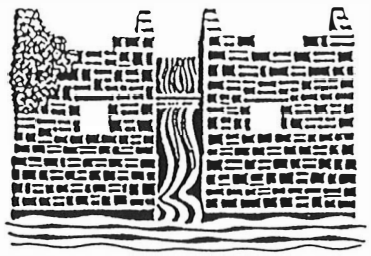


Gunpowder Mills Study Group

NEWSLETTER 22, FEBRUARY 1998

GMSG MEETING AT BISLEY, SURREY

SATURDAY 6 JUNE 1998

In April 1994 Bill Curtis hosted the Group for a very successful day-meeting at Bisley and we are grateful to him for being willing to arrange a similar meeting on Saturday 6 June. The programme will be as follows:

Morning from 9.30 am
A demonstration with hands-on experience of the use of gunpowder in a variety of original firearms on the **Short Siberia Range**.

Lunch Break, 1.00 pm to 2.00 pm
A buffet lunch will be provided at one of the historic club houses in Bisley Camp.

Afternoon, 2.00 pm to 5.00 pm
2.00 pm to 3.30 pm Display and discussion by Bill Curtis and others of gunpowder containers, packaging and the means of carrying gunpowder for immediate use. Those attending are encouraged to bring along their own examples, photographs and slides.
3.30 pm to 4.15 pm Tea and a Tour of the Bisley Ranges.
4.15 pm to 5.00 pm Group Talks and Discussion.

Cost
The total cost for the day is likely to be about £7 including the use of the range, the hire of a Target Marker, lunch and tea, but will depend to some extent on the number of people attending.

Finding the Site
The entrance to Short Siberia Range is on the north-west side of Queen's Drive, about 1km south-west of Bisley village, which is on the A322 about 5km south-south-east of Junction 3 on the M3. The range is about 2km from Brookwood Station on the Waterloo to Southampton line.

Registration
Please let Bill Curtis know by 23 May if you are coming: W S Curtis, PO Box 493, Rhyl, Clwyd LL18 5XG, tel 01745 548981, e-mail wsc@wscurtis-books.demon.co.uk

Please note that subscriptions for 1997-98 are now due. See enclosed form.

GMSG MEETING AT FAVERSHAM 24-26 October 1997 **Alan Crocker**

About fifteen members attended the Group's Autumn Meeting at Faversham, Kent, last October. The local arrangements had been made by Arthur Percival, who in the 1960s was one of the first people to recognise the importance of recording the history and surviving remains of the gunpowder and modern explosives industry in Britain. In particular in 1967 he wrote the seminal booklet *The Faversham Gunpowder Industry and its Development.* He also spearheaded the successful campaign to restore one of the Chart gunpowder incorporating mills and open it to the public and was a key figure in establishing the Fleur de Lis Centre at Faversham, which houses the local museum with important exhibits on the local gunpowder industry. More generally he has arranged for the Faversham Society to publish other booklets on the gunpowder industry including Ted Patterson's *Gunpowder Terminology and Incorporation, Gunpowder Manufacture at Faversham: Oare and Marsh Factories* and *Black Powder Manufacture in Cumbria* and Wayne Cocroft's *Oare Gunpowder Works.* We were all therefore very much looking forward to hearing Arthur's introductory talk on the Friday evening on "Faversham and its Gunpowder Industry" but unfortunately we discovered on the previous day that he was unwell and unable to participate in the meeting.

Arthur had arranged for us to hold our evening meetings at "The Chimney Boy", a pub near the Fleur de Lis Centre, and after a very enjoyable bar meal, with enormous helpings, we went upstairs to an excellent meetings room, where, instead of Arthur's introductory talk, we had a discussion, led by Brenda Buchanan, but with contributions from Steve Chaddock, Wayne Cocroft and Alan Crocker, on the development of an "interpretative heritage site" at Waltham Abbey. Since October there have been further developments and an updated account of the situation is given elsewhere in this Newsletter.

On the Saturday morning we had talks in the meetings room at the Fleur de Lis Centre. First there were contributions from Keith Fairclough and Glenys Crocker on "17th and 18th Century Inventories of the Faversham Gunpowder Industry". Keith discussed the contents of a 1678 inventory of William Buckler's mills. At that time these were concentrated near the town centre and later became known as The Home Works. The inventory, held by London Metropolitan Archives (formerly the Greater London Record Office), contains sections on the boiling house, the coopers' house, the corning and dust house, the coal house, Stonebridge house, two yards, a watchhouse, an incorporating (pestle) mill and items belonging to the works (a hoy and two finger rings). Buckler, who had succeeded Daniel Judd at Faversham after the Civil War and Interregnum, also held gunpowder mills at East Molesey and Wandsworth in Surrey. Keith discussed several aspects of the inventory including the location of the sites and the technology represented. In particular he noted that only three pestle or trough mills are recorded at Faversham, far fewer than at Buckler's other sites.

Glenys then discussed inventories of 1748 and 1753. The first of these was from a deed of sale of the Kingsmill site (part of The Home Works) by Matthew and Lydia Cox to Thomas Pearse and is held by the Public Record Office (PRO: TS21/874). It lists 24 items including a (saltpetre) earth house, a boiling or refining house, a horse mill for charcoal, a horse mill for saltpetre or brimstone, a mixing house with boulting engines for charcoal and brimstone, two horse powder mills, two water powder mills with a wheel 14ft in diameter and four troughs 14ft long, each with ten mortars and 20 pestles, a corning house, a dusting house and a drying house.

The 1753 inventory is from an indenture of co-partnership between Thomas Pearse, Benjamin Pryce and William Stevens and concerns powder mills at Faversham and Chilworth in Surrey, magazines at Barking Creek in Essex and at Liverpool, and an office in London. It is in the BP archives held at the University of Warwick (Ref 38646) The Faversham mills

were on the freehold estate of Thomas Pearse, land held of St John's College and land held of Matthew Cox. Glenys gave details of the items on the land of Matthew Cox, which were featured in the earlier 1748 inventory. They included two stone water mills, one double horse mill, a corning house and two dusting houses, a glazing mill, a refining house, saltpetre earth, refined saltpetre, rock petre (of uncertain meaning), brimstone, charcoal, barrels, a hoy, a barge and three punts. The two stone water mills had 12 stones, clearly indicating that there were four edge-runner incorporating mills, each with a bedstone and two runners. It was interesting to note that they had been introduced in the previous five years. Incidentally the stones were valued at £26 each, giving a total of £312, compared for example with only £35 for two waterwheels.

Glenys pointed out that the 1753 inventory shows the involvement of Pearse & Co in private trade, since it includes the magazine at Liverpool and lists several grades of powder at a time when the government required only one. Finally she read from an account of a visit to Faversham and Chilworth mills by two Americans (Frederic Lee pointed out that they should be called American colonialists) in 1735. This is reproduced elsewhere in this Newsletter.

The next talk was by Alan Crocker on "The Faversham Apprentices' Illustrated Notebooks of 1796". He started by showing slides of the 12 drawings in *The Rise & Progress of the British Explosives Industry* (Whittaker, London, 1909). Eleven of these are of gunpowder manufacture at Faversham and one, in two parts, of gunpowder testing at Purfleet. Four of these drawings are dated 1796 and one 1798 but the printed captions all say that they date from 1798. Also the text of the volume states that they are from "a MS book evidently compiled by John Ticking, Master Worker of the Royal Faversham Mills in the year 1798".

Alan then pointed out that when in 1986 Glenys Crocker was writing her Shire Album on *The Gunpowder Industry* she obtained from Arthur Percival copies of 25 photographs of drawings in "Royal Laboratory Courses", a manuscript volume which belonged to Francis Whitworth and now held at the Kent Archives Office (U269,018/1). Twelve of these drawings were similar to those in *The Rise & Progress* but of better quality. Five were dated 1796 and none 1798. The originals were inaccessible at the time and the copies were unsuitable for publication, so Alan retouched five of them and Glenys used these in her Shire album. Alan then projected one of the Whitworth drawings which is not in the *Rise & Progress* and four pairs of drawings from the two sources, pointing out the relatively minor differences.

Then in 1989 Alan and Glenys had acquired a booklet containing the originals of *The Rise & Progress* drawings from a descendant of the Curtis family, who as Curtis's & Harvey took over the Faversham mills in 1898. This booklet contains four additional drawings and 21 pages of compactly written text. The paper used in the booklet is watermarked 1797, a year after the date on several of the drawings, which suggested that they might have been copied from those at the Kent Archives Office. However when these were examined it was discovered that they are on paper watermarked 1799 and 1800. It would thus appear that both sets were copied, perhaps at different times, from a lost original. The text of the Curtis-family booklet includes regulations for the supply of His Majesty's navy with gunpowder, the process for charring wood in iron cylinders, the process of making gunpowder, two tables of results of proof tests on Faversham powder from different incorporating mills, the method of proving powder at Purfleet, the method of grinding saltpetre, sulphur and charcoal and the method of treating sulphur at Faversham. At the foot of one of the tables is written "Signd Jno Tiking, Master Work". This is the only reference to Ticking in the booklet so it is difficult to justify the claim in *The Rise & Progress* that he was the compiler of the booklet. In conclusion, Alan speculated about who the original owner of the Curtis-family booklet might have been, and pointed out that in 1989 he had purchased a microfilm of the Whitworth volume from the Kent Archives Office for £32.93. Those present supported the suggestion

that the Group might provide some financial support to publish a book about the drawings.

After coffee Wayne Cocroft presented his talk on "The RCHME Surveys of the Faversham Gunpowder Mill and Explosive Factory Sites". In 1991 the remains of the Oare Works, which are about 1 mile NW of the town, were threatened by gravel extraction and the creation of a gypsy encampment and John Williams, the Kent County Archaeologist, asked the Royal Commission to survey the site. The Group supported this request and it was Wayne who led the team which carried out the work and produced the Commission's report. It was this survey which introduced the Commission to recording gunpowder mill sites and prepared them for a much more extensive survey at Waltham Abbey, followed by a national survey at a less detailed level, again undertaken by Wayne, of all gunpowder and explosive manufacturing sites in England. These of course included the Home Works at Faversham and the Marsh Works, which are 1 mile N of the town, and also modern explosives factories near Uplees, 2.5 miles NNW and the Abbey Works, 0.7 miles NE of the town. Wayne was therefore ideally qualified to give a detailed account of the Faversham industry.

It is thought that the Home Works started in about 1560 but the first definitive records are dated 1653. In 1759 they became the first Royal Gunpowder Mills. In the meantime the Oare works had been established in the early 18th century but remained in private ownership. Following a bad explosion at the Home Works in 1781 the Government set up the Marsh Works but at the end of the Napoleonic Wars the two mills were acquired by John Hall who already owned the Oare Works. All three mills were taken over by Curtis's & Harvey in 1898 but after World War I became part of ICI before closing in 1934. The developments at Uplees started in 1872 and guncotton, "Tonite" for mining and quarrying, and detonators were made there. A works for loading TNT into shells was also established nearby. All of these works closed at the end of World War I. Finally the Abbey Works were started as a mining explosives factory in 1924 but became a non-explosive blasting cartridge factory in 1931.

Wayne's talk was illustrated by detailed historic maps, especially of the Royal Gunpowder Mills, beautiful aerial photographs, especially of the coastal Marsh and Uplees Works, and fascinating early photographs of gunpowder manufacture at Faversham at the end of the 19th century. One of these (which has been used as the cover illustration of Ted Patterson's book on the Oare and Marsh Factories) gave rise to considerable discussion as it shows a workman loading a large piece of timber into a charcoal retort. Most of us had thought that the timber used was in the form of thin sticks as obtained for example by coppicing. There was also discussion, prompted by their presence at the Marsh Works, about the use of earth houses. These were originally used to produce saltpetre from pigeon droppings but were later used to recover as much saltpetre as possible from damp gunpowder and from the liquor left over after refining was completed. It was suggested that earth probably makes a good filter for removing sulphur and charcoal from gunpowder.

