

# OHIO VALLEY HISTORICAL ARCHAEOLOGY

Journal of the  
Symposium on Ohio Valley Urban and Historic Archaeology



VOLUME 16

OVHA MONOGRAPH NO. 1:  
BIBLIOGRAPHY OF NITER MINING  
AND GUNPOWDER MANUFACTURE

2001

# OHIO VALLEY HISTORICAL ARCHAEOLOGY

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Originating in November of 1982 and first convened in March 1983, the Symposium on Ohio Valley Urban and Historic Archaeology serves as an annual forum for the presentation and discussion of regional research in the field of historical archaeology and related disciplines. Participants in this dialogue include members of the archaeological community, museum and historical society representatives, officials of various Federal and state agencies, and the interested public. Selected papers presented at the Symposium and contributed articles are published in the organization's official journal, *Ohio Valley Historical Archaeology* (formerly – 1983-1987 – known as the *Proceedings of the Symposium on Ohio Valley Urban and Historic Archaeology*).

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Front cover: Firing of late 16<sup>th</sup> century artillery as depicted by Cyprian Lucar (1588).

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Wickliffe, Kentucky

Donald B. Ball, Editor

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## OVHA MONOGRAPH NO. 1

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## EDITOR'S PREFACE

To live effectively is to live with adequate information.

- Norbert Wiener

*The Human Use of Human Beings* (1954)

The 19<sup>th</sup> Annual Symposium on Ohio Valley Urban and Historic Archaeology convened on Saturday, March 31, 2001, at Curris Center, Murray State University, Murray, Kentucky. This year's meeting was capably and graciously hosted by Dr. Kit W. Wesler. A total of 10 papers were presented on a variety of regional research topics (see **For the Record**).

As previously announced within the Editor's Preface column and discussed at various annual business meetings, for some time the Symposium has been desirous of establishing a formal monograph series devoted to disseminating major works of broad regional interest and application. To advance that effort, the nature of this year's issue of *Ohio Valley Historical Archaeology* is markedly different from all previous volumes in this series in its singular presentation of a monograph length survey by Donald B. Ball and Gary A. O'Dell of the bibliographic resources of two interrelated but less heralded though inordinately significant chemical industries within the region. Despite their contributions to both American and chemical history, niter mining and gunpowder manufacture have been largely – and unfortunately – neglected by most historical and industrial archaeologists.

At various times during the 18<sup>th</sup> and 19<sup>th</sup> centuries, literally hundreds of caves and rock shelters were mined for niter in a broad band from the eastern seaboard westward to the Ozarks and into northern Texas and dozens of gunpowder mills were in operation. With only rare exception have these sites been the subject of serious archaeological inquiry. Though appropriately covering sources related to the Chinese origins of gunpowder (blackpowder) and the subsequent diffusion of this chemical compound to Europe, the primary focus of this

effort is directed toward the development and spread of these industries in the eastern United States during the Colonial and Revolutionary War, War of 1812, and Civil War eras. Following the development of the earliest "smokeless" powders (e.g., guncotton and cordite) in Europe beginning in the mid-19<sup>th</sup> century and the conclusion of the Civil War, the extraction of niter from cave deposits – always undertaken as a matter of last resort – collapsed as a viable industry throughout the region.

At 128 pages, over 100,000 words, and in excess of 850 references, this compilation is likely the most extensive bibliographic listing and sourcebook for these industries currently available. Though constrained by spatial limitations, it is anticipated that the present compilation of sources should amply serve as a point of departure for the further study of these significant industries within a regional, national, and international framework.

To paraphrase the opening quote to this preface, it may reasonably be argued that to research effectively one must research with adequate information. It is hoped that this study will simultaneously serve to make readily accessible a broad sampling of both the published and archival sources pertaining to these topics and prompt additional documentation, study, interpretation, and preservation of niter mines and gunpowder mills. The compilers of this bibliography welcome and actively solicit input from readers regarding additional sources and suggestions for improvement.

Donald B. Ball  
Editor

August 2001



## FOR THE RECORD

### PAPERS PRESENTED AT 19<sup>th</sup> ANNUAL SYMPOSIUM ON OHIO VALLEY URBAN AND HISTORIC ARCHAEOLOGY

A total of ten (10) papers were presented at the 19<sup>th</sup> Annual Meeting of the Symposium on Ohio Valley Urban and Historic Archaeology convened Saturday, March 31, 2001, at Curris Center, Murray State University, Murray,

Kentucky. These paper are listed alphabetically by author's last name (or last name of senior author in the case of co-authored papers).

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- Ball, Donald B. – Notes on a Lesser Known Early Map of the Old Stone Fort (40CF1), Coffee County, Tennessee.
- Carstens, Kenneth C. and Nancy Son Carstens – A Mid- to Late 18th Century Ohio River Flatboat near Mound City, Illinois.
- Carstens, Kenneth C. and Nancy Son Carstens – Using Archival, GIS, and Terrestrial and Aerial Remote Sensing Techniques: A Third Decade of Fort Jefferson Research Begins.
- Ezell, Ray and Larry McKee – Recent Archaeological Investigations at Fort Defiance and Sevier's Station, Clarksville, Tennessee.
- Mansberger, Floyd – A New Look at the American-Period Fort Massac, Massac County, Illinois.
- O'Dell, Gary A. – Field Identification of 19th-Century Niter Mining Sites.
- Quertermous, Grant – Systematic Posthole Testing at the Tilghman House, Paducah, Kentucky.
- Stratton, Christopher – Archaeological Excavations in and around the Powder Magazine at Fort de Chartres, Randolph County, Illinois.
- Wesler, Kit W. – Comparing Assemblage Patterns in Western Kentucky and Southeast Missouri: Preliminary Formulation.
- Wesler, Kit W. – Reconnaissance of the Supposed Juchereau Tannery Site of 1702-1703, near Grand Chain, Illinois.

## OVHA MONOGRAPH NO. 1

# BIBLIOGRAPHY OF NITER MINING AND GUNPOWDER MANUFACTURE

Donald B. Ball and Gary A. O'Dell

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Despite being among the nation's earliest significant extractive chemical industries, the mining of cave niter and processing of saltpeter ( $\text{KNO}_3$ ), and the related manufacture of gunpowder, during the American Revolution, War of 1812, and Civil War are unappreciated by many historical and industrial archaeologists. Though emphasizing sources relating to the production of blackpowder, materials relating to guncotton and smokeless powder are also included. This bibliographic listing will be of interest to historic and industrial archaeologists, military and chemical historians, historic preservationists, and speleologists.

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It was a great pity, so it was,  
This villanous saltpetre should be digg'd  
Out of the bowels of the harmless earth,  
Which many a good fellow had destroyed  
So cowardly; and but for these vile guns,  
He would himself have been a soldier.

William Shakespeare  
*Henry IV, Part 1*

The compilation of any extended bibliography must inherently bring to mind the old adage that "Rich men collect books – poor men collect bibliographies." As always, it remains both expensive and arduous to physically accumulate (and appropriately house and file) all possible documentary resources relating to a given area of research. Taken in this context, the compilers have attempted to make this listing as comprehensive and (in contemporary terminology) "user friendly" as possible. The brief overviews of the niter mining and gunpowder industries will provide a basic context for understanding the rudiments of the various manufacturing processes. The following bibliographical essay will serve to better guide researchers to the sources best reflecting their area of interest. Annotations following many of the citations in the body of the bibliography will further aide in assessing the usefulness of a given source.

The many and varied sources appearing herein reflect research undertaken by – and should be of legitimate

interest to – historic and industrial archaeologists, military and chemical historians, speleologists, historic preservationists, and persons interested in cave conservation. It is inevitable that many useful and informative references have been inadvertently slighted. We encourage our colleagues to build on this effort, search for information long overlooked, and share the results of their research with those who value these remnants of an almost forgotten craft.

Despite any unintentional omissions, the compilers are of the opinion that in ways great and small the resources listed herein have substantially contributed to our fund of knowledge regarding these significant early American industries. Indeed, we trust that this compilation will serve as a useful and solid sourcebook for other researchers. We collectively owe a deep debt of gratitude to all those authors – scholars, businessmen, military personnel, and "everyday" people alike – who have come before. It remains our hope that a greater awareness of and access to these resources will simultaneously prompt and encourage further interest in both the preservation and additional serious study of these (and other) often ignored and unappreciated early industrial sites found scattered across the landscape.

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## NITER MINING AND GUNPOWDER MANUFACTURING PROCESSES

Prompted largely by the need for domestically manufactured gunpowder during the American Revolution, War of 1812, and the Civil War, niter mining as one of the earliest and most significant extractive chemical industries in the eastern United States was clearly and directly related to the demands for this crucial material caused by periodic wartime necessity during the period ca. 1775 to 1865. The amount of effort required to produce large quantities of saltpeter from cave earth was inefficient when compared to the yield obtainable from other, larger, and more easily accessible sources such as parts of India<sup>1</sup> and (later) the northwest coast of South America. However, when access to these sources was denied due to wartime conditions, resort was made to the comparatively labor intensive domestic deposits of the region. The greatest geographic extent of the industry occurred during the Civil War when the Confederacy actively exploited virtually all known and accessible caves and rock shelters throughout Appalachia, Tennessee's Central Basin and Highland Rim, deep in the Ozarks, and into northern Texas.

The processes<sup>2</sup> associated with the production of saltpeter (potassium nitrate,  $KNO_3$ ) from cave or rock shelter earth (and other sources such as the dirt beneath old houses or barns) were relatively simple and straightforward. In general terms, various types of wooden "hoppers" or leaching vats were constructed and filled with excavated earth. This earth was soaked with water (LeConte 1862:9 recommended 12 hours) and the water subsequently allowed to drain into a collection trough typically fashioned from a large, hollowed out log.

Ideally, the expended, leached earth was returned to the floor of the cave so that the nitrate content would regenerate in several years (estimates range from three to ten years) as a consequence of groundwater seepage and bacterial action. In some instances (for example, the more remote rock shelters in Appalachia and likely the Ozarks), the cave earth was transported to a site near water and disposed of following the initial leaching process. The unfortunate consequence of such a practice was the needless squandering of a precious renewable resource. A parallel may be drawn between the need of a saltpeter

miner in an eastern cave and the greed of a "forty-niner" operating a water sluice in a western gold field. In both instances, the motivators prompting the extraction of mineral wealth in either form went hand-in-hand with a lack of regard for soil and water conservation. Historically, two of the more flagrant examples of irresponsible soil disposal are the high pressure hydraulic mining devices used in late 19<sup>th</sup> century California and strip mining for coal in Appalachia.

Where possible – such as at Mammoth Cave and Great Saltpeter Cave, Kentucky, and Big Bone Cave, Tennessee – water was brought to the leaching vats through a system of pipes made from hollowed, narrow tree trunks. After leaching, the resultant chemically impregnated water – called "beer", "liquor", or "mother liquor" – was transferred to a series of large (20 to 500 gallon) cast iron (or less frequently copper) boiling kettles to evaporate the water. Rather than being carried out by hand as at most sites, at Mammoth Cave the collected "liquor" was pumped uphill to the kettles through a second series of log pipes and wooden pumps.

Following the first boiling, the dried, recovered calcium nitrate – lime saltpeter or  $Ca(NO_3)_2$  – was dissolved in clean water and leached a second time through a hopper filled with alkali derived from wood ash. This step was taken to remove the calcium and effect a conversion to potassium nitrate ( $KNO_3$ ). After being strained through several layers of cloth to remove many of the larger impurities, the resultant liquid was boiled to the point of evaporation. When dried, the recovered crystals were packed and moved onto market for further purification (if necessary) or used "as is" in producing blackpowder of various grades.

The conversion process was particularly important in that it enhanced the quality of the gunpowder. Potassium nitrate is far less hygroscopic (moisture absorptive) than calcium nitrate and does not absorb atmospheric moisture as readily as other forms of nitrate. Accordingly, gunpowder produced with potassium nitrate has a considerably longer shelf life and is less prone to spoilage. The development of this process in western Europe at least as early as the 15<sup>th</sup> century is discussed in greater detail in Hall (1997:74-79).

In light of the technology used, access to three resources were necessary for the profitable operation of these facilities. The first was an ample source of water for the multiple leaching procedures. The second required resource was an abundance of wood for both fueling the evaporation process and construction of the required leaching vats, ladders, walkways, tools, and associated

<sup>1</sup> Anonymous (1857:501) provides a rare look at specific amounts of saltpeter exported from India for the periods 1834-1835 and 1855-1856.

<sup>2</sup> The recovery, separation, conversion, crystallization, purification, and refinement processes are described in much greater detail in Faust (1967), LeConte (1862), and Rains (1861; 1862).



support structures for living quarters, providing roofs for the evaporation kettles, and storage space for the processed nitrates. As the examined literature gave no suggestion as to the use of either charcoal or coal as a fuel, it is reasonable to conclude that intensive, prolonged niter production in a given deposit would result in extensive local deforestation<sup>3</sup> and further require the assistance of an auxiliary crew whose duties related only to procuring adequate amounts of fuel for the kettles. The resultant large ash and charcoal filled fire pits should be readily identifiable archaeological features associated with this industry. With the exception of the kettles, all or most of the leaching system (at both the "liquor" and potash states) and related tools were made of wood on site and frequently abandoned when mining activities ceased. A thick layer of ash at the site of the second leaching vat might result from such a device deteriorating in place near a cave or processing area.

Lastly, the third required resource was access to a transportation network to physically bring in supplies and equipment. Notably, these items included the tools needed to construct the necessary vats and other items of equipment and – importantly – the sizable iron kettles needed for the evaporation process. These same routes were needed to transport the finished product to market. In this regard, early niter miners in the eastern United States faced some of the same logistical problems confronted by the hard rock mining enterprises in the undeveloped American west beginning in the 1850s.

In simple terms, the making of gunpowder involved the process of mixing the three required ingredients in more or less the following amounts: saltpeter (75%), sulfur (15%), and charcoal (10%). The interaction of the components may be briefly described as: "The saltpeter supplies the oxygen for the combustion of the charcoal, but the sulfur is the life, for this inflammable element catches the first fire, communicates it throughout the mass, makes the powder quick, and gives it vivacity" (Davis 1941-1943:40).

In reality, the production process was slow and painstaking both to avoid explosions and insure that only pure chemicals were carefully mixed in the proper amount.

<sup>3</sup> A similar impact on local forests occurred around late 18<sup>th</sup> and early 19<sup>th</sup> century iron furnaces that relied upon charcoal as a source of fuel. From the 1860s to the 1880s, the area surrounding Lake Tahoe on the California-Nevada border was clear cut for miles around to provide wood to the sprawling mine complexes, related supporting industries (e.g., iron foundries and rail roads), and domestic requirements at nearby Virginia City and Gold Hill, Nevada.

For example, aside from their concerns for using only the best available gun saltpeter and pure sulfur, most manufacturers were also very specific about the type of wood they converted into charcoal with the Confederate powder mills in the Carolinas and Georgia favoring cottonwood (*populus heterophylla*). When circumstances allowed, powder makers preferred to "age" (thoroughly dry) the selected wood prior to charring it.

The specific composition of gunpowder varied dependent upon the intended use (e.g., shoulder arms or cannon) as did the size of the individual grains of powder with "fine" grains giving better performance in small arms and larger, much courser grains working best in cannons and mortars. By the mid-1800s, the production of gunpowder typically entailed the following steps: (1) preparation of the raw ingredients; (2) initial mixing of these in the needed proportions; (3) incorporating<sup>4</sup> the ingredients to ensure thorough mixing; (4) pressing the mixed ingredients to improve the density of the individual grains; (5) corning, a process to produce and separate grains of various sizes; (6) glazing the grains to slightly polish them; (7) drying the still damp grains; (8) molding into blocks for some specific applications; and (9) packing for storage or transportation.

Due to the explosive nature of the product, the evolution of gunpowder mills as a very specialized type of industrial site resulted in several distinctive attributes being manifest in their physical layout. Most mills were decentralized – that is, the production activities were sequentially undertaken in spatially distant buildings scattered over a number of acres. Because of the very real danger presented by any exposed flame, the mills operated only during daylight hours. Where possible, the portions of

<sup>4</sup> As described by Hall (1996; 1997:69-74), one aspect of the process of carefully mixing the ingredients was slow grinding for as long as 12 hours (some powder makers ground for as few as 3 or 4 hours) with these materials being moistened with a small amount of water during the final phases of the grinding. The purpose of this was to force the particles of saltpeter and sulfur into the micropores of the pulverized charcoal to insure more thorough burning. The ability of the charcoal to absorb the saltpeter and sulfur accounted for the selectivity shown by powder makers for certain species of wood. It is recognized that Hall uses the term "corning" for this mixing process. His description of the process, however, clearly concerns the steps taken to thoroughly combine (incorporate) the components rather than the steps taken to granulate and further process the monolithic "cake" of gunpowder produced after the final stages of the mixing process and pressing.

the complex which required motive force (such as the extended grinding of the components) used water power, hence many early mills were located near streams with a dependable flow. A lesser number of facilities such as England's Waltham Abbey Royal Gunpowder Mills and the Confederate powder works at Augusta, Georgia, were large, carefully designed structures with integrated production processes. The architecture of these impressive facilities reflects massive brick firewalls between segments of the mill, large expanses of windows, and purposely less substantial roof design intended to direct any explosion upward and outward to prevent or minimize extensive damage to the remainder of the facility.

Aside from the purely chemical and mechanical processes associated with the manufacture of gunpowder, the workplace etiquette of powder mills took on a character of its own reflecting the ever-present danger of this occupation. As recorded in Anonymous (1852:643-644):

In this silent region [at the Hounslow Powder Mill in England], amidst whose ninety-seven workplaces no human voice ever breaks upon the ear, and where, indeed, no human form is seen except in the isolated house in which his allotted task is performed, there are secreted upwards of two hundred and fifty work-people. ...Here no shadow of a practical joke, or caper of animal spirits ever transpires; no witticisms, no oaths, no chaffing, or slang. A laugh is never heard; a smile never seen. Even the work is carried on by the men with as few words as possible, and these uttered in a low tone. ...If one man wishes to communicate any thing to another, or to ask for any thing from somebody at a short distance, he must go there; he is never permitted to shout or call out. ...Amidst all this silence, whenever a shout *does occur*, every body knows that some immediate danger is expected the next moment, and all rush away headlong from the direction of the shout. As to running toward it to offer any assistance, as common in all other cases, it is thoroughly understood that none can be afforded. An accident here is immediate and beyond remedy (*italics in original*).

### LITERATURE OVERVIEW

Emphasizing (though not restricted to) sources in English, this bibliographic compilation is organized into the following four generalized sections:

- Section I** Niter Mining and Production;
- Section II** Gunpowder Manufacture;
- Section III** Archives and Extended Studies; and
- Section IV** Internet Sites of Related Interest.

A number of diverse sources pertaining to niter mining and the related production of saltpeter are presented in Section I. In addition to these sources, much important research is reported in so-called "ephemeral" publications such as the *Electric Caver* and *Journal of Spelean History*. These can be found archived in a number of libraries, particularly that of the National Speleological Society in Huntsville, Alabama. State guides showing the location and distribution of a number of saltpeter caves are available for Kentucky (Dougherty, ed. 1985), Indiana (Blatchley 1897; Powell 1961), and Tennessee (Bailey 1918; Barr 1961; Matthews 1971).

Several interesting accounts of prehistoric burials encountered by the early mining activities in Kentucky appear in George (1985; 1994) and Meloy (1968). The scholarly and historical literature on the prehistoric archaeology of the region's caves and rock shelters is voluminous in its own right. As the orientation of these studies is directed toward aspects of cave use other than niter mining, it was necessary to exclude them from the present compilation. Regardless, the few sources listed herein should provide assistance in locating a portion of these many studies which have served to so ably document the significance of these resources. See also Mason (1876:43) for a late 19<sup>th</sup> century comment on the impacts wrought by niter mining activities on prehistoric deposits.

The introduction of saltpeter into the repertoire of the experimental alchemist and that of the industrial and medical chemists in the 13<sup>th</sup> century revolutionized the development of chemistry. Saltpeter was an amazing substance and could be used in numerous chemical experiments. From saltpeter could be prepared nitric acid, or the "spirit of nitre," leading to knowledge of the other so-called mineral acids, sulfuric and hydrochloric. From the very first knowledge of saltpeter, speculations as to its nature were diverse and ultimately aided in the transformation of the early recipe-book alchemical approach to a more theoretical and essentially modern chemistry that had developed by the beginning of the 19<sup>th</sup> century. Much of the research driving this evolution involved gases and the nature of combustion. Saltpeter or niter, as a combustible material, held a central role.

During the 17<sup>th</sup> century, the theoretical debate focused upon whether saltpeter was an animal, vegetable, or mineral substance, for it had long been known to be both a product of organic decomposition and to spontaneously generate within caves and rock crevices. Because niter was so widely distributed throughout the natural world, some philosophers thought it might be the key substance to explain natural processes. By the 18<sup>th</sup> century, a fourth possibility had been added with the theory of nitro-aerial



particles drawn from the atmosphere. As the century progressed, the niter discussion became embedded in the phlogiston debate. Processes were explained in terms of the gain or loss of phlogiston, yet phlogiston was rather poorly defined as a property rather than an actual substance that could be captured and analyzed. Phlogiston was given off by materials during combustion, which, in a closed container, resulted in a "phlogistonated" air that would no longer support combustion. The phlogiston theory was short-lived, however, replaced at the end of the century by Lavoisier's oxygen-based theory of combustion. The "phlogistonated air" had been deprived of oxygen, leaving behind a gas that Lavoisier named "azote," soon replaced by the term nitrogen, which means "forming niter." Lavoisier's work finally settled the question of the nature of niter, attributed to the family whose parent is nitric acid. Early works pertinent to the historical development of chemical theory involving niter include Académie des Sciences (1776:601-617; 1786:21-30), Baume (1773), Boerhaave (1727), Boyle (1772), Glauber (1689), Lemery (1717), and Mayow (1907 [1674]).

Further information on the chemistry and production of saltpeter appears in Aber (1796), Anonymous (1862; 1871; 1881), Baume (1773), Beckmann (1846), Bowles (1829), Boyle (1772), Calvert (1961), Claridge and Campbell (1968), Craig (1862), Davy (1821), De Paepe (1981; 1982), du Pont (1926), E. I. du Pont de Nemours & Company (1906), Eller (1981; 1984), Faust (1949; 1968), Fliermans and Schmidt (1977), Gale (1912; 1917), Glauber (1998), Hauer (1972), Hess (1900), Hill (1976; 1978; 1981a; 1981b; 1992), Hill et al. (1974; 1981; 1984), and Hill and Forti (1997:157-162). Additional sources include Jackson (1949), Jha (1996), LeConte (1862; 1903; 1937), Lewis (1989; 1990; 1992; 1997), Mansfield and Boardman (1932), Mawson (1930), Maxon (1932), Mayow (1907), Multhauf (1971), Nichols (1901), Pace (1971), Plemons (1995), Rains (1861; 1862), Ross (1914), Thrun (1982), Whiting (1776), Whittaker (1934), and Williams (1975). In what is likely the most unusual source of niter, Ephraim G. Squire (1852:476; 1853:384) – best known for his pioneering research on prehistoric earthworks in the eastern United States – describes the use of human corpses in Nicaragua in the mid-19<sup>th</sup> century.

Anonymous (1878a) is of note as an early announcement of the theory that niter formation is a result of bacterial (organic) action. Extended discussions of European niter mining and production appear in Académie des Sciences (1776; 1786), Agricola (1950), Åhslund (1975; 1996), Anonymous (1644), Boerhaave (1727), Bowles (1829), Ercker (1951), Lemery (1719), Lewis (1991), Maxime (1879), Stubbe (1670), Tartaglia (1546), Ure (1842), and Williams (1975).

Of particular interest to the Colonial and Revolutionary War era, Anonymous (1845:1; 1887:68), Boyd (1950), De Paepe and Hill (1981:88), Hauer (1971; 1982b), Hovey (1897), Jefferson (1964:30), Jones (1899:295), New York Committee of Safety (1776), Parsons (1891:598, 601), and Whiting (1776) serve to briefly document the general extent of these early niter mining and saltpeter production efforts. There appear to be relatively few published resources on these early activities and niter production was never a self-sustaining undertaking.

The best known and today most publicly accessible site of niter mining during the War of 1812 is Kentucky's Mammoth Cave in Edmonson County. Numerous aspects of the mining efforts and associated equipment at this cave have been ably documented by Anonymous (1810; 1831:275; 1852), Ballou (1855), Bird (1837), Borresen (1941; 1942), Bullitt (1845:20-21), De Paepe (1979; 1980; 1981; 1984a; 1984b; 1984c; 1984e; 1985), De Paepe and Hill (1984), and Faust (1967). Additional studies include George (1988a; 1988b; 1989; 1990a; 1990c; 1990d; 1992; 2001), George and O'Dell (1992), Hill and De Paepe (1979), Hovey (1880b:915; 1897), Hovey and Call (1912:7), Jackson (1949), Meriam (1834; 1844), Mullins (1986), Niles (1963:3), Olson and Krapak (1995), Procter (1898:649), Sides (1985), Ward (1816), and others.

