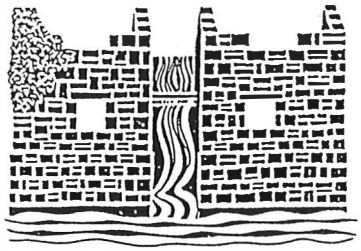


Gunpowder Mills Study Group

NEWSLETTER 24, FEBRUARY 1998

GMSG MEETING AT CHILWORTH, SURREY

SATURDAY 5 JUNE 1999

At the Group meeting in October 1998 it was agreed that we should explore the possibility of holding the next meeting at Waltham Abbey. However, this proved difficult and it has been decided to hold the meeting at Chilworth instead. It is 10 years since we last met at Chilworth and much new information about the history of the site has been discovered in recent years.

Provisional Programme

10.30	Meet in the car park of the Percy Arms at Chilworth, 2.5 miles south-east of Guildford on the A248, opposite Chilworth railway station (NGR TQ 030472).
10.30-11.30	Walk eastward along the tramway past the 1885 brown powder mills, across the 1916 Admiralty cordite factory, with views of the buildings of the 1892 cordite factory across the valley, and reach Postford Pond.
11.30	Meet those unable to arrive earlier at the Postford Pond car park, 100 yds along a lane on the north side of the A248 (NGR TQ 039479).
11.30-12.30	Explore the sites of the 1630s Upper Works at Postford and Waterloo Ponds and in the grounds of Postford House and return to the Percy Arms.
12.30-15.00	Lunch at the Percy Arms followed by Members' Talks.
15.00-16.00	Walk westward to the Lower Works where the East India Co set up their mills in 1626 and examine the surviving buildings, mainly late 19th century.
16.00-16.30	Tea at Waterworks Cottage on the site of the Lower Works.
16.30-17.30	Walk through the Middle Works of the 1650s, which were active until 1920, and return to the Percy Arms.
17.30	Depart

There will be a charge of £2 to be collected on the day but please let Alan Crocker know if you plan to attend and if you would like to make a brief contribution:
6 Burwood Close, Guildford, Surrey GU1 2SB; tel 01483 259401 or 01483 565821;
fax 01483 876781; e-mail a.crocker@surrey.ac.uk or alan@glfd.freeserve.co.uk

Please note that subscriptions for 1999-2000 are now due. See enclosed form

Alice Palmer, *The Low Wood Gunpowder Company, its inception and early growth, 1798-1808*, GMSG. 1998. A4, 73 pp + ix, 5 tables 2 maps and 10 figs. ISBN 0 9534500 0 7. £7.50 (£6 to GMSG members plus £1 p&p, from Alan Crocker, address on page 26).

This, the first book to be published by the GMSG, is a reprint of a dissertation written by Alice Palmer in 1970 for the University of Lancaster School of Education. It concerns the establishment and early history of the Low Wood gunpowder mills near the Leven estuary in Furness, which was then in Lancashire but is now in Cumbria. When Glenys and I first met Alice, at the time when the Group was formed, she kindly allowed us to copy her dissertation and we immediately recognised its value to gunpowder historians. It was one of the first accounts of the formation of a gunpowder mill and remains the most detailed available. This is because Alice carried out an enormous amount of documentary research at the Lancashire Record Office at Preston, which holds the extensive archive of the Low Wood Company. This material is not indexed, so Alice had to look through all the cash books, balance accounts, wages book, bill book, pocket accounts book, magazine accounts, bundles of bills and receipts, boxes of bundles of letters, bonds, insurance policies, trade lists, wills etc. She also interacted with other people who were active in researching the gunpowder industry at that time particularly, Paul Wilson, Mike Davies-Shiel, Arthur Percival, Ted Patterson and George Kelleher. She was therefore able to extract the crucial facts about the way the mills were financed and built, the people involved, the manufacturing methods adopted and how the trade developed. She did this for the first ten years of the firm's existence, which was a very important period because of the development of the mining and quarrying industries in the North of England, the Napoleonic Wars and especially the abolition of the slave trade.

The book is divided into seven chapters. The first deals with the way in which the licence was obtained in October 1798, the mills were financed and the staff and workers recruited. There is then an account of buildings and machinery, processing and raw materials, illustrated by ten of the contemporary Faversham drawings used in *The Rise and Progress* of 1909. The edge runner stones came from various quarries in the North of England and with great difficulty were brought to the site by sea. The saltpetre and sulphur also came by boat, mainly from Liverpool. The charcoal was made locally from juniper, known in Cumbria as savin, at first in pitsteads but in 1801/2 the Company purchased charcoal cylinders. They sold their first gunpowder in August 1799. The third chapter is on the partners: Daye Barker, who ran the mills and had previously been associated with local cotton mills, James King, a local merchant and banker who kept the accounts, Christopher Wilson Junior, a wealthy business man and banker of Kendal, and Joseph Fayrer, a retired sea-captain of Milnthorpe but with important contacts at Liverpool. There is then a chapter on Liverpool and the slave trade, for which Africa powder was in tremendous demand. Tables are provided giving the amount of gunpowder sold annually from the Liverpool magazines at Liscard and noting the dramatic decline when the slave trade was abolished in 1807. The "country trade" covering mining, quarrying and sport is then discussed followed by a chapter on "growing pains", examining financial problems, accidents, wages, underselling, waste disposal and income tax. There is then a conclusions chapter followed by nine appendices, containing transcripts of selected documents and lists of customers. Finally there is a postscript summarising how research on the gunpowder industry has developed since 1970 and explaining the part played by GMSG.

I am very pleased that GMSG has been able to publish Alice Palmer's dissertation and I encourage all members and others interested in industrial history and local history of Cumbria to obtain a copy. I understand that Alice is not offering to research the next 10 years of the history of the Low Wood Company so volunteers are also needed!

Alan Crocker

GMSG AUTUMN MEETING IN LONDON 31 OCTOBER 1998 **Alan Crocker**

Twenty-three members attended the Group's meeting at the Institute of Historical Research, University of London, on Saturday 31 October.

The first talk was by **Glenys Crocker** who gave an account of research in progress on the complex watercourses at the Chilworth mills, explaining how the Tillingbourne and its tributary, the Postford Brook, had been harnessed by the construction of leats and mill ponds to serve corn, fulling, wire, gunpowder and paper mills as well as to flow water meadows. When the East India Company arrived in 1626 to make gunpowder at what became known as The Lower Works, they re-used the sites of disused corn and fulling mills and raised the dam of the mill pond, flooding the lord of the manor's hop grounds. They also neglected to repair the dam. The Company left after about 8 years of stormy relations with the landowners and the mill pond was then reconstructed in what seems to be a unique way. It is now rectangular, with a dam on both the upstream (east) and downstream (west) ends, is entered by leats at the NE and SE corners and has a culvert underneath to drain the valley floor. The leat along the north side of the valley may have been new when the pond was reconstructed after the East India Company left. Alternatively it may have been a medieval leat which pre-dated the first dam, was made redundant by that dam and re-instated when the pond was reconstructed. A great deal of money was also spent after the East India Company left in creating the Upper Works which has a pond with an exceptionally long dam. A survey carried out by Sir Jonas Moore in 1677 describes Upper, Middle and Lower Works at Chilworth and states that the Middle Works were established during the 1650s. These were on the leat which enters the rectangular mill pond at its SE corner. The 1677 survey also lists 19 named watermill buildings spread over all three Works and indicates that the Lower Works extended farther down the valley than was previously realised, into the next parish of Shalford. Most of the mills in the Lower Works were on a leat running down the valley from the SW corner of the mill pond. Glenys considers that this leat previously served Thomas Steere's wireworks which operated between 1603 and 1606 in defiance of the monopoly held by the Mineral and Battery Works. The Lower gunpowder works dam may have been reconstructed and the Upper Works built when the king put a large amount of money into the Chilworth mills in the 1630s, or one or both of these undertakings may have been carried out later. No direct documentary evidence has been found. The matter was therefore discussed in terms of estimates of the production capacity which would have been needed to fulfil known contracts.

In the second talk, **Keith Fairclough** spoke about the people associated with the Chilworth gunpowder mills in the early 17th century, and therefore complemented Glenys's presentation. The East India Company was founded in 1601 and at first had no difficulty in obtaining gunpowder. Then in 1623 there was a shortage which led to them importing saltpetre as a profitable ballast and in 1625 to establish a mill at Thorpe in Surrey, "on the skirts of Windsor Forest". This mill was to manufacture gunpowder for their own purposes and not for sale. However, it was claimed that the activity at the mill upset the king's deer so the Company was forced to move the mill to a new site and selected Chilworth, again in Surrey. The powdermaker was William Blyth, formerly a saltpetreman in the north of England. He was joined at Chilworth by a clerk, William Collins, who had been with the Company since 1619 and was a survivor of the Amboyna massacre. Collins took over the mills in 1629 but was soon in debt. His creditors seized some of his powder and sold it openly which led to the Company losing its right to manufacture, although they were still allowed to repair gunpowder. Cordwell then went to America for a year leaving his wife in charge. In 1635 the Evelyn family, who had mills at Godstone in Surrey, lost its monopoly of gunpowder manufacture because they were not willing to accept a reduction in price from 8½d to 8d per

lb. Collins was joined by Samuel Cordwell and was able to produce 50 barrels of powder per week. Then in November 1636 Cordwell took over the monopoly and was able to meet all his targets of 120 barrels per week. This is the time at which it is thought that the Upper Works were constructed. The monopoly was however short-lived as the Civil War was approaching.

Peter Edwards, who is writing a book on the arms trade in the Civil War, gave the next talk on local production of gunpowder between 1638 and 1651. Because it was such an important commodity, gunpowder was one of the few monopolies which survived into the Civil War period. Indeed the king used it as a fiscal device and this led to illegal manufacture, eg Baber at Bristol. During the Civil War the Parliamentarians controlled the south-east of England where all the main mills were located. Cordwell at Chilworth for example was able to supply 1000 barrels at one time in 1643. The Royalists relied at first on Baber developing mills at Oxford, which produced 35 barrels a week. He also had mills elsewhere including Bristol (15 barrels a week), Worcester and Shrewsbury. In addition there were mills at Chester, Gloucester, Nottingham, Stafford, Warwick, Glamorgan and North Wales. There is little evidence of gunpowder manufacture in Scotland. There was a great shortage of skilled workers and much poaching of employees took place. The Royalists had to pay more for their powder than the Parliamentarians; the local powder cost more than that from the major mills, the Irish powder being particularly expensive. In practice imported powder sustained both sides. Peter showed overheads containing a wealth of detailed information and his book will clearly be invaluable to gunpowder historians.

