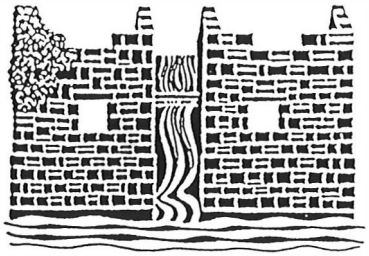


Gunpowder Mills Study Group

NEWSLETTER 19, AUGUST 1996

MEETING AT THE INSTITUTE OF HISTORICAL RESEARCH, SENATE HOUSE, UNIVERSITY OF LONDON SATURDAY 12 OCTOBER 1995

PROVISIONAL PROGRAMME

10.00-10.30 Assemble and Coffee in the Common Room on the Ground Floor

10.30-10.40 Chairman's Introductory Remarks
10.40-11.30 Peter Guillery, RCHME, London: The Purfleet Gunpowder Magazines"
11.30-12.00 Keith Fiarclough: "Thomas Coram, Founder of the Foundling Hospital: his Business Career in Gunpowder"
12..00-12.30 Brenda Buchanan and Wayne Cocroft: "Oscar Guttmann: his Life and Monuments"
12.00-12.45 Brenda Buchanan: "Gunpowder at ICOHTEC Meetings"

12.45-14.00 Lunch. It is recommended that members bring a packed lunch which may be eaten in the Common Room where hot drinks can be purchased.

14.00-14.45 Alan Crocker: "Tyddyn Gwladys Gunpowder Mills near Dogellau, Gwynedd"
14.45-16.00 Members' Contributions and Discussion of Group Activities

16.00 Prepare to vacate room

As in previous years we shall be meeting in The International Relations Room on the second floor of Senate House. Goodge Street, Warren Street and Russell Square underground stations are nearby. Parking might be available in the University of London car park - entrance at NW corner of Russell Square. To cover administrative costs a fee of £2 will be made.

Please let Alan or Glenys Crocker know if you are coming and if you would like to give a member's contribution in the afternoon:
6 Burwood Close, Guildford, Surrey GU1 2SB; tel 01483 565821; fax 01483 259501; email a.crocker@surrey.ac.uk.

GMSG MEETING IN PARIS, 11-12 MAY 1996

Alan Crocker

Thirteen members, including our host Patrice Bret, and a variable number of Patrice's French colleagues attended the Group's weekend Spring Meeting in Paris. A technical account of the visit will appear in the next Newsletter and the following informal notes are simply intended to indicate how much we all enjoyed the programme that Patrice had arranged. Actually, I would have enjoyed it more if I had not caught an awful cold from Eurostar on the way and had to miss a party at Patrice's home on the Saturday evening, which the others thought was great.

Glenys and I travelled to France on the Friday and spent a day sightseeing before the meeting started after lunch on the Saturday. Patrice introduced us to René Amiable, of the *Société National des Poudres et Explosives* (SNPE) who showed us around the Arsenal district before we ended up having champagne in the SNPE offices. Then we set off on a coach, provided by SNPE, to Essonne, to drive past the site of the gunpowder mills featured in Diderot's *Encyclopaedie,* which have disappeared, and to try to find a church in which gunpowder was made during the Revolution. Eventually, with the help of passers-by, we found the church only to discover that it was occupied by some form of secret society who refused to let us in. The next stop was nearby Le Bouchier, an old gunpowder factory which has become an SNPE research centre. This was fascinating for those of us who enjoy trying to interpret water-powered gunpowder mill sites. In particular a large waterwheel has survived which use to power a pair of incorporating mills. We also visited the exhibition hall of the research centre, where a range of products, including various types of explosives were displayed. We returned to Paris and I spent the evening in bed while the others went to Patrice's party.

On the Sunday morning we went by train to Sevran-Livry, 15km NE of the centre of Paris, and walked to Nobel's house and laboratory, now the Town Hall and marriage parlour, where we were met by the mayor and other local dignitaries and had coffee. Another long walk brought us to the park which is the former site of the national gunpowder works (1865/73 - 1971), where René Amiable was formerly the director. The works had at first been powered by steam, using overhead cable drive, and we toured the grounds looking for, and sometimes finding, remains of this system. Then we had to rush to the main building (the *Centre Gustave Maurouard*), which formerly housed the steam engines, for the unveiling of a plaque commemorating Maurouard's contribution to the use of steam power in gunpowder manufacture. This seemed somewhat strange to us as some British mills had steam power nearly a century earlier. However it was all good fun, especially the *Vin d'Honneur.* We also selected individually, from a menu, the food which we wanted for lunch.

Then we visited the Sevran-Livry gunpowder museum, founded by *Les Amis de Poudres* (or something similar), the principal *Ami* being René Amiable. This housed an excellent display of equipment, models, drawings and photographs. Then, rather belatedly, came lunch, which was completely different from what we had ordered as the caterers could not be found. However it did not matter as the resourceful *Amis* went to a takeaway and returned with great quantities of food

and wine. This was followed by lectures back at the *Centre Gustave Maurouard*. I found it a bit difficult to stay awake for these, but of course I had a cold. I did however manage to thank everyone involved for arranging such a splendid, informative and hilarious meeting. Finally, by chance, some of us ended up in the museum store and saw a wonderful collection of gunpowder manufacturing equipment which has been collected when mills elsewhere in France have closed. This was a tremendous bonus and much appreciated.

Many thanks to Patrice for making it all possible, to René who is so knowledgeable and contributed so much of his time to organise our visit and oplan, to all of their French colleagues who helped and, of course, to Brenda Buchanan who, as our International Secretary, interacted with Patrice in planning the meeting.

GUNPOWDER SECTION AT ICOHTEC, BUDAPEST, 7-11 AUG 1996

Brenda Buchanan

Historians of gunpowder are grateful to the International Committee for the History of Technology (ICOHTEC) for the opportunity to follow up their first international gathering at the Bath Symposium in 1994, by a second meeting at the 23rd Symposium in Budapest.

Twenty-one papers were presented to the Gunpowder Section. They were well-balanced in that 12 were given by colleagues who had attended the 22nd Symposium and 9 came from scholars welcomed to our discussions for the first time. Of these, our Hungarian hosts presented three papers: **László Lukács** introduced the history of powder making in Hungary; **József Lugosi** described the extraordinary 'Györ' programme of 1938 which involved a return to old methods at a time of national need; and **Othmar Mueller** raised the problem of the information now available on the illegal use of these techniques. Our other new colleagues came from France, Greece, Italy, Russia and the United States, further emphasising the international nature of the subject.

It is impossible briefly to do justice to the papers, which ranged widely in chronology and subject matter, and prompted keen discussion. The complementary contributions by **Heinz Walter Wild** and **Gerhard Kramer** of Germany, presented by the former, enhanced our understanding of the properties of the basic ingredients (saltpetre, sulphur and charcoal) and developed further Kramer's insights into the early use of calcium or 'lime' saltpetre before the procedures for making potassium nitrate had been appreciated. **Alexandre Herlea** introduced us to a mid-fifteenth century Rumanian version of the 'Firework Book', whose additional pages of a century later stressed the importance of testing both the ingredients and the gunpowder produced. In developing his study of saltpetre making in eighteenth century Sweden **Bengt Åhslund** emphasised the systematic nature of production there, and touched upon the intriguing matter of the public discussion of the subject in the Age of Enlightenment.

Valter Panciera opened up new ground by his account of saltpetre production in the Republic of Venice in the sixteenth and seventeenth centuries, where state control favoured the survival of papers describing the technology involved in this matter and that of the chemical composition of the powder produced. By referring to the interest of the Venetians and the Turks in the collection of saltpetre in what was to become Greece, **Stelios Papadopoulos** reminded us of the political complications which often underlay this subject. Of the local centres of production set up to serve private needs, that of Dimitsana was the most important for it became the centre of powder making in the Greek War of Independence (1821-25). Many features survive at this water-powered site which, when fully restored with the support of the Hellenic Investment Bank, will become an open air museum.

Bert Hall and **Kelly DeVries** developed further their work on the relationship between early gunpowder and weaponry. The former traced an intricate path between the novelty of corning the incorporated powder (first simply and then in a controlled form), in an attempt to combat spoilage from damp, and the separate but complementary response to the problem provided by the improvement in the quality of gunpowder. The latter described the construction of a data base of over 4400 powder weapons, with information on gun metals for some 3000 of these, largely for the first half of the fifteenth century, which allows a connection to be posited between the changing chemistry of gunpowder and the developing metallurgy of gun making. The general conclusion was that by the mid-sixteenth century a pattern had been established that was to persist for both until the nineteenth century.

A new aspect of the subject was introduced by **Brenda Buchanan** and **Patrice Bret** with their complementary papers on the use of gunpowder in the eighteenth century as a barter good in the triangular African or slave trade. Both found this market for powder large and profitable, but whereas the former emphasised the private returns to the Bristol merchant partnerships (who for a time also supplied the Liverpool slave traders), and the influence of the demand for *Guinea powder* on gunpowder technology, especially the proportions of the ingredients and the grain size of the powder, the latter assessed the public returns to the Gunpowder Administration of this *poudre de traite*, providing nearly one-third of its profits from 1775, and gave an overall picture of this trade by charting production in a number of French Atlantic ports. The ending of the slave trade (1807 in England and 1815 in France), had a profound effect on the location of powder manufactories.

