storing cordite paste.

L135 Tray Magazine Grade 2 - built 1882

This was a cordite tray store situated on the opposite side of the canal from L 133 with a round arched canal footbridge to the north. After incorporation cordite was extruded into the cord-like strands (which gave it its name) which were laid on trays for storage and onward processing. The much photographed L 135 and footbridge is the epitome of the magazines of the Mills. The loading platform with covered porch and elephant hide floor covering fixed with copper nails still survives. The distinctive 4 point lightning conductor on the roof is the standard pattern applied over the whole site from 1858.

L 141 Sorting House Grade 2 - built 1889

An Expense Magazine at the north end of the steam mills, similarly served by the raised tramway, with raised doors. By 1910 it was termed 'Sorting House', probably by then associated with cordite production.

---

§ The Grand Magazine at the northern-most part of the site is, surprisingly, not covered by an English Heritage listing. It is however, protected by virtue of being within the Scheduled Ancient Monument area.

EXPLOSIVES LEGISLATION

The main legislation reflecting Government control of gunpowder and later, explosive manufacture, transport and storage was contained in Acts of 1719, 1771, 1772, 1860 and 1875. The first two Acts were concerned mainly with outside transportation and storage.

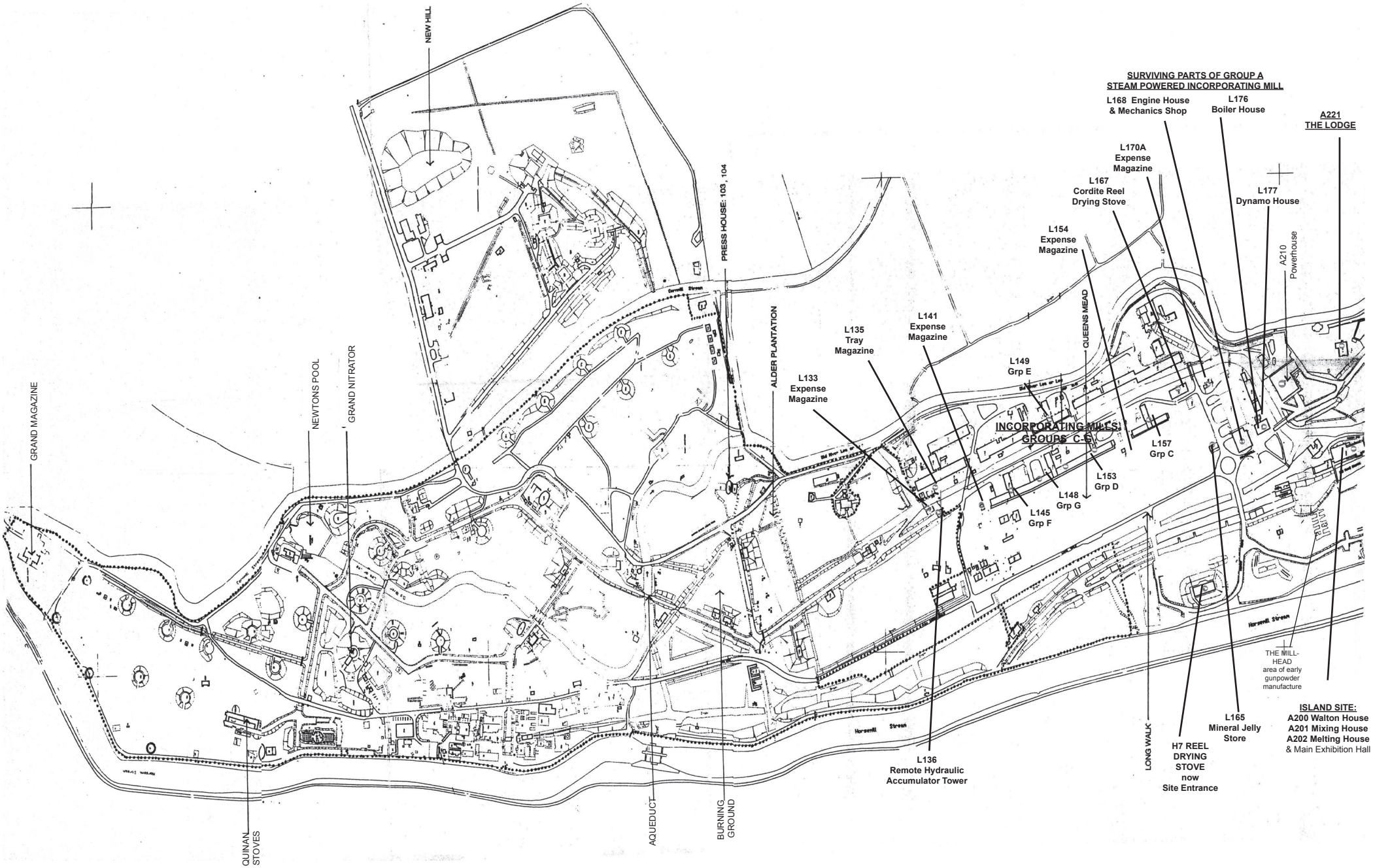
The 1772 Act was the first to include regulation of activity within the manufacturing facility, introducing provision for licensing of manufacture; limiting the amounts of powder which could be processed at one time and laying down limits for material which could be held awaiting processing, minimum distance of storage buildings from mills and the materials to be employed in the construction of storage buildings. The concept applied to storage construction was opposite to that for manufacturing. In the latter, a light construction was employed at appropriate points in order to channel blast away from adjacent buildings in the event of an incident. In contrast, storage buildings had to be of strong construction in order to protect the contents. By the mid 19th century it was apparent that the 1772 Act was failing - it did not cover new types of ammunition and explosives or processes and the mechanics of enforcement were lacking.

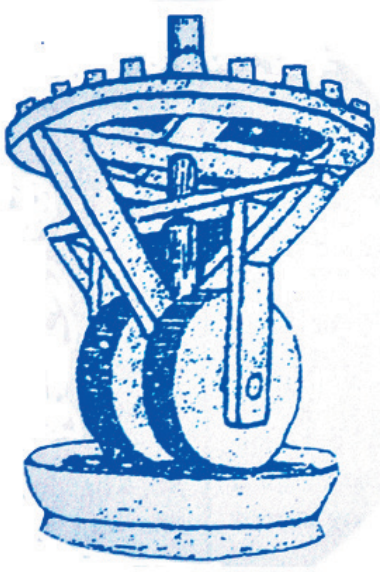
A particularly serious explosion in Birmingham in 1859 led to the Act of 1860 which covered the new types of explosives and, in the manufacturing area; amended the maximum permissible charge for incorporation, introduced limits for material processed in danger buildings and laid down requirements for Expense magazines. However, in spite of further legislation to improve and extend the 1860 Act, it still failed to adequately regulate the industry. There was a serious explosion in Erith in 1864 and a further one in Birmingham in 1870.

A report of 1864 on conditions at Erith exemplified the situation- magazines not closed or guarded, doors opening directly on to a river bank with a footpath along which the public walked (frequently smoking pipes), the presence of small boys augmenting their pocket money by selling matches to the smokers, passing river steamers emitting showers of sparks from their funnels and, to cap it all, the annual burning of nearby reed bed stubble - all so serious it almost passes into the humourous.

The subsequent Explosives Act of 1875, including an effective licensing and inspection system, finally proved an effective and long lasting medium for control of the industry.

SITE MAP OF THE ROYAL GUNPOWDER MILLS WALTHAM ABBEY





Published by the Friends Association of the
Royal Gunpowder Mills, Waltham Abbey
(registered charity No. 1115237)
January 2007

TRIALS TRIBULATIONS and PRANKS

Edited by

Norman Paul

An anthology of recollections by
ex-staff of the Waltham Abbey
Explosives Research Establishment

Introduction

After closure of the Research Establishment at Waltham Abbey the staff from both North (MoD) and South (Royal Ordnance) Sites were dispersed to other establishments throughout the UK. To keep people in touch with their former colleagues I started a quarterly newsletter in 1992 with items of interest, staff experiences and the developments taking place at the old Waltham Abbey Sites. This publication, called 'TOUCHPAPER', was produced 'in-house' at my then workplace at Fort Halstead in Kent.

On my retirement in 1998 I no longer had the facilities to print and send out the newsletter and the Friends Association was set up, partly to fund the continuation of what seemed to fill a popular need.
The name 'Touchpaper' was continued and although the nature and content has changed over the ensuing years it still provides my ex-colleagues with an opportunity to recall many of the incidents and happenings of the Establishment.

This booklet is a compilation of the many contributions that have been made of staff recollections, some serious and others of a more humorous nature. I believe it gives an insight into the social nature of the Establishment which, while engaged in serious scientific endeavours, nevertheless shows the sense of fun and general comradeship prevailing.

The anecdotes can be sub-divided into four main classes:

Trials - accounts of various trials with some unexpected results.

Tribulations - When things didn't always go according to plan.

Pranks - The many japes played by staff.

General Recollections - including 'My First Impressions'.

Many of the contributions could fall into two or more of these categories so, for this reason, they are listed solely in date of publication order.

I hope you enjoy reading these as much as I enjoyed publishing them over the years.

Norman Paul

Bill Pember - Extract from Obituary

Bill Pember died earlier this month, he must have been quite young, early sixties I would think. I worked with Bill in the late 60s/early 70s (at Newton's Pool) and again in ISRG in the 90s.

Bill had a fiendish and almost self-destructive sense of humour in the early days. It became the habit of the Superintendent (George Whitbread in those days) to take guests and VIPs to the Pool to witness the spectacle of an underwater explosion, usually just before lunch. When George and the visitors were assembled on a piece of hard-standing beside the Pool, Bill would start the count-down over the Tannoy: Five!, Four!, Three!, Two!.....BANG!! He would always 'fire' before the count-down has finished. George Whitbread, you may remember, was irascible at the best of times and on each occasion became incandescent with rage. On several occasions, Bill came within a hair's breadth of disciplinary action.

There was another occasion when George Whitbread wanted a blast wall removed in the Newton's Pool area. George 'came up the hard way' and considered himself a man of action. One morning, he attacked the blast wall with wads of plastic explosive (PE). All that happened was that the moss was blown of the wall. George retired 'hurt' for lunch intending to return later and finish the job. However, Bill had witnessed George's efforts from afar and, in the mean time, he borrowed a masonry drill, put in a pattern of holes, stemmed in some PE and fired. The wall was reduced to pieces of rubble of manageable size - a perfect job, in fact. When George returned from lunch he was characteristically purple with rage. He threatened Bill with dismissal for insubordination. When George had calmed down, he realised that he hadn't a case. He could hardly claim that he didn't want the wall demolished and Bill (no doubt with his tongue firmly wedged in his cheek!) had said that he was "only trying to help". We knew better, of course.....!

Jim Burgess DECEMBER 2006

One of the largest motors was originally intended for the Blue Streak missile and was fuelled by a mixture of an oxidising acid and kerosene. I was part of a team making temperature and pressure measurements when the acid line sprang a leak, spraying us all with fuming nitric acid. We were wearing some protective clothing but there was a concerted rush to the open air shower that had been provided for such an event. Unfortunately it had room for only one person at a time and there were three of us, I still have a small scar as a memento.

Another experimental motor was fuelled by hydrogen and oxygen. The hydrogen was delivered on large trailers each carrying a battery of enormous red cylinders arranged horizontally and secured by chains. I had climbed on top of the trailer to unfasten the chains when a colleague opened the valve of the top cylinder preparatory to connecting it to a feed pipe. An immensely long bluish flame immediately shot out. It missed him, but I found myself momentarily sitting astride a hydrogen cylinder which appeared capable of imminently taking off into the stratosphere and making me the first BHCHS former pupil to go into orbit. Luckily the culprit hadn't let go of the valve key and had the presence of mind to immediately turn it off again, when the flame died as rapidly as it had arrived. All the insouciant gentleman could say was "Never mind, there must have been a bit of grit in the valve ", No Health and Safety enquiries in those days!

I was nominally employed at ERDE for 9 years but they sponsored me to do a degree and then a doctorate at University for the last 6 of them and at the end I got transferred to the UKAEA so I never returned to Waltham Abbey, but I cannot forget the rickety old bicycles painted in camouflage colours provided for getting between the two main parts of the site along the canal towpaths and the MOD police at the gates who were armed and kept their ammunition in an old biscuit tin with a picture of the Queen on the lid.