The early 19<sup>th</sup> century witnessed a small flurry of "learned" papers (e.g., Brown 1806; 1809; 1819; Cornelius 1819; Kain 1819; Mitchell 1803; 1806) relating to the search for rich cave niter deposits. Such activities resulted in many less heralded sites within the region also being mined during the War of 1812 and into the 1820s. These caves included (but are certainly not limited to):

- Dixon Cave (De Paepe 1979; George 1987a; Hovey and Call 1912:7; Lewis 1988) and Cedar Spring Cave (De Paepe 1984d) also located in Edmonson County, Kentucky;
- Big Cave (Great Saltpeter Cave) in Rockcastle County, (southeastern) Kentucky (Brown 1806; 1809; Collins 1847:500-501; De Paepe 1981b; Engel and Engel 1998; George 1987b; 1988c; 1990b; 2001; Hunter 1963; O'Dell 1992a; 1992b; 1992c);
- Saltpeter Cave (Duncan 1993; 1995; 1997; George 1975; 1981; McGrain 1966; Sides 1985; White 1967), Cascade Cave (Jillson 1934), and Tygart's Cave (George 1988d) in Carter County, (eastern) Kentucky;
- numerous rock shelters in western Kentucky (George 1984b) and eastern Kentucky and along the Big South Fork of the Cumberland River in north-central Tennessee (Brown 1809; Coy et al. 1984; Des Jeans 1997; Fig and Knudsen 1984, Jillson 1954; Ruchhoff 1986:87; Smyth 1903; Walker 1983);
- Wyandotte Cave (Anonymous 1856; George 1991; Gray 1868:749; Hovey 1880a:878; Jackson 1949) and nearby

Salt peter Cave (Blatchley 1897:173-174) in Crawford County, Indiana; and  
- various caves in Virginia (Faust 1964; Hauer 1982a).

Notable among the studies of niter mining during the War of 1812 is the biography of Free Frank by Walker (1983). Born a slave, Frank purchased the freedom of himself and his sizable family with the money he made from producing saltpeter in Pulaski and other counties in southeastern Kentucky.

Niter mining activities conducted by the Confederates during the Civil War extended into various parts of the Carolinas, Virginia, West Virginia, Tennessee, Georgia, Alabama, Missouri, Arkansas, and Texas. Within the Confederacy, there were no known niter deposits in Florida, Mississippi, or Louisiana. Surprisingly, however, no firm evidence was encountered in the examined sources which confirmed niter mining during this era in any portion of "neutral" Kentucky despite the abundance of caves and rock shelters in the mountainous eastern portion of the state.

As used in its broadest sense, niter "activities" also appropriately includes the development or (in one instance) purchase of extensive "nitre beds" or "nitre plantations" ("nitriaries" in official terminology) by the Nitre and Mining Bureau in several parts of the South as authorized by the CSA Congress in April 1862 (cf. LeConte 1862:6-9; Price 1862). According to CSA Col. Isaac M. St. John in a report dated October 1, 1864 (Secretary of War 1900v:699; see also Price 1862:7), a total of 13 nitriaries ("niter beds") were being operated by the Bureau in the following locations within the Confederacy:

- Alabama: Selma; Mobile; Talladega; Tuscaloosa; Montgomery;
- Florida: Tallahassee;
- Georgia: Augusta; Columbus;
- South Carolina: Columbia, Ashley Ferry, Cooper River, Charleston; and
- Virginia: Richmond.

Because of the requisite time it takes for such beds to "ripen", they were not a major source of saltpeter for the South. However, the cumulative scale of these operations is demonstrated by a statement made by Lt. Col. John W. Mallet (1909:10) of the CSA Ordnance Bureau: "...it was estimated that by [the end of the war] ...they already contained some three or four million pounds of saltpetre."

CSA Lt. Col. John W. Mallet (1909:10) also reports a possible 14<sup>th</sup> nitriary in Savanna, Georgia. Such a location would seem both reasonable and likely in light of Savanna's riverine proximity to Augusta. It is noted, however, that neither Rains (1882) nor Secretary of War

(1900v:699) make any specific mention of such a facility.

The location of the nitriary purchased – rather than constructed – by the Confederate government in South Carolina remains unclear on the basis of the sources examined. It is known that Senator James Chesnut, Jr., a South Carolinian on the staff of CSA President Jefferson Davis, was instrumental in establishing a "nitre plantation" in his home state in 1862 (Chestnut 1905:215). This was presumably the same "saltpetre plantation" which on December 12, 1863, the State of South Carolina agreed to sell to the Confederate government (State of South Carolina 1863:116). Though the Journal of the South Carolina Senate mentions this facility several times (ibid.:46, 54-54, 89, 103-104, 116), the official record is silent concerning its specific location<sup>5</sup>.

Mary Chesnut's (1905:215) remark that "the Confederacy sent to Columbia [South Carolina] to learn of Professor [Joseph] LeConte how to build theirs [i.e., niter beds]" suggests that he had practical experience in constructing them. Though LeConte (1862:6-7) describes the layout and operation of niter beds in his booklet on saltpeter production, he does not mention the location of any then existing nitriaries. In light of LeConte's academic affiliation with (what is now) the University of South Carolina and the subsequent appointment of his brother, John, as supervisor at the Columbia nitriary (E. LeConte 1938; Secretary of War 1900v:702), it seems reasonable to conclude that the "purchased" nitriary was located in Columbia while other such facilities in South Carolina were constructed by the Confederate government.

As authorized by the CSA Congress in April 1862 (Matthews, ed. 1862:27-28), among its other duties the Nitre and Mining Bureau was tasked with overseeing the production of saltpeter throughout the Confederacy. The Bureau promptly divided the South into a series of administrative districts and with military efficiency began the process of inventorying deposits, testing soils, leasing caves, and setting up or interfacing with all niter mining operations within the area on behalf of the CSA Ordnance Department. A rare example of the text of such an inventory report prepared by the state geologist for Mississippi (no niter caves were found) appears in State of Mississippi (1864:89-94). Some niter mines were operated by private parties; their saltpeter was purchased for the military. According to Powers (1981:96):

<sup>5</sup> In an address before the South Carolina legislature on November 25, 1862, Gov. F. W. Pickens (State of South Carolina 1862:25) discusses the establishment of "...a saltpetre plantation near this place" suggesting that it was located near Columbia, the state capitol.



[Isaac M.] St. John seized the reins of the Nitre and Mining Bureau at a low point in the war. His first action decentralized command while unifying control over the entire industry. He divided the Confederacy into 14 districts, each supervised by an experienced ordnance officer who enlisted labor from those subject to military duty. Over these districts were 3 supervisory divisions: First Division (Alabama, Georgia and South Carolina), Second Division (Virginia, Tennessee, Kentucky and North Carolina), and Third Division (trans-Mississippi area). ...Officers didn't have to go through elaborate channels to impress a cave for production. The Bureau became an efficiently running machine. Its central headquarters in Richmond was noted for its small number of officers. Within 6 months, the Bureau had increased production to 2,000 lbs. of powder per day, which almost met military needs.

Strangely, the vast resources at Mammoth Cave in south-central Kentucky were not mined by either side in the Civil War. The Union imported most of its saltpeter during the war and had no serious interest in the site. Alternately, among other reasons (including some legal issues) the Confederates saw its location in a neutral state so close to Union troops as being too great a risk to develop while not being able to adequately defend it. This matter is discussed in much greater detail in Faust (1967).

Except for Texas, most of the gun saltpeter produced by the Confederates was processed from  $\text{Ca}(\text{NO}_3)_2$  derived from cave earth typically devoid of large amounts of organic material. In Texas, the few caves mined for niter contained much greater concentrations of guano and other organic remains (cf. Haas 1996; see also Anonymous 1906).

Aspects of Confederate niter mining and saltpeter production efforts have been documented by Anonymous (1860; 1863a; 1874:165; 1878b; 1903; 1906; 1911), Barr (1961:451-460), Blair (1986), Boggs (1913:32-33), Chapman (1970), Chesnut (1905:215), B. Davis (1982), L. Davis (1967), Deitrich (1862), De Paepe and Hill (1981a), Eggleston (1874:165; 1875:67), Faust (1960; 1964), Haas (1996), Halliday (1995), Hamilton (1865:40), and Hauer (1982a). Additional sources include Loveless (1962), J. Matthews (ed., 1862:27-28; 1863:104), L. Matthews (1971:3-21), Meenehan (1984), Miles (1961), Osterlund (1982), Peterson (1967), Powers (1981), Price (1862), Rains (1861; 1862); Robin (1861), Schafer (1994), Schwab (1901:270), Secretary of the Treasury (1863:21, 55, 58), Schafer (1994), Shanks (1868:13), Shepard (1857), Sheridan (1980), J. Smith (1984), M. Smith (1981; 1987; 1990a; 1990b; 1992; 1993a; 1993b; 1996; 1997), State of

Mississippi (1864), State of South Carolina (1862; 1863), State of Virginia (1861; 1862a), Stiles (1862), Tarkington (1973), and "V. & C." (1862:19).

Because of his role as a consulting chemist for the CSA Nitre and Mining Bureau, the writings of Joseph LeConte (1862; 1903:178-228; 1937; see also E. LeConte 1938) are of particular note. Aspects of Confederate importation of saltpeter during the war are discussed by Anonymous (1863b; 1864:53), Hancock and Wilkinson (1966), and State of Georgia (1861:28).

Post-Civil War niter mining is poorly reported throughout the cave belt of the old Confederacy. Of note in this regard is Barr's (1961:460) comment about Big Bone Cave in Van Buren County, Tennessee: "A set of nitrate workings near the mouth of the cave is of more recent origin than the Civil War workings, as proven by bandsaw markings and nails." Eller (1981:106) notes: "There are only two reports of post-Civil War cave saltpeter mining in this country. A small Rockcastle County, Kentucky, cave was utilized as a saltpeter source by one family well into the 1900's, and there was an abortive attempt to revive the Big Bone Cave, Tennessee operation." Though other caves and rockshelters within the region were likely mined for niter following the Civil War, there is no firm evidence that these activities ever constituted more than a non-commercial "cottage industry."

With the demise of niter mining as a profitable business at the end of the Civil War, the industry collapsed in the eastern and central United States. In addition to long standing importation of niter from India (Anonymous 1857:501; 1862:590; Boatman 1958; Hutchinson 1917; Jha 1996; Leather and Mukerji 1911; Singh 1980), reports of (typically) late 19<sup>th</sup> century production or deposits of this material in the American west (Anonymous 1881), the Dominican Republic ("Americus" 1871), the west-central coast of South America (Anonymous 1877; 1884; 1891; Curtis 1892:359; Donald 1936; Mueller 1968), Minas State in Brazil (Redman 1894:716), Argentina (Anonymous 1827:302), and the Philippine Islands (Barrett 1897:179) serve to demonstrate the multiple sources of commercial saltpeter potentially available in the years following the Civil War.

The natural, cultural, and economic geography of niter caves has been examined by De Paepe (1985:5), De Paepe and Hill (1981a; 1982; 1984), George (1973; 1986), Hauer (1972), Hill et al. (1981), Imlay (1797:135), O'Dell (1995), Osterlund (1982), Plemons (1995), Sheridan (1980), and M. Smith (1981). Those examining the remnants of the niter mining process as industrial archaeology sites will find much useful comparative information in studies by

Barr (1961:451-460), Borresen (1941; 1942), De Paepe (1981; 1985), De Paepe and Hill (1981b), Des Jean (1997), Faust (1955; 1967), Fig and Knudsen (1984), George (1988a; 1990a; 1990b), George and O'Dell (1992), Jillson (1954), and Matthews (1971:3-21).

The only known examples of archaeologically excavated niter sites are the Newt Kash Rockshelter in Menifee County, (eastern) Kentucky, reported by Webb and Funkhouser (1936:140-147) and Saltpeter Cave in Carter County, (eastern) Kentucky, documented by Duncan (1993; 1995; 1997). Both of these sites were mined during the War of 1812. Eller (1981) and De Paepe (1985:34, 36) present interesting accounts of contemporary efforts to produce niter with equipment similar to that historically used at Mammoth Cave which give useful insights into experimental archaeology. Porcher's (1863:184-185) description of an indigo vat and its physical similarity to niter leaching vats should catch the attention of historical archaeologists.

In light of so many niter mine sites dating to the Civil War, the lack of formal archaeological excavation at these industrial sites is all the more surprising in light of the increasing level of interest shown in recent years toward battlefield and Civil War archaeology. Though presumably battlefields and forts may seem more "glamorous" than niter mines, there yet remains much to be learned concerning the technology, extractive efficiency, productivity, environmental impacts (both in and out of a given cave or rock shelter), and functional areas forming the totality of the site complexes. The approaches used would need to be sufficiently flexible to allow thinking in terms of a more traditional accretive series of functional and processing areas near the mouth of a cave while alternately assessing the best ways to investigate the extractive actions within the cave (including the extent of the mined area).

Saltpeter (niter) as a chemical compound has utility as a food preservative and was used as late as the Civil War as a treatment for rheumatism. This material also had 19<sup>th</sup> century commercial applications in the manufacture of (among other products) enamel glazes and glass. Any of the nitrates would, in fact, make good fertilizer. There is no evidence that cave niter was ever mined for any of these purposes on any appreciable level within the region. Indeed, within the region there was only one effective market for this labor intensive product. It is thus appropriate to present in Section II a broad sampling of the diverse literature on early gunpowder manufacture (including sources referable to the later manufacture of guncotton and smokeless powders).

Though useful summaries of the processes used in manufacturing blackpowder appear in publications such as T. Davis (1941-1943), Hamilton (1916:10-14), and Howard (1975; 1996), Ramage (1975:14-19) in particular is simultaneously well written and contains several good photographs of the types of equipment used in a commercially operated 20<sup>th</sup> century powder plant. Among 19<sup>th</sup> century sources, Anonymous (1845; 1852), Hay (1878), and Rees (1819) are clearly written and particularly informative. For information on 18<sup>th</sup> century gunpowder manufacture, the well illustrated Diderot *Encyclopédie* (Gillespie 1987:I, Plates 150, 154-158; see also M. Brown 1980:207-221; Guttman 1906) is invaluable.

Extended comments on the history, development, chemistry, and manufacture of blackpowder appear in al-Hassen and Hill (1986), Anonymous (1850; 1870b; 1871; 1872; 1874; 1875; 1883; 1885a; 1885b; 1894; 1952; 1980; 1990), Bailey (1996), Bishop (1864), Buchanan (1996), Buchanan, ed. (1996), Burdge (1898), Clephan (1909), Crozier (1998), Curtis (1996), Dutton (1942), E. I. du Pont de Nemours & Company (1880), Gillispie (1959:Plates 154-158), and George (1984a; 1986a; 1986b). Additional sources include Hall (1996; 1997; 1999), Hancock and Wilkinson (1966), Henshaw (1959), Jixing (1996), Khan (1996), Kramer (1996), Lucar (1588), Maxim (1899), Milner (1996), Newton (1883), Nye (1670), Oman (1924:205-214), Partington (1999), Rae (1996), Stubbe (1670), Van Gelder and Schlatter (1927), Wang Lin (1947), Webb (1935), Whitten (1990), and N. Wilkinson (1966).

English and Old World gunpowder making technology – which so influenced American efforts, particularly the Confederates – has been documented by Anderson (1862), Anonymous (1879), Baddeley (1857), Bas (1996), Berg (1996), Biringuccio (1943), Bret (1996), Buchanan (1995), Crocker and Faircloth (1998), DeVries (1996), Everson and Cocroft (1996), Hall (1996; 1997; 1999), Kelleher (1996), Mauskopf (1996), Mußmann (1996), Napier (1788), Needham (1981; 1985), Needham et al. (1987), Nye (1670), Percival (1968), Raistrick (1972:256-257, 286-287), Ruhmann (1996), Schultze (1996), Stewart (1996), Tascón (1996), Temple (1986), Tomlinson (1979), West (1991), H. Wilkinson (1841), Wild (1996), and Wilson (1964). Useful information on the processing of sulfur appears in Burditt (1891).

Aspects of Colonial era and Revolutionary War gunpowder production have been examined by Anonymous (1832; 1853; 1859:291-292, 293, 295), M. Brown (1980:127, 207-221), Burdge (1898), Downs (1896:499), Howard (1975; 1976), Howard and Gerhardt (1980), Lenik



(1975), Pennypacker (1882:844), Salay (1975; 1977), J. Taylor (1858:124-125), and R. Taylor (1879:152). The many primarily documents compiled by the State of Pennsylvania (1852; 1853) will be invaluable resources on both saltpeter and gunpowder production in the state during the Revolution War.

Interesting comments on the first production of gunpowder in frontier Kentucky in 1777 by Monk Estill, a slave, appear in J. Brown (1887) and George (1987). Du Bois (1907:15) remarks that African gunpowder production was observed by travelers in the period 1824-1828 prompting the possibility that some slaves brought to America also brought the knowledge and skills to make gunpowder.

Useful information on powder production in the War of 1812 and afterwards appears in Anonymous (1825:119; 1952; 1980; 1990), Bishop (1864), Coxe (1814), Dutton (1942), and George (1986a; 1986b). Additional studies appear in Jenkins (1889:213-214), Johnson (1989), O'Dell (1989; 1980; 1990), O'Dell and Johnson (1999), O'Dell and Rebmann (1996), O'Malley (1996), Rennick (1984:241), and Weaver (1971).

Various aspects of the history of Confederate powder making and transport have been examined by Andrews (1908:210), Anonymous (1861:41), Bragg (1997; 2001), Bridgewater (1973:v), Comeaux (1927), Confederate Provisional Congress (1861:41-42), Confederate Treasury Department (1861: 14), B. Davis (1982), J. Davis (1958), Evans (1899), Goodspeed (1886:841), C. C. Jones (1874:25), C. E. Jones (1918), King (1874:389), Luke (1978), Mallet (1903; 1909), McMahan (1965:22), Mell (1902), Milgram and Gentieu (1961), Ordnance Bureau (1862:72-73), Porcher (1863), Savas (1991), M. Smith (1991; 1997), Smyrl (1996a; 1996b), State of Virginia (1862b), Steuart (1996), Ross (2000), Van Gelder and Schlatter (1927), and Vivian (1996). Among the various sources examined, only Cable, ed. (1889:939) specifically addresses gunpowder as a commodity on the South's civilian markets. As the CSA officer who designed, built, and commanded the powder mill at Augusta, Georgia, Col. George Washington Rains (1882) was uniquely qualified to discuss the workings of the largest industrial complex built by the Confederate government.

In light of his pivotal role in the production of CSA ordnance, the reports and papers prepared by Josiah Gorgas (1876a:59; 1876b:62; 1884) and a biography of Gorgas (Vandiver 1994; see also Carroll 1989; Evans, ed. 1899: I, 622-24) deserve special attention. The methods and efficiency of the Nitre and Mining Bureau cannot be fully understood removed from the greater war-driven

needs of the Ordnance Department and the Confederacy. A partial listing of the network of powder mills established, enlarged, or utilized by the CSA Ordnance Department appears as **Table 1**. Some powder mills are likely missing from this inventory, others may have been misidentified (e.g., some or most of the 25 "powder mills" reported along the Conagre River in North Carolina may have been niter mining or processing sites), while some mills are known to have been dismantled and reassembled in another state to protect them from capture or destruction. Hancock and Wilkinson (1966) specifically discuss the role of the du Pont Company's Civil War era activities as a major supplier of Union gunpowder.

Though it is an indispensable component of gunpowder, little attention has been previously directed toward ascertaining the sources of Confederate sulfur. Lt. Col. John Mallet (1903:101) of the CSA Ordnance Bureau reported "There were no sulphur deposits in the South." CSA Gen. Josiah Gorgas (1884:69-70) noted that at the time the war began "...some four hundred or five hundred tons" of sulfur were located in New Orleans where it was used to process sugar (see also J. Davis 1958: I, 473; this supply is also verified - but not quantified - by Mallet 1903:101; 1909:10). An August 12, 1861, report by John Tyler, Jr., of the CSA Ordnance Office states that on that date his agency had in inventory 300 tons of sulfur - presumably part of the New Orleans supply - at an unspecified depot (Secretary of War 1900j:555).

Later in the war, Lt. Col. William Le Roy Broun (1898:370; see also Mell 1902) of the CSA Ordnance Bureau recalled that "The Confederacy had [no] ...sulphur to spare" and substituted asphalt in shrapnel artillery shells suggesting that available supplies of sulfur were routinely allocated solely for the production of gunpowder. It is of note that despite the Artillery Corps being issued substitute material, the Confederate Torpedo Service was allowed access to available stocks of gunpowder in the process of developing and successfully deploying electrically ignited "torpedoes" (mines) in the waterways of the South. Some of these devices used up to 50 lbs. of blackpowder (Crowley 1898).

Sulfur was one of the items specifically mentioned in General Orders No. 69 signed by USA President Abraham Lincoln on February 22, 1864. This presidential order provided instructions for the continued implementation of the Union blockade and listed the items to be considered contraband (in addition to arms and ammunition, this list also included gunpowder or any of its components) by the Union navy. Sulfur was brought into the Confederacy's eastern ports - though in ever diminishing amounts - by blockade runners throughout the war. By the end of the



**TABLE 1. PARTIAL LIST OF GUNPOWDER MILLS IN THE CONFEDERATE STATES.**

<u>State/ Powder Mill</u>	<u>Location</u>	<u>Operation</u>	<u>Production</u>	<u>Source(s)</u>
<u>Alabama</u> Selma Mills	Selma, AL	1864(?) - 1865	600 lbs./day	Gorgas (1876b:62) Secretary of War (1897d-e)
<u>Arkansas</u> Arkadelphia Powder Mill Crook Creek Powder Mill	Arkadelphia, AR Carroll Co., AR	1863(?) - 1864 1862(?) - 1863	--- ---	Secretary of War (1891k) Secretary of War (1887; 1891h)
<u>Georgia</u> Augusta Powder Works	Augusta, GA	1862 - 1865	5,000-7000 lbs./ day	Bragg (1997; 2001); Comeaux (1927); J. Davis (1958:316-317, 475-476); Gorgas (1876b:62); Jones (1918); King (1874:389); Meenehan (1984); Milgram and Gentieu (1961); Porcher (1863:342); Savas (1991); Schafer (1994); Secretary of War (1893; 1895d; 1897g; 1898h; 1900t-u); Rains (1882); Ross (2000); Van Gelder and Schlatter (1927) Secretary of War (1891o)
Canton Powder Mill	Canton, GA	1863(?) - 1864	---	Secretary of War (1882c-z; 1882aa-jj; 1882kk); Secretary of the Navy (1921:a-f; 1921g)
<u>Louisiana</u> New Orleans Powder Mills (3 mill complex)	New Orleans, LA	1861 - 1862	6,200 lbs./day (combined)	J. Davis (1958:I, 474); Gorgas (1876b:62) Howard and Gerhardt (1980)
<u>North Carolina</u> Raleigh Mills	Raleigh, NC	1861(?) - 1865	600 lbs./day	Secretary of War (1895b); Secretary of the Navy (1921n-o) Secretary of War (1895c)
Rocky Mount Powder Mill	Rocky Mount, NC	1777 - 1865	---	Smith (1997:98-99)
<u>South Carolina</u> Columbia Powder Mill	Columbia, SC	1863(?) - 1865	---	Secretary of War (1898b-d; 1900g; 1900j); M. Smith (1997)
[25 unnamed powder mills]	Conagree River, SC	? - 1865	---	Smith (1997:99)
<u>Tennessee</u> Anderson, King & King Powder Mill Cheatham, Watson & Company [Sycamore] Powder Mill Dodgion [Dodgian] Powder Mill Manchester [Stone Fort] Powder Mill	Bristol, Sullivan Co., TN Ashland City, Cheatham Co., TN Elizabethton, Carter Co., TN Manchester, Coffee Co., TN	late-1861(?) 1861 - 1862 late-1861(?) Sept. 1861 - March 1862	--- 1,000-2,800 lbs./day --- 1,500-2,000 lbs./day	Bridgewater (1973:v); Goodspeed (1886:841); Jones (1876:101); McMahan (1965:22); Rains (1882:7-8);

<u>State/ Powder Mill</u>	<u>Location</u>	<u>Operation</u>	<u>Production</u>	<u>Source(s)</u>
<u>Tennessee</u> (continued)				
Manchester [Stone Fort] Powder Mill (continued)				Secretary of War (1884b; 1898b; 1900j); M. Smith (1997:98)
McSpadden Powder Mill	Jefferson Co., TN	late-1861(?)	"small"	Smith (1997:99)
<u>Texas</u>				
Anderson Mill	Travis Co., TX	1861-1865(?)	---	Smyrl (1996a)
Longhorn Cavern	Burnet Co., TX	1861-1865(?)	---	Smyrl (1996b)
Marshall Powder Mill	Marshall, Harrison Co., TX	1863-1865	---	Luke (1978); Secretary of War (1888; 1896b-c); Speir and Journey (1996); Steuart (1996)
San Antonio Powder Mill	San Antonio, TX	1863+	"no great value"	Secretary of War (1888)
[name unknown]	Corpus Christi, TX	1861(?)	---	Vivian (1996)
[name unknown]	Waxahachie, TX	1861(?)	---	Steuart (1996); Vivian (1996)
<u>Virginia</u>				
Petersburg Naval Powder Mill	Petersburg, VA	1861(?) - 1865(?)	---	Secretary of the Navy (1898m)
Richmond Mills	Richmond, VA	1864(?) - 1865	1,500 lbs./day	Gorgas (1876b:62)
[name unknown]	Greenbrier Co., VA	1862+	---	State of Virginia (1862a:xxi)
[name unknown]	Page Co., VA	1862+	---	State of Virginia (1862a:xxi)
<u>West Virginia</u>				
[name unknown]	Pendleton Co., WV	1862+	---	Secretary of War (1890c; 1890h) State of Virginia (1862a:xxi)

war (early 1865), the CSA Ordnance Bureau reported that it was anticipating increasing production of sulfur to 20,000 lbs. per month (Secretary of War 1900x), apparently recovered in the course of other war-related mining operations (e.g., lead and iron ore in portions of eastern Appalachia).