After lunch **Alan Crocker** spoke about the capacity of English gunpowder mills in the late 17th century and his paper is printed elsewhere in this Newsletter. Then **Bill Curtis** summarised the paper he had presented in August, at the ICOHTEC conference in Lisbon, on the innovations in gunpowder manufacture introduced at the Confederate mills at Augusta, Georgia. In 1860 there were only three small mills in the Southern States so in July 1861 a new site for a large steam-powered mill with an ample supply of clean water was selected at Augusta and building commenced two months later. One novel technique was agitation of the saltpetre to produce finer crystals. There were 12 incorporating mills, six on either side of the laboratory, and each had a charge of 60 lbs. The charges were steamed which reduced the incorporation time. Normal pressing was eliminated and glazing, dusting and drying were reduced to one process, which led to a great saving of labour and time. However presses were used for compressing dust and the resulting material was not re-incorporated. The beds of the mills were hollow and heated, which saved about one-third on incorporation time. The resulting powder, about 3 million lbs was made, was said to be "superior". However it was found to be poor for artillery - the reason is not clear. Most of these new processes were adopted from British ideas.

Next **Wayne Cocroft** and **Brenda Buchanan** told us about the gunpowder seminar which formed part of the ICOHTEC symposium held in Lisbon in August. A report on this meeting, prepared by Brenda, appears elsewhere in this Newsletter. **David Harding** then gave a short contribution on the use of presses in gunpowder mills and again this forms the basis of an article in this Newsletter. Finally **Peter Filby** showed us a copy of an interesting large format book he had brought along entitled *Imperial Britain: an illustrated descriptive record of industrial achievement during the War for Freedom, 1914-1918, vol 1. Industrial*, St James's Press, 1920. The first chapter by Lt-Col C D Crozier, Director of Inspection of High Explosives, is on "Explosives during the War", with sections on high explosives, picric acid (lyddite), TNT, Queensferry factory, Amatol, propellants, Gretna factory, nitro-cellulose propellants, other explosives used and inspection. There was then a discussion about ideas for the next meting of the Group but, as explained on page 1, these have been superceded.

CAPACITY OF ENGLISH GUNPOWDER MILLS IN THE LATE SEVENTEENTH CENTURY

Alan Crocker

The County Record Office at Stafford holds an archive of documents deposited by the Dartmouth family. George Legge became Lord Dartmouth in 1682 and was commander of the fleet in 1683. Col William Legge was Lt Gen and Treasurer of the Ordnance from 1660. The papers therefore contain much material of interest to gunpowder historians, including a document entitled "State of the Powdermakers Contracts" (D742/M/1/92). This is undated but internal evidence indicates that it was prepared in July 1687. It consists of two sheets of imported paper measuring 465 x 360mm (similar to English "Post" paper), folded to produce a booklet of four pages plus a cover. Pages 1 to 3 contain nine entries, each giving the following information: name of maker; date of contract; amount of rough saltpetre supplied; number of barrels proved and received; number of barrels of powder in arrears; date by which the remaining barrels should be delivered. The top part of page 4 contains a summary of the arrears and the bottom part the number of troughs at each of the mills.

In all, 13 contracts are listed and the names, dates, saltpetre supplied (in tons, cwts, quarters and lbs), barrels to be made and barrels in arrears are summarised below.

1. Polycarpus Wharton (PW)	06 Oct 1684	114.14.0.12	1950	0536
2. ,,	05 Apr 1686		4000	0000
3. ,,	29 Jan 1686	170.04.1.04	4000	0294
4. PW & John Freeman (JF)	10 Aug 1682	085.15.0.00	2400	0363
5.	19 Feb 1683	051.12.3.13	1000	0400
6. PW as JF's executor	19 Feb 1683	019.17.3.20	0434	0420
7. Peter Rich	26 Apr 1687	170.04.1.00	4000	3557
8. John Richardson	02 Dec 1684	193.06.1.07	3673	0680
9. ,,	not signed		1000	1000
10. Peter Azier & partner	06 July 1686	061.15.1.04	1000	0055
11. Peter Hudson	14 Dec 1686	021.05.2.02	0500	0274
12. Peter Samyne	30 Apr 1687	010.12.3.02	0250	0158
13. John Nutt	19 Aug 1686	011.15.1.05	0200	0123.83

The locations of the mills (name, river, county) at which these powdermakers were active and the number of troughs available are given below.

Wharton	Chilworth	Tillingbourne	Surrey	46
,,	Wooburn	Wye	Bucks	26
,,	Sewardstone	Lea	Essex	12
Rich	Wandsworth	Wandle	Surrey	36
,,	Molesey	Mole	Surrey	
Richardson	Hounslow	Crane	Middlesex	11
Hudson	Waltham Abbey	Lea	Essex	09
Samyne	Walthamstow	Lea	Essex	06
Azier etc	Faversham	Westbrook	Kent	09

Notes:

(a) The 36 troughs for Rich were shared between Wandsworth and Molesey.

(b) Freeman (see contracts 4-6) died in 1683. He had been a partner of Wharton at Chilworth.

(c) Nutt (see contract 13) is otherwise unknown. However the entry for his contract states that some of his saltpetre had been delivered to Samyne, suggesting that he had a link with Walthamstow mill.

The above information reveals the following:

* During the five year period between August 1682 and July 1687 thirteen contracts were

placed for a total of 24,407 barrels of gunpowder. The fact that contract 2 had been completed and that contract 9 had not started suggests that no other contracts were placed.

* Of the 24,407 barrels, 7,861 had not been delivered which does not seem excessive as some of the contracts were recent.
* Four of the contracts were for about 17 barrels of gunpowder to be made from each ton of rough saltpetre but other contracts varied from 16 to 26 barrels. One ton of pure saltpetre would make nearly 30 barrels of powder at the standard 75 lbs per barrel, which suggests that some of the rough saltpetre supplied was quite pure but that in other cases only just over half of the weight was really saltpetre.
* Eight powdermakers and nine mills are named. Other makers and mills known to be active at the time but apparently not supplying the Ordnance were Dewye at Carshalton, Surrey and Hammond at Battle, Sussex.
* All of the mills had troughs and not edge-runners.
* The total of 155 troughs were distributed under counties as follows:
  Surrey 53%; Essex 17%; Bucks 17%; Middlesex 7%; Kent 6%.
* The 155 troughs were distributed under makers as follows:
  Wharton 54%; Rich 23%; Richardson 7%; others 16%.
* The 24,407 barrels were distributed under makers as follows:
  Wharton 57%; Rich 16%; Richardson 19%; others 8%.

The document also states that, in order to complete contracts 7, 8, 11 and 12, Rich, Richardson, Hudson and Samyne, were expected to make, respectively, 350, 150, 120 and 65 barrels of powder per month. Again respectively, these makers had 36, 11, 9 and 9 troughs, so that they were to produce 9.7, 13.6, 13.3 and 7.2 barrels per trough per month. As troughs can contain a different number of mortars for incorporating powder, these figures suggest that, on average, Richardson and Hudson had longer troughs and hence more mortars per trough than Rich and especially Samyne. An examination of illustrations of early stamp mills has indicated that on average they had about 5 troughs. Also it seems that on average the charge of a mortar was about 30 lbs and that the average time for incorporation was about 40 hours, although the practices in different countries and at different periods varied considerably. However if these figures are used and it is assumed that a trough could be used for 40 hours in a working week, one obtains a result of 6.5 barrels per trough per month, remarkably close to what was expected of Samyne. Perhaps the other makers achieved greater outputs by using some combination of longer troughs, bigger charges, incorporating for shorter times and having a longer working week.

However, another estimate can be obtained from the contemporary information given by Henshaw (printed in Thos Sprat, *History of the Royal Society*, 1722, pp 277-83). He states that each trough had about eight mortars and that to make excellent powder it ought to be wrought for 30 hours. This gives 13.9 barrels per trough per month, close to what was expected of Richardson and Hudson.

R T W Kempers, *Epouvettes: a comprehensive study of early devices for the testing of gunpowder*, Royal Armouries, 1998. A4, 352pp, 240 b&w and 28 pp of colour illus. ISBN 0 948092 27 0, £70 incl p+p, £75 incl p+p overseas.

This is the first of a new series of monographs from Royal Armouries. It is the first comprehensive study of eprouvettes ever attempted in a single volume. It contains a survey of gunpowder testing through the ages, a proposal for eprouvette typology, an illustrated survey of types and experimental data based on firings by the author and a list of over 700 eprouvettes traced. Obtainable from L Saunders, Royal Armouries Museum, Leeds LS10 1LT

THE USE OF PRESSES IN MID-18th CENTURY BRITISH POWDER-MAKING

David Harding

At the end of the meeting at the Senate House in October 1998 I aired a point about the use of powder presses in the mid-18th century. I think I failed to make myself clear, so I would now like to air the point in written form. I believe it may be quite important for our understanding of British powder-making in that period.

We know that in 19th century British powder-making (at the Waltham Abbey mills for example) it was customary for *all* the mill cake to be pressed after incorporation and before granulation. Therefore, when we find powder presses being mentioned in the mid- (and now, thanks to Crocker and Fairclough) early-18th century, we tend to assume that the presses were already used in the same way as later. Yet I know of only two sources which state explicitly how powder presses were used in Britain in the mid-18th century, and both say they were used merely for re-cycling the dust produced during granulation.

The first such source is mentioned in Crocker and Fairclough's important article in *Industrial Archaeology Review*, where they note that in 1748 the press at the Faversham mills was described as being 'to press the dust that comes from the ... [dusting house]'.[1] They show that powder presses were in use in England c1750, and debate whether they were used for pressing just the dust or alternatively all the mill cake, and they conclude in favour of the latter.

However, a second reference indicates again (and this time more explicitly) that at this period the press was indeed used just for compacting dust, so as to allow it to be re-granulated. The source in this case is an explicit description of modern British powder-making machinery and method, sent by the East India Company to their settlement at Madras in 1753-54.[2] In building up their military strength in India after recent setbacks, the Company wished to improve the quantity and quality of the powder made at their mills in India. The approach they adopted was to buy accurate scale models of a modern British powder mill, with some full-sized machinery (including a powder press), and to send them to India with a written description of how the equipment was to be used. This description shows that there were stone edge-runners, on which 'the Composition is ... ground till the Workman thinks it is come to a sufficient Body'. The resulting cake was then granulated in a 'Corning Engine' of the well-known form, with numerous hoops containing double sieves, the top mesh being parchment punched with holes and the bottom one being a fine hair sieve, with a *lignum vitae* roller in each hoop. The description states: 'the Dust which does not come to a Grain, goes through the Hair Sieve which the Parchment Sieve stands in, and falls into the Trough that is under the Sieves, which Dust is took up when it lyes three or four inches thick in the Trough and put in the Press...'. This is the ONLY use given for the press. The resulting press-cake was placed in a 'Trough that stands near the Sieves, and broke into small pieces with a Wooden mallet, and put into the Corning Sieves again and so till all is done'. (Incidentally, this is why, as Crocker and Fairclough note, the press was customarily situated in the corning house; it was evidently an adjunct to granulation, not a distinct stage which all the powder passed through.)