After lunch we were welcomed at the restored Chart Mills, which formed part of the Home Works, by a helpful member of the Faversham Society. Here we were also joined by Sheila Smith of Swale Borough Council and Richard McCrow of the Groundwork team who should soon be starting to carry out some clearance and fencing work at the Oare Works. There were originally two waterwheels at the Chart Mills and four pairs of stone edge runners at this site. One waterwheel and one pair of edge runners has been restored and there is a display about gunpowder manufacture. One point which I found interesting was the dressing of the side (circular) faces of the stones. This had been done in quarters leaving a smooth cross a few inches wide. Presumably this cross had been painted so that the mill-man could observe whether the stones were turning correctly or skidding. The problem was that the cross was on the inner face of the stone so I suggested that it should be remounted the other way round.

However Gerry Moss noted that there was also a very faint cross on the outside of the stone, which suggested that stones might have worn asymmetrically during their working life and, from time to time, had to be reversed.

We then went on to the Marsh Works, a very flat site much of which has been destroyed by gravel extraction. It now consists of large ponds with strips of land between. One of the staff of Bretts, who operate the site, welcomed us and we were allowed to explore with Wayne Cocroft as our leader. The buildings which survive are of great interest. They include late 18th century weatherboarded saltpetre earth and refining houses, with impressive timber roofs. There was also a glazing house which had been powered by electric motors by means of a shaft which passed along a tunnel through an enormous mound which we all climbed for the view over the marshes. We then saw the massive wall of an ICI corning house which separated the corning machine from its electric motor. However it was not clear which was on which side of the wall. Wayne also tried to show us the proof house. It was covered with vegetation but this did not stop him from taking photographs.

Our last stop of the afternoon was the Oare Works and again Wayne Cocroft acted as our leader. This site is also owned by Bretts but Swale Borough Council are about to take a long lease of the site and it is hoped to obtain a grant from the Heritage Lottery Fund in order to make it safe for the general public and to open a small interpretation centre. It is also currently being considered for scheduling as an ancient monument. We entered at the south end and first saw the packing house with a very large, tied-arch, corrugated-iron roof, which Malcolm Tucker recognised as dating from about 1840 and said was now rather rare. We then saw the foreman's house, which has suffered from an arson attack, the cooperage which used to have a clock tower, the glazing house remodelled in 1926, a puzzling brick pit at the pump house which appears to have been used or re-used to raise water to the upper leat, the corning house built into the hillside with a massive concrete dividing wall similar to that at the Marsh Works but with interesting differences and also a massive blast wall with an exterior arched chamber previously thought to be for a steam boiler but reinterpreted by Malcolm as accommodating a shaft from a former waterwheel, the foundations of a row of four pairs of electrically powered incorporating mills built in 1926, and finally the 170m long test range terraced into the hillside and lined with Wellingtonias, only the stumps of which remain.

We reassembled for dinner at "The Chimney Boy" and were joined by John Williams, of Kent County Council, who afterwards talked to us on "Challenges in Industrial Archaeology in Kent". He emphasised that he was trained as a prehistoric and Romano-British archaeologist but had included material in his talk which had been provided by his colleague David Eve, who studied industrial archaeology at the Ironbridge Institute. He showed us slides of major excavations carried out ahead of road works which had revealed many important Bronze Age, Romano-British and Saxon sites, talked of the significance of maritime archaeology in Kent as it has the longest coastline of all the English counties, and of the problems posed by the massive developments associated with the Channel tunnel. He then talked about industrial sites in Kent including docks, coal mines, malthouses, paper mills, windmills (the Council owns eight) and of course the gunpowder mills. His department has to deal with a far higher number of planning applications than the national average and his team of 10 staff have a demanding job. It is therefore important for them to liaise with specialist groups, such as our own, and it is perhaps unfortunate that Kent has no county-wide industrial archaeology society.

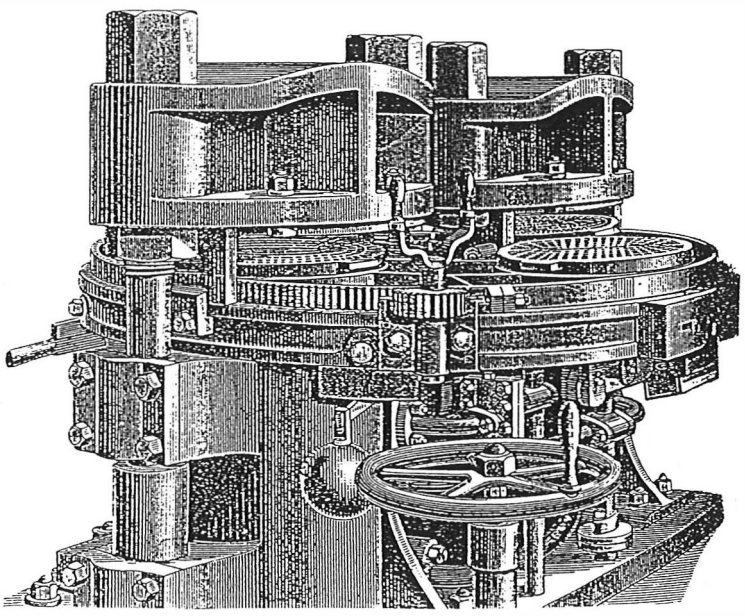
On Sunday morning we met in the town centre and drove to the Abbey Works where we were met by the very helpful manager, Peter Filmore, who conducted us around the factory. It is now operated by Long-Airdox, a subsidiary of Cardox International, Cardox being an abbreviation of carbon dioxide. They make Cardox tubes which are used for coal and mineral

mining, stone quarrying and civil engineering projects. These consist of a steel tube containing an electrical firing head, a non explosive "heater", which is a paper tube containing a chemical energiser, and a liquid carbon dioxide charge. On firing, the carbon dioxide gasifies, expands and breaks material along natural or induced fracture planes. The tube can be reused thousands of times, the heaters cost as little as £2.50 and recharging with liquid carbon dioxide is a simple process. The British coal mining industry used to be a major customer and over 100 staff were employed. However, because of the introduction of new coal extraction machinery and the closure of mines only four staff now work at the site. Because of this it has been unnecessary to introduce new equipment so that the works is a time-capsule of 1930s technology. It consists of nearly fifty separate huts linked together by a man-operated tramway, which is still used. Peter showed us around most of the huts which are in use today. These included the panelled offices with old furniture and a display of historic photographs, heaters and tubes, the mechanical workshop with belt driven machines, the hut where the paper heater tubes are made, the workshop where the liquid carbon dioxide is put in the iron tubes and finally the room where the heater tubes are filled and sealed. The works still makes some 50,000 heaters and 500 cardox tubes a year and has had no serious accidents since the 1930s.

On the way to lunch we called at Standard Quay on Faversham Creek to see "The Lady of the Lea", the last wooden sailing barge built in the 1930s to carry gunpowder from Waltham Abbey to the magazines at Purfleet. David and Elizabeth Wood have researched this barge in great detail (see David's *Powderbarge W ↑D*, Society for Spritsail Barge Research, 1977). We all thought that it would be good to link the barge in some way to the Waltham Abbey project. Finally we had sandwiches and drinks at a pub in the village of Oare and, after an exhausting weekend, decided that we would not spoil our recollections of Wayne's wonderful aerial photographs of the Uplees factory by trying to see the traces of foundations from ground level. So we dispersed at the end of a very rewarding weekend and are very grateful to all those who helped to make it a success, particularly Arthur Percival and Wayne Cocroft.

THE MANUFACTURE OF GUNPOWDER IN ENGINEERING (continued)

In this issue we are printing the remaining four illustrations of machines for manufacturing gunpowder taken from vol 25 of *Engineering* (1878).



11. Machine for making 400 pellets of gunpowder, 3/4 inch in diameter and 1/2 inch long, at one time. Hydraulic rams are used to compress meal powder into pellets and to eject them from the mould plates.

A VISIT TO FAVERSHAM AND CHILWORTH MILLS IN 1735

Glenys Crocker

The diary of Robert Hunter Morris recounts his 18-month stay in England as a young man accompanying his father who was visiting London as the agent of a group of New Yorkers.(1) The title of the published paper on the diaries "An American in London" is, as Frederick Lee has pointed out, misleading: the Morrises would not have thought of themselves as Americans but as colonialists. Lewis Morris, the father, was active in politics first in New Jersey and then in New York. His son came to act as his secretary and to further his own education. Much of their time in England was spent sight-seeing and establishing contacts.

Most of the men in public life whom they met were connected with the navy or were colonial agents, partly because several of the officers had been stationed in New York and partly because of family connections with prominent naval families. One of these was a naval officer Captain Vincent Pearse, who was one of Lewis Morris's sons-in-law and was related to a commissioner of the navy, Thomas Pearse. The latter had acquired the gunpowder business which had formerly been run by the Grueber family and the Morrises visited his works at both Faversham and Chilworth.

On Sunday 13 July 1735 they stayed at the Pearses' home at Rochester, and 'spent the forenoon in talking with Mr. Pearses two overseers of His powder works about a mill of His that wanted force'. On the following afternoon they set out to Faversham to see the powder mills, which they did next day:

> We rosse at 8. My father and I after brakefast went to see the severall mills for making of powder, the method of refigning the salt peeter, and of gr[i]nding it, also of grinding the Cole and Brimstone. When we had seen what was worth seeing about the mills, it raining, we returned to the House where we lay, and, having Dined, we sat out on our returne to Rochister. It was at this place my father proposed the making of powder by cyllinders to turn one against another. He also proposed an alteration in on[e] set of mills that wanted force. This alteration was relolved [resolved] upon and Mr. Hall directed to make a moddle of it ...

The Morrises returned to London and the following Saturday, 19 July, Mr Pearse came to take them to Guildford to see his powder mills there. They spent the night at Chilworth and next morning:

> We went to View the mills, which took us till noon. We saw four pair of large bed stones and as many bed Stones for them to run on. The runners were 6 foot diamiter and the bed Stones something bigger. These stones were not yet put up. We saw the same conveniences for making and corning powder here as at Feversham. We dined and sat the afternoon in the house with two countrymen. The one rented the paper mills Just by Mr. Pearses House, which we were also to see in the morning ... The other lived in the mantion House ... We supped on some frogs, which one of the gentlemen would not Eat. Mr. Pearse Eat most of them HimSelf ...

The intended visit to the paper mill was not reported - next day he went fishing, got wet in the rain, set off again for a walk but was rained off, and the following day they returned to London.

The descriptions of the mills at Faversham are tantalisingly vague; one admires the elder Morris's confidence as an engineer and would dearly like to see Mr Hall's model. The description of Chilworth is a clear indication that edge runner mills were being set up and is the earliest known evidence for their appearance at the site.

1. "An American in London, 1735-1736: the diary of Robert Hunter Morris", edited by Beverley McAnear, *Pennsylvania Magazine of History and Biography*, vol 64 (1940), 164-217, 356-406.

GUNPOWDER AT THE XXTH INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE, Liege, Belgium, 20-26 July 1997

Brenda Buchanan

This four-yearly International Congress covers all aspects of the history and philosophy of science, technology and medicine, and attracts well over one thousand scholars. With such a crowd and so many simultaneous sessions it might be thought difficult to make new friends but this is not the case and it was at the previous congress at Zaragozza, Spain, in 1993 that I was introduced to Patrice Bret, the noted French historian of science who is now a member of GMSG. At Liege too, several new contacts were made. ICOHTEC is part of this larger body and so, although it has grown in size, it is still called the International *Committee* for the History of Technology.

In order that gunpowder history should not be neglected I submitted a paper and was allocated to a session with the daunting title "Technology and Engineering in the Classical Period (1543-1800)". Here fifteen papers were presented and amidst the various languages and different subjects my own attempt to provide a survey of matters of current interest to gunpowder historians found a place. The first two parts of my paper have already had a uesful airing in the *Gunpowder* book[1] and the pages of the GMSG Newsletter[2], so I will only mention them here briefly: The first concerned names - gunpowder, black powder, or the north European "krudt", all of them significant because they are historical designations of technical origin; the second reviewed the debate about ingredients, especially saltpetre, and the possible link with the introduction of the granulating process known as corning. The difficulty of revising traditional views on this subject was also considered.

