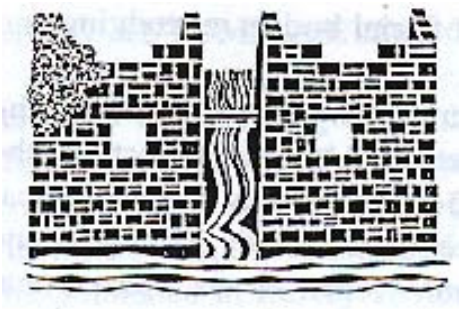

Gunpowder & Explosives History Group

Newsletter 10, Spring 2005

GEHG SPRING MEETING

Saturday, 21st May 2005, Waltham Abbey Archive Day

Royal Gunpowder Mills, Waltham Abbey

The main theme of the day will be the archives at the Royal Gunpowder Mills and we shall have both a general account of the progress made by our member les Tucker in the organising of this material, and a special talk by our colleague Professor Seymour. We are very privileged to have Professor Mauskopf of Duke University, North Carolina, an eminent historian of science and technology, at our spring meeting. Professor Mauskopf will be revealing his initial thoughts on his study of some recently discovered family papers of Sir Frederick Abel, which are currently held at Waltham Abbey. Sir Frederick, the War Department chemist in the late19th century, was closely involved in the 1860s in developing methods for the safe manufacture guncotton and later with the development of cordite. He was also president of the Royal Society of Chemistry.

10.30 Meet in the Saltpetre House where coffee, tea, and biscuits will be served.

11.00 Seminar

13.00 Lunch

14.00 Further presentations by members on this and related themes, and group business

A more detailed programme will be sent out to members at a later date.

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FREIBURG IM BREISGAU, POWDER TOWER Kenneth Major

Medieval powder tower at Freiburg im Breisgau, Baden-Wurtemburg, the lucam to the right was where the powder barrels were hoisted into the store room.

SALTPETRE – GEHG SPRING 2004 MEETING Gerry Moss

A meeting of the Gunpowder and Explosives History Group was held at the Royal Gunpowder Mills, Waltham Abbey on 14 May 2004. The Chairman of the group, Brenda Buchanan, started the meeting with a talk on the production of saltpetre in England and India. It is the oxidant and main ingredient in gunpowder. In the 13th century Roger Bacon used 7:5:5 saltpetre:sulphur:charcoal which was later adjusted to 75:10:15. The saltpetre, potassium nitrate, comes from the decomposition of organic matters; sulphur from volcanic sources; and charcoal is preferably from alder or willow. As well as the potassium nitrate both the calcium and sodium salts have been used. Sources of saltpetre include the efflorescence on the walls of stables or animal dung or bird droppings. It was then processed in a nitre bed mixed with lime and potash (i.e. wood ash) from which was leeched the crude saltpetre and concentrated in an associated boiling house. An illustration of a saltpetre works in Ipswich in 1593 shows a rectangular arcade around a courtyard with heaps of dung, etc in mounds under the arcade to keep off the rain. The saltpetre men who collected dung for the nitre beds from farmers, innkeepers, etc, were resented as they removed a valuable

fertilizer for the farmers' fields. The problems of home supply led to saltpetre being imported from abroad, first through the Baltic ports and later from Morocco. From the early decades of the 17th century it was being brought from India by the East India Company, at first in small quantities and often as ballast in their ships returning to England. The Indian production was based on a small scale village production, each providing a few pounds. It was still being made in this way in the early 20th century. England has little experience of saltpetre production, only of purification by crystallisation.

Wayne Cocroft, from English Heritage, described saltpetre production at the Royal Gunpowder Works. The earliest evidence for saltpetre refining is a 1783 print. The meeting was in the saltpetre melting house although it was not clear why it was so called. One of the significant contributions of William Congreve was standardising the purification and crystallisation of saltpetre. His system involved three recrystallisations, skimming off a surface scum and filtering through charcoal. Fine crystals were encouraged by agitation while cooling. No buildings survive at Waltham Abbey although there are refining buildings at the Marsh Works, Faversham, which were also used for the recovery of saltpetre from old unusable powder. The crystallising shed had characteristic vents in the wall and a boarded roof to prevent dirt falling in the pans. Ian Goodall, also from English Heritage, told us about his work on a building at Lowwood which had been a saltpetre refinery, and included a mill, corning house, store and boiler house. Rebuilt in the 1849 the boiling room was on the first floor, there were six hearths, of which three boiling pans survive. A third saltpetre house which survives at Wooley, Somerset, was described by Malcolm Tucker. It was established in about 1720 and was used until about 1800.

Two presentations described an experimental approach to the production of saltpetre. Robert Smith from the Royal Armouries started with experiments with replica medieval guns and how to get the maximum muzzle velocity. This led to collaborating with the reconstructed medieval village in Denmark making saltpetre to replicate medieval gunpowder. Early work produced calcium nitrate from stable manure but this gave gunpowder with insufficient power. More recent experiments used chicken droppings and lime and straw packed in layers in a bed followed by leaching out soluble material with water. The leachate was then concentrated to give calcium nitrate.

Work is still progressing; see **www.middelaldercentret.dk/english/us_home.htm**. The other experimental approach was by John Edmonds, from the Chiltern Open Air Museum, on reproducing a mid-19th century confederate nitre bed. This is based on a book by LeConte see **http://docsouth.unc.edu/lecontesalt/leconte.html** which describes production during the US civil war in Carolina. John used a cubic metre tank with repeated layers of garden compost, dry cowpats, blood, woodash and lime to fill the tank. Holes in the bottom of the tank were used to collect water which had percolated through the mix giving 15-60 pounds of saltpetre after recrystallisation.

Other relevant web sites are:-

http://ballia.nic.in/industry.htm

http://pigseye.kennesaw.edu/~rbentley/notes_on_making_saltpetre_from_the_earth_of_the_caves.html.