In other words, the press was used to recycle dust without having to put it back under the edge runners, which would obviously have reduced the mill's output. By using a press as described in the 1753-54 document, dust could be made into useable grain at the same time as the edge runners were incorporating the next 'charge' of mix. There is evidence that by using a press to recycle dust in this way, a large potential loss of efficiency was avoided: statistics from the East India Company's Bombay mills in 1838 indicate that the granulating process left no less than 30% of the cake as dust, needing to be recycled.[3] This was with a dense, hard cake which had been pressed under a screw-press. Given that in the method of

*c*1753-54 they were granulating mill-cake taken straight from the edge-runners, which was presumably softer and more friable than the 1838 press-cake, the enhanced efficiency gained by using a press to recycle the dust might well have been much higher than 30%. The powder produced by this method would obviously have been a mix of denser and more durable grains that had been under the press, and lighter, perhaps softer and less durable grains that had not. There would have been consequences for the rate of burning.

If I am right about this, it raises the question of just when *all* the mill-cake began to be pressed as a routine stage of manufacture. Perhaps it was one of Congreve's improvements in the mid-1780s? He (or someone else) perhaps discovered empirically that grains made from press-cake were less friable and hygroscopic, and thus more durable, than ones made from mill-cake.

Does anyone know of other *explicit* descriptions of the use of powder presses *c*1750 or earlier, which may perhaps show I am barking up the wrong tree?

1. Crocker, G & Fairclough, K R, "The introduction of edge-runner incorporating mills in the British gunpowder industry", *Industrial Archaeology Review*, Vol.XX, 1998, p29, quoting PRO: TS21/874 ref 54.
2. *Records of Fort St George: Public Despatches From England 1753-54*, pp179-180, "A Description of the Models for Making Gun Powder".
3. British Library: Oriental and India Office Collections: L/MIL/3/1341, Collection No.16, enclosures to paras 10-18 of letter from Madras dated 6 Oct 1840 No.40, being a letter from Capt W Jacob dated 29 May 1838, giving the yields from 100lb of 'press cake'.

Agathe Guenand, *La fabrique des Poudres et Saltpêtres du Ripault 1786-1817*, Université Francois Rabelais, Tours, July 1998. A4, card covers, 457 pp, 36 illus.

Le Ripault gunpowder mill and saltpetre refinery is at Monts, which stands on the Indre, a small tributary of the Loire, about 15km south-west of Tours. It was established by the *Régie royale des poudres et salpêtres*, under the administration of Lavoisier and his colleagues, in 1786 and finally closed in 1961. This university thesis, which has been beautifully published as a limited edition of 50 copies, describes in detail the first 31 years of its life. However it starts with an account of the administration of gunpowder in France from 1336 to 1817. It then explains why Monts was chosen as the site of the mill and how the land was acquired. The mill buildings, offices, chapel and the housing for the managers and workers are then described and also the magazines at Tours, Saumur, Le Mans, Bourges, Châtellerault and Limoges. There is then a section on raw materials, manufacture, storage and proving. This is followed by an account of the people who worked at the mill and of their lives. There is then a section on the protection and transport of powder and finally some conclusions, including a summary of the later history of the mill. The illustrations occupy about 80 full pages and are either in colour or, for some of the reproductions of documents, on cream rather than white paper. They include historic and modern maps and plans, photographs of surviving mill buildings, a waterwheel and the chapel, with a detail of the mechanism of its clock, four fold-out 1811 drawings of the stamp-mill and the glazing mill, historic prints of saltpetre refining, gunpowder incorporation, relevant buildings, powder barges, other boats and portraits, and finally many facsimile reproductions of documents. One of the mill buildings has been converted into a museum and another, and also the chapel, into meeting rooms. This is a very impressive and valuable book and I am greatly indebted to **Patrice Bret** (who features prominently in the acknowledgements section) for providing me with a copy.

ROYAL GUNPOWDER FACTORY WORKERS LIVING IN WALTHAM CROSS, HERTS, IN 1891

Chris Hicks

The Royal Gunpowder Works runs up the east side of the Lea Valley, both north and south of Waltham Abbey an is totally within Essex. Access to the north site is from Powder Mill Lane and this runs north from a causeway across the valley. At the western end of this causeway is Waltham Cross, Hertfordshire, part of the parish of Cheshunt.

The first housing reached when travelling west from the powder works is Holdbrook, a renovated 1960s concrete jungle. However this was built on the original Waltham New Town development which local historians believe to have been developed in response to the growth of the RGPF when guncotton was introduced in the 1860s.

Thanks to work done by the Local History Group of the Lea Valley U3A I had access to the 1891 census for Waltham Cross and Cheshunt. The opportunity was taken to identify RGPF workers in the area and to do some basic analysis of who they were and where they lived.

The area searched was Waltham New Town, Waltham Cross and then northwards about half a mile up the main High Road to the 'Old Pond' area of Cheshunt. (Cheshunt is a quite complex poly-focal settlement centred on several road junctions.) A person was taken as working for the RGPF if his occupation description mentioned gunpowder, powder mills or

The other local large employer at the time was the Royal Small Arms Factory at Enfield Lock, which was on the west side of the valley and about the same distance south of Waltham Cross as the RGPF is east. On the returns the initials RSAF are used to indicate small arms workers. There is at least one case where this appears to have got confused - an assembler from Birmingham is listed as working at RGPF.

At some point during the processing of the returns someone has annotated the numerator's entries with either Powder or Gun, presumably while compiling the employment statistics. Again there are several cases where the wrong allocation has been made.

Another problem area is the Gun Cap Factory. This employed many of the young women in the area, but where was it and which of the two larger factories did it come under? Only one male employee - a fitter - was found, all others were unmarried women, mostly in their late teens.

A total of 64 RGPF workers were identified, of which 7 appear explicitly connected with gunpowder and 3 with guncotton. There are 11 foremen and the manager of the smokeless powder factory. Thirty are just described as labourers.

The trades that could be for the gunpowder plant, only one of each, are: Saltpetre Refiner; Incorporator; Powder Maker; Corning house; Millman powdermills; Powdermill Hand; Foreman Powderstores. The possible guncotton trades are a labourer, the manager and Chargeman (Danger House).

Origins and Families

Of the 64 RGPF workers identified, 45 are married heads of their own households, and one is married but living with his in-laws. The other 18 are unmarried, of these, 5 are lodgers, 1 is living with his brother and the rest are sons living at home.

The striking thing is that all but one of the workers born in Cheshunt are still single. Of the wives of Waltham Abbey men a third are not local girls - does this mean the men have been away at some point, military service perhaps? The majority of men from outside the area appear to have got married before moving in.

Worker Born	Widower	Single	Wife Born W.A.	Chesh	Herts	Essex	Other	Total
W. Abbey	1	1	4	3	2	0	6	17
Cheshunt	0	8	0	1	0	0	0	9
Herts	0	2	2	0	2	3	1	10
Essex	0	6	1	0	1	4	0	12
Other	0	1	2	1	3	3	6	16
Total	1	18	9	5	8	10	13	64

Of the married households 22 have had all their children in Cheshunt and 8 had children in Waltham Abbey before moving to Cheshunt. Eight had children outside the area before moving to Cheshunt and 7 were childless.

There are only two father and son pairs, both fathers are foremen and both sons are storemen. There are also two pairs of brothers. Two RGPF workers had sons working at the RSAF and one was the son of a RSAF employee.

The Manager of the Smokeless Powder Works can only have been at RGPF for less than a year, the age of his youngest child, as the whole family was born in Scotland. His brother a Chemist and his wife were also living in the house. A widowed foreman had his cousin acting as housekeeper to his children and he also had a live-in girl servant - the only one in the RGPF entries.

The age profile of the workers is well spread, with a peak in the late 20s.

Age	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50+	?
Married	0	4	10	5	7	8	5	7	1
Single	6	5	4	1	0	0	0	0	1

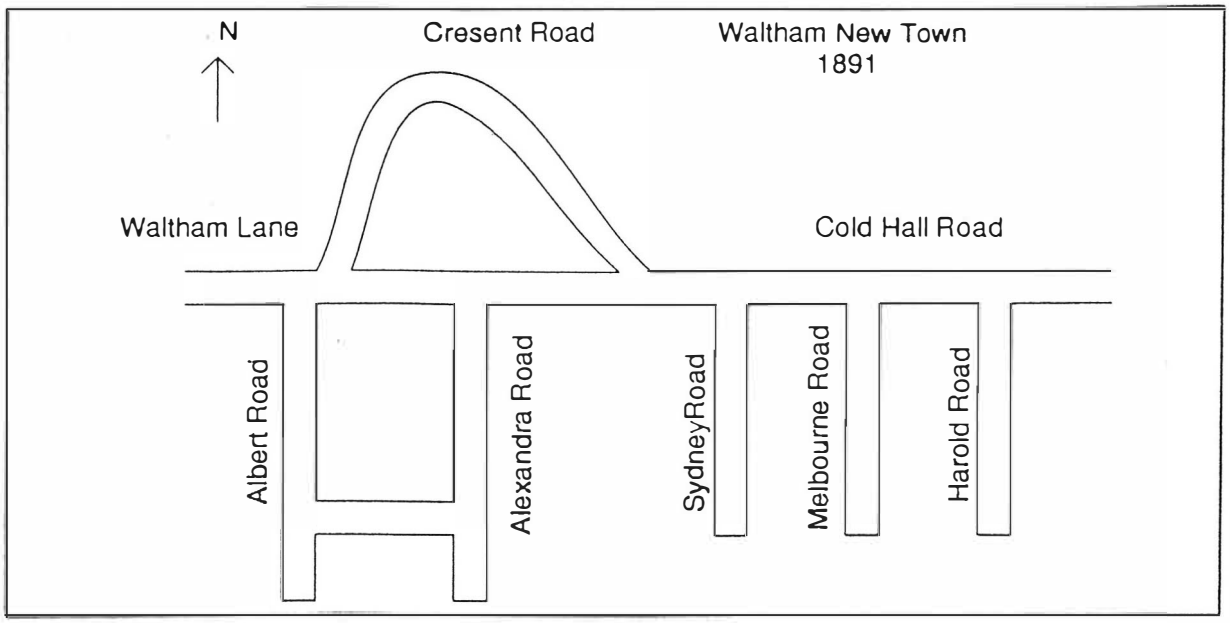
Location

The area searched can be divided into four. Waltham New Town was a housing development of the mid-19th century and the nearest housing in Hertfordshire to RGPF. Waltham Cross was the old settlement at the road junction, which principally just fronted the main streets. Eleanor Estate was a new housing development still being built in 1891 - with Queens Road and Eleanor Road this formed a shell around the N.E. of Waltham Cross between the High Road and Waltham Lane, to the west of the main railway line. The fourth area was Crossbrook Street which was the High Road from Theobalds north to the next road junction at the Old Pond. The distribution in these four areas was :

	Total	Heads
Waltham New Town	33	24
Waltham Cross	8	5
Eleanor Estate	16	12
Crossbrook Street	7	5

The workers are spread evenly between the areas in terms of age and origin, although they are concentrated towards the RGPF. The only observed grouping is that all the Foremen and the manager are in Waltham New Town (including Waltham Lane) but one acting foreman is elsewhere, in the Eleanor estate.