Next comes the crucial process of incorporation and parts of this section will be reported more fully. The growing preference for edge runners over stamps in Britain in the course of the eighteenth century, endorsed by the law of 1772, can be seen as an effective answer to the question of their comparative effectiveness and safety. But the experience of looking at this subject in its international context, and especially of editing the *Gunpowder* book, suggest that it would be unwise to generalize from the practice of any one country, especially when others provide evidence of a continuing preference for stamps. Thus it was long the view in France, and in the USA too through French influence, that stamps produced the best powder, and did so safely. Edge runners *were* adopted by the former at a time of national crisis in the mid-1790s, but only for a short period and because they offered an economy of time, particularly in the preparation of materials; incorporation in roll mills was not introduced by the du Ponts until 1822[3]. Despite the higher capital cost of edge runner mills and the difficulty of acquiring stones of the right material, this method was adopted by the Dutch, whose powdermaking skills were prized in other countries.[4]

A common factor in the adoption of edge runners by the British and Dutch may have been that both were trading nations, and so able to see the practices used overseas. The observations of Sir James Hope, a Scottish lead mine owner visiting Zeeland in the Netherlands in 1646, have been noted in a recent article,[5] but they are worth considering further because they provide not only the earliest known reference to edge runners in British powder mills, but also an intriguing reference to the use of a press.

Sir James was taken to see two horse-operated 'oyle milnes ... lyke unto our ordinarie pouder milnes or ... leidmilnes, consisting of tuo stones turned upon edge'. The fact that he was able to compare what he saw in Zeeland with something which was 'ordinarie' at home suggests that edge runners were already a familiar sight in Scottish powder mills. The account is difficult to follow, but essentially Sir James describes how the 'kaille' seeds were 'brayed' under the edge runners and warmed in a copper pan before being packed in woollen bags, folded in haircloth and leather, and placed between iron plates in a press, to produce oil used

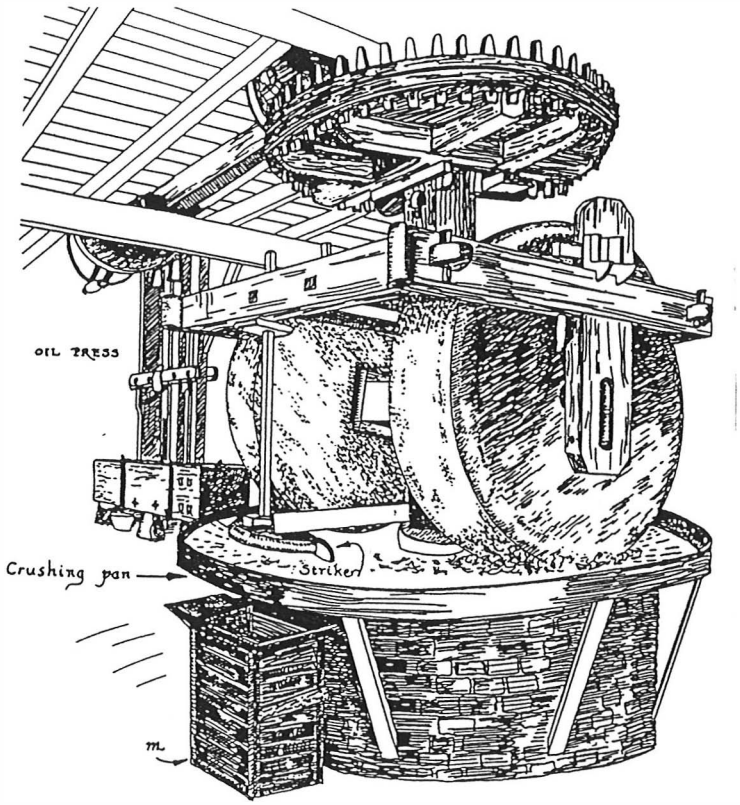


Figure 1 A Dutch oil mill from J Vince, *Power before Steam*, p 43.

largely for lamps. Pressure was exerted by stamps but it is the idea of the association of edge runners with a press which is the intriguing feature here. A drawing by Sir James has been lost, but the above figure of a Dutch horse mill or 'kollergang' for the extraction of oil from the seeds of flax, linseed, rape and cole provides a useful guide.[6]

The conversion to gunpowdermaking in the 1660s of a mill at Waltham Abbey 'heretofore an Oyle Mill'[7], suggests adaptability in the equipment used. Similar evidence comes from Hanover where a powder mill, established south of the city of that name in 1672, served other uses from the turn of the century including that of an oil mill. And when the 'roll mill', known in Germany from the Middle Ages but adopted more quickly by the wealthier Dutch, was introduced in north-west Germany, it was employed first in the manufacture of oils. Its use spread to powdermaking where its advantages were thought to be those of quality, because the product was more homogeneous and better compressed than when stamped; and safety, because the edge runners exerted a steady and consistent pressure rather than a pounding.[8]

It is likely that as research continues, more evidence will be found for the early use of edge runners like those mentioned by Sir James Hope in the 1640s. A study by Glenys Crocker and Keith Fairclough is awaited with interest, to see the case made for the identification of such mills near Windsor in 1680, at Sewardstone by 1694 (where the inventory of 1708 includes a reference to a press), and Wandsworth before 1715.[9] At present however it seems that none shows the continuity of use found in the edge runner mills in the Bristol region. Gunpowder had previously been produced in the cramped conditions of the city, but from the 1720s new works with new equipment were built on 'green field' sites by merchants engaged in the profitable new commercial ventures such as the slave trade. Seeking an outlet for their funds, they supplied the capital needed for the works, especially the innovative stone and later cast iron edge runners. They also provided the credit network required to sustain such businesses in the national and international markets, where they flourished until the early 19th century.[10]

It is ironic that the most important technological information about edge runners, concerning weight and condition, should have sprung from the efforts of these powdermakers to gain a Government contract in the 1760s, rather than from some aspect of their profitable private trade. But it is from correspondence with the Board of Ordnance that we learn of their fear that at 2.5 to 3 tons their runners were too light, as they understood those of the successful suppliers of the London area to be 5 to 6 tons in weight. They were told not to worry on that score for the Faversham runners did not much exceed 2 tons - they had however been *'turned Smooth* (in a kind of Turning loom)' by two men sent by the makers of the runners after delivery. 'The Smoothness of the Runners and bed' were of great importance.[11] There is no evidence of this advice having been followed, but another industry in which the quality of the stones used in the production of powders had to be of the highest standard, was that of medical supplies. It is not known when edge runners were adopted, but from the beginning of the eighteenth century monopolies granted to the Society of Apothecaries to provide bulk supplies to the Navy, the East India Company and ships sailing to Australia, must have required large scale productiuon. Edge runners were still in use at Apothecaries Hall in Blackfriars Lane in 1911.[12]

Lastly in this paper the uncertain matter of testing powder was considered. Briefly, this had been investigated by learned societies from the mid-seventeenth century, but the range of methods used over the years, including ratcheted spring triers, recoil gauges, testing poles, the ballistic pendulum, and proof mortars, all serve to indicate the difficulties involved.

This problem, together with that of blasting techniques in mining, and the military demands which from the mid-eighteenth century focussed research on the chemistry of detonation and the ballistics of projection, helped promote the beginnings of a scientific approach to the formerly pragmatic technology of powdermaking. All these aspects of the subject offer scope for continuing reserach today.

Endnotes

1. Brenda J Buchanan, ed, *Gunpowder: The History of an International Technology* (Bath University Press, 1996, "Introduction".
2. *Newsletter GMSG*, **20**, (Feb 1997), pp 19-21 & 25.
3. Patrice Bret, "The organisation of Gunpowder Production in France, 1775-1830", in ref 1 pp 266-8; Robert A Howard, "Black Powder Manufacture", *Jnl Soc Indust Arch*, **1**, (Univ West Virginia, 1975) p 17.
4. See contributions by Olaf Mussman and Manfred P Schulze in ref 1.
5. Brenda J Buchanan, "The Technology of Gunpowder Making in the Eighteenth Century: Evidence from the Bristol Region", *Trans Newcomen Soc*, **167** (1995-6) pp 125-9.
6. John Vince, *Power before Steam* (John Murray, 1985) pp 42-5.
7. Keith Fairclough, "Early Gunpowder Production at Waltham Abbey", Essex Journal, **20** (1985) p 14.
8. Olaf Mussman in ref 1, pp 332-7.
9. For preliminary notes see *Newsletter GMSG*, **21**, (August 1997) pp 4-6.
10. For a study of the Woolley mills, with reference to those at Littleton, see B J Buchanan & M Tucker, *Indust Arch Review*, 5 (3) (1981) pp185-202; for additional information see ref 5; for evidence on investment see B J Buchanan, PhD thesis, University of London.
11. B J Buchanan, "Meeting Standards: Bristol Powder makers in the Eighteenth Century", in ref 1, pp 237-52.
12. James F Fisher, "The Buildings and Treasures of the Society of Apothecaries", *Trans Ancient Monuments Soc*, **33** (1989) pp 1-21.

THOMAS CARTER GUNPOWDER MAKER, 1655-68

Charles Trollope has sent us a copy of a Contract and Agreement, dated 1 August 1656, between the Commissioners for the Admiralty and Navy and Thomas Carter of London, cooper, on behalf of himself and partners, for 100 barrels of new powder good and serviceable made of new and meet materials.(1) He also sent a useful transcript by Adrian Caruana. The powder was to be delivered in lots of at least 20 barrels per week starting on 1 September. It was to be Tower Proof and remain so for two years after the last lot was delivered to the stores at the Tower. It was agreed that two of the barrels would be put in a dry room with two locks, one key being kept by the Officers of the Ordnance and the other by Carter. After two years it would be taken for proof but, if Carter so wished, it would be sun-dried before this. The result, good or bad, would be assumed to be true for all 100 barrels. However, if at the end of two years any of the 100 barrels were found to be defective, Carter had to replace them or pay £1 per barrel. Also Carter would have to pay for such barrels to be collected and delivered to the Tower. In payment for the powder Carter was to receive 105 barrels of "decayed and unserviceable powder" from the Tower and to be paid £1 per barrel for the new powder.

In the Group's *Gazetteer*,(2) Thomas Carter is recorded at Bedfont Mill, Middlesex from 1655 to 1668. He is said to have taken a 15-year lease of the site, a former sword mill, in 1655, to have worked in partnership with a number of other powdermakers operating mostly in the Lea Valley and to have had contracts to supply the Ordnance. In 1666 he had a contract to make saltpetre in Surrey and London and its suburbs. A year later he established a second mill just downstream but died in 1668.(3,4) The *Gazetteer* also has Carter at Enfield and Enfield Lock in Essex in 1665(5). Keith Fairclough has explained that in January of that year Carter signed a contract to deliver to the Ordnance 200 barrels of powder a month from these two mills and that he had been supplying the Ordnance since 1652.(6)

The 1656 contract coincides with the Commissioners having serious concerns about the quality of powder being delivered to the Tower. A report was prepared on the powder supplied by six makers: Josias Dewy (Chilworth; 3,992 barrels; 18% bad), John Samyne (East Molesey and Wathamstow; 3,686; 47%), John Freeman (Sewardstone; 2.016; 40%), Daniel Judd (Faversham; 1,138; 53%), Thomas Carter (Bedfont and Lea Valley; 2,373; 60%) and William Molins (Carshalton; 1,893; 76%). One can understand why the Commissioners were concerned and apart from the powder supplied by Molins, Carter's was the worst. A certificate made by the Ordnance officers on 10 February 1658 on the state of the various powder makers' contracts again lists six names: Vincent Randyll (Chilworth; 2,240 contract barrels; 1,765 received), Thomas Warren (unknown; 784; 3), Thomas Carter (268.8; 208), John Freeman (560; 510), John Samyne (672; 547) and Thomas Fosson (Carshalton; 224; 130).(7)

Further information about Carter and indeed other powdermakers active in the 1650s would be welcome.

