

- 7 JUL 2009

Gunpowder & Explosives History Group

Newsletter 4, Winter 2002

GEHG SPRING MEETING

Firepower, The Royal Arsenal, Woolwich

Provisional Programme

Saturday 25th May 2002

- 10.30 Members may be met at Woolwich Arsenal railway station for a short guided walk to the Old Guard House
- 11.00 Coffee in the meeting room. Introduction to the site and its history
- 12.00-13.00 Lunch, members may bring their own food
- 13.00 Tour of exhibitions and privileged access to parts of The Royal Arsenal site
- 16.30 Tea and disperse, the museum closes at 17.00

Since the late seventeenth century The Royal Arsenal, Woolwich, was at the centre of the development and manufacture of British explosives and ordnance. Parts of the site remained in government hands until the early 1990s, and in common with the other sites the group has recently visited at Waltham Abbey and Priddy's Hard, a trust has received a large grant from the Heritage Lottery Fund to redevelop the site as a heritage attraction, in this instance to house the collections of the Royal Artillery. These have much to interest the group including displays of ammunition, ordnance and Congreve rockets. Other parts of the site are being developed in different ways.

The cost of the visit will be around £10 per person (payable to the treasurer on the day); this will cover the cost of admission and the hire of a meeting room.

The simplest route to *Firepower* is by rail, by taking a train from Cannon Street, Charing Cross or London Bridge to Woolwich Arsenal, it is then a 5 minute walk from the station, the route is sign-posted. Details of other methods of transport, including a map for car users, is given on the *Firepower* web site: www.firepower.org.uk

If you would like to attend the meeting at *Firepower* please let Wayne Cocroft know by 26th April 2002, email wayne.cocroft@rchme.co.uk or telephone 01223 556203

GUNPOWDER & EXPLOSIVES HISTORY GROUP AUTUMN MEETING

'Explosion!' - the Museum of Naval Firepower, Priddy's Hard, Gosport

Brenda Buchanan



Priddy's Hard, Gosport, powder magazine 1771. © W D Cocroft

'EXPLOSION!' - the Museum of Naval Firepower, is one of three formerly secret sites, decommissioned by the Ministry of Defence in the last decade and only recently opened to the public. Most of us are already familiar with the **Waltham Abbey Royal Gunpowder Mills**, through our personal links and the excellent spring meeting held there earlier this year. The third project, still to be visited, is **'FIREPOWER, the Museum of the Royal Artillery** at The Royal Arsenal, Woolwich. All three have been financed in part by grants from the Heritage Lottery and Millenium Funds. They are all relevant to our general interest in the history of gunpowder and explosives. Group visits will allow us to assess both the surviving features that were available for future development - for example the largely rural site at Waltham Abbey had few manageable buildings, in contrast to the tightly built-up area at Priddy's Hard with its great magazine and other substantial structures - and the use that has been made of them. We will also see the inter-dependence of this trio of sites, as the production of explosives at Waltham Abbey was followed by their dispersal to major naval and military depots. A third exercise is the practical one of testing the facilities available for meetings. Both Waltham Abbey and Priddy's Hard have come through this with flying colours, with helpful administrators, a reduced rate of entry, an excellent meeting room available for the day, with a good supply of tea and coffee, and experts able to take us into those parts of the site not open to the general public. At Priddy's Hard our particular thanks go to Commander Gurney the Curator, and Nicky Kelso the Operations Manager.

There were three parts to the meeting: 1) the AGM and short introduction to the site; 2) lunch and a self-guided tour of displays in the original buildings, especially the imposing great magazine; 3) a tour led by Commander Gurney, of storerooms and a smaller magazine. The report on the AGM is made by Brenda Buchanan, who chaired the meeting. Jim Lewis has kindly agreed to report on the site itself, the exhibitions, and the guided tour of some of the usually inaccessible features.

GUNPOWDER & EXPLOSIVES HISTORY GROUP FIRST ANNUAL GENERAL MEETING

Saturday 3 November 2001

The meeting was attended by 23 members (more than half our total membership), and four visitors. Apologies were received from Rene Amiable, John Boyes, and Mary Mills. This level of interest was welcomed as showing that despite the concerns of a year ago that the purpose of the original Gunpowder Mills Study Group had now been fulfilled, there remains a very considerable commitment to the subject, and a continuing need for a simple organization. It was to maintain this continuity but with a new vigour that a year ago we decided to broaden our approach beyond gunpowder, to the historical study of explosives in general. Our new title, the **Gunpowder & Explosives History Group**, shows our interest in both aspects of this field of study.

The Election of Officers was deemed unnecessary as Brenda Buchanan, Wayne Cocroft, and Kenneth Major, had agreed to act as the Chair, Editor, and Treasurer respectively, for the first three years of the re- formed Group. Brenda thanked Wayne and Kenneth for their hard work and unstinting support throughout the first year.

The Group's accounts. The Treasurer, Kenneth Major, presented the Group's accounts, which are taken to 31st December 2001. During the year the Group assumed control of the remaining funds of the Gunpowder Mills Study Group.

Income

Money from Gunpowder Mills Study Group	£1208.52
Subscriptions	£235.00
Payment for entrance to Waltham Abbey	<u>£105.00</u>
	£1548.52

Expenditure

Entrance and expenses at Waltham Abbey	£83.00
Newsletters	£33.73
General expenses	<u>£115.97</u>
	£233.54

Carried forward to 2002	£1314.98
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Newsletters (new series). Three have been circulated, with a range of subject matter and contributions varying in length from a few sentences to several pages. Members were asked to keep on sending in material. The Editor raised the question of the

electronic distribution of the *Newsletter*, but it was thought that whilst this would be very useful for those sent overseas, members would prefer to receive theirs by post. The advantage of receiving a copy of uniform appearance was mentioned, and this may be lost by newer methods, especially in the print-out.

GEHG Website. At our meeting a year ago Paul Merricks offered to investigate the opening of a **website**, and he was now invited to share his conclusions. Paul explained that this useful method of electronic communication would allow us to share our interests with those with similar concerns, more easily than was otherwise possible. He would be willing to contribute the technical expertise, but the intellectual content should come from within the Group. Reservations were expressed about the work involved in preparing material for the web, and the skills required to access it. Paul suggested that the *Gazetteer* compiled in 1988 for the GMSG by Glenys Crocker would provide suitable material, though the question of updating would pose a considerable challenge. Brenda Buchanan recalled that in the earliest days of the Group the possibility of giving priority to the compilation of a bibliography rather than a gazetteer was discussed, but the latter was the first choice and the bibliography was never tackled. It was suggested that this could now be remedied electronically, with access to the lists already compiled by members. Gerry Moss in particular mentioned the availability of his own book list. The matter of the earlier series of the *Newsletter* was also raised. Alan Crocker suggested that making this available on the web would be appreciated by new members, but the idea of an index was thought to be more manageable at present. After a good general discussion on the subject of a website the idea of a working party emerged, with Gerry Moss being willing to add his experience in this field to that of Paul, and Peter Jenkins offering to provide the common touch. The matter was left in their hands for the time being.