In the Trans-Mississippi Department of Texas, it was reported that sulfur was one of many commodities purchased by Confederate agents in Mexico and sent by rail across the border beginning as early as 1861. As late as the spring of 1865, Union scouts reported a CSA gunpowder mill still in operation in Marshall, Texas (cf. Luke 1978), suggesting a long standing dependence upon – and continued supplies of – imported sulfur. Logistically, as the war progressed it was more practical to import sulfur rather than saltpeter. One lb. of sulfur would make at least eight lbs. of gunpowder whereas one lb. of saltpeter would yield only 1.33 lb. of powder. It is ironic that in the years following the Civil War, vast deposits of sedimentary sulfur were discovered along the Gulf Coast area of both Texas and Louisiana and this region now leads the nation in terms of annual production of elemental sulfur.

Wigginton (1979) is particularly informative con-

cerning gunpowder making as an Appalachian "cottage industry" in the post-Civil War period. Though some "home" production of gunpowder was likely accomplished, it remained necessary to import (i.e., obtain from elsewhere) both sulfur and saltpeter.

Aspects of the production and chemical attributes of guncotton and later "smokeless" powders (under development prior to the Civil War and used extensively thereafter) are addressed by Anonymous (1844; 1846; 1866; 1867; 1869; 1870a; 1870c; 1882; 1884; 1889; 1949), Blackwood and Bowden (1952), Buchanan (1995), Coffey (1997), Frost (1990:71-78), Hamilton (1916:14-18), Munroe (1888), O'Conner (1961:140-148), Stovall (1964), Thomas (1997), and Vernidub (1996). The literature concerning the post-Civil War development of guncotton, gun-paper, nitroglycerin, nitrocellulose, and other forms of modern explosives and propellants is voluminous and the references included herein are but a sampling of these resources. For further information on these materials as they existed in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, interested readers should consult issues of *Scientific American* and *The Manufacturer and Builder*.

World War II era blackpowder production at the

massive Indiana Army Ammunition Plant (INAAP) is examined in Gaither (1995). The INAAP facility is located near Charlestown, Clark County, (south-central) Indiana. Though built and principally operated in World War II, this plant also produced blackpowder during the Korean War and Vietnam era. Operated around the clock during its "heyday" in the mid-1940s, INAAP produced 51% – just over half – of all of the blackpowder used by the United States and all of its allies. This massive complex consisted of several thousand structures and 55 miles (88.5 km) of railroad distributed over an area in excess of 20,000 acres (8,093 hec). In terms of sheer volume of output, the INAAP facility is likely the largest blackpowder plant ever constructed. The production line was closed at the end of the Vietnam era. With the demise of the Cold War, this facility was declared surplus government property and much of its land base is currently (2001) being transferred out of Federal ownership for development as a privately owned industrial park.

For all practical purposes, the development of alternative explosive compounds as early as the 1860s (as evidenced by the intensive experiments by Austria with guncotton in artillery; Secretary of the Navy 1921m; 1922c-i) and the 1888 adoption of cordite ("smokeless") powder as the "regulation" powder to be used in military long arms scattered throughout the British empire. In general market terms, within the United States the introduction of cartridge feed repeating weapons during the Civil War and the increased availability of these weapons after the war resulted in all muzzle loading small arms becoming obsolete. In turn, the advent of modern "smokeless" powder on the civilian market about 1900 resulted in the obsolescence of many of these early cartridges ("smokeless" powder produces much higher chamber pressure in a weapon than blackpowder – in real terms, this means that the "new" powder would blow up an "old" gun). Commercial ammunition makers such as Remington and Winchester dropped a large number of these cartridges during World War I and most of the rest died as a result of ever declining Depression-era sales and the subsequent shift to World War II production needs. Though the use of blackpowder in various civilian sporting and target weapons remain popular, it's market share in terms of pounds consumed per year is but a vestige of pre-1900 figures. At this time, GOEX, Inc., of Doyline, Louisiana, is the only commercial blackpowder mill operating in the United States.

Few sources were encountered which specifically examined powder mills as archaeological sites. Industrial archaeologists have documented 18<sup>th</sup> century powder mills and their related technology in both the United States (Howard 1975) and England and Scotland (Buchanan

1995; Cocroft 2000; Percival 1968; Philp 1983; Raistrick 1972:256-257, 286-287; Wilson 1964). A study of a World War I nitrogen fixation plant in Alabama appears in Coffey (1997). The sites of only three powder mills are known to have been formally examined or excavated to any degree. Reports of excavations have appeared concerning the Revolutionary War era Ford Mill in New Jersey (Lenik 1975), the 1810-1833 Trotter Mill near Lexington, Kentucky (O'Dell and Rebmann 1996; O'Malley 1996), and the Confederate powder mill (site 41HS17) in Marshall, Texas (Luke 1978; Speir and Journey 1996).

Though lesser heralded in the annals of gunpowder research, powder magazines are an integral and necessary aspect of the study of powder production and storage. One of the earliest powder extant magazines in the continental United States is located deep within the walls of the Castillo de San Marcos, a 1671-1695 era Spanish stone fort in St. Augustine, Florida (National Park Service n.d.:30-31). The remains of 18<sup>th</sup> century French wood and earth magazines have been excavated at Fort Toulouse (1717-1763) in Alabama (Waselkov 1989:xvii) and Fort Michilimackinac (ca. 1750-1781 occupation) in Michigan (Heldman and Minnerly 1977). Waselov's (1989:xvii) comments on placement, wall construction, vaulted roofs, and other architectural similarities in 18<sup>th</sup> century French built powder magazines are worth reviewing.

A British powder magazine has been excavated at Fort Stanwix (1758-1781) in Rome, New York (Hanson and Hsu 1975:27-32). Abbot (1868:136-137) provides a useful firsthand description of magazines built under field conditions in Virginia by the Union army late in the Civil War. An early 19<sup>th</sup> century (1813-1814) log and earth magazine was excavated at the site of Fort Mitchell in Russell County, Alabama (Chase 1974). A likely comparable "makeshift" magazine was partially excavated at Fort Star, a USA Civil War artillery position at Smithland, Kentucky (Quertermous 1999:92). Efforts to locate a field magazine constructed by Confederate troops at the Honey Spring Battlefield (fought July 17, 1863) in McIntosh County, Oklahoma, are reported in Cheek (1976).

The practice of using a single, specially designed substantial brick or rock arched ceiling room within the walls of a fort as a repository for an installation's entire supply of gunpowder was continued through the various episodes (series) of early fixed fortifications built by the United States beginning in the early 19<sup>th</sup> century (see Lewis 1979). This purely architectural approach was rendered obsolete with the devastating effects of then-new rifled artillery in the April 10-11, 1862, USA attack on the CSA-held brick masonry Fort Pulaski (built 1829-1847) in



Georgia near the mouth of the Savannah River (Lattimore 1954). A very informative study of the evolution and distinct types of 20<sup>th</sup> century magazines is the summary report on over 20,000 (mostly World War II era) such structures currently inventoried by the US Army (Murphy et al. 2000). Though the dimensions and materials are markedly different, the makeshift simple log magazines dating to the mid-18<sup>th</sup> century had much engineering in common with the designs adopted in the 20<sup>th</sup> century. Both eras utilized structures which would direct an explosion either upwards, in but a single horizontal direction, or both, as a means of best controlling a potential disaster.<sup>6</sup>

Information encountered in archival holdings and extended published series appears in Section III. In the aggregate, these sources focus on regional War of 1812 niter mining and powder production and trans-regional Confederate activities. Among other resources, researchers should find of interest the very informative Knopf series for its coverage of primary documentation relating to the War of 1812 and the various early regional advertisements and notices reflecting the more day to day aspects of commercial niter and gunpowder activity.

For coverage of the Civil War, the War of the Rebellion (Official Records) series for both the Union and Confederate armies and navies combined with the Southern Historical Society Papers are absolutely indispensable. In general terms, the army records present a broad picture of the Confederate efforts to produce or obtain niter and gunpowder and the related efforts by the Union to destroy these supplies and facilities. Alternately, the naval records are largely concerned with the interdiction of gunpowder, sulfur, niter, and other war materiel by the Union and Confederate navies on both the open sea and the inland waters (notably the Ohio River) of the United States. These records are particularly insightful concerning the ever diminishing effectiveness of Confederate efforts to import critical supplies through the

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<sup>6</sup> In the course of official duties about 1990 at the Savanna Army Depot Activity (SADA) near Savanna, (north-western) Illinois, one author (Ball) was shown the site of an ammunition bunker that “blew” during the timeframe of the Korean War. Almost 40 years later, the resultant crater was still large enough to “swallow” a good sized house. The design of this World War II era bunker – three concrete walls mounded with earth, a “lighter” front wall, and a light framed wooden roof – served its purpose. Despite the violence of the blast, no other magazines were ignited because the design of the structure directed most of the force of the explosion upward and in but one horizontal direction.

Union blockade of southern ports.

The Hopkins papers in the Georgia Department of Archives and History in Atlanta provide detailed and invaluable information on the daily operations of CSA niter mining sites in northern Alabama. Alternately, the George Washington Rains Papers on file with the Southern Historical Collection at the University of North Carolina at Chapel Hill presents unique insights into the operation of the Confederacy’s largest powder mill at Augusta, Georgia.

Another exceptionally informative – and, regrettably, greatly underutilized – Civil War-related serial publication is Confederate Veteran magazine, published monthly in Nashville, Tennessee, from 1893 until the 1930s. This journal did much to preserve the war as seen through Southern eyes and should be examined as a major resource for the history of that era. A very detailed, privately published index of this magazine was released in the 1950s.

Aside from numerous references to the locations of Southern saltpeter mines and gunpowder mills appearing in the War of the Rebellion series, some of the relatively detailed descriptions (Secretary of War 1884a; 1890i; 1891g; 1892b; 1897d) of the structural complexes associated with larger scale saltpeter mining operations provide useful insights into the development of realistic archaeological expectations and appropriate excavation strategies for the investigation of the various functional areas associated with sites of this nature. Such firsthand accounts reinforce the observation that despite its importance to the success of the enterprise, the collection and initial leaching of nitrous earth at caves and rock shelters constituted only a portion of the total range of routine “hands on” extraction and processing activities undertaken at these facilities.

The various Internet listings presented in Section IV are intended to serve as a guide to a sampling of the electronic sources currently available on gunpowder, sulfur, and saltpeter. Among the sites presently on line, those sponsored by the three leading manufacturers of blackpowder (Elephant, Goex, and Swiss) for contemporary shooters are among the more informative. The cumulative level of information offered by these sites on both the manufacturing processes and physical layout of the operating mills affords invaluable insights into the archaeological interpretation of mill sites. Among other web sites well worth reviewing are the ones devoted to the Confederate powder mill at Augusta, Georgia (see Section II – Bragg 1997; 2001), and the British Isles’ Waltham Abbey Royal Gunpowder Mills and Ballincollig Gunpowder Mills. Researchers will find particularly useful

the archival subdirectories of the site maintain by the Hagley Museum of Wilmington, Delaware.

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### I. NITER MINING AND PRODUCTION

Aber, Israel, Jr.

1796 *The Art of Manufacturing Saltpetre by Cheap, Easy and Expeditious Methods: Compiled from Different Authors, Reduced to Practice, & c.* J. Woods, Newark, New Jersey (24 pp.; copy on file in Library of Congress; the author notes: "This art, if propagated and practiced as it might be in North America is sufficient to produce a source of wealth equal to the mines of Peru in South America"; Aber represents himself as a person "long acquainted with the method of preparing the materials, extracting, crystallizing, and refining Saltpetre"; his tract includes substantial extracts of several important papers on saltpetre manufacture, duly noted as to source, but also contains numerous phrases, sentences and entire sections within the part purported as his own work that were obviously lifted from the Essays published by the New York Committee of Safety [1776, see below], constituting outright plagiarism; on the first page, Aber notes that "I shall, in the first place, deliver my method of collecting and preparing the materials," and then presents a shortened and slightly altered version of the initial paper in the 1776 Essays, written by Dr. Benjamin Rush; all in all, Aber's pamphlet is little more than a condensed version of the 1776 Essays, omitting only the Wisner [cf. Burdge 1898] piece on gunpowder).

Académie des Sciences

1776 *Recueil de Memoires et d'Observations sur la Formation & sur la Fabrication du Salpêtre. Par les Commissaires Nommés par l'Academie pour le Jugement du Prix du Salpêtre* [Collection of treatises and observations on the formation and manufacture of saltpeter. By the Commissioners named by the Academy to judge the Saltpeter Prize]. Lacombe,

Paris (55 + 622 pp.; in French; the 1776 and 1786 [see below] research collections represent seminal work that greatly influenced not only saltpeter production in France but also throughout the world; France, traditional enemy of Britain, was almost always excluded from the Indian saltpeter trade monopoly held by the East India Company; France was thus forced to develop artificial means of production, but this critical material was always scarce; in 1774, A. R. Turgot was appointed Controller General of Finance, and, addressing gunpowder production as his first task, established the Gunpowder Commission in 1775; Turgot appointed four commissioners, including the celebrated chemist Antoine Lavoisier, and ordered the Paris Academy of Science to advertise and award cash prizes "... de trouver les moyens les plus prompts & les plus économiques de procurer en France une production & une récolte de Salpêtre plus abondantes..." [1786, Part 1, p. 11] ["to find the swiftest and most economical means to procure in France a more abundant production and harvest of Saltpeter..."]; although the judging was originally to take place in 1778, 66 papers were received and the period for submission extended to 1782; although Turgot was dismissed in 1776, Lavoisier continued to head the Gunpowder Commission; as a direct consequence of this competition, saltpeter production in France increased so dramatically that France was able to export gunpowder to America during the American Revolution; these volumes contain the best of the papers submitted; of particular note are two essays by Lavoisier [1776, Part 2, pp. 601-617; 1786, Part 1, pp. 21-30]; the 1776 essay contains Lavoisier's observations on the origin of niter; which finally placed this question on the right track; through his research on the chemistry of gases, Lavoisier concluded that



nitric acid rather than niter was the parent of the family of nitrates [see also Bret 1996; Multhauf 1971]; the 1786 essay presents a brief history of saltpeter research, the paper by the two Thouvenels was judged the overall winner in the competition [see 1786, Part Two, pp. 55-166]; the following papers appear in the 1776 volume:

Part One

- Introduction, pp. 1-48

- Table of Contents, pp. 49-55

Part Two

- Extrait des Ouvrages de Glauber, sur la Nature & la Formation du Salpêtre [Extract of Glauber's Work, on the Nature and Formation of Saltpeter], pp. 1-65;

- Premier Mémoire sur le Nitre [First Treatise on Niter], by Lemery, pp. 66-101; originally published in Lemery [1717];

- Second Mémoire sur le Nitre [Second Treatise on Niter], by Lemery, pp. 102-143; originally published in Lemery [1717];

- De la Précipitation du sel Marin dans la Fabrique du Salpêtre [On the Precipitation of Marine Salt in the Manufacture of Saltpeter], by Pourfour du Petit [1729], pp. 144-160;

- Dissertation sur la Génération du Nitre, qui a Remporté le Prix de l'Academie de Berlin [Dissertation on the Generation of Niter, Which Won the Prize of the Berlin Academy], by Pietsch [1749], pp. 161-214;

- Pensées sur la Multiplication du Nitre [Thoughts on the Multiplication of Niter], addition to above by Pietsch, pp. 215-235;

- Instruction sur la Construction & l'établissement des Nitrières, Publiée par Ordre du Conseil Royal du Département de la Guerre, a Stokholm [Instruction on the Building and Setting Up of Nitriaries, Published by Order of the War Department of the Royal Council 1747], pp. 236-283;

- Mémoire Abrégé et Pratique sur la Formation du Salpêtre [Revised Treatise and Practice on the Formation of Saltpeter], by Elia Bertrant, pp. 284-293;

- Dissertation sur la Génération du Salpêtre [Dissertation on the Generation of Saltpeter], taken from the Mémoires de la Société Economique de Berne, by Théophile-Sigismond Grunner, pp. 294-331;

- De la Nature, de la Génération & de la Plantation la Plus Avantageuse du Salpêtre [Concerning the Nature, Generation, and Most Efficient Plantation for Saltpeter], by unknown author, pp. 332-380;

- Expériences de M. Neuhaus, au Sujet de la Formation du Salpêtre [Experiments of Neuhaus on

the Formation of Saltpeter], extracted from two letters [1765] to the Société Economique de Berne, pp. 381-386;

- Extrait d'un Mémoire de M. de Vannes, Apothicaire à Besançon, sur la Nature du Nitre, sur la Manière la Plus Economique & en Même temps la Moins Onéreuse à la Franche-Comté, pour le Fabriquer en Grand: Ouvrage Couronné en 1766 par l'Academie de Besançon [Extract of a Treatise by de Vannes, Apothecary to Besançon, on the Nature of Niter, on the Most Economical and at the Same Time Least Arduous Manner, by Honest Account, for Large-Scale Manufacture, Work Honored in 1766 by the Besançon Academy], pp. 387-402;

- Extrait d'une Dissertation Suédoise, Intitulée: Examen Chimique & Economique des Moyens d'Augmenter la Fabrication du Salpêtre dans le Royaume de Suède [Extract from a Swedish Dissertation, Titled: Chemical Investigations and Economic Means to Increase the Manufacture of Saltpeter in the Swedish Kingdom], [1771], by Abraham Granit, translated from Swedish by Baer, Almoner to the King of Sweden, pp. 403-456;

- Description d'une Nitrière Artificielle [Description of an Artificial Nitriary], by de Milly, pp. 457-474;

- Mémoire sur les Méthodes Employées en Prusse & à Malte, pour la Génération du Salpêtre [Treatise on the Methods used in Prussia and Malta to Generate Saltpeter], by Ducoudray, Officer of the Royal Artillery Corps, pp. 475-491;

- Mémoire sur la Nitrière de Malte [Treatise on the Nitriary of Malta], by Desmaziz, pp. 492-513;

- L'art de Faire du Salpêtre, mis en Pratique à Dresde [The Art of Making Saltpeter, Put into Practice in Dresden], [1771], by Jean-Chrétien Simon, pp. 514-578;

- Mémoire sur la Récolte la Fabrication du Salpêtre en Asia [Treatise on the Harvest and Manufacture of Saltpeter in Asia], by Clouet, pp. 579-584;

- Manière Dont se Fait la Poudre dans l'Inde [Manner in Which Powder is Made in India], by Clouet, pp. 585-586;

- Extrait d'un Ouvrage de M. Bowles, Publié à Madrid en 1775, sous le Titre d'Introduction à l'Histoire Naturelle & à la Géographie Physique de l'Espagne [Extract of a Work by Bowles, Published in Madrid in 1775, subtitled Introduction to the Natural History and Physical Geography of Spain], pp. 586-597 [see also Bowles 1829];

- Méthode de Fabriquer le Salpêtre en Amérique [Method of Manufacturing Saltpeter in America], [1775], pp. 597-600;

- Sur l'Existence de l'Air Dans l'Acide Nitreux, & sur les Moyens de Décomposer & Recomposer cet

Acide [On the Existence of Nitric Acid in the Air, and on the Means to Decompose and Recompose this Acid], by Lavoisier, pp. 601-617;

- De la Manière de Fabriquer le Salpêtre en Chine [Concerning the Manner of Manufacturing Saltpeter in China], by d'Incarville, pp. 618-622.

1786 *Recueil de Mémoires et de Pièces sur la Formation et la Fabrication du Salpêtre* [Collection of Treatises and Documents on the Formation and Manufacture of Saltpeter]. *Mémoires de Mathématique et de Physique*, Vol. 11, Moutard, Paris (196 + 636 pp.; in French;

Part One: Histories

- Extrait des Registres de la Commission nommée par l'Académie des Sciences pour le Prix proposé sur la formation du Salpêtre [Extract of the Commission Records named by the Academy of Sciences for the Prize on the formation of Saltpetre], pp. 1-4;

- Programme du Prix proposé pour l'année [Program of the Prize proposed for the year], pp. 5-12;

- Extrait détaillé du Rapport Fait à M. le Contrôleur Général des Finances, sur les Pièces qui ont Concouru en 1776, Pour le Prix Proposé par l'Académie de Resançon [Extract Detail of the Report Made by the Controller General of Finances, on the Documents Which Were Compiled in 1776, for the Prize Proposed by the Academy of Resançon], pp. 13-20;

- Extrait de recueil de mémoires & d'observations sur la formation & la fabrication du salpêtre [Extract of the collection of treatises and observations on the formation and manufacture of saltpetre], by Macquer, Darcy, Lavoisier, Sage, and Baume (1776), pp. 21-30;

- Extrait de l'Instruction, publiée en 1777 [Extract of the instructions published in 1777], by the Régisseurs des Poudres, pp. 31-187;

- Extrait de quelques Ouvrages & Mémoires relatives à la fabrication du Salpêtre, qui ont rédigés pendant le Concours ou depuis la proclamation du Prix [Extract of some works and treatises relating to the manufacture of Saltpetre, which have been drafted pending the Concourse or since the proclamation of the Prize], pp. 188-192;

- Observations sur des terres & pierres salpêtre [Observations on the saltpetre earths and stones], by the Duke de la Rochefoucauld, Clouet, and Lavoisier, pp. 192-196.