AGC

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1. PRO, WO55, 463.
2. *Gunpowder Mills Gazetteer*, Glenys Crocker ed, Wind & Watermill Sect. SPAB, 1988, p16.
3. Philo, P and Mills, J, "The Bedfont Gunpowder Mills", *Lond Arch*, **5**(4), 1985, pp95-102.
4. Bedfont Research Group, *Bedfont*, Hounslow & District History Soc, 1987, p64.
5. See ref 2, p7.
6. Fairclough, K, Newsletter GMSG **19**, pp11-12, August 1996.
7. *VCH Surrey*, **2**, pp322-4.

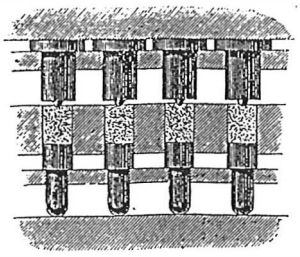
NEW OWNER OF LOCHFYNE GUNPOWDER MILL SITE JOINS GMSG

Paul Hadfield of Coleraine, County Londonderry, who works at the University of Ulster, recently purchased the Lochfyne Gunpowder Mill site at Furnace on the north shore of Loch Fyne in Argyll and has joined the Group. A party of GMSG members visited the site on a very cold, wet day in April 1990 (see GMSG Newsletter 7, pages 7-8) and we have provided Paul with some information about the site. It was established in 1841, was worked by Robert Sherriff, senior and junior, Robert Robin & Son, Carl Heuser and from 1879 by John Hall & Son of Faversham, and had closed by 1887. There are striking remains of several buildings, particularly the terrace of six under-driven incorporating mills which are not shown on an 1870 map but were present by 1883. They were waterpowered but the details of this are obscure. It is hoped that Paul will be able to discover much more about the history of this impressive site. His home address is 6 Union Street, Coleraine, N Ireland BT52 1QA and he may be contacted at work as follows: tel 01265 324236; fax 01235 324978; e-mail pja.hadfield@uist.ac.uk

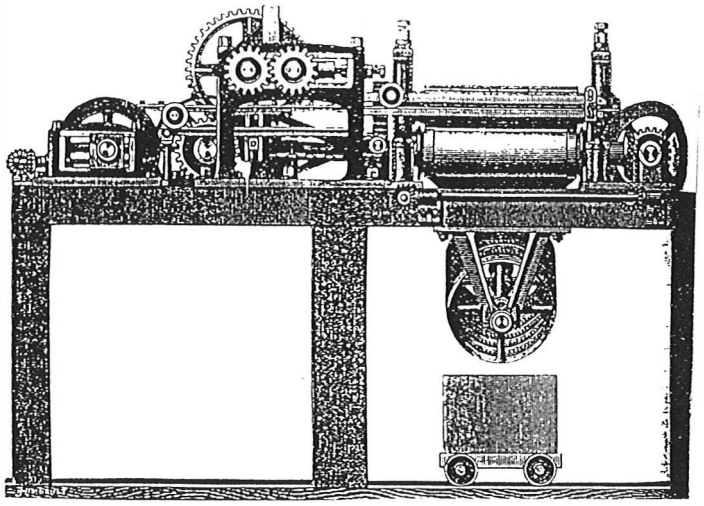
A RARE GUNPOWDER MAGAZINE BY CURTIS'S & HARVEY

Bill Curtis has drawn our attention to this item which was included in a sale at Sotheby's on 8 December 1997. It was described in the catalogue as follows: "possibly late 19th century, with cylindrical body of sheet iron riveted down a central seam, applied with a copper plaque cut-out with the number 696, bronze base and lid, the latter pierced with four holes for securing bolts and cast with the inscription 'To be returned to Curtiss & Harvey Gunpowder works Hounslow' (two securing bolts missing), retaining its original removable Japanned gunpowder tin, *62.2cm; 24½in high.*" The estimated price was £400-600 and "£550" has been inserted by hand. A note explains that "Curtiss & Harvey Ltd are recorded as gunpowder and explosives manufacturers with offices at 110 Cannon Street, The City, in 1915."

This suggests that Sotheby's do not know much about gunpowder manufacturers but are they correct in stating that this item is rare? Do members know of other examples from Curtis's & Harvey or elsewhere?



12 (above). Detail of the mould plate and rams used in the pellet press of figure 11



13 (right). Machine for making pebble powder with rollers which cut sheets of press-cake into strips and then cubes. These fall into a reel to be dusted and are then collected in a gun-metal truck.

LEGISLATION AND THE HOUNSLOW EXPLOSION OF 1772

Keth Fairclough

In 1771 an Act, 11 Geo III c35, consolidated previous legislation regarding gunpowder and extended its application to Scotland for the first time. The Act was limited, it had no concern with the production of gunpowder and included no additional safety provisions for its carriage and storage. Then in 1772 another Act was passed, 12 Geo III c61, which did regulate the production of gunpowder for the first time and which did introduce new safety measures for its storage and transport. This new Act was a response to an explosion at Hounslow gunpowder mills on the morning of Monday 6 January 1772, which had caused widespread alarm.

Initial press reports(1) show some confusion. A report in *The London Evening Post* dated Tuesday 7 January first stated that the powder mills at Molesey had blown up, that the explosion had been so great as to shake houses in London and that people thought that they had heard four shocks 'which were occasioned by different warehouses where gunpowder lodged blowing up one after another'. The following paragraph noted that another account said that the explosion had been at mills on Hounslow Heath and that considerable damage had been experienced at Hounslow, Twickenham, Isleworth and Brentford, but that 'the men were gone to breakfast when the accident happened, and no lives were lost'. The subsequent issue stated that the powder mills at Hounslow Heath belonged to Mr Hill(2), and said that there had been seven distinct explosions as gunpowder was stored at several places on the site, but did note that the magazine, being a strong building, had withstood the blast. One fatality was reported, a dwelling house within 100 yards of the explosion had been torn to pieces and a child had been buried in the ruins, but its parents had survived with substantial bruising. This newspaper carried no further reports.

A much longer report appeared in *The Public Advertiser* for the morning of Wednesday 8 January, most of which was reprinted in the January issue of *The London Magazine*.(3) This report noted that the explosion at Hounslow had 'done as much Damage to the Windows in those Parts as could have been performed by Wilkes riotous Mob, after a Brentford Election'. Nothing was said of the damage to the mills. It was reported that several people had been killed near them, but most of the account concentrated upon the widespread damage to property over a wide area and the alarm it had caused over an even wider area. It was said that the explosion was heard in London 'within a few seconds over or under, half an hour after nine', yet 'By one of Mr Mudge's Watches(4), which was in perfect Order, within a Mile in a direct Line of the Spot, the Explosion was heard, if the Confusion it occasioned did not cause a Mistake, at 24 Minutes after Nine, which gives nearly six Minutes for its passage'. One gentleman reported that the bridge between Battersea and Chelsea 'appeared to be actually lifted up three Times under his Feet'. Special mention was made that Horace Walpole's mansion at Strawberry Hill escaped damage, when that of 'Mr Hindley's (the late Lord Radnor's)' three quarters of a mile away lost many of its windows including 'an irreparable Loss in some painted Windows'. But it was added, 'The Cottagers however are the most to be lamented, who, besides feeling for the Expence of new glazing, which at this Season cuts deep into their finances, are the last who will be heard'. Yet, its an ill wind, for it also noted that 'it is diverting to see of what Consequence the poor Country Glaziers have become by their Misfortune, their Assistance being courted by Rich and Poor'.

The following day *The Public Advertiser* reported that the explosion had been felt over 40 miles away, in parts of Essex and beyond Erith in Kent, and that a messenger had been sent from St James to Mr Smith(2), the proprietor of the mills, with orders to bring an exact account of the damage sustained by him and the neighbourhood. Another daily, *The Gazateer and New Daily Advertiser*, had carried a shorter notice repeating some of the above details,

but had added that 'Immediately after the Accident People flocked from all Parts, for some Miles round, to the Spot, out of curiousity to see the Effects of the Explosion'.

On Saturday 11 January the weekly newspaper, *The Westminster Journal*, could open its report on the explosion, 'We can with good authority, assure the public, that only a small part of the gunpowder-works on Hounslow-heath belonging to Mr Edmund Hill and Co blew up on Monday notwithstanding the great explosion, and they consisted of what is called the graining and dusting-houses, in which we supposed to be about 200 barrels of powder, but that none of the workmen received the least injury'. It also carried some of the report that had appeared in *The Public Advertiser*, but added that the King had sent £200 to 'the poor workmen and unhappy sufferers by the late accident' and detailed additional accidents. A boy at Molesey had been injured by the plough he was guiding when the four horses pulling it bolted, and a pregnant lady in a post-chaise on Hounslow Heath had taken fright and suffered a miscarriage. This report also stated that the mills were 'in a most ruinous condition, yet large quantities of gunpowder are constantly kept in it'.(5)

The report carried by *The Gentleman's Magazine* at the end of the month was short and somewhat facetious. It mentioned that the powder mill had blown up 'by what accident is not known'; that it had been heard in London and Westminster, and that it had caused widespread alarm, initially arousing fears that it was an earthquake; and that it had been heard more than 100 miles off in Gloucestershire. That was the first paragraph, the other paragraph ran: 'About the time the explosion was felt at London, some families at Stockwell were terrified with the rattling and breaking of their china, which they attributed to a preternatural cause. A lady of fortune was so firmly persuaded that some invisible agent was concerned, that she discharged her maid, whom she suspected of having an intercourse with the wicked spirit; and when she was gone, as no more mischief ensued, consoled herself that she had got rid of so dangerous an inmate.'(6)

The explosion had caused widespread concern. *The Westminster Journal* had queried safety at the mills, and *The Public Advertiser* had demanded 'Surely, it will be highly prudent in the Legislature, if nothing of that Sort is already provided for, to guard against a Repetition of the Calamity'.

Parliament did respond. *The London Magazine* in its coverage of parliamentary debates soon afterwards stated that 'In consequence of the apprehension of dangers occasioned by the explosion of the Powder-mills at Hounslow, a bill was brought in'. This bill noted that it was 'to prevent the great Mischiefs which may arise from Explosions, occasioned by the improper Construction and Use of the Mills, Engines, and Buildings, employed in the Making of Gunpowder, and from keeping and carrying Gunpowder in too great quantities or in an improper manner'. The bill was presented in April 1772 by Beaumont Hotham, an MP counted as being in the opposition, but with family naval links, and whose wife was the widow of James Norman, a powder producer at East Molesey(7). By June it had received the Royal Assent.

The bill specifically banned the use of pestles in the incorporation of gunpowder, limited the amount of gunpowder that could be incorporated at any one time, and included regulations about the drying and storage of gunpowder and about the storage of charcoal at gunpowder mills during and after the process of production. It awarded JPs the right to licence the construction of any new mills, but it did not allow them to restrict production at existing locations or at any mill to be built by the state. It also limited the quantities of gunpowder that could be stored by any dealer or user of gunpowder, limited the quantities that could be carried by any cart or barge, and introduced new safety precautions for such carriage. However government powder mills and magazines were specifically exempted from such provisions. This bill was to receive several amendments as it passed through parliament.

Minutes in the *Commons Journals* or *Lords Journals* are not that informative, but they indicate that the amendments were made in the Commons not in the Lords, and that one amendment was contentious and required a division. Two petitions from gunpowder makers were noted, one from Hill at Hounslow, the other from Pigou and Andrews near Faversham.(8) Other information of these changes can be gleaned from a comparison between the original bill(9) and the Act, and from parliamentary reporting in the press, then in its infancy and still controversial(10). Another source, perhaps the best, has not been consulted because Sir Henry Cavendish kept his parliamentary diary in shorthand.(11)

Although there is no evidence that the explosion at Hounslow had been caused by pestle mills the bill banned them. However, Parliament added a clause that allowed mills at Battle, Crowhurst, Sedlescombe and Brede in Sussex to continue to use pestle mills for the production of fowling powder known as Battle powder. The following year another Act, 13 Geo III, c.13, extended this exemption to the mills at Old Forge Farm, Tonbridge. There is no evidence of any petition from the proprietors of these mills. Perhaps MPs were determined to preserve their enjoyment of hunting and believed that the quality of their fowling powder relied upon the continuing use of pestles. *The London Magazine*(12) also noted that complaints from Hill that the banning of pestles would cause him great hardship led to an award of fifteen hundred pounds compensation, Parliament being 'in general very tender of injuring private property by an Act, readily granted this request'. At this date Hill was the only Ordnance supplier who still used pestles to produce gunpowder.