ALEXANDER SPEARS' ACCOUNT OF 'REFINEING THE SALTPETRE'

Dr Brenda J.Buchanan

Background notes

A manuscript notebook attracted my attention in 2000 because, according to the antiquarian bookseller's catalogue, it contained in addition to extracts copied from a history of Kent and a work on fossils of 1853, 26 pages on the 'Manufacture of Gunpowder'. The notebook did not disappoint. It contains many details of gunpowder processes and machinery, expressed in an idiosyncratic way that makes it possible to endorse the opinion of the bookseller that 'from the spelling mistakes and the way it is written it would appear to be an original description'. I transcribed the notebook, but there the matter rested until the Group's meeting on 'Saltpetre' at the Waltham Abbey Royal Gunpowder Mills, attended also by members of the History Group of the Royal Society of Chemistry (May 2004). We explored the history, chemistry and practicalities of making saltpetre with such enthusiasm that it seemed worthwhile returning to the subject as my contribution to our recent Members' Day at the Institute of Historical Research in London (October 2004).

It has to be admitted that as an historical document the notebook is sadly lacking. The only evidence that it contains about the author is the simple book label, which provides the following details:

ALEXANDER SPEARS,
No. 3, St Andrews Terrace
Marine Town, Sheerness

The Kent address led me to make enquiries of Dr Arthur Percival of the Fleur De Lis Heritage Centre in Faversham, especially as the society had recently published a *Faversham Gunpowder Personnel Register, 1573-1840,* compiled by Raymond Godfrey and Arthur Percival. There are three entries for Spears but unfortunately no Alexander, and no reference has yet been found in the post-1840 work currently being undertaken by John Breeze. The family names in the register however continue to suggest the possibility of a connection with the Faversham Gunpowder Works. Dr Percival also enrolled the Sheppey Local History Society in the search, and I was delighted to learn from Jonathan Fryer that the Directories of 1901 and 1905 show Alexander at that address. The terrace was built in the late nineteenth century and occupied by professionals and the middle class. Number and name have changed several times as new streets were built, but No.3 St Andrews Terrace survives as 80 Broadway.

Information from the Census Returns has come courtesy of Dr Gerry Moss. In 1901 there were two of the name we seek at that address: father, 47, an inspector pattern 'makies' (maker); and son, 23, a draughtsman engineer. In 1881 the father, then 27, had himself been a pattern maker 'engine' (engineer). It seems likely that the manuscript was his work, probably written in the 1870s when he was in his twenties. The handwriting is readable but untutored, showing little knowledge of spelling and punctuation. This suggests that he was self-taught, making up for his lack of schooling by keeping manuscript notes, an effort that made his accession to the ranks

of an engineering inspector all the more creditable. Engineering drawings in the first pages of the notebook indicate his skills and interests, and his brief but detailed description of the 'Navy Well Sheerness' and the Maudslay steam engine made for 'the Steam Factory at Woolwich' in 1839, suggest an association with the Board of Ordnance. Some of the accounts, of for example the dimensions of the water wheels, are remarkably precise, suggesting a close familiarity with the machinery in question, but no gunpowder works are named except for Waltham Abbey. Indeed, the fact that Spears identifies the 'Dusting House Reels' as being 'at Waltham Abbey', suggests that the other machines were elsewhere or he would not have thought it necessary to be specific about this item.

It is hoped that the following transcription of four pages may prompt further ideas and advice on the author, date and purpose of the notebook, and some elucidation of the processes described. Modern punctuation has been added in brackets.

'Refineing the saltpetre'

pp.1-2

276. Gallons of water to 20. Cwt. of Saltpetre boiled and kept skimed while boiling as it rises to the top, and occationally throw in a dash of cold water the which will cause the skim to rise more freely [.] the solution must then be allowed to boil 4 or 5 hours until it is free from scum and the liquor is sufficiently reduced [,] a point to be ascertained by practical experience, [.] it is then pumped out of the copper into a trough with 4 brass cocks, through which the solution then runs off at 170 degrees heat into the filtering bags. Then removed in copper poreing pans to the crystelizing pans. The time from liting the fires to the running off is from 6 to 8 hours.
Previous to Charging the copper with Petre a wooden bottom perforated with holes. [,] with iron shod rim and stand is placed in the copper to prevent anything from sticking to the bottom, [.] Troughs and bags are well cleaned, having poured on them from a watering pot boileing water till completlly cleaned from all signs of petre. the washings are put into the pan the same as the others [.] after the pans are filled they must be washed all round the sides with boiling water. And all the shills (*sic*) on which the pans stand are all washed in a similar way. the [crystalizing ?] pans are then covered close with wooden covers to keep it from working over the sides and to make it crystalise solid together [.] it must then stand for the space of about 36 0r 40 hours. in warm weather longer [,] perhaps 3 days [.] the pots are then uncovered the following morning to allow them to cool. when ready to be poured off they are all scraped and watered with cold water and blocked [raised ?] up on one side. let them stand that way for 6 or 8 hours or longer if not wanted. The mother-water that runs out of the pans when poured. runs along drains into cisterns in the refeining house. Each stage must have different cisterns if the petre differs in quality; then it is pumped up out off the cisterns into iron pots which may hold 300 Gallons [.] with a steady and slow fire it is kept boiling till the petre becomes to such a consistency that it congeils freely when dropt on a cold surface, [.]