Waltham New Town



In 1891 the extent of Waltham New Town appears to be as on the map. Several roads were added later. I am not certain if the cross road between Albert and Alexandra Roads was there or not.

For each of these roads the total number of entries, the number of gunpowder workers and the number of small arms workers was noted. In none of the roads were munitions workers dominant and except at the east end Small Arms workers outnumber those from the RGPF.

Road	Total	RGPF	RSAF	
Cold Hall Lane	40	6	1	RGPF on south side at east end.
Harold Road	25	9	4	
Melbourne Road	35	6	3	
Sydney Road	30	4	2	
Alexandra Road	31	1	3	
Crescent Road	37	0	7	
Waltham Lane in WNT	10	4	3	
Waltham Lane North Side	90	2	9	This is whole way into High Road
Waltham Lane South Side	5	1	2	

The distribution of the RGPF workers within the roads appears random. If the development of the area was related to the guncotton factory only Harold Road, the nearest to the site has a significant concentration of RGPF workers by this census.

The Median Worker

The most common employee is a labourer, born in Waltham Abbey, aged around 30, living in Waltham New Town, with a couple of children born in Cheshunt to a wife from outside the area.

[A 3-page detailed list of the 64 workers discussed above is available on request - ed.]

ICOHTEC GUNPOWDER SECTION: THIRD MEETING

Brenda Buchanan

The Gunpowder Section has now developed its own momentum within ICOHTEC, to whom we are grateful for this opportunity to meet. Despite this continuity the meeting in Lisbon on 18-22 August 1998, like those in Bath and Budapest, will be remembered for its particular flavour - especially the theme of the oceans and their heritage derived from EXPO '98; and the visit to the recently-restored gunpowder mill at nearby Barcarena. We were introduced to the latter by a paper presented by José Manuel Mascarenhas who, with colleagues António de Carvalho Quintela, João Luís Cardosa and Maria da Conceição André, has published a study entitled *A Fábrica da Pólvora da Barcarena* (1995). This book is so well-illustrated and finely-presented it may be recommended as providing even non-Portuguese speakers with some understanding of the site.

The powder mills, *c*15km from Lisbon, were founded on the banks of the Barcarena stream in the sixteenth century and a table in the survey names the 22 managers of the works over the years 1645 to 1862. Incorporation was initially by water-powered stamps (with bullocks in reserve), until in 1729 these were replaced by stone edge runners. As a safety measure these were in turn replaced in 1782 by weighted wooden runners with bronze tyres and bronze beds. But the work remained hazardous, with six explosions between 1805 and closure in 1972. Although the surviving works at Barcarena are more grand in style than those at the Waltham Abbey Royal Gunpowder Mills, there are so many echoes of the latter that it was appropriate for Steven Chaddock in his paper to lead us through the legal, organizational and physical processes by which the WARGM are also becoming an 'interpreted site', ready to receive visitors.

The main theme of the oceanic heritage received ample treatment in papers which showed the importance of such voyages in the history of explosives. The Barcarena factory played a significant part in Portuguese expansion overseas, but José Manuel de Mascarehas selected two case studies to show how this was supported by the development of gunpowder factories abroad, from 1630 in Goa (south-west India), and from 1808 in Rio de Janeiro (Brazil - set up when the Portuguese Court was established there as Napoleon's troops invaded Portugal). The latter site is well looked-after by the Brazilian Institute for Cultural Heritage, but the former is endangered by vegetation and possibly housing. In a new role for our Section we are seeking to make these concerns known, for such sites are important not only in their own right but also as part of an international network of surviving explosives factories. A very positive response to this initiative has been received from UNESCO, to which ICOHTEC has an attachment. We have been informed that the gunpowder mills will be examined as part of a project for safeguarding World Heritage cultural properties in Goa.

The oceanic theme was developed further by Brenda Buchanan who suggested that trade and exploration, colonial settlement and imperial aspirations, had all been influenced by the demand for saltpetre. In examining the importance of supplies from India, she questioned the validity of the distinction made between that 'occurring naturally' and that 'prepared artificially', and suggested also that the control of this rich supply may have influenced national research priorities, freeing the British to concentrate on the techniques of powder making whilst encouraging other western countries to boost home supplies of saltpetre by developing an understanding of its chemistry. Bengt Åhslund's paper on the provision of powder for both military and non-military purposes in seventeenth century Sweden, and Thomas Kaiserfeld's on the conflict of interest there between agriculture and the state over the use of farmyard dung, culminating in public debates in the 1770s and 1780s on whether it was of greater value as field manure or in saltpetre making, confirmed the strategic importance of this scarce resource.

Other speakers pursued the oceanic theme through an examination of the transfer of technology overseas. Wayne Cocroft presented an overview of the process, with information about explosives disseminated through personal visits, professional journals, trade fairs and the movement of staff so that expertise acquired at for example the WARGM could be put to practical use at works in India such as those at Madras. In contrast, using unpublished documents supplemented by plans and drawings (enlivened by busy camel trains arriving and departing), Patrice Bret focused upon the transfer of French gunpowder technology to Cairo during Bonaparte's expedition to Egypt of 1798-1801, which involved transforming a disused mosque into a powder works using French revolutionary processes operated by Egyptian manpower. Bill Curtis's study of the Augusta Gunpowder Works in Georgia, 1862-65, drew attention to the problems of powder supply faced by the Confederacy, and the effort made to overcome this by drawing on European experience - a link demonstrated by details of several British patents. Little survives of the Augusta works, but through Maria Barabanova-Priamurskaya's paper we were privileged to be able to see the design of its contemporary - the Okhtinskiy Powdermill in St Petersburg, rebuilt in the mid-1860s after a devastating explosion in 1864. From 20 unpublished drawings we were able to see the layout of the whole powder 'township' in its 'citadel'.

Our grasp of matters metallurgical was tested by three papers. Kelly DeVries reported 'work in progress' on the gunpowder weaponry of the Burgundian Dukes - Bold, Fearless, Good and Bold II - whose meticulous records, especially in the 15th century, provide a great opportunity to study the relationship between metallurgy and powder chemistry. Ignatio Carrion Arregui's account of initiatives taken by the Spanish Crown in the 16th century provided the context for an account of the experimental smelting of iron cannons in 1578 in Mondragón (Gipuzkoa, Basque country) by British and German craftsmen. Although technically successful this was not pursued on economic grounds, although in the early 17th century cannon foundries with the new furnaces were set up in Cantabria. Bert Hall took the more general approach of defending cast iron cannon, suggesting that the iron founders began to control their smelting by techniques which perhaps unconsciously regulated the amount of silicon in guns, so these became less liable to burst when fired too rapidly or with too great a charge, because of the critical role played by silicon in preventing fractures.

The last group of papers covered a wide range of topics related to the understanding of this subject. Asitesh Bhattacharya surveyed the case for and against an earlier development of gunpowder in ancient India, than that in China more generally recognized. Robert Howard spoke on the 'perceptions and realities' of black powder, and drew on his long practical experience to explain the effects of the different stages of production. René Amiable's paper (presented by Patrice Bret) described the work of the inventor of 'poudre B', Paul Vieille, of being true scientific origin in contrast to the more empirical approach of Frederick Abel. Seymour Mauskopf could not be with us to present his paper on 'Frederick Abel and the development of gun cotton', for the excellent reason that he was receiving the Dexter Award of the American Chemical Society, so this struggle of the titans must be deferred for another symposium. In explaining the chemistry of explosion Ian Rae explained the important work of Hermann Sprengel in the classification of oxidisers, and showed that in blasting explosives there was no simple progression from black powder through nitro-glycerine compounds such as dynamite to ANFO, but rather a process of selection from what was available and appropriate, as in the various explosives used to improve access to New York harbour in 1885.

We concluded with an unscheduled meeting during which we were able to view material for which there had previously been no time. We also benefitted from some trenchant advice from Robert Howard on the practicalities of establishing and maintaining a gunpowder

museum, and from Susie Howard on the human skills of dealing with visitors to such sites. A file of the many reviews received so far of *Gunpowder*, the proceedings of the Bath symposium, had been passed round during the sessions, and encouraged by this we resolved to explore the possibility of seeking to publish the Lisbon papers, possibly with a selection from those given at Budapest. As ICOHTEC plans its next meetings, we trust that the Gunpowder Section will continue to occupy the niche it has now secured.

Patrice Bret, *Lavoisier et L'Encyclopédie Méthodique. Le Manuscrit des Régisseurs des Poudres et Salpêtres pour le Dictionnaire de l'Artillerie,* Leo S Olschki, Firenze, 1997. 202 pp, 20 illus. ISBN 88 222 45180.

This book contains the first published transcript of a manuscript containing articles on gunpowder and saltpetre prepared by Lavoisier and some of his colleagues. It was intended that these articles should form part of a dictionary of artillery for a volume of *l'Encyclopédie Méthodique* edited by Pankoucke at the end of the 18th century. However, the manuscript was not completed and was only rediscovered in 1995. Patrice Bret has transcribed the text, which occupies 105 pages of the book and written a 55 page introduction

The manuscript consists of an incomplete alphabetical list (a to f) of articles related to gunpowder and saltpetre. Translated crudely into English, with the number of pages in brackets, these are (a) potash (6.0), hydrometer (2.7), watering (1.6), saltpetre workshops (1.6); (b) barrel (1.2), stamping (2.6), stamps (0.1), alder buckthorn (1.8); (c) barrel hoops (0.3), barrel covers (0.6), charcoal (22.2), fouling gun barrels (3.0), crystallisation (2.6), refining saltpetre (5.7); (d) purification of saltpetre (1.1), detonation (8.1); (e) mother liquor (4.7), skimmers (0.4), proving potash, powder and saltpetre (9.3), eprouvette (9.9); (f) digging for saltpetre (1.1), furnace (1.4). There is also an article by Lavoisier on saltpetre (6.5) from another source, but considered to have been intended for the same encyclopaedia. The twenty illustrations are facsimiles of pages of the original manuscript apart from one which is a longitudinal section of a saltpetre refining furnace dated 1788.

The depth of Patrice's analysis of the material is indicated by the fact that there are 154 footnotes to the introduction, 348 to the transcript and a 10 page bibliography. Clearly the book contains a wealth of valuable information for all those interested in the history of gunpowder manufacture.

MORE REPRODUCTIONS OF HISTORIC COMMERCIAL BOOKLETS

In Newsletter **23**, an account was given of reprints of Curtis's & Harvey, New Explosives Co and EC Powder Co booklets produced by **Jim Buchanan** a friend of Bill Curtis. I am pleased to report that Jim, whose main interests are early breechloading firearms and their ammunition, has now joined GMSG. He has provided a full list of copies of early books and catalogues which he is willing to copy for members. He emphasises that he does not represent a commercial concern and that his copies are intended for collectors of guns and ammunition and not book collectors. All his copies are enlarged to A4 size and are bound with coloured card covers. His list contains 120 items and gives the date of the original publication (1855 to 1939), the number of pages (6 to 390) and the price (£5 to £30). Most are ammunition catalogues but some are journals or articles from magazines and journals. Members interested should contact Jim at 8 Chiltern Walk, Tunbridge Wells, Kent TN2 3NJ.