Brian Waite DECEMBER 2006

ORIGINAL TOUCHPAPERS March 1992 - June 1998

A Wildlife Encounter

One misty autumn morning I was riding my bike up the Long Walk to the Main Lab. It was about a quarter to eight. No one stirred (scientific staff were all still abed). As I approached the old H10 building I heard the clip-clop of hooves and, looking around, I saw a fully grown stag trotting along behind me. I yelled in fright and must have scared it because it started to gallop - towards me! I pedalled as fast as I could, yelling at the top of my voice with the stag rapidly gaining. As I reached the Main Lab it suddenly passed me, veered in front and then turned left while I ended up at the foot of the steps to the Main Lab. Who was most scared I shall never know.

Win Yeandle DECEMBER 1992

The Flying Cat

'Griff', the Safety officer told me of the time he was sitting in the library when a LAW motor was fired in the proof stand opposite. Out of the corner of his eye he saw a flying object which he took to be an errant part of the motor. Enquiry revealed that it was a cat sleeping on top of the proof stand who departed somewhat precipitously when the motor fired underneath him. We all reckon the cat's name was SAM.

Bryan Howard DECEMBER 1992

Sex Rears It's Ugly Head

When ERDE amalgamated with RPE Westcott to become PERME I pointed out to the Director, Lionel Bellamy, that he now had two SE branches; Explosives at Waltham Abbey and Engineering at Westcott. Being an ever helpful chap I suggested that our lot become SEX but he ruled against this; we stayed as SE and the others became SEng - Pity! I also recall that I had requested samples of an HMX precursor compound called SEX. At the time the availability was difficult and in one of the old WA files there is a note to the effect that 'Dr Beck cannot have any more SEX until April!" Honestly, it's true.

Cyril Beck DECEMBER 1992

Sex Rears It's Ugly Head - AGAIN

Further to my last article in December 1992 I also recall an hilarious conversation with a young lady in the US Office of Naval Research when I tried to explain that, although SEX was in short supply in the UK, I might be able to oblige her needs later in the year when other, higher priorities had been satisfied!

Cyril Beck MARCH 1993

First Impressions

I joined ERDE in 1953. They said they wanted someone to do 'Rheology'. I didn't know what it meant either, but I needed the job. In an advertisement in the Manchester Guardian it was printed as 'Theology" and got some peculiar applicants! They put me on the North site and gave me a bicycle, apparently made by a blacksmith on an off day from assembling steam engines. Riding along the high level runways I leaned back on the pedals to relax and enjoy the scenery. When I picked myself up from the mud below the runway I realised that if I knew little about rheology I knew even less about back pedal brakes. The week I joined they abolished Saturday working. The lab workers were very pleased. They only tidied the lab on Saturdays and were now trying to explain to a puzzled management that in future they wouldn't work on Friday afternoons but would spend the time tidying the lab. My first boss was Phil Freeman. He was remarkably good at predicting the results of an experiment. I then learned that he doubled his income at the Walthamstow Greyhound Track and brought the same infallible predictions into play in his job. My first instructions on joining were "Be nice to the Temperature Recorders". I had thought that these devices were smudged purple ink traces on chart recorders and it took me a long time to find out that they were a body of people working 24 hours in shifts taking temperature and other observations on long running tests.Living far from home I had to find lodgings and my first digs were in Cheshunt with a dear old lady who gave me the same meal every night for five weeks, including dumplings and runner beans. We only used the kitchen with the oven door open and the gas on (fortunately the gas was lit!) I then moved to the hostel and stayed there until I got married. They later closed the hostel and various single people who had (apparently) ignored each other for years over breakfast now married each other - just to have somewhere to go. If you think the present day canteens are terrible then count your blessings. One of my assistants only ate there once but objected to the Elastolplast in her stew. We may not have obeyed the hygiene rules but we did follow the Health and Safety Rules. For instance, when Geoff Church assembled a home made seismograph he earthed it to a water tap. Admittedly he used the first bit of wire to hand, which was Red but he put a label on it -'N.B. This wire is Green.' Incidentally, this seismograph was because George Whitbread was accused of making bangs that shook our building, broke our tensile test specimens and spoilt our graphs. It was very useful later when George was also accused of cracking the Abbey Church tower with his bangs. We were ale to show that lorries rumbling past had a greater effect and that if they wanted the tower to last another 1000 years they had better stopped ringing the bells! At one time I had a new assistant testing the fracture strength of cordite who tried to take home a pocketful of

T of I Lesson

I was once asked to carry out an urgent Temperature of Ignition test using the old T of I apparatus in L149. I placed the glass tubes containing the weighed mixture into the heating block, put up the screen, set the Variac (remember them?) for the required heating rate and switched on. In due course, loud BANG! tinkle, tinkle (the latter the remains of the glass tube descending from above). Another BANG! tinkle, tinkle. Two heads then appeared around the door, one above the other, their attached bodies cowering in the corridor outside. The upper head (Randall Wyatt) spoke, "What are you testing?" "Barium Styphnate mixtures" I replied. BANG!, tinkle, tinkle. The lower head (Ken Bascombe) said, "What sample size?" "200 milligrams", I said. BANG! tinkle, tinkle. Both heads shouted in unison, "FIFTY milligrams! BANG! tinkle, tinkle.

Tony Whittaker SEPTEMBER 2005

Explosive Experiences

When I left Buckhurst Hill High School for Boys in 1954 I took a job as a scientific assistant at the Explosives R&D Establishment, the erstwhile gunpowder factory at Waltham Abbey. This was in the days of National Service and serving one's country in such a capacity was a welcome alternative to serving it on a barrack square. On one of my first visits to the canteen (where there was waitress service no less, and flowers on the tables, quite a change from school's spartan dining hall), I shared a table with a youngish lady who asked me if I recognised her. I said honestly that I didn't and was then embarrassed to learn that she had been at my school for some time as an assistant and had just left to take a job in the ERDE offices.

I was first initiated into the mysteries of making 10 pound batches of TNT in big enamel buckets (it's quite safe when wet !) and the more modern explosive RDX but soon afterwards I was transferred to the rocket motor section which was headed by a German speaking scientist who the junior team members firmly believed had actually worked with von Braun, Hitler's rocket expert. *(This was Hans Ziebland, a German scientist who had originally been directed to work at Waltham Abbey by the Government. Ed.)*

found it somewhat difficult to handle!

II. The Guncotton Lab had a very high roof which was ventilated by a skylight which was 'blacked out in the war and more or less permanently fixed shut lest it be inadvertently left open. Thus, above the door level, there was a 'dead space' which was virtually unventilated At the height of the war (or should I say the depth) we were, perforce, virtually vegetarian and while on night shift my evening meal consisted of a large potato which I boiled in its jacket in a large beaker. Sometimes, for variety, I also cooked some white cabbage, The latter always cooked in the fume cupboard so that I did not fill the dead space with the smell of boiled cabbage; fearing the wrath of Percy Smith when he arrived the next morning. One of the guncotton chemists observed my activities and decided to join me in my 'home cooking'. We had a large gas ring in the lab on which we boiled the kettle for tea but one night when I left the lab to visit the toilet I returned to find that he was busy frying kippers on the gas ring (where he got them from I do not know). The smell was indescribable and I warned him that he should not be around when Percy arrived in the morning, We eventually managed to clear the air but it took about two weeks. I have never fried a kipper since!

Jim Jeacocke MARCH 2005

More Matters Culinary

As a young Assistant Scientific Officer in the early 1950s, many brought sandwiches for lunch and in the summer ate them outside the 'Old Main Lab'. In winter however, and unknown to the upper echelons, instead of going to the canteen we heated up soup or boiled an egg in the lab upstairs. One episode I remember; someone, I won't mention her name to spare her blushes, decided to have an egg. Since it was Easter we decided to dye it with methylene blue. Unfortunately the shell had cracked and the white went blue and the yolk green. It cost us her lunch!

As an item of research can anyone tell me if there was a standard MoD cookbook or did each cook do her own thing? I only ask because Plum Duff always had the same sultana or currant density and both the gravy and custard did not vary in viscosity at all the MoD establishments I visited - except at AML Holton Heath whose Duff had a much higher currant count.

I once wrote a satirical verse based on "Oh God our help in ages past"
(bet it started "Oh Cod ...". Ed.) about the shrinking size of cod portions. It didn't go down too well and I was hauled before Miss Davidge and asked to explain myself and justify my criticism. They never did publish it.

Geoff Howell JUNE 2005

samples to show his proud parents. He got stopped at the gate and searched and, do you know, I never saw him again. I was once stopped at the gate myself and happened to be carrying a book home which was my PhD thesis. The policeman on duty stopped me and asked "Is that your own book Sir?" and I said 'Yes!' "Are you sure?" said he. "Of course" I said "It's got my name on it in big gold letters". When I emerged from the search room half an hour later I had learned another new thing - NEVER TRY AND TEASE A POLICEMAN! I must have learned other things whilst in the rheology section - but that's another story.

John Vernon JUNE 1993

First Impressions 2

John Vernon's 'First Impressions' jogged my memories of joining ERDE, also in late 1953 and made me wonder how I survived my early days there. On my first day I was directed to the Rheology Section but, on protesting that I had understood that I was to work on Combustion research, I was quickly interchanged with Les Helps who had joined the same day and had been directed to Combustion! This did not create a good impression of the efficiency of the administration. My first task given to me by Gordon Adams was to study the polymerisation of gelling agents in pure nitroglycerine. Only vaguely aware of the potential hazards I was soon making my first contact with the custodian of the NG, George Whitbread, who placed me in the tender care of Harry Rumbold (a well known character who never removed his NG Worker's cap). Armed with a plastic bottle. Harry took me to the magazine where we discovered that all the labels on the aluminium churns had fallen off owing to the damp. Harry was completely unconcerned and proceeded to take each churn off the shelf and bang it down on the concrete before prising the lid off and sniffing for the familiar bouquet of NG. With my knowledge limited to what I had seen in films I had always thought that NG was somewhat shock sensitive!

Having survived my first contact with NG I was only slightly bemused some weeks later when one of my colleagues returned from stores, proudly bearing the largest retort stand, largest glass funnel, largest filter paper and a 1 gallon aluminium beaker. However, my suspicions were aroused later that day when I noticed an empty gutta percha bucket on the bench next to the funnel now filled with an orange-brown liquid. Suspicion turned to horror when I saw that as each drop of filtered NG (confirmed as such by my nonchalant colleague) fell into the aluminium beaker a spark shot between beaker and funnel. Concurrently with this operation, Mr Brewin (SP2 at the time) had been chairing a meeting of the High Explosives Committee in the adjacent office and having called a natural break wandered into the lab to pass the time of day with his bright young scientists and to enquire what they were up to.

Once enlightened it was amazing to behold, considering his portly constitution, how rapidly he disappeared next door and shepherded the Committee members to reconvene at a more distant venue. The next morning my colleague was summoned to SP2's office and returned chastened and annoyed. He had suffered the worst punishment then available to ERDE Management - he was transferred to Woolwich. I was left wondering whether a career at ERDE was something I could survive.
John Hicks DECEMBER 1993

Reminiscences

I initially started work at the Woolwich Arsenal but during WW 2 I came to Waltham Abbey to try out, on a production scale, my new high nitrogen process for nitrocellulose from wood which had performed well up to the semi-technical scale at Woolwich. The nitration overheated and caught fire which was a good start to my first days work at Waltham Abbey! After this I was put in charge of initiators! John Hicks (December 1993) referred to the horrors of being sent to work at Woolwich. This was only equalled by many staff following the planned move from Woolwich to Waltham Abbey when the Chemical Research and Development Establishment was set up in 1945. One day I came home and said to my wife "The move is on, either Waltham Abbey or Australia". She replied "Don't tell me it's Waltham Abbey!" We were mainly concerned about the schooling prospects for our two small daughters. For the record our girls had a very happy and successful time at the Quaker Lane School. My Woolwich connection continued and I still remember the problem of the Waltham Abbey transport office requiring a file reference to carry 'in-section- stores to Woolwich. I got over that by quoting the only number I ever remembered - my Co-op divi number. **'Gudge' Taylor MARCH 1994**

Now It Can Be Told

We were going to test a special high pressure closed vessel at the back of the 'Stockade' (H67). A number of interested engineers and scientists had gathered to be in at the first firing (albeit at a safe distance). The designer, an external contractor, was so confident, he suggested we make a saddle for him to sit astride during the test. We persuaded him to retreat to a safe place with the rest of us. Just before the firing I had a phone call so didn't take much notice of the muffled 'crump' from outside but on emerging from H67 I became aware of the crestfallen engineers surveying the 2 doors of the firing pit that had blown off their hinges. Due to a miscalculation the pressure release valve failed and at some 40 tons per square inch had ejected into the wall. MORAL - never leave at critical moments - You'll miss all the fun! There was no more talk of saddles. **Bryan Howard JUNE 1994**

Don't Try This At Home!