pp.3-4

It is then ladled out of the pots into single filtering bags of a more open texture than the first [,] put into crystalising pans the same as the other and stand the same time [.] this petre that is got from the mother water is returned into the boiling house to be boiled and filtered again along with the other petre – being considered as grough. The petre from the crystalising house is now tested and if it does not stand the test it must

go through the same operation of boiling again [.] if the petre is so foull [,] the quantity of petre is deceased and the quantity of water is increased. if it stands the test it is then taken to the melting house [.] it takes about 2 hours to melt 1 Iron pot full of between 3 and 4 Cwt. the furnace door is then opened and it is required to stand about two hours. before it is ready for casting [.] it is then jeted out into circular moulds made of bell metal, that holds about 40 lb. it is tested again and if any common salt be detected in it. [,] it must all go back to the first operation again (it is tested by nitret of silver and distelled water), [.] the common salt is retained in the mother-water and it is left at the bottom of the reduceing pot [.] the common salt is filtered through a petre bag put into a basket placed on a handbarrow laid across the Crystaliseing pan. Saltpetre in the Grough state is generally refined three times [,] that is [,] after standing the usual time to crystalise brought back again and again to the refeining copper [.] the last is called the treble and taken to the Melting-house to be cast into cakes.

Conclusion

Any interpretation of this information will be most welcome, especially as to time, place and procedures. The account of the refining of saltpetre seems to come between the simpler system described by John Stephenson of the East India Company (*Treatise on the Manufacture of Saltpetre*, Calcutta, 1835), and that reported by the explosives engineer Oscar Guttmann (*The Manufacture of Explosives*, 2 vols, London, 1895), but this does not mean that the procedure fits between them chronologically, despite the mid-century date of the book on fossils already mentioned. A well-established powder works may have gone on using older procedures long after one that was more-recently set up. Also, the refining of saltpetre provides only a small part of the account of gunpowder making in the manuscript, and some details in the fuller transcript may provide better clues as to the date of this survey. Whatever the case, this stray notebook has raised many questions about which all advice is welcome.

Note from information supplied by Charles Trollope

Fraser Baddeley writing in 1857 described two methods of saltpetre preparation the ‘old method’ and the ‘new method’,which has only just been adopted’ (Baddeley 1857, 2-5). In brief in the ‘old method’, 35 cwt of grough saltpetre was put in a 500 gallon copper containing 270 gallons of water. This was then boiled and the impurities skimmed off the surface, during this process cold water was thrown in to precipitate portions of the chlorides. After 3½ to 4 hours the furnace doors would be flung open to cause the chlorides and salts to settle to the bottom. The solution would then be pumped out and filtered and allowed to crystallise, the resulting saltpetre was then put through this process another two times. During the third boiling a quantity of ground charcoal was added to aid the purification process, the charcoal being collected during the later filtering process. Saltpetre triple refined is perfectly pure and is suitable for the manufacture of gunpowder. In the final part of the process to drive off excess moisture the saltpetre was melted and cast into blocks for storage.

In the ‘new method’ 40 cwt of grough saltpetre was put into 270 gallons of water and heated, it was then filtered and run off into large troughs where the liquor was continuously raked to aid the formation of very fine crystals. They were then

collected and put into a washing cistern where cold water was run over the crystals. The resulting saltpetre being as pure as the triple refined, the final part of the processing was drying on copper trays. The new method was able to produce pure saltpetre from grough in one day, instead of the 6 days that the old method required. It was also claimed that the new method used about half of the amount of coal and labour than the old method, as well as savings in the provision of apparatus. It was suggested that the 'new method' followed French practice.

Baddeley's account therefore points to the Spear's account describing the refining of saltpetre as practiced at the Royal Gunpowder Factory, Waltham Abbey, during the early 19th century. By later in the century this method had been entirely superseded by the 'new method'. It, therefore, appears unlikely that Alexander Spears actually witnessed the 'old method' in operation at Waltham Abbey. But, as Brenda notes, he may have witnessed the process at another factory. An alternative explanation may be that Alexander Spears had acquired the notebook second hand and stuck his own bookplate in the volume.

Baddeley, F 1857 *Pamphlet on the Manufacture of Gunpowder as carried on at the Government Factory, Waltham Abbey*. Waltham Abbey: Privately Published

SALTPETRE - A FOOTNOTE

Wayne Cocroft

In addition to being the most significant ingredient of gunpowder, saltpetre, or potassium nitrate, may also be used for food preservation. A query to the food column of *The Guardian* (5 January 2005, 9) asked why saltpetre was preferred for preparing salt-beef, and if brine alone was used, would the outcome have been the same. The main effect saltpetre has on salt-beef is during the cooking process when it reacts with micro-organisms in the beef to give it a pinky-red colour. Brine will produce perfectly satisfactory salt-beef, however, when it is cooked it has greyish colour. Saltpetre for culinary purposes may be acquired from The Natural Casing Company (01252 713545); it costs 500g per kilo including postage and packing.

The Guardian, 5 January 2005, 5

MARITIME SIGNAL ROCKET COMPOSITIONS

Gerry Moss

This note arises from a request by Mark Jarmain, a member of the Ordnance Society, for information regarding maritime colour signalling rockets in use before 1806. An ordnance and expense book written by Gunner William Rivers preserved at the Royal Naval Museum, Portsmouth, both provides a valuable insight into the maritime night system and suggests that a well-developed system was in operation at the beginning of the 19th century. Rivers was born in Bermondsey, Surrey in January 1755 and probably first went to sea about 1771 with the Honourable East India Company, but by 1778 he was a Midshipman with the Royal Navy on board HMS Conquestadore. After service on HMS Triumph and HMS Barfleur in about 1790 he transferred to HMS Victory and served on board until 1811 when he was superannuated. He died at Portsea on 30 April 1817.

In his ordnance notebook, which he purchased at Sheerness while Victory was being refitted, he transcribed recipes for 'Signals at Night, etc'. In his book he recorded over 60 colour mixes, with 20 more for sky and water rockets. The variety of shades listed in the colours implied that a sophisticated system of night signalling was in operation.