Reportage in *The London Magazine* also indicated that some gunpowder producers supported the new legislation, for an opponent, George Dempster the MP for Perth Burghs, suggested that these producers hoped that the licensing system would mean that no new mills would be built and that this would force up prices to their advantage. The introduction of licensing by JPs had been the controversial issue that led to a division when a clause was added allowing producers whose application for a licence had been refused to appeal to the Kings Bench. Dempster believed that such a right of appeal was of little use as it would be too expensive. In his speech he cited an occurrence the previous year when the construction of a new mill at Maidstone was vetoed by the Kent JPs, who had assumed discretionary powers which the Act of 1771 had not given them. Yet he thought his opposition was in vain, for 'The loudness of the explosion at Hounslow has had such an effect upon the ears even of this House that they can hear nothing'. *The London Magazine* also reported part of the argument forwarded by Serjeant Price, counsel for Pigou & Co, who also thought that the bill was partly an over-reaction to events at Hounslow. He produced witnesses who argued that 'there was no danger to be apprehended from the blowing up of the mills by any but the people employed in them, or by those who were extreamly near them', that the problems at Hounslow had resulted from the 'fire's being communicated to eight hundred barrels of granulated powder', and that such problems would be lessened if little powder was stored at production sites, which they said was already general practice. There is no evidence to suggest that the safety measures in the bill were substantially altered as a result of these submissions from Pigou.

There were other amendments to the measures relating to storage and transport. One allowed mine owners to store up to 300 lbs rather than the 200 lbs others were limited to, another insisted upon the loading and unloading without delay of all powder barges and wagons. A major amendment was the addition of a clause which for the first time prohibited the use of charcoal or other combustible materials for fires, prohibited the use of candles for lighting and prohibited the practice of smoking on any powder barge. This was a blanket prohibition, which was reworded in subsequent safety legislation of 1860, 23 & 24 Vict. c139, so that smoking remained banned, but fires and lights were allowed except when the barges were

being loaded or unloaded or when the deck hatches of the barges were open.

The explosion at Hounslow had brought about a major review of safety procedures. Some of the changes introduced by the Act were obviously the result of the accident at Hounslow, even though the reports perused do not give a clear picture of what had actually caused the explosion, but other changes were obviously the result of the widespread concern which had caused some to think of what else could go wrong and what could be done to prevent it. The Act may have been introduced quickly as a response to widespread fears, but it was to remain on the statute book as the main legislative control until 1860.

Notes

1. Four newspapers in the Burney collection at the British Library have been consulted: *London Evening Post, Public Advertiser, The Gazateer and New Daily Advertiser*, and *The Westminster Journal*. In addition *The London Magazine, The Gentleman's Magazine* and *The Annual Register* were consulted. The Ordnance records at the Public Record Office have not been consulted.
2. An Edmund and John Smyth built the mills in 1757, and had brought their nephew Edmund Hill in as a partner the following year. But from November 1764 the mills had been under the sole control of Edmund Hill, although Edmund Smyth still held an interest in the freehold and leasehold property: J West, *Gunpowder, Government and War in the mid-eighteeneth century*, Royal Historical Society Studies in History, Volume 63 (Woodbridge & Rochester, 1991), 203-05 3. *London Magazine*, Volume 41 (1772), 40-41
4. Probably Thomas Mudge who was made free of the Company of Clockmakers in 1739 and whose business was based in Fleet Street from 1751 until his retirement to Plymouth in 1771: G. Clifton, *Directory of British Scientific Instrument Makers 1550-1850* (London, 1995), 195 5. In what must be a misprint the article placed the powder mills at Greenwich when making this comment.
6. *Gentleman's Magazine*, Volume 42 (1772), 41
7. Sir Lewis Namier, John Brooke, editors, *The History of Parliament: the House of Commons 1754-1790* (3 vols, London, 1964), ii, 640-41
8. *Commons Journals*, xxxiii 687,694,706,715-16,734,752,758,792,947*; Lords Jo*urnals, xxxiii 408,413,418,425,432-33
9. Sheila Lambert, editor, *House of Commons sessional papers of the eighteenth century* (147 volumes, Wilmington, 1975), xxii, 405-18
10. P G Thomas, 'The beginnings of Parliamentary reporting in newspapers 1768-1774', *English Historical Review*, Volume 74 (1959), 623-36
11. Cavendish's reports, said to be of a high quality, were kept in 'a version of Gurney's shorthand'. The diaries are now in the Egerton collection at the British Library. Reports of this 1772 gunpowder bill are to be found in Ederton Mss 241 fos 232-50,273-74: P D G Thomas, *Sources for debates of the House of Commons 1768-1774* (London, 1959), 54; D L Jones, *Debates and proceedings of the British parliaments: a guide to printed sources*, House of Commons Library document no 14 (London, 1986), 59.
12. *London Magazine*, Volume 41 (1772), 611-12. This report has been inaccurately summarised in P Langford, *Public Life and the Propertied Englishman 1689-1798* (Oxford, 1991), 44-45

THE EXPLOSION AT MOBILE, ALABAMA, ON 25 MAY 1865

Bill Curtis

On 12 April 1865, at the end of the American Civil War, one of the last ports to fall to the Federal forces was Mobile on the Gulf of Mexico. It had been a very successful entry point for supplies running the Union blockade and had materially contributed to the South's war effort. Huge stores of warlike material were captured. The town was packed with refugees, paroled Confederate prisoners of war and freedmen seeking work, as well as the Northern garrison and the original inhabitants.

Marshall's Warehouse near the waterfront was in the heart of the business and cotton press district where traffic was very heavy. It had been used by the Confederates as a munitions magazine. The Federal forces continued to use it as such and were packing more and more into it as captured material was brought in by train. On Thursday 25 May there were already 200 tons in store and more was coming in by the train load.

The soldiers engaged in handling this material were not trained ordnance personnel. In addition, they were, in modern parlance "de-mob happy" and are said to have been drinking. By 2 pm the word had already gone around the town that these men were behaving carelessly and irresponsibly. Broken boxes of ammunition with their contents spilling out lay where they had been dropped. It is quite probable that the men were also smoking. The NCO appeared to have lost control when the warehouse superintendent, Julius Becker, found the men "dropping boxes and rolling them end-over-end from one side of the warehouse to the other". He went in search of the lieutenant, who was lunching, and demanded that the officer return to his duty and maintain discipline.

By 2.45 pm, an ordnance clerk noticed that the officer had returned and was lounging against a box. Five minutes later there was a huge explosion. In addition to powder there were military shells and small arms ammunition. In an instance eight city blocks were levelled. Violent upheavals and explosions followed in rapid succession. Ships in the bay disappeared and iron shot with other debris rained down over a wide area. All across the city broken glass lay everywhere. Most of the warehouse district still standing was in flames. The loss of life was very heavy and has never been more accurately estimated than some figure between five and six hundred. In money terms the cost was at least five million dollars and ten thousand bales of cotton were lost. The fires were not brought under control for thirty-six hours.

By Friday morning the extent of the damage could be seen. The site of Marshall's warehouse was a crater ten feet deep. Working parties were still unearthing bodies and everywhere there was tumbled brickwork and charred wood.

Having survived without damage throughout the war, the last word can be taken from the diary of a Union soldier who wrote "Today I went and viewed the ruins of Mobile."

Based on a 1993 leaflet by George Schroeter from Mobile Public Library.

WALTHAM ABBEY ROYAL GUNPOWDER MILLS: PROBLEMS AND PROGRESS

Brenda Buchanan

New developments at Waltham Abbey, unthinkable even a decade ago, are beginning to offer a focus for the growing interest in this subject, by providing a physical context within which its importance can be demonstrated through the rich archaeological remains surviving there.

The former Ministry of Defence site lies north-east of London (centred at NGR TL 376 015). It was decommissioned in 1991, and when visits around that time were organised by GMSG, a sorry picture of dilapidated buildings and encroaching vegetation met our eyes. The future prospects were uncertain but it was felt that there should at least be a survey of the site. The suggestion was take up with enthusiasm and expertise by the Royal Commission on the Historic Monuments of England, and it is the archaeological work of their officers which now underpins developments there. For the most accessible account of the survey, see Chapter 23, "The Field Archaeology of Gunpowder Manufacture", by Paul Everson and Wayne Cocroft, in *Gunpowder: The History of an International Technology*, Brenda J Buchanan, ed, 1996.

In the meantime there was also a feeling in the local community that a site of such significance should not be lost, and so a consortium of interested parties was established with the Ministry of Defence as a key player, but also including representatives of English Heritage, English Nature, Essex County Council, and the Lea Valley Regional Park Authority. A Steering Committee was set up with the power to enter into contracts, and CIVIX and Prince Research Consultants became its main development and business planners. Much credit must go to the Steering Committee and their consultants: the site has been decontaminated at a cost of £16m, met by the MoD; a further sum of £5m has been secured from the same body as an endowment and revenue producing fund, together with a generous contingency fund to help provide for any further decontamination work which may be necessary; and lastly a Heritage Lottery Fund grant has been won, providing up to £6.5m to be spent on the essential work of restoring and displaying the site before the hoped-for opening to visitors at Easter 2000.

The site and its assets have been vested in the Waltham Abbey Trust Company (WATCO), composed of four Foundation Trustees of whom I have the honour to be one. I was nominated by the Science Museum - the other three by MoD, English Heritage and English Nature. We have been meeting regularly since May. An Operating Charitable Company (OCC) has also been established and this is concerned with the development and management of the site, through annual schemes carried out with the approval of WATCO. It is intended by this separation of responsibilities that the integrity of the site and its funding will never be compromised. The OCC consists of up to 20 members, largely recruited from applicants who responded to advertisements, and includes Alan Crocker, Chairman of GMSG.

So much has been achieved, can there be any problems as the title suggests? There are bound to be some of an administrative nature in this period of transition, as the Foundation Trustees come to terms with their financial responsibilities and the Steering Committee is in effect replaced by the OCC. But the problems are greater than this, and concern the challenge of doing justice to a large complex site of major international significance, the interpretation and display of which must meet the exacting standards of experts, whilst at the same time remaining accessible to local needs and interests. Altogether some 80,000 visitors a year must be attracted if financial viability is to be achieved.

In some ways these tasks would be easier if the site were less important, but superlatives may be used about its every aspect. It covers 71 hectares, and with 300 surviving structures and 21 listed buildings, more than two-thirds of it has justifiably been designated a Scheduled

Ancient Monument. Secondly, with equal justification, 34 hectares have been designated a Site of Special Scientific Interest because wild life (including the largest heronry in Essex) has flourished in places to which the public has for so long been denied access. And these areas are not distinct and separate, for there is artifice within the wild lands which must be placed in context - for example, waterways may reflect the need for power and transport rather than the natural course of the River Lea, and trees like alder may represent plantation growth for charcoal rather than natural seeding.

Most remarkably, this present landscape represents only the final stage of a process of evolution which began more than 300 years ago, and it is this remarkable continuity of use, in private hands until purchased by the Crown in 1787, which represents the third superb feature of Waltham Abbey - for it has ensured that at some time all the developments in the technology of powder making were to be found here before gunpowder was phased out from the 1880s by the advent of more powerful chemically-based explosives such as cordite. Even after the manufacture of explosives ceased in 1943 (due in part to war damage), research continued until the works closed in 1991, presenting the world of industrial archaeology with what is perhaps the greatest challenge it has yet faced.