"A DOGMATICAL DEMONSTRATION OF POWDER AND MINES"

Kim Owen, who lives in a cottage at the Lower Works of the Chilworth gunpowder site near Guildford in Surrey, is a descendant of William Bickford who, in 1831, patented the safety fuse. The story of this successful invention and the resulting Bickford Smith company is told by Brian Earl in chapter 4 of his *Cornish Explosives*, Trevithick Society, Penzance, 1978. Kim has in his possession a manuscript book with the above title which has xv plus 151 pages and 4 plates. The fly-leaf is signed J S Bickford, April 21st 1853, corresponding to John Solomon Bickford who was one of the company's principals in 1864. However the title page has an indecipherable signature and a French quotation glorifying military endeavour. Then comes a page with "February 20, 1830, By Lt General Sir Richard Church to Captain Jochmeed[?]". Church has signed the next page on which the title is repeated together with a list of the six main subjects which the book covers: 1. The Invention of Gunpowder; 2. Its Explosion, Elasticity, Density, Gravity, Velocity and Inflammation; 3. The Invention of Mines and Fougasses; 4. Their Charge and Dimensions of Cube-boxes; 5. The manner of making and loading them; 6. The necessary Tables, deduced from a new Theory. At the foot of this page there is a quotation in German from Föllner and on the next page one in Latin from Ovid.

The next three pages contain a dedication "To His Highness William Earl Regent de la Lippe Schaumburg & Sternberg, Knight of the most noble order of the Black Eagle, Generalissimo of all His Most Faithful Majesties Forces and Field Marshall of England &&&". This contains a request for patronage and protection and refers to "the General History of the late war" which was published in five volumes in London in 1766. This clearly refers to the Seven Years War (1756-63) between Prussia, with British financial support, and a coalition of Austria, Russia and France. Lippe Schaumberg is in Germany, roughly mid-way between Cologne and Hanover and Sternberg is 70 miles east of Hamburg. The dedication is signed by "your Highness's Most humble and Obedient Servant, George Smith", who could have been an ancestor of the George Smith who married William Bickford's daughter in 1831.

There follows a seven page Preface which ends with "Bloxen in the County of Oldenburg, the 24 March 1766". Oldenburg is 85 miles north-west of Hanover. The last of the introductory pages then gives a more detailed contents list: 1. The invention of gunpowder; 2. Further observations on powder; 3. Theory of powder; 4. Application of fire-arms; 5. To find the velocities of shots; 6. Table of velocities; 7. Of mines and their invention; 8. Definitions of the several mines; 9. Making galleries and chambers; 10. Manner of loading and stoping the mines; 11. Proper quantities of powder to charge mines; 12. Yallier's table for the charge of mines; 13. The authors table for cube-boxes; 15[a]. The manner of directing the galleries; 15[b]. How to make fougasses and cassions; 16. How to make powder magazines.

It appears from the text that George Smith, the author, was an English military man who had spent much of his life on the Continent in Holland and Germany. He had a good knowledge of science and engineering, was fluent in German and, judging by the quotations in the book, was very fond of literature. The text is largely based on German and French practice and his own experience. The first part concerns the invention and use of powder in guns and not the manufacture of powder. The second part, illustrated by four plates, is on the construction of mines or tunnels beneath an enemy's fortifications and the way in which these should be charged with powder. An appendix deals with the construction of magazines.

Kim Owen and I would be interested to hear from members or others who might be able to clarify the origins of this book.

Alan Crocker

LONDON ADDRESSES OF GUNPOWDER MAKERS

Will Adye-White has extracted the following addresses from *London Gunmakers, Historical data on the London gun trade in the nineteenth and twentieth centuries*, by Nigel Brown, Christie's Books, London. He admits that he may have missed some entries and, as the information has been transcribed three times, some errors may have been introduced. It is also clear that some companies had London offices before the dates given here.

The American EC & Schultze Gunpowder Co Ltd: 1900-10, 28 Gresham St, EC

Sir Henry Bridges: 1850-63, 35 St Swithin's Lane, EC; 1863-64, 25 Birchin Lane, EC

John, Thomas & Samuel Sharp: 1852-5, 29 Nicholas Lane; 1855-57, 59 King William St, City EC; 1857-83 Chilworth near Guildford; 1883-84, 44 King William St

Chilworth Gunpowder Co Ltd (Westfield Bros): 1886-91, 6 Gt Winchester St, EC; 1891-99, 55 Charing Cross SW; 1899-1912, 54 Parliament St, SW; 1913-19, 16 St James's St

Cooppal & Co (Royal Belgian Powder Factories, Wetteren): 1886-91 (Agent: Theo Bock & Sons & Co), Crosby Buildings, Crosby Square, Great St Helen's EC; 1891-93 (Agent: Jason R Watson), 1893-1910 (Cooppal & Co Ltd) and 1911-18 (Cooppal & Co), Cornwall Buildings, Queen Victoria St; 1918-? (Agent: Jas R Watson & Co), ?

The Cooppal Smokeless Powder: 1894-1909, 35 Queen Victoria St, EC; 1910-14 (Co Ltd) Cornwall Buildings, Queen Victoria St

Cotton Powder Co Ltd: 1876, 23 Queen Anne's Gate, SW

Cramer Buchholz, Ronsahl (Westphalia) & Rubeland: 1884-85, 79 Leadenhall St, EC; 1885-86 (Agent: William Brodersen) 104 Leadenhall St, EC

Curtis's & Harvey: before 1842-1873, 74 Lombard St & Hounslow Heath Mill, Middlesex; 1873-99, 74 Lombard St EC; 1899-1912, 3 Gracechurch St, EC; 1913-21, 110 Cannon St, EC; 1922-8, 2 Buckingham Gate, SW1

Dartford Gunpowder Mfg: 1856-73, 34 Throgmorton St, EC

Dartford & Battle Gunpowder: 1873-5, 12 Queen Victoria St, EC; 1875-76, 11 Queen Victoria St, EC

Pigou's & Wilkes: 1850-65, 1865-73 (Pigou & Wilkes), 34 Throgmorton St, EC & Dartford

Pigou, Wilkes & Laurence Ltd: 1873-5, 12 Queen Victoria St, EC; 1875-99, 11 Queen Victoria St; 1899-1900, 3 Gracechurch St, EC & Dartford (works)

John Hall & Son: 1850-75, 23 Lombard St, EC; 1875-97 and 1897-99 (John Hall & Son Ltd) 79 Cannon St, EC; 1899-1900, 3 Gracechurch St, EC & Faversham (works)

EC Powder Co Ltd: 1884-87, 11 Queen Victoria St, EC; 1887-97 and 1907-23, 20 Bucklersbury, EC; 1897-1906, 40 New Broad St, EC

John & Henry Gwynne, Engineers: 1874-79, 89 Cannon St, EC & Hammersmith (works); 1879-80 (powder machinery makers), Hammersmith (works)

J & E Hall, Powder Machinery Makers: 1884-89 and 1889-1903 (J & E Hall Ltd), 23 St Swithins Lane, EC & Dartford (works)

Henry Hathaway, Makers' Agent: 1884, 1 Aldgate, E

Hay, Merricks & Co Ltd: 1878-9, 116 Fenchurch St, EC; 1879-81, 4 New London St, EC; 1881-93, same with Edinburgh & Glasgow; 1893-99, same with Roslin; 1899-1900, 3 Gracechurch St & Roslin

Jukes, Coulson & Co, Exporter of Powder & Arms: 1774, 10 All Hallows Lane; 1779-83 (Iron materials to Birmingham & African merchants); 1800-35, 94 Upper James St; 1844, 11-12 Clements Lane, Lombard St

Kames Gunpowder Co: 1854-63, 147 Leadenhall St; 1863-67 (Agent: Laroche, Nainby & Co), 45 Lime St; 1867-79 (Agent: Macallum & Jackson), 5 Lime St; 1869-73 (Agent:

Macallum & Co), 3-4 Great Winchester St Buildings; 1873-75, K G Co, same; 1875-77, 18 Austin Friars; 1877-98, 74 Lombard St

Kennall Gunpowder Co: 1878-81, 27 Bishopsgate St Within; 1881-82 35 Queen Victoria St, EC

National Explosives Co Ltd: 1905-7, 10-11 Austin St & Hayle, Cornwall (works)

The New Explosives Co Ltd: 1898-1904, 75 Queen Victoria St & Stowmarket (works); 1904-20, 62 London Wall

Nitrokol Powder Co: 1908-17, 39 Victoria St, SW

Nobels Explosives Co Ltd: 1896-1903, 1 Arundle St, Strand; 1904-8, College Hill Chambers, Cannon St, EC; 1909-18, 101-107 Kingsway, WC

Explosives Trades Ltd: 1919, 6 Cavendish Square, W1; 1920, 320 Winchester House, Old Broad St, EC2; 1921, Angel Rd, Edmonton, N18; 1922-27, Nobel House, Buckingham Gate, SW1

The Normal Powder Syndicate Ltd: 1896-97 and 1897-99 (TNP & Ammunition Co Ltd), 38 Parliament St, SW; 1899-1900 (TNP&ACL), 2 Bank Buildings, Cricklewood, NW; 1901-1910, (TNP&ACL), Hendon, NW; 1910 (The New Normal Ammunition Co Ltd)

Geo & Joseph Oliver, Gunpowder Cylinders & Drums: 1890-1923, 37-39 Wapping Wall, E

The Patent Cotton Gunpowder Co: 1874, 4 Queens Square, Westminster, SW

The Patent Gunpowder Co Ltd: 1874-75, 2 Great Winchester St, EC; 1875-78, 5 & 6 Great Winchester St, EC

Frederick Arthur Perry, Machinery Maker: 1917, 63 Queen Victoria St, EC

Roslin Gunpowder Works: 1872-75, 65 Fenchurch St, EC; 1875-6 (Roslin Gunpowder Mills), 5 Fenchurch St, EC

The Safety Blasting Co Ltd: 1882-86, 11 Queen Victoria St, EC

Schultze's Granulated Wood Gunpowder Co Ltd: 1868-69, 9 Northumberland St, Charing Cross, WC

Schultze Gunpowder Co Ltd: 1869-71, 2 Bond St, Walbrook, EC; 1871-73, 25 New Broad St, EC; 1873-77, 62 Bishopsgate St Within; 1877-79, 8 Bucklersbury, EC; 1879-82, 3 Bucklersbury, EC;1882-86, ?; 1886-99, 32 Gresham St, EC; 1899-1911, 28 Gresham St, EC

Schultze Co Ltd (Eley Bros): 1911-15, 254a Gray's Inn Rd, WC; 1916-22, 39-41 New Bond St, EC; 1922-28, Nobel House, Buckingham Gate, SW1

William Slater/Slatter, Patent Copper Barrel Maker: 1830-39, 332 High St, Wapping; 1855 (Barrel maker), ?