Future meetings. The possibility of a spring meeting at **The Royal Arsenal, Woolwich** was raised. This would have the advantage of completing the trio of sites mentioned above, and our member Mary Miles was willing to help us with the arrangements. For the autumn meeting Gerry Moss spoke of the preliminary plans of the Royal Society for Chemistry for a seminar to commemorate the **Life and Work of Sir Frederick Abel**. Special facilities had been established at **Waltham Abbey** in 1863 to enable this explosives chemist to develop his work, and it would be particularly appropriate if this meeting were to be held there as a joint venture with our Group. This will be discussed further with Gerry and members kept informed. The possibility of a future meeting at the **Birmingham Proof Office** was also raised. Brenda mentioned her interest in devoting one of our regular meetings to a specific theme, with perhaps some speakers from outside the Group. Alan Crocker observed that in the programme for the day there was no allocation of time for members' contributions. It was explained that where the focus was on a particular site, visited at some distance and with a tight programme to follow, it was difficult to include this item although its general desirability was recognized.

Priddy's Hard: its history and layout. After the business meeting, Wayne Cocroft introduced us to the present site with a short talk, an account of which is incorporated in Jim Lewis' report (see below). In thanking Wayne and drawing the first part of the meeting to a close, Brenda Buchanan referred to the volume by Jonathan G. Coad entitled, *The Royal Dockyards 1690-1850* (Scolar Press for the RCHME, 1989),

which includes an excellent chapter on 'Weapons: The Ordnance Yards'. This gives a good account of Priddy's Hard with a photograph of the great purpose-built powder magazine of c.1770, capable of holding at least 4,500 barrels of powder. The significance of this planned design is underlined by the contrast with the haphazard methods of haulage and storage at **Upnor Castle** on the Medway. This Elizabethan fortress was adopted by the Board of Ordnance as a major gunpowder store from 1668 to 1827, capable in 1691 of holding over 5,000 barrels. By the mid-eighteenth century however a report by the Surveyor-General had revealed a general 'want of neatness and regularity everywhere'. His account of the way powder barrels from the river hoys were hauled into the magazine above is particularly interesting:

The method now used to lift up the powder barrels into the magazines is by running a rope through a pulley, one end of which is fastened to a powder barrel, and a man taking hold of the other jumps out of the window, and his weight draws up the barrel into the magazine, which is a dangerous and uncertain method, for if he is too light, the powder barrel will not ascend, and if he is too heavy, he is sure to bruise himself against the pavement, whereby it is very difficult to get men who will run such a risk upon labourer's pay.....(pp.266-8)

Perhaps a visit to Upnor Castle should be included in some future programme. The fortress survived these extraordinary procedures and is now in the care of English Heritage. Coad notes that eventually capstan pulleys were introduced, one of which still survives.

This part of the meeting over, the active sessions which followed are described below by Jim Lewis. At the end of the day we returned to the meeting room for a general discussion and refreshments.

A VISIT TO PRIDDY'S HARD SATURDAY 3rd NOVEMBER 2001

Jim Lewis

The day began with the AGM of the Gunpowder & Explosives History Group in the impressive conference centre at the newly opened attraction 'Explosion: Museum of Naval Firepower', Priddy's Hard, Gosport. The name Priddy's Hard originates from one of the 18th century owners of the land, Miss Jane Priddy. In 1758 the Board of Ordnance, as part of a strategy to improve Britain's defences, purchased the land, an isolated piece of shore directly opposite the dockyards at Portsmouth. By 1764 600 metres of fortified ramparts had been built to afford protection to a small garrison that had been stationed there. At about this time there was growing concern over the safety of the Portsmouth gunpowder magazine and the Board of Ordnance, after considering other nearby sites, decided to build a new storage facility at Priddy's Hard. The magazine was completed in 1771 to a design by Captain Archer of the Royal Engineers and stands today as a lasting memorial to those early builders.

After the morning formalities the Group had time to take lunch and also to visit the extensive displays in the museum and great magazine: that ranged from the use of gunpowder through a collection of small arms, torpedoes, naval mines and big guns, to missiles, which included such devastating and destructive weapons as the Exocet.

In the afternoon the Group was met by Commander Derek Gurney, the Curator of Explosion, who guided members on a tour of the reserve collection. This collection is normally out of bounds to the general public. Commander Gurney explained the museum's collection and conservation policy and also outlined the difficulties his small team of conservers and volunteers were currently experiencing while protecting and restoring the vast range of artefacts in what were essentially unheated and leaky buildings. Inside the buildings, makeshift plastic tents had been constructed to help reduce damp and condensation that can swiftly undo hours of painstaking conservation work. Commander Gurney and his team are to be congratulated for maintaining this programme of work under such conditions and on a shoestring budget.

The day, including the warm November weather, was enjoyed by all. Brenda Buchanan presented Commander Gurney with a copy of Wayne Cocroft's book, as a mark of appreciation for being such an excellent host and tour guide. However, many in the Group will have fond memories of seeing various members lying prostrate on the tarmac trying to decipher the maker's marks on the base of several Edwardian lampposts, while others measured the diameter of projectiles. Perhaps the most enduring memory of the visit was of the banging noises emanating from inside a locked building in which one of our number, no doubt mesmerized by the magnificence of the reserve collection, had dallied too long. Just another normal day in the life of the Gunpowder & Explosives History Group!