In the book the recipes are given using a special code, which is reproduced below, using these characters the different compositions could be defined. Also illustrated is an example of a sheet describing the composition for star shells, other sheets provide compositions for sky rockets, signal lights by night, water rockets, wheel rockets quill tubes, cones, kitts, pumps, and signal lights.

As part of the request for information there was a suggestion that a conference might be held in Portsmouth in 2005 to discuss maritime signal rockets, but no further information is available. Mark Jarmain may be contacted at 99 Bayford Road, Littlehampton, West Sussex, BN17 Tel:- 01903 731946 Fax:- 01903 726318

Saltpetre		Gold		Brimstone (Sulphur?)	**B**	Pitch	**Pth**
Sulphur		Quick Silver (Mercury)		Beat Iron		Tallow	**Ta**
Meal - ** Powder		Lead		Amber	**Ab**	Linseed Oil	**Ld.O**
Corn - Powder		Silver		Iron		Tin Glass	
Glass - Dust		Copper		Spirits Turpentine	**Sp T**	Pewter	
Brass - Dust		Tin		Rockpeter	**R P**	Rosin	**R Z**
Saw - Dust		Lamp Black		Indigo	**Ind**	Sulphur Vivian	
Charcoal Dust		Champher	**C**	Vitrol Water (sic)	**V.W**	Verdegris (sic)	**Vdg.**
Sea Coal Dust **		Wood Ashes		Stone Blue	**St.B**	Wine Vinegar	**W.V**
Brick Dust		Steel Fileing		Yellow Arsenic	**Y.As.**	Spirits Wine	**Sp.W**
Antimony	or **An**	Iron Fileing		Argol Red	**Arg**	Rice Water	**R.W**

p144 Characters for composition

Quality	Chtr	lbs	ozs	drs	Quality	Chtr	lbs	ozs	drs	Quality	Chtr	lbs	ozs	drs
White (Oil of Almonds left for 4)		-	4	-	Yellow		4	-	-	Red Fixt Point Star 1		4	-	-
		-	12	-			1	-	-			1	-	-
		-	6	-			1	8	-			1	-	-
	Sp.W	-	2	-		Sp.W	-	1	-	Red Fixt Point Star 2		-	8	8
	C	-	0.5	-	Light Yellow		4	-	-			-	2	-
White Isinglass Steep		4	-	-			1	-	-			-	1	10
		1	-	-			1	-	-	Gold Rains		-	4	-
	A	2	-	-		Sp.T	-	-	8			-	2	-
White		4	-	-	Different Colours -very Beautiful!		-	1	-			-	1	-
		1	-	-			-	1	-	Light Yellow (+ Isinglass steeped in glue)		8	-	-
		1	-	-			-	1	-			3	-	-
Green		-	-	8		C	-	-	4			2	-	-
	RP	-	4	-		Sp.T	-	-	4		C	-	4	Q+
		-	2	-	Tailed Star- -Coarsely ground		-	3	-		W.V	-	-	1
	C	-	2	-			-	2	-		Sp.W	-	-	1p+
Blue with Red		-	8	-			-	1	-	Gold Rains		-	4	-
		-	4	-			-	-	12			-	1	-
		-	12	-	Brilliant Star- **mixt to a paste		-	3	8			-	1	-
	Sp W	-	2	-			-	1	8	Woolwich Stars for Ship Information (Isinglass Dist.)		-	8	-
	Sp T	-	0.5	-			-	-	12			8	-	-
Blue with Red - WR		-	8	-		Sp.W	**	**	**			2	-	-
		-	4	-	Silver Stars		2	-	-			2	-	-
		-	2	-			1	-	-			-	3.7	-
	Sp W	-	2	-			1	-	-		Sp.W	One Pint		
	Sp T	-	2	-		A	1	4	-		W.V	Two Pints		

p148 Compositions for stars

Royal Naval Museum, Portsmouth, Rivers Papers Manuscript 1998/41 (3) Ordnance & Expenses book

BIG EXPLOSIVES COMBINE 29 COMPANIES WHO ARE TO AMALGAMATE PLAN TO MEET POST-WAR CONDITIONS

Faversham Times, 2 December 1918, page 3

Our City Editor writes: After negotiations extending over a period of at least eighteen months, a scheme has now been devised, and is submitted for consideration of shareholders, for a great amalgamation of explosives manufacturers in this country.

The reasons put forward for this consolidation of interests are that the explosives and allied trades shall be able to effectively deal with the problems which must arise when war is finally concluded. Such an amalgamation as is proposed will enable the various technical, commercial, and financial problems to be more satisfactorily handled, and essential improvements in working conditions and economies in manufacture and distribution to be introduced.

Foreign manufacturers of explosives and kindred commodities have already formed themselves into powerful combinations, and British interests must be similarly consolidated if they are to maintain their position in the future. The companies – many of them of a private character – have, of course, made huge profits out of the war, but they must now adapt themselves to the production of the manufactures of peace and reconstruction. Naturally, some of them fare better than others in the terms upon which they will enter the new combine, and it will be interesting to note how the prices of their shares are affected when the conditions have been fully digested.

THE 29 COMPANIES

The new combine will be known as Explosives Trades Limited, and its authorised capital will be £18,000,000 consisting of £6,500,000 6 per cent. Cumulative Preference shares, £8,000,000 of Ordinary shares, £1,500,000 of Deferred shares, and £2,000,000 of shares the character of which is to be decided upon at a later date. All the shares will be of £1 each. If the whole of the shareholders in the ?companies include din the combine agree to exchange their holdings for tehsecurities of the new companies it will have an issued capital of £15,247,458, mad eup of as to £6,292,443 in preference, £7,584,194 in ordinary, and £1,430,821 in Deferred shares.