William Slater: 1850-68 (gunpowder maker and, from 1864, barrel maker), 332 Wapping High St, E

The Smokeless Powder Co Ltd: 1890-99, 9 New Bond St, EC, Dashwood House

The Smokeless Powder & Ammunition Co Ltd: 1899-1904, 28 Gresham St, EC

South African Pioneer Powder Factory Ltd: 1884-7, 6a Austin Friars, EC

South African Explosives Co Ltd: 1887-88, 6a Austin Friars, EC

Walkers, Maltby & Co, Patent Shot Manufacturers: 1788-1815, 1816-25 (W, M, Parker & Co) and 1826-27 (W, P & Co), Red Bull Wharf, Upper Thames St

R W Wallace & Co, Agents of The Cotton Powder Co: 1880, 60 Mark Lane, EC

The Walsrode Smokeless & Waterproof Gunpowder Co: 1894, 65 & 66 Basinghall St, EC, Q V Wolff & Co; 1898-1903 (TW (Anglo) S&WGC, Agent: Beutner & Co), 57 Belgrave Rd; 1904-06, 38 St George's Square, SW

War & Sporting Smokeless Powder Maker Syndicate Ltd: 1896-98, 11 Queen Victoria St, EC

Wolffe & Co (Walsrode Powder), Agent: George Beutner: 1892-93, 5 Laurence Pountney Hill, EC; 1893-96, 65 & 66 Basinghall St, EC

USE OF GUNPOWDER BY THE POST OFFICE, 1791-93 and 1814-15

Russ Nicholls has been carrying out research on account books in the Post Office archives and has provided us with snippets of information on the supply of gunpowder and weapons. They were provided for horse and foot posts, mail coaches and packet boats. Most of the entries refer to warlike stores, ordnance stores, small arms, fire arms, pistol and blunderbuss cases and cannon and do not refer explicitly to gunpowder. However in April 1793 John Berkley was paid £1581.11s.10d for iron cannon, gunpowder and warlike stores for the use of the packet boats on the Falmouth station and £514.4s.4d for those on the Harwich station. In October 1814 W B Ruddick was paid £1124.9s.10d for gunpowder supplied by the Ordnance Board from their magazine at Pendennis Castle for the Falmouth packet boats. Also, Thomas Alcock, Treasurer of the Ordnance, was paid £837.18s.0d for powder and warlike stores for the Falmouth packet boats for 1814, and £2.16s.0d for gunpowder supplied to the Queensbury packet by His Majesty's Ship *Princess* in 1815. Other suppliers were J J & R Mangles (warlike stores), James Wilkinson (brass-barrelled pistols and small arms), H W Mortimer (fire arm repairs), Thomas Foster (pistol cases), George Bell (cannon). The other packet boats mentioned are the *Chesterfield* and the *Lady Louise* (from the Ordnance store at Halifax, presumably in Nova Scotia), the *Grace*, the *Townshend* and the *Sandwich* (from the Ordnance store at Barbados), the Milford boats and the Carteret, Chesterfield, Westmorland boats. Clearly Russ has discovered yet another source of fascinating information on gunpowder history.

PENRHYNDEUDRAETH EXPLOSIVES FACTORY

Bill Curtis has sent us a copy of a press release from the North Wales Wildlife Trust (NWWT). It reports that, following an extensive clean-up operation, ICI have sold the former Gwaith Powdwr ["Powdr" in my Welsh dictionary!] site near Penrhyndeudraeth to NWWT for £1. It opened in 1865 and closed in 1995. The Trust is embarking on a major programme of restoration work, with grants from the Heritage Lottery Fund and the Countryside Council for Wales, with the aim of establishing a nature reserve. A ceremonial handing over of keys took place on 14 December and a public open day is planned for May, with guided walks and events for children and adults. For more information contact Morgan Parry or Frances Cattanach (NWWT) on 01248 351541 or Peter Cartwright (ICI) on 01294 487642.

PIGEON DROPPINGS

Alan Crocker

Assume a pigeon weighs 1kg, that it deposits 1% of its body-weight (in its pigeon house) per day and that this material contains 10% saltpetre. This gives 1gm of saltpetre per bird per day. One tonne of gunpowder contains 750kg of saltpetre which would then be produced by 750,000 pigeons in one day. Assume that the average capacity of a pigeon house is 750 birds. Then 1000 pigeon houses would be sufficient to produce 1 tonne of gunpowder per day. Alternatively one pigeon house would provide enough dung after 1000 days, which roughly would be the interval between visits by the saltpetre men. Therefore, if a county had 200 settlements and each settlement had 5 pigeon houses, it could produce 1 tonne of gunpowder per day and the British isles could produce 100 tonnes per day.

An appropriate prize might be available for the best response to this nonsense!

GUNPOWDER LABELS

Peter Cartwright

The articles on gunpowder labels in Newsletter **23**, based on information provided by Bill Curtis and Jim Buchanan, prompted me to look in the ICI archives where I found three large leather-bound books of labels of explosives manufacturers. There are hundreds of them, mostly in mint condition, and in several languages for the overseas markets of John Hall, Pigou & Wilks, Curtis's & Harvey etc. My favourite is a Curtis's & Harvey "Honker" medium grain gunpowder which is circular (about 6 inches across) and coloured red with a small central print of a duck being shot!

There are also special labels which are either separate or have overprinting on manufacturers' labels of the type: "Made expressly for ... Gunmakers ... etc". There are examples of forgery and imitation - one example is a German FFF gunpowder by a company masquerading as "Cutbis's and Harvey's of Hounslom and London".

I do not have time to make a detailed study of these volumes but it did fascinate me that in the case of Curtis's & Harvey the labels confirmed that the company had premises, in rough chronological order, at: Hounslow [H]; H Heath Mills; H and London [L]; L & H etc; H, Tunbridge [Tu] and L; H, Tu, Glynn Neath [GN] & Kames [K]; H, Tu, GN & Kyles of Bute [KoB]; H, Tu, GN & K Mills; H, Tu, GN & Clyde Mills; H, Tu, GN & Glen Lean [GL] and KoB; H, Tu, GN & K; H, Tonbridge [To], Cliffe, GN, K and GL Mills; H, To, GN, Faversham [F], K & Roslin [R]; H, To, GN, F, K, R & Dartford [D]; H,To,GN, F, K, R, D & Ballincollig; Sandbank, L & Glasgow.

I wondered whether researchers might be interested in viewing this material.

[Information we have about Curtis's & Harvey shows that they were established at Hounslow in 1820, took over Glen Lean (Clyde Mills, Sandbank)) in 1846, Tonbridge in 1859, Glyn Neath in 1864, Kames (Kyles of Bute) in 1876, Ballincollig, Camilty (West Calder), Dartford, Faversham, Kennall Vale and Roslin in 1898, and opened Cliffe at Hoo in 1900. - ed]

TOUR OF 'MILLS IN THE PELEPONNESE', 12-19 October 1999

Tour operators *Island Holidays* have organised this tour which will be mainly based at Dmitsana, where there are over 60 water-powered sites including 20 gunpowder mills, 18 fulling mills and 27 flour mills. The village is loved by Greeks all over the world as being the centre of gunpowder production that supplied the Greek forces in the War of Independence which resulted in the Greek State in 1830. The mills have been recorded and a museum and a working gunpowder mill established with the support of the ETBA Cultural Foundation of Athens, who are members of GMSG. This tour was suggested by Glenys and me when in 1997 we went on an *Island Holidays* tour of mills (mainly wind- and water-powered corn mills) in the Cyclades Islands. Glenys had earlier been on another tour of mills in Crete, where the English leaders, John and Chris Henshall live. They are fluent Greek speakers and research the tours very thoroughly on the ground before the party arrives. They are supported by Alan Gifford of Derby, an engineer who is an authority on corn mills. The *Island Holidays* brochure explains that "the food and wine of the area are high on the list of priorities, as those who have been on previous mills tours well know". We agree. The cost is £870 (single supplement £65), including all food and wine, transportation and entrances. The only extra is travel insurance. The tour is limited to 15 participants and 11 places had been booked by the end of January, which is sufficient for the tour to definitely go ahead. We shall be going of course and recommend the tour to all GMSG members. Further details from *Island Holidays* (tel 01764 670107) or Alan Gifford (tel 01283 702299).

SMALLARMS OF THE EAST INDIA COMPANY

David Harding reports that Volumes III and IV of his *Smallarms of the East India Company 1600-1856* will be published on 1st March 1999, completing (after 21 years) a work of some 1.2 million words, 2368 pages and 646 illustrations. Volumes I and II have won two awards and are fast selling out.

Volume III is entitled 'Ammunition and Performance', and includes a long chapter on gunpowder (71 pages of A4 with 433 source notes and five illustrations). This aims both to extend smallarm specialists' understanding of gunpowder, and to make a contribution to gunpowder studies. The East India Company bought powder in England and also made their own in India, and David opens up the wealth of information on powder and powder-making to be found in the Company's vast archives. He concentrates on the Company's English-made powder in the mid-18th century (with much information on English mills, makers and methods), and their Indian-made powder of the mid-19th century (some of which was made by methods very different from Congreve's, as used at Waltham Abbey, which did not prove so successful in the different circumstances of India).

Other chapters investigate what could be called 'applied gunpowder studies', namely the performance of powder, shot and paper cartridges in combination, in British military smallarms of the 18th and early 19th centuries, including a mass of newly re-discovered data on accuracy, range, misfire rates, penetration through wood etc..

Anyone wanting an advertising 'flier' should write to David at 30 Rosebery Road, Muswell Hill, London N10 2LH, or fax him on 0181-883 5286, or e-mail him at 'david.harding@virgin.net'. The special introductory price of Vols.III & IV in UK is £98 plus £7 p&p. This will go up to £129 (including p&p) from 1st July 1999. If there is sufficient demand among members of the GMSG, David will investigate having some laser-printed copies of the gunpowder chapter run off and bound. The cost would of course depend on how many members express interest.

A FAMILY OF SULPHUR REFINERS

Simon Malone of Thetford, Norfolk has contacted us about his family history research. His great-great-great-grandfather James O'Brien (1777-1842) was employed for 23 years until 1821 at the Royal Gunpowder Mills, Faversham, as a sulphur refiner. He was born in Ireland, married at Bobbing in Kent in 1897 and raised a family of seven children all born at Faversham. In 1821 he and his eldest son, James Edward, were made redundant and James snr was eventually awarded a pension of 8s 9d (44p) a week because he had little hope of finding alternative employment because of the "peculiar nature of his work". By that time James jnr had worked with his father for seven years in the sulphur refinery. He married at Hadlow in Kent in 1823 had three children in Faversham and a further nine at Waltham Abbey between 1830 and 1847, where again he was working in the sulphur refinery at the Royal Gunpowder Mills. His son Thomas joined him at work in 1861. James died in 1866 at Sulphur Cottage, Eleanor Road, Cheshunt and he is buried in the old cemetery Waltham Abbey. Sulphur Cottage is still clearly distinguished by an engraved namestone in its gable end. Simon has speculated that James O'Brien snr might have worked as a sulphur refiner at Ballincollig before moving to Faversham but there is as yet no evidence for this. Simon would like to hear from anyone who can add to the history of his ancestors. His address is 5 Lawson Road, Croxton, Thetford, Norfolk IP24 1NQ; tel 01842 754998.