THE ANNUAL PRODUCTION OF GUNPOWDER AT ENGLISH POWDER MILLS IN THE 1680s: HOW MUCH? HOW EFFICIENTLY? AND FOR WHAT MARKETS?*

Brenda Buchanan

We have been very successful as a Group in locating the network of powder mills in this country from the sixteenth century (1), and as individuals in exploring the changing technology involved as stamps gave way to edge runners and cast iron began to replace stone (2). The question of the annual production of gunpowder in terms of the three aspects raised in the title above has proved much more intractable, and we know little about the output of the English powder mills at any time before the mid-eighteenth century. For that period we are indebted to Jenny West's calculations for the years of the War of Austrian Succession (1740-8) and the Seven Years War (1756-63), which show a mean annual supply during the former of **13,553 barrels** and during the years 1755-62 for the latter of **14,493 barrels**. But the capacity of the mills must have been much greater than this, for the figures provided for the years from 1755 to 1758 show that the annual total then contracted for and expected was on average **26,122 barrels**.(3)

The search for earlier evidence proved disappointing until a chance following up of a reference found in H.C.Tomlinson's work on the Ordnance Office 1660 – 1714 (4), produced the document shown in Table I (PRO, WO 49/220), dated 1687. This shows the Board of Ordnance's 'Survey' of the mill owners under contract to supply them with powder; the location of their mills; and an assessment of their productive

capacity in terms of barrels per day, week, month, and year. From this we are able to see that the total output capacity of these major gunpowder mills amongst which Chilworth was pre-eminent, was **34,704 barrels** per year. There the matter might have rested had not a document in the Dartmouth Family papers in the Staffordshire Record Office (D742/M/1/92) been drawn to Alan Crocker's attention. As described in *Newsletter* 24(5) the document itself is undated, but since it refers in part to dated contracts, the last of which was placed in April 1687, it is likely that it was drawn up shortly after that. By great good fortune, this second document is complementary to that shown in Table I. Each requires the other for its fullest interpretation. In particular, the information in the Dartmouth paper on the number of troughs at seven of these mills, and the contracts entered into at four of them, cannot be interpreted other than speculatively without the evidence on output that is provided so fully in the Board's 'Survey'.

Table I

A calculate of the State and Capacity of the severall Powder Mills in this Kingdome to Furnish Powder into his Mats Stores, upon the Survey of the said Mills Taken in Anno 1687 Viz					
Owners names	Place where standing	Barrels /Diem	Barr /Weeke	Barr /Moneth	Barr /Yeare
Mr Tiphaine Azire	Feversham	8	48	192	2304
Monrs de Plait Dante	Cranford	1	6	24	288
Monrs de Paine	Temple Mills	1½	9	36	432
Mr Samyne	Walthamstow	4	24	96	1152
Sr Policarpus Wharton	Susam	6	36	144	1728
Sr Peter Rich	Wandsworth	14	84	336	4032
~	Molsey	12	72	288	3456
Mr Hudson	Waltham Abbey	7	42	168	2016
Sr Policarpus Wharton	Chilworth	45	270	1080	12960
~	Clapton	12	72	288	3446
Captn Richardson	Hounslow	10	60	240	2880
		130½	723	2892	34704

Table I 1687 Survey, PRO WO49/220 Price Book 1687-1702. Note the inaccurate total in the last column, which should read 34694.

Before examining Table II in which these two sets of information are drawn together and analysed, it is useful to consider the reasons for the location of these papers, and their timing. In 1687 Lord Dartmouth was the Master General of the Board of Ordnance. Before his ennoblement on promotion to this office he was George Legge (1648-91), of a family which had strong links with the Board. His father William Legge was its Lieutenant General from 1660 until his death ten years later, and George then held this office from 1672 (although he did not succeed to it fully until 1679), before becoming Master General in 1682. There was thus a good reason why some of the Board of Ordnance material entered the Dartmouth family papers, although most went with the War Office deposits to the Public Record Office. It is a happy serendipity which has now brought together again these two complementary documents.

Why was the survey undertaken at this time? As gunpowder historians we may welcome it as providing evidence of output and technology, but the contemporary

context of the survey was undoubtedly political. The last of the Stuart kings, James II, was about to be ousted from his throne by William of Orange, and it was important that the Board of Ordnance should review its resources. Both George Legge and his father were strong supporters of the Stuarts. William Legge had been Governor of Oxford when the king's army was garrisoned there during the Civil War, and he was appointed to his position at the Board on the restoration of the monarchy in 1660. George Legge held many official positions throughout his life, including both military and naval commands, and he must have been alarmed to see the growing influence of William of Orange. The survey of 1687 was probably a response to the crisis, brought to a head a year later when William of Orange accepted the invitation issued by leading Whigs and Tories, and landed at Torbay. Dartmouth's known loyalties to the old monarchy were such that in 1691 he was committed to the Tower, formerly one of his own responsibilities, and accused of conspiracy against William III.

Table II The capacity of English powder mills, 1687

	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6
Owner's Location	Barrels per year	Barrels per month	Number of troughs	Barrels per trough per month	Barrels per month by contract	Barrels per trough per month
Mr Tiphaine & Azire Feversham	2304	192	9	21.3	-	-
Monse de Plait & Dante Cranford	288	24	-	-	-	-
Mons de Paine Temple Mills	432	36	-	-	-	-
Mr Samyne Walthamstow	1152	96	6	16.0	30 Apr 87 65	1687 10.8
Sr Policarpus Wharton Susam	1728	144	12	12.0	-	-
Sr Peter Rich Wandsworth, Molsey	4032 3456+ 7488=	336 288+ 624=	36	17.3	26 Apr 87 350	1687 9.7
Mr Hudson Waltham Abbey	2016	168	9	18.7	14 Dec 86 120	1686 13.3
Sr Policarpus Wharton Chilworth, Clapton	12960 3446	1080 288	46 -	23.5 -	-	-
Captn Richardson Hounslow	2880	240	11	21.8	2 Dec 84 150	1684 13.6
OUTPUT CAPACITY	34704 total should be 34694	2892	Average number of barrels per trough per month by survey = 19.7 (7 cases)		Average number of barrels per trough per month by contract = 11.0 (4 cases)	

Sources: Owners, Location and Columns 1 & 2 are from PRO (WO49/220) 'A calculate of the State and Capacity of the severall Powder Mills in this kingdome upon the survey of the said mills taken anno 1687'. Columns 3 & 5 are from Staffordshire RO (D742/M/1/92) 'State of the powder makers contracts', Columns 4 & 6 are by calculation.

These two documents thus enable us to take stock of the English gunpowder industry at a significant time in the nation's history. In Table II, the list of owners and the location of their mills is taken from the Board's 'Survey'. These are not exactly the same as in the Dartmouth document, where the 13 contractors were transcribed by

Alan Crocker as: Polycarpus Wharton (sometimes with John Freeman, died 1683), operating at Chilworth, Wooburn & Sewardstone; Peter Rich at Wandsworth & Molesey; John Richardson at Hounslow; Peter Azier & partner at Faversham; Peter Hudson at Waltham Abbey; Peter Samyne at Walthamstowe; and John Nutt, who is not identified with any particular mill but may have had connections with Walthamstowe.