Part Two: Treatises

- Mémoire sur la Formation du Salpêtre, & sur les Moyens d'Augmenter en France la Production de ce Sel [Treatise on the Formation of Saltpetre, and on the Means to Increase the Production of this Salt in

France], by Cornette, pp. 1-54;

- Mémoire Chimique & Economique sur les Principes & la Génération du Salpêtre. Ouvrage qui a Remporté le Prix Royal, au Jugement de l'Académie des Sciences [Chemical and Economic Treatise on the Principles and the Generation of Saltpeter. Work which Won the Royal Prize, in the Judgement of the Academy of Sciences], by Thouvenel and Thouvenel, pp. 55-166;

- Recherches sur la Formation & la Multiplication des Nitres [Researches on the Formation and Multiplication of Niters], by de Lorgna of the Republic of Venice, pp. 167-267;

- Mémoire qui a Partagé le Second Prix sur la Formation & sur la Fabrication du Salpêtre [Treatise Which Shared the Second Prize on the Formation and Manufacture of Saltpetre], by Gavinet and Chevrand, pp. 268-322;

- Observations sur les Moyens d'Augmenter la Récolte du Salpêtre en France [Observations on the Means to Increase the Harvest of Saltpetre in France], by Chevrand, pp. 323-370;

- Dissertation sur le Salpêtre, avec Quelques Idées sur la Nitrification, ainsi que sur la Manière d'Augmenter Considérablement la Récolte du Salpêtre [Dissertation on Saltpetre, with some Ideas on Nitrification, as Well as on the Manner to Greatly Increase the Harvest of Saltpeter], by J. B. de Beunie; pp. 371-398;

- Essai sur les Moyens de Faire Générer le Salpêtre en Abondance & Avec la Plus Grande Economie [Essay on the Means to Generate Saltpetre in Abundance and with Very Great Economy], by Count Thomassin de Saint-Omer, pp. 399-420;

- Mémoire sur la Formation & la Fabrication du Salpêtre, Présenté pour Concourir au Prix Proposé par l'Académie Royale des Sciences de Paris [Treatise on the Formation and Manufacture of Saltpetre, Presented in Competition for the Prize Proposed by the Royal Academy of Sciences of Paris], by Romme, pp. 421-502;

- Mémoire sur des Terres Naturellement Salpêtrées, Existantes en France, lu à l'Académie, le 5 Juillet 1777 [Treatise on the Natural Saltpetre Earths, Existing in France, Read for the Academy, 5 July 1777], by Clouet and Lavoisier, pp. 503-570;

- Mémoire sur des Terres & Pierres Naturellement Salpêtrées dans la Touraine & dans la Saint Onge [Treatise on the Natural Saltpetre Earths and Stones in Touraine and Saint Onge], by Clouet and Lavoisier, pp. 571-609;

- Mémoire sur la Génération du Salpêtre dans la Craie [Treatise on the Generation of Saltpetre in Chalk], by Duke de la Rochefoucauld, pp. 610-624;

- Expériences sur la Décomposition du Nitre par le Charbon [Experiments on the Decomposition of Nitre by Carbon], by Lavoisier, pp. 625-632;
  - Mémoire sur la Fabrication Artificielle du Salpêtre [Treatise on the Artificial Production of Saltpetre], pp. 633-636
- Agricola, Georgius
- 1950 *De Re Metallica*. Dover Publications, Inc., New York (originally published 1556; 1950 reprint of 1912 translation from Latin by Herbert C. Hoover and Lou Henry Hoover) Agricola's classic work was the definitive text on methods and materials for miners and metallurgists for nearly two centuries; the Hoover translation contains extensive annotations; the volume contains several brief sections on the production of saltpeter and its metallurgical applications, notably as a flux; of particular interest is a woodcut illustration of saltpeter manufacture).
- Åhslund, Bengt
- 1975 *A Rural War Industry: The Impact of Saltpetre Production in Sweden*. International Commission for Military History: ACTA No. 2. Washington, D.C. (Åhslund investigates the impact of the production of a war material – saltpeter – on a pre-industrial, primarily agricultural society, relative to the national economy; peasants were obligated to supply saltpeter soils from their barnyards to the government, or pay a cash substitute if too distant; about 1637, niter production was organized into a paramilitary corps known popularly as the Crown Boilers, entitled to visit farms and remove the soils, which had been designated Crown property; as Swedish influence and territory expanded in the late 17<sup>th</sup> century, this system of saltpeter manufacture was introduced through much of the Baltic region; despite increasing regimentation, niter production gradually declined until a thorough reform was instituted in 1800; the Crown relinquished ownership of saltpeter soils, abolished the Crown Boilers, and required annual delivery of finished niter from peasants; this new system proved a failure and a more successful system implemented in 1811 whereby farmers were given a good price for their voluntarily supplied niter produced with technical aid from trained government personnel; Åhslund notes that the obligation to furnish and transport, first, saltpeter ingredients and later finished niter imposed a heavy burden on Swedish farmers, diverted their labors from agriculture, and subjected them to abuses from the corps of Crown Boilers).
- 1996 The Saltpetre Boilers of the Swedish Crown. In: *Gunpowder: The History of an International Industry* (Brenda J. Buckman, editor), pp. 163-181. Bath University Press, Bath, U.K. (Åhslund revisits saltpeter production in Sweden, covering much of the same ground as in Åhslund [1975] but focuses in greater detail upon the activities of the so-called "Crown Boilers" or saltpeter-makers who worked strictly for the Swedish government from the mid-17<sup>th</sup> to the beginning of the 19<sup>th</sup> centuries; the author has identified 7,200 of these niter-workers who plied their trade during the period 1630-1700; more than half of the saltpeter boilers were residents of the Kronoberg area of Smålan).
- "Americus" (sic)
- 1871 The Annexation of San Domingo. *The Galaxy* 11(3; March):410-421, New York (notes [pg. 412] that within the Dominican Republic: "The country abounds in rich ... deposits of nitre").
- Anonymous
- 1644 *An Ordinance of the Lords and Commons, Assembled in Parliament, for the Making of Salt-Peter, Within the Kingdom of England, and Dominion of Wales, for the Preservation and Safety of the Kingdom*. Printed for Edward Husbands, London (8 pp.; reproduction of original in Thomason Collection, British Library; University Microfilms, 1967; Early English books, 1641-1700; 235:E.40, no. 24; University of Kentucky Library, Microfilm B77-100, Reel 235, Lexington, Kentucky; this ordinance was intended to encourage saltpeter production in England, because "the great expence of Gunpowder, occasioned by the present Warre within His Majesties Dominions [the English Civil War, 1642-1660], hath well neer consumed the old store... whereas forraign Salt-Peter is not equall in goodnesse with that of our own country, and the forraign Gunpowder far worse conditioned, and lesse forceable than that which is made in England... whereas divers forraign Estates have of late prohibited the exportation of Salt-Peter and Gunpowder, out of their own Dominions and countries... which will inforce us to make use of our own materials"; by the provisions of the 1644 ordinance, persons appointed by the government shall have authority to search and dig for saltpeter on private property, to occupy outbuildings as needed for their work, and to commandeer carts and wagons for saltpeter transport; any person who refuses to allow the saltpetermen to search or dig on their premises is subject to the process of law; on their part, the saltpeter-makers are obligated to restore property to its former condition at conclusion of their work, and are liable for any damages).
- 1810 The Subterranean Voyage, or the Mammoth Cave Partially Explored. *The Enquirer* April 20, pg. 6, Virginia (cited in De Paepe and Hill 1981; likely the earliest published account of this well known Kentucky



- cave, the author notes "...it is arched over by a large ledge of rocks from which issues a clean fountain; from this the workmen are supplied with a sufficiency of water for their saltpeter works").
- 1827 Travels in La Plata and Chile. *The North American Review* 24(55; April):295-321, Cedar Falls, Iowa (of interest is the remark [pg. 302] "The regions of the Pampas [in Argentina] are uncommonly salubrious, particularly the parts toward Mendoza. The soil is here strongly impregnated with saltpetre...").
- 1831 The Kentucky Cavern. *The New-England Magazine* 1(3; September):275-276, Boston (though not mentioned by name, this piece obviously describes Mammoth Cave in Edmonson County, Kentucky; it is observed [pg. 275] that "Formerly, when this cavern was first discovered, this part of it [the mouth of the cave] was nearly filled with earth, which has been recently manufactured into saltpetre"; it is further noted that in another part of the cave "This part of the cave is called the First Hopper. The soil at the bottom of the cave is very light, and strongly impregnated with [niter] salt").
- 1845 Biographical Sketch of Gen. Joseph Palmer. *The New Englander and Yale Review* 3(9; January):1-23, New Haven, Connecticut (this study reports [pg. 1] that Joseph Palmer was born in England and migrated as a wealthy young man to America in 1746; on a tract of land in Braintree, Massachusetts, he subsequently constructed [among other enterprises] "...a salt manufactory, in which were made common salt, medicinal salts, and saltpetre").
- 1852 The Underground Territories of the United States. *International Monthly Magazine of Literature, Art, and Science* 5(1; January):17-28, New York (a lesser heralded early travelogue of Mammoth Cave, Kentucky; includes 7 well done engraved illustrations though none depict niter mining; the only brief mention of mining activities is the comment [pg. 19] "The entrance of this wide [natural] arch is somewhat obscured by a large mound of saltpetre, thrown up by workmen engages [sic] in its manufacture, during the last war").
- 1856 The Wyandot Cave of Indiana. *The Living Age* 50(644; September 27):796-798, New York (while largely descriptive of the cave's natural features, the author notes [pg. 796] "Dr. Adams of Corydon [Indiana], who was the former owner of the cave, once drove a thriving business here, in the manufacture of this [Epsom] salt and saltpetre").
- 1857 The Commercial Result of an Improved Policy in India. *The Living Age* 55(704; November 21):499-501, New York (a very informative glimpse into the extent of saltpeter production in early 19<sup>th</sup> century India; notes [pg. 501] that during the period 1834-1835, 490,554 lbs. of saltpeter were shipped from Calcutta while for the period 1855-1856, 787,278 lbs. were shipped from the same port).
- 1860 Mammoth Cave in Missouri. *The Living Age* 66(845; August 11):334, New York (this brief article notes: "The cave is in Phelps County, one and three-quarters of a mile from the Gasconade River, on a creek called Cave Spring Creek, in township 38, section 21, range 9 west. We went into the cave... [and] passed into the left gallery, which ascends nearly twenty feet on a bed of saltpetre. This galley is called the Dry Chamber, and is about five hundred feet in height [sic; should read length]; the height varies from one hundred to about thirty feet").
- 1862 Saltpetre as a Source of Power. *Atlantic Monthly* 9(55; May):587-593, Boston (easy to understand discussion of the various types of saltpeter and sources for same; of note is the remark [pg. 590] that "Under the most favorable conditions of abundance of labor, obtainable at a low price, potash saltpetre can be made [from cave earth] at a cost about one-fourth greater than the average price of India saltpetre").
- 1863a *The Stranger's Guide and Official Directory for the City of Richmond, Showing the Location of the Public Buildings and Offices of the Confederate, State and City Governments, Residences of the Principal Officers, Etc.* Geo. P. Evans & Co., Printers, Whig Building, Richmond (of note is the remark [pg. 14] "Nitre and Mining Bureau — I. M. St. John, Sup't. Office, on Bank, st., near 9<sup>th</sup>, (in newly painted brick houes [sic])").
- 1863b Monthly Record of Current Events. *Harper's New Monthly Magazine* 26(154; March):557-562, New York (as gleaned from correspondents or newspapers in the South, it is noted [pg. 560] that: "Mr. St. John, the superintendent of the nitre and mining bureau, offers to purchase 1000 tons of nitre, to be paid for in Confederate notes or bonds at the rate of 90 cents a pound if delivered at any port east of the Mississippi River, or 50 cents if delivered at any port between the Rio Grande and the Mississippi").
- 1864 Life on a Blockader. *Continental Monthly: Devoted to Literature and National Policy* 6(1; July):46-55, New York (authored by "one of the squadron off Wilmington [NC]," this rare insight into both the tedium and high adventure aboard a US navy blockader observes [pg. 53] "We steam alongside, and learn that our prize is the schooner *St. George*, bound for Wilmington, via the Bermudas, with a cargo of ...saltpetre, etc., and worth perhaps four thousand dollars").
- 1871 Information on Potash and Saltpetre. *The Manufacturer and Builder* 3(5; May):107-108,

- New York (general comments on the chemistry of saltpeter; notes [pg. 107] "...saltpetre consists of one equivalent of potash and one of nitric acid...").
- 1877 Editor's Scientific Record. *Harper's New Monthly Magazine* 55(329; October):790-795, New York (notes [pg. 795] "Important discoveries of nitre deposits in Chili [Chile] are announced by Señor Vadilla, government agent, at a place called Cachinal de la Sierra").
- 1878a Editor's Scientific Record. *Harper's New Monthly Magazine* 57(339; August):469-475, New York (notes [pg. 471] "Warrington has given in *Nature* a statement of the new theory of nitrification proposed by Schloesing and Müntz, which completely confirm those of the French chemists. According to their view, nitrification, instead of being brought about by purely chemical forces, is, in fact, the work of a living organism. In proof of this, they show that the process, however active, is stopped at once by the vapor of chloroform, and also by a temperature of boiling water. It must therefore be that the production of nitre in the soil is due to oxidation brought about by these living mycoderms").
- 1878b Decision of the Supreme Court of Tennessee that the Confederacy was *de jure* as well as *de facto* – Opinion of Judge Turney. *Southern Historical Society Papers* 5(6):288-291 (recounting of an 1872 court case involving an 1861 loan of \$600 made by the Branch Bank of Tennessee to an entrepreneur to establish a saltpeter manufactory; following the war, the debtor maintained he was not obligated to repay the loan since it was for the purpose of producing goods for a belligerent power; the court determined that the Confederate government was a *de facto* legal authority, the contract for producing saltpeter was valid, and the money should be repaid to the lender. Europe for the manufacturer of gunpowder").
- 1881 Niter Deposits in the Far West. *The Manufacturer and Builder* 13(10; October):227, New York (brief discussion of discovery of niter deposits in an unspecified state in the western United States; includes comments on the commercial uses of niter apart from gunpowder).
- 1884 American Geographical Society's Bulletin (No. 1). *The Atlantic Monthly* 54(321; July):110-117, Boston ("There is a certain strip of land bordering upon the Pacific and about four hundred miles long, of which the northern three-quarters belonged to Peru and Bolivia, the remaining quarter to Chile. Upon this land a heavy rain never falls and often years pass in which the soil does not feel a shower. ... Yet this hideous region blooms and blossoms like a rose in the eye of the capitalist and economist. Its money value is immense. From this region the world derives almost its whole supply of nitrates – chiefly saltpetre... The nitrate-bearing country is a plain, from fifty to eighty miles wide, the nitrate lying in layers just below a thin sheet of impacted stones, gravel, and sand. The export of saltpetre from this region was valued in 1882 at nearly \$30,000,000, and the worth of the Peruvian section, which is much the largest and most productive, is estimated, for government purposes, at a capital of \$600,000,000").
- 1887 A Girl's Life Eighty Years Ago. *Scribner's Magazine* 2(1; July):67-86, New York (of note is the comment [pg. 68] that: "[Dr. Robert Southgate of Scarborough, likely in New York] ... held a position under the English government and [was] ... accused of sympathizing too warmly with it, before and during the Revolutionary War, in spite of the fact that Dr. Southgate was at the time engaged in the manufacture of saltpetre for the supply of the American troops").
- 1891 Niter Deposits of the Pacific Coast of South America. *The Manufacturer and Builder* 23(10; October):240, New York (primarily exported to England and the United States, Chilean nitrates were used at the time for producing both saltpeter and nitric and sulfuric acids).
- 1903 S. K. Phillips. *Confederate Veteran* 11(11):516 (obituary; during the Civil War, Phillips served as chief clerk and disbursing officer for CSA Gen. Gabbott of the Nitre and Mining Bureau).
- 1906 Gunpowder for the Confederacy. *Confederate Veteran* 14(3):119-120 (summary of information provided by Mr. William L. Marrs who described working as a CSA laborer in niter mines in Carroll County, Arkansas, and New Braunfels and Rio Frio, Texas, where production reached 600 lbs. of saltpeter per day).
- 1911 Clarence H. Williamson. *Confederate Veteran* 19(9):437 (death notice; Mr. Williamson served with the CSA Nitre and Mining Bureau beginning in April 1863).
- Bailey, Thomas L.
- 1918 Report on the Caves of the Eastern Highland Rim and Cumberland Mountains. *Resources of Tennessee* 8(2):85-138. Tennessee Geological Survey, Nashville (Bailey visited more than 100 caves to determine if saltpeter extraction was a viable undertaking as a contribution to the military efforts associated with World War I; he concluded that while this material could still be produced, the relatively low yield of the process was not competitive with Chilean nitrates or the nitrogen



fixation method; nitrate percentages in the analyzed soil samples ranged from almost zero to as high as 2.39%).

Ballou, Maturin Murray

1855 (untitled figure). *Drawing Room Companion* 8(20; May 19):309. Boston (illustration of the War of 1812 era wooden pump tower at Booth's Amphitheater portion of Mammoth Cave; this pump was used to transport nitrated "liquor" to the evaporation kettles at the mouth of the cave; figure reproduced in De Paepe 1985:19).

Barr, Thomas C., Jr.

1961 Caves of Tennessee. *Bulletin* No. 64, Division of Geology, Tennessee Department of Conservation and Commerce, Nashville (notes on historic saltpeter mining in various caves within the state; see particularly "Big Bone Cave" pp. 451-460; reprinted 1972; 567 pp.).

Barrett, John

1897 The Cuba of the Far East. *The North American Review* 164(483; February):173-181, University of Northern Iowa, Cedar Falls (in discussing the natural resources of the Philippine Islands, at that time still a Spanish colony, Barrett notes [pg. 179] "The minerals include ...sulphur, and saltpetre"; it is tempting to speculate that these materials could have been produced in the Philippines, transported to Mexico or Cuba, and sold to the Confederates).

Baume, Antoine

1773 *Chymie Expérimentale et Raisonnée* [Analytical and Experimental Chemistry] (3 vols.). Didot, Paris (a large portion of Volume III of Baume's work is concerned with chemical reactions involving niter; in a section entitled simply "Sur le Nitre" [Concerning Nitre, pp. 589-598], he focuses specifically upon its nature and origin; Baume examines the various factors involved in niter formation: the presence of organic material in a state of decomposition, the presence of calcereous earths, and the influence of air and humidity; he concludes that niter is derived from the interaction of all of these factors).

Beckmann, John

1846 *A History of Inventions, Discoveries, and Origins* (2 vols.; translated by William Johnston, 4<sup>th</sup> edition.), H. G. Bohn, London (see chapter entitled "Saltpetre. Gunpowder. Aquafortis", Vol. II, pp. 482-512; originally published in German in 1797; Beckmann begins with a lengthy discussion as to whether the ancient Greeks and Romans were acquainted with saltpeter, and concludes that it is unlikely that the "nitrum" of the ancients is the same as the substance known to moderns as saltpeter; the first certain mention of saltpeter, Beckmann

believes, is to be found in the writings of Roger Bacon and Albertus Magnus in the 13<sup>th</sup> century; he accepts the opinion that gunpowder was invented in India and brought to Europe by the Arabs by way of Africa; Beckmann very cursorily describes the methods of processing saltpeter and making gunpowder).

Bird, Robert Montgomery

1837 The Mammoth Cave of Kentucky. *American Monthly Magazine*, May-June issue, New York (of particular note is an illustration [reproduced in Faust 1967; De Paepe 1985:17; and De Paepe and Hill 1981:7] of the mouth of Mammoth Cave showing part of the wooden log piping systems used in the niter leaching process and Bird's remarks that "...two tottering chimneys of stone, behind the cottonwood tree on the right, the ruins of [the] old saltpetre works").

Blair, Larry O.

1886 Four Who Visited Nickajack During the War Between the States. *National Speleological News* 44(7):269-273 (during the Civil War, a major processing operation was established in Nickajack Cave downstream from Chattanooga, Tennessee, which became one of the most important sources of nitrates for the Confederate war effort; Blair presents documentary evidence linking four men to this site who visited there or were employed at the cave during the time of mining operations; see also Barr 1961:395-306; Cornelius 1819; Shapard 1857).

Blatchley, W. S.

1897 Indiana Caves and Their Fauna. *Annual Report* No. 21, pp. 121-212. Indiana Department of Geology and Natural Resources, Indianapolis (in the course of fieldwork conducted in the 1890s, Blatchley noted [pp. 173-174] the remnants of saltpeter workings at Saltpeter Cave - about one-half mile north of better known Wyandotte Cave [also worked for saltpeter] - in Crawford County, Indiana; these workings likely dated to the War of 1812).

Boatman, Roy M.

1958 Indian Saltpeter. Typescript on file, Hagley Museum and Library, Wilmington, Delaware (a brief account of the manufacture of saltpeter in the Bengal Region of British India, based in large part upon Leather and Makurji [1911]).

Boerhaave, Herman

1727 *A New Method of Chemistry: Including the Theory and Practice of That Art: Laid Down on Mechanical Principles, and Accommodated to the Uses of Life: The Whole Making a Clear and Rational System of Chemical Philosophy: To Which is Prefix'd a Critical History of Chemistry and Chemists, from the Origin of the Art to the Present*

*Time* (1st English edition, 2 volumes, translated from Latin by P. Shaw and E. Chambers with additional notes and index). J. Osborn and T. Longman, London (xvi + 383 [Vol. I] + 335 [Vol. II] pp.; Boerhaave's "new system" of chemistry divides substances into three classes: fossil, vegetable, and animal; his use of the term "fossil" is not comparable to modern usage; by this word he means, in general, mineral substances; these classifications are related to the manner of growth of each of these separate bodies, in terms of their complexity and their relation to the earth; fossils "grow adhering to the earth" and are "simple and homogenous," having no "distinction of parts" [I, pg. 54]; vegetables, by contrast, also grow adhering to the earth but have distinct parts; lastly, animals also have distinct parts but are not of the earth; fossils are further divided into "simple" kinds, Metals, Salts, Stones, Earths, and compound fossils including Sulphurs and Semi-metals; the category Salts, of course, includes saltpeter; of saltpeter, Boerhaave notes that it originates in three different ways: in limestones or in the mortar of old buildings; dug up in a "fat" soil such as those of India; or from places where animal excrements have long resided; though having only little to say on sources of saltpeter, Boerhaave presents very detailed instructions for refining [II, pg. 235]; if the presence of contaminants is suspected, he recommends boiling the "lixivium" with a small portion of fixed alkali [potash], skimming it, and filtering it again; when a "pellicle" [a thin saline crust] appears on the surface of the liquor, "place several small sticks in the vessel below the liquor, and set it in a cool place to shoot [crystals]"; "No salt runs into crystals so soon as nitre," he notes, and "Crystallization, therefore, is an incomparable method of separating one salt from another").

Boggs, William R.

1913 *Military Reminiscences of Gen. Wm. R. Boggs, C.S.A.* (Introduction and Notes by William K. Boyd). Seeman Printery, Durham, North Carolina (Boggs remarks [pp. 32-33] that following consultation with the governor of Georgia, "It was determined that I should visit the mines, nitre caves and foundries in upper Georgia, for the purpose of ascertaining if State control or aid would facilitate the working of them. Very soon after my inspection and before any decided action had been taken, the Nitre and Mining Bureau of the Confederate Government was created").

Borresen, Thor

1941 Report on the Remains of the Old Saltpetre Works, Within Mammoth Cave, Kentucky. Typescript on file, National Park Service

Headquarters, Washington, DC. (13 pp.; in November 1940, Borresen visited Mammoth Cave to assess the condition of the 1812-era saltpeter works and recommend methods of preserving them from further deterioration; he provides a brief history of the cave and mining operations based on the local Park Service files, then addresses the condition of the mining works; much of the original works were missing, some through natural decay but much also through carelessness and abuse; Borresen urges establishment of a program for protection of the remaining artifacts without delay, noting, however, that no large scale restoration should be undertaken; the most important first step should be to erect a railing to prevent visitors from walking or climbing on the wooden remains, and to replace wood pipes in their original positions from where they have been cast aside; much of the wood appears sound on the exterior surfaces, he notes, but is thoroughly decayed from dry rot on the inside; he recommended an archaeological survey of the artifacts and testing various timbers to estimate the necessary types and amount of chemical treatments; Borresen further recommended that the tour through the sections of cave where the saltpeter works exist should focus upon history rather than scenery and that guides should be trained in historical interpretation).

1942 Report on the Present Conditions of the Leaching Vats, Saltpeter Works, Mammoth Cave National Park, Kentucky. Typescript on file, National Park Service Headquarters, Washington, DC (14 pp. + 6 pp. of attached correspondence; while Borresen's 1941 report was based upon initial impressions, this later report represents investigation in much greater depth; Borresen reiterated his appeal for immediate attention and application of preservatives, focused upon vats and wooden pipes; depending upon the type and location of artifact, preservatives might be applied by brush, spray, or dip; he advises strongly against excavating any of the vats in order to treat buried portions, as this would destroy the natural appearance and formations of the soil; of particular interest in this report is attached correspondence between Borresen and the Forest Products Laboratory in Wisconsin, to which wood samples from the artifacts had been submitted for evaluation; unfamiliar with the cave, the Wisconsin lab made some recommendations which must have secretly amused Borresen; to their suggestion that the entire saltpeter works be enclosed in a glass climate-controlled chamber, in reply he noted the aesthetic and practical disadvantages of erecting such a structure though more than a mile of cave passage; to the suggestion

that vats be removed entire and soaked in a preservative solution, he observed that such undertaking would be very difficult given the large size of the artifacts; Borresen's reports were instrumental in stimulating efforts to preserve the remaining mining artifacts in Mammoth Cave, and are also significant to the modern historian by providing a detailed snapshot of the extant remnants; the report refers to attached photographs, plans and drawings which were not available to this reviewer).

Bowles, Don Guillermo

- 1829 On Making Saltpetre in France, and in Spain. *Journal of the Franklin Institute* 8:305-307 (this account includes a fairly detailed description of saltpeter manufacture in Paris: "The rubbish and filth of old houses is carried to the works, and pounded with hammers" then mixed with wood ashes and water, and boiled to crystallization; according to the writer, the abundance of nitrates in the soils of Spain – "a third part of all the lands, and the very dust on the roads in the eastern and southern parts of the kingdom" – could supply the world; in the nitrate regions, the earth near the villages was plowed two or three times in winter and spring; the soil was then placed into containers of various sizes, the nitrate concentration leached out with water, and the soil replaced on the fields to regenerate saltpeter; Bowles relates the comments of a Spanish farmer: "I have two fields. I sow one with corn, and have a crop; I plough the other, and it furnishes me saltpetre!").

Boyd, Julian P.

- 1950 *The Papers of Thomas Jefferson 1760-1776*. Falls Church, Virginia (numerous letters concerning saltpeter and gunpowder).

Boyle, Robert

- 1772 *The Works of the Honourable Robert Boyle, in Six Volumes, to Which is Prefixed the Life of the Author*. London (of particular interest is the chapter entitled "A Physico-Chymical Essay, Containing an Experiment, with Some Considerations Touching the Differing Parts and Redintegration of Salt-Petre" in Vol. I, pp. 359-376; Boyle obtained a sample of saltpeter from a druggist and, after dissolving it and causing it to precipitate into its crystalline form, repeatedly ignited it until it would burn no more; then dividing it into two parts, he dissolved one part in water; to both substances he added "spirit of nitre" (nitric acid) and, observing the form of the crystals which subsequently appeared, concluded that the newly formed substance was saltpeter; saltpeter was thus "produced by the coalition of two bodies, which are neither of them inflammable; the one being a fixed salt... the other being a spirit

abounding with acid particles" [pg. 367]; Boyle's experiment had previously been conducted by Glauber [1689]).