The next group of papers examined the introduction of scientific method to the subject of gunpowder. It can be no coincidence that for the first time we met named individuals. **Brett Steele** explained the work of the mathematician Leonhard Euler whose study of gunpowder mechanics, arising from the needs of the Prussian army after the War of Austrian Succession (1740-48), was central to the ballistic revolution which forged a synthesis between Newtonian science and gunpowder weaponry. Its continuing influence may be demonstrated by the advantages of western armies over Asian and African forces, even those equipped with European arms, until they also began to incorporate scientific understanding into their military training. **Wayne Cocroft's** concern was with Sir William

Congreve (father of the more famous rocket-devising son of that name), who began his work on improving gunpowder manufacture after the defeat of Britain in the American War of Independence (1775-83). He was a practical experimenter, an influential figure in the state-controlled powder industry, and a bridge across the special and educational divide between gentlemen experimenters and powder manufacturers. Surviving sites at Waltham Abbey may be associated with his work, as also with that of Sir Frederick Abel and Sir Andrew Noble, experimenters who were selected by **Seymour Mauskopf** as exemplifying a synthesis between the different research traditions which existed from the mid-eighteenth century to the 1870s, namely: the chemical or material tradition which was laboratory-based, and the physical or dynamical tradition which was military-based. With Abel and Noble, and French researchers such as Berthelot, the traditions became more-or-less completely synthesized. Into this pantheon René Amiable sought to elevate Gustave Maurouard, who from 1867 to the 1870s designed a revolutionary power plant near Paris. His elegant design involved workshops along the fan-shaped arc of a circle, at the centre of which was a steam power house. When capacity had to be increased, Maurouard added a linear arrangement in which the workshops were added along straight lines. In contrast the reconstruction of the Okhtinsky Powder Mill in St Petersbourg (1824-42), nearly a century after it was founded, was described by **Dimitri Gouzévitch** being undertaken not by an individual but by a committee from the élite State engineering corps, after a study of European and American experience in this field.

The use of powder in mining received attention from **Peter Milner**, who described the goldfields of the State of Victoria, Australia, in the nineteenth century when gunpowder was the dominant explosive. He speculated on the extent to which its use came to be influenced by the introduction of machinery such as rock drills. It was appropriate that the mining engineer, explosives expert and historian of gunpowder, Oscar Guttmann (1855-1910), should receive a tribute from **Brenda Buchanan** and **Wayne Cocroft**, for he was born in Hungary and undertook his early work there. He later moved to London but continued through his profession and his interests to demonstrate the international nature of both engineering and historical scholarship.

In the last paper by **Ian Rae** the focus shifted once more to the ingredients of gunpowder but the matter was taken further by the consideration of their purity, especially that of the saltpetre. The purification of the separate components before incorporation ensured the quality of the final product and its consistency in action. This gave it the status of *standard substance*, to be relied upon in blasting and gunnery, but also capable of acting as a standard in other applications such as the checking of the alcoholic content of distilled liquors.

The success of these sessions raises the hope that the Gunpowder Section will meet again under the auspices of ICOHTEC. Evidence of the continuity already established was present at Budapest in the form of the advance copies of the volume entitled *Gunpowder: the History of an International Technology*, edited by Brenda Buchanan, published by Bath University Press, and containing the papers associated with Bath Symposium.

SICILIAN SULPHUR

Paul Everson

The Mediterranean island of Sicily is one of the richest naturally occurring sources of sulphur, which comes from the volcanic and mountainous central region extending nearly 100 miles west from Mount Etna. In particular, Sicily is known to be the principal source of sulphur for British gunpowder manufacturing throughout its commercial production (Crocker 1986, 11; West 1991, 174). The best quality sulphur or brimstone for use in the government mills was imported from Sicily and was called 'Licara <*alias* Lercara> firsts, after the mining commune of Lercara Friddi situated 30 miles north of Agrimento (Smith 1868, 107; Wardell 1888, 43).

A splendid display of selected material from Italian state archives, newly exhibited in part of the papal apartments in the fortress of Castel Sant' Angelo in Rome, includes as item 372 a 'Plan by Benedetto Maria Trigona, Baron of Madrascata, of an oven for burning and refining sulphur', dated 12 June 1827. As shown in figure 1, it illustrates in elevation, section and detail of its fittings a structure apparently analagous to a lime kiln.

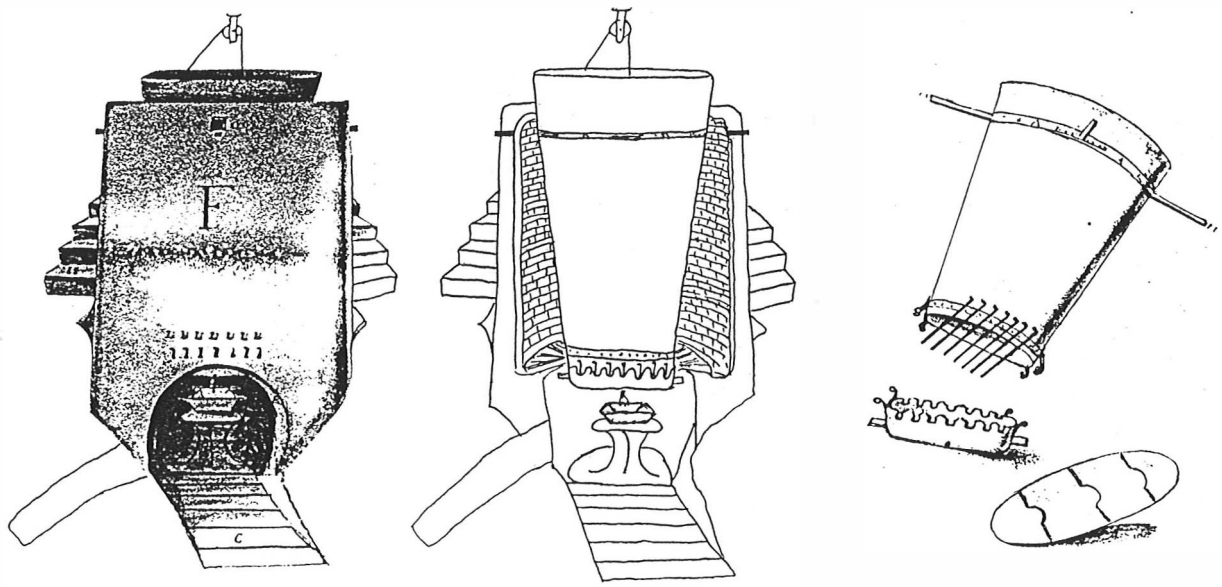


Figure 1. The 1827 oven for burning and refining sulphur. [Reproduced/redrawn from poor quality colour prints provided by the author. Unfortunately it has not been possible to decipher the labelling. - ed]

The Italian diagram belongs in the deposit of the Archivo di Stato di Caltanissetta in central Sicily. The state archives of Agrigento, Caltanissetta, Catania, Nessina, Traponi and Noto (Syracuse) were inherited from the provincial archives created by the Bourbons in Sicily in 1843. These conserve the administrative and peripheral documents of the state, first Bourbon then Italian, from the start of the 19th century, as well as national documents of private individuals and the church.

Improvements in the quality and refinement of its ingredients was a dominant theme in the manufacturing history of gunpowder in Britain and western Europe in the decades on either side of 1800 (Cocroft forthcoming). The evidence in the


(a)


(b)


(c)

Figure 2. Three illustrations of methods of refining sulphur taken from Agricola's *De Re Metallica* of 1556. [In (a) the sulphur ore in pots A is heated and the vapour passes through the spouts into pot B, where it thickens into a wax-like substance, which flows into the wooden tub and then the workman makes it into cakes. In (b) the sulphurous mixture is heated in the upper pots, which have perforated bottoms, and the sulphur drips down into the lower pots which contain water. In (c) the arrangement is similar except that the lower pot is buried in the ground. -ed]

government gunpowder mills in Britain shows that the imported sulphur typically contained about 3 to 4 per cent of earthy impurities and in this form was known as 'grough sulphur'. The simplest refining method of heating the 'grough sulphur' and skimming the impurities off the top remained in use until the subliming furnace or kiln was introduced in the later 18th century (RCHME 1994; Cocroft, forthcoming).

Such initiatives may have affected procedures at source as well as at the manufacturing end, whether the sulphur was destined for gunpowder or other use. Certainly, too, exploitation of Sicilian sulphur deposits was greatly increased in this period under the exceptional stimulus of the demand for sulphuric acid following the development of the Leblanc process for producing synthetic soda and the broad-based development of the scientific chemical industry to which sulphuric acid was central (Mack Smith 1968, 384-7; Taylor 1972, 183ff). Refining kilns like that illustrated clearly represented a step up in scale from more traditional

methods illustrated by Agricola (ed Hoover and Hoover 1950, 578-82). With the technical improvments brought by the application of James Gill's regenerative furnace in the 1880s, batteries of refining kilns remained the most substantial surface structures associated with sulphur mining into the 20th century.

In *Queer Things about Sicily,* Norma Lorimer described the mining landscape at Serradifalco ten miles west of Caltanissetta in 1905, with details that recall the earlier illustration (Sladen and Lorimer 1905, 349-66).