The capacity of the mills in terms of the barrels that could be produced annually and monthly for the government stores are shown in Cols.1 & 2, from the Board's 'Survey'. Col.3 turns to equipment and from evidence in the Dartmouth 'Contracts' shows the number of troughs available at seven out of the eleven powder mills. Before the introduction of edge runners, troughs were essential for the process of incorporation. They were long hollowed-out trunks or receptacles, usually by this time containing separate mortars or basins, in which the ingredients of gunpowder were over a period of many hours, incorporated or beaten together by descending stamps or hammers. As may be seen from the note in *Newsletter 24*, the many problems involved in basing any estimate of productive capacity on these troughs defied solution. There were too many unknown variables: troughs varied in length and thus in the number of stamps that could be accommodated; the size of the charge was not known; and nor was the number of hours spent on incorporation. But if this partial information in the Dartmouth 'Contracts' is related to that available in the Board's 'Survey', then we are able to move on to sounder ground with regard to the estimation of the capacity of these mills. In Table II this has been achieved by regarding *the troughs as a unit of power and the barrels as a unit of weight*, the relationship between the two allowing us to estimate the productive capacity of the mills. This is set out in Col.4, which shows that not only was Chilworth the major producer of gunpowder, well ahead of any competitors, it was also the most efficient. Close behind in terms of efficiency if not of volume of output were Hounslow and Faversham, followed by Waltham Abbey, Wandsworth & Molesey, Walthamstowe, and Susam or Sewardstone. Of course each case deserves individual scrutiny, to explain for example the low-rating of Susam despite it being in the same ownership as Chilworth. Nevertheless, in pursuit of the overall picture we may claim that **on average each unit of power (or trough) was capable of producing nearly 2000lbs of powder per month**. This has been calculated by dividing the number of barrels per month for the seven cases by the number of troughs available at those mills, to produce an estimate of the average number of barrels per trough per month, each powder barrel weighing 100lbs. We already know from the Board's 'Survey' (Table II, Col.2), that the possible **monthly output of the government contractors was 2892 barrels or nearly 300,000lbs**.

But how much of this capacity was contracted to the Board, and how much if any was available for private sale? This seems at first the most insoluble of problems, and yet there is evidence in the Dartmouth 'Contracts' which enables us to go some way towards solving it. This shows that Mr Samyne of Walthamstowe was issued a contract for 250 barrels, for the successful completion of which he was to produce 65 barrels per month. Table 2 shows that this implied a figure of 10.8 barrels per month for each of the 6 troughs available, although as shown in Col.4 he had the capacity to produce 16 barrels per trough per month. Similarly with Sir Peter Rich at Wandsworth & Molesey, who was contracted to produce 4000 barrels at 350 barrels per month, or 9.7 barrels per trough per month, when he could have made 17.3. At

Waltham Abbey the order was for 500 barrels, produced at 120 barrels per month, an average of 13.3 barrels per trough per month at mills capable of producing nearly 19 barrels per trough per month. Lastly, Captain Richardson at Hounslow was contracted to produce 3673 barrels at a rate of 150 barrels per month, or 13.6 per trough per month when his mills were capable of making 21.8. In each case therefore, on the Board of Ordnance's own reckoning, there was spare capacity at the mills.

How great was this spare capacity, overall? The Dartmouth paper shows that contracts placed by the Board of Ordnance required the production of an average of 11.0 barrels per trough per month, on equipment that could have produced 19.7 barrels per trough per month. At that time therefore, the **military requirements were only some 55% of the productive capacity**. There remained up to 45% of the fixed capital equipment that could be put to use to meet the needs of the private market. This was of two-fold importance: the Board itself was relieved of the need to maintain this costly spare capacity, which could however be drawn upon in time of war; and the powder makers were able to pursue their private trade with merchants and traders, within the limitations posed by wartime requirements. This allowed gunpowder to develop as an important civil commodity, permitting a balanced commercial growth that was particularly important as British power expanded overseas.

What conclusions can be drawn?

First, we have a firm indication from the Board of Ordnance 'Survey' of the productive capacity of their major suppliers of gunpowder in 1687. It was 34,704 (corrected to 34,694) barrels a year. Second, of the eleven mills listed, that at Chilworth was pre-eminent in terms of output and efficiency. It could provide more than a third of the available output, and its large-scale productive capacity (46 troughs) did not militate against efficiency, for at 23.5 barrels per trough it led the field. Third, the productive capacity of these mills exceeded the requirements of the Board by as much as 45%, which allowed for a more flexible accommodation of military needs by the powdermakers and a greater development of the commercial market by these firms than has generally been thought.

These two documents form a wonderful 'cross-section' of gunpowder manufacture at a particular time. Like all good documents they also raise many questions. We need to know more about the powdermakers and their mills. Are some of the large suppliers missing, requiring their integration into the overall picture? The number of French, probably Huguenot, names is intriguing. What is known about them? Where was Cranford mill, owned by de Plait & Dante? The modern Cranford is on the former Hounslow Heath, but in the Board's 'Survey' this small-scale mill is listed separately from Captain Richardson's Hounslow mills which, to add to the confusion, later became known as the Bedfont Mills.⁽⁶⁾ Are there any other known cases where the number of troughs may be related to output figures, to form a corrective to the calculations made here? And does similar evidence for output and efficiency exist for other period of gunpowder history? These are challenges to keep in mind as other aspects of gunpowder research are pursued, for the last conclusion to be drawn is the apparently mundane one, that some of the most useful pieces of evidence may emerge when we are not, strictly speaking, looking for them.

References

- * An earlier version of this paper was presented at the GMSG meeting at Chilworth, 5 June 1999.
- 1 Glenys Crocker, ed., *Gunpowder Mills Gazetteer* (SPAB Occasional Publication 2, 1988).
 - 2 Brenda J. Buchanan, 'The Technology of Gunpowder Making in the Eighteenth Century: Evidence from the Bristol Region', *Trans. of the Newcomen Society*, vol.67 (1995-96), pp.125-59; Glenys Crocker & Keith R. Fairclough, 'The Introduction of Edge-Runner Incorporating Mills in the British Gunpowder Industry', *Industrial Archaeology Review*, vol.20 (1998), pp.23-36.
 - 3 Jenny West, *Gunpowder, Government and War in the Mid-Eighteenth Century* (Royal Historical Society, Boydell Press, 1991), pp. 213, 219.
 - 4 H.C. Tomlinson, *Guns and Government. The Ordnance Office under the later Stuarts* (Royal Historical Society, Swift Printers, 1979), p.117.
 - 5 Alan Crocker, 'Capacity of English Gunpowder Mills in the Late Seventeenth Century', *GMSG Newsletter*, Old Series, 24 (1999), pp.5-6.
 - 6 *Gazetteer*, pp.16-18; West, pp.197-99 (which includes the information that a son of the then Lord Dartmouth became a partner in the Bedfont Mills c.1789 & pp.203-05; Phil Philo & John Mills, 'The Bedfont Gunpowder Mills', *The London Archaeologist*, vol.5 (1985), pp.95-102.