Although in an explosives laboratory there are many 'fires' (bunsen burners etc.) sources of ignition are carefully controlled in case they go 'walkabout'. In the Main Lab this was an ancient flint lighter kept chained to the bench but which sometimes had to be removed to light the bunsen under the stability bath in the room next door. The inevitable happened, the lighter went missing overnight so there was no way in which we could start work the next morning. The late Ted Hitch remembered that he had read somewhere that fire could be produced by mixing potassium permanganate with glycerol and then adding concentrated sulphuric acid. Nothing daunted, Ted found a large porcelain dish to which he added a substantial quantity of potassium permanganate and moistened it well with glycerol. Cautiously adding a few drops of sulphuric acid he (and the rest of the lab staff) waited with baited breath for a flicker of flame but no such luck. A few more drops - same, nothing! Ever the impatient Ted gave the dish a good dose of sulphuric when it all happened at once. The permanganate reacted, the glycerol charred then a cloud of purple vapour erupted from the dish filling the lab with pungent fumes - but no flame. Before we could start work we had to decontaminate the lab or all the results would have been haywire. Fortunately the lighter was found and life returned to normal (or as normal as it ever was!)
Jim Jeacocke DECEMBER 2004

Matters Culinary

I. In the hiatus between the closure of RGPF and the opening of CRDD (Chemical Research an Development Department), the first suggested name for the Establishment - not many people know that we were left to our devices; we spent the time clearing out solutions that were no longer required (I have mentioned earlier how I turned 3 miles of the Lea bright green) but Ted Hitch thought he had a better way of using his time. To this end, one morning, he brought in his shaving kit and an egg to boil for his breakfast. He boiled the shaving water, set the egg to boil and retired to the Extraction Room to shave. While he was frantically trying to get a lather from his shaving soap (we had liberally dosed the water with alum) we noticed that the egg was white shelled. Realising that the egg would look the same without its shell we 'titrated' the shell with glacial acetic acid until it stopped fizzing and the shell had completely dissolved. By the time short tempered Ted came to retrieve his egg he

The RDX Lab

When the decision was taken to build the RDX Pilot Plant on the South Site a new laboratory facility was needed so a small hut was built adjacent to the Main Lab specifically for that purpose *(presumably the 'Green Hut' that still stands. Ed.)*

This was necessary since one of the specification tests (carbon content) was so sensitive to contamination that a relatively clean atmosphere was required (even blowing into the reaction flask was enough to give erroneous results). Many rumours circulated about this new material, in particular that it turned one green. At least a change from the bright yellow from Tetryl that I was at the time! But eventually the lab was up and running.

Then, disaster; 'Our Lab' was to be taken over by a lot from Woolwich who had been bombed out. We didn't think much of that and, for a time, there was a certain animosity between us.

Ernie Bowell was one of the first 'evacuees', the others that I remember were: Wood, Clarke, Kemp, Quick, Townley (on whom I played the TNT coated bluebottle trick mentioned in an earlier edition) and, in particular, G J Bennington-Davies. We soon began to fraternise, especially when we discovered that they had an alternative use for the extraction bath, which was to keep a continuous supply (source unknown) of hot coffee available.

Jim Jeacocke JUNE 2004

Initiation Japes - One That Went Wrong

We generally played japes on new entrants in the late 1930s and one I recall had unfortunate consequences, A large funnel was stuffed down the waistband of the victim's trousers and a coin placed on his forehead which was tipped back. He was required to tip the coin into the funnel. Before he could do that a beaker of cold water was emptied into the funnel. We soon found that acetone was more effective since it froze the nether regions. Unfortunately, Gary Cooper joined when he was several years older than most of us and he was wealthy enough to have invested in the new fashionable Celanese underwear. He not only got very cold but was enclosed in a sticky mess as Celanese was somewhat soluble in acetone!

Dick Doe JUNE 2004

I Cannot Tell a Lie

It was me, or more accurately -it was us! When Dr Owen transferred away in the late 60s the chequerboard top of his Messerschmidt bubble car just called out for a set of chessmen. Perhaps we shouldn't have used Bostick! I told B.b S.m.k.ns at the time that it wouldn't do the Perspex roof any good. The effect was topped off by a big bow of bog paper and it looked very pretty in the middle of the roundabout by the telephone exchange. We weren't to know that Alan would return many years later in charge of the establishment. It seems we got away with this dastardly deed - until now.

Dave Salter JUNE 1994

Deer Editor

I was called out one wet Sunday morning by the MoD Police. A stag had been found by Fred Hastings whilst on patrol with his guard dog at the rear of M343 South Site. It had one back leg entangled in some wire and the area was in a mess; fur and blood everywhere, as the animal struggled to escape. Fred's plan was to throw the stag over, tie its legs together and wait for the RSPCA to treat it. The first part was easy. I twisted its antlers over and Fred pulled its front legs from under until it toppled over. His next instruction was to sit on its neck and he would tie its front legs together. The stag had other ideas. He gave one big lurch and I went flying. Unfortunately one of its antlers caught my trouser fly and away went two buttons, plus most of my raincoat buttons and the point just grazed my chin. At this juncture the air turned blue. We threw the animal over but tied its antlers down to an iron post and then tied its front legs. Soon after, the RSPCA arrived, tranquillised it, washed its many cuts and grazes and dressed its legs with iodine soaked bandages, then gave it another injection to counter the tranquilliser. With the famous words "When we undo the ropes, Run!" We proceeded to free the beast which staggered up *(Staggered? Ed)*, turned to chase us but instead reeled drunkenly off into the woods. The strange thing was that no one ever saw or found any trace of him after that.

The final insult was when Fred submitted his report the next day which was presented to the Director. He got a rocket for releasing it back into the establishment instead of showing it the gate and releasing it outside!

George Saville SEPTEMBER 1994

Retirement Story

I remember the retirement of Dr. C H Johnson, Chief Superintendent in the 1950s, who seemed a very austere and remote figure to us. It was announced that he would give a farewell talk on the 'History of ERDE'. His secretary, worried that no one would turn up, rang around to ask us to attend, so dutifully we did.

His talk began: "Well I expect you know all about the history of this place so instead I'll talk about claret." He then gave a remarkable talk about different chateaux and vintages, produced a lot of bottles, including some rare and expensive wines and opened them all. After that I always made a point of attending retirements of senior people - but, alas, the idea didn't seem to catch on!

John Vernon SEPTEMBER 1994

Extract from letter....

...I'm just getting over the hay fever season. Dr Llewellyn, the Establishment doctor said, in 1960, that I'd grow out of it by 50 years of age. 73 now and I still suffer from it!

Bob Rainbird SEPTEMBER 1994

....Response

Of whom else can it be said that he is rarely wrong that such an occasion remains vivid in the mind after 34 years! While affording Bob all sympathy he may be reminded of his good fortune to be able to complain at 73; vastly in excess of the mean age of death of GPs! As visiting doctor to the establishment for decades I had acquaintance with many individuals and many Sections. Looking back I realise that it was a wonderful place and quite unique and have come to recognise that to have worked there was a privilege.

It is plain that the site will contain a remarkable display of industrial heritage, including perhaps, oneself stuffed and standing next to the formidable Sister McCarthy who had so commanding a manner that when she said "Drop your breeches now" I never recall any man who showed not instant obedience. I have always rejoiced in the fact that she never said it to me.

"The people who were not there will never know"

Dr John Llewelyn DECEMBER 1994

A Prank that Backfired

Part of the 1st floor of the Main Lab was fitted with a false roof to form a balance room, extraction room and office. The loft, so formed was used as a repository for obsolete and obsolescent equipment and had facility for on and under bench storage. Hot air, with its tendency to rise, brought with it the dust and grime of ages. I have mentioned before that, in the early days, we worked a 6 day week with a courtesy Saturday afternoon off. Some of us, anxious to go out in the afternoon, would come to work wearing 'second best' clothing. In such cases it was well to keep out of the way of the 'old man' (W C Blanchard) as, if he saw anyone respectably dressed, would immediately demand retrieval of some archaic device in the remotest corner of the loft. Two of us, having spoilt the knees of numerous pairs of trousers, decided to take revenge. We had been working long enough to know some of the properties of diethyl ether, in particular its low boiling point. It was a hot summer and with the aid of a bicycle pump we injected a few mls of ether into the front tyre of his bicycle in the hope that, as he cycled home the ether would expand and give him a puncture. The thought of this rather florid gentleman wheeling his heavy bike home intrigued us. Unfortunately we had overlooked another property of ether, its solvent effect and cycle inner tubes were made of rubber. I was then 'nobbled' by the old man who asked if I would have a look at his front tyre which was flat. I approached the task with trepidation but on removing the inner tube found that the ether had loosened an existing puncture repair patch which was easily replaced. There was, however, a strong smell of ether about so I inflated and deflated the inner tube a few times to remove the last traces - there I did wrong, the ether had swollen the tube so that when I came to put it back on the wheel it was now about 9 inches too long. I called my fellow conspirator and, by putting a number of 'tucks' in the tube we managed to get the outer cover on and inflate the tyre.

With a silent prayer we kept an eye on the cycle for the rest of the afternoon but, thankfully, all was well.

Jim Jeacocke JUNE 2004

Now the path through the vegetation was in most places hardly any wider than the Land Rover itself, with the inevitable result that if you forgot to retract one of your trafficator arms, you would arrive at New Hill with the unfortunate device either wrapped backwards along the side of the vehicle, or missing altogether. I don't know how many trafficator arms we got through. The comments from the MT section, who of course had to maintain the vehicle, were along the lines of how much better their grandmothers could have done it.

However, the vehicle speeded up the work of the section noticeably, and it wasn't long before we actually got a second Land Rover, and then the trafficators went out of fashion and we had the now universal turning indicator lights. I don't think that any of the many section members who drove the 'Rovers' ever had a real accident, although there were some 'incidents'.

One day on New Hill I drove one of them up onto the top of an earth embankment where we were to install an air blast gauge. This embankment formed a blast wall around one of the old NG process buildings. The Land Rover got up the steep bank fairly easily in low range bottom gear. However, there was no room on the top to turn round, so when the time came to descend, I had to reverse back down. But the vehicle lost grip and began to slide backwards down the steep slope, accelerating and finally hitting the road with such violence and at such a steep angle that the towing hook hit the road surface and went straight through the tarmac. The vehicle was transfixed, impaled by its own towing hook! Fortunately the MT people took pity on me and rescued the vehicle without reporting the incident.

There was the usual Establishment speed limit of 10 mph on the New Hill roads (which were tarmac topped and in quite good condition). One afternoon after finishing for the day I was driving along the main north-south road towards the bungalow, when I was amazed to be overtaken by the other Land Rover - going backwards ! It was being driven by another member of the section (whom I won't name but who was a very skilful driver), laughing hugely at my amazement as he went past. There was, of course, no one else on New Hill at the time !

Jim Hawkins MARCH 2003

A Chemist's Poem - The Night to Make Crystals

Twas the night to make crystals and all through the hood
Compounds were reacting; I'd hoped that they would.
The hood door I'd closed with the greatest of care
To keep noxious vapours from fouling the air.
The reflux condenser was hooked to the tap
And the high vacuum pump had a freshly made trap.
I patiently waited to finish my task
While boiling stones merrily danced in the flask.
Then from the pump there arose such a clutter
That I sprung from my chair to see what was the matter.
Up with the fume hood and up with the door
And half of my product foamed out on the floor.
Then to my disbelief, what should appear
But a black viscous oil that once had been clear.
I turned off the pump, all in a rush
And the oil that sucked back filled the line up with mush.
Then all of a sudden I heard a loud crash
And the ether boiled out of the flask with a splash.
My nose turned quite red, my eyebrows went bare
The blast had singed off almost half of my hair.
I shut the fume hood door with a violent wrench
As acid ate holes in the floor and the bench.
I flushed it with water but to my dismay
Found sodium metal had spilled in the fray
And then 'ere the fire got way out of hand
I managed to quench it with buckets of sand.
With aqueous base I diluted the crud
And shovelled it up, six buckets of mud.
I extracted the slurry, again and again
With ether and then with dichloromethane.
Chromatographic techniques were swiftly applied
Several times 'til the product was quite purified.
I finally viewed, with a satisfied smile
One half a gram in a new shiny vial.
I mailed the yield report to my boss
"Ninety percent (allowing for loss)"
"Good Work" said the boss in the answering mail
"Now use same conditions - on a preparative scale!"