THANKSGIVING SERVICE FOR MICHAEL WILKS

Alan Crocker

Glenys and I attended this service which, as announced in Newsletter **23**, was held at the Church of Christ the King, Gordon Square, London on 13 October. Well over a hundred people were there, almost entirely former colleagues and students of Michael at Birkbeck College. Michael's widow, Stella, had sent a copy of the GMSG obituary to Roy Foster, Professor of Irish History at Hertford College, Oxford, who gave the address. This prompted him to mention that Michael had played a key role in establishing the Group, which surprised most of those present. The church was an appropriate venue for the service as Michael's grandfather had been a priest there when it was the London headquarters of the Catholic Apostolic Church, founded by Henry Irving. Incidentally, one of the main supporters of this sect was Henry Drummond of Albury in Surrey who in 1842 bought the Chilworth gunpowder works as a dowry for his daughter who was marrying a future Duke of Northumberland. Michael's service included organ pieces by Messaien, readings from T S Eliot and the hymn Cwm Rhondda, sung in English. There was a reception at Birkbeck College after the service where we were able to chat with Stella and Roy Foster.

ORDNANCE OFFICE - WALKER AGREEMENT OF 1786

Francis Haveron of the Surrey Industrial History Group has given us a photocopy of an agreement dated 17 February 1786 between the Principal Officers of George III's Ordnance (Sir William Howe, Lieutenant General; James Luttrel, Surveyor General; Gibbs Crawford, Clerk; John Aldridge, Storekeeper; Thomas Baillie, Clerk of Deliveries) and Samuel Walker & Co (Joshua, Joseph, Thomas and Jonathan Walker & John Crawshaw) of Rotherham, Yorkshire, gunfounders. Walkers were a major company and their rolling and slitting mill is featured for example in Plate IV, dated 1812, of the article on "Iron" in Rees's *Cyclopaedia*. The Company agreed to deliver to Woolwich Warren 1000 tons of iron ordnance by 31 December 1787. Details are given of the quality of iron to be used, the way in which the guns were to be cast and bored, the way in which they should bear the king's cypher and the arrangements for examination, proof, acceptance, rectification, rejection and removal. The Ordnance agreed to pay £12 per ton for the guns which were accepted.

An appendix gives a schedule of tolerances for the bore, vent, trunnions, diameter, length etc for 42 to 4 pounder Government and merchants guns. I was surprised to find that these are given in tenths of an inch and not eighths, sixteenths etc and also that another column, apparently in the same hand, gives them in up to two decimal places of an inch (using a decimal point. This may have been added later as the heading of the column refers to a Board order which appears to be dated 27th March 1843 but unfortunately the year is blurred. This is puzzling however as it is difficult to understand why a column in decimals should be added 57 or more years after the agreement was signed. The year 1786 might seem early for the use of decimals but the system is said to have been introduced by the mathematician Simon Steven in 1585 and in 1684 *Cocker's Decimal Arithmetic* was published. Also John Smeaton used decimals in the late 18th century. A second appendix gives the charge of powder to be used in the proof firing. This was 25, 21.5, 18 and 15 lbs charge for 42, 32, 24 and 18 pounders and n lbs for n pounders where n equals 12, 9, 6, 4, 3, 2, 1.5, 1 and 0.5.

The photocopy of the document does not indicate where the original is kept but it is presumably in the War Office records at the Public Record Office. A copy (16 sheets of A4) can be provided on request.

I am indebted to **Robin Clarke** for valuable discussions.

Alan Crocker

MUSEUM OF NAVAL ARMAMENT AT PRIDDY'S HARD

Philip Magrath has written as follows: "The complex at Priddy's Hard near Gosport provided the navy with arms and ammunition over a two hundred year period. Plans are now underway to open a museum of naval armament in the late summer of next year. To that end efforts are being made to clarify certain areas of operation in the early years. For example the powder magazine, operational in 1777, accommodated 4238 barrels of powder and was connected to a small stone-built harbour by means of a rolling-way. Now it is assumed by some that barrels were simply rolled along to be loaded into sailing vessels known as powder hoys for forward transit to the fleet. The problem is we have no evidence with which to back this assumption up. In terms of the safety implications is this really how full barrels of black powder were moved or perhaps some other means of conveyance was used, like an all wooden wheelbarrow? Any information on this or related matters would be most welcome."
Address: Museum of Naval Armament, Priddy's Hard. Priory Road, Gosport, Hants PO12 4LE

GERMAN BOOKS ON THE HISTORY OF GUNPOWDER MANUFACTURE

Frieder Schmidt of Die Deutsch Bibliotek, Leipzig, is Vice-President of the International Association of Paper Historians but has a wide interest in industrial archaeology including gunpowder mills. He has sent us photocopies of six German texts on the history of gunpowder manufacture. These clearly contain a wealth of information which could be extracted by someone with a reasonable ability to read German including, for four of the texts, Gothic script. The content of the texts is outlined below and if any member would like to see one or more of these for their own research purposes and with a view to preparing an article for the next GMSG Newsletter, I would be pleased to provide copies.

"Der Zersprungenen Pulver-Mühle in Zurich." A print, with an extended caption, of an explosion of a powder mill at Zurich on 19 July 1723. From *Die Zürcher Papierfabrik an der Sihl Zürich, 1838-1938.* (See back cover of this Newsletter)
Christoph Wilhelm Jakob Galteres, *Technologisches Magazin*, pp 475-89, Manningen, 1790, "Schriften von Pulvermachen, nach chronologische Ordnung". A list of books on gunpowder making from 1540 to 1789. After the earliest (Biringoccio) there are 7 books from the 17th century and 81 from the 18th century. At least two (1786 and 1788) are about English mills.
Carl Franz Hottenroth, Article from a journal, pp 101-25, 1820, "Beschreibung der im Budissiner Weichbilde besindlichen Pulverfabrik und des darin gesertigten gewöhnlichen, besonders aber des Rundpulvers". Appears to describe contributions to gunpowder technology by Hottenroth ancestors and gives accounts of stamp mills, corning, drying etc and of different types of "round-powder".
D Johann Heinrich Moritz Poppe, *Technologisches Lesebuch,* pp 41-56, Stuttgart, 1825, "Die Pulvermühlen". There are sections on history, ingredients, incorporating, corning, drying, glazing, proving and transport.
Moritz Oppenman, *Der Klüt*, **38** (1966), pp 59-63. "Vergangene Pulvermühlen. Appears to be a rather elementary account of gunpowder making.
Winfried Hecht, *Pulver aus der Reichsstadt Rottweil*, Kleine Schriften des Stadtarchivs Rottweil 4, 1977. A5, 23 pages, 4 illus. Gunpowder making appears to have commenced at Rottweil in 1544 and there is a drawing of the mill in 1564. Details are given of the mills in the 17th and 18th centuries and a few facts about the first half of the 19th century.

GUNPOWDER MILL RECORDS IN THE TED PATTERSON ARCHIVES

When Ted Patterson died (obituary in Newsletter **22**) **Miles Oglethorpe** sorted the material he had collected on the gunpowder industry. The items relating to Scotland were retained by the Royal Commission on the Ancient and Historical Monuments of Scotland but the rest, contained in two boxes, was transferred to the Royal Commission on the Ancient Monuments of England for deposit in the National Monuments Record at Swindon. Miles has sent us a list of this English (and Welsh) material and a summary of the contents is given below.

Box One (17 items). Manufacturing method books for Elterwater, Faversham, Gatebeck (x2), Hounslow & Bedfont, Lowwood (x5) and Sedgwick (x2). Plans, notes, photographs, photocopies and correspondence relating to Bassinghyll, Blackbeck, Lowwood, Elterwater and Gatebeck. Similar for Act of Parliament 1860, Ballincollig, Devon & Somerset, Dolgelley, Ferndale, Fernilee, Glyn Neath, Hounslow & Bedfont, Other Foreign, Tonbridge. Similar for Barwick, Chilworth, Cornwall, Dartford, Ewell, Godstone, Hounslow/Bedfont, Kynochtown, Waltham Abbey, Worsborough Dale. Dye-line drawings relating to a hydraulic cartridge machine and cake press at Gatebeck and Blackbeck factories respectively.

Box Two (6 items; number 6 in 8 sections). Manufacturing method books for Elterwater, Gatebeck (x2) and Sedgwick (x2). Papers, booklets, map extracts, photocopies relating to New and Old Sedgewick and Gatebeck. Similar for Faversham. Similar for Battle. Photocopy of Faversham lease of 1899.

It is not known whether this material is available to researchers. Let me know if you want a copy of the more detailed list provided by Miles Oglethorpe.

THE 'EC' POWDER COMPANY LIMITED

David Milbank Challis, of Industrialogical Associates, is a new member of GMSG and interested particularly in the 'EC' Company. He notes that trade directories have 'EC' entries from 1890 to 1913 under the parish of Stone, near Dartford in Kent. In 1890 George John Henry is shown as the manager and in 1895 [William] D[alrymple] Borland. He was living at Beacon Lodge, near the site of the works, and was still there in 1934. However in about 1920 the site was acquired by BPCM for the extraction of clay for Johnson's cement works at Greenhithe. David has been informed that there was a clock tower in the middle of the works which was removed and relocated at the cement works. The 'EC' works were on the southern slope of Bean Hill, at over 300 ft the highest ground in the area, in Beacon Wood in the hamlet of Bean in the parish of Stone. Strictly, they were not at nearby Green Street Green which is the address the Company used in the *Rise & Progress* of 1909. The 1:2500 OS map surveyed in 1907 shows a wooded site approximately 250 yds east-west and 100 yds north-south. There are about 25 buildings, most of them small and well-separated along a system of branching roads. It looks just like a small powder factory. However the only words printed on the area are "Reservoirs" and "Testing Range". Examining this map in detail suggests that the photographs in Jim Buchanan's copy of an 'EC' booklet (see Newsletter **23**, p 20), show buildings, a chimney stack and a pond at the south-east corner of the site. Another edition of this OS map shows the site blank, presumably for security reasons during the World War I. The Company number was 17909 and its records are at PRO BT 31/14727.

David poses the following questions: 1. What was the origin of the Company, when was it founded and for what purpose? 2. Why were the works located at Bean away from ready transport? 3. What type of manufacture was employed? 4. Was this a new process at the time? 5. Did it require machinery? 6. How many people might have been employed? 7. Would the Company have built housing (there are groups of terraced cottages nearby)? 8. Would the

Company have had to obtain raw materials and get them transported to the site? 9. Would these materials have been bulky? 10. In the 1890s what means of transport would have been used: water (via Greenhithe) and horse cart; railway (via Dartford, Northfleet, or Southfleet) and horse cart? 11. How would finished products have been dispatched? 12. Was Beacon Lodge acquired or built for the manager by 1895? 13. Did the works close before or during the First World War or later? 14. Was the Company taken over or wound up? 15. Did the 'EC' brand name survive?