REGISTER OF FAVERSHAM GUNPOWDER WORKERS

A press release issued by the Faversham Society notes that they have received a grant of £300 from Shell International Limited towards compiling a list people employed in the three local gunpowder factories. The task is being co-ordinated by John Breeze, the Honorary Curator of the Chart Mills, so far he has identified about 700 individuals. The grant money will be used in part to buy paper and laminated sheets to display the names in the Chart Mills. For further information John Breeze may be contacted on 01795 534915 or via the Faversham Society's email address faversham@btinternet.com.

Arthur Percival

LIGHTNING RODS

The radio programme *The Long View* presented by Jonathan Freedland on Radio 4 on 25 September 2001 drew attention to possibly the earliest recorded use of lightning rods to protect a powder magazine in England. The theme of this programme was the relationship between politicians and the experts they turn to for advice. One of the case studies the programme explored was that of Benjamin Franklin, a fellow of the Royal Society since the 1750s, and the government's need for advice on how to protect the Purfleet magazines from lightning strikes. During the 1750s he conducted a number of table top experiments which had established that electricity and lightning were the same phenomenon. He also established that a building protected by metal rods would be safe from lightning damage. Franklin had later emigrated to the America and by the 1770s was employed as the agent for the state of Philadelphia in London.

In 1772 the Board of Ordnance approached the Royal Society for advice on the best method of protecting the newly built magazines at Purfleet from lightning strikes. A committee including Cavendish, Franklin, Watson and Wilson visited the magazines, and following the lead given by Franklin recommended the adoption of pointed lightning rods. It was noted that pointed rods had been in use in America for over

twenty years. The one dissenting voice was that of Benjamin Wilson, a court portrait painter and electrical expert, he believed that blunt, and in particular ball-shaped, ends were more effective, he also suggested that they should be placed close to the wall tops.

In 1777 Edward Nixon the storekeeper at Purfleet reported that the manager's house had been struck by lightning. In order to try to resolve the issue of which was the most effective type of lightning rod Franklin and Wilson built models for public demonstration. Wilson argued that the pointed rods would attract the lightning they were trying to protect against. Franklin was, however, able to show that by attracting lightning and discharging it to earth the building was effectively protected, while a large blunt object attracted more charge that could safely be discharged to earth.

[Wayne Cocroft]

GUNPOWDER MAGAZINES in WEST LONDON 1816 to 1831 Beryl Williams

From Elizabethan times until 1855, the main responsibility of the Board of Ordnance was to provide both the Army and the Navy with all their arms and ammunition. During the Napoleonic Wars, as the demand for gunpowder steadily increased, stocks were falling and shortages were foreseen, so that in 1804 moves were made to expand production at the Royal Gunpowder Factory at Waltham Abbey. Such an increase in output would require an increase in off-site storage capacity to accommodate extra stocks, so at the same time the Board planned more storage magazines, to supplement those built in the 1760s at Purfleet on the Thames tideway, which already had a total capacity of more than 50,000 barrels.

As large quantities of gunpowder are most easily and relatively safely transported by water, storage sites had always been very close to the coast or navigable rivers. In 1804, because of the threat of imminent invasion as Napoleon massed his Grand Army at Boulogne, the decision was taken to build new gunpowder magazines inland - well away from the coast at sites which could be served by the growing canal network. Magazines to hold more than 20,000 barrels were constructed as part of the Royal Depot at Weedon in Northamptonshire, and a smaller facility was included in a depot being built at Derby.

The output of gunpowder from the Waltham Abbey Factory rapidly increased, so that by 1813, even more off-site storage was required. As a result of Napoleon's defeat at Trafalgar in 1805, there was no longer a serious threat of invasion, so these latest magazines were built close to the Grand Junction Canal near London, about 5 miles up from its junction with the Thames, at Brentford.

In the Railway & Canal Historical Society Journal No. 151, July 1992, there is an article by *Hugh Compton* and *Alan Faulkner* entitled *NORTH HYDE MILITARY DOCK*. This is a history of a 47-acre site in the Parish of Heston, close to the Grand Junction Canal, that was purchased by the Board of Ordnance

in 1813, for use as a powder depot. The plan was to build a short branch canal from the main line to act as 'a defensive loop or moat' around a large gunpowder storage facility. Although the loop was never quite completed, possibly because of the many engineering problems that arose due to an unexpectedly high water table, by 1816 there were 1,200 yards of branch canal, with five short lateral arms each leading to a side-dock.

The article includes a sketch plan of the site showing gunpowder magazines at the end of the first, third and fifth side-arms, each with three strategically placed earth mounds to contain any accidental explosion. The second and fourth arms each had a mixing house and a cooperage. Also shown are the sites of the Storekeeper's house and the Barracks built to accommodate three officers and 50 other ranks.

Gunpowder was brought from the Thames up the Grand Junction Canal by Government barges which entered the branch canal through a 14 foot wide stop-lock before passing to a covered barge house at the end of one of the three magazine docks. There is no description of the magazines, other than that the first three cost £12,876, and were built to hold 6,800 barrels each. Eventually, there were six of them which, according to an anonymous letter to the press in 1830, contained a total of 42,000 barrels of gunpowder. The writer of this letter described the uneasiness prevailing in the vicinity following a threat, received earlier that day by the storekeeper, to 'blow up the immense magazines in his care'. Extra troops had been sent from Woolwich and Hounslow, but there was no attack.

By the end of the following year 1831, all the gunpowder had been removed from the North Hyde site and demolition of the magazines followed soon after. Building materials were salvaged and taken away by canal to be re-used in the building of the Wellington Barracks in Birdcage Walk, and the site was put up for sale. The Barracks became an orphanage, but the branch canal and surrounding area was eventually used as a wharf for a brick and tile works complex that was developed on the adjacent site. By 1936, the canal branch had been filled in and factories obliterated the site of the magazines.

EMILY WOODS neé DRAYSON

Wayne Cocroft

A memorial on the south wall of the south aisle of the Abbey Church of the Holy Cross, Waltham Abbey records the burial of Emily Woods.

‘To the memory of Emily Woods buried in the adjoining churchyard wife of William Woods, and daughter of William and Ann Marie Drayson, all of whom are buried at Gillingham, Kent. Born at Waltham Abbey 24th July 1811, died at Dovercourt 8th June 1894’.