Peter Honey MARCH 1995

Anecdotal

With reference to an earlier article (I Cannot Tell a Lie - JUNE 1994), I was the miscreant responsible for seducing Dave Salter into putting chessmen on Alan Owen's bubble car. I still maintain that it was not such a heinous crime that Alan had to report it to the MoD Police. If he had spoken to any other organic chemists he would have known that acetone was not the best solvent to use on a Perspex hood!

Of the many characters I can recall one of the most memorable was Dr Donald Hodge. He always used to claim that he was the only sane person at ERDE, having a certificate to prove it. His oddest quirk of behaviour was to carry on a conversation he was having with you the last time you parted. I was on holiday one year in Yorkshire and my wife and I were sitting outside a pub one afternoon when up the road came Donald and his wife. Recognition was instantaneous but they didn't break step. As he swung past he continued our last argument with the telling phrase "What is more Simkins, you do not know anything about ballistics."

Bob Simkins DECEMBER 1995

A Christmas Tale

Christmas is traditionally a time for remembering and at this time I think back to how I spent one particular Christmas Day when I was a full time water warden. Ron Kerr and I worked 24 hour shifts, handing over at 8 am each day. On this occasion I took over and, after breakfast, had a leisurely cycle ride around North Site checking; Waterways Cottage gate, along the river bank to Newton's Pool, on to Fisher's Green point, down to Edmondsey Weir, then through the factory, down to Lower Island Weir - unlocking and relocking 3 sets of security gates on the way and then home.

I had just started my Christmas Lunch when the phone rang - message from King's Weir - "taken up two gates." That meant that I would have to go out and take up the equivalent of two gates to release the floodwater through the factory site. Up at Edmondsey Weir the water was already coming over the banks. I had to winch up the gate, turning a heavy iron handle 285 turns then a quick cycle ride down to Lower Island Weir to let the water past out of our level. Again, a heavy iron handle with 250 turns to get the gate up. Got home sweating and exhausted only to hear my wife say "King's Weir have taken up two more gates. So, back up to Edmondsey, another 285 turns, back to

Transport to New Hill

When I joined George Whitbread's Detonation Section (as it was then called) in 1959, the 'road' to New Hill was little more than a rough track through some dense vegetation which extended most of the way up to the bridge over the Cornmill Stream. Once over the bridge one was in a very different environment, with few trees and good road surfaces. As most of the Section's work involved explosions in one or other of the three semi-enclosed firing chambers, we were always having the job of carting the experimental paraphernalia from the labs in L149 up to whichever firing point was to be used. One of these firing points was in a structure about half-way up the track towards New Hill, the other two were on New Hill itself. For transport purposes the section was provided with a large and very heavy hand-cart, which had to be loaded and then manhandled up the track. It was a case of all hands to the cart, scientists and industrials alike pushed and pulled the beast in all weathers. Never was a cart so roundly cursed as that one. George knew very well how unpopular the thing was, and whenever he was directly involved in a firing he would join in the 'tractive' effort with the enormous gusto with which he did most things. He and the E Branch Superintendent (G K Adams) were also regularly badgering the admin. to obtain some better form of transport.

Eventually it became recognised in the higher reaches of the administration that the motor vehicle had been invented, and one never-to-be-forgotten day we were astounded to learn that we were to be allocated a Land Rover ! It was a pity that we weren't going to get a road to drive it on, but one can't have everything. There was a modicum of pruning carried out on the vegetation, and after all, a Land Rover is a cross-country vehicle, so we counted our blessings and certainly didn't complain. Our new pride and transport joy was equipped with the then still current 'trafficators', a pair of orange semaphore turning indicator arms which normally were tucked into the side of the vehicle, and which swung out to the horizontal when the driver indicated an intention to turn. Unfortunately, these devices were not self-cancelling, and it was easy to forget to retract them after completing a turning manoeuvre.

How We Got London Weighting

There was a common boundary of the South Site with the RSAF. Now, to be eligible for the additional "Outer London Weighting Allowance' at least a part of the establishment had to be within 12 miles of the King Charle's statue in London. RSAF just crept in but the RGPF did not and it rankled with us. Just after the war the then Minister paid us a visit, expressed a desire to meet the staff side, and wanted to know if there was any particular topic we wished to discuss. We replied - "London Weighting!" Tim Gravener, site safety officer and chairman of the IPCS and myself as chairman of the Whitley Committee were deputed. We made a 'recce' of the boundary fence with the RSAF and found a gate which was locked. We could not find out who held the key but the best case we could make was based on the fact that there was a gate which, theoretically, could be opened. Came the great day and we took the Minister to the boundary fence when, to our utter astonishment, we found the gate open - by whom we never did find out. The Minister needed no convincing that the RSAF and RGPF were one site and instructed his minions to implement London Weighting forthwith. It also meant that our conditioned hours were reduced from 44 to 42; but that's another story.

Jim Jeacocke MARCH 2002

Another Prank

This one was perpetrated by Eric Speller (sadly no longer with us) and myself on one of the guncotton acid factory foremen.

Standard issue for the foremen was an army greatcoat and, over time, the acid fumes gave the brass buttons a dark green patina. Thus, the foreman was almost perfectly camouflaged on his tour of the factory at night, as malefactors soon found out. Eric and I were in 'Dad's Army' and one night, armed with a button stick and tin of Brasso, we went into the foremen's changing room, found the appropriate coat and cleaned the top button at the front until it gleamed like a headlight. It was a moonlight night and the moonlight glinting on the button enabled him to be seen at 100 yards, much to the delight of the men.

The next morning, just as dawn was breaking, he came into the laboratory asking for a sample of nitrating acid saying " the acid made the button dark and an application would do so again". I tried to point out that it was the years of acid fume that had changed the colour of the buttons and that the application of fresh acid would either dissolve the button or burn a hole in his coat - It did both!

Jim Jeacocke JUNE 2002

Lower Island, not forgetting to unlock and re lock three sets of gates, another 250 turns then home again exhausted. During the evening another call to lift one of the two gates at the rear of the Abbey Church then down to Lower Island to take up another gate and home again to bed. At 3 am another call out to lift the second gate at the Abbey Church and another visit to Lower Island. While I was out I decided to cycle all round North Site to see if all was well and found a large raft of rubbish in the gates at Newton's Pool which had to be cleared. I just got started when the bulb in the overhead light blew so had to finish the job in the dark which was a bit risky. Home again at 5.30 am, cup of tea and back to bed. 7 am another call but, as all our gates were up could do no more. On Boxing Day had no calls at all but the day after I had to put down nearly all the gates again as the flood levels dropped. As I said at the beginning of this tale - A Christmas I will NEVER forget!.

George Savill DECEMBER 1996

Down to the Lea in ships

As well as undertaking the most esoteric and exacting scientific studies nearly all staff in my days were a very social bunch and partook in a wide range of leisure activities, may of them sponsored by the very active Social and Sports Club. I well remember the glorious days of the ERDE Sailing Club when we built 'Heron' sailing dinghies on the site of the North Site Surgery and launched them on local waters. We had practice sailing and a children's regatta on the Lea by Lea Road from 1961. The guiding lights were Bob (Commodore) Simkins, Eric Speller, Jack Mead and ICP Smith. It all started with a notice in the Powdermill Lane Office asking if someone would like to go sailing with the CSSA for a week. After an enthusiastic response an inaugural meeting was called by the Social & Sports Club to appoint an ERDE Sailing Club Committee. It duly became known as the Fisher's Green Sailing Club where we all worked with the incentive of larger waters on the old Ham River gravel pit. Happy Days!

'Gudge' Taylor JUNE 1997

Stationary - Stationery

Recent news of the death of Ron Lamb brought to mind his favourite quip when he was in charge of the Stationery Stores. On being asked by a member of staff "Do you keep stationery up here?" his reply was "No, we jig about a bit!" A standing joke was that the sign outside the building - erected at great expense said 'Stationary Stores' or, as we liked to say "The stores that do not move."

All this reminds me of an incident back in the early 1980s when I requested a new kettle element. On opening the pack the washer fell out and rolled under the first rack in a long, long row of free standing racks holding a multitude of forms, envelopes and other items. There must have been nearly 200 'Dexion' racks about six foot high and six foot wide placed back to back. Ron leant the first rack back so that I could retrieve the washer. Unfortunately the rack behind tipped forward, shooting the contents of the shelves into the next row. It didn't stop there. The second rack and the one next to it pushed over the three in the row behind and so and so on, just like a row of dominoes. The noise was tremendous, seemed to go on for ever and there was nothing we could do to stop it. In all some 100 racks ended up spread across the floor with the contents of hundreds of items completely mixed up. It took the stores staff a couple of weeks to put everything back in place and the racks were then securely bolted together - just in case I made a return visit. I submit, to this day, that it was entirely due to an unsafe design and in no way was I responsible. It didn't stop Ron telling everybody that it was all my fault!

Norman Paul DECEMBER 1997

A Correction and an Explanation

When the Chemical Inspectorate was bombed out of Woolwich Arsenal it was transferred to Waltham Abbey and ensconced in the 'RDX Labs' and there was much rivalry (not always friendly) between the two staffs. Contrary to the Editor's footnote in a recent issue the incident referred to concerned RDX/TNT when, after breaking a thermometer in the water bath one of the Inspectorate staff solemnly reported the presence of globules of mercury in the samples under examination. We therefore cooked him up a 'special' which tested our ingenuity as our experience of coating dead bluebottles with TNT was rather limited!

On the subject of TNT/RDX I recall the first batch that was made. If the TNT got too hot the viscosity fell and would not support the RDX leading to some separation during cooling. I was brought a sample and asked to find out how much TNT was at the bottom and RDX at the top. Saying "That's easy" I picked up a hacksaw and cut through the middle and was just about to say "Come back in half an hour" when I found he was halfway down the stairs. I never did tell him that the hacksaw had a special phosphor bronze blade!

Jim Jeacocke MARCH 2002

Guncotton and the Black Ditch

After nitration and stabilisation cotton linters were pulped and to do this they were suspended in water and, effectively, ground exceedingly small. This slurry was then moulded into cylinders, about the size of a large fruit can, in presses which extracted the water. The water went through filters and was discharged into the Black Ditch and thence to the river. The guncotton factory operated for the best part of 60 years and eventually, as part of the closure programme, the water was let out of the ditch which then dried up.

I was with the safety officer when of his danger building visitors came into to ask him if he could arrange for him to have a few sackfuls of the "lovely fine tilth" for his allotment. Knowing the history of Black Ditch he got a handful and proceeded to ignite it in his ash tray. The subsequent fire and residue suggested that the 'tilth' was about 50% guncotton - the microfines that had passed through the filters and deposited due to the sluggish flow. A rough calculation indicated several tons of guncotton in the bed and the ditch was re-flooded with great speed.

Jim Jeacocke MARCH 2002

The Black Hole - A Possible Explanation

I have been thinking about Jim Hawkins' article on the 'Black Hole' in Newton's Pool in the June 2001 Touchpaper and have a possible explanation.

All process water from the nitroglycerine plant ended up in Newton's Pool for many years and, during the war, was in continuous operation. NG is slightly soluble in water and process water tends to be warm. When this enters the cold water of the pool it would separate out and fall to the bottom. Therefore, each Saturday morning a small charge (probably a 1oz guncotton primer made in the Factory) was detonated in the pool. This was performed for many weeks, months (? years) with no apparent result; the charge being set off in roughly the same place each time. Then, one Saturday, for some reason, it was dropped off in a different place and fired. There was a mighty roar and Newton's Pool spread itself over the landscape. The subsequent enquiry suggested that there could have been a depression in the bottom of the pool into which NG had been gravitating for some time and that this was now much deeper!

Jim Jeacocke DECEMBER 2001

Better Guncotton ??

During the war, chemists of all persuasions were drafted into the factory to operate as shift chemists. I was working at night in the guncotton laboratory when two examiners from the Patent Office were drafted in to run the Guncotton Factory. They provided some company during the long night shift and had an apparently inexhaustible supply of stories about curious inventions which were the subject of patent applications. One such concerned in invention of a sponge rubber cuff (left or right handed) for use while eating winkles! One night we were discussing guncotton and the fact that our product contained 13.2% Nitrogen. One of the pair had read that it was theoretically possible to nitrate up to 14.6% and he decided to try it! He reasoned that the best way was to take 'standard' guncotton and re-nitrate it. In vain did I try to tell him that it didn't work like that but he wouldn't listen. I was only a lowly lab, assistant and he was a CHEMIST! A supply of guncotton was arranged, a dipping pan filled and the experiment started. The resulting decomposition produced enough brown fumes to fill the dipping house and stop all work. The 'chemist' and I were in the laboratory when Ernie Monk (the principal foreman) arrived. I learned a lot of new swear words that morning.