"As we dropped into the valley where the mine lay along the hillside, the fumes of sulphur caught our throats and hurt our eyes; yet we were told that the fires which heat the kilns were very low just now, for, in the three spring months when the crops are growing, there is a law which limits the fumes to a distance of six miles. These little fires which heat the kilns never go out; some of them have burnt continuously for many years. They are called the Gill fires.

... At the points where these fires burst out, there are kilns in which the sulphur ore is burnt and smelted. When sulphur is roasted, it pours out like a stream of olive oil. These fires are above ground, of course, and it is from them that all the choking fumes arise.

... the sulphur was dropping out of the kilns into pans very like the tins in which we roast our beef on Sundays. When it is cold and firm, it is turned out of the pans and carried away to the station on the backs of mules. There were grey sulphur dough-cakes lying like loaves of bread all ready for baking. These dough-cakes are made out of sulphur dust mixed with mud. If the sulphur dust was put into the furnace unmixed, it would choke the fire."

On the road to the mine, Lorimer noted

"... at intervals of a few minutes we met packs of dark mules, each between two high-piled blocks of bright yellow sulphur, as even and firm-looking as the cut corner stones of a cathedral. There is no cart-road to the station from the mine, and to us it seemed almost incredible that the whole output of this wealthy mine should still be carried, a hundred-weight or two at a time, on the backs of mules over a hillside as rough as Vesuvius. In the distance these trains of sulphur laden beasts, winding slowly in and out of the mounds of refuse, seemed like trails of black ants on their mysterious business."

References

Agricola, G, 1556, *De Re Metallica,* ed Hoover H C and Hoover L H, New York 1950

Cocroft, W D, forthcoming, *Dangerous Energy. The field archaeology of military explosives production*

Crocker, G, 1986, *The gunpowder industry,* Shire Publications

Mack Smith, D, 1968, *A history of Sicily. Modern Sicily after 1713,* London

RCHME, 1994, *The Royal Gunpowder Factory, Waltham Abbey, Essex. An RCHME survey, 1993,* London

Sladen, D and Lorimer, N, 1905, *Queer things about Sicily*, London

Smith F M, 1868, "A short account of the improvements in gunpowder", *Quarterly Review*, **125**, 106-133

Taylor, F S, 1972, *A History of industrial chemistry*, New York

Wardell, W H, 1888, *Handbook of gunpowder and guncotton*, HMSO, London

West, J, 1991, *Gunpowder, government and war in the mid eighteenth century*, Royal Historical Society, Studies in History, **63**

SULPHUR MINING IN SICILY

Alan Crocker

The above article by Paul Everson on Sicilian Sulphur has reminded me of a document I saw in 1986 in the records of the Lowwood Gunpowder Mills, which are held at the Lancashire Record Office in Preston (DDLo 4/16) It is entitled "Royal Prescript of the King of Naples re agreement for sulphur mining in Sicily, 27th June 1838" Some of it was difficult to read and my notes are rather inadequate. They read as follows:

"As sulphur mining increased in Sicily to about 300,000 Cantars* beyond usual foreign demand ... price has fallen ... profits should benefit Sicily. Therfore Contract with Company of Jaix Aycard & Co [?] to cause value of sulphur to rise to proper price. Company obliged to purchase 600,000 Cantars*. Send records for 1834, 35, 36, 37. Company will keep 150,000 Cantars* in stock.

Royal Refinery at Girgenta [Agrigento] set up, directed by Mr Jaix supplies flower of sulphur gratuitously to Royal Powder Mills. Company to set up in Sicily a manufactory for sulphuric acid and sulphate of soda.

Naples, 27th June 1838. N Santangelo (Minister of the Interior)."

My impression when I saw the document was that the King of Naples was trying to persuade the Lowwood Gunpowder Company to invest in the new Sulphur Company in Sicily, or at least to place a regular order.

* The Oxford English Dictionary states that the Cantar is a "measure of capacity and weight used in some countries bordering the Mediterranean, varying greatly according to the locality from 73 ¾lbs in Rome to 502 ¾lbs in Syria".

EDGE-RUNNERS FOR FAVERSHAM, 1784-5

Charles Trollope

A year or two ago the question of the size of eighteenth century edge-runners was raised. War Office records at the Public Record Office include (PRO WO51-260 P40 O.S. 1784-5):

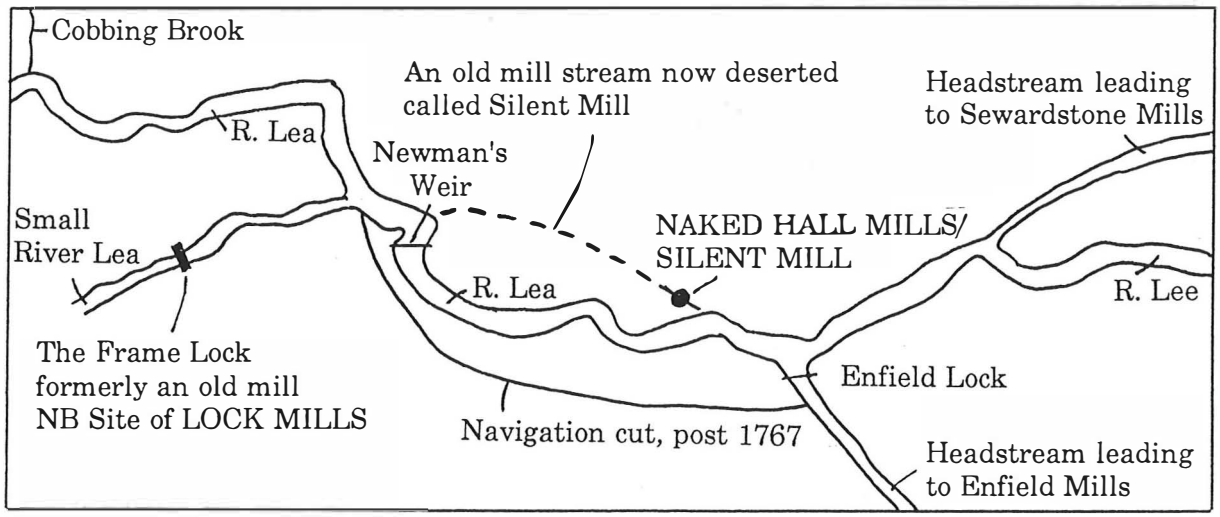
For Faversham 4 Blue marble Runners 6' 10" Dia 20" Thick

There is a great deal on Faversham in the WO51 Series for purchase, repair, improvements and salaries etc.

GUNPOWDER PRODUCTION AT TEMPORARY SITES IN ENFIELD

Keith Fairclough

During the second half of the seventeenth century the lower Lea valley emerged as one of the main centres of gunpowder production in England. Nearly all water mills along the river between Waltham and Tottenham were gunpowder mills at some time or other. In addition a couple of new mill sites were opened in the Enfield area to meet the requirements of the industry. This is an attempt to discuss these two sites, to follow up the work of Juanita Burnby on the Lock mills at Enfield,(1) using additional material on that mill and by discussing another mill nearby. It also allows me to correct an earlier statement that the Naked Hall mills may have been situated along the small river Lea.(2) It has to be emphasised that there has to be an element of speculation in this discussion, dictated by the nature of the material used and the apparent lack of surviving documentation about the mills, but there is sufficient evidence to suggest that both these sites were first opened to meet the increased needs for gunpowder dictated by the outbreak of the 2nd Dutch War (1664-67), and both eventually were taken over by the owners of the gunpowder manufactory at the nearby Sewardstone mills. The sketch map that shows these two sites is based on a map of 1766 showing the canalisation proposals made by Smeaton and Yeoman.(3) Since then the course of the small river Lea has been diverted and the millstream serving the other mill has been swallowed up by the development of the Royal Small Arms Factory on the site, so there are now no visible remains of either site.



Sketch map of the sites of Lock Mills and Naked Hall Mills / Silent Mill. North is approximately at the left and the distance between Newman's weir and Enfield Lock is about 1km.

Lock Mills

Burnby notes several references to a powder mill in the vicinity of Enfield Lock, Wild Marsh and Rammey Marsh. It is possible that this mill stood alongside the mouth of the head stream leading to Enfield mills, but the evidence does suggest that the most probable site was along the lower reaches of the small river Lea as it passed between Wild Marsh and Rammey Marsh and before it re-entered the

main river. If so, then these powder mills were erected alongside a copyhold fishery within the manor of Enfield known as Rammey Reach.