Brown, Samuel

- 1806 A Description of a Cave on Crooked Creek, with Remarks and Observations on Nitre and Gunpowder. *American Miner Journal* 1:100-113 (see also following article).
- 1809 A Description of a Cave on Crooked Creek, with Remarks and Observations on Nitre and Gunpowder. *American Philosophical Society Transactions* o.s. 6(39):235-247 (Brown's classic article is perhaps more likely than any other to be cited in scholarly works on saltpeter and gunpowder; Brown, a physician and entrepreneur in Lexington, Kentucky, purchased Great Saltpeter Cave in 1804; the large niter processing operation established there, designed and built by Swiss immigrant Dufour, was used as a model for the works constructed later by Charles Wilkins at Mammoth Cave; Brown describes the nitrate production process at his cave, and notes that nitrates may be found not only in many caves but also, in greater quantity, in the sandstone rock shelters of eastern Kentucky; a significant portion of the paper is devoted to theorization on the origin of niter).
- 1819 On a Curious Substance Which Accompanies the Native Nitre of Kentucky and of Africa. *American Journal of Science* 1(2):146-148 (Brown recalls a black substance of "a bituminous appearance and smell" that he observed in a sandstone rockhouse in Kentucky that had been mined for niter, and notes mention of a similar material, reported by Barrow, in an African cave; whereas Barrow attributes the origin of niter in the cave to this material, Brown does not believe there is a derivative connection.)

Bullitt, Alexander Clark

- 1845 *Rambles in the Mammoth Cave During the Year 1844*. Morton & Griswold, Louisville (reprinted 1985, Cave Books, St. Louis; see pp. 20-21 for a brief discussion of the War of 1812 saltpeter mining efforts in this well known Kentucky cave; on pg. 20, Bullitt records "...the ruins of the old nitre works, leaching vats, pump frames and two lines of wooden pipes; one to lead fresh water from the dripping spring to the vats filled with the nitrous earth, and the other to convey the lye drawn from the large reservoir, back to the furnace at the mouth of the cave").

Calvert, M. A.

- 1961 The Search for a Domestic Source of Saltpeter for Use in Making Gunpowder, 1620-1920. Master's



thesis, University of Delaware, Newark (a well-documented scholarly work that traces the American effort to produce nitrates for gunpowder manufacture from the colonial era until gunpowder was superseded by smokeless powder early in the 20<sup>th</sup> century; as Calvert notes [pg. 32]: "The tremendous advances in industrial chemistry in the nineteenth and twentieth centuries finally dispossessed the ancient trade of saltpeterman and ended a long and unrewarding search for an American source of saltpeter. The amazing thing is that so much effort and energy should have been expended in such fruitless endeavor with so few results over so long a period of time"; 52 pp.).

Chapman, Mary

1970 Pendleton County's Saltpeter Caves and Their Role in the Civil War. *Karst Caver* 4(4), Monongahela Grotto, National Speleological Society (summary of CSA niter mining efforts in Pendleton County, West Virginia).

Chesnut, Mary Boykin

1905 *A Diary from Dixie* (Isabella D. Martin and Myrta Lockett Avery, editors). D. Appleton and Company, New York (as the wife of a prominent Confederate official, Chesnut's insights on the status and workings of the Confederacy are particularly insightful; she observes [pg. 215] in her diary entry for August 8, 1862, "What has not my husband been doing this year, 1862, when all our South Carolina troops are in Virginia? ... He laid the foundations of a nitre-bed; and the Confederacy sent to Columbia [South Carolina] to learn of Professor LeConte how to begin theirs"; this is apparently the same "nitre plantation" the governor and legislature of South Carolina agreed to sell to the Confederate government in December 1863 [see State of South Carolina 1863; see also E. LeConte 1938]; later printings of Chesnut's diary have appeared).

Claridge, G. G. C. and I. B. Campbell

1968 Origin of Nitrate Deposits. *Nature* 217:428-430 (soil surveys conducted by the authors during 1964-1965, along the western margin of the Ross Sea and Ross Ice Shelf, indicated widespread occurrence in Antarctica of nitrate salts derived from various parent materials; sulfate salts and nitrates of sodium, calcium and magnesium and traces of iodate manifested as distinct horizons, on the Roberts Massif, and as nodules evenly distributed through the soil, at the McGregor Glacier junction; Claridge and Campbell attribute the differences in composition, amount and distribution of the salts in the soils to the marked climatic differences between the two locales; previous research has shown that Antarctic snowfall contains small quantities of

nitrogen in the form of nitrate; according to the authors [pg. 429], "We believe that the compounds of nitrogen, sulphur and iodine in tropical and temperate regions [derived from the ocean surface] are transported to the polar regions by the atmosphere in the course of circulation to maintain the permanent anticyclone induced by the altitude of the Antarctic continent and which is centered over the continent; during transport, they are oxidized to nitrates, sulphates and iodates; the greater part of these compounds are removed with atmospheric precipitation"; Claridge and Campbell theorize that nitrate and other salts are in fact distributed by the atmosphere worldwide, but only in extremely arid regions such as the Chilean desert or the Antarctic Continent, where there is nearly a complete absence of biological activity or leaching, can nitrate salts accumulate in large quantities; see also Mueller 1968).

Collins, Lewis

1847 *Historical Sketches of Kentucky*. Lewis Collins, Maysville, Kentucky, and J. A. & U. P. James, Cincinnati (reprinted 1968 as *History of Kentucky* by Henry Clay Press, Lexington, Kentucky; brief discussion of saltpeter mining in Big [Great Saltpeter] Cave in Rockcastle County, Kentucky, during War of 1812; see pp. 500-501).

Cornelius, Elias

1819 On the Geology, Mineralogy, Scenery and Curiosities of Parts of Virginia, Tennessee, and the Alabama and Mississippi Territories, &c. with Miscellaneous Remarks, in a Letter to the Editor. *American Journal of Science* 1(3):214-226 and 1(4):317-331 (in the continuation of this two-part article, Cornelius notes the presence of numerous caves, and presents a detailed account of the "Nicojack" Cave in Georgia [in actuality, in Tennessee; see description of Nickajack Cave in Barr 1961:305-306]; according to the author, Nicojack, like many other regional caves, contains abundant deposits of saltpeter from two distinct types of earth, a clay soil and a black soil, the latter is more richly impregnated with nitrates; Cornelius describes mining and processing of saltpeter, and observes that if spent earth is replaced in the cave, it becomes replenished with nitrates "in a few months"; like Kain [1819], whose writings he acknowledges, Cornelius attributes the formation of saltpeter to the decomposition of animal remains and particularly to the practice of Native American cave burials; see also Blair 1986; Shepard 1857).

Coxe, Tenche

1814 *A Statement of the Arts and Manufactures of the United States of America for the Year 1810*.

Philadelphia (this compilation provides a statistical summary, for states and for individual counties within states, of the quantities and value of certain American manufactures – individual firms, however, are not identified; during 1810, Kentucky led in saltpeter manufacture with 47% of total production, followed by western Tennessee and Virginia; in gunpowder, Maryland, Pennsylvania, and Delaware were top producers, accounting for more than 60% of total U. S. production; Coxe's report is based upon the 1810 U. S. Census of Manufacturers [see below, under archival sources] and underreports actual production because response to the census was sketchy at best).

Coy, Fred E., Tom Fuller, Larry Meadows, Don Fig, Jim Rosene, and Garland Dever

1984 Samuel Brown on Saltpeter from Sandstone Cliffs in Eastern Kentucky in 1806. *Tennessee Anthropologist* 9(1):48-65 (examines an early study of saltpeter deposits in the caves and rock shelters of eastern Kentucky; see also Brown [1806; 1809]).

Craig, Benjamin F.

1862 Report on Nitrification, Presented to the Smithsonian Institution in 1858. *Annual Report of the Board of Regents of the Smithsonian Institution for 1861*, pp. 305-318. Washington (conventional wisdom at the time of Craig's writing held that nitrates derived primarily from the decomposition of organic material, producing ammonia which combines with mineral bases such as lime or potassium to form nitrates of those bases; Craig notes recent research indicating that atmospheric nitrogen is also converted into nitrates, and proposes a hypothesis in which  $\text{NO}_2$  is converted into  $\text{H}_4\text{N}_2\text{O}_3$  and subsequently to  $\text{KNO}_3$  if potassium is present; in regions such as India, organic matter is carried to the subsurface by seasonal rains, and as it decomposes there nitrates in solution rise to the surface through capillary action and accumulate in the soil by evaporation of the liquid; Craig observes that conversion of atmospheric nitrogen is probably significant to the formation of nitrates in caves, and briefly discusses American saltpeter production during the War of 1812; he proposes that caves should be routinely stockpiled with organic matter so that, in case of national emergency, rich nitrate sources would be ready; he further notes saltpeter production from various natural sources, and notes that artificial saltpeter production using compost beds is too slow and labor-intensive; the most effective means of nitrate manufacture, he suggests, could be achieved through large-scale replication of the atmospheric processes; Craig warns of America's vulnerability in being wholly dependent upon imported nitrates).

Curtis, William E.

1892 Our Commercial Relations with Chili. *The North American Review* 154(424; March):359-365, Cedar Falls, Iowa (Curtis notes [pg. 359] that "The commercial prosperity of Chili [Chile] is largely due to the possession of ... the almost unlimited beds of nitrates of soda which underlie the sands of the desert which stretches for more than a thousand miles between the Andes and the ocean. These nitrate beds are owned by corporations or individuals, who pay a large export tax to the government upon the saltpetre and other products into which nitrate is converted. The government receives from this export tax an income reaching annually to the sum of \$20,000,000 or \$25,000,000 ... In addition to the nitrate beds owned by corporations or individuals, there is a large tract remaining in possession of the government").

Davis, Burke

1982 *The Civil War: Strange and Fascinating Facts*. Fairfax Press, New York (contains a chapter on the manufacture of gunpowder, focusing on the Confederate Nitre and Mining Bureau operations; 249 pp.).

Davis, Lee Carson

1967 Bean Cave, Marion County, Arkansas. *White River Valley Historical Quarterly* 2(11; Spring). (brief but informative history of this significant CSA niter mining site situated on the bank of the White River; in operation as early as 1861, the Confederacy subsequently spent \$30,000 outfitting this cave; these works were destroyed by a USA detachment in December 1862; three of the evaporation kettles destroyed at that time still survive; accessible at: <<http://198.209.8.166/periodicals/wrvq/v2/n11/sp67b.html>>).

Davy, John

1821 *An Account of the Interior of Ceylon*. Longman, Hurst, Rees, Orme and Brown, London (written by a scientist and astute observer well acquainted with practical geology, Davy's account of Ceylon [modern Sri Lanka] is superior to many similar works in the genre of traveler's literature; the author briefly describes the production of saltpeter and gunpowder on the island, visited several saltpeter caves, and lists 22 known saltpeter caves; this list of names, he notes, is "not those of the caves themselves, which are generally nameless, but of the nearest inhabited places, which are in many instances several miles remote, most of the caves being situated in the wildest and most deserted parts of the country" [pg. 31]; Davy attributes nitrate formation in caves to the action of atmospheric nitrogen ["azote"] and oxygen upon feldspar and

calcium carbonate, under conditions of low humidity and high organic matter; he disparages the idea that cave nitrates are solely formed by bat guano or other animal matter; saltpeter was produced by mining the cave earth or pulverizing impregnated rock [see George 1987a for an account of nitrate rock mining in Kentucky's Dixon Cave], mixing with wood ashes, and leaching through a fiber mat; 530 pp.).

Deitrich, W. M.

1862 Authorization for Making Nitre (manuscript). University of Kentucky Manuscript Collection, Lexington, Kentucky (an exemption from service granted to G. W. McGee, saltpeter miner, by Captain Deitrich, Knoxville, Superintendent of 7<sup>th</sup> District, Confederate States Nitre and Mining Bureau).

De Paepe, Duane

1979 The Legend of the Mammoth-Dixon Cave Connection. *Cave Research Foundation Annual Report for 1979*, pp. 61-62. Cave Research Foundation, Dallas, Texas (there have been persistent stories for generations about a possible connection between the Historic Entrance of Mammoth Cave and the trunk terminus of Dixon Cave; located in close proximity, geologically the two passages are related, the intervening distance between them sealed by ancient breakdown collapse; the story originates with Meriam's 1844 published account [see citation] in which he related that saltpeter miners at work in Dixon could be heard at Mammoth; an experiment in 1979 verified Meriam's account, demonstrating that hammering noises at the end of Dixon Cave could be heard just outside the Historic Entrance to Mammoth [saltpeter rock-mining was also practiced at Dixon Cave; see George 1987a]).

1980 Mammoth Cave and the New Madrid Earthquakes of 1811-1812. *Cave Research Foundation Annual Report for 1980*, pg. 33. Cave Research Foundation, Dallas, Texas (brief summary of the effects of the New Madrid earthquake on the saltpeter mining operations in Mammoth Cave, using secondary sources; De Paepe notes that detailed field investigations of recent years have not identified any rockfall within the cave that might be associated with this event; for a more detailed account of earthquake effects at the cave, see George and O'Dell [1992], also George [1990a; 1990d; and 1992]).

1981a Saltpeter Mining Features and Techniques. *The NSS Bulletin* 43(4):103-105. National Speleological Society, Huntsville, Alabama (brief discussion of the tools and various types of leaching vats used by saltpeter miners).

1981b Great Saltpeter Cave: Prototype to the Wilkins-

Gratz Mammoth Cave Saltpeter Operation. *The Cave Research Foundation Annual Report*, pp. 27-28. Cave Research Foundation, St. Louis (De Paepe notes the parallels between the hoppers and other artifacts of saltpeter processing equipment used at Mammoth Cave during the War of 1812 and those in the operation at Great Saltpetre Cave, located south of Lexington, which predate those at Mammoth; De Paepe concludes that Mammoth Cave owner Charles Wilkins must have been familiar with the efficient innovations at Great Saltpetre and duplicated these for his own operation; George's [1987b] research confirms this and indicates that the Great Saltpeter works were designed and built by John Jame Dufour).

1982 The Transportation of Kentucky Cave Saltpeter. *Cave Research Foundation Annual Report for 1982*, pp. 25-26, Cave Research Foundation, St. Louis (Lexington was the most important market center in Kentucky during the early 19<sup>th</sup> century for much of the produce of the state, including saltpeter; most of the nitrate from the cave region was shipped to Lexington and used by powdermills there or shipped to eastern manufacturers; shipping routes to the east were both overland and by water; land routes were via the Wilderness Road through the Cumberland Gap and along what later became known as the National Road, which during the period of the War of 1812 extended west to Pittsburgh at the Forks of the Ohio; shipment up the Ohio River to Pittsburgh was possible during the warmer months, but ice on the river forced a much longer passage downriver to New Orleans and back up the eastern seacoast; a more detailed account of saltpeter marketing and transportation is to be found in O'Dell [1995]).

1984a Economic Geography of the Mammoth Cave Regional Saltpetre Industry. In *The Cave Research Foundation Annual Report for 1974-1978* (Richard A. Watson, editor), pp. 131-133. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1975*, pp. 67-69; De Paepe reports upon investigations of several caves in the Mammoth Cave region, including Mammoth Cave, for traces of historic saltpeter mining activity; as preliminary steps in an interpretation of the economic significance of the niter mining industry, the field investigation complimented the compilation of a card file data bank containing all known reports and maps describing "mining features and the underground landscape of the period"; no conclusions were reported in this early phase of the study).

1984b Survey Interpretation of the Circa 1810 "An Eye-Draught of the Mammoth Cave" Map. In *The*



- Cave Research Foundation Annual Report for 1974-1978* (Richard A. Watson, editor), pp. 194-195. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1976*, pp. 49-50; the "Eye-Draught" map is associated with the saltpeter mining operation at Mammoth Cave and is labeled with the names of passages known to the operators at that time; three copies of the map survive, dating from about 1810; recent cave survey reconnaissance was able to correlate the passages depicted on the map with modern place-names, and a rendition of the eye-draught map is included in the report with these modern names substituted for the original nomenclature; interpretation of archaeological and documentary evidence suggests that "the side passages from the Main Cave were the more important nitrate gathering sites and the main trunk served as the transportation artery to the leaching hoppers").
- 1984c Saltpetre Mining Sites in Historic Mammoth Cave. In: *Cave Research Foundation Annual Report for 1974-1975* (Richard A. Watson, editor), pp. 258-259. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1977*, pp. 47-48; De Paepe discusses documentary and field evidence indicating the areal distribution of historic saltpeter mining activity in Mammoth Cave; the Blue Spring Branch apparently represents the furthest penetration of mining activity in the cave).
- 1984d Cultural Resources in Cedar Spring Saltpetre Cave, Edmonson County, Kentucky, and Central Kentucky Circa 1812 Saltpetre Mining Investigations. In *Cave Research Foundation Annual Report for 1974-1975* (Richard A. Watson, editor), pg. 328. Cave Books, St. Louis (the first 900 feet of this cave shows evidence of intensive saltpeter mining activity, including hundreds of tally marks on walls and ceiling [such marks are uncommon in the Mammoth Cave region], abundant mattock marks in the soil, and artifacts associated with mining and processing).
- 1984e Central Kentucky Circa 1812 Saltpetre Mining Investigations. *Cave Research Foundation Annual Report for 1987*, pg. 51. Cave Research Foundation, Columbus, Ohio (briefly noted is recent progress in archaeological reconnaissance and interpretation of saltpeter mining operations in and around Mammoth Cave National Park, Kentucky).
- 1985 *Gunpowder from Mammoth Cave: The Saga of Saltpeter Mining Before and During the War of 1812*. Cave Pearl Press, Hays, Kansas (non-technical writing style, excellent illustrations; also discusses other saltpeter caves in the immediate area; good supplement to Faust 1967 though unfortunately devoid of textual references; ii + 38 pp.).
- De Paepe, Duane and Carol A. Hill  
1981 Historical Geography of United States Saltpeter Caves. *The NSS Bulletin* 43(4):88-93. National Speleological Society, Huntsville, Alabama (summarizes the areas utilized for the production of cave niter during the Revolutionary War, War of 1812, and Civil War).
- 1984 Economic Geography of the Mammoth Cave Regional Saltpetre Industry. In: *The Cave Research Foundation Annual Report for 1974-1978* (Richard A. Watson, editor), pp. 131-133. Cave Books, St. Louis.
- Des Jean, Tom  
1997 Niter Mining in the Area of the Big South Fork of the Cumberland River. *Tennessee Anthropologist* 22(2):225-239 (study of the sandstone rockshelters and associated remains such as hoppers and tools in Tennessee's Upper Cumberland Plateau worked for niter principally in the War of 1812 and Civil War eras; these sites were interpreted as "cottage industries" because of the area's geographic isolation).
- Donald, M. B.  
1936 History of the Chile Nitrate Industry. *Annals of Science* 1(1):29-47 (the Chilean nitrate region is situated between Arica on the north and Copiapó to the south, with 600 miles of sandy desert between that forms a barrier between Peru and Chile; the presence of nitrates [in the form of sodium nitrate] here was known from the 16<sup>th</sup> century and used to make small quantities of inferior gunpowder, but was not mined commercially until about 1800; Donald describes the early and contemporary methods of processing soda nitrate and its conversion to potassium nitrate; exploitation of Chilean nitrates was stimulated by the European discovery in the mid-19<sup>th</sup> century of a simple process to convert sodium nitrate to potassium nitrate using potassium chloride; by 1879, nitrate processing had become industrialized in the modern sense, using crushers and heated leaching tanks; exports of nitrate and a valuable by-product – iodine – had become mainstays of the Chilean economy, and remained significant in the global market long into the 20<sup>th</sup> century).
- Donnelly, R. W.  
1956 Scientists of the Confederate Nitre and Mining Bureau. *Civil War History* 2:80 (notes on establish of niter beds by the Confederacy).
- Dougherty, Percy H. (editor)  
1985 Caves and Karsts of Kentucky. *Special Publication* No. 12, Series XI, Kentucky Geological

Survey, Lexington (includes chapters addressing caves in northeastern Kentucky, the Pine Mountain area, Mammoth Cave, and other related topics).

Duncan, M. Susan

1993 Kentucky's Saltpeter Caves: A Review and Comparison of an Early Nineteenth Century Industry. MA thesis, Department of Anthropology, University of Kentucky, Lexington (168 pp.; professional excavations carried out in Saltpeter Cave, located in Kentucky's Carter Caves State Resort Park, indicate that there was little standardization of leaching vat types, artifact types, or construction methods; the cave was mined during the War of 1812 period; no evidence suggested that any mining was carried on during the Civil War; from the extent of the works and spoil piles, the author concludes that Saltpeter Cave was one of the top niter producers during the War of 1812; the thesis also contains an extensive literature review).

1995 Kentucky's 1812 Saltpeter Caves: A Case Study and Literature Review. In: *Historical Archaeology in Kentucky* (Kim A. McBride, W. Stephen McBride, and David Pollack, editors), pp. 51-66. Kentucky Heritage Council, Frankfort (literature overview and study of Saltpeter Cave at Carter Caves Resort State Park in Carter County, [eastern] Kentucky).

1997 Examining Early Nineteenth Century Saltpeter Caves: An Archaeological Perspective. *Journal of Cave and Karst Studies* 59(2):91-94 (focus on Saltpeter Cave in Carter County, Kentucky).

du Pont, Bessie G. (translator)

1926 *Life of Eleuthère Irénée du Pont, from Contemporary Correspondence 1814-1819* (Vol. 10). University of Delaware Press, Newark (E. I. du Pont was very concerned about the vagaries in the prices and available quantities of domestically produced saltpeter in Kentucky and Tennessee; contracts had gone unfilled, and rumors abounded; the miners had quit working the caves and rock shelters, or the caves had all been exhausted; in 1815 du Pont sent his son-in-law Antoine Bidermann to tour the saltpeter producing region, posing as a real estate speculator but in actuality to spy out the situation and determine the truth about saltpeter; Bidermann's observations are reported in the letters, written to his father-in-law [see Section III - Hagley Museum, letters dated 11 June - 22 August 1815; also see George 1988b]).

Eggleston, George Cary

1874 A Rebel's Recollections, III. *The Atlantic Monthly* 34(202; August):163-167 (of interest is the remark [pg. 165] about the Civil War that "When nitre was found to be growing scarce, and the supply

of gunpowder was consequently about to give out, women all over the land dug up the earth in their smoke-houses and tobacco barns, and with their own hands faithfully extracted the desired salt, for use in the government laboratories").

1875 *A Rebel's Recollections*. Hurd and Houghton, New York (book version of Eggleston 1874; pg. 67 reproduces word for word the above noted statement).

E. I. du Pont de Nemours & Company

1906 *Some Facts About Saltpeter*. Wilmington, Delaware (15 pp.).

Eller, P. Gary

1981 Chemical Aspects of the Conversion of Cave Nitrates to Saltpeter. *The NSS Bulletin* 43(4):106-109. National Speleological Society, Huntsville, Alabama (summary of experiments in replicating the niter extraction techniques used at Mammoth Cave, Kentucky).

1984a Stability Relationships for Cave Nitrate Minerals. In *The Cave Research Foundation 1974-1978* (Richard A. Watson, editor), pp. 173-174. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1976*, pp. 28-29; Eller discusses the stability of various nitrate minerals at differing humidities, providing a table demonstrating the relationships; he concludes that nitrate minerals in crystalline form are unlikely to be found in the humid caves of the Southeast; potassium nitrate [true saltpeter - cave "saltpeter - is actually calcium nitrate and requires conversion] would be an exception, but potassium is an uncommon ion in the cave environment; since Eller limits his discussion to cave sites, he does not mention that crystalline potassium nitrate is frequently present in the sandstone rock shelters of Kentucky).

1984b Saltpeter Production from Cave Sediments - An Important and Early American Chemical Industry. In *The Cave Research Foundation 1974-1978* (Richard A. Watson, editor), pg. 193. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1976*, pg. 48; according to Eller, nitrate production from cave sediments was one of America's first and most important chemical industries; the availability of domestic saltpeter for gunpowder production was significant to the westward expansion of the nation and during three wars [Revolutionary War, War of 1812, and Civil War]; the brief summary is supplemented by two tables: "Americans Concerned with Saltpeter," which includes both noted scientists and statesmen, and "Historical Highlights of American Saltpeter Production").

Engel, Scott A. and Annette S. Engel

1998 Great Saltpetre Cave, Rockcastle County, Kentucky: A Geology and Archaeology Field Guide. *The Electric Caver* 35(3):5-13, Greater Cincinnati Grotto of the National Speleological Society, Cincinnati (this article describes regional geology and hydrology in relation to the caves of eastern Rockcastle County and in particular to Great Saltpetre Cave, including in-depth discussions of passage morphology and sediment studies; two brief sections at the end of the article describe nitrate formation and historic saltpeter mining in Great Saltpetre and nearby caves).