St Barbara's Day (4 December) 1997

A ROTHERHITHE POWDER MILL TRADING TOKEN

Tim Everson of Kingston Museum & Heritage Service, who also deals in 17th century trading tokens, has informed us about an interesting halfpenny of 1669. These tokens were 'coins' issued by traders between 1649 and 1672 to provide small change and they carry the name and trade of the dealer and town of issue. This particular token was issued by Rebekah Smalman in 1669 at the Powder Mill in Rotherhithe, which was also known as Redriff. It is listed and illustrated in *The Norweb Collection,* volume 46 of *Sylloge of Coins of the British Isles*. It is number 5028 and is not a very clear example. The reading is as follows:

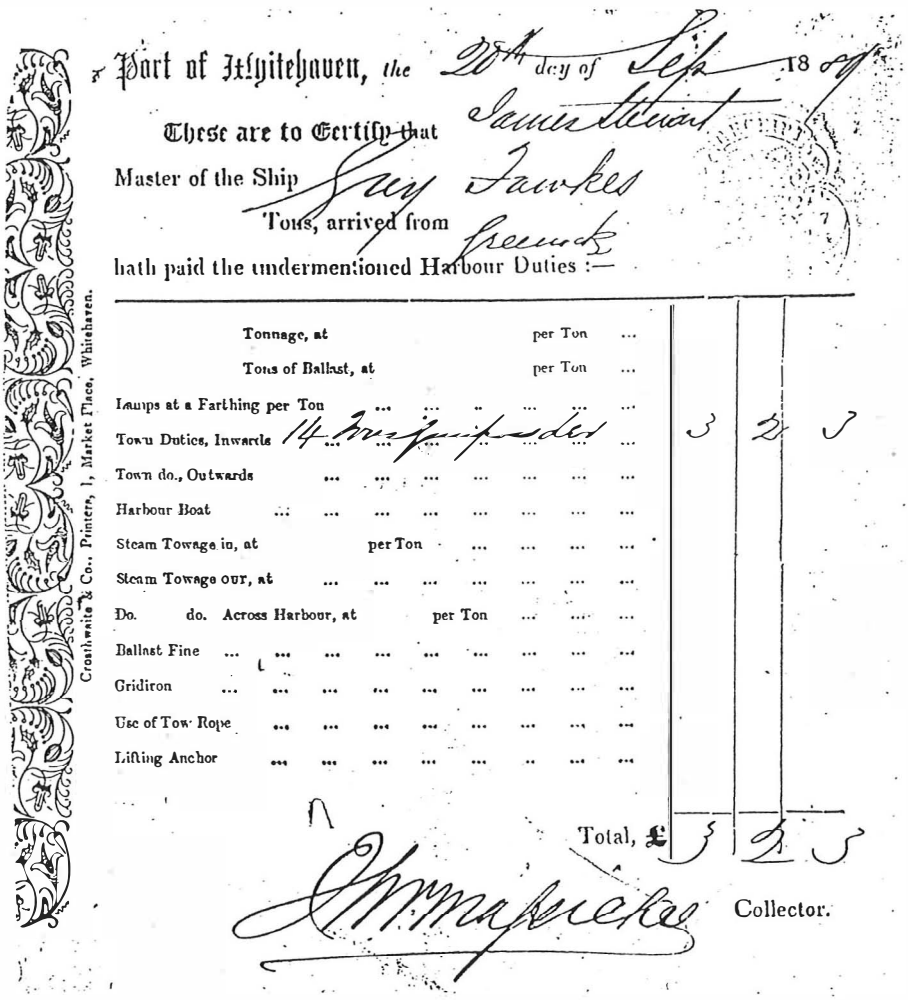
Obverse: REBEKAH SMALMAN AT YE, surrounding an illustration of a millstone

Reverse: POWDER MILL IN REDERIFF; HER HALF PENY 1669

It is a rare token and, if one became available on the market, Tim thinks that it would probably fetch at least £100.

As noted on page 24 of the *Gunpowder Mills Gazetteer*, two gunpowder mills are known to have existed at Rotherhithe by the 1540s and a powdermaker was still recorded there in 1600. Indeed these are thought to have been the earliest waterpowered gunpowder mills in Britain. However, the existence of a powder mill at Rotherhithe as late as 1669 came as a surprise. It is stated in the book that the Powder Mill may be the issuer's sign, especially given the millstone, but was possibly a building nearby. Indeed it is suggested that it might refer to an inn called 'Ye Powder Mill'. In the example illustrated, the millstone is not very clear but appears to have the conventional dressing of furrows in harps, as used in corn milling. This has been confirmed by examining a better example held by Guildford Museum. It does not therefore represent an edge runner and would in any case, in 1669, have been an exceptionally early use of edge runners for incorporating gunpowder. Alternatively it might have symbolised a stone used for grinding raw materials rather than for incorporating. However the most plausible explanation would seem to be that Rebecca Smallman was a widow running an inn at Rotherhithe called the Powder Mill, which was named after a gunpowder mill which had closed much earlier. Perhaps more information about Rebecca Smallman can be obtained but Keith Fairclough has already noted that her name does not appear in the Hearth Tax Returns of the 1660s.

WHITEHAVEN HARBOUR DUTIES



Port of Whitehaven, the 20th day of Sept 18 89

These are to Certify that James Stewart

Master of the Ship Guy Fawkes

Tons, arrived from Greenock

hath paid the undermentioned Harbour Duties :—

Tonnage, at per Ton			
Tons of Ballast, at per Ton			
Lamps at a Farthing per Ton			
Town Duties, Inwards 14 Gunpowder	3	2	3
Town do., Outwards			
Harbour Boat			
Steam Towage in, at per Ton			
Steam Towage our, at			
Do. do. Across Harbour, at per Ton			
Ballast Fine			
Gridiron			
Use of Tow Rope			
Lifting Anchor			
Total, £	3	2	3

John Mayoucks Collector.

Crosthwaite & Co., Printers, 1, Market Place, Whitehaven.

John Boyes has sent the copy of the certificate, dated 20 September 1889, which is reproduced here. It was found by a friend of his in a box of old documents in a second-hand bookshop. He notes that the names of the ship (Guy Fawkes) and the captain (James Stewart) seem too good to be true but that the form itself and the writing, as well as the ports of departure (Greenock) and arrival (Whitehaven) appear to be authentic. However the duty of £3.2s.3d for 14 tons is odd as it works out at about 53.357d per ton. Perhaps the figure is a total for several duties which have not been itemised separately. One of the others, "Lamps at a Farthing a Ton", is puzzling. Perhaps boats had to pay duty proportional to their weight, or the weight of their cargo, towards lighting the harbour. Incidentally, 14 tons was typical of the loads of gunpowder carried on River Wey barges from the Chilworth gunpowder mills to the factory magazine at Barking Creek on the Thames estuary. It seems strange that a vessel sailing down the west coast would only be carrying the same amount and apparently not unloading anything else. Any ideas would be welcome!

The Royal Gunpowder Factory, Waltham Abbey, Essex. An RCHME Survey, 1993.

Those unable to purchase a copy of this report when it was published in 1994, will be interested to know that it has been reprinted and is available from RCHME Publications Section, tel 01793 414600. Cost £11 plus £2.50 p&p. Cheques payable to RCHME.

SECOND BUCHANAN SEMINAR

Steve Chaddock

This meeting and tour of the National Monuments Records Centre was held at the Swindon office of the Royal Commission on the Historical Monuments of England on Friday 13th June 1997. It was jointly arranged by RCHME and the Centre for the History of Technology of the University of Bath.

Members of the GMSG attended the seminar along with other interested groups and individuals. Before and after the seminar the staff of the RCHME Swindon office made themselves available to conduct a tour around the surviving buildings of Brunel's railway works, vitally positioned between London and Wales for maintenance and refuelling. We also saw the superb facilities of the NMRC including a substantial archaeological library, historical photography by parish and industrial process indexes catalogued by subject as well as a perhaps surprising set of back issues of Country Life.

After informal drinks in an ante-room, Wayne Cocroft of the RCHME's Keele office [now at Cambridge] and author of the forthcoming academic tome, 'Dangerous Energy' gave an information-packed and well-illustrated lecture on "19th Century Developments in the Manufacture of Gunpowder".

Wayne started by looking at the role that the RCHME have played in recording the monuments that are redundant defence sites and considered the process by which a contracting defence business had led in the early 1990s to the earmarking for closure of around 150 MoD sites in England. One of the first on the list was the former Royal Gunpowder Factory at Waltham Abbey in Essex which went through a public consultation programme in 1992 at which point the suggestion was to retain only a handful of the 200 plus structures on the site. In almost his final act as a RCHME commissioner Professor Buchanan paid a visit to the site and shortly afterwards wrote to the RCHME secretary urging a detailed survey. The outcome of the survey can be summed up as a fuller understanding of an internationally important monument, a complex landscape illustrating the development of gunpowder manufacture from the mid 1600s and the early development of the new chemical propellant, cordite, from the 1890s. The result was blanket protection by English Heritage through Scheduled Monument legislation and the listing of 21 buildings.

The main thrust of the lecture was to consider the technology of gunpowder manufacture in the nineteenth century which is best illustrated with references to the remains at Waltham Abbey. Gunpowder technology can be considered as ten individual processes:
(1) The production and refining of the three raw materials: sulphur, saltpetre, charcoal. (2) Mixing in correct proportions. (3) Milling or incorporation. (4) Breaking down. (5) Pressing. (6) Granulating. (7) Dusting. (8) Glazing. (9) Stove drying. (10) Finishing, glazing and dust removal.

In considering each of these processes, we were able to see that the developments in gunpowder technology were really an advancement in one or two separate aspects at a time. For instance in the 1780s and 1790s William Congreve invested much effort in the process of refining the raw materials. Illustrated by the construction of a charcoal retort house, primarily to serve Waltham Abbey, at Fisherstreet and Fernhurst in Sussex in 1795 and 1796 respectively. Both sulphur and saltpetre saw developments in their refining processes in 1790s.

Steam was introduced to drying stoves in 1805 but the use of steam as a prime mover was unusually slow in its appearance, possibly because of the danger of escaping sparks or the expense of supplying each isolated explosives buildings with a boiler and engine. Steam powered mills at the Oare works in Faversham may date to the 1820s but the grandest and best surviving examples are to be found at Waltham Abbey, where six ranges of Incorporating mills were built from 1856 and 1889. These powered 36 edge runner mills and there were in

addition older water-dependent mills. The steam-mills are architecturally impressive and designed with the chance of explosion in mind: thick bay dividing walls and thin exterior walls and roof. The expensive underpowered steam-driven shafts were protected in a cast iron tunnel running under all the bays. The benefit of steam power over water power was probably in the flexibility that came with the availability of power, as opposed to an improvement in finished product.

In the pressing process the use of water-generated hydraulic power is seen around 1850 and again well-illustrated by an excellent survival at Waltham Abbey. The pressing of powder, from the late seventeenth century in hand-cranked presses and then, from the start of the nineteenth century, in hand-powered hydraulic presses, enabled a more powerful powder to be made. Pressing made the powder harder and less hygroscopic, increased the density and also made it less likely to produce dust during granulation. The water-powered press at Waltham Abbey would deliver 70 tons of pressure per square foot and the expensive hydraulic pump and water wheel are protected on the other side of a massive brick traverse originally built for a horse-powered corning engine in the early years of the nineteenth century. Centralised hydraulic systems using pipes to transfer power had been used in docks and a similar system was introduced at Waltham Abbey in the 1870s to power prismatic powder presses and an isolated press house built in 1879.

The expansion of facilities in the 1870s at Waltham Abbey reflects the general arms race of the time but larger guns demanded more gunpowder. The example given was of the largest gun in the Crimean War, a 68-pounder taking a 16 pound charge of powder, in comparison to the 110 ton guns of the late 1880s, which fired a 960 pound charge. For the powder maker this meant that over 19 mill loads were needed for one charge. The emergence of larger guns also meant that standard powder was no longer suitable, as in large quantities it acted more like an explosive than a propellant. The search for suitable charges of gunpowder led to the development of pebble and prismatic powders and their attendant manufacturing technologies. The decision of which technology to settle on was partly driven by economics, despite the in-depth research that was carried out into the stresses and strains a particular powder might exert on the interior of a cannon barrel.