Emily's father may perhaps be identified as the William Drayson, who was recorded as the Clerk of Works at the Royal Gunpowder Factory in 1827 (Simmons, 1963, 19). The burial of William and Ann Marie Drayson at Gillingham, might also imply an association with the Faversham powder mills. It may even suggest that William was

originally from the Faversham area and perhaps returned to the area with his wife after his retirement from Waltham Abbey. The relationship between William and Emily Drayson and Frederick Drayson, who wrote the 1830 Treatise on Gunpowder, is unclear. Members of the Drayson family also had connections with the Maresfield Gunpowder Mills in Sussex. In 1852 the Maresfield mills were leased to Henry Drayson (son of William and presumably Emily's brother) of Framfield for 98 years; it was a short-lived venture and in 1859 the company was wound up in the bankruptcy courts (Lampson (nd), 15). A business card of 'Drayson, Harvey & Co' preserved in the Hagley collections confirms the link back to Waltham Abbey stating 'Draysons, late of the Royal Gunpowder Mills, Waltham Abbey, Essex', the plural also suggesting that more than one member of the family was involved. Henry Drayson visited the Du Ponts at Hagley in 1857 and in 1858 Lammot Du Pont visited Maresfield. Drayson was absent, the foreman explaining that he had spent time in prison for forgery and other crimes, Lammot called him 'A damm rascal!' (Wilkinson, 1984, 42-49).

Hagley Archives, Wilmington, Delaware

Lampson, M (nd) *A history of Maresfield powder mills* Privately published

Simmons W H , 1963 *A short history of the Royal Gunpowder Factory at Waltham Abbey* Controllerate of Royal Ordnance Factories

Wilkinson, N B 1984 *Lammot Du Pont and the American explosives industry 1850-1884* University Press of Virginia

CHILWORTH GUNPOWDER WORKS, SURREY

Guildford Borough Council, who own about half of the area of the former Chilworth gunpowder and explosives factory works, has commissioned English Heritage to undertake an archaeological and architectural survey of their section of the site. English Heritage will fund the survey of the remainder of this nationally important site. Survey work began in November 2001 and will continue until about easter 2002. The report on the survey work is scheduled to be complete by autumn 2002.

Wayne Cocroft

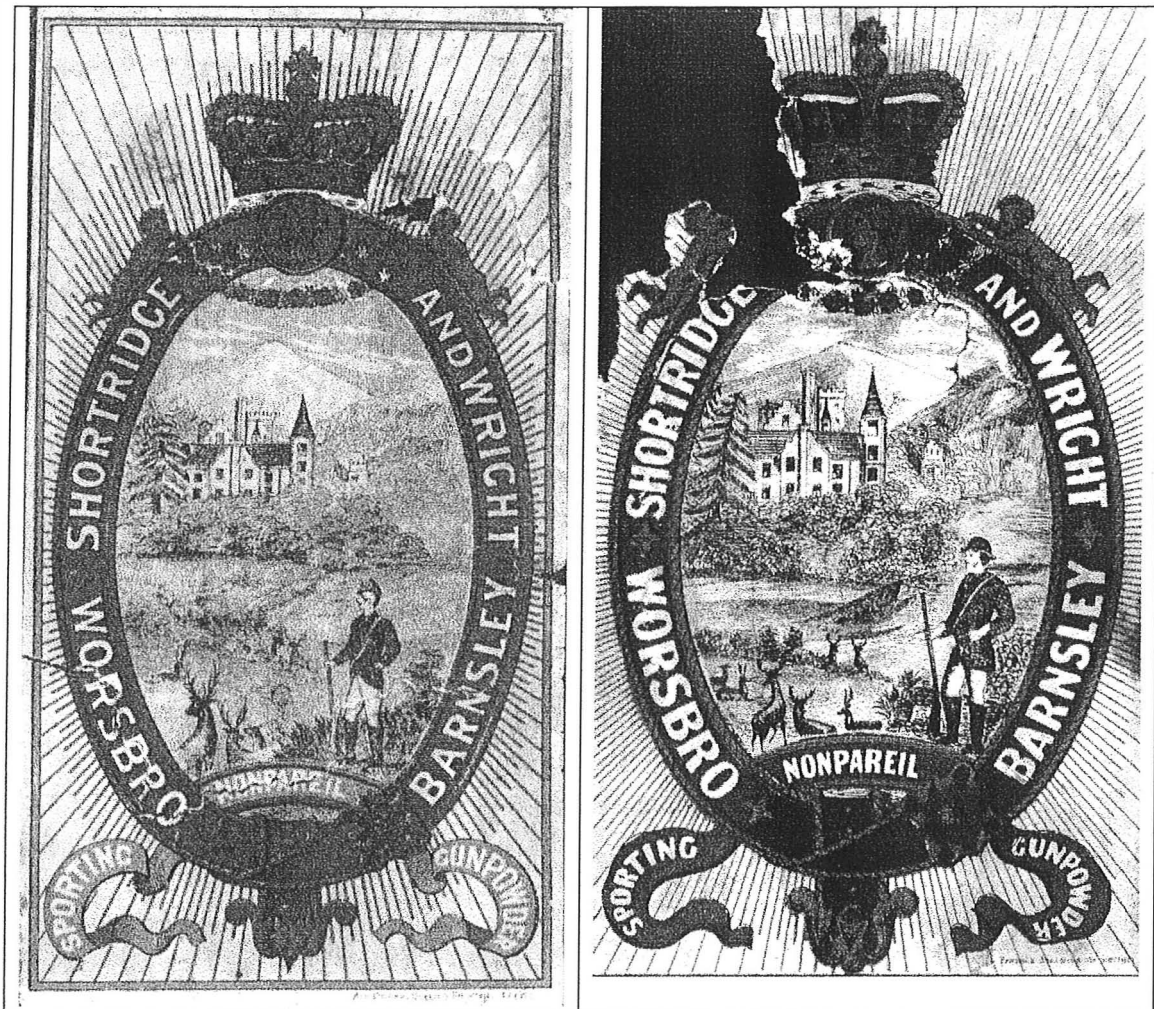
WHITE GUNPOWDER

The London correspondent of a contemporary [paper] says – I have heard in the city of a curious invention which concerns alike sportsmen, riflemen, and the scientific. It is the manufacture of "white" gunpowder. It is composed of yellow prussiate of potassa, chloride of potassium, loaf sugar, crystallised sugar, and brimstone. It possesses superior qualities over the black powder, being quicker and more powerful in its action, and not fouling the gun; for the delicate in the olfactory nerves it may be added that it is without unpleasant smell. It has just been patented. – Country Paper.