Ercker, Lazarus

1951 *Treatise on Ores and Assaying* (translated and annotated by Anneliese G. Sisco and Cyril S. Smith). University of Chicago Press, Chicago (originally published in German in 1580; this classic work was first published in 1574 and reprinted again and again, using the same blocks, for nearly two hundred years; little biographical information is known of Ercker, a German, but from his writing it is apparent that he was a practical chemist rather than a theorist; for his era, the text is amazing for its clarity, with realistic descriptions of apparatus used and straightforward lab instructions; Ercker describes saltpeter production in far more detail than Agricola [1556]; according to Ercker, saltpeter can be made from several different kinds of earth: "The best earth, which is very rich in saltpeter and does not contain much salt, is the earth from old sheep pens that have rotted from disuse, provided that it is very dry and not wet" [pg. 292]; saltpeter could also be obtained from very old walls, the rubble in the cellars of old razed buildings, and "all earth from buildings with dirt floors, cellars, or rooms that are old and have been unused for a long time" [pg. 293]; further, earth from horse stables with dirt floors, old rotted garbage dumps, old latrines, and from breweries and dye-houses and the ash dumps of soap boilers and tanners would also supply niter; Ercker reports the opinion of the "old masters" of saltpeter-making that spent earth will regenerate if left in a dry place; in addition to detailed instructions for the production of saltpeter, the book contains many fine woodcuts of the apparatus and processes involved; 360 pp.).

Faust, Burton Sherwood

1949 The Formation of Saltpetre in Caves. *The NSS Bulletin* 11:17-23. National Speleological Society, Huntsville, Alabama (Faust was one of the first modern historians concerned with the role of saltpeter production and gunpowder manufacture in American history; in an analysis of the various

theories proposed to account for the presence of saltpeter in caves, Faust concludes that no single process can fully explain the development of niter deposits; cave saltpeter, he concludes, is a consequence of the complex interaction of numerous processes and mechanisms, of which the most important may be the action of nitrogen-fixing bacteria upon surficial organic matter; regardless of the original mechanism by which they are produced, the most plausible explanation is that water-soluble nitrates accumulating in the soil are leached by precipitation and transported by groundwater to leave evaporite deposits in cave floors and wall; noting problems, particularly in terms of the distribution of deposits within caves, with both groundwater transport and with in-situ creation from organic decomposition, Faust speculates upon whether bacteria may exist having the capability to produce fixed nitrogen directly from inorganic elements and compounds).

1955 Saltpetre Mining Tools Used in Caves. *The NSS Bulletin* 17:8-18. National Speleological Society, Huntsville, Alabama (Faust's account is not limited to tools, but also describes physical alterations left as a result of mining operations; according to his many years of personal observation, most tools and other equipment used in cavern nitrate mining were made of wood; only limited evidence of metal tools can be found, in the form of pick marks or shovel traces; wooden implements were readily made by hand and could be discarded without concern, whereas metal tools were expensive and hard to obtain; consequently metal tools are seldom found as historic mining artifacts in caves; based on Faust's account, artifacts can be divided into a number of broad classes: [1] tools for digging, scraping or sorting out saltpeter earth, such as paddles, shovels, mattocks, and sieves, or wedges for splitting rocks; [2] implements for conveying the soil, including jute sacks and wooden boxes, and winches for lifting soil from lower elevations; [3] artifacts that improve accessibility of the cave environment, such as ladders, steps, plank bridges, trestle-works, and slides; and [4] processing equipment used to leach and concentrate nitrates from the soil, including various forms of soil vats or hoppers, collection troughs or tubs and wooden pipes, and boiling kettles).

1960 The Last of the Petre-Monkeys. *National Speleological Society News* 18(1; January):10-11 (interview with John Salling, the last surviving Confederate saltpeter miner).

1964 Saltpetre Caves and Virginia History. In: *Caves of Virginia* (Henry H. Douglas, editor), pp. 31-56.



Cave Survey, Falls Church, Virginia (this brief but important work traces saltpeter production from the barnyards of the colonial period in Virginia to niter mining in caves during the War of 1812 and the Civil War; the concluding section describes the remaining physical evidence of mining activity found in 17 regional caves).

1967 The History of Saltpeter Mining in Mammoth Cave, Kentucky (Parts I-VII). *Filson Club History Quarterly* 41(1):5-20; 41(2):127-140; 41(3):227-262; 41(4):323-352 (detailed history of War of 1812 mining efforts at this site and the equipment and processes used for the production of saltpeter).

1968 Notes on the Subterranean Accumulation of Saltpetre. *Journal of Spelean History* 1:3-9 (a posthumous reprint, virtually identical in wording to Faust [1949] with a few minor changes).

Fig, Don and Gary Knudsen

1984 Niter Mining: An Incipient Industry of the Red River Gorge, Kentucky. *Proceedings of the Symposium on Ohio Valley Urban and Historic Archaeology* 2:67-73. Louisville, Kentucky (Red River Gorge is located in eastern Kentucky's Daniel Boone National Forest and many of the sandstone rock shelters in this scenic region contain artifacts associated with niter mining; the authors describe some of these artifacts and classify saltpeter hoppers into three major construction styles; they attribute these remnants primarily to the Civil War era, but provide no documentation to support their conclusion, noting that "no archaeological excavation of a niter mine has been conducted").

Fliermans, C. B. and E. L. Schmidt

1977 Nitrobacter in Mammoth Cave. *International Journal of Speleology* 9:1-19 (the authors conducted experiments in Mammoth Cave and several other known saltpeter caves in the southeastern United States, to evaluate the role, if any, of bacteria in the formation of large saltpeter deposits; these experiments were designed to identify the presence, distribution, and population densities of the chemautotrophic nitrifiers, *Nitrobacter agilis* and *Nitrobacter winogradskyi* in cave sediments; the specific technique used involved production of species specific antibodies produced from sensitized rabbits, which introduced into samples, produces a reaction visible by fluorescent microscopy if the organisms are present; based on their study, Fliermans and Schmidt concluded Nitrobacter, dominated by *N. agilis*, are present in relatively high population densities in Mammoth Cave sediments and are common among saltpeter caves in the southeast; they suggest that Nitrobacteria is the etiological agent responsible for formation of

saltpeter deposits).

Gale, Hoyt S.

1912 Nitrate Deposits. *Bulletin* 523, pp. 5-36, U. S. Geological Survey, Washington (Gale describes the various forms of nitrate minerals, and the locations within the United States where exploitable deposits are located; calcium nitrate, or nitrocalcite, is the form commonly found in limestone caverns, but he notes that potassium or sodium nitrate may be found in crevices or under overhanging ledges; he provides a brief reconnaissance of the states in which niter deposits occur in caves: Alabama, Arkansas, Illinois, Indiana, Kentucky, Missouri, Tennessee, and West Virginia; Gale then moves westward to describe nitrate deposits from certain Colorado and California soils and from rock ledges and crevices in Wyoming, Idaho, Utah, Oregon, New Mexico, and Nevada, the latter subjected to an extended discussion; nitrate deposits in western caves occur in Idaho, Utah, Nevada, California, and Texas; although recognizing the source of nitrates originating in microbial activity upon organic matter, and seepage transport of nitrates through bedrock, Gale attributes the majority of cave deposits to have derived from bat guano).

1917 Origin of Nitrates in Cliffs and Ledges. *Mining and Scientific Press* 115:676-678 (in his essay, Gale compares nitrate formation in the soils of India, in caves and cliffsides in the U.S., and in the caliche deposits of Chile; he concludes that the mode of origin and accumulation is essentially the same in these several environments; nitrates form through the action of nitrifying bacteria upon decomposing organic matter, which may be subsequently leached and redeposited; in his discussion of cave nitrates, Gale stops just short of associating the migration of nitrates from surface soils and consequent evaporative deposition in caves; although he observes that nitrates are constantly leached from surface soils, he presumes that nitrates are produced within cave environments from existing organic matter therein and are transported to other locations in the cave where they accumulate).

George, Angelo I.

1973 On the Saltpeter Trail. In *Guidebook to the Kentucky Speleofest* (Angelo I. George, editor), pg. 23. Louisville Speleopress, Louisville, Kentucky (George presents a very brief overview of the areal geography of saltpeter mining and gunpowder manufacture in Kentucky, noting that the greatest number of known saltpeter caves occur in the state along a swathe from Meade County on the Ohio River to Allen County on the Tennessee border).

1975 Miscellaneous Notes on Two Prominent New

- Athens Salt Merchants: Samuel Brown and Charles Wilkins. *Journal of Spelean History* 8(2):16-18 (this article represents an early stage in George's continuing investigations of Brown and Wilkins, both entrepreneurs in the manufacture of Kentucky saltpeter; Brown is best known for his association with Great Saltpeter Cave, and Wilkins as the owner-operator of the Mammoth Cave niter works; in this article George focuses upon the activities of Brown, who, in partnership with Thomas Hart, Sr., branched out from the manufacture of saltpeter to that of common salt derived from local licks and wells; Brown & Hart underwrote the establishment of possibly the largest salt-making operation in the state, loaning \$3,000 to a Col. Outlaw to set up 400 boiling kettles and other equipment on a site probably located in Clay County; George's article summarizes Brown's joint involvement in salt and saltpeter and speculates that Charles Wilkins may have taken over some of Brown's interests when Brown departed Kentucky in 1806).
- 1981 A Field Trip of the Cumberland Plateau Saltpeter Industry Conducted Along the Wilderness Road in Kentucky. In *Guidebook, 10th Annual Speleofest 1981* (Shelley Page and Ralph Mann, editors), pp. 48-56. Louisville Speleopress, Louisville, Kentucky (56 pp.; this article consists of the road log for a field trip along the approximate route of the former, settlement-era Wilderness Road in Kentucky, emphasizing the correlation between early transportation routes and the locations of saltpeter and gunpowder manufacturing sites; stops described in the road log include: furnace locations and spoil piles on the Richard Mullins farm associated with saltpeter mining at Great Saltpetre Cave; Great Saltpetre Cave; the State Road of 1798, also known as the Bighill Wagon Road; John Coffey Cave; and Boone's Gap; includes map of old trails, traces and roads along the Cumberland Plateau with locations of known saltpeter caves and powder mills, a map of John Coffey Cave, and an excellent illustration of the processual and material flows involved in refining cave saltpeter).
- 1984a Saltpeter and Gunpowder Manufacturing in Kentucky. *The CRF Annual Report*, pp. 40-44. Cave Research Foundation, St. Louis (early, shorter version of George [1986]).
- 1984b Western Kentucky Saltpeter Sites. In *Western Kentucky Speleological Society Survey Annual Report 1984* (John E. Mylroie, editor), pp. 7-10. College of Science, Murray State University, Murray, Kentucky (11 saltpeter mining sites, found adjacent to major stream valleys and near pioneer wagon roads, are known from the area of the state west of Bowling Green, Kentucky; George attributes this relative scarcity to the later settlement of this region, and to the historic lack of forest cover of the Sinkhole Plain, a prairie grass biome; see Carol A. Hill on correlation of forest and saltpeter caves, esp. 1981a).
- 1985 *Mummies of Short Cave Kentucky and the Great Catacomb Mystery*. George Publishing Company, Louisville, Kentucky (Short Cave, located in Edmonson County, Kentucky, was the site of the discovery of several prehistoric mummies during the saltpeter mining operations conducted there in the early 19<sup>th</sup> century; George compares the history of mining operations at the cave to the legend of a catacomb filled with Egyptian-style mummies allegedly found by settlers near Lexington, Kentucky, and reported at length in Thomas Ashe's *Travels in America* performed in 1806; Ashe's reputation as a notorious liar, swindler, and thief has led historians over the years to entirely discount the story of the catacomb, but George theorizes that the catacomb legend elaborated by Ashe has its origins in the unreported discovery of Indian burials during niter mining at Short Cave, the tale transplanted to a Lexington locale to enhance the story; 72 pp.).
- 1986 Saltpeter and Gunpowder Manufacturing in Kentucky. *Filson Club History Quarterly* 60(2):189-217 (this paper describes the distribution of saltpeter and gunpowder production sites in Kentucky and demonstrates a direct relationship between the sites and transportation routes and available water and timber; George notes that, because only 133 of the nearly 4,000 known caves in Kentucky and only 6 rockshelters were mined for niter, that miners must have been very selective in establishing operations; although George's basic premises regarding transportation, water and timber appear correct in most instances, he was unaware of the work being conducted in Kentucky's Daniel Boone National Forest by the U.S. Forest Service; the USFS has catalogued several hundred sandstone rockshelter sites, often in relatively remote areas, where archaeological evidence indicates mining activity took place; this article was reprinted under separate cover in late 1986 as "Saltpeter and Gunpowder Manufacturing in Kentucky," George Publishing Company, Louisville).
- 1987a Saltpeter Rock Mining Activity in Dixon Cave, Edmonson County, Kentucky. *Proceedings of the Symposium on Ohio Valley Urban and Historic Archaeology* 5:78-89 (niter mining is known to have taken place in Dixon Cave, evident from the remains of leaching vats; the floor of the cave is covered with a large mass of rock debris and boulders, and tradition holds that that nearly the entire rock mass



- was overturned in search of nitrate-enriched soil; George's investigation of physical evidence in the cave indicates that, instead, niter was extracted through excavation and processing of impregnated bedrock from the cave walls: "Saltpeter miners physically removed limestone wedges and flakes by hand or used pick axes, mauls and gluts. The rock was then reduced to gravel size. Gravels and finer fractions were transported to the hoppers in the cave and processed for their nitrate content" [pg. 87]; bedrock mining, while commonly practiced in sandstone rockshelters, has been rarely noted in caves; George's work is the first to present evidence of this unusual niter mining method used in the Mammoth Cave region).
- 1987b Saltpeter Activity of John James Dufour. *Journal of Spelean History* 21(1):10 (Dufour, a Swiss immigrant and vintner who settled in the Bluegrass region of Kentucky, was hired by Dr. Samuel Brown to design and build a large-scale nitrate processing operation at Great Saltpetre Cave in Rockcastle County; Dufour's innovations, including large rectangular vats rather than the commonly used V-vats, were later duplicated at Charles Wilkins' still larger operation at Mammoth Cave; see also De Paepe [1981b] and George [2001]).
- 1988a Rotunda V-Vat Complex, Mammoth Cave, Kentucky. *Cave Research Foundation Annual Report for 1988*, pp. 74-76. Cave Research Foundation, Cedar Falls, Iowa (description of the Rotunda Complex of soil ridges indicating the former presence of V-vat leaching hoppers; the former V-vats were destroyed by cave guides during the long history of the cave as a tourist attraction during the 19<sup>th</sup> and early 20<sup>th</sup> centuries, the wooden artifacts burned for torches and bonfires to illuminate the large Rotunda room; imprints of these artifacts are still visible in the soils adjacent to the tourist trails).
- 1988b Pre-1815 Demise of the Saltpeter Industry, Kentucky. *Journal of Spelean History* 22:15-20 (using documentary evidence, George concludes that the lack of availability of saltpeter on the market during 1814-1815 had two contributing causes: [1] the wasteful practices of miners who failed to replace leached soils to allow regeneration of nitrates; and [2] price-fixing practices by du Pont and other large end-users, who ordered their local buyers to set a ceiling of 18-20 cents per pound for niter; at that price, the itinerant rural miners of Kentucky refused to make saltpeter and returned to traditional pursuits; after the war, the importation of saltpeter from British India at less than 10 cents per pound assured the fate of the industry).
- 1988c Interim Chronology of Historic Events at Great Saltpetre Cave. *Journal of Spelean History* 22(2):7-11 (this represents an early stage of work in progress, and several erroneous first conclusions are corrected in George [2001]; reconstruction of events prior to 1821 is based mostly on primary sources and post-1821 upon secondary sources and oral traditions of families associated with the cave; within two years of Great Saltpetre's 1798 discovery, small-scale saltpeter mining was being conducted at the cave; after several intervening transactions, in 1804 the cave was purchased by a partnership that included Lexington entrepreneur Samuel Brown; the cave subsequently becomes one of the largest saltpeter producers in the state, featuring a number of innovations later copied by Mammoth Cave owner Charles Wilkins; the mining operation ceased shortly before the end of the 1812 war, but was again mined on a limited basis during the 1844-1849 Mexican war; from this time until the eve of WW II, the cave served only local folk uses; in 1940, the cave was purchased by local resident John Lair, and the following year Lair and his Renfro Valley Barn Dance made a WHAS/CBS remote radio broadcast from the cave on opening night; the destruction by fire of the newly built lodge later that year ended Lair's attempted commercialization of the cave, which was closed after 1943; in 1968, having made several improvements [road construction destroyed the remains of an external saltpeter furnace below the south cave entrance], Lair again opened the cave for tourism in 1968, but met with little financial success; the cave was closed to the public after the property was sold at auction in 1985, and a few months later, John Lair died at age 91 years).
- 1988d Tygart's Saltpeter Cave, Carter County, Kentucky. *Karst Window* 24(1):10-11 (this description of a saltpeter cave in Eastern Kentucky is illustrated by a detailed map showing the location of saltpeter excavations and artifacts; the cave is short but of ample dimensions, and has three entrances; the saltpeter works are found inside the west entrance, which is 55 feet wide and 15 feet high, leading to a room 35 feet wide and about 12 feet high that tapers to a crawlway at both ends; an excavated trench 20 feet long, 8 feet wide, and 3 feet deep leads to the saltpeter room; along the southeast wall of the room are high wall excavations with clear mattock marks; the central portion of the room is step highwall excavated; there are two definite V-vats in the east part of the room and evidence of other, destroyed vats northwest of these; leached



- earth was not recycled but instead dumped out the entrance, forming a large talus slope).
- 1989 V-Vats and Rectangular Hoppers in Mammoth Cave. *Cave Research Foundation Annual Report for 1988* (Karen Bradley Lindsley, editor), pp. 73-74, Cedar Falls, Iowa (account of the transition of saltpeter leaching vat style from V-vats to much larger and more efficient rectangular hoppers during the period 1811-1812, based on archaeological and documentary evidence).
- 1990a Tandem Pump Towers in the Rotunda, Mammoth Cave, Kentucky. In: *Cave Research Foundation Annual Report for 1989* (Karen Bradley Lindsley, editor), pp. 56-58. Cave Books, St. Louis (a level survey of the saltpeter pipeline at Mammoth Cave conducted by the National Park Service and Cave Research Foundation in 1986 revealed that the pump tower was four feet too low for gravity feed; this and subsequent discoveries imply damage attributed to the effects of the 1811-1812 New Madrid earthquake, which may have caused liquification of the earth upon which the tower was constructed; this theory is further elaborated in George and O'Dell [1992]).
- 1990b Place Name Changes, Cultural Geography, and Distribution of Saltpeter Hoppers in Great Saltpeter Cave. *The Electric Caver* 26(7):72-83. Greater Cincinnati Grotto of the National Speleological Society, Cincinnati (George traces the origins of names for features and passageways in this historic cave, and even changes in the name used for the cave; documents the nine separate cave maps associated with the cave, the first created in 1805 represents the first instrument survey of a cave in the United States; notes that the most of the present artifacts associated with the displays for the failed WWII-era commercialization of the cave [the "Museum"] are actually not from this site but were manufactured in modern times or acquired from other caves; discusses the types and arrangements of the cave's numerous authentic mining artifacts, the processing hoppers, in relation to possible changes in the management of the saltpeter mining operations there; accessible at: <<http://www.caves.org/conservancy/gsp/articles/angelo.html>>; online version does not include bibliographic citations).
- 1990c *Prehistoric Mummies from the Mammoth Cave Area: Foundations and Concepts*. George Publishing Company, Louisville, Kentucky (during the early 19<sup>th</sup> century, the mummified remains of early Native Americans were discovered in several caves in Kentucky and Tennessee, the result of mining operations for mineral such as saltpeter, glauber salt, gypsum, alum, and copperas; "Fawn Hoof," found by miners in Mammoth Cave, was perhaps the most famous of these mummies and was exhibited throughout the region in a traveling show; George presents an edited collection of writings concerning these mummies, comprising the contemporary descriptions, anthropological speculations, and the folklore that was generated by their discovery; 117 pp.).
- 1990d Effects of the New Madrid Earthquake (1811-1812) Damage to the Mammoth Cave Saltpeter Works, Kentucky. *Journal of Spelean History* 24(1):10-12 (early version of research discussed at greater length in George and O'Dell [1992]; see also George [1992]).
- 1991 *Wyandotte Cave: Down Through the Centuries*. George Publishing Company, Louisville (this detailed history of well-known Indiana show cave includes references to saltpeter mining during the War of 1812; 68 pp.).
- 1992 *The New Madrid Earthquake at Mammoth Cave*. George Publishing Company, Louisville (reprint collection of two articles concerning the effects of the 1811-1812 New Madrid Earthquake and aftershocks upon the saltpeter mining operations at Mammoth Cave: George and O'Dell [1992] and George [1990d]).
- 1994 *Mummies, Catacombs and Mammoth Cave*. George Publishing Company, Louisville (153 pp.; from 1805 to 1814, at least six Native American mummy burials were unearthed during saltpeter mining operations at Short Cave, located in the present-day Mammoth Cave National Park; George traces the possible connection between these discoveries and the legendary lost Catacombs of Lexington, Kentucky, mummy-filled crypts alleged to lie beneath the Central Bluegrass city; ancient human remains were also discovered in other caves during the early 19<sup>th</sup> century saltpeter mining boom, and George discusses the mummies from Big Bone Cave, Tennessee, and in and around Mammoth Cave; the best known of these "curiosities" was Fawn Hoof, discovered in Mammoth Cave, and the national attention focused upon this mummy made the cave world famous; George's book is the result of more than 20 years research and is illustrated with many vintage wood cuts, lithographs, and photographs; this is a greatly expanded and enhanced version of George [1985]).
- 2001 *The Saltpeter Empire of Great Saltpetre and Mammoth Caves*. HMI Press, Louisville, Kentucky (Angelo George has drawn upon more than 20 years of his research, reflected in a long string of interim publications, to present the well-illustrated story of Kentucky's two largest saltpeter mining operations,

Great Saltpetre Cave in Rockcastle County and Mammoth Cave in Edmonson; the great demand for Kentucky saltpeter give rise to a fierce competition between the men who owned these caves; Dr. Samuel Brown, who purchased Great Saltpetre Cave in 1804, is better remembered in American history as one of the early pioneers of inoculation against disease; Charles Wilkins, a merchant in Lexington where Brown lived and practiced, carried on saltpeter brokerage as a major component of his business; this pursuit led him to purchase Mammoth Cave to insure a steady supply to meet his contract obligations; at Great Saltpetre, under Brown's management, innovations in saltpeter processing increased the output and efficiency of the operation far beyond other regional works; his 1809 paper on niter mining remained influential through World War I; Brown and his partners lost their remarkable cave in 1809 when Charles Wilkins, who hoped to obtain Great Saltpetre Cave, used his influence to help embarrass Brown politically and financially; although Wilkins was subsequently unable to acquire Great Saltpetre, he replicated the processing innovations there when he obtained an interest in Mammoth Cave in 1810, a technology transfer accomplished through the bridge of Dr. William Ridgley, Brown's personal physician and Wilkins' brother-in-law; see esp. Brown [1809]; George [1987b; 1988b; 1988c]; George and O'Dell [1992]; and extensive Wilkins correspondence 1809-1815 in Hagley Archives; xii + 121 pp.).

George, Angelo I. and Gary A. O'Dell

1992 The Saltpeter Works at Mammoth Cave and the New Madrid Earthquake. *Filson Club History Quarterly* 66(1):5-22 (references to production problems at Mammoth Cave from 1812-1814 have long puzzled researchers; the authors attribute these problems to the New Madrid earthquake that produced a series of strong shocks during the winter of 1811-1812 and damaged the works; the key piece of documentary evidence is a letter to du Pont from their purchasing agent in Philadelphia, who quotes from a letter received from Charles Wilkins, owner of the Mammoth Cave operation: "...little business has been done at his Cave during the Winter. The Earthquake on the 16<sup>th</sup> Dec'r had thrown down several of the hoppers & sunk the pump three feet ...frequent repetitions [sic] of alarms had so frightened the hands, it was with difficulty they could ...be got to work. The Manager has refused to go into the cave ever since").

Glauber, Johann R.