Wayne then considered the sources of the machines that enabled the powder makers to develop new products. Often it was seen that existing machinery was obtained from other industries and altered to suit the stringent conditions of the explosives factory. The people who were involved in the development process were also seen as important to the development of powder technology in the nineteenth century, not just the big names like the Congreves but the men and women in the factory landscape. At Waltham Abbey the foremen in 1891 were almost all in their 50s and 60s, experienced and trustworthy. The only young (27-year old) foreman was himself the son of a foreman.

After summing up, a brief outline of developments on the Waltham Abbey site was given. Thanks to a successful Heritage Lottery application being announced in November 1996 (£6.5 million) the project is now fully funded to the end of Stage 1. An incremental development is planned and Stage 1 will allow the newly formed Trust to consolidate the important remains on the site while also developing facilities for the visiting public, who will be allowed in after over 200 years of government secrecy. These facilities will include exhibitions, catering and toilet facilities as well as an interpretation of the important remains on the site. Dr Brenda Buchanan has thankfully accepted a place on the new 'Trust' which is at present in the process of inviting directors to subscribe to the new 'operating company', which will include persons with professional expertise in different areas. It is hoped that one of the new directors will head up a Society of Friends of the RGPF Waltham Abbey in due course.

PIGOU AND PARTNERS AT DARTFORD AND THE SUPPLY OF GUNPOWDER TO THE HUDSON'S BAY COMPANY

Will Adye-White

The following dates can be added to the entry for Dartford mills, Kent in the Group's *Gunpowder Mills Gazetteer*.

1. Pigou, Andrews & Co changed their name to Pigou & Co for a very short period prior to 1838.
2. Pigou & Wilks, operated under this partnership from about 1839 until about 1874 (not about 1850).
3. Pigou, Wilks & Laurence were at Dartford from about 1874 until their merger with Curtis's & Harvey in 1898. The Battle mill in Sussex, operated by Charles Laurence & Son, was shut down, according to the *Gazetteer*, in 1874. This would mean that had Charles Laurence not amalgamated with Pigou & Wilks, he would have become the late firm of Charles Laurence & Son.

Notes 1 and 2 are based on information regarding the supply of gunpowder to the Hudson's Bay Company. It is to be found in the Company's minutes, notes etc as published by Lester Ross and Lynn Sussman of Parks Canada in their Research Bulletin No 94, June 1978. Actually they mention that Pigou & Wilks run to 1876, which cannot be correct if the date of 1874 for closing the Battle Mills is correct.

Note 3 is based on several sources. The first of these is advertisements on page 250 of the book *Modern Breech-Loaders* by W W Greener (Cassell, Petter and Galpin, 1871), which list four gunpowder manufacturers: Pigou & Wilks, Dartford; Chas Lawrence & Son, Battle; John Hall & Son, Faversham; Curtis & Hervey *(sic)*, Hounslow. The second source is, the Ross and Sussman account mentioned above and the third is another book by W W Greener *The Gun and how to use it with notes on shooting*, published in 1881, which mentions Pigou, Wilks & Lawrence and gives a brief description of their mills. From these three sources, it is reasonable to block the time-frame of the amalgamation to between 1871 and 1881. Next with the Hudson's Bay Company information, a date of 1876 can be put forward but rejected because of the 1874 date for the closure of Battle in the *Gazetteer*. Making an assumption that the mills at Battle would be unable to pass muster with the Explosives Act of 1875, it can be assumed that Lawrence had something that Pigou & Wilks wanted. This could this have been money, a good name and reputation, or perhaps a superior brand of powder. The answer may never be known, but if Charles Lawrence initially owned or marketed 'Alliance' powder, then indeed there may have been a legitimate reason. Thus putting a date of 1874 is not unreasonable.

Other companies from whom the Hudson Bay Company purchased gunpowder were:
1. William Bridges, 1865-75; 2. Curtis & Harvey 1824-75; 3. John Hall & Son 1868-75;
4. James Hennessey & Co 1866-72, powder stores?; 5. Kames Gunpowder Co 1856;
6. Marcullum & Co 1869, 1874; 7. Walker Parker & Co 1827-75, shot and ball;
8. Watkins & Co 1838; 9. A Watling & Co 1839-43.
(I am advised that the accuracy in spelling of some of these names was sometimes conjectural at best, so be circumspect.)

Regarding 7, I have in my collection of gunpowder containers a small 6.25 lb wooden keg marked WALKER PARKER CO / .. .25lb No 6 / RIFLE 1F. They were allegedly in business from 1826 to 1827 before undergoing a name change. This barrel is not for shot or ball. It contained gunpowder, althgough the bung end is missing. Did they make their own or did they buy and re-label? I also have an early Kames keg that could have been part of the 1856 shipment but again this cannot be confirmed since Kames probably sent shipments to merchants and merchant groups within Canada, eg The Northwest Company.

THE GUNPOWDER TRADE ASSOCIATION, 1866-1886

[This report, prepared by **Brenda Buchanan**, is a more detailed account of the paper presented by **Frederic Lee** at the meeting of the Group in May 1997 than could be included in the report of the meeting in GMSG Newsletter **21**, pages 2-3. See also "The Struggle between Laflin & Rand and Du Pont" on pages 17-18 of the same Newsletter.]

We are grateful to Frederic Lee for introducing members of the Group to an aspect of the subject not usually covered in our meetings, that of the management of the market for gunpowder (in this case in the USA), rather than the details of its manufacture. There was a demand for the product for mining (especially coal and copper), land clearance and construction (especially canals), military use, and fireworks. The product was supplied by DuPont and other firms of whom over 30 were named, and the powder ranged in size from A and B to C and F, with gradations within each class. Three different market areas were defined: the purely local; the regional, for example the bituminous coal region of Ohio; and the national, powder from the east coast being sold in for example California. Sales were organised by commissioned agents who acted as middlemen seeking orders (sometimes through sub-agents) and relaying them to the producers,

With the end of the Civil War in 1865 demand for military powder was greatly reduced, leading to and increased competition that was made worse by the decline of mining in areas such as New Hampshire. Suppliers had to seek to retain their own sales, whilst also trying to establish markets elsewhere. This rivalry led to a period of price instability, especially in the years 1866-72 when in New Orleans for example there were twelve downward price revisions in 77 months. Since neither material nor labour costs were reduced commensurately, profits declined, even at DuPonts the major suppliers in the Brandywine Valley.

The manufacturers tried to assert their control over the market in various ways. Some smaller firms merged, and in 1868 there was an unsuccessful attempt to form a National Board. In the 1870s a new initiative was taken by two of the biggest firms, DuPont and Laflin & Rand, whose policy of buying up independent suppliers of the Pennsylvanian anthracite coal industry allowed them to increase their share of that market from 45% in 1870 to 85% in 1874, and 96% in 1878. This strategy was then extended, with surviving companies seeking to establish and maintain control through confidential Articles of Association covering Prices, Terms of Trade, Forms of Competition (controlling for example the issue of new labels so that price changes could not be introduced); and Agents (whose previous extensive powers were limited by their becoming salaried employees rather than independent negotiators).

The formation of a Trade Association did not solve all the problems, especially as new Monopoly Laws in the 1890s meant that a fine line had to be drawn between simple co-operation and exclusive control, but it did enable the major suppliers to survive and to meet other more technical challenges such as the growing demand for new explosives especially dynamite. This account of the management of the structure of the market in the USA serves to show us how much could be learnt from a similar study in the UK, especially in terms of the activities of firms like Curtis's & Harvey before they were in turn taken over by ICI.

DECONTAMINATION OF EXPLOSIVES SITES

In June 1997 *Gardeners' World* reported that scientists have discovered that the houseplant Madagascan periwinkle can break down TNT into harmless by-products and that sugar beet can do the same for nitroglycerine. *(Information from Wayne Cocroft)*

THE EXPLOSIVES MAGAZINE AT GREENWICH

This is the title of an article written by our member **Mary Mills** which has appeared in the December 1997 issue, volume 18(12), of *Bygone Kent*, pages 731-7. It is the first of a series of papers she is planning to write on the many historic industrial activities on Greenwich Marsh, the site for the New Millennium Experience. Members will remember that we published a print of this magazine with some notes provided by Wayne Cocroft in GMSG Newsletter **19**, August 1996, page 26 and that Mary wrote a short note on its location in GMSG Newsletter **21**, Aug 1997, page 7.

This new article explains the proposal to move the Ordnance Office's magazine from the Tower of London to Greenwich in 1694. It then gives information about the excavations needed for the foundations of the building, the brickwork and timber required for its construction, the number of doors (10) and windows (50), false walls as a protection from damp, and the roof. The resulting building, as shown in the print, is described and the importance of water transport emphasised. The arguments for its location being at Enderby's wharf, the present Alcatel site, are then presented. Information is given on the ships that carried gunpowder to and from the magazine and a list is provided of the other magazines which Greenwich supplied. Some of these like Chatham and Sheerness were nearby, others like Portsmouth and Plymouth were farther away, some garrisons like Edinburgh and Guernsey were farther still and some bases like Jamaica and Nova Scotia were abroad. However, local residents did not appreciate the presence of the magazine and representations to remove it were made to Parliament in 1718 and again in 1750. Finally the magazine was closed in 1768 and a new one built at Purfleet. However the name Royal Magazine was used for a Greenwich pub until 1846, when it burned down.

The article reproduces part of Rocque's map of London, dated 1741, which shows the magazine, a detailed full-page but rather feint plan of the area from the 1720s, and of course the print, which shows the magazine with its large central building and one of its two wings with a strange spire. This print is said to date from 1794, 26 years after the magazine closed, whereas Wayne Cocroft said it is thought to date from the 1730s. I suspect that the earlier date is more consistent with the costumes being worn but this needs clarification.

So, Mary has written a fascinating account of the Greenwich magazine and I am sure that readers of *Bygone Kent* will be looking forward to her later articles about industries in the area. Incidentally *Bygone Kent* is an impressive 64 page monthly A5 journal covering all aspects of local history in the County and only costs £1.95 per issue.

Alan Crocker

ICI SELLS ITS EXPLOSIVES BUSINESSES

The Guardian reported on 24 December that ICI had agreed to sell its remaining explosives businesses to its former Australian subsidiary for £222 million. This deal will make ICI Australia, which is due to change its name to Orica in Febraury 1998, the world's largest explosives manufacturer. It became independent from ICI last July and already owns ICI's former Asia-Pacific explosives businesses. It is now acquiring ICI's explosives operations in Canada, Latin America and Europe, together with distribution businesses in the USA, and will have 20% of the global market in commercial explosives. In November 1997 ICI sold its explosives interest in Africa to AECI for more than £70 million.

A NEW SURVEY OF THE TYDDYN GWLADYS GUNPOWDER MILLS

Prompted by the publication of the paper on "The Gunpowder Mills at Tyddyn Gwladys near Dolgellau" by Alan and Glenys Crocker, published in *Melin* (Journal of the Welsh Mills Society), **12**, 1996, pp2-25, GMSG member Bill Jones of Blaenae Ffestiniog and several colleagues have commenced a detailed survey of the ruined buildings which survive at the site. They came to this task after completing a survey of the Hafodlas Slate Quarry in the Gwydr Forest, which took some 7,500 man-hours over four years. For this work and the resulting report, they were presented with the prestigious 1997 Field Work and Recording Award of the Association for Industrial Archaeology at its annual conference at Newcastle in September. We congratulate Bill and his colleagues on this achievement and look forward to seeing the results of their new project. Indeed they have made a good start as on their first working visit to the Tyddyn Gwladys site they were able to show that the waterwheel at the terrace of six under-driven incorporating mills was considerably larger than reported in the *Melin* paper.