From June 1620 until at least 1687 this fishery was tenanted by members of the Robinson family of Enfield. In 1678 the will of Thomas Robinson of Enfield, tanner, mentioned 'my wear and wearhouse and my land all covered with water and fishery called Rammey Reach'. In 1713 the lease was held by John Flanders, the miller at Enfield Mill, and it remained within this milling family until 1764, when it was purchased by Bourchier and Thomas Walton, owners of the Waltham Abbey gunpowder mills. The weir was a fishing implement, on which to fix nets and fish traps, but it could also be manipulated to provide a flash of water to help navigation in the main river below, and so tenants were entitled to a toll for providing such assistance. The weir appears in a toll list of 1725, the tenants of 'Flanders Frame' being entitled to 1/-. After the construction of the Lee Navigation in 1767, the weir was no longer required for the navigation, but it remained *in situ*, being noted as an eel weir on a 1783 map.(4)

Unfortunately none of the numerous documents about this fishery mention any gunpowder mills, but other evidence does suggest that there were mills alongside this fishery, and it may be that an additional function of the weir was to increase the power supply to any such mills, although at this date horse mills may have been more important. A map of Middlesex by John Seller about 1679 shows gunpowder mills at the site, and they are still shown as such on subsequent maps by Morden or Seller in 1695, 1722 and 1733, although there must be some doubt about the existence of the Lock mills at the last two dates. A detailed map of Enfield in 1754 shows only a sluice, whilst the 1766 map of Smeaton's canalisation plans notes 'The Frame Lock formerly an old mill'.(5)

A mill existed at this site. Can anything be said about its history. In June 1653 when there was a shortgage of gunpowder as a result of the 1st Dutch War the Council of State ordered the Ordnance Board to treat with John and Henry Wroth, owners of the manor of Enfield, to see if they could obtain the use of certain mills known as 'ye Lock'.(6) No further information is available, and there is no evidence that the mills were converted to gunpowder production at this time. The very wording of the request does suggest that the mills already existed, and a reference to the burial at Enfield in August1657 of 'An Oyleman from the Lock' further suggests that they might have been oil mills.(7) Then in January 1665, during the 2nd Dutch War, Thomas Carter signed a contract to deliver 200 barrels of powder a month from 'Enfield Mills and ye Locke Mille by it', being lent £400 in advance, possibly to help pay for the costs of converting the mills to gunpowder production. Carter had supplied powder to the Ordnance ever since 1652, and during the late 1650s was one of the major suppliers and continued to be so after the Restoration, when he acted as a sub-contractor to Daniel O'Neal, who had been awarded a gunpowder monopoly by King Charles. Carter had worked the gunpowder mills on Hounslow Heath since at least 1655, but it is not known whether he worked other sites as well at that date. It seems likely that he converted the Enfield sites at the outset of the 2nd Dutch War, in response to Ordnance pleas for increased production, but there is of course the possibility that the conversion had been carried out earlier. There is a reference to a gunpowder mill in the 1664 Hearth

Tax returns for Enfield. Unfortunately neither Carter's will nor a probate inventory of his estate in 1678 notes any gunpowder mills at Enfield, although both mention his mills at Hounslow. Yet the Lock mills were still *in situ* in 1671 when tax returns for the Bulls Cross quarter note that the owners of the powder mill were to pay 9s 0d, based on an assessment of £9.(8) Nothing else has been discovered about production at this site, except for references cited by Burnby to the existence of such mills in 1673, 1697 and 1703,(9) and the map evidence already cited, but Burnby notes that land at the site had become the property of John Freeman by 1689 and Sir Polycarpus Wharton in 1702, so it seems probable that the site had been taken over as part of the larger gunpowder manufactory situated at Sewardstone mills. It thus seems likely that any production at this site had definitely ceased at some stage towards the end of the War of the Spanish Succession, if not sooner, for it was at this period that the main site at Sewardstone mills ceased to produce gunpowder.(10)

Then, in 1767, Thomas and Bourchier Walton informed Parliament that they were 'possessed of the Toft, Soil, and Ground, whereon an ancient Mill lately stood, and of the Mill Stream thereto belonging, situate above Newman's Weir, held, by Copy of Court Roll, of His Majesty's Manor of Endfield, which Premises the Petitioners lately purchased, for the Purpose of building one or more new Mill, or Mills, in the Room of the said ancient Mill'.(11) However, these expansion plans were never carried out, and the site was never again used as a mill or production site.

The wording of Carter's 1665 contract does suggest that the Enfield mills, at the main mill site in Enfield at Ponders End, were also used to produce gunpowder during the 2nd Dutch War. If so, this is the only reference to such a use that has been found. Moreover a lease in 1671 states that the main mills were corn and leather mills, and cited previous tenants as Charles Whitehead and Nicholas Whare or their assignees, but made no mention of Carter.(12) Further evidence is needed before it can be definitely stated whether Enfield mills were used to produce gunpowder production for a short time or not.

Silent Mill / Naked Hall Mills

The other site to be discussed stands on the eastern bank of the river Lea in the vicinity of the later Royal Small Arms Factory. A gunpowder mill is shown at this site on the 1733 edition of a map of Essex by John Ogilby and William Morgan, but not on the original 1678 edition which did not emphasise features such as mills.(13) Then in 1740 a mill on the same site known as Silent Mill is shown on a map of the navigable river Lea prepared in 1740 by William Whittenbury, surveyor to the Lee Trustees. In preparing this map Whittenbury used a map of the lower Lea below Waltham that had been made a few years earlier by William Walton, a partner in the Waltham Abbey gunpowder mills.(14) Walton's map no longer survives. Silent mill still appears on the published maps of the Lea canalisation plans, issued in 1766 and 1767, and on a manuscript map of 1766, showing these same canalisation plans, it is shown as 'An old Mill Stream now deserted called Silent Mill'.(15) This is the only map which shows the millstream serving this mill. The site was still referred to as Silent Mill by John Rennie in 1806 when he recommended that this area provided greater water power than that available to Cheshunt mill, the site first considered by the Ordnance for the

erection of a gun manufactory.(16).

Such evidence leads to some speculation as to why it was called Silent Mill. It may be noted as that because it was no longer working, but is it just possible that it was so named because it was a gunpowder mill using the newer and quieter technology of edge runner stones to incorporate gunpowder rather than the older and noisier technology of stamp mills? Edge runner stones were a technological innovation in England during the last decades of the seventeenth and the first half of the eighteenth century. The process was probably imported into England from the continent, and there is some evidence to suspect that Sir Polycarpus Wharton had a part to play in the introduction of this new technology. This technology was in place at the nearby Sewardstone gunpowder mills in 1703, and had probably been introduced during the previous decade.(17) Incorporation by edge runner stones was far more efficient than by stamp mills, the task being accomplished in far fewer hours, and to a better standard. Presumably they were also far quieter. Walton who made the original survey of the lower Lea in the late 1730s would be aware of new developments within his own industry, and would indicate them. That the name appeared on the 1740 map could be evidence of this new technology in place along the Lea, and perhaps also evidence that it was still unusual enough to warrant such a name. It can also be noted that the engraving of the Waltham Abbey powder mills worked by John Walton that accompanies Farmer's History of Waltham Abbey indicates two stamp mills and two dumb mills at these works, so perhaps the Walton family were in the process of introducing this new technology at this date.(18)

Silent mill had probably been part of the gunpowder manufactory based at Sewardstone, but it also had an earlier history. In April 1665 a new supplier to the Ordnance is noted in their minutes, John Lucas, and in June 1665 the Ordnance wrote to two tenants of fishing weirs in the Waltham area, requesting them not to draw away water to the detriment of the mills worked by Lucas. In August 1673 a similar request stated that Lucas worked mills known as Naked Hall mills. There is no evidence that Lucas supplied the Ordnance after 1673.(19) Such evidence suggests that Lucas could have been working a site along the Lea, and a site in the Enfield area could well have been affected by the operation of fishing weirs upstream at Waltham. The next that is known is that when John Freeman died in December 1684 he left Naked Hall mills in Enfield and Sewardstone mills to Polycarpus Wharton, the infant son of Sir Polycarpus Wharton.(20) How he had acquired them from Lucas is not known, but this does seem to confirm that the Naked Hall Mills of Lucas and the Silent Mills of the later period were one and the same, although they had been probably rebuilt once they became part of Sir Polycarpus Wharton's manufactory.

References

1. J. Burnby 'Gunpowder and saltpetre production in Enfield', in A. Robertson, J. Burnby, *Guns and Gun Powder in Enfield,* Edmonton Hundred Historical Society Occasional Papers no 50

2. K R Fairclough, 'Early gunpowder production at Waltham', *Essex Journal,* Vol 20 no 1 (Spring 1985), 11-16, footnote 18

3. Map in keeping of British Waterways, private communication Richard Deane

4. Public RO, SC2 188/55-57, DL43 Bundle 7 no.10, SC11/441, DL 30/403Bfo.150, DL/30/406 fos.56,130, DL 30/407 fo.39; PROB 11/216 sig 55, MR 593; Essex RO, D/AMW4/103, D/AMR7/4, Calendar of County Records: Sessi Records 1687-99, 456/109, T/R 36/2; Greater London RO, Acc 801/333-51, 1117, 1186, Acc 2558/MW/C/15/358

5. British Library, K1 TAB 18(10); Burnby, *op cit*

6. Calendar State Papers Domestic 1652-53, 391

7. Burnby, *op cit*

8. Public RO, WO 47/2, 10 June 1653, WO 47/6 fo.119, WO 49/87 fo.15, WO 49/91 fo.107, WO 49/93 fo.91, WO 49/94 fos.21-74, PROB 5/3776, PROB 11/327 sig 92; Phil Philo and John Mills, 'The Bedfont Gunpowder Mills', *London Archaeologist,* Vol 4 (Autumn 1985) 95-102; Burnby; Essex RO, E179/253/23

9. Burnby, *op cit*

10. For further details of these works: K R Fairclough, ref 2 above; K R Fairclough, 'The hard case of Sir Polycarpus Wharton', *Surrey Archaeol Collections,* Vol 83 (1996) 125-35