(*Volunteer Service Gazette* 22 Dec 1860 page 132.)

David Harding

WORSBOROUGH, DERBYSHIRE, GUNPOWDER LABELS – Jim Buchanan



Jim Buchanan has sent photocopies of two nineteenth century powder labels from the Worsborough powder works. The labels are in colour, the left hand label is surrounded by a red garter with the lettering of the lower scroll set against a light blue background, the lettering is white. The vegetation is coloured green. The label was printed by Alf Cooke, Queen's printer, Leeds. The garter of the right hand label is dark blue and the lower scroll has a red background, the lettering is white. The label was printed by Pawson & Brailsford, Lith(ographer), Sheffield. Although superficially the labels are similar careful inspection reveals that they were printed from different plates.

The Worsborough gunpowder works, Yorkshire, were established by 1849 on a tributary of the River Dove. The mills were acquired by Kynoch Limited in the 1890s and closed in 1911 (Crocker, 1988, 41-42).

Crocker, G 1988 *Gunpowder mills gazetteer* SPAB, London

OSWALD SILBERRAD AND THE ROYAL ARSENAL

Simon Coleman

Assistant Archivist, NCUACS, University of Bath

Oswald Silberrad, 1878-1960, was an industrial consulting chemist who directed the Silberrad Research Laboratories at Buckhurst Hill, Essex, from 1907 until his death. Unable to attend a British university due to his inability at the classics, he was educated at Finsbury College and the University of Würzburg, where he obtained a PhD in chemistry. From 1901 to 1906, as Chemist to the Explosives Committee and Director of Research, Silberrad worked at The Royal Arsenal, Woolwich, where he solved the complex problem of high explosive shell detonation and made other important discoveries. He later developed an erosion-resisting alloy for warships' propellers and during the First World War was Honorary Consultant to Lord Moulton, Director-General of Explosives Supply. In his long career he also developed new powerful dynamites and made valuable discoveries relating to the industrial manufacture of many chemical compounds and synthetic materials.

The Silberrad Papers, comprising Silberrad's personal archives and those of the Silberrad Research Laboratories, have recently been catalogued by the National Cataloguing Unit for the Archives of Contemporary Scientists and deposited in the Science Museum Library. A large body of correspondence and papers covers much of his work from 1908 onwards, while Silberrad's eventful years at The Royal Arsenal are documented in an incomplete and unpublished biography of him by Lord Moulton's son, Hugh Fletcher Moulton. Hugh Fletcher Moulton's text was largely based on the detailed record of Silberrad's career kept by his sister Dora, who worked as his secretary until her death in 1927. Among many drafts of the biography are copies of fragments from Silberrad's own memoirs, probably written in the last years of his life. This work is valuable for the light it sheds on some of his ideas and opinions while working at The Royal Arsenal and on the way he coped with excessive bureaucratic interference.

The failure of lyddite (the common name for picric acid) high explosive shells to detonate properly was the most serious failure of British munitions exposed by the Boer War of 1899-1902. Lyddite was the only high explosive used in the British Army at the turn of the century. Sir Frederick Abel had managed to effect the detonation of picric acid by using a mixture of ammonium picrate and potassium nitrate. This simply ignited the picric acid which formed the charge of the shell and it would then burn until sufficient pressure caused the shell to burst. During the Boer War many of the larger shells only partially exploded, distributing a large part of their charge as a cloud of greenish-yellow fumes, to the amusement of the Boers, and most of the smaller ones failed to burst. Silberrad found that the detonation of high explosive charge could be brought about by the direct use of an endothermic substance such as fulminate of mercury. The difficulty with such compounds was their sensitivity and the large quantities of them required to detonate the charge. After testing numerous compounds he found one which when used as a primer gave perfect detonation with only a small detonator. This substance was Trinitrophenylmethylnitramine, or 'tetryl', until then a practically unknown chemical

curio. In 1903, after Silberrad's successful demonstration, it was introduced into the British Service and was known as 'Silberrad's explosive'.

Before Silberrad began his work in 1901 it was believed that picric acid was the only substance that could withstand the shock of discharge from the gun and explode as a high explosive. In his search for a suitable substance to detonate picric acid Silberrad found that other nitrated aromatic compounds with less sensitivity to the shock of discharge could also be detonated by his method and used as a high explosive shell filling. He discovered that TNT was the most suitable of these other compounds: it was less sensitive to shock than picric acid, did not form dangerous salts, was easy to manufacture and could be detonated by the method used for picric acid.

At this time the Germans were also experimenting with TNT which they introduced into their service in 1904 but, unlike Britain, they quickly built factories to manufacture it on a large scale. The inevitable result of British short-sightedness in munitions policy was that at the start of the First World War the country was not only without TNT but had practically no facilities for manufacturing it.

Other useful research carried out by Silberrad at Woolwich centred on artillery propellants, particularly 'flashless' or 'flameless' artillery powders, the discovery of which would enable big guns to fire at night without emitting any flash and thus not give away their positions to the enemy. Early in 1902 Silberrad observed that the real cause of the flash from artillery was the after-ignition of the gases produced by the explosion and not the explosion itself. By 1906 he had produced a propellant which he demonstrated to be flashless for a small calibre gun. However, he was unable to develop this work any further due to a nine months delay in setting up new machinery. Typically, there was a wrangle over who should do the work and how much it was to cost - the actual installation of the equipment took only a few weeks. Silberrad left The Royal Arsenal in 1906 and those given the task of developing the flashless artillery powder were unable to apply it to larger calibre guns or to devise a means of controlling the smoke produced - in fact they made no progress at all and gave up on the problem in 1913. It was not until 1915, when Silberrad was again asked to investigate the matter, that any advances were achieved.

From the beginning of his employment at Woolwich Silberrad seems to have been frustrated by War Office red tape and the apparent willingness of officials to create the maximum amount of delay and obstruction at every opportunity. He writes in his memoir 'nothing was too small for the War Department to deal with at length', and suggests that the officials' attitude towards him was due in part to his youth (he was twenty-three when appointed) and the influence he possessed as Director of Research while still reporting to the Explosives Committee.

Partly due to the fact that Silberrad's work was kept secret for many years, the discoveries he made were later not credited to him. But a statement by Sir William Crookes to the Council of the Royal Society in 1919 and other material in the Silberrad papers strongly emphasise the fact that he alone solved the problem of detonating lyddite and introduced TNT into the British Service. Crookes says 'In 1902 Dr Silberrad discovered Tetryl...thus creating an immense national asset out of this practically unknown chemical curio. He subsequently worked out the conditions for the manufacture and purification of this product... I confidently leave it to the

Council to imagine how great a catastrophe would have befallen the country had it not been for Dr Silberrad's discoveries'.