Jim Jeacocke MARCH 2002

A Rocket Trial or Another Fine Mess .....

This concerns a 'rocket motor incident' at Aberporth. Sea Dart had started acceptance trials but at the first guided firing the guidance had been lost on launch and the self-destruct button had to be pressed. Investigation found that the launch blast had displaced a waveguide component in the radar module. Modifications were made but further testing to prove the design were needed. Faced with the extra costs the project team approached ERDE E Branch asking for an explosive simulant to test the radar's blast resistance (we had previously produced a successful simulant for the Bloodhound Mk 2 after it too had blasted its launch control post and gone AWOL).

We set about designing the simulant; the waveform being very different to that from Bloodhound and it became clear that a propellant device was needed, rather than the detonating cords used before. P2 Branch came up with a device comprising two 'J' rounds screwed end to end (dubbed a 'JJ round') designed to stood vertically, nozzle upwards and clamped onto an angle iron framework. It was tested at ERDE and shown to generate the desired noise spectrum and we set off for Aberporth for the first trial firing. The Sea Dart platform comprised a reinforced concrete block on which the launcher and radar module was mounted and below deck was a control room housing the radar equipment (mimicking the proposed shipboard installation) A group of smartly dressed mid-ranking Naval officers turned up and were installed in the control room, the steel doors closed and the countdown proceeded (under the control of an RAE Range Controller in a separate cabin above and behind the platform with a good view of the proceedings. Instead of the expected smooth roar there was a loud explosion followed by the controller's voice "It's taken off - the bloody thing's taken off!" There was no sign of our JJ round - we found the remains later down on the foreshore. While we were recovering from the shock the steel door opened and out spilled a group of very disconcerted naval officers covered in paint flakes and spalled concrete dust. None was injured and they all took it in the finest traditions of the service. The sight we will never forget was when they arrived the next morning for the second trial, resplendent in immaculate uniforms - except that they had forsaken their caps in favour of smart, new, white, construction worker's hard hats!

Jim Hawkins JUNE 1998

Gun Trials at the Royal Arsenal

There was at one time a gun firing range at the southern end of the Royal Arsenal site at Woolwich but had long since passed into disuse when I started my career at the Chemical Inspectorate (also based at Woolwich) in 1950 but it was brought vividly to life for me many years later while browsing in the PERME library at Waltham Abbey. I found a large volume entitled 'History of the Royal Arsenal' and, thumbing through it, stumbled across an account of a most remarkable trial that took place in the time of the British Raj. It seems that the troops manning the north-west frontier in the Himalayan mountains were having difficulty manhandling gun carriages up the mountain passes. Someone had the bright idea of dispensing with the carriages, arguing that the gun might be mounted on the back of a mule and, moreover loaded and fired whilst so deployed. The war office decided to test its feasibility. Since a mule was not available a donkey was acquired and on the appointed day tethered at the end of the range. It proved to be quite placid, chewing contentedly on the grass whilst preparations were made. The animal stood obediently while the fuse was lit and the bombadier stepped back.

A group of generals and other senior officers had come to witness the event and were standing at a distance behind the gun, Unfortunately, no sooner had the soldier stepped back when the animal, finding itself unrestrained, decided that life had suddenly become most enjoyable and began bucking and frolicking and running around in celebration. As the muzzle waved around in a random pirouette the assembled brass threw themselves flat and awaited the inevitable. Unsurprisingly, when the gun fired, nobody was actually looking to see in which direction it was pointing. Nobody was hurt and the donkey was also unharmed but, despite a widespread search, the shot was never found.

Needless to say the idea was abandoned.

Jim Hawkins September 1998

The Black Hole in Newton's Pool

Newton's Pool was the E Branch facility for underwater explosive testing. At a maximum depth of 7m and with charges suspended at mid-depth it allowed the measurement of free-field shockwave parameters out to about 2m from the charge. The normal maximum charge weight was 8lb TNT equivalent. A spectacular plume of water, some 30m high would signal the test firing of a big charge and a powerful ground-borne thump would shake the control room on the poolside. One day when the button was pressed, nothing happened. The detonator had functioned but the booster had failed and fragments of the detonator case had severed the cords holding the charge which was now lying somewhere on the bottom. I had always wanted to explore the bottom of Newton's Pool - could this be my chance? In the summer months we often enjoyed a quick dip in the pool to cool ourselves off but I had always wanted to bring in my aqualung to have a proper look at the bottom. It took a bit of persuading George Whitbread and Griff (the Site Safety Officer) to agree but in the end they agreed, subject to my having a safety line attached. The water was surprisingly clear and the bottom was quite firm and smooth. In the middle however, things were different. I found a pit full of oozy black mud. The happy chirruping of my exhaled bubbles changed to a dull 'gloop, gloop' as I pushed into it. The underwater torch was useless and I was reduced to groping around blindly with my hands trying to locate any large lumps but there appeared to be no firm bottom - just an increasing viscosity with depth. I gave up any hope of finding anything, extricated myself from the mud and swam back to report my findings to George and Griff. They seemed relieved that they weren't going to have to report how one of the staff had drowned in Newton's Pool. So we were still left with 8lb of unexploded Poly-X somewhere in the bottom of the pool. It was decided to carry out a counter-mining operation and a very large charge was lowered into the bottom mud and detonated. But it wasn't half as much fun!

Jim Hawkins JUNE 2001

‘Good Old Charlie’

Charlie Carrington, who ran the Chemical & Glassware Stores, delighted in putting one over ‘Them Up There’ and proved useful to me on many occasions. I had my first lesson in guile from Percy Smith who ran the guncotton lab during the war. The lab had a board floor which was scrubbed every Saturday morning (yes, we worked then) but soon got dirty and made the job of picking up spilt guncotton difficult. I suggested that we get some linoleum for the floor and Percy agreed. The application was submitted and refused. Nothing daunted we marched to the Burning Ground and found some old pieces of lino which we distributed about the floor and Percy then applied to have the ‘worn out’ lino replaced. This application went by a different route, was agreed, and Charlie happily supplied us.

Many years later, Tom Pearson, the fire chief, had a problem. If the brigade spotted a leak in a hose they circled it with an indelible pen. He wasn’t allowed to order them as the stores stocked ‘chinagraph’ wax pencils which were virtually impossible to use on a wet hose. I arranged with Charlie for Tom to put in a request for ‘6 Hose Makers’ which Charlie would annotate as ‘Not a stock item, try local supplier’. Armed with this Tom went to the cash office, demanded two shillings out of petty cash and went to the local stationers and bought 6 indelible pencils.

Jim Jeacocke MARCH 2001

‘Putting One Over On Charlie’

You couldn’t always get anything you wanted from Charlie Carrington and getting replacement glass cloths, used for drying beakers etc., from him was not easy. To get a new one you had to take the remains of the old one back. Of course we tried to get more by tearing the old ones in half and asking for two but Charlie’s eagle eye would spot that they were really just one cloth and that’s all you got.

I did manage to fool him on one occasion when I tore an old cloth into four ragged bits and dyed three of them in a variety of pale colours. Of course it may be that he was just having an off-day but I did manage to get four brand new cloths on that occasion.

Norman Paul MARCH 2001

More Trials (and Tribulations!)

This unusual trial was to measure the underwater shockwave performance of a new Poly-X explosive formulation at charge sizes up to 64lb which was too big to do at the Newton’s Pool facility at Waltham Abbey. The work was either farmed out to NCRE at Rosyth or making use of AUWE’s Mining Trials Establishment. The latter was located at St.Thomas’ Head (near Weston-Super-Mare) where the tidal range in Spring is an exceptional 40 foot (the second highest in the world). At the planning meetings with AUWE we had been offered (and gratefully accepted) the services of a Navy Trials team complete with a Tank Landing Craft, a Gemini inflatable and sundry bits of Naval equipment. Their presence was to prove more fortunate than we could have imagined. The trial was planned to coincide with the Spring tides so that charges could be fired at mid-water when the depth was some 40 feet. Spring tide maxima and minima occur around noon or midnight so that we were going to have to lay out the charge, transducers and rigging on the beach at low tide (in this case at midnight!), wait for high water at midday the following morning before firing. The rigging would then be supporting the charges and transducers at mid-water. The planning of this complicated system of anchors, floats, trots and rigging was done (very competently) by the Navy Trials Team and the day before the trial they strung it all together on the beach and we laid out our transducer cables and attached them to the rigging at appropriate points. After an exhausting day preparing charges and setting up and testing the recording electronics we stored the charges in the magazine, locked up and left to snatch a few hours rest before returning for the midnight operations.

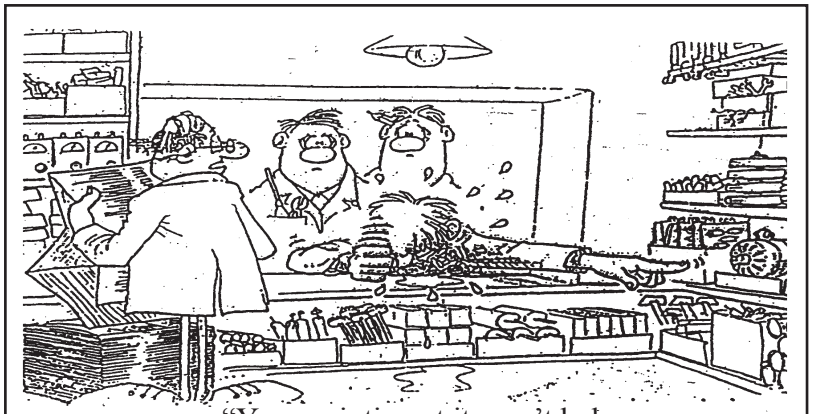
At the pre-arranged time we returned and waited for the MTE resident to arrive (an MoD Scientific Assistant who had the magazine key) - and waited - and waited. It soon became clear that we were not going to have enough time to lay out the charges before the tide rose unless something was done quickly. The ‘something’ was provided by the Navy. They first attacked the padlock with a hacksaw but it was soon clear that the hardened steel hasp would not yield. Then, from a truck, they produced an oxy-acetylene cutter and after a hurried search for bits of steel plate to prevent sparks getting through the cracks in the door, had the padlock off in no time. With the fast incoming tide lapping over our wellies we were just able to complete setting the charges. We found another padlock, secured the magazine and retired

for a few hours sleep.
The next morning we were treated to an object lesson in skilled boat handling as the Navy checked the layout was sitting correctly. The charges were successfully fired and recordings made. After packing up we all celebrated in a local hostelry where the Navy Team demonstrated an ability to consume large quantities of the local scrumpy that made the locals - and us - aghast.
Over the years the Detonation Section (and its successor; Explosives Performance Section) was involved in numerous trials at a variety of Service Establishments and we soon formed definite impressions of the relative merits of the three Services. Not for nothing was the Royal Navy known as the Senior Service; without exception we found them intelligent, resourceful, friendly and helpful. The Royal Airforce were also usually helpful although some of the wartime swashbuckling attitudes were still apparent. As for the Army; the least said the better. Their prime consideration seemed always to be to find out our equivalent Army ranks and to be sure everything was done 'by the book'; with a lot of strutting around with pace sticks thrown in for good measure.
Jim Hawkins SEPTEMBER 1999

Yet More Rocketry

Towards the end of the Second World War, Les Cole and I were a few minutes late leaving work in the Main Lab and, as we cycled over the bridge by the 'Searcher's Box', we heard the sonic boom of a V2 rocket. It had been raining hard and outside the Stores there was a deep puddle into which a large piece of red-hot metal had plunged causing it to vanish in a cloud of steam. We said to each other "Must be close" but didn't know how close until we turned out of Powdermill Lane towards Waltham Cross. There, in the middle of the road between 70 Highbridge Street (HQ of the 56 Battalion Essex Regiment Home Guard) and the Ordnance Arms pub (an alternative HQ) was a very large hole gushing water and emitting streaks of flame. We looked at each other without speaking. We knew that if we had left on time that was exactly where we would have been. The front of the Ordnance Arms had vanished and we noticed that the roof was resting on the footboard of a bed which was protesting loudly at the unwelcome load. It was well known that Mrs May, the landlady, retired to bed after mid-day closing to refresh herself for the rigours of the evening, so we decided to investigate and entered what was left of the bar. The stairs were visible but the handrail and bannisters were gone so we called out and

Trouble In Store - cartoon JUNE 1997



"Your pointing at it won't help.
The computer record shows none in stock!"