1689 *The Works of the Highly Experienced and Famous Chymist John Rudolph Glauber:*

*Containing a Great Variety of Choice Secrets in Medicine and Alchymy in the Working of Metallick Mines, and the Separation of Metals: Also Various Cheap and Easie Ways of Making Salt-Petre, and Improving of Barren-Land, and the Fruits of the Earth. Together with Many Other Things very Profitable for all the Lovers of Art and Industry.* Thomas Milbourne, London (translated by Christopher Packe; in three parts separately paginated, 440, 220, and 92 pp.; Glauber [1604-1670] operated a manufacturing establishment in Amsterdam, and acquired an extensive knowledge of acids, salts, and their relationships; Glauber's research on niter and nitric acid led him to conclude that niter was a one of the key substances in nature, a "Universal Salt" distributed throughout the Animal, Vegetable, and Mineral kingdoms; niter is found in the dung and urine of beasts, and those excrements arise from the substances upon which those beasts have fed [I, pg. 309]; saltpeter "is either digged out of the Earth, being generated of the Urine of Men and Beasts, and elicited by water, and by decoction shooteth into christals, and separateth from other Salts; or it is taken from the Mortar of old walls made with Lime, or it is taken out of Mountains and Limy or Chalky Hills, by the help of water; or it is made by Art of common Salt, Wood, or Lime-stones" [I, pg. 258]; and "Nitre or Salt-petre may be had from all things, viz. From Herbs, Wood, fourfooted Beasts and creeping Things, from Birds in the Air, and Fishes in the Water, yea from the very Elements themselves, as Earth, Water, Air and Fire" [I, pg. 310]; in an experiment later duplicated by Boyle [1772], Glauber separated potassium nitrate into nitric acid [spirit of niter] and potash and then recombined them to form niter once more [I, pg. 275]; there are numerous references to and discussions of niter throughout the Works, including its use in metallurgy, instructions upon its manufacture, and exhortations as to the good to the nation and profit to the husbandman from such labors).

Gray, F. M.

1868 A Trip to the Wyandotte Cave. *The Galaxy* 5(6; June):746-757, New York (largely descriptive of the natural wonders of the Crawford County, Indiana, cave; Gray remarked [pg. 749] "The outer portion, called the 'old cave,' has been known since the first settlement of the country, and at one time was extensively worked for saltpetre").

Haas, Oscar

1996 Mission Hill, Texas. In *The New Handbook of Texas* (6 vols.; Ron Tyler, Douglas E. Barnett, Roy R. Barkley, Penelope C. Anderson, and Mark F.

- Odintz, editors). Texas State Historical Association, Austin (Haas notes that "Potassium nitrate for the manufacture of gunpowder for the Confederate Army was extracted from bat guano taken from the Brehmer Cave in the valley" near the settlements of Mission Hill and New Braunfels, Texas).
- Halliday, William R.  
1995 An Informative Pigeon River, NC Nitrate Department Cover. *Journal of Spelean History* 29(3):68-71 (the discovery of a Confederate Nitrate Bureau cover originating from Pigeon River, North Carolina, prompted author Halliday to theorize upon the origin of nitrates in the forest litter of the eastern United States as a consequence of the formerly abundant population of passenger pigeons in this region; he speculates that the Bureau, starved for sources of niter, may have investigated pigeon roosts as possible sources to be mined).
- Hamilton, J. R.  
1865 The Natural Wealth of Virginia. *Harper's New Monthly Magazine* 32(187; December):32-43, New York (Hamilton remarks [pg. 40] "Scott [County] - ... Saltpetre is found in the caves which abound here"; by the time this article was published, the market for cave saltpeter had already collapsed for the last time).
- Hancock, Harold Bell and Norman Beaumont Wilkinson  
1964 "The Devil to Pay": Saltpeter and the Trent Affair. *Civil War History* 10(1):20-32 (regards CSA importation of saltpeter from Great Britain).
- Hauer, Peter M.  
1971 Pennsylvania's Only Saltpeter Cave: A Background Study. *Journal of Spelean History* 4:71-74 (located in Bedford County, Saltpeter Cave is a small sandstone fissure allegedly mined for niter during the late 18<sup>th</sup> century; there is no direct physical or documentary evidence for saltpeter mining in the cave, only tradition and the place-name; Hauer notes, however, that encouragement of saltpeter-making in Bedford County during the Revolutionary War is well-documented, and that sandstone cliffs in the region were mined for nitrate content during this period).
- 1972 American Saltpeter Cave Survey. *National Speleological Society News* 30:65.
- 1982a Caves in West Virginia's Pioneer History. *Journal of Spelean History* 16(2-3):12-16 (Hauer describes the many historic uses and traditions associated with caves in West Virginia, including water supply, natural refrigeration, moonshining, and recreation; the greater part of the account is focused upon nitrate mining from such well-known sites as Greenville Saltpeter, Organ, Schoolhouse, and several other caves).
- 1982b Saltpetre History. *Journal of Spelean History* 16(2-3):16-24 (an overview of the production of saltpeter from American caves from the early Colonial period through the Civil War).
- Helene, Maxime  
1879 *La Poudre a Canon* (French). Librairie Hatchette et Cie, Paris (cited in Faust 1967; "Maxime Helene" was a pen name for Maxime Vuillaume; of note therein is an illustration and descriptions of various types of niter leaching vats used by the French in the extraction of this material).
- Hess, W. H.  
1900 The Origin of Nitrates in Cavern Earths. *Journal of Geology* 8:129-134 (Hess proposed the first seeping groundwater hypothesis for the origin of nitrates in caves in which bacteriological decomposition of surface organic matter released nitrate ions which were subsequently transported into caves by percolating groundwater; see also Nichols [1901]).
- Hill, Carol A.  
1976 *Cave Minerals*. National Speleological Society. The Speleo Press, Austin, Texas (137 pp.; a brief [pp. 43-45] discussion of the types and origins of nitrate minerals covers material that is expanded upon in later works by Hill [1978; 1981a; 1981b]; this volume served as inspiration for the greatly expanded and lavishly illustrated *Cave Minerals of the World* [Hill and Forti, eds., 1986, 2<sup>nd</sup> ed. 1997]).
- 1978 Geology and Minerology of Cave Nitrates. Master's thesis, University of New Mexico, Albuquerque (125 pp.; Hill presents in detail the research questions, methods of investigation, and conclusions concerning saltpeter origin that comprise the core concepts discussed in numerous other works by this author; for derivative work in more compact form, see esp. Hill 1981a; 1984a; 1992).
- 1981a Origin of Cave Saltpeter. *The NSS Bulletin* 43(4):110-126. National Speleological Society, Huntsville, Alabama (taking into account [1] geographic distribution of saltpeter caves, in relation to climate and vegetation, [2] occurrence and concentration of nitrates relative to individual cave morphology, and [3] competing theories of nitrate formation in caves, Hill concludes that nitrates accumulate as a result of transport by seeping groundwater from external sources, most likely highly organic surface soil acted upon by nitrifying bacteria).
- 1981b Mineralogy of Cave Nitrates. *The NSS Bulletin* 43(4):127-132. National Speleological Society, Huntsville, Alabama (examines the occurrence of



- KNO<sub>3</sub> and other nitrate compounds in caves in the U. S.).
- 1984a The Origin of Cave Nitrates. In *The Cave Research Foundation 1974-1978* (Richard A. Watson, editor), pp. 171-172. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1976*, pp. 26-27; this report discusses experiments conducted by Hill to test, by analysis of core samples from holes drilled into the limestone bedrock of caves located in several states, whether cave nitrates arise from slowly seeping groundwater or are derived from the limestone; these experiments provided evidence for lengthier discussions of nitrate origin, particularly in Hill [1981a, 1992]).
- 1984b Mineralogy of Cave Nitrates. In *The Cave Research Foundation 1974-1978* (Richard A. Watson, editor), pp. 174. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1976*, pp. 29; Hill briefly discusses the occurrence of nitrates in caves; nitrate minerals do not manifest in crystalline form in caves of the Mammoth Cave region, but deliquesce in the relatively high humidities and disperse into the soils; in contrast, crystalline forms have been found in caves in the arid Southwest; nitrate minerals are covered in much greater depth in Hill [1981b] and Hill and Forti [1997]).
- 1992 On the Origin of Cave Saltpeter: A Second Opinion - Reply. *The NSS Bulletin* 54(1):31-32. National Speleological Society, Huntsville, Alabama (Hill's response to Lewis [1992] addresses his criticisms of the seeping groundwater hypothesis for nitrate accumulation in cavern soils; she notes that nitrates are always found in dry passages, a result of slow capillary diffusion, because flowing water would leach away nitrates, and that if nitrates formed as a result of bacterial action on atmospheric nitrogen within caves, then all caves would be saltpeter caves; critical experimental evidence in support of origin by seeping groundwater, cited by Hill, is high nitrate values found up to 30 cm into cave bedrock, with little sign of decrease).
- Hill, Carol A. and Duane De Paepe
- 1979 Saltpeter Mining in Kentucky Caves. *Register of the Kentucky Historical Society* 77(4):247-262 (the authors note that saltpeter mining was important to the early economic development of Kentucky and, by contributing an item necessary to gunpowder manufacture, helped preserve national security in wartime; the article focuses primarily on describing the 1812-era mining operations at Mammoth Cave and briefly mentions operations conducted at a few regional caves; in addition to Mammoth Cave, the partnership of Wilkins and Gratz owned and operated two other nearby caves, Dixon and Short Cave; mining was also conducted at Long Cave and Forestville Saltpeter Cave, both located within present park boundaries, and Cedar Spring Cave and Coach Cave outside the Park; reference is also made to Great Saltpetre Cave).
- Hill, Carol A., Duane De Paepe, P. Gary Eller, and Peter M. Hauer
- 1984 Saltpetre Caves of the United States. In *The Cave Research Foundation 1974-1978* (Richard A. Watson, editor), pp. 227-229. Cave Books, St. Louis (originally published in *Cave Research Foundation Annual Report for 1977*, pp. 16-18; with a brief introduction, this report consists primarily of a table of 172 identified saltpeter caves listed by county for 13 states; Tennessee led the count with 67 known sites, followed by West Virginia with 26 and Kentucky with 20; the listing represented the first comprehensive inventory of saltpeter mine caves; a map of the eastern United States showing distribution of sites is included).
- Hill, Carol A., Duane De Paepe, P. Gary Eller, Peter M. Hauer, John Powers, and Marion O. Smith
- 1981 Saltpeter Caves of the United States. *The NSS Bulletin* 43(4):84-87. National Speleological Society, Huntsville, Alabama (for this compilation of known saltpeter caves, the authors note that the distribution of caves with nitrates has only slight relation to the distribution of limestone caves; the occurrence of saltpeter caves is generally limited to a region including parts of Kentucky, Tennessee, Virginia, West Virginia, northern Georgia and Alabama, southern Indiana, southern Missouri and northernmost Arkansas).
- Hill, Carol A., P. Gary Eller, Carl B. Fliermans, and Peter M. Hauer
- 1984 Saltpetre Conversion and the Origin of Nitrates in Caves. In *The Cave Research Foundation 1974-1978* (Richard A. Watson, editor), pp. 34-38. Cave Books, St. Louis (originally published in *1974 Cave Research Foundation Annual Report for 1974*, pp. 33-37; an "action history" experiment in saltpeter production was conducted in summer 1974 in Mammoth Cave National Park; based on documentary and archaeological evidence, a small-scale replication was made of the saltpeter production process commonly used in U.S. caves during the 18<sup>th</sup> and 19<sup>th</sup> centuries; a typical leaching V-vat was constructed using only hand tools, and approximately one bushel of saltpeter earth mined from Mammoth Cave; leach water was circulated through the vat several times, and a potash solution

produced from wood ashes added to the collected leachate to convert calcium nitrate to potassium nitrate; the leachate was concentrated in an iron kettle over an open fire; an analysis of the products of crystallization revealed the minerals schoenite, arcanite, and niter; refining of these products by fractional crystallization gave a calculated recovery of only 11% of the total nitrate present in the bushel of earth; the authors conclude that the historic nitrate production process was very inefficient, or the low yield may simply reflect the inexperience of the modern saltpeter-makers).

Hill, Carol and Paolo Forti

1997 *Cave Minerals of the World* (2<sup>nd</sup> edition).

National Speleological Society, Huntsville, Alabama (463 pp.; this lavishly illustrated volume covers 255 minerals known to occur in caves, classified using Dana's System of Mineralogy into categories of native elements, sulfides, oxide-hydroxides, halides, arsenates, borates, carbonates, nitrates, phosphates, silicates, sulfates, vanadates, and organic minerals; nitrates are covered on pp. 157-162; the authors note that the hygroscopic nature of most nitrate minerals precludes crystal formation in humid climates, the exception being niter (potassium nitrate); forms of nitrate other than potassium are dominant in cave soils leached for saltpeter, but in deliquescent rather than crystalline form: "When saltpeter earth was leached in the process of making gunpowder, the dissolved calcium and nitrate ions were removed, and upon evaporating the mother liquor leachate to dryness, a very deliquescent, nearly solid, thick slurry of nitrocalcite was obtained" [pg. 158]; Hill and Forti also note that sources of nitrates found in saltpeter earth are variable, including surface organic material, bat and rat guano, and basaltic rock, but that only nitrates derived from surface organic material and transported into cave environments by seeping groundwater can account for the multi-ton saltpeter deposits and short regeneration times; this volume contains a cave mineral bibliography of nearly 4,500 citations).

Hovey, Horace C.

1880a Eighty Miles of Caverns in Indiana. *Scribner's Monthly* 19(6; June):875-888, New York (though Hovey discusses several caves, most of his remarks are directed toward Wyandot Cave in Crawford County, Indiana; while touring the cave accompanied by Mr. Rothrock, the owner, Hovey recorded [pg. 878]: "The guide told us that he had left the larger part of the cave in its natural state... He next showed us some barrels of salts and saltpeter made from nitrous and magnesium earths that abound there"; the article contains a detailed

map [pg. 877] of the cave as it was known at that time).

1880b One Hundred Miles in Mammoth Cave.

*Scribner's Monthly* 20(6; October):914-925 (though largely a travelogue, of note is the observation [pg. 915] "The first objects exhibited to visitors are the relics of saltpeter works in the Rotunda. Ruts of cart-wheels and hoof-prints of oxen remain in the indurated clay, leading to the pumps, pipes, and eight large vats, from which, during the war of 1812, Mr. Archibald Miller took niter to Philadelphia by wagon, to be used in making gunpowder. Log benches are still exhibited where once sat swarthy miners...").

1897 Our Saltpeter Caves in Time of War. *Scientific American* 76:291 (Hovey emphasizes the historic

importance of nitrates mined from American caves to the conduct and ultimate victory in the Revolutionary War and the War of 1812; concerning the War of 1812, he notes the writings of Samuel Brown [see Brown 1809] and focuses upon the works at Mammoth Cave; Hovey makes several errors in his assumptions which have been revealed by more recent scholarship; he notes that the historic record does not indicate where the American colonies obtained gunpowder to wage the war of the revolution, stating that "a few pounds of saltpeter were made from excavations under old stables, and by artificial processes, but the bulk of it undoubtedly came from the caves of Virginia"; the chief source of gunpowder for the colonies was supplies smuggled in from our French allies; though insufficient as sole sources, more than "a few pounds" of niter were made by processing the earth from stables and cellars, and were significant to the war effort; the recently discovered saltpeter caves, however, played no significant role in the Revolution [see Calvert 1961; Howard 1976; Salay 1975; 1977]; Hovey is correct in attributing importance to saltpeter from Kentucky caves in the War of 1812, but his assessment of nitrate rock mining in Kentucky's sandstone shelters as too difficult and given up in favor of cave soil processing during the war period, is incorrect; archaeological site inventories in the unpublished files of the US Forest Service indicate that shelter rock mining was extensive in Kentucky).

Hovey, Horace C. and R. E. Call

1912 *Mammoth Cave of Kentucky*. Morton, Louisville (includes the following remarks [pg. 7] concerning Dixon Cave situated near Mammoth Cave: "Every foot of the floor was searched and overturned long ago by the industrious miners, who carried the niter-bearing earth outside to the vats and boiling tubs

whose ruins are yet visible. The miners left the rocky fragments within the cavern piled in what might be described as transverse stony billows, of which we counted eighteen; each waves being forty feet through at the base, and rising thirty or forty feet above the true floor"; 131 pp.).

Hunter, George

1963 The Western Journals of Dr. George Hunter, 1796-1805. *Transactions of the American Philosophical Society*, n.s. 53(4), (John F. McDermott, editor) American Philosophical Society, Philadelphia (an important primary reference on the niter mining industry in Kentucky, including a description of Great Saltpeter Cave in Rockcastle County and a detailed account of the mining and refining of saltpeter there).

Hutchinson, C. M.

1917 *Saltpetre: Its Origin and Extraction in India*. Superintendent Government Printing, Calcutta (24 pp.; the author provides an account of saltpeter production in India during the early 20<sup>th</sup> century; Hutchinson concludes: [1] that the present sources of nitrates are underexploited due to the practices of the saltpeter makers [nunia] and the low prices given for crude saltpeter; [2] artificial niter-beds would probably provide an additional source of saltpeter; [3] the methods of the nunia are inefficient and a better method of extraction needs to be developed; and [4] an increased demand for Indian saltpeter might be developed if trade practices are improved, such as standardization of the product and elimination of middlemen; the pamphlet is illustrated with several b/w photographs of saltpeter manufacture by the nunia).

Imlay, Gilbert

1797 *A Topographical Description of the Western Territory of North America*. Debrett, London (Imlay notes [pg. 135] that saltpeter "...is discovered in greater plenty on the waters of Green River, than it is in any other part of Kentucky"; 598 pp.).

Jackson, George F.

1949 Saltpeter Production in American Caves. *The NSS Bulletin* 11:24-27. National Speleological Society, Huntsville, Alabama (Jackson briefly discusses saltpeter production in the early 19<sup>th</sup> century, focusing primarily on Kentucky's Mammoth Cave and the Wyandott Cave of Indiana; also mentioned are Dixon Cave, located near Mammoth, and Donaldson Cave located in today's Spring Mill State Park in Indiana).

Jefferson, Thomas

1964 *Notes on the State of Virginia* (Introduction by Thomas Perkins Abernethy). Harper Torchbooks/

Harper & Row, New York (among the many topics discussed in this survey of the cultural and natural landscape of Virginia written at various times in the early 1780s and originally printed in Paris in a limited edition of 200 copies in 1785, Jefferson observes [pg. 30] "In the lime-stone country are many caves, the earthy floors of which are impregnated with nitre. On Rich creek [presently in West Virginia], a branch of the Great Kanaway, about sixty miles below the lead mines, is a very large one, about twenty yards wide, and entering a hill a quarter or half a mile. The vault is of rock from nine to fifteen or twenty feet above the floor. A Mr. Lynch, who gives me this account, undertook to extract the nitre. Besides a coat of the salt which formed on the vault and floor, he found the earth highly impregnated to the depth of seven feet in some places, and generally of three, every bushel yielding on an average three pounds of nitre. Mr. Lynch having made about ten hundred pounds of the salt from it, consigned it to some others, who have since made ten thousand pounds. They have done this by pursuing the cave into the hill, never trying a second time the earth they have once exhausted, to see how far or soon it receives another impregnation. At least fifty of these caves are worked on the Greenbrier. There are many of them known on Cumberland River"; several printings of this book have appeared).

Jha, Ashutosh K.

1996 Production of Saltpetre in Medieval India with Reference to Bihar. In: *56th Indian History Congress*, Rabindra Bharati University, pp. 468-470, Firma KLM Pvt., Calcutta, India (the province of Bihar in India was noted for saltpeter production during the 17<sup>th</sup> and 18<sup>th</sup> centuries, when the British erected and maintained five factories to refine the crude local product; prior to the British presence in India, Bihar saltpeter production was minimal; the city of Patna became the principal supply center and Hugli, Balasore, and Pipli the export ports; the author attributes the abundant natural nitrates in the soil of this region to organic matter contributed by a dense population and numerous domestic animals in the vicinity of each village, acted upon by the residues resulting from the practice of burning wood and animal dung for fuel, and favored by the presence of a warm and humid climate).

Jillson, Willard Rouse

1934 The Cascade Caves of Carter County, Kentucky. *Register of the Kentucky State Historical Society* 32:33-37 (saltpeter mining is briefly mentioned in this laudatory account of the caves in this Kentucky state park).



- 1954 *Geology of Crystal Cave in Southern Pulaski County, Kentucky*. Roberts Printing Company, Frankfort, Kentucky (39 pp.); Jillson provides a description and map of the cave, more familiar today as Sloans Valley Cave System; the map – the result of surveys made by Jillson and his students from Transylvania University in Lexington – shows a room labeled as the “Salt Peter Chamber”; his brief description of the artifacts in this room is invaluable to researchers, because the chamber was completely inundated by the creation of Lake Cumberland; Jillson notes the presence of “...25 calcined casts of old wooden vats or troughs used in leaching Saltpeter....The old vats were 7 feet long, 3 feet wide at the top, 3 feet deep and of a triangular pattern”; by “triangular” he is presumably describing V-vats).
- Johnson, Roxanne T.  
1989 *An Analysis of the Early Record Keeping in the Du Pont Company 1800-1818*. Garland Publishing, Inc., New York and London (105 pp.); Johnson’s study was intended to analyze the record keeping techniques and developments in du Pont account books, particularly in regard to the early introduction of double-entry bookkeeping; although much of this study will appeal mainly to those interested in the history of accounting, the case study of du Pont, the foremost U.S. manufacturer of gunpowder during the 19<sup>th</sup> century, illuminates a number of interesting aspects of the economics of gunpowder production; Johnson reviews the capitalization and establishment of the firm, cash flows, operating expenses and revenues, profits and losses during the study period, which included the War of 1812).
- Jones, Augustine  
1899 *The Life and Works of Thomas Dudley, the Second Governor of Massachusetts*. Houghton, Mifflin and Company, Boston and New York (due to social upheaval in England during the period 1642-1643 and feeling that the young colony might be in danger of attack from the enemies of England, it is noted [pg. 295] that: “‘This Court, taking into serious consideration the great danger that this commonweal [sic] is liable unto by foreign and domestic foes, which we have just cause to conceive will be ready, as opportunity and means are put into their hands to practice against us... [We should] tend to the raising and producing such materials amongst ourselves as may protect the making of gunpowder, the instrumental means that all nations lay hold on for their preservation.’ Then follows in the order directions that every plantation shall proceed to, produce saltpetre according to the directions therein given, placing the matter under the care of the military, that it may be executed promptly and faithfully”).
- Kain, John H.  
1819 Remarks on the Mineralogy and Geology of the Northwestern Part of the State of Virginia, and the Eastern Part of the State of Tennessee. *American Journal of Science* 1(1):60-67 (Kain devotes a significant proportion of his article to an account of the caves of the region, and notes that the numerous caves found in the Cumberland mountains and other parts of Tennessee have been very productive of saltpeter; he attributes the origin of these nitrates to an accumulation of organic matter, animal and vegetable, in the cavern soils).
- Leather, J. W. and Jatindra Nath Mukerji  
1911 *The Indian Saltpetre Industry*. Superintendent Government Printing, Calcutta, India (when this tract was written near the beginning of the 20<sup>th</sup> century, saltpeter production in India had been greatly curtailed by both the invention of smokeless powder and the expanded use of Chilean nitrates; in 1910, however, nearly 20,000 tons were exported from Calcutta for the world market; saltpeter production was still carried on in the traditional manner, through collection of organically-enhanced earth from existing and former village sites by a low caste of workers known as Nuniah; the crude saltpeter produced by these workers was sold to refiners who prepared a purer grade for export; the crude nitrate was made by leaching the nitrate-rich soil mixed with ashes in vats formed from mud and set into raised earthen beds, with drain holes in the front part of the bed; the weaker, secondary leachates and the spent earth are spread around the production area and allowed to renitrify and later reprocessed, over and over across a span of years; the stronger, first-run leachate was concentrated either by boiling in iron or earthen pans, or through sun-drying; the material sold to re-refiners consisted of a mixture of potassium nitrate and common salt; 19 pp.).
- LeConte, Emma  
1938 *A Journal, Kept by Emma Florence LeConte, from Dec. 31, 1864, to Aug. 6, 1865, Written in Her Seventeenth Year and Containing a Detailed Account of the Burning of Columbia, by One Who Was an Eyewitness*. Transcript prepared May 1938 by the Historical Records Survey of the Works Progress Administration, Transcript on file at Call number 420, Manuscripts Department, Southern Historical Collection, University of North Carolina at Chapel Hill Library, accessible at: <<http://docsouth.unc.edu/leconteemma/leconte.html>> (as the daughter of a

consulting chemist for the CSA Nitre and Mining Bureau and the niece of the superintendent of the Nitre Bureau works in Columbia [pg. 86], Emma LeConte was in a unique position to record minutia relating to the more day-to-day operations of the bureau in Columbia, South Carolina, in the final days before the fall of the city to Federal forces; of note is the information she provides regarding the personnel, workforce, and equipment of the Bureau's Columbia operation; her account is a useful supplement to the writings of her father [J. LeConte 1903:178-228; 1937] describing the same events:

- January 2, 1865 [pg. 3] – “Have just returned from Aunt Josie’s, where we spent the evening in company with Capt. and Mrs. Green. We had a very pleasant evening... Capt. Green of the Nitre Bureau is an odd sort of man, and his wife is awfully ugly”;
- January 18, 1865 [pg. 8] – “[When Columbia falls] ...perhaps we may run with Uncle John’s family to whatever point he moves the Nitre Bureau works”;
- January 21, 1865 [pg. 9] – “Everyone seems to feel that Columbia is doomed. Aunt Josie thinks we had all better run off with the Nitre Bureau and camp in the woods of North Carolina till danger is over”;
- February 5, 1865 [pg. 16] – “Aunt Josie says... We are to travel out of the track of the enemy and stop at some little village until Columbia is out of danger, or until it is decided where the Nitre Bureau will be located”;
- February 22, 1865 [pp. 44-45] – “We learned from Sandy that the negroes at the nitre plantation... have taken possession of and brought home some of our things”;
- March 7, 1865 [pg. 50] – after the LeConte family’s clothes were stolen “The officers of the Nitre Bureau contributed, throwing in shirts, collars, socks, etc.”;
- March 12, 1865 [pg. 54] – “Hearing that many articles were taken from the Nitre Bureau negroes, Aunt Josie went forth with high hopes, but all she recovered was a portion of one of her dresses and the flounce of my green embroidered silk”;
- April 16, 1865 [pg. 63] – “News came today that Camden [South Carolina] was taken by the [CSA] raiders, so there is some chance of getting our rice after all - (rice stored there belonged to the Nitre Bureau)”;
- May 29, 1865 [pg. 76] – following the collapse of the Confederacy, “Poor father is looking very badly... and is very much troubled. He can get no employment and not one cent of money in the house. ...In the meantime, a flatboat belonging to the Nitre Bureau has been secured to father by Uncle John in

payment of salary due”).