The cataloguing of the Silberrad papers has made available an extensive archive of the career of this little-known and unusual scientist. The papers will provide researchers with a valuable source for the history of explosives and the development of a number of important industrial processes in the first half of the twentieth century.

No.35 MUNITION STORE, HORLEY, SURREY, IN WORLD WAR ONE

Gerry Moss draws our attention to a recently published account of the First World War filling factory at Horley, Surrey. The factory, laid out to the west of Horley railway station, was probably established in late 1915 and was described as a 'depot for completing foreign ammunition', production probably began by summer 1916. A headed letter dated October 6th 1916 described the factory as '35 Munitions Store, Ministry of Munitions'. The main activity undertaken during 1916 and 1917 appears to have been filling shrapnel shells for 18-pounder guns. The forged steel shells being manufactured by American and Canadian factories. Production figures for the factory show that 3,158,500 shells were filled in 1916 and 1,578,600 in 1917, giving a total of 4,737,100. No figures are given for 1918, which may suggest that production had ceased and that the site was used for storage only. It was clearly still functioning at this date, as the local parish magazine recorded the death of a woman war worker from pneumonia in July 1918. A photograph thought to have been taken during the early 1920s and annotated 'gas shell dump in Surrey' suggests that the site was later used for storing surplus mustard gas shells.

The factory was probably dismantled in the 1920s, and during the mid-1930s a house-builder acquired the site and erected 18 houses prior to the outbreak of war in 1939. During the Second World War the Royal Canadian Engineers used the undeveloped areas of the former factory as an open store, and huts were built to accommodate airforce personnel. Post-war the original plan to cover the area of the munitions factory with a housing estate was revived; today little remains except for odd brick and concrete foundations in a number of gardens.

B Buss No.35 Muniton Store, Horley, Surrey, in World War One, *Surrey Industrial History Group Newsletter* 2001, 8-15

[Gerry Moss]

The naming of the factory at Horley as No35 Muniton Store is only one designation this site received, other Ministry of Munitions' documents describe it as National Filling Factory No.16 and No.17, National Filling Factory No.17 appears to be its most common form of address (editor).

A NEW INTERPRETATION CENTRE FOR THE LEA VALLEY

On Saturday 27th October, Nicky Gavron, the Deputy Mayor of London, officially opened the new Interpretation Centre on the former site of the Royal Small Arms Factory (RSAF) at Enfield Lock. The event was attended by a large gathering of people representing the local community, business and official bodies. After the opening ceremony a jazz band entertained the visitors and a series of lectures was given to explain the history of the site. There were also a number of special activities arranged for local children.

The RSAF started life in 1816 and by 1857 it had become the first factory in the UK to manufacture weapons, the Enfield pattern 1853 rifle, using true mass production techniques by the system of interchangeable parts. Probably the factory is best known for the manufacture of the Lee Enfield Rifle, which served the allied forces throughout two world wars and beyond. From 1937 the famous Bren Gun was manufactured at Enfield Lock, followed by a range of innovative designs. The SA80 weapons system, the standard arm of the British forces, was still being manufactured at Enfield Lock when the closure of the factory was announced in 1987.

The Interpretation Centre is housed in part of the large machine room, now a Grade II listed building. This is to be found under the tower of the restored 18th century Thwaite's three faced clock. Visitors will be able to see the original factory church font under its protective pyramid, walk through the Interpretation Centre and read the illustrated panels that provide a brief history of the site. Wall plaques have been placed on some of the remaining buildings to explain their previous functions and an information brochure has been produced detailing two site walks.

Jim Lewis

ICOHTEC GRANADA SYMPOSIUM JUNE 2002

The next meeting of the International Committee for the History of Technology (ICOHTEC) will be held in Granada, Spain between 24-29 June 2002. It is proposed to hold a session of the Gunpowder and Explosives Section during the meeting. The title of the session will be:

Gunpowder and Explosives: recent research and future themes

Anyone interested in submitting a paper on their present research or future plans should contact Brenda Buchanan email ssxbjb@bath.ac.uk who is organising the session. A 500 word abstract and short CV to the programme committee. Please contact, James Williams, preferably by email, techjunc@pacbell.net by 28 February 2002. He may also be contacted at James Williams, 790 Raymundo Avenue, Los Altos, California 94024-3138, USA for further information.

For further information on ICOHTEC and the Granada symposium see www.icohtec.org.

[Brenda Buchanan]

Publication received

A Fábrica da Polvora de Barcarena Catálogo do Museu da Polvora Negra (2000)
António de Carvalho Quintela, João Luis Cardoso and José Manuel de Mascarenhas

Câmara Municipal De Oeiras, Oeiras, Portugal, paperback, 80 pages, 75 colour and black & white illustrations.

This well-produced booklet provides a guide to collections of the recently established gunpowder museum at the Barcarena powderworks situated close to Lisbon, Portugal. It includes a brief history of the technology of blackpowder manufacture and the development of the Barcarena works until a serious explosion in 1972 led to their closure. Nitrocellulose manufacture continued until 1978, and after laying derelict for nearly twenty years the historic part of the blackpowder works was opened as a museum in June 1998. The booklet is generously illustrated with a mixture of historic engravings, plans and photographs, and photographs of artefacts, which are particularly useful for the none-Portuguese reader.

No price is given on the booklet and it is believed that it only available from the museum at Barcarena.

Wayne Cocroft

PUBLICATIONS FOR SALE

Crocker, G 1988 *The Lowwood Gunpowder Works A Short History* £1 incl.p&p

Palmer, A 1998 *The Low Wood Gunpowder Company its inception and early growth 1798-1808* Gunpowder Mills Study Group Cost £7.50 members £6 p&p £1

Harding D F, 1999 *Smallarms of the East India Company 1600-1856* Volume III *Ammunition and Performance* Foresight Books (Offprint of Chapter 21, Gunpowder – including relevant sections of contents list, introduction, index, etc). Cost £5 p&p £1

Orders should be sent to: Glenys Crocker, 6 Burwood Close, Guildford, Surrey, GU1 2SB, please make cheques payable to 'Gunpowder and Explosives History Group'.

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The editor welcomes short articles and notes, notices of meeting and publications relating to the archaeology, history, and technology of gunpowder and explosives for inclusion in the newsletter.

Deadline for the next issue: 30 June 2002 – submission by email or 3.5-inch floppy disc, Word 2000 (or earlier versions) appreciated

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