Charlie Carrington in the North Site Chemical Stores was always most helpful, provided you didn't upset him, or his tea break and stayed the right side of his 'barrier' unless invited over. In the days of real research my Superintendent, Ray Williams, gave me the job of making potassium nitroform (a tricky process). In the pure state it was a white crystalline solid when completely dry and had to be kept in a desiccator over phosphorous pentoxide desiccant. Charlie was 'Out of Stock' at the time and 'minimum order' requirements ruled. "Don't blame me" he said "You get on to Them Up There. I can't order in until the last bottle has gone ." It had so I phoned 'Them Up There and was told "Can't be done, this month's order has gone, you'll have to wait." After trying other labs with no success (they weren't going to let go of any as they would then be in the same state), something snapped. I phoned "Them Up There" again, no joy so I facetiously required "What would happen if the Stationery Office ran out of ink". This brought an immediate response from the Head of Them Up There who phoned My Head to complain that I had made one of his girls cry! I was asked to explain myself. Support from MY Head was forthcoming and BDH sent a bottle by express overnight. Charlie seemed to get what he wanted after that if you mentioned that you were working on something unstable and I was in his good books for ever after. Two weeks later, after a brief period out of the desiccator the unstable compound fumed off violently, blew the stopper out of the bottle which hit one of my colleagues on the head and turned the inside of the fume cupboard a bright orange. I wasn't asked to make a second batch.
Geoff Howell DECEMBER 2000

More Trouble with Stock Takers

Previous articles regarding the iniquitous stock takers seems to have struck a deep chord in the memories of ex-workers so here are just two more:

Distillation Equipment

Almost every lab had some form of disillation equipment and we were frequently visited by Customs & Excise to check we weren't making illegal hooch. In L159 we had attached to the wall a Manesty still for the production of distilled water. One day along came a stock taker proudly bearing a newly issued Dymotape labelling machine to replace the old pressed aluminium label with a plastic one which he stuck on the hot boiler. He was disconcerted to see the embossed numbers immediately disappear, Undeterred he tried again and stuck it on the wall next to the still. About a year later the water jacket rusted through and, deciding it was beyond repair, we scrapped it and took it of the wall but forgot to tell Admin. It didn't matter as for several years the stock taker came along and was happy to record the WA number on the now blank wall!

Dave Salter DECEMBER 2000

All That Glistens ...

As organic chemists we were obsessed with the idea of melting point as a criterion of purity. The trouble with modern high explosives such as RDX and HMX is that they decompose rather than melt. One way to determine the melting point is to use a 'Bertholet Bar' - a metal bar heated at one end producing a temperature gradient along the bar on which crystals were sprinkled and observing the point (i.e. temperature) on the bar gave an instantaneous figure, The bar was made of copper and the possibility of a reaction with the metal arose. We proposed a gold plated bar that Johnson-Mathey were willing to make. It all worked fine except the bar took a long time to heat up so we left it on all the time. Trouble arose when the stock taker turned up to record such an obvious asset as a gold plated bar. We watched, so sympathetically as he attempted to punch a WA number on the red hot bar. We eventually reached an agreement with Admin. that a permanently red hot bar was unlikely to wander. I wonder what happened to our golden bar when Waltham Abbey finally closed?

Bob Simkins DECEMBER 2000

ascertained that she was indeed upstairs and apparently uninjured. We said that we would come up to assist her. Very gingerly, and singly, keeping close to the wall, we climbed the stairs and found Mrs May still in the bed, which was complaining more and more about the attentions of the roof. We suggested it would be a good idea if we all left the premises with all possible speed, only to be told "You can't rescue me yet. I haven't got my knickers on!" We, therefore, had to retire while the necessary garment was located and installed, after which we had some difficulty in persuading her down the somewhat rickety stairs and out into the road, Shortly after, the bed gave up the unequal struggle.

Jim Jeacocke SEPTEMBER 1999

Nothing New Under The Sun

'Old timers' may remember Ernie Monk, the principal foreman of the GunCotton factory, whose length of service must be unrivalled. He was taken on as a 'boy', exceptionally at 14 after his father was killed in the NG Plant explosion on South Site before the turn of the 19th century.

I was working in the Guncotton Lab at the outbreak of war and when someone was needed to take the guncotton VM test on a Saturday afternoon I volunteered. Ernie came in for the results and, in my youthful brashness, I told him how important accurate results were to the making of good cordite. Ernie listened and then told me how Waltham Abbey cordite was the world recognised standard and how, in the early days they checked if it was dry enough to use. In his own words: "We had an iron box made up with a loose fitting lid with a hole in it. We put a handful of 'cotton' in the bottom, replaced the lid, then went to the boiler house, got an ember on a shovel and popped it in the hole. If we got a cloud of steam and brown fumes it wasn't dry enough. If the lid, and sometimes the box, took off, we knew it was ready" (So much for Health & Safety at Work!)

The point of this tale is that when I was a representative of the European Explosives Industry in the UN Group of Experts on the Transport of Dangerous Goods, meeting in Geneva in 1990, the German delegate told of a new test they had devised consisting of "an iron box with a loose fitting lid ...." They were somewhat chastened when I told them that they were at least 100 years too late!

Jim Jeacocke SEPTEMBER 1999

Still Nothing New Under The Sun

Those familiar with the batch manufacture of nitroglycerine will recognise what I mean when I mention the "NG Stool." Batch nitration consisted of spraying glycerol into a large vat of nitrating acid while stirring and cooling. The temperature had to be closely monitored and if it rose above a predetermined level the batch was 'drowned' by dumping into a large tank of water underneath.

Watching the thermometer for 8 hours a day was rather soporific and in the early days there was a tendency to 'nod off'. Since this could lead to a dangerous event the operator was provided with a one-legged stool. If he 'nodded-off' he 'fell-off'.

When Alfred Nobel started his factory at Ardeer in Scotland in the 1880s the "NG stool' was installed and ever since then it has tacitly implied that it was their idea. However, in my researches into gunpowder for a paper, given at the centenary commemoration of Nobel's death, I discovered that the concept is 2-3 hundred years older. Before charcoal burning was mechanised the burner would make a wigwam of wood, cover it with clods of turf and set light to it. If fire broke through the wood would burn rather than char. To keep an eye on the process the burner would set a log vertically in the ground to sit on. If he 'nodded-off' he 'fell-off'. So much for new ideas!

Jim Jeacocke SEPTEMBER 1999

A Tale in Three Parts

PART 1. I won't say that there was a black market (or even grey) market in Waltham Abbey but George Smith, one of the seniors in the Main Lab, who also had a sweetshop in Farm Hill Road, could obtain things that were otherwise difficult. After VE Day when things were marginally easier I fancied a goose for Christmas. Early in the year I approached George to see if one of his farmer friends would run a couple of goslings for me. "Right Oh boy" (everyone under 30 was a boy to George) and there the matter rested until just before Christmas Eve. "I'll be bringing your geese in tomorrow" was the message from George and I made preliminary arrangements. The next morning arrived but instead of two nicely plucked, oven-ready geese they were just as they had been 'on the hoof' except that they were now dead.

PART 2. It had been decide to build a mono-propellant facility and by their nature they are potential explosives and an explosion in a motor might transfer to the header tank. A 'detonation trap' was required for the fuel line and I was given the job. Up at the top end of North Site was a large black wooden hut adjacent to a brick splinter proof shelter. One was an ideal workshop and the other suitable as a bomb proof. I had working with me a lab worker who was a butcher by trade and to whom I explained my problem, "Easy, we'll go to the black hut at lunchtime and I'll see to them. Thus, armed with sharp knife and ball of string (and the geese) we hied off to the top end. My advice to anyone contemplating plucking a goose is the same as Mr Punch's on marriage - don't The butcher worked with amazing speed and very soon, the geese looking very presentable, we set about cleaning up. Unfortunately the only places we couldn't reach were the roof trusses and for long after that - certainly until I left the Group - whenever we put on a demonstration, goose down would float down from the roof. When questioned I would point to the ventilation louvres and blame the pigeons. No one seemed to spot the difference between goose down and pigeon feathers.

PART 3. And the 'detonation trap'? A few weeks after it had been installed I was transferred to another Section - to run the mono-propellant proof stand.

(P.S. The goose was lovely)

Jim Jeacocke SEPTEMBER 2000

Trouble with Stock Takers 1

I had ordered a new semi-micro balance and after due negotiations it was set up in our balance room. The next day the stock taker turned up to mark it with the appropriate WA number. Before we could stop him he took a set of punches and start to mark the number on the base. It was made of black glass and shattered at the first blow. Several months later a replacement was delivered and, sure enough, the next day a stock taker turned and assured us he had learned his lesson and would not attack the glass base. We watched in amazement and then, unbelievable horror as he proceeded to punch the number on the delicate gold foil cross beam - too late! Several months later a second replacement arrived (heaven knows how the books were balanced) followed in due course by the stock taker. This time he proposed to stick a plastic label with the number on the base. When he had gone we took the label off and cleaned the base with chloroform. I punched out the number on the lab punch and it was duly kept in a safe place against the annual stock inspection - honour all round.

Bob Simkins SEPTEMBER 2000

Trouble with Stock Takers 2

I too had my troubles with stock takers. The first time was over platinum crucibles which, being very valuable, were checked every year. It wasn't just to see that none were missing but that no one had 'trimmed' any metal off and so they were weighed. I showed him how to use the automatic balance and he recorded all the weights. The next year he repeated the exercise and complained that there was a weight difference on virtually all the crucibles. I had to explain that he had weighed them to four decimal places and that a loss of up to 0.0005 g was hardly significant, bearing in mind that these were constantly in use, being heated up to red hot temperatures and requiring some cleaning on occasions. The difference amounted to about 0.001% loss on a 60 g crucible. I don't think he was ever really satisfied with the explanation.

Of course they were a fine body of chaps and only doing their job; but sometimes with excessive zeal and often without any appreciation of their actions.

Norman Paul SEPTEMBER 2000

Another Rocket Motor Story

I should perhaps have concluded my earlier story of the Aberporth rocket motors with the important detail that the following firings of our simulant motors were entirely successful. Moreover, detailed examination of the remains of the first round revealed a pre-existing metallurgical flaw in the coupling ring which was deemed to have caused the failure.

And now for the story of a trial at P&EE Shoeburyness - this time of a genuine and quite large solid propellant rocket motor, the purpose of the trial being to observe the effect of attacking the motor with a small shaped charge. The received wisdom of the vulnerability experts was that a moderately energetic deflagration would ensue and that only a small air blast was to be expected. The Detonation Section was to measure and record the air blast waveforms at a number of points around the site. The motor was mounted horizontally some 2m above ground on a steel framework. The air blast gauges were mounted 2m above ground at a range of distances out to about 20m from the motor.

We took cover in a caravan located some distance away behind a blast wall. A moderately energetic deflagration it most certainly was not. Instead there was the most almighty thunderclap of an explosion. The caravan rocked wildly, one of the strip lights was jerked of the ceiling and just missed someone's head.

After a suitable wait for all the debris to have landed we emerged to an incredible sight. Where the rocket motor had stood was a wide shallow crater in the ground. Of the motor itself and stand there was no sign - and no sign of our blast gauges! The site resembled nothing more than one of a large meteorite impact in the Australian outback. After much searching we eventually found most of the blast gauges buried under varying depths of earth and in a very sorry state.

Needless to say, all the air blast recordings had gone way off scale even though we had set some channels to an appreciably higher level in the case the event was more energetic than the experts had predicted.

After that I read all vulnerability assessments with a jaundiced eye.

Jim Hawkins DECEMBER 1999

And Another Trial

Subsequent to the trials that Jim Hawkins attended, NCRE decided that they needed to carry out a trial to determine the effect of the new Poly-X explosive against an actual target. Permission was given for the target to be an old destroyer, with the proviso that it must not be sunk! I was given the job of making a 70lb charge and then attending the trial to act as safety officer, since the trial was to take place near the Rosyth Dockyard in the Firth of Forth and also because Poly-X had no safety certificate. The charge, suitable primed, was despatched to NCRE and I went by sleeper train to Glagow and thence by local train to Inverkeithing, the nearest station to Rosyth. There was a car, with Wren driver, waiting for me and I was driven to a landing stage and then by boat to a depot ship close to the Forth Bridge and the destroyer. All instrumentation was in place and the recording electronics had been tested by the navy trials team. It only remained for the charge to be located at the predetermined spot, where its detonation would deflect the plates of the destroyer but not (hopefully) sink it.