No fewer than 29 companies are included in the arrangement, their names being as follows:

Abbey Imperial Chilled Shot
Alliance Explosives
Australian Explosives
Bickford Smith
William Bennett Sons and Company
Birmingham Metals and Munitions
British Explosives
British South African Explosives
British Westfalite
Cotton Powder
Curtis's and Harvey
E.C.
Eley Brothers
Eley Brothers (Canada)
Elterwater Gunpowder
King's Norton metal
Kynoch
Kynoch-Arklow
National Explosives
New Explosives
Nobel's Explosives
Electric Blasting Apparatus
Patent Electric Shot
Roburite and Ammonal
Sedgwick Gunpowder
Schultze Gunpowder
St Helens Electric Fuse
Unity safety Fuse
W H Wakefield

The Board will be a large one, consisting of eighteen directors, with Sir Harry McGowan as chairman and managing director, and Sir George J Smith as deputy-chairman.

The side of the scheme which will be of the greatest interest to shareholders is, of course, the terms upon which their shares are to be exchanged for those of the new company. The conversion value of the ordinary shares of the companies is based upon a valuation of the business assets existing at Dec 31, 1915, the goodwill considerations being calculated on pre-war earnings. One half of the sum for assets is to be represented by Preference shares of the new companies at par, and the other half, and also the goodwill by Ordinary shares at par.

EXCHANGE VALUE OF SHARES

The conversion value of all expenditure on capital account incurred for war purposes is to be represented by deferred shares of an amount equivalent to 20 per cent of the cost of the plant and buildings so erected, while the growth of assets between Dec 31 1915 and Dec 31 1916, is to be satisfied by Preference, Ordinary, and Deferred shares.

The following table shows the exchange of shares which are dealt in on the Stock Exchange, the other companies mentioned being of a private or semi-private character.

Company		Value of Shares	5% Pri	Merger Exchange Ord	Def	Cash
Brit SA Expl	Ord	12s	?.2	.57083	-	5.473d
Brit Westfalite	Ord	£1	1.5	6	1.5	11.9d
	Ord	£1	2	7	1	-
	Pref	£1(7%)	1 1/6	-	-	-
Curtis & Harvey	Ord	£1	1	1.7	.4	-
E.C.	Ord	£1	1	1.25	1/6	-
Eley Bros	Ord	£1	1	1.6	.16	-
K Norton Metal	Ord	£10	7	16	6	-
	Pref	£10(7%)	14	-	-	-
Kynoch	Ord	£1	0.5	1.25	.33	-
	Pref	£1	1	-	-	-
Nationa Expl	Ord	£1	1	1	-	-
Nobel's Expl	Ord	£1	1.5	2.5	.5	6d
	Pref	£1(5%)	1	-	-	-
Roburite & Am	Ord	£1	-	1	-	-
	Pref	£1 (10%)	1 1/3			

In explanation of the above table we will take the case of Nobel's Explosives for every £1 ordinary shares at present held by shareholders will receive 1½ Preference shares, 2½ Ordinary shares, ½ a Deferred share, and 6d in cash in the new company, or a total value of £4 10s 6d on the nominal value of the shares. Friday's closing price in the Stock Exchange of the ordinary shares of this company was 4½. Each Preference share is to be exchanged for one Preference share is to be exchanged for one preference in the new concern.

Holder of the new Company's Preference shares issued in exchange for Ordinary shares will receive 10.26d per share in respect of dividend for 1918, which is equivalent to 6 per cent for six months.

It is not surprising, having regard to the varied interests involved, that the scheme has taken so long to prepare. Some shareholders may imagine that they are entitled to better treatment, but their recent prosperity has been exceptional, and united, rather than singly, they stand a better chance under peace conditions.

Submitted by Arthur Percival

THE ROYAL NAVAL PROPELLANT FACTORY CAERWENT, GWENT

The Dinham Propellant Factory Research Group

John Smart

The 'Dinham Propellant Factory Research Group' (DPFRG) is a group of six people, who due to their interest in the history of the Royal Naval Propellant Factory Caerwent (RNPF); met and became friends. We enjoy a free exchange of knowledge and discoveries regarding the factory. There is no constitution, no rulebook, no chairperson/committee, politics or meetings. Our intention is to enjoy delving into the industrial history of the RNPF Caerwent, with others interested in the site, whilst it still exists; we are most likely the last generation able to have this privilege.

View looking east over Press Houses Unit 2 Photograph by John Smart ©DPFRG

The most useful part of having a title for our group is when visiting museums or record offices. Individuals get service; but groups get serious attention!

The history of the factory and details of the manufacturing processes, have been discovered over time from many sources, and we are slowly improving our understanding of them. It is not intended here, to detail a particular area of our research into the RNPF, but to share what we have discovered and explain our fascination with
the RNPF.

Why Dinham? This is because locally the Factory is known as Dinham, named after the hamlet consisting of a farm, chapel and castle hill on whose land the factory was built. People living as far away as Newport and Chepstow, who are of the generation conversant with its production days, still refer to the RNPF Dinham. Caerwent is on the southern side of the A48, and most likely the only place the officials in London could find on the map; hence RNPF Caerwent. The main gate is on the north side of the A48, at the end of the Dinham Road out of Caerwent.