11. Commons Journals, xxxi, 361

12. Greater London RO, Acc 144/2

13. British Library, MAPS, K.13; 2345(39)

14. British Library, K.TOP.VI.6.II; Public RO, RAIL 845/1, Trustees, 3 Aug 1741

15. Bodleian Library, Gough Mss 17; British Library, MAPS 1240(18); London Borough of Tower Hamlets, Local History Coll 980; Essex RO, D/DU 567/2

16. Institution of Civil Engineers, Manuscript Reports of John Rennie, Volume 4 fos.122-32, letter to R H Crew, Secretary to the Board of Ordnance, 18 September 1806

17. Greater London RO, Acc 1953, Deeds & Papers 42

18. J. Farmer, *The History of the ancient Town, and once Famous Abbey, of Waltham, in the County of Essex, from the Foundation to the present Time,* London 1735, pp 2-3

19. Public RO, WO 47/7 fos.58,90, WO 47/19B, 5 August 1673, WO 51/17 fo.173

20. Public RO, PROB 11/380, sig 103

JOHN SMEATON, JAMES WATT AND WORCESTER PARK GUNPOWDER MILLS IN THE 1770s

Alan Crocker

Worcester Park gunpowder mills, also known as the Tolworth, Long Ditton and Malden mills, were on the Hogsmill River in Surrey (NGR TQ 211656).(1) They were first established in the late 16th century by the Evelyn family but seem to have been closed when the site was incorporated into Nonsuch Park in the early 17th century. Then, in about 1720 they were re-built by William Taylor and when he died in 1764 held in trust until 1774 when his son William reached the age of 21 years.(2) During the 1770s the famous engineers John Smeaton and James Watt were involved in designing equipment for the mills and this paper discusses what is known about their innovations. Incidentally note that these mills are not to be confused with the Ewell powder mills which were 3km farther upstream.

The Royal Society holds in its library six volumes of "Civil and Mechanical Engineering Designs 1741-1792 of John Smeaton FRS", and a catalogue of these has been published by the Newcomen Society.(3) In particular volume 2 contains the following seven drawings relating to Worcester Park gunpowder mills:(4)

1. Plan of mill building, 1:48. 1771
2. Plan of powder mill, 1:24. 1771
3. Sectional elevation of powder mill, 1:24. 1771
4. Elevation of waterwheel, 1:12. 1771
5. Connection between shafts of waterwheel and pit wheel, 1:12. 1771
6. Mechanism for starting mill, 1:48. 1772
7. Plan and elevation of steam drying house, 1:48. 1772

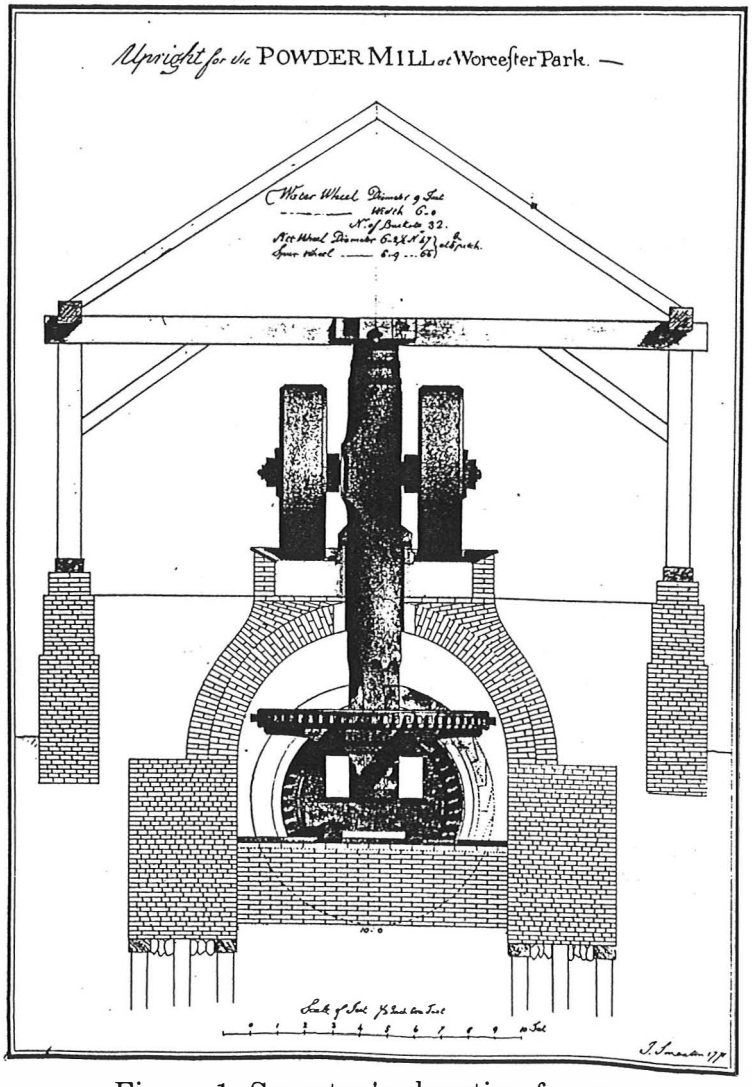


Figure 1. Smeaton's elevation for an incorporating mill at Worcester Park

Figure 1 is a reproduction of drawing 3, retouched and much reduced.(5) It shows an under-driven incorporating mill with a pair of edge runners 6ft 6ins in diameter and 1ft 8ins thick mounted asymmetrically relative to the upright shaft. The water-wheel, which is stated to be 9ft in diameter and 6ft wide, is seen in the background but it is not obvious from this drawing whether it powered a

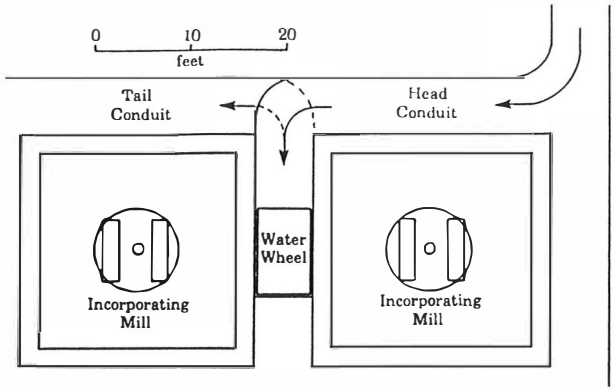


Figure 2. Sketch of Smeaton's design for a pair of incorporating mills at Worcester Park

single mill or a pair of mills. However, it is clear from drawing 1, from which the outline sketch of figure 2 has been prepared, that it was for a pair. This drawing, together with drawing 4, demonstrates that the waterwheel was designed to achieve maximum efficiency. In particular, when viewing the wheel from its clockwise side:

a. It was an overshot wheel with the water entering as a horizontal sheet at about 11 o'clock. This could cause problems when the wheel was being started from rest, so a tilting 4ft-wide extension of the pentrough could be lowered so that some water entered the buckets at 12 o'clock. This extension was raised when the wheel was in motion.

b. The wheel fitted very closely into its pit with only 1 inch to spare on either side.

c. The water left the bottom of the wheel in the opposite direction from which it entered.

d. The section of the wheel between 3 and 6 o'clock fitted closely against a masonry quadrant so that the water could not escape from the buckets until it reached the bottom.

A note on drawing 1 states: "The Head Conduits to carry at least 2 feet of water". This suggests that two or more conduits and hence two or more pairs of incorporating mills were contemplated.

Drawing 6 is significant as it is dated 1772 (not 1771 as stated in reference 3). It is labelled "A scetch of the method of setting off the powder mill at Worcester Park, after charging". The date, a year later than drawings 1 to 5, suggests that it was prepared when the mills were being built or that a problem had been discovered after they had been built and Smeaton's advice had been sought.

An outline sketch based on drawing 7 is given here as figure 3. It shows a steam drying house and is inscribed "Description and explanation, Book 5, Reports & Estimates, p 203, dated 28th June 1772". Unfortunately "Book 5" has not survived but the plan and elevation appears to show the following. There are two adjacent rooms, the larger one used for drying and the smaller one, with a chimney, for a furnace and boiler. Steam is piped from the top of the boiler in separate pipes to four table-like constructions in the drying room. The tops of these tables consist of steam chests a few inches deep and condensed water is drained from them, collected together into a single pipe and returned to the lower part of the boiler. Around the walls of the drying room are nine shelves, about 1ft apart and 1ft 8ins

wide, upon which the trays of damp gunpowder would be placed. The system could be controlled by means of taps on the pipes so that the temperature could be regulated far more accurately than in the traditional gloom stoves heated by conduction through a domed metal plate which formed the backing of a furnace in an adjacent room.(6) It is again significant that this drawing is dated 1772. If the Smeaton-designed incorporating mills had not been installed it seems unlikely that he would have been appointed to design a stove.