The charge was duly produced and with myself, lowered into a small boat and taken to where an oil drum, with red flag marker was floating. The drum was attached to each end of the destroyer by cables of equal length and the charge, with detonator in place, gently lowered so that it was suspended at a predetermined depth on another cable - all being expertly carried out by a CPO. A third cable was attached to the drum and this was then towed out by motor boat till all three cables were taut and the charge accurately located. By then everybody had returned to the depot ship and the charge was duly detonated. A great column of water rose up followed by huge bubbles. The man in the motor boat immediately let go of the tiller, grabbed a large landing net and, steering with his feet, was soon busy scooping up stunned fish that had come to the surface. Meanwhile other members of the team had been busy preparing potatoes and we all had a very enjoyable and very welcome lunch of fresh fish and chips. Another tribute to naval efficiency - incidentally; the destroyer didn't sink!

Dick Doe DECEMBER 1999

Explosives Testing!

The sad passing of George Whitbread will have stirred many memories of that remarkable man, not least in those who had the privilege of serving under him. One of my earliest memories was of an event shortly after my joining the Detonation Section when George was Section Leader.

One of the ERDE chemists (Dr Batty) had synthesised a new organic liquid whose structure promised a useful high explosive performance but at the cost of a sensitivity that would almost certainly be very high, My job was to devise an experimental setup using electronic timing to determine the detonation velocity using only a 50 ml sample.

George always took everyone's safety to heart and would often undertake any hazardous procedure himself. In this case George decreed that he alone would undertake the transfer of the liquid into the setup which was erected inside a large explosion chamber - a massive steel enclosure, 2m long, 1m deep and 1m high with inch thick explosion proof windows and heavy sliding doors. It could withstand the detonation of 50g of high explosive. I was ordered to wait in the corridor outside whilst the transfer was made. However, I couldn't resist the temptation to look through a window to watch. To my horror I saw that he had actually climbed inside the chamber and was kneeling down with his face inches above the receptacle. Moreover, because the light was poor he was holding a torch between his teeth. The transfer could only have taken a few minutes but it seemed like an eternity and my mouth was dry by the time he emerged.

When the preparations were completed the warning hooter was sounded, the charge fired and the experiment completed successfully. But for a long time after that I had the nightmarish vision of the sample detonating prematurely and of my having to drag his body out of the chamber and finding the back end of a bloody torch sticking out from the back of his head!

As Jim Jeacocke said of that era, so much for Health & Safety at Work!

Jim Hawkins JUNE 2000

The Day the Lea Turned Green

During experimental work on flashless propellants it was decided to dye the different compositions making it easier to identify them.. The first was dyed green and in the Main Lab we made up alcohol solutions of Malachite Green in aliquots sufficient for each batch. Subsequent compositions were dyed pink etc. No one told us that the experiments had finished and a number of aliquots accumulated on a shelf in the extraction room. In the interim between closing RGPF and the opening of CRDD we busied ourselves clearing out a lot of redundant materials - among them were the solutions of green dye disposed of in the time honoured manner. It was some time later that we heard reports of a mysterious green stretch of the Lea which had been seen moving slowly down towards the Thames. Of course we never owned up!

Jim Jeacocke MARCH 2000

The Bicycle Shed Syndrome

Readers will be familiar with this; where a vast project goes through 'on the nod' but much time is spent on trivia. Thus, in any large organisation a multi-million pound expansion is agreed with little or no discussion but hours are spent on arguing about what colour the bike sheds should be painted.

Back in the days before pocket calculators, tables of logarithms were *de rigeur* and as we were setting up the 'Sensitiveness Group' in L149 I decided to put a set of log tables in each of the laboratories so that there always a set to hand and saving on arguments as to who'd pinched whose log tables. From laboratory suppliers one could obtain 'Log Tables for the Use of Students', price one penny. I ordered 12 copies costing one shilling (we're talking old money here) which I thought, considering the overall cost of setting up L149, as quite reasonable. Nothing happened for weeks until one day I was summoned (yes- that is right word) to see the Education Officer who had before him a file some two inches thick (approx. 50mm). Apparently my innocent request had caused great flutterings in high places and questions had been asked as to whether the Department could afford to subsidise part-time students at a penny a time. I was asked to make a written submission justifying my request. I explained my reasoning and the Education Officer heaved a sigh of relief, closed the file and sent the order through. By this time the price had doubled to twopence per copy and the total cost was two shillings. What the hidden cost in administrative manpower was we will never know.

Jim Jeacocke JUNE 2000

Even More Trials (and Tribulations!)

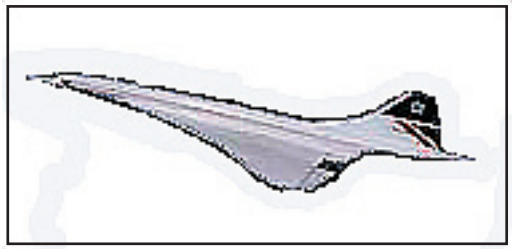
Jim Hawkins account of underwater trials at St.Thoms's Head brought back memories of my own. Even though the trials took place in the early '70s I can picture them as if they were yesterday. The ERDE team consisted of Jim Hawkins, Jeff Munns and myself and, as it was summertime we thought we would dispense with the usual B&B and rented caravans at nearby Burnham on Sea. The overnight allowance would just about cover the cost and we could take our respective spouses and offspring to enjoy the Somerset air. So it was that a certain caravan site became a temporary Waltham Abbey Centre of Excellence - but more of that later. The trials site was approached via a track through a farmyard with the farmer acting as unofficial security guard. If his dogs liked the looks of you, you were in. If not it was a sharp nip on the ankles! The control point was high up above the Bristol Channel and our recording equipment was set up (4 double beam Tetronix oscilloscopes plus sundry bits of kit). Power was by a large old diesel generator which played 'old harry' with the electronics until we sorted it out. The object of the exercise was to record underwater explosive pressure profiles using transducers connected to the scopes via very long cables which snaked out over the sand and up the head to our control room. As Jim has already said the Navy lads were very keen - sometimes too keen - they didn't always appreciate that there is a correct way to reel cables. Do it right and no problems; do it wrong and you end up with an unholy tangle as happened more than once causing Jeff to tear his hair and curse the Queen's Navy.

On one occasion, whilst waiting for high tide and taking the opportunity to catch up with some sleep in my car I was vaguely aware of a gentle rocking motion. Had I floated out to sea? No; we were surrounded by the farmer's herd of cattle and the rocking was caused by a cow scratching it's backside on my rear bumper. All very amusing until we realised that they were steadily munching their ways towards our cables. We managed to head them off eventually - big things cows! - with only minor damage to our kit.

Perhaps my most enduring memory was one early morning. Jeff and I knocked on Jim's caravan door. No response. Louder knocks and yells, still no response. High tide was at dawn so we set off without him and were about to push the plunger when up rolls Jim, "Sorry lads, overslept." Personally I blamed the scrumpy!

Eric Kendrew DECEMBER 1999

Sonic Bang trials (a la Concorde)



One of the more unusual jobs that fell to the Detonation Section when Concorde was still a designer's dream was the development of an explosive simulation of a sonic bang that supersonic aircraft were know to produce. At the time Britain had just one supersonic plane (the English Electric Lightning) and supersonic flights over land were rarely permitted. There was a clear need to investigate the effect of supersonic bangs and we were asked by C H E Warren of the Royal Aircraft Establishment if we might be able to produce some sort of explosive device with sufficiently similar signature. The aim was to produce an 'N' shaped wave with a duration of about 100ms and a peak amplitude of a few Pascals - a waveform far removed from anything known to air blast experts. A few experiments with long linear charges (using detonating cord) gave us some waveforms to consider and from these John Hicks (Section Leader) with remarkable hindsight showed us how an N-wave might be achieved, Subsequent rapid development confirmed the basic soundness of the concept and we soon had a respectable simulant for the bang generated by a Lightning. A considerably larger version followed intended to simulate the Concorde bang.

The Royal Aircraft Establishment were also developing a device to simulate sonic bangs but their aim was more limited in spatial terms, as their concern was to test small objects. They came up with a device like a very large version of the 'His Master's Voice' horn called 'The Blunderbuss'. A famous Welsh wit in the RAE team (D Webb) used to delight in explaining to visitors that it was really an acronym standing for 'Bloody Loud Ultra Noisy Device Emitting Realistic Bangs Using Simple Systems'!

There followed many trials by both establishments to test and make use of our simulants.

Jim Hawkins MARCH 2000

Damage Limitation

E Branch maintained three large experimental firing chambers, each able to withstand the detonation of several kilos of high explosive. The noise from these firings could be heard up to several miles around Waltham Abbey although the intensities depended markedly on the weather conditions. Air blast studies such as those of the sonic bang simulation had to be done in the open air on New Hill and these too contributed to the far field noise.

There were, not unnaturally, fairly frequent complaints received from the public about noise and alleged damage, The Lea Valley nurseries were particularly vociferous complainers and we went to great lengths to minimise the sound pressure levels in their particular directions. Some of these nurseries were well maintained while others were close to what 'loss adjusters' know as "dilapidation awaiting an insured catastrophe'. Whilst many complaints may have been deserving of serious concern one could say that others may well merited some cynicism. The owners of these were always submitting claims for replacement of shattered glazing panels. One of Bert Dunwoody's regular jobs was to drive out to one or other of the nurseries and make sound level measurements when firings occurred. I don't think Bert ever witnessed a panel breaking!

The local vicar also began to wonder about the effects of firings on his Abbey Church and it was deemed politic to asses the effects. Ground vibration rather than an air blast was the predominant concern, Fortunately the Detonation Section had acquired a seismometer in connection with other studies. This was mounted on one of the massive interior stone walls and its output monitored. Many measurements were made and we were easily able to identify the structural vibrations induced by ERDE firings. To put them in perspective we also made measurements as heavy lorries were passing and were relieved to find that these were considerably larger than those caused by our firings.

The really big surprise came when someone suggested we measure the effect of ringing the Abbey bells. The results were staggering as the structural vibrations were so much larger than anything else and we were able to inform the vicar that if he wanted his Abbey to last another few hundred years the best thing he could do was to stop ringing the bells!

Jim Hawkins MARCH 2000

ROYAL
GUNPOWDER
MILLS
WALTHAM ABBEY

Published by the Friends Association of the
Royal Gunpowder Mills, Waltham Abbey
June 2006

WOODLAND TREES
OF THE
ROYAL GUNPOWDER MILLS
WALTHAM ABBEY

Norman Paul

CONTENTS

AFTERWORD

When production ceased in 1945 and the site became a Research and Development Establishment, little use was made of the northern wooded part which was left, largely, to run wild. Maintenance was restricted to keeping clear the paths, roadways and the few buildings still in use.

Following the final closure of the Establishment in 1991 nature was left to its own devices until decontamination and initial work started some years later. Many intrusive trees (mainly self-seeded sycamore) and over-crowded areas were cleared and replanted; mainly with willow and alder.

A woodland management scheme was instituted in the mid 1900's and will continue in order that the woodland is preserved in an healthy condition.

WEEPING ASH

Fraxinus excelsior 'pendula'

This unusual Weeping Ash can be seen at the southernmost tip of the Island Site by the canal bridge.

Similar in most respects to the common ash except in its weeping habit with long, drooping branches sweeping almost to the ground.

This specimen has been pruned on the bridge side but on the canal side the branches reach down to the water.

THE ROYAL GUNPOWDER MILLS WOODLAND

INTRODUCTION

This booklet details the development of the woodland on the Waltham Abbey site and shows the changing influence of the industrial nature on the site over the past 300 years. In its present state the woodland provides a natural habitat for a diverse wildlife population.

Lea Valley

After the last Ice Age, some 8-10,000 years ago, the floor of the Lea Valley was undoubtedly covered in marshy woodland. However, early human settlers would soon have discovered that the rich soils, moderate climate and plentiful supply of wood and water made the valley sides a good place to live. The woodland of the valley floor would steadily have been cleared and replaced for the most part by meadows and marshes. The area was kept open by hay cutting and grazing by cattle, horses and sheep.

River Lea

Rather than follow a single deep channel the river would have been made up of number of different channels that constantly changed their route over the years. During the wet months of the year there would be regular flooding. Although the nutrients in the silt that were washed down with the floodwater maintained the richness, ditches were dug to ensure that the water was able to drain off as soon as the river level dropped. This flooding continued to be a feature of the valley, particularly in the area around Waltham Abbey, right up to the middle of the twentieth century when a comprehensive flood relief scheme for the Lea Valley was completed. This has significantly lowered the natural water table on the site but without any apparent detriment to the trees.