Our research is broadly 1939 to 1968, the period of Cordite Manufacture for the Navy on this site. Construction of the RNPF started in September 1939, production commenced in December 1940 in the Sulphuric Acid Plant in Unit 1. Cordite production, designed for 150 tons per week peaked in March 1943, when 283 tons per week was being produced. This was achieved with 6,000 people on a three-shift system. On announcement of closure in March 1965 there were 1,387 persons employed. The number of people employed was small compared to Royal Ordnance Factories constructed at the same time, some of which employed 10,000 or more persons. However in studying the history of the RNPF it is apparent that the number of workers is misleading; the facts are quite astounding. To give some idea of the scale of the RNPF:-

Area of land within the boundary fence	3 sq miles
Area of land including soft security buffer	5 sq miles
Perimeter fence 8’ high steel palisade	6.5 miles
Unit 1/2 division fence 8’ high steel palisade	1.5 miles
Buildings in 1942	800+ number
Buildings extant	435 number
Roads 10’ to 20’ wide	29 miles
Railway standard gauge	12 miles
Water requirement for 150 tons Cordite / week	3,000,000 Gallons / Day
Water storage in 2.25 Million gallon reservoir	2 number
Electric trucks (90, with 60 in use)	50 miles / week / truck
Steam main distribution pipes	60 miles
20,000 Gallon Static Water Tanks	10 number
Air Raid Shelters 40 to 50 people	75 number
10 Bed Hospital	1 number

The above items are impressive in themselves; our endeavours have discovered other items of interest, both large and small, that still exist:-

- Around the site are numerous service marker posts, despite the need to build quickly and economically, they proudly display on their tops RNPF.

- The Home Guard formed from factory workers has also left a poignant reminder discovered in the undergrowth by their camp in Unit 1. It is an inclined cast concrete slab about 6' square, showing the coat of arms of the 131st Monmouthshire Home Guard Light Anti Aircraft Battery. Could it be that some of the members of the Home Guard, were reproducing their memory of the Fovant Badges that they saw before they departed for France in WW1? Initially, defence of the Factory on the ground was by a detachment of the 5th Battalion South Wales Borderers. In due course they were replaced by D Company, 1st Monmouthshire Battalion Home Guard.
- On the brick gate pillars at all three gates, cast in concrete for economy, is the motif of the Naval Anchor and Rope from the badge of the Naval Armament Supply Department who were responsible for production. Even though the instructions were to build quickly and economically it appears that you could not at the time construct a gate pillar for the Royal Navy without embellishing it.
- In the office block the Fire Zone Warning Panel still exists. When a telephone call was made dialling –000- its zone location was automatically recorded and transmitted to the Main Gate and the Main Control in the basement of the office block. During WW2 it was also connected to the Factory Observer System for aerial attack, and after dark the control room of the Decoy Site at Coed Llifos some three miles away. In the control room at Coed Llifos, they would activate their corresponding zone switch to that received automatically from the RNPF, and reproduce the effects of the attack to divert the raid.
- A Nitroglycerine truck way from the Washing House to the Spray Annex still exists. It is complete with asphalt, grooves for the tyres of the Nitroglycerine Trolley, and passing place so that two trolleys can be used.
- Construction details are numerous. The buildings are mostly of brick to give splinter protection, with reinforced concrete roofs for protection against firebombs. It is apparent that speed of construction was paramount, as on some roofs timber edge shutters were used and others used brick shuttering, as timber was not available. Buildings built during WW2 have external brick windowsills; post war buildings have tile sills due to the use of cavity walls. Windows are glazed with wired glass, apart from production areas using products that would be damaged by light; these windows are formed of glass blocks. The main staircase in the Office Block is a classic 1930 art deco with its overlooking balcony, two story height windows, metal balustrade and oak handrail.
- Open channel salt glazed pipes still exist on site in ditches. These were installed when the effluent drainage system failed at its joints, and leaked acidic effluent into the ground, causing the natural limestone swallow holes to expand and threaten to engulf buildings and roads. The benefit of the channels, apart from easy maintenance of joints was that limestone, quarried on site could be shovelled into the channels neutralising the flow.
- In Unit 2 the Nitroglycerine Cold Brine Tank still exists within its house, due to it being lost in the woods. This house is complete with external temperature gauge registering 28. Internally the sectional cast iron tank has lids, and lid lifting hooks. It is surrounded with a timber framing infilled with cork. This allows a narrow internal passage just large enough to squeeze round the brick building.

- A metal post outside the Paste Mixing and Sheeting House still exists. This supported the Nitrocellulose Ring Main as it was raised out of its ditch before entry into the house. A metal plate, with two holes for this pipe is visible on the front elevation, denoting the entry/exit point for the ring main flow and return pipes.
- Traces of an ash/tarmac path around the inside of the perimeter fence are believed to be that provided for the Home Guard. The fence also has inset bastions at regular intervals. This enables a defending force to be able to observe and fire upon an attacking force or saboteur.
- Sir Robert McAlpine was principal Building Contractor. They still to this day have a working depot adjacent to the South East corner of the site. Though disused, their rail access into the depot, from out of the sidings in the RNPF, complete with gate in the perimeter fence, can still be identified on the ground.

We have been able to talk to some of the people who worked at the RNPF; they have given personal recollection:-

- The Messenger. One of the few people able to move between the Units, as he cycled around both Units 1 and 2. Having delivered his message he had to wait for a reply; he was left in no doubt the message was more important than he was. The factory was constructed as two independent Units, with the division marked by a fence similar to the perimeter fence, this very substantial barrier of 8ft high steel palisade impressed the significance of the two independent units. More important than the danger area fences that were only 4ft high chain link.
- The Press Ladies. Able to describe the movements they made in the Press House including drawing back the rope mantlet, having set up the press and retiring to the control room. Also how, if it were close to the end of a shift, they would nudge the applied pressure control, hoping the supervisor had not noticed, to avoid missing the bus home.
- The Fitter. Has a vivid recollection of the glass washing columns in the Nitroglycerine Nitration House together with the headaches people received from the fumes. As a fitter moving around the factory, he used paths. These were not apparent but are extensive and can be located in part. The total length is likely to a least equal the road length of 29 miles. They do not in the main follow the roads but form short cuts.
- The Chief Chemist. Transferred from the RNCF Holton Heath in the late 1930s and retired from RNPF in 1968 (closure) after continuous service. Now at 93 years of age he gave details of the chemical processes for the production of acids and nitrocellulose. He also located the gas point in the Main Laboratory where he used to light his pipe!
- A Stove Worker. Remembering that he had to obey without question the instructions of the Red Spots. These were the supervisors who wore a red spot on their sleeves to denote rank, supervising workers in at least the Cordite Section if not elsewhere in the Factory. Also pointed out to us were the remains of telephone posts, at road junctions or more frequently along roadsides in the absence of junctions. These were to enable workers seeing a fire, but not within a building to dial –000- before heading towards it and attempting to put it out. All workers were instructed in fire fighting and the use of the equipment provided; with the clear instruction to not evacuate, but to put out that fire.