Some answers to these questions are given by the *Rise & Progress*, p 365. The capital in 1909 was £49,500 in £1 shares, the last dividend being 15%. They manufactured all varieties of nitrocellulose and smokeless powders of nitrocellulose base. They had agents throughout the world and won 1st prizes in 1885 and 1908. Other comments please to David at 4 Oliver Road, Shenfield, Brentwood, Essex CM15 8QD, tel 01277 261610, fax 01277 261609.

THE NAVAL WAR OF 1812, A DOCUMENTARY HISTORY, VOL 1

Russ Nicholls has provided some notes and a few photocopied pages taken from this book edited by William S Dudley of the Navy Historical Centre, US Navy, 1988. Six weeks before the War or 1812 with Britain, the Secretary of the US Navy ordered that all the gunpowder they held had to be tested. Samuel Evans, the Commandant of the Navy Yard at Gosport (now Norfolk, Virginia) did not have an eprouvette available and therefore compared his powder with approved powder from the frigate *United States*. He used a howitzer carrying a 3 lbs ball, elevated 9 degrees and charged with half an ounce of powder. The average "distance thrown" using the frigate powder was 373 ft and that for the powder in 72 of his barrels was 148 ft, individual tests ranging from 63 ft to 410 ft. He also tested 7 barrels of priming powder in the same way, the average distance being 204 ft. The powder in other barrels was "in a cake and entirely damaged". Similarly Captain William Bainbridge of the Navy Yard at Charlestown reported that he had all the powder in the Boston magazine proved and had condemned 14,600 lbs, plus 2,985 lbs from the *John Adams* and 2,229 lbs from the *Chesapeake*, totalling 19,814 lbs. The *Chesapeake* had 9,900 lbs of powder fit for service and the *John Adams* 6,400 lbs but it is not stated how much good powder was in the Boston magazine, perhaps none. He wanted to know what to do with the damaged powder. Clearly the situation was very unsatisfactory.

HER MAJESTY'S ORDNANCE FACTORIES, WALTHAM ABBEY

Jim Buchanan has sent copies of this 3-part article by Frederick G Engelbach, which appeared in *The Navy and Army Illustrated*, Oct 14th 1899, pp 105-107, Dec 30th 1899, pp 405-407 and Jan 13th 1900, pp 434-435. It is particularly well illustrated. Part I has portraits of Major F L Nathan, Assistant Superintendant, Lt W B Anley, Officer in charge of danger buildings, and photographs of the staff headquarters, a police sargeant searching a man at the entrance, loaded boats going downstream through a lock, a worker showing boots used in buildings, a brick traverse separating a mixing house from other buildings on Lower Island, specimens of cordite and primers, and landing acetone on arrival at the factory. Part II has an acid mixing shed, mixing acids by compressed air, two women in the cotton-picking room, an oven for drying cotton, the nitrating shop, a machine for washing guncotton, moulding guncotton discs and a press for making guncotton discs. Finally Part III has two charges of guncotton before and after incorporation, cordite mixing using a dough incorporator, cordite being pressed into cords, winding 60 strands of cordite into one rope, baking cordite to remove acetone, a ruined nitroglycerine house, pulverised brick and stone following an explosion, a nitroglycerine lift and a nitroglycerine danger building. The text is also of some interest.

Glenys Crocker, *The Gunpowder Industry*, 2nd edition, Shire, 1999. A4, card covers, 32 pp, 46 illus. £2.95. ISBN 0 7478 0393 5.

The first edition of Glenys's Shire Album on *The Gunpowder Industry* was published in 1986, shortly after GMSG was established, and has been out of print for several years. Our knowledge and underestanding of the subject has of course increased enormously since then and Glenys has been able to incorporate much new material in this second edition. For example several new illustrations, including conservation work at Waltham Abbey, the opening of Ballincollig and a selection of labels, have been introduced. Also the bibliography is much more extensive reflecting all the recently published work. Shire have also introduced general changes to the design of their Albums but the cover still shows the proving mortar at the Cherrybrook Mills site in Devon with, appropriately, 'Crocker[n] Tor' on the sky-line.

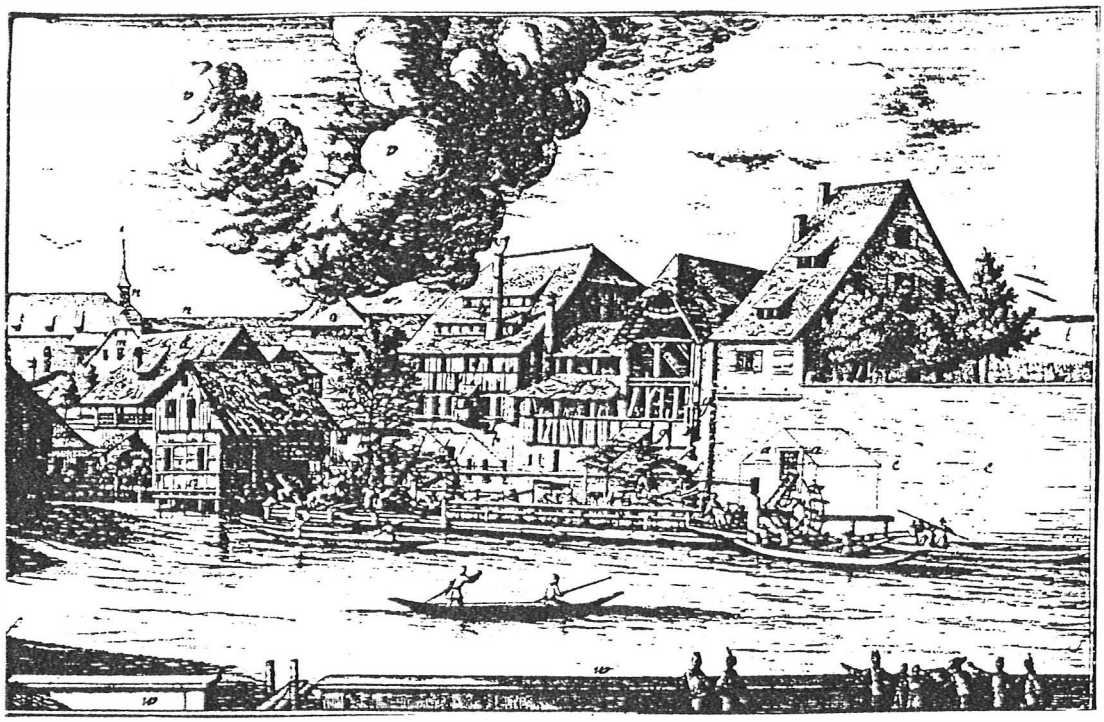
Glenys has received the following note from Arthur Percival of the Fleur de Lis Heritage Centre, Faversham: "As we can't survive without *The Gunpowder Industry* I had ordered copies from Shire for delivery on publication of the second edition. What a splendid job you have made of bringing it up to date. It is a miracle of compression."

Norman B Wilkinson, *Explosives in History, the Story of Black Powder*, Rand McNally, Chicago, 1966 (with Hagley Museum, Delaware). Large A5, card covers, 64 pp, 15 illus.

John Day has lent me his copy of this 1966 book which he acquired second-hand recently. It is from the Rand McNally Classroom Library and aimed at schoolchildren in the USA. It has chapters on: The Discovery of Black Powder; Black Powder in Early America; The American Revolution; Powder Mills in Young America; How Black Powder Was Made; Powder in an Expanding Nation; Black Powder in Early Wars; The War of 1812; Keeping the Peace - and Fighting the Mexican War; The Civil War, The Spanish-American War; Improved Black-Powder Technology; The New Explosives; Epilogue. The book is packed with interesting and useful information and, as those who have read Norman Wilkinson's account of Lammot du Pont's visit to Britain in 1858 (*Trans Newcomen Soc*, **47**, 1974-6, pp 85-96) would expect, it is very thoroughly researched and beautifully presented. If you can find a copy it is worth reading, particularly for the American side of the story about gunpowder in the Revolution and the War of 1812.

G I Brown, *The Big Bang - a history of explosives*, Sutton, 1999. £19.99

George Brown, who is a retired teacher of chemistry, spoke to me over the phone before Christmas about his forthcoming book and said he would ask Alan Sutton to send GMSG a copy to be reviewed in the Newsletter. This never arrived but on page 7 of the "Friday Review" in *The Independent* on 5 February there was a Scientific Note by George entitled "An explosive element of modern civilisation". This discusses the discovery of gunpowder and then lists various types of high explosives including guncotton, dynamite, gelignite, Lyddite, TNT, RDX, PETN, HMX and HNIW. Important events in the history of explosives are then mentioned including the development of guns, the end of the Byzantine empire, the Moguls in India, the overthrow of the Incas, the Aztecs, the Red Indians, the Aborigines and the Maoris, the Armada, the American Civil War, the WWI shell shortage, atomic bombs, hydrogen bombs and Semtex. Important people are then listed including Nobel, Abel, Fawkes, Congreve, du Ponts, Forsyth, Bickford, Munroe, Weizmann, Oppenheimer and Groves. Further information is no doubt available in the book.



Powder mill explosion in Zurich, 19 July 1723

PRINCIPAL CONTENTS

Names in brackets indicate sources of information rather than authors

GMSG Publication: AlicePalmer, *The Low Wood Gunpowder Company, 1798-1808*		2
GMSG Meeting in London, 31 October 1998	Alan Crocker	3
Capacity of English Gunpowder Mills in the Late 17th Century	Alan Crocker	5
The Use of Presses in mid-18th Century British Powder-Making	David Harding	7
Review: Agathe Guenand, *La fabrique des Poudres et Saltpêtres*		8
Royal Gunpowder Factory Workers Living in Waltham Cross in 1891	Chris Hicks	9
ICOHTEC Gunpowder Section: Third Meeting	Brenda Buchanan	12
Review: Patrice Bret, *Lavoisier et L'Encyclopédie Méthodique*		14
More Reproductions of Historic Commercial Booklets	[Jim Buchanan]	14
"A Dogmatical Demonstration of Powder and Mones"	[Kim Owen]	15
London Addresses of Gunpowder Makers	[Will Adye-White]	16
Use of Gunpowder by the Post Office, 1791-93 and 1814-15	[Russ Nicholls]	18
Gunpowder Labels	Peter Cartwright	19
Smallarms of the East India Company	[David Harding]	20
A Family of Sulphur Refiners	[Simon Malone]	20
Ordnance Office - Walker Agreement of 1786	[Francis Haveron]	21
Museum of Naval Armament at Priddy's Hard	[Philip Magrath]	22
German books on the history of gunpowder manufacture	[Frieder Schmidt]	22
Gunpowder Mill Records in the Ted Patterson Archives	[Miles Oglethorpe]	23
The 'EC' Company Limited	[David Milbank Challis]	23
Reviews of books by Glenys Crocker, Norman Wilkinson and George Brown		25

Deadline for next issue: July 15, 1999; earlier submission, especially on 3.5" floppy disc appreciated

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