Norman Paul
Friends Association

Development of the Woodland

With the use of the land for the manufacture of gunpowder the effect of this industrialisation has had a further marked effect on the area and variety of trees on the site. In the 18th century the northern parts of the site, that were not used in connection with gunpowder manufacture, were densely planted with **Alder**, **Crack Willow** and **Alder Buckthorn**. Once they became established, these were regularly coppiced (cut back to just above ground level every 15 years or so) over a period of 150 years to make high quality charcoal - one of the principal ingredients of gunpowder. Coppicing stopped more than 50 years ago and the trees have now grown up and matured into woodland with a high canopy.

The woodland comprises an area of nearly 120 acres, most of which is designated by English Nature as a site of special scientific importance (SSI). The new woodland management plan proposes that about one fifth of the woodland will be brought back into a coppice regime. One of the first (experimental) areas to be recut is behind the Moulding House. Despite their considerable size the trees have responded reasonably well and are sending out new growth from the stumps and further coppicing will take place in the future.

Other trees within the woodland that are worthy of note are **Ash**, **Poplar hybrids**, **Sycamore**, **Walnut** and **Common Hawthorn**. Also included is the **Elder** (or Elderberry) which is generally found as a large shrub or small tree.

The woodland is a haven for large numbers of both flora and fauna. Many species of birds are resident; the site is home to the largest heronry in Essex and the alder trees attract flocks of over wintering siskins. There are two herds of deer (fallow and muntjac), foxes badgers and, more recently, otters.

Outside the main woodland there are other notable trees in the southern open area which are listed in the second part of this publication.

OAK

Quercus robur

The English or Common Oak is a basic part of the English countryside and is used in major construction work, panelling and furniture.

The shape can vary greatly depending on its habitat. A lone oak usually has a short, broad base, spreading into many sizeable branches to form a large rounded crown. Close grown specimens may well have long straight trunks with very little branching. Maximum height is generally around 35 m.

The leaves are alternate and deeply lobed. The fruit (acorns) are often in pairs on long stalks.

Very few oaks are present on the site but two close grown trees can be seen on the canal bank opposite the main Exhibition Hall. Recently some have been planted on the most easterly New Hill area and a number planted in the shape of an anchor to commemorate Nelson's victory at Trafalgar to the north of Queens Mead behind the Main Lab.

LONDON PLANE
Platanus acerifolia

A single large specimen of the London Plane is growing on the Island Site, immediately to the north of the old Mixing House and Saltpetre Store.
Many London Planes were planted over 200 years ago and are still surviving in the squares of London. It is a fast growing hybrid between the Western, or American, Plane and the Oriental Plane, first described in 1670 from a specimen at the Botanic Gardens at Oxford. It is very pollution resistant with its shiny leaves easily washed by rain. The bark is shed regularly in patches which prevents grime from accumulating and brings about the familiar mottled appearance,
The leaves are similar to the Sycamore but grow alternately instead of in opposing pairs. Male and female flowers grow on the same tree, either singly or in clusters. It bears bobble-like fruit which remain on the tree throughout the winter.

ALDER
Alnus glutinosa

Alders represent the bulk of the trees on the site. Despite being broad-leafed deciduous trees they bear small cones. The leaves are unusual in that they are either rounded or have a notch at the tip. The leaves, twigs and bark are unpalatable with the result that unlike many other trees and shrubs they are not eaten by deer or rabbits. They regenerate very easily from seed in damp, open conditions, as can be seen around the acid factory and the corning mill. They naturally occur in damp conditions but there is a disease called Phytophthora or Alder Blight that is spreading across the country and occurs on the site and seems to affect trees with their roots actually in water. This disease is invariably fatal to the tree, is closely related to that which caused the Great Irish Famines (Potato Blight). The retention of such a large area of alder trees is therefore of great importance. Alder is a fairly unique tree in that its roots contain nodules of nitrogen fixing bacteria, similar to members of the Pea family and is often planted to enrich poor soils.

ALDER BUCKTHORN

Rhamnus frangula alnus

A large shrub (which is not related to Alder!), also known as 'Black Dogwood' although it is not botanically a Dogwood either.
The shiny leaves are alternate and untoothed with 7-9 pairs of parallel veins. Greenish flowers appear in early summer which turn to red and purple.
It used to grow more extensively on the site and often grows in the same sort of area as Alder but, as the other trees grew up it was shaded out. A large block has now been replanted on the east side of the Burning Ground. Apart from needing plenty of light it is susceptible to browsing by the deer and during its early life needs to be protected with a tree-guard. It is the principal food plant of the caterpillars of the Brimstone butterfly. Its charcoal was much sought after as an ingredient for making gunpowder fuses because of its even, slow-burning properties.

LOMBARDY POPLAR

Populus nigra 'Italica'

Also on the site are two Lombardy Poplars on the eastern edge adjacent to the café. These were probably planted purely for decorative and windbreak reasons.
Easily recognised by the long narrow outline with all its branches sweeping almost vertically upwards. It bears alternate, hairless leaves which are roughly triangular. A fast growing tree reaching a height of 30 m.
Early in the 18th century, cuttings of a male tree were brought from Lombardy, in northern Italy, giving rise to its name. It is now thought to be originally a native of Asia.
The Lombardy Poplar is not affected by soot and smoke and since the dense high crowns form an excellent screen it is commonly planted in a line to hide industrial structures. It is also used as a windbreak around orchards and other crop growing fields.

HORSE CHESTNUT
Aesculus hippocastanum

Introduced into Britain from the Balkans in the late 16th century the Horse Chestnut is one of the best known species with its sticky brown buds, magnificent white ‘candle’ flowers. Its very large leaves with 5 - 7 stalkless leaflets and its spiny rounded green fruit containing the much prized ‘conkers’.
Generally a large spreading tree with arching branches that are usually turned up at the ends. Mature trees reach a height of some 35 m. The bark is red-brown or dark grey-brown and scaly. The wood is very light and weak and is used for making fruit trays and fence panels but little else.
It grows rapidly on most soils but requires plenty of space. A fine example can be seen towards the southern end, with a small stand planted towards the northern end of Queens Mead.

ASH
Fraxinus excelsior

A tall, fast growing tree with widely spaced branches that has an upright, open character that casts only a little shade beneath it. Like the Walnut the lleaf is made up of a central stalk with 6 or more separate leaflets on each side. All the leaflets are more or less the same size and have long tips. The bark is pale fawny grey (the colour of ash) and splits into vertical cracks. The black buds stand out against the pale bark and are very noticeable at any time of year. The fruit form in bunches about 6 inches across, which hang at intervals along the branches. Each fruit is a single seed with a wing that helps it fall away from the parent tree. Vast numbers of seeds are produced each year. The young growth of the tree is very palatable to browsing animals and further spread is likely to be controlled by the deer. So far as is known this light strong wood was not used for the production of charcoal at the Mills. It seems to have been self-seeded early in the 20th century and specimens occur all over the site. Large numbers occur throughout the woodland and a small copse has been planted at the southern end of Queens Mead.

POPLAR Hybrids

A number of these trees are located at the northern end of the site and in the bend of the Old River Lea just north of the Burning Ground. They are probably Black Poplars (*Populus nigra*) distinguished from the White Poplar (*Populus alba*) which has much whiter underside to the leaves. It is difficult to be absolutely certain which actual variety of *P. nigra* since poplars tend to readily hybridise. Although they can naturally propagate from seed they tend to be either planted or grown from suckers. They would only have grown naturally when the woodland was much more open than it is now. They grow very rapidly and produce a tall tree with arching branches. It is difficult to imagine why they would have been deliberately planted as their timber would have been of little use on the site and far from ideal for charcoal production. Some of them are favoured by Herons as bases for nest building. During the early summer months the down from the trees' flowers form a carpet on the ground beneath. These trees are becoming somewhat rare in the British Isles.

(see also the Lombardy Poplar p17)

OTHER SPECIMEN TREES OUTSIDE THE MAIN WOODLAND

In addition to the main woodland there are some fine specimen trees on the more open Southern part of the site.

These are:

Horse Chestnut

Lombardy Poplar

London Plane

Oak

Weeping Ash

All these trees would have been planted for ornamental and/or screening purposes and, judging by their size, none earlier than about the late 1940s.

ELDER
Sambucus nigra

Commonly called the Elderberry this is often shrub-like but on suitable ground it can reach 9 m*P. nigra*. It grows vigorously, especially where the nitrogen content of the soil is high. Typically it colonises abandoned dwellings and can be seen growing around and even on, many of the old building remains.
The stalked leaves are opposite, consisting of 5 - 7 leaflets which have a distinctive smell that many find offensive, The stems have a large centre filled with spongy pith which is easily removed resulting in a hollow stem which has been used by children to make whistles and pea shooters.
The small white flowers grow in erect umbels with a heavy, sweet scent. When the berries form they droop downward, turning from green to black.
Both the flowers and the ripe fruit are used for making wine and jams and are rich in vitamin C. Different parts of the tree have also been used to make dyes: green from the leaves, black from the bark and blue from the flowers.

SYCAMORE
Acer pseudoplatanus

This large maple needs no introduction. All these trees are thought to date from early in the 20th century when a few were self-seeded or introduced to the site.. Regrettably this tree is extremely invasive, producing huge numbers of winged seeds that easily colonise new areas, rapidly germinate and quickly grow into large mature trees. The large leaves cast a dense shade that inhibits the growth of less vigorous species. The seedlings and young growth are very palatable to rabbits and deer but, unless large numbers of these browsers exist, they grow out of reach in only a few years. This species was much more widespread on the site but, in the preparations for opening to the public, huge numbers were cut down and their stumps treated to prevent regrowth. The woodland management plan proposes the steady reduction in the numbers with other species being allowed to take their place.

WALNUT

Juglans regia

Originally a native of Asia Minor imported to Rome from Greece by about 100 BC. The invading Romans carried with them the seeds' the familiar walnut which was prized as a source of cooking oil. This tree is rarely seen growing wild in Britain as its timber is so sought after. Although now a native tree it is on the northern edge of its distribution and usually occurs where it has been specifically planted. In its early years the Royal Small Arms at Enfield Lock was a subsidiary part of the Royal Gunpowder Factory and when there was a need to ensure good quality wood for rifle stocks the planting of Walnut was encouraged in a number of locations, including this site. In recognition of this a group of trees has been planted about halfway up the left hand side of Queens Mead. It is one of the last trees to come into leaf; seldom before the second half of May. The grey bark is smooth in young trees but becomes fissured with age. The tree can be recognised by its leaf, Like the Ash tree each leaf is made up of a central stalk with separate leaflets either side. In the case of the Walnut there are usually 7 leaflets, which get larger towards the tip of the leaf.

HAWTHORN

Crataegus monogyna

Also known as May or Quickthorn, There are two species of Hawthorn in Britain but only the Common Hawthorn has been found on the site. The seeds were undoubtedly brought by birds from the surrounding countryside and grew up as scrub in small clear areas. It shows masses of small white flowers in May and June with green berries turning red in the autumn. Widely used for hedging but can reach a height of 10 m.

Although usually thought of as a bush or shrub most of the Hawthorns on site have grown up in competition with surrounding vegetation and appear as rather wispy trees. Unless the surrounding woodland is coppiced many of these trees will steadily lose out to larger trees and die from lack of light.

A large specimen tree can be seen on the eastern side of Queens Mead by L157.

SILVER BIRCH
Betula pendula

Its silvery white trunk and pendulous branches make this one of the most decorative and easily recognised of Britain's native trees. It is one of the world's hardiest trees, despite its delicate appearance. In young trees the bark is reddish rather than the black-marked white of older trees. It displays a delicate tracery of drooping branches and usually grows to about 15 m although some reach up to 30 m. The thin shiny leaves are ragged and alternate on slender stalks. Purple-brown male and pale green female catkins open in April. The fruiting catkins stay on the tree until winter when they break up into scales and wind-borne seeds.
A small stand can be seen on the northern edge of the Burning Ground.

CRACK WILLOW
Salix fragilis

This tree gets its name from the brittle nature of the twigs. The charcoal made from the tree is, conversely, far from brittle and is much prized by artists as well as in the manufacture of gunpowder. It grows by the waterside and has long narrow leaves but the branches are not pendulous like the Weeping Willow. The grey bark is deeply ridged and cracked. There are separate male and female trees with yellow male and green female catkins appearing in May. In summer the female catkins mature into long white woolly seeds.
Because the new growth is very palatable to browsing animals it is usually pollarded (i.e. similar to coppicing but cut about 7 feet above the ground), otherwise they will grow to about 24 m. The prefix 'H' on buildings refers to the name Hoppit which was an area where Crack Willow was grown. A remnant of this plantation survives in the area to the north of the car park and there are numerous other specimens around the site. Those most easily seen are to the right hand side of the track by the southern part of the acid factory. A block has been planted on the west side of the Burning Ground.

AERIAL VIEW OF SITE