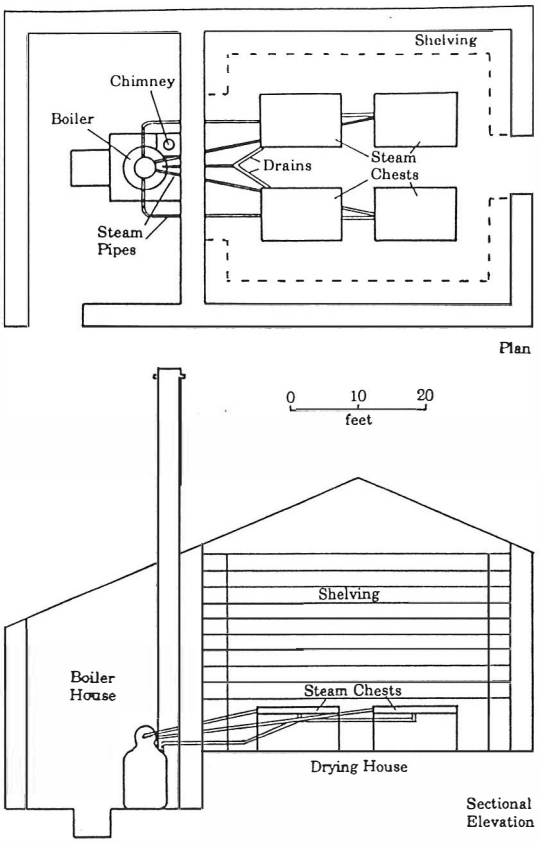


Figure 3. Outline sketches of Smeaton's proposed stove at Worcester Park

The Royal Society volume also contains drawings dated 1771 of incorporating mills to be installed at Bourchier Walton's Waltham Abbey gunpowder mills.(7) One of these is very similar to figure 1, except that it was powered by a low breast-shot wheel 15ft in diameter and, unusually, the spur wheel on the upright shaft meshes with the bottom of the pit wheel rather than the top. Also, there are drawings, again dated 1771, of a waterwheel for "the upper stack of powder mills on Hounslow Heath, belonging to Saml Underhill Esqr".(8) These were the Bedfont Mills, although Underhill had died in 1764 and they were being worked by Mark Nesfield and Richard Taylor.(9) An inscription on one of these drawings states "The inside machinery the same as Mr Walton's at Waltham Abbey". All three of these gunpowder mill projects, Worcester Park, Waltham Abbey and Bedfont are included in a list compiled by Smeaton in 1780 of "mills executed". No completion dates are given but typically Smeaton's projects appear to have been completed about a year after the drawings were prepared.(10)

Further information about the Worcester Park mills is contained in the James Watt papers, which have recently been acquired by Birmingham Central Library. They are being researched by Richard Hills and I am indebted to him for providing the following transcripts.(11)

"5 May 1778. Mr Taylor called about Engine to assist his powder mill - wants 5000 Hods. pr hour to be raised to 11 feet high."

"9 May Saturday went to Mr Taylors Mills at Ewel he has at present 4 pr of Gunpowder Millstones and is erecting 2 pair more - The stones are about 6½ feet diam and 20 inches thick they roll round on a bed of 8 feet diam - and same thickness, weight abt 6 pound [*sic*] pr pair - The new stones weigh about 4 ton pr pair he says that 2 horses will make 4 turns pr minute with the small stones, and

the mill wheel moves 2 pair of stones 7 turns pr minute wheel 9 feet 2 inches diam shuttle 7 feet long by 1¾ inch high 15 inch ?peum? [opening?] above lower side of shuttle - Mr Smeaton in a report of his says the river gives only 5000 Hod pr hour."

It should be noted that James Watt took out his patent for separating the condenser of a steam engine from the cylinder in 1769 and joined Matthew Boulton at the Soho Foundry, Birmingham, in 1775. They extended the patent until 1800 and, during this 25-year period, together built about 500 steam engines. Their early engines were for pumping and it was not until after 1780 that they introduced engines with rotary motion suitable for a wide range of industrial uses. The proposed 1778 engine for Worcester Park was therefore a pumping or "returning" engine which would raise water from the tail-race back into the head-race of the mill so that it could be re-used.(12)

In order to derive the maximum amount of information from these two transcripts it is necessary to have a definition of a "Hod" of water. I have failed to find one and therefore assume that it is an abbreviation for a "Hogshead". The size of a hogshead depended on the commodity but the most common was probably that used for ale which, in the late 18th century, was 63 gallons. However when the larger imperial gallon was introduced it became 52½ gallons. The term was also used for the size of barrel which holds this quantity. Therefore, the 5,000 hods of water which William Taylor wanted to raise in an hour with a steam engine was probably equivalent to 262,500 gallons. Also, according to John Smeaton, the same amount of water normally flowed through the mills in an hour so Taylor wanted to double his water power. This would of course mean that the flow of water through the waterwheel would be doubled leaving the flow unchanged both upstream and downstream. The average discharge of water from the Hogsmill into the Thames at Kingston is now about 720,000 gallons an hour (13) and, as the gunpowder mills were about one-third of the way along the river from its source at Ewell, the flow there would be about one-third of this, remarkably close to Smeaton's value. This supports the suggestion that the hod really was a hogshead.

It is now possible to calculate, from the rate of flow and the head of water, the average water power at the mill. The head would have been 11 ft, which is the 9ft diameter of the waterwheel plus the 2 ft of water in the head conduit, or alternatively the height through which Taylor wanted to pump water. The calculation gives about 15hp and as Smeaton's overshot waterwheels would have an efficiency of approximately 60% this would be reduced to about 9hp available power. Roughly, it took about 5hp to power each pair of stones so that it appears that there was hardly enough water power for two pairs. It is therefore not surprising that Taylor was interested in installing a steam pumping engine.

James Watt stated that Taylor had 4 pairs of edge runners all 6ft 6ins in diameter and 1ft 8ins thick, exactly the same dimensions as shown in the Smeaton drawing of figure 1. Assuming these to be of hard limestone, with a specific gravity of about 2.7, they would weigh just under 8 tons per pair, rather than about 6lbs as noted incorrectly by Watt. Two pairs of stones were powered by a waterwheel 9ft 2ins in diameter which corresponds well with Smeaton's 9ft. Also the 7ft length of the

"shuttle", which was the movable gate which controlled the flow of water to the wheel must have been the 6ft 2ins width of the head conduit. However there was only one waterwheel and 4 pairs of stones. Presumably the other two pairs were being operated by horses, although Watt only mentions horses in connection with the 2 pairs of new small stones Taylor was erecting.

In conclusion, it seems certain that Smeaton's design was used to install at Worcester Park, probably in 1772, one waterwheel and two under-driven incorporating mills. These would have used all the available water power and the other two mills must have been powered by horses. Then in 1778 Taylor wished to convert this second pair of mills to water power and was therefore interested in installing a steam engine, effectively to double the water supply. At the same time he was erecting a further two mills with smaller stones and these would probably be powered by horses. It is not known whether a steam engine was in fact installed but by 1804 there were "in Long Ditton, two gun powder wheels each moving two mills".(14) Clearly a second waterwheel had by then been introduced and water was available to turn it. Incidentally the first detailed map of the site is dated 1818-19 but unfortunately none of the buildings are labelled. However one rectangular building spans a mill stream and would appear to be a conventional pair of incorporating mills.(15) No explosions are known to have occurred at the mills between 1760 and 1843.(16)

References

1. Crocker, G, ed, *Gunpowder Mills Gazetteer*, Wind and Watermill Section, SPAB, London, 1988, pp 24-5.

2. West, J, *Gunpowder, Government and War in the Mid-Eighteenth Century*, Boydell Press, 1991, pp 210-11.

3. Dickenson, H W and Gomme A A, eds, *A Catalogue of the Civil and Mechanical Engineering Designs, 1741-1692 of John Smeaton FRS preserved in the Library of The Royal Society*, Newcomen Society Extra Publication **5**, London 1950, p 33.

4. "Designs by the late John Smeaton, FRS, collected and arranged by John Farey," **2**, 1821, Library, The Royal Society, London: ff. 41v, 42, 43v, 44, 47A, 47B.

5. Crocker, G and Crocker, A, "Gunpowder Mills of Surrey", *Surrey History*, **4**(3), Phillimore, Chichester, 1990, pp 134-158, see pp 146-8.

6. Crocker, G, *The Gunpowder Industry*, Shire, Princes Risborough, 1986, pp 19, 21.

7. Smeaton designs, ref 4: ff. 33v, 34, 34v, 35, 36v, 37, 38v, 39, 39v.

8. Smeaton designs, ref 4: ff. 40, 41.

9. West, ref 2.

10. Smith D, "Mills and Millwork", chapter 3 in *John Smeaton FRS*, Skempton A W, ed, Thomas Telford, London 1981, pp 59-81 and 254-6.