- The Security Guard. After many years of daily patrols around the site still finds new features not previously seen.

Railway sidings and paper stores ©W D Cocroft

From documents in the National Archives, Kew it is clear that the RNPF was approved and funds allocated to build a factory to manufacture Cordite. It follows that this should be the only export, however this is far from the truth. Due to changing needs in wartime and after, the following has been made and exported:-

- Cordite- Many types and sizes were produced for Navy use; SC, RDN, NF, MNF, SSC, 4-inch and 5-inch SUK Rocket charges, Scrolled Pleated Sheet Charges, SC/T, Picrite-oxamide compositions and others. All packed in wooden boxes and dispatched via one of two Van Loading Buildings, into rail wagons.
- Sulphuric acid - Production not required for factory use was exported. The two acid factories could produce a combined total of 60 tons of sulphur trioxide per week. The sulphur trioxide was converted to oleum and diluted as required to give sulphuric acid for factory use. Sulphuric acid at a concentration of 96%, and oleum; were both exported in rail tankers. By June 1941 some 400 tons of oleum had been exported to the Sulphuric Acid Control and other factories.
- Nitric acid - The nitric acid plant in Unit 2 was built twice as big as Unit 1, despite the fact that if RDN or NF Cordite were made in this Unit, less acid (approximately 66% less) would be required for that Units Cordite production. This was intentional so that there would be considerable quantities not required for Factory use. Nitric acid was exported at a concentration of 99.5% in rail tankers to ROF Bridgwater, ROF Pembrey and the Nitric Acid Control.
- Nitroglycerine - With the addition of Triacetin Liquor to the Nitroglycerine, it was sufficiently desensitised, to enable it to be loaded into aluminium containers, and exported by a specially converted lorry to IMI Summerfield

near Kidderminster. Between 1952 and 1967 a total of 2,358,000 lbs of casting liquid was exported by this method.

- Tetryl – Although, it is not Cordite, or a product necessary for Cordite manufacture, a full manufacturing plant was still provided for Tetryl, presumably because a plant was provided at RNCF Holton Heath, when that factory was built 25 years earlier.
- Nitrocellulose - At the end of the production run in the Nitrocellulose Section a production batch would be diverted from entering the main pipe to the Intermediate House; and wrung in a Centrifugal Hydroextractor until damp, this was then exported to RNCF and others.
- Electricity - The two boiler houses provided steam for turbines to power alternators as well as factory process steam. The alternators were rated at 880kw at 6,600volts, 3 phase, 50 cycles; there were four. Any electricity not required in the Factory was exported into the National Grid from two bulk supply sub stations.
- Ammunition - In the late 1940s large quantities of ammunition were stored in specially provided Elephant Huts, awaiting Broken Seal examination, following examination they were exported off site.
- Rocket Motors – Post-war the manufacture of the propellant and assembly of Gosling, Magpie, Sealyham and Seaslug Rocket Motors was carried out on site in converted buildings, and in newly constructed "J" buildings in Unit 1.

It has been discovered that some important developments in propellant manufacture were invented and developed at the RNPF; subsequently being adopted within the industry:-

- Chromium Plated Beater Blades - In the Nitrocellulose Beater Troughs (cast iron tanks 16ft long, 8ft wide, 2ft 7in to 3ft deep holding 1,030 lbs of Nitrocellulose and 8,000 lbs of water) there were 22 phosphor bronze blades held in a shoe, this was used to cut the mixture and turn in into a pulp, the typical process time was four and a half hours. The inherent problem was the blades wearing out and instead of cutting the mixture they tended to tear it. At RNPF, following experimentation the blades were coated in Chromium, increasing the life of the blade by a factor of 5 and as the blades now cut the mixture the process time could be reduced to two and a half hours.
- Modified Non Flash Cordite (MNF) - Unit 2 was constructed to produce 75 tons of SC. However, the quantity of solvent (Acetone) used in the dry mix caused dimensional irregularities in the NF cord and was prone to air inclusions in large diameter extrusions. From experimentation at the RNPF it was found that these difficulties could be solved, if the amount of solvent used in the dry mix in the incorporator, resulted in only 2% of solvent remaining at the pressing stage. This was impractical as the press pressure required to extrude this mixture was excessive. However when the dough incorporated with acetone, was pre-pressed, dried, left to mature for a minimum of 16 hours and then hot rolled in the Roller House; before pressing into cord, the problems were solved. MNF was adopted for Naval use in 1947.
- Unit Load Supports – During Second World War the boxes of cordite were packed individually into railway wagons by hand. Any small spaces between the boxes and the sides of the wagon were packed with small packing timbers to secure the load in the wagon. After the Second World War a system of Unit Loads was adopted. This consisted of cordite boxes being stacked on pallets

at the Blending House, all moved on the pallet by forklift truck, and loaded directly into the rail wagon. The space left between the pallet and the wagon side was large and if packed with timber would be wasteful in time and materials, and made the removal of the pallets at their destination difficult. A short accro prop was manufactured on site complete with timber platforms at both ends. When the pallets were placed in the wagon, any spaces between pallets could be supported by inserting the accro prop; and twisting the screw, to extend the device until contact was made with the pallet load and the wagon side, or pallet to pallet. This was adopted in other Navy establishments.