"TRIAL OF POWDER NEARLY A CENTURY OLD"

[This account, abbreviated from one which appeared in *Field*, 16 July 1898, **92**, page 107, was sent by **Will Adye-White**.]

"On 9 May 1878 we tried Mr Baker's modified chokebore with some finely granulated powder made by an ancestor of Mr Pigou in 1790, which had been lying in a brick vault ever since, but which produced most wonderful shooting at 40 yds, both in pattern and penetration. The tin-plate of the case was entirely corroded, so that a very light touch of the finger and thumb burst the walls, which were previously broken, allowing the powder to escape; but nevertheless it seemed as strong as ever and produced most excellent targets. The powder was of very fine grain, an excellent colour, very hard and perfectly clean. This powder has certainly kept most marvellously."

"LANGDALE'S BLAST FROM THE INDUSTRIAL PAST"

Alice Palmer has sent us a copy of this article by Sheila Richardson which appeared in *Cumbria*, Dec 1997, pages 24-6. It does not add much to our knowledge of the Elterwater gunpowder mills but it is interesting to discover what aspects of the history of the industry is considered to be appropriate to a general readership. Much of the account concentrates on the fatal accidents which occurred at the site, one of which resulted in a ghost that has been seen on a "number of occasions". There are also details about the establishment of the village school by the Company and about the rough football matches played annually between the Powder Monkeys and the Quarry Cloggers from the neighbouring slate quarries. Some of the information has been collected from elderly local people and there are snippets of good factual material about water power including the reserve mill pond of Stickle Tarn, transport of gunpowder on carts using copper-shod horses and on boats on Lake Windermere, and the slave trade, which had finished before the Elterwater Mills were established in 1824. There are two photographs: a modern general view of Elterwater village with the Langdale Pikes in the distance, and an historic print of about 70 gunpowder workers of widely varying ages.

NOTES ON GUNPOWDER PRODUCTION IN THE USA

In response to a request for information on current gunpowder production in the USA, our member **Robert Howard**, who is Curator of Industry and Technology at the Hagley Museum, Wilmington, Delaware, has sent us a few informal notes, a summary of which may be of interest to members.

GOEX have moved from Moosic, Pennsylvania to an old military reservation at Shreveport (actually Doyline) Louisiana. Instead of moving ancient equipment from Moosic they have set up machinery acquired from a mill in South Africa. The move was planned but brought forward following a fatal accident last April. A tram car exploded, set off a shed with powder and knocked down the graining (corning) mill. Two people walking with the tram were killed, one set of wheels from the tram was found several hundred feet away, the shed disappeared completely, the graining mill building was blown away but most of the four-roll horizontal machine was intact and was moved to the new location. Robert was able to salvage four truck loads of equipment for the Museum. Don (Mac) McDonald is the Technical Manager of the plant and Mic Fahringer, following the retirement of his father Frank, the Financial Manager.

The only other gunpowder mill in the Americas is the Pernambuco or Elephant plant in Brazil. They too have had some adversities and are also moving to another site further from civilisation.

ROYAL BAVARIAN GUNPOWDER FACTORY - DACHAU

Wayne Cocroft reports that a colleague has recently drawn his attention to an article on the Dachau concentration camp in Bavaria.(1) In the introduction it states that the camp occupied the site of a former gunpowder factory, a subsidiary of the former Royal Bavarian Army arsenal at Ingolstadt. Evidently, the Dachau factory was empty when it was taken over by the Reich Labour Service in March 1933.

A number of photographs in the article show some of the original factory buildings, but these are long single storey sheds of indeterminate function. The article notes that most of the remaining factory buildings were demolished in the winter of 1978-9.

1. Mollo, A, "Dachau", *After the Battle*, **27**, 1980, pp 1-29

GUNPOWDER AT ICOHTEC 25

The 25th Symposium of ICOHTEC will be held in Lisbon, 18-22 August 1998. It will be part of a larger programme of celebrations in Portugal this year, with the general title "World Exhibition EXPO98".

The general theme at ICOHTEC will be "European Technology in a Global Context". There will be at least twelve parallel sessions offering variations on this theme, of which Gunpowder History will be one, with the title "The Technology and Application of Gunpowder in an International Context". The convenors will be open to proposals for papers from around the world. Abstracts of about 30 words should be sent to the Conference organisers by 28 February, on forms specially provided. Please contact Brenda Buchanan (tel 01225 311508) about these details and about likely costs, if you wish to attend.

A full report of the Symposium will appear in a future GMSG Newsletter.

OBITUARY: EDWARD MERVYN PATTERSON DSc MRIA FRSE FRGS, 1920-1977

The death occurred on Friday 11 April 1997, after a brief illness, of Ted Patterson, who had carried out extensive research into the history of gunpowder manufacture in the UK. He was born in Bangor, Co Down, and attended the local grammar school and Queen's University, Belfast. After graduating in 1941 he moved to Scotland where he worked as a research chemist in the Explosives Division of ICI. During this time, his interest in geology flourished and in 1956 he was awarded a degree of Doctor of Science by Queen's University, Belfast, for his research publications on geology and geochemistry, particularly of the Antrim and Mourne areas. He became a lecturer in geology at St Andrews University in 1947, was elected a Fellow of the Royal Institute of Chemistry in 1958 and was President of the Geological Society of Glasgow in 1964-7. In 1954 he returned to work for ICI and became plant manager of the Detonator Department at Nobel's Explosives Ardeer Factory in 1960. He was elected a member of the Royal Irish Academy in 1955 and a Fellow of the Royal Society of Edinburgh a year later.

Ted had many and varied interests. A major one was transport history and he wrote several books on railways in Northern Ireland. However in recent years he developed an increasing interest in industrial archaeology taking advantage of his position at Ardeer to focus his research on gunpowder manufacture. This resulted in several papers and successful collaboration with several individuals and organisations, especially the Faversham Society and the Royal Commission on the Ancient and Historical Monuments of Scotland. He joined GMSG in its early days and made substantial contributions to the Group's *Gazetteer*. His sudden death saw him in the midst of research on the gunpowder factory at Glyn Neath in South Wales and the Castlederg and Victoria Bridge Tramway. He will be much missed by his daughter and her family and by friends and colleagues in the many circles in which he was involved.

This obituary, communicated by Miles Oglethorpe, is based on information compiled by Ted Patterson's daughter, Anna Singer, who has been instrumental in saving much of his archival legacy. Material relating to industrial archaeology (and the explosives industry in particular) has been donated to the three Royal Commissions (RCHAMS, RCHME and CADW) and in due course will find its way into the appropriate National Monuments Records.

NEWS OF MEMBERS

Will Adye-White New member with large collection of powder containers and knowledge of mills in Canada and the USA. Address: 15 Core Cres, Brampton, Ontario, Canada L6W 2G6, ☎ (905) 459-3080

Ken Bascombe Members will be sorry to hear that Ken, who worked at Waltham Abbey, is seriously ill and has moved to a nursing home in Dorset. He is unable to take part in the Group's activities but we are continuing to send him newsletters c/o a trustee.

Wayne Cocroft Change of address: RCHME, 24 Brooklands Avenue, Cambridge BB2 2BY, ☎ 01223 556203; fax: 01223 311203; e-mail: cambridge@rchme.gov.uk

Peter Filby Apologies to Peter whose entry was omitted from the July 1997 membership list: Peter Filby, 8 Sedgwick Street, Cambridge , CB1 3AJ

Paul Hadfield New member who owns the site of the Lochfyne Gunpowder Mills in Argyll. Address: 6 Union Street, Coleraine, N Ireland BT52 1QA ☎ 01 265 324236; fax: 01265 324978; e-mail: pja.hadfield@uist.ac.uk

Peter Lewis Peter's name should be added to the membership list: Beamish, The North of England Open Air Museum, Co Durham DH9 0RG ☎ 01 207 231811

LAVOISIER AND THE APPLICATION OF ACADEMIC CHEMISTRY TO THE GUNPOWDER AND SALTPETRE INDUSTRIES

[This is the title of an article in French by our member **Patrice Bret** in *Archives Internationales d'Histoire des Sciences*, **46**, 1996, pp 57-74. The following summary is a mixture of my translation of the French *résumé* and the version I then realised was printed in the paper. -ed.]

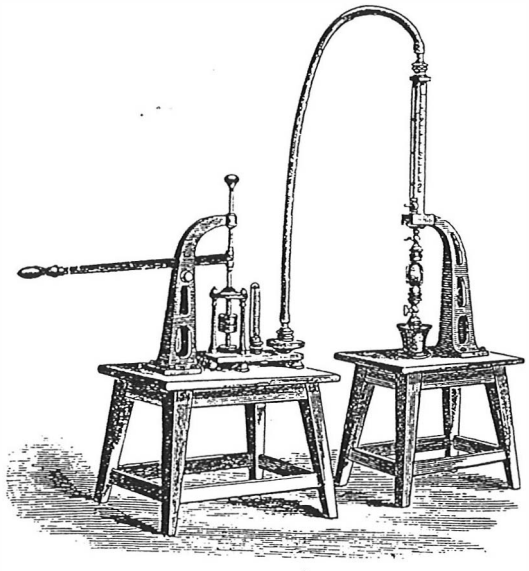
In the mid-18th century, before the appearance of mineral acid and alkali manufacturing, gunpowder production was the only chemical activity on an industrial scale, handling several million pounds of material in France. However, academic knowledge had almost no place in it; the nature of saltpetre was unknown, the manufacturing processes remained empirical and those responsible for production, under the control of a farming company, were managers rather than chemists.

In 1775, Turgot chose Lavoisier as one of the administrators of the new *Régie des Poudres et Salpêtres* set up under State control. The strategy of this financier-chemist permitted a doubling of production in ten years by prospecting and exploiting new resources and by a scientific policy at the interface of academic and industial spheres, of learned understanding and practical know-how. Lavoisier encouraged research on the chemical and physical phenomena of nitrification, carbonisation and detonation and also worked on these himself. Developing the diffusion of scientific procedures and education by experience, the *Régie* introduced the use of the areometer and of potash into saltpetre workshops and chemical analysis of crude saltpetre in the refineries. It created an artificial nitrate industry, exploited the discoveries of academic research and started applied research. However, above all, the managers created a school where the students received theoretical assignments (mathematics, physics and chemistry) before following practical stages on the different technical operations of manufacture and on accounting. Thus the *commissaires des poudres* (the managers of the *Régie*'s factories), formerly recruited from the gentry and the lawyers, became the first group of chemical engineers.

Further details may be obtained from Patrice Bret, Comité Lavoisier, Academie des Sciences, 23 Quai de Conti, F-75006, Paris.

WALTHAM ABBEY SOUTH SITE ARTEFACTS — **Alan Crocker**

The Curatorial Group of the Waltham Abbey project, on which I serve, is faced with the immediate task of saving buildings, equipment and other artefacts from the South Site, which is now owned by Royal Ordnance plc. This detached part of the site was established in the 1880s for the manufacture of guncotton, nitroglycerine and cordite and during February is to be cleared for redevelopment. Two nitroglycerine roundhouses, an early steel-framed building associated with cordite production and a 1930s building for the manufacture of the explosive RDX will be removed to the North Site. Artefacts being saved include one large horizontal and two very impressive vertical cordite presses, dilly carts in which cordite paste was dried, and an enormous number of smaller items, such as rope curtains, safety telephones, copper barbed wire, posters, non-sparking fixtures and safety lights. There is also a vast archive of paper records, and a great quantity of late 19th century building material, such as corrugated iron, bricks, slates, poles, pipes and bridges which could be re-used on the North Site. Steve Chaddock, the site achaeologist and produced a comprehensive list of artefacts.



14. Apparatus for determining the density of gunpowder. It consists of a cup of mercury on the right-hand table into which dips a globe with taps and a tube. The top of the tube is linked to an air pump on the left-hand table. From *Engineering* of 1878.

PRINCIPAL CONTENTS

Names in brackets indicate sources of information rather than authors

Deadline for contributions for Newsletter 23 is 15 July 1998 but earlier submission, especially on 3.5" floppy disc would be helpful.

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