11. James Watt papers, Birmingham Central Library, C3/3, Journal, 3 Feb 1778 to 21 Dec 1778.

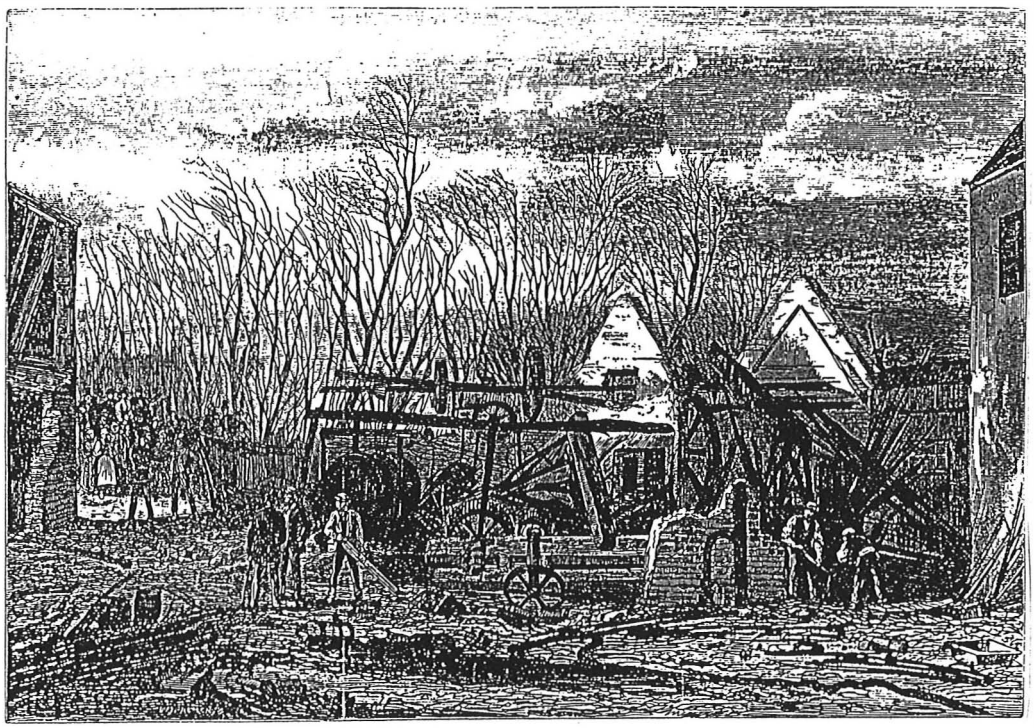
12. Buchanan, R A, *Industrial Archaeology in Britain*, Book Club Associates, London 1974, pp 253-7.

13. Fish, H, Harris, B J D, Mander, R J, Nicolson, N J and Owen, M, "Rivers and Waters", chapter 2 of *The Surrey Countryside*, Salmon J E, ed, University of Surrey 1975, p 41.

14. Manning, O and Bray, W, *The History and Antiquities of the County of Surrey*, 1, London, 1804, p 475.

15. Plan of Manor of Tolworth as Inclosed by Act of Parliament, 1818 and 1819, Surrey Record Office, QS6/4/29.

16. Crocker and Crocker, ref 5, p 155



Scene of the powder explosion at the Oare Works, Faversham, 1867
[Courtesy Mildred Cookson, Wind and Watermill Section, SPAB]

GUNPOWDER PRODUCTION AT TIDE MILLS ALONG THE LEA

Keith Fairclough

The early development of the gunpowder industry is associated with Surrey, for that is where the most important producers and those who were awarded monopolies to supply the government were situated, but there is also early evidence of the industry along the Lea. Not at Waltham Abbey as has often been claimed,(1) but at tide mills along the lower Lea within the parish of West Ham. In 1588 the Three Mills were described as 'but 1 corn mill and 1 powder mill which standeth still more than she goeth'. The 'master of the powder mill' was James Mounsey, a London grocer, a member of the profession that sold gunpowder. He had acquired an existing lease to the Three Mills and converted an oil mill to a gunpowder mill. It is not known how long this venture continued, his lease expired in 1589 and by the end of the century this particular mill was grinding corn once more. Mounsey's will in January 1607 indicates no involvement with gunpowder production.(2) In 1597 St Thomas mill was described as a gunpowder mill and was still shown as such on a 1622 map.(3) In 1615 Saynes mill was described as a gunpowder mill, the tenant between 1612 and 1616 being Christopher Alleley.(4) Evidence in 1628 shows that there had been a short-lived gunpowder mill at Temple mill in Leyton, but away from the main site, and probably at the turn of the century.(5) In 1589 and 1598 there were references to George Hall of Blackwall and William Smyth of West Ham making gunpowder, but no link between either of them and any tide mill has been uncovered.(6)

None of the above ever signed contracts to supply the Ordnance Board. Did they produce solely for the private markets, or were they sub-contractors or business associates of those producers who did supply the Ordnance? Whatever, the manufacture of gunpowder at these tide mills was not to last. When the industry flourished along the lower Lea valley from the 1640s onwards none of these tide mills was ever put to this use, and in 1739 a lease to Spilmans mill specifically prohibited their conversion to gunpowder production.(7) In addition the earliest known gunpowder mill in this country was also a tide mill.(8)

This raises the question of why tide mills were chosen by gunpowder producers. What exactly was the water power used for? Mills were used to grind and prepare raw materials such as charcoal and brimstone, and they were used to incorporate the raw materials to produce gunpowder. In Queen Elizabeth's reign some incorporation was still done bv hand, but new stamp mills driven by horse or water power were being introduced. Evidence from the ensuing centuries shows that incorporating stamp mills were worked continuously for up to 24 hours to produce the necessary quality, yet a tide mill could then only work discontinuously for short periods of about three or four hours at a time, twice in every twenty five hours, and would thus not seem to be an ideal power source for an incorporating mill. There is also no evidence of any artificial ponds at any of the Lea tide mills to store sufficient water to provide continuous power. Were the gunpowder producers at Stratford still using manual methods of incorporation, whilst using tidal power solely to prepare the raw materials? Was gunpowder incorporation a discontinuous process at these sites? Or what? Suggestions would be welcome.

References

1. K R Fairclough, "Gunpowder production at Waltham Abbey in 1561?", Gunpowder Mills Study Group Newsletter **13** (August 1993), 3-4; Victoria County History, Essex, **v**, 164

2. Essex RO, T/P 48/1, Court o£ Sewers, 17 October 1588; Public RO, PROB 11/109 sig 15; REQ 2 65/42

3. Essex RO, T/P 48/1, Court of Sewers, 11 May 1597; City London RO, Comptrollers Bridge House Plans 52A. This map is reproduced as Plate XXI accompanying P E Jones,·Some Bridge House Properties', Journal of British Archaeological Association, Third Series, XVI(1953)

4. Essex RO, T/P 48/1, Court of Sewers, 19 December 1612, 23 March 1615, 30 November 1616

5. K R Fairclough, "Temple Mills as an industrial site in the 17th century", *Essex Archaeology and History,* Vol 22 (1991), 115-21

6. Public RO, Req 2 65/42; Essex RO, Session Rolls, Epiphany 1598-9

7. City of London RO, BH/GB2 fo 43

8. Victoria County History Surrey, **ii**, 310

WALTHAM ABBEY POWDER MILLS IN 1808

Ken Bascombe

I can make a few comments on the 1808 print of Waltham Abbey powder mills discussed in the article on page 16 of Newsletter **18**. I suspect that the six tall posts are intended for use with flags; the buildings appear to be grouped in three rows of three with an adjacent post, which might well have indicated that a critical process was in progress. There is just a possibilty that a conductor to earth is involved, but these do not look tall enough.. The single flag shown in Farmer appears to have been "hoisted to the top of the mast" rather than on dry land!

If you have never noticed the hill, then I have never appreciated the watercourse at the extreme front of the picture! This (very properly absent from Farmer in 1735) must be the navigation constructed in about 1767. Armed with this, I took a walk, in February, up the towpath and from there it was just possible to detect parts of the skyline - just! There are so many trees around the former Royal Gun Powder Factory (and some on the marshes too) that when they go into leaf I am sure that the hill will be completely invisible from the towpath, and the long rows of buildings will also shut it out when moving about the site.

DURAMEAU'S "A SALTPETRE FACTORY IN ROME", 1766(?)

The following quotation, describing the painting reproduced here, is taken from Michael Levy's *Painting and Sculpture in France 1700-1789*, Yale University Press, 1993, pp 230-31.
"Durameau trained at the Ecole royale des élèves protégés and then went to Rome in 1761. A souvenir of his years there is his boldly atmospheric, almost timeless gouache of a saltpetre factory (Louvre, Cabinet des Dessins), signed and dated 1766(?), exhibited at the Salon in 1767."
[Thanks to Wayne Cocroft for providing this information]

ALFRED NOBEL CENTENARY MEETING

The Historical Group of the Royal Society of Chemistry is holding a symposium at University College London on Thursday 21 November 1996, to commemorate the centenary of the death of Alfred Nobel. Attendance is free of charge and there are no registration formalities or special arrangements for lunch. College facilities are available and there are restaurants, pubs etc nearby.

Programme

10.15 Coffee
10.45 Welcome and Introduction: Robin Clark FRS, University College, London

Nobel the Man: Chair Lord Porter FRS, Imperial College, London
11.00 "The Life of Alfred Nobel": Trevor Williams, Editor Emeritus *Endeavour*
11.40 "Nobel's Developments in Explosives": John Dolan, Nobel Explosives, ICI
12.20 "Nobel's Health and Final Illness", Tony Butler, University of St Andrews
13.00 Lunch

The Chemistry Prize: Chair Robin Clark FRS, University College, London
14.30 "Sir William Ramsey: The First British Recipient of the Chemistry Prize":
Katherine Watson, Wellcome Institute for the History of Medicine
15.10 "Does the Nobel System Reflect the Development of British Chemistry?"
William H Brock, University of Leicester
15.50 "The Path to Stockholm; a Personal Reminiscence"
Sir Geoffrey Wilkinson FRS, Imperial College, London
16.30 Close

Further enquiries to be made to John Hudson, Royal Society of Chemistry.
[Gerry Moss is thanked for providing this information]

POWDER MAGAZINE AT CENTURIAN WAY, PURFLEET

Tony Yoward has provided us with a copy of the following entry under "Essex" in *Transactions, Ancient Monument Society,* **40**, 1996:
"No 5 is the only survivor of a group of five large gunpowder magazines built in 1763-5 to designs by James Gabriel Montresor for the Board of Ordnance. These magazines were the government's principal gunpowder depôt and this building appears to be the most substantial surviving powder magazine in England. A rectangular brick structure with twin barrel vaults, it survives largely unaltered and retains many internal features of interest. There is evidence of the precautions taken to avoid accidental ignition of the gunpowder in the use of copper and the avoidance of iron in the building fabric. The original overhead travelling crane system is the earliest known surviving instance of this method of goods handling in England. The timber king-post roof frame is also notable, exceptionally densely built in order to help contain any accidental explosion."