The design of the site by Freeman Fox And Partners, following detailed requirements issued to them by the staff at the RNCF Holton Heath, has left us with numerous different buildings each specifically built for a defined purpose. When looking at a building from the outside you get an impression of size; however when you enter it appears four times larger. The quality of the design made the buildings adaptable to constantly changing processes/products to satisfy service requirements.

We should not forget the quality of the people who worked at the RNPF. With only one major accident (a cordite charge in a press exploded) and no fatalities caused by production accidents in the whole of the 26 years is astounding for such a dangerous environment. They did what was required of them, and leave us to try and work out how.

My sincere thanks to the other members of the DPFRG; who without their efforts, this could not have been written.

John Smart

GUNPOWDER MILLS GAZETTEER Glenys Crocker

The Gunpowder Mills Study Group's gazetteer of black powder manufacturing sites was published by SPAB Mills Section in 1988. Last year it was agreed that an electronic version should be placed in the Mills Archive (based at Reading) and I have now begun preparing this by scanning the original.

Apart from highlighting those sites that have seen major changes since 1988, correcting known errors and replacing superscript number with author-date references in the text, I am not revising the original entries. However, I am adding extra paragraphs to give new information where this is readily available to me. I am not attempting to do this comprehensively because I see it as a continuing process to which others besides myself may contribute.

In most cases the additions are references to new material that has been published so I am giving a very brief note of the content and a reference. In the case of Rotherhithe I am including more detailed information given to me by Graham Dawson of the Surrey Archaeological Society and the South & Lambeth Archaeological society. A copy is given here both for information and as an example of how the entries are set out.

Rotherhithe (TQ 36 80)
There are records of a gunpowder mill on land east of the town, which was held from the 1530s onwards by members of the Lee family, and of a gunpowder mill erected by Henry Reve on land called 'the Crenge' in 1554-5.

Chronology
1543 Lease of 1563 indicates that premises on the east of Rotherhithe had been occupied by the Lee family for making gunpowder for 20 years (*Rise and Progress*, 210-11).
1554-5 Henry Reve has erected a mill on 'the Crenge' (*Rise and Progress*, 208; *VCH Surrey*, **2**, 310).
1562 Francis Lee, Brian Hogge and Robert Thomas had erected five new mills and tendered to supply government (*Rise and Progress*, 210-11).
1563 Lease for 21 years to Francis Lee of tenement, gunpowder mill and wharf on east of Rotherhithe, late in the tenure Thomas Lee died, now of Francis Lee his son (Rise and Progress, 210-11).
1578 Francis Lee gunpowder maker to the Queen at Redreff (Rotherhithe) (*Rise and Progress*, 210-11).
1600 Richard Neede of Rotherhithe, powder maker (*VCH Surrey*, **2**, 314).

Information added 2005
A tenement and mill called Gunpowder Mill with wharf belonging to Robert Hammond (Survey of Rotherhithe 1632, PRO E178/5672). (Information provided by Graham Dawson, Southwark & Lambeth Archaeological Society) who states that this would lie just west of where the river turns south between Rotherhithe and the Isle of Dogs and comments since there is no reference to a mill there when the site belonged to Bermondsey Abbey, Reve's mill site must have been new and represents considerable capital investment.

New site added 2005
SOUTHWARK
Chancery suit of 1549 (PRO C1/11250) re lessee's failure to maintain wharf. Witness (PRO C24/16/13) stated that *c*.1543 Charles Wolman was put in to manufacture of gunpowder for the king. The site is 190 on fig 8 in Carlin's *Medieval Southwark* (1996), immediately west of Tower Bridge. It was part of a larger property including Carlin site 195, to its west, which did include a tide mill {Information supplied by Graham Dawson, who comments that the tide mill was derelict by the mid-15th century so it is unlikely that gunpowder production involved the use of a mill.)

[Added to Bibliography: Carlin, M, 1996 *Medieval Southwark*].

EXPLOSIVES ON THE INTERNET *Wayne Cocroft*

www.black-powder.co.uk This website is run by Peter J Starley, a black powder supplier based in Warwickshire. The site includes a copy of the 1908 Taylor & Challen catalogue of gunpowder manufacturing machinery and links to other web sites on the history of gunpowder, historic gunpowder sites and modern manufacturers and suppliers.

ADVANCE NOTICE GEHG SPRING 2006 MEETING Wayne Cocroft

Following our Spring 2004 meeting, which took the theme of saltpetre production and preparation we would now like to turn our attention to the smallest ingredient of gunpowder - sulphur.

Some of the topics we might address include:- the sulphur trade, where was the sulphur acquired from and who was involved in the trade? How was sulphur refined? How did this change through time? What evidence do we have for sulphur refining at different gunpowder works? How was sulphur refined by the wider post-medieval chemical industry? What contribution did sulphur make to gunpowder? Sulphur was also a crucial raw material for the later chemical explosives industry, for the production of highly concentrated sulphuric acid used in the production of nitric acid, and for use in conjunction with nitric acid for nitration processes.

The meeting will be in the Saltpetre Melting House at Waltham Abbey, if you are able to contribute a short piece on any aspect of sulphur please contact Brenda Buchanan or Wayne Cocroft. The date of the meeting will be confirmed by a short note or in the next Newsletter.

MIDLOTHIAN GUNPOWDER COMPANY SAMPLE BOX Jim Buchanan

The Midlothian Gunpowder Company operated 1889-1918

CONFERENCE THE EXPLOSIVES INDUSTRY IN CUMBRIA

The 20th Spring Conference of the Cumbria Industrial History Society will take the above topic on 23 April 2005 at St Martin's College, Ambleside. Details and booking form from Ron Lyon, Chrondenn, Church Street, Skirwith, Penrith, Cumbria, CA10 1RQ.

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Names in brackets indicate sources of information rather than authors