BARGES AND PUNTS

Elizabeth and David Wood

We thought that a couple of items in Newsletter **18** might have been published to provoke a reaction from us, representing the Society for Spritsail Barge Research!

Regarding the Weedon Gunpowder Magazines (article on page 12), we had an opportunity last year, when we were cruising up the Grand Union, to at least walk round the perimeter of the site and to spot, from the canal, the entrance to the 'cut' to the works. We were able to look down on the still extensive site from a derelict car park (probably an MoD lorry park). It appeared that little had changed since Alan Crocker's visit in 1986 as no further demolition seemed to have taken place. We shall try to investigate further on a future visit.

The comment that did give rise to discussion and a request for further information was the comment that gunpowder was transported up the Thames from Waltham. We have certainly come across the trial run to Weedon but are fairly certain that we have never heard of Waltham barges working to Brentford. The boats owned by Henry Warlow are certainly known. Waltham barges seem to have worked to and from Woolwich and Purfleet but not to Brentford.

The explosion on the Regent's Canal was of a mixed cargo. It seems likely that the fumes given off by the oil lamp burning in the cabin were ignited and it was just unfortunate that the mixed cargo contained both petroleum and gunpowder - a somewhat lethal combination!

We were also interested to see the mention of the report on the punts at Waltham and Faversham (review on page 17). We have come across gunpowder punts which were registered with the Port of London Authority in amongst the barges owned at Isleworth an will investigate further.

REVIEWS

Wayne Cocroft, chapter on "The Munitions Industry" in *Thames Gateway. Recording Historic Buildings and Landscapes on the Thames Estuary*, RCHME, 1996, pp 89-97. (Proceedings of a Conference held in London on 24 March 1995)

This is one of the 14 chapters in a book, which also includes contributions on the aspects of interest to industrial archaeologists : "Early Salt Workings", "Sheerness Dockyard", "The Royal Arsenal", "The Royal Docks" and "Fortifications" and "Defences" of different periods. Wayne Cocroft was well qualified to write about the munitions industry as he is the author of the forthcoming RCHME book of national scope on the explosives industry. The first few pages are on gunpowder, especially on stores and magazines, which were often in bad condition. He relates, for example, the story of 2,000 barrels of powder falling through one of the floors of the White Tower, at the Tower of London, in 1691. He mentions the construction of the Greenwich magazine in the 1690s, two at Tilbury, each capable of holding 3,000 barrels in 1716 and the five at Purfleet, each capable of holding 50,000 barrels in the 1760s. The Purfleet magazines were recorded photographically by the RCHME in 1973, before four of them were demolished, and the surviving magazine has recently been the subject of a detailed analysis.

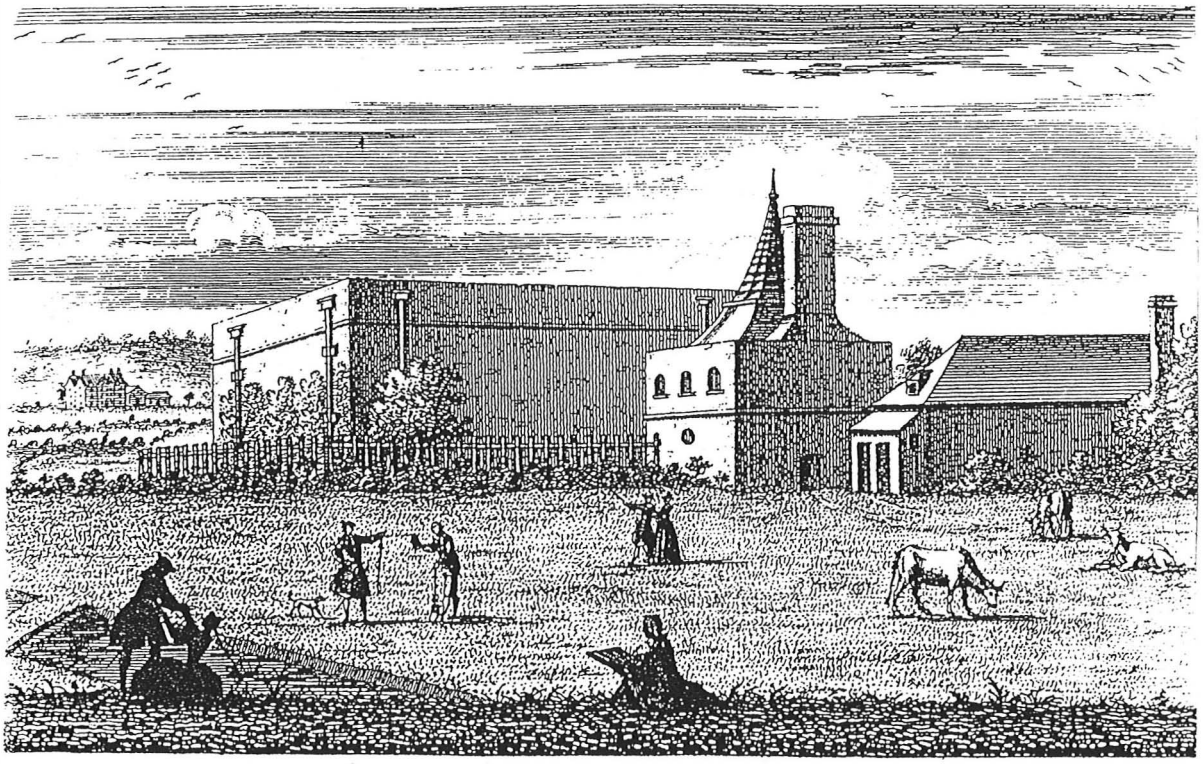
Factories for modern explosives and propellants are then discussed. These include, examples at Tripcock Ness near Thamesmead, Uplees on the Swale near Faversham, Pitsea Hall Farm, Kynochtown and Cliffe Marshes. Other munitions factories are also dealt with including, during World War I, the use of unsuitable buildings for the production of TNT. This contributed to disasters at Silvertown, when 74 people were killed, and at Uplees when 106 lives were lost.

This account certainly whets the appetite for Wayne's forthcoming book.

K R Fairclough, "The Hard Case of Sir Polycarpus Wharton", in *Surrey Arch Coll*, 83, Surrey Archaeological Society, Guildford 1996, pp 125-135

The abstract of this well-researched paper by Keith Fairclough probably gives the best account of its contents:
"In the last decades of the 17th century, Polycarpus Wharton, the son of an important Ordnance Board official, was by far the most important supplier of gunpowder to the government. He produced at several sites including Chilworth mills in Surrey, the largest gunpowder manufactory in England, and was so well thought of that he was asked by the Ordnance Board to help develop and improve the quality of gunpowder production. Yet growing financial problems meant that in 1698 he ceased production, and subsequently petitioned the Board about debts which he claimed were owed to him and his father. So severe were his problems that he spent some time in a debtor's gaol, and the evidence suggests that he never recovered financially. This article attempts to recount what is known of his life and career, but cannot explain his quarrel with the Ordnance Board."

THE POWDER MAGAZINE NEAR GREENWICH



Wayne Cocroft has provided us with information about the Greenwich magazine, including the above print (Greenwich Local History Library, Martin Collection 1182), which is thought to date from the 1730s. The history of the building of this magazine has been summarised by O F G Hogg in *The Royal Arsenal,* vol **1**, OUP, 1963, pp 106-7. In October 1694 the Ordnance Office wrote to the Treasury explaining that the Queen had been pleased because gunpowder had been removed from Greenwich house to stores at Gravesend and Tilbury which were now full so that a new powder house was needed. They estimated that it would cost £6,218 13s 9d to build a magazine, a wharf, a proof house and a dwelling house for the storekeeper. A map which accompanied a survey of the Manor of East Greenwich in 1695 shows that a "New Magazine" had already been built at the side of the Thames at NGR TQ 391788. This is the large building in the print and presumably the smaller buildings are the proof house and the dwelling house. Note also the mandatory cows (see GMSG Newsletter **18**, p 16) and the nonchalant humans. In practice the presence of the magazine caused great public concern and eventually in the 1760s the gunpowder was removed to new magazines at Purfleet.

Wayne suggests that the parapet on the magazine building in the print may indicate that it had a low vaulted roof covered with sand and shingle. He also notes other interesting buildings on the map including a "House for Fire Works" (NGR TQ 392768), a "Mount for trying of Mortars" (NGR TQ 389 765) and a "Laboratory" (NGR TQ 387777), which according to Hogg was used for manufacturing fireworks, including match, but had been closed by 1694.

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