LeConte, Joseph

- 1862 *Instructions for the Manufacture of Saltpetre*. Charles P. Pelham, State Printer, Columbia, South Carolina (brief directions for the production of nitre from both cave soil and manure; accessible at <[http:// metalab.unc.edu/docsouth/index.html](http://metalab.unc.edu/docsouth/index.html)>; 14 pp.).
- 1903 *The Autobiography of Joseph LeConte* (William Dallem Armes, editor). D. Appleton and Company, New York (as a CSA major, LeConte served as consulting chemist to the Nitre and Mining Bureau during the Civil War; see particularly pp. 178-228 for an account of his wartime service and experiences; accessible at <<http:// docsouth.unc.edu/leconte/leconte.html>>; xvii + 337 pp.).
- 1937 *Ware Sherman, A Journal of Three Months' Personal Experience in the Last Days of the Confederacy*. University of California Press, Berkeley (though largely autobiographical, there is useful information on LeConte’s role as consulting chemist for the Confederacy’s Nitre and Mining Bureau and his efforts to safeguard the equipment used for nitre production during the last days of the war; xxxi + 146 pp.).

Lemery, Louis

- 1719 *Mémoire sur le Nitre* (Treatise on Nitre), pp. 31-51, 122-146. In *Histoire de l'Académie Royal des Sciences* (History of the Royal Academy of Sciences), multivolume 1699-1790. Volume for 1717. Paris (493 pp.; French chemist Lemery discovered that some plants contain substantial proportions of nitre and in an influential 1717 paper proposed a theory that nitre followed a cycle through plants and animals).

Lewis, Warren C.

- 1988 Another Look at Saltpeter Rock Mining Activity in Dixon Cave. *Journal of Spelean History* 22(3):3-5 (referring to George [1987a], Lewis provides additional analysis and interpretation of the activity at Dixon Cave, a saltpeter mining site located in Mammoth Cave National Park, Kentucky; in contrast to George, who believed soil excavations in this particular cave were minimal, Lewis suggests that the original soils may have been processed prior to the rock mining and that traces of this work were eradicated by subsequent activity; discussing George’s analysis, he notes in conclusion that George has made a significant contribution by recognizing and documenting rock mining in Dixon Cave).
- 1989 Some Historical Speculations on the Origin of Saltpeter. *NSS Bulletin* 51:66-70, National

- Speleological Society, Huntsville, Alabama (Lewis reviews the classic works of philosophers, alchemists and scientists from ancient times to the early 19<sup>th</sup> century regarding the origin of saltpeter, focusing on the period from the mid-15<sup>th</sup> to late 18<sup>th</sup> century; see citations for Biringuccio [1943 (1540)], Agricola [1950 (1556)], Glauber [1689], Mayow [1907 (1674)], Lemery [1719], Boerhaave [1727], and Academié des Sciences [1776; 1786] which are among the works included in Lewis' discussion).
- 1990 The Collector of Saltpeter. *Journal of Spelean History* 24(1):13-14 (an interesting essay upon the occupation of the European saltpeter hunters, who combined practical knowledge with resourcefulness in the practice of their trade; they roamed the countryside in search of the special conditions that allowed niter to accumulate in quantities sufficient for extraction; their work was often odious, for their quarry was to be found in dung heaps and compost piles, stables and sheep pens and privies, wherever organic matter lay protected from the weather; the saltpeter men searched beneath the floorboards of dwelling places, scraped the masonry of cellars and foundation walls, and worked the dry caves and rock shelters and clifflines, where slow seepage might leave telltale saltpeter crusts; in wartime, the demand for their product was such that the saltpeter makers were, by royal edicts, permitted great liberties on otherwise private property; observing the association of niter with decomposing organic matter, many nations constructed artificial compost beds specifically for saltpeter production).
- 1991 Saltpeter Beds: A Review of Nitrate Production in Compost Heaps. *The NSS Bulletin* 53(2):89-97, National Speleological Society, Huntsville, Alabama (Lewis discusses artificial production of nitrate in Europe from the 14<sup>th</sup> through the 18<sup>th</sup> centuries, an era in which organic matter was composted in various mixtures, with various additives intended to accelerate production or increase yield; for his review, Warren draws upon many of the classic sources, such as Agricola [1556], Biringuccio [1540], and Ercker [1574]; an extensive discussion of the microbiology involved in nitrate production is included, and the author notes the handicap suffered by the saltpeter makers in their experiments due to a lack of knowledge of the role of bacteria).
- 1992 On the Origin of Cave Saltpeter: A Second Opinion. *The NSS Bulletin* 54(1):28-30. National Speleological Society, Huntsville, Alabama (Lewis takes exception to the theory that nitrates accumulate in cavern soils by groundwater transport from external sources; instead, he argues, nitrate formation is a consequence of the action of bacteria within dry caves, not in contact with moving water, that utilize nitrogen within the cave atmosphere).
- 1997 Saltpeter in Ancient Writings of the Middle-East. *Journal of Spelean History* 31(2):24-26 (long before the discovery of gunpowder, nitrates were used by ancient civilizations, including the Sumerians, Assyrians, and Egyptians, as components in medicinal remedies and in the production of hardened copper, soap, and glazes for pottery; as Lewis notes, in summary: "Mastery of the processes of solution, concentration by boiling, treatment with alkali, filtration, and repeated crystallization from concentrated solution show a high level of development of practical chemistry by these early people").
- Loveless, A. M.  
1962 Saltpeter Caves in the Cumberland Gap National Historical Park. *Daily News* 52(22; April 24), Middlesboro, Kentucky (short article on a saltpeter cave near the junction of Kentucky, Tennessee, and Virginia; this site was likely mined during or before the Civil War).
- McGrain, Preston  
1966 Geology of the Carter and Cascade Caves Area. *Special Publication* 12. Series X. Kentucky Geological Survey, Lexington (32 pp.; this small book describes the regional geologic setting and provides maps and descriptions of individual caves and notes other geologic features of interest; the remains of nitrate mining works in Saltpeter Cave, located in Carter Caves Park, are briefly noted, and two b/w photographs of artifacts and excavations in that cave are included; see Duncan [1993; 1995] for accounts of modern archaeological investigation at Saltpeter Cave).
- Malone, Dumas (editor)  
1930 *Correspondence Between Thomas Jefferson and Pierre Samuel du Pont de Nemours*. Boston (includes discussion of niter mining).
- Mansfield, G. R. and Leona Boardman  
1932 Nitrate deposits of the United States. *Bulletin* 838, U.S. Department of the Interior, Government Printing Office, Washington (account of the distribution of nitrate deposits in the U.S., divided into three kinds, cave deposits, caliche deposits, and playa deposits; includes a brief history of the commercial extraction of nitrates and relates the contemporary theory for accumulation of nitrate salts in caves as a result of the leaching and redeposition of nitrates formed near the surface by the activity of nitrifying bacteria on organic matter).
- Mason, Otis T.  
1876 The So-Called Pygmy Graves in Tennessee. *Harper's New Monthly Magazine* 54(319);



December):43-48, New York (though largely concerned with the Middle Mississippian "stone box graves" in the Cumberland River Valley, Mason notes [pg. 43] "Owing to the nitre in the soil of the caves, the corpses have not altogether decayed, the flesh being dried up and the hair turned red or yellow. The working of the caves for saltpetre during the last century has nearly destroyed these witnesses of ancient civilization...").

Matthews, James Muscoe. (editor)

1862 *Public Laws of the Confederate States of America, Passed at the First Session of the First Congress; 1862*. R. M. Smith, Printer to the Congress, Richmond (of note herein is Chapter XXVI [pp. 27-28] entitled "An Act for the Organization of a Corps of Officers for the Working of Nitre Caves and Establishing Nitre Beds": this act reads as follows:

"The Congress of the Confederate States of America do enact, That for the purpose of procuring a supply of nitre, adequate to the wants of the Government, during the continuance of the war with the United States, the President be, and is hereby, authorized to appoint a corps of officers, consisting of one superintendent, with the rank, pay, and allowances of a major of artillery, four assistants, with the rank, pay, and allowances of captain of artillery, eight subordinates, with the rank, pay and allowances of first lieutenants of artillery.

Sec. 2. The duties of the officers, under the supervision of the Chief of Ordnance, shall be to inaugurate and prosecute a system for the efficient working of the nitre caves, and to purchase and contract for the delivery of nitre produced within the limits of the Confederate States; to inspect the nitre caves and other natural deposits of nitriferous earth, and to report the probable annual supply from these sources, and the extent and economy, or otherwise, with which they are now being worked by private enterprise; to establish nitre beds in the vicinity of the principle cities and towns of the Confederacy, and to contract for the necessary grounds, sheds, etc., and for the offal and other materials used in the preparation of nitre beds; to diffuse information and to stimulate enterprise in the production of an article essential to the successful prosecution of the war.

The superintendent will make reports, at stated periods, to the Chief of Ordnance, to be submitted to the Secretary of War, for the information of Congress. This organization to be continued at the discretion of the president.

Approved April 11, 1862").

1863 *The Statutes at Large of the Confederate States of America, Passed at the Third Session of the*

*First Congress; 1863. Carefully collated with the Originals at Richmond*. R. M. Smith, Printer to Congress, Richmond, Virginia (pg. 104: "CHAP. XI.--An Act to alter and amend An Act entitled 'An Act for the sequestration of the estates, property and effects of alien enemies and for indemnity of citizens of the Confederate States, and persons aiding the same in the existing war with the United States,' approved August 30, 1861, and An Act altering and amending the same, approved on the 15<sup>th</sup> day of February, 1862.

"The Congress of the Confederate States of America do enact, That any district court of the Confederate States may, in its discretion, direct any of its receivers to lease out any sequestered land within his district, on which are any mines or beds of copper, lead, iron, coal, saltpetre or other minerals, for a period not exceeding three years, and in such manner, and upon such terms as the court may prescribe, and such orders may be made, either by the court, or by the judge thereof, in vacation. "APPROVED April 2, 1863")

Matthews, Larry E.

1971 Descriptions of Tennessee Caves. *Bulletin No. 69*, Division of Geology, Tennessee Department of Conservation, Nashville (brief discussions of several caves in eastern and middle Tennessee mined for saltpeter; see particularly "Saltpeter Mining Artifacts in Tennessee Caves" [pp. 3-21] which contains a number of excellent photographs of various types of well preserved niter leaching vats and other items of equipment such as tools and wooden water pipes; 150 pp.).

Mawson, Douglas

1930 The Occurrence of Potassium Nitrate Near Goyder Pass, McDonnell Ranges, Central Australia. *Mineralogical Magazine* 22:231-237.

Maxon, Ralph Nelson

1932 The Niter Caves of Kentucky. *Journal of Chemical Education* 9(11):1,847-1,864 (largely drawn from Brown [1809], Maxon's paper primarily examines the process of removing nitrates from cave soil).

2001 The Niter Caves of Kentucky. *Muzzle Blasts* 62(9; May):77-80. National Muzzle Loading Rifle Association (slightly condensed version of above).

Mayow, John

1907 On Sal Nitrum and Nitro-Aerial Spirit. In: *Medico-Physical Works: Being a Translation of Tractatus Quinque Medico-Physici*, pp. 1-182. *Alembic Club Reprints No. 17*, The Alembic Club, Edinburgh, Scotland (331 pp.; originally published in Latin in 1674; Mayow (1643-1679), a Fellow of Royal Society of London, came close to anticipating

Lavoisier's theory on the role of oxygen in combustion; in Mayow's experiments on the nature of combustion, he determined that air could exist in two states, one that would support combustion and one that would not, being exhausted of some necessary substance; drawing a parallel to the incendiary nature of saltpeter, he proposed that air supporting combustion contained particles he named "nitro-aerial"; these particles were present in both air and saltpeter and were responsible for the ability of each to support combustion; saltpeter originated through a process of attraction by which loose, dry earth draws sal nitrum (saltpeter) from the air; in his essay, *De sal-nitro et spiritu nitro-aereo*, he wrote "But although the spirit of nitre does not proceed altogether from the air, still we must believe that some part of it originates from the air. For, since some part of the nitre is derived from the air, as has been shown above, while the fixed salt, of which nitre in part consists, proceeds from the earth, the remainder of the nitre, that is to say, its acid and fiery spirit, must be derived, in part at least, from the air" [pg. 8]; according to Mayow, this would account for the phenomenon in which earth leached of saltpeter regenerates its nitrate content in time; little notice was taken of Mayow during his own lifetime, but his ideas were recognized a century later as precursors to the role of oxygen)

Meenehan, John

- 1984 Slick Mud to Dry Powder. *National Speleological Society News* 42(7):232-235 (a rather breathless account of the involvement of George Washington Rains, of North Carolina, in saltpeter mining and gunpowder manufacture during the Civil War; the article is largely taken from B. Davis [1982] and is enhanced by the inclusion of many photographs of niter mining and processing artifacts from several saltpeter caves).

Meloy, Harold

- 1968 *Mummies of Mammoth Cave*. Micron Publishing Company, Shelbyville, Indiana (reprinted 1977; an account of the most famous mummies discovered during niter mining operations at Short, Mammoth, and Salts caves, Kentucky; 42 pp.).

Meriam, Ebenezer

- 1834 (untitled article). *Kentucky Intelligencer* 2(15; September 30):2 (cited in Faust 1967; of particular note is Meriam's recollection of Kentucky's Mammoth Cave that "A narrow winding foot-path conducted us to the mouth of the Cave, near which are the ruins of several furnaces, constructed many years since, and employed in the manufacture of Saltpetre, and about fifty iron kettles, used for the same purpose").

- 1844 Mammoth Cave. *New York Municipal Gazette* 1(17; February 21):317 et seq., New York (cited in Faust 1967; Meriam worked in this cave during the War of 1812 and provides one of the few first-hand accounts of its operation during that conflict).

Miles, W. D.

- 1961 The Civil War: A Discourse on How the Conflict was Influenced by Chemistry and Chemists. *Chemical and Engineering News* 39:108-123 (cited in Eller 1981; focus on the significance of niter production as a chemical industry).

Mitchell, Samuel Latham

- 1803 Frederick Hoffman's Essay on the Dissimilarities of Fixed Vegetable Alkaline Salts. *Medical Repository* 6:364-365.
- 1806 Caverns in Virginia, Kentucky, and Tennessee, Which Afford an Inexhaustible Supply of Salt-Petre. *Medical Repository* 9:86-87 (numerous caves are present in the limestone strata of Virginia, Kentucky, and Tennessee, which contain an "earthy substance...useful in the manufacture of salt-petre"; the nitrate supply available from these caves is inexhaustible, since leached earth, when replaced, will regenerate in about three years, so that "There seems to be no end to the possible repetition of these processes...."; Mitchell declines to speculate on the origin of cave nitrates, observing there is insufficient knowledge at the present time).

Mueller, G.

- 1968 Genetic Histories of Nitrate Deposits from Antarctica and Chile. *Nature* 219:1131-1134 (Mueller hypothesized that Chilean nitrates were derived from saline groundwater originating in Andes mountains, which accumulates in topographically low salt pan basins between western coastal foothills and the eastern mountains; concentrated salts with relatively low solubilities (such as sulfates and chlorides) precipitate into salt pans whereas the more soluble salts (such as nitrates) ascend by capillary action up the slopes of the dry coastal foothills and precipitate by evaporation near the surface of the porous soils; nitrate deposits along the western side of the Ross ice shelf, formed in the arid Antarctic climate where leaching and biological activity are likewise minimal, exhibit the same trends of vertical distribution as the salt deposits of Chile).

Mullin, Marsha A.

- 1986 Historic American Engineering Record: Mammoth Cave Saltpetre Works. HAER KY-18. Manuscript on file, National Park Service, Mammoth Cave, Kentucky (32 pp., 15 plates; project historian Mullins has compiled a detailed inventory and description of the existing remains of

the Mammoth Cave saltpeter works, combined with a thoroughly researched history of production at the site; this account serves as compelling justification for inclusion of Mammoth Cave among the more significant archaeological sites in American industrial history; an extensive bibliography is included, and an appendix of 15 full-page illustrations; these include 19<sup>th</sup> century lithographs depicting aspects of the mining and processing operation, site plans representing current archaeological interpretations, and engineering diagrams of the processing apparatus; see also Borresen [1941; 1942]).

Multhauf, Robert Phillip

- 1971 The French Crash Program for Saltpeter Production, 1776-94. *Technology and Culture* 12(2):163-181 (see also Académie des Sciences 1776; 1786).

New York [State] Committee of Safety

- 1776 *Essays upon the Making of Salt-Petre*. Loudon, New York (39 pp.; Library of Congress. Just prior to and during the Revolutionary War, several Committees of Safety of the various colonies caused instructions for the making of saltpeter and gunpowder to be published, either in local newspapers or as separate tracts; the pamphlet begins with an essay by Dr. Benjamin Rush [see also Aber, 1796] on saltpeter-making, reprinted from the *Pennsylvania Journal*; a short piece on the method of making saltpeter in the kingdom of Hanover, 1766; the instructions published in local papers by the Massachusetts Committee of Safety in 1775 [by Dr. William Whiting]; the instructions of the Philadelphia Committee of Safety in 1776 [attributed to Rush]; Capt. Pryor and Thomas Paine's experiments on making saltpeter; and a short piece on gunpowder manufacture by Henry Wisner of Pennsylvania [see also Burdge 1898]).

Nichols, H. W.

- 1901 Nitrates in Cave Earths. *Journal of Geology* 9:236-243 (Nichols's paper is principally a critique of Hess [1900], previously published in the same journal; Nichols takes issue with the Hess theory by which nitrates produced by bacteria in surface soils are transported into caves by seeping groundwater and deposited through evaporation; Nichols supports nitrate origin intrinsic to the cave, derived from bat guano and other organic material; he argues, in rebuttal to Hess, that bats do frequent distant parts of caves which would account for remote nitrate deposits; that cave earths do contain quantities of organic matter, and that the lesser amount of soluble phosphates in cave earths, compared to guano, is accountable to a reversion from soluble to insoluble

forms; Nichols further criticizes the interpretation given by Hess to analysis of soils and drip water in caves; modern research appears to provide support for Hess's seeping groundwater theory rather than the guano theory [see also Hill 1981a, 1992; Olson and Krapak 1995]).

Niles, Jason

- 1963 *Diary of Jason Miles, June 22, 1861-December 31, 1864*. Ms. transcribed 1963, on file in the Southern Historical Collection, University of North Carolina, Chapel Hill (in the course of a visit to Mammoth Cave, Kentucky, on June 25, 1861, Niles observed [pg. 3] : "We saw the tracks of carts or wagons inside, used in the manufactures of saltpetre, long ago...").

O'Dell, Gary A.

- 1990 A Sketch of the Saltpeter Manufacturing Millennium in World History. *Journal of Spelean History* 24(4):22-31 (traces the production of nitrates and their use in gunpowder manufacture from ancient China to the advent of modern smokeless powder).
- 1992a Great Saltpetre Cave. In *Rockcastle County, Kentucky, and Its People*, pg. 44. Don Mills, Waynesville, North Carolina (380 pp.; the Rockcastle book is typical of many modern county histories, consisting of numerous short recollections of people and places; Great Saltpetre Cave played an important role in the early history of the county and remains today a well-known regional landmark; this brief summary of the cave's known history is largely based upon the work of Brown [1809] and George [1987b; 1988d; 1990b] and the author's own acquaintance with the site; see also Collins [1847]; De Paeppe [1981b]; O'Dell [1992c]; White [1967]).
- 1992b Rockcastle's Underground Wilderness. In *Rockcastle County, Kentucky, and Its People*, pp. 48-49. Don Mills, Waynesville, North Carolina (380 pp.; a general description of the karst features and history of cave exploration in this region of southeastern Kentucky which includes a strong conservation message and a brief section on saltpeter mining activity).
- 1992c Saltpeter Mining in Rockcastle County. *Mount Vernon Signal*, 7 May, section 2:1.
- 1995 Saltpeter Manufacturing and Marketing and Its Relation to the Gunpowder Industry in Kentucky During the Nineteenth Century. In: *Historical Archaeology in Kentucky* (Kim A. McBride, W. Stephen McBride, and David Pollack, editors), pp. 67-105. Kentucky Heritage Council, Frankfort (a detailed examination of the saltpeter industry in Kentucky during the 19<sup>th</sup> century, focused primarily upon the early 1800s and the role of Kentucky's



- nitrate industry in the War of 1812; production processes, location of saltpeter mining sites, marketing practices and factors, and individuals prominent in the Kentucky trade are discussed).
- Olson, Rick and Ivan G. Krapak  
1995 Regeneration of Nitrates in Mammoth Cave Sediment: A Mid-term Report. In: *Proceedings Mammoth Cave Park's 4<sup>th</sup> Science Conference* (editor not given), pp. 109-116, National Park Service, Mammoth Cave, Kentucky (experimental data derived from sediment samples of Mammoth Cave by Olson and Krapak tend to support the Hess [1900] hypothesis for the occurrence of cave nitrates; Hess proposed the first seeping groundwater hypothesis for the origin of nitrates in caves in which bacteriological decomposition of surface organic mater released nitrate ions which were subsequently transported into caves by percolating groundwater; more recently, Hill [1981; 1992] has proposed a process by which nitrifying bacteria in both surface soils and the underground environment acted upon nitrogen compounds transported by groundwater to the site of deposition; local groundwater seepage is attracted to caves and shelters due to a moisture-density gradient within the bedrock created by evaporation at the bedrock interface thus resulting in concentration of nitrate salts; see also George [1986], Lewis [1992], and Thrun [1982]).
- Osterlund, Marilyn  
1982 The Location and Size of Saltpeter Mining Caves in Tennessee, Alabama, and Georgia. In: *National Cave Management Symposia Proceedings* (Ronald C. Wilson and Julian J. Lewis, editors), pp. 105-109. Pygmy Dwarf Press, Oregon City, Oregon (brief examination of various saltpeter caves mined during the Civil War by the Confederacy).
- Pace, Norm  
1971 Caves and Saltpetre: A Novel Hypothesis for Saltpetre Formation. *Caving in the Rockies* 13:7(October):2-4. Colorado Grotto, National Speleological Society (reprinted as "A Novel Hypothesis for Saltpetre Formation" in [1978] 1971 *Speleo Digest*, John E. Cooper, editor, pp. 245-246, National Speleological Society, Huntsville; Pace proposed a variant of the seeping groundwater hypothesis for the origin of nitrate deposits in cave soils; according to Pace, saltpeter caves are found in regions of deciduous forest, where bacterial action on decomposing organic matter releases ammonia from plant proteins which is transported by groundwater percolation into the underlying bedrock and emerges into the cave atmosphere [pg. 4]: "Nitrifying bacteria resident in cave soils could utilize this ammonia as a source of energy, depositing nitrate as the oxidation end product"; his theory, differing from recent conceptualizations by postulating nitrate deposition based on ammonia in the cave atmosphere, resembles that of Lewis [1992], in contrast to bacterial action on seepage-derived ammonia within cave soils and bedrock [see esp. Hill 1978; 1981; 1984a; 1992; Hess 1900; Nichols 1901]).
- Parsons, Katherine Loomis  
1891 The Natural Bridge of Virginia. *The New England Magazine* 10(5; July):590-606, Boston (largely descriptive of this well known natural formation; the author remarks [pg. 598] "Some half mile from the bridge, the irregular opening of Saltpetre Cave appears at the base of a great bluff"; a well executed lithograph of this cave appears on pg. 601).
- Peterson, Richard  
1967 Saltpeter Mining in the Civil War. *D. C. Speleograph* 23:46-48. District of Columbia Grotto, National Speleological Society (a very brief overview of Confederate niter production, mentions establishment of the Niter and Mining Bureau, efforts to promote small scale home production, and the role of Virginia as the leading supplier of cave saltpeter; Peterson's statement, "Since few if any records exist as to the actual method of operation of running these caves when they were being mined, our knowledge of what occurred at the mine itself is based mostly on the relics that remain," has proved erroneous, as such documentation has proved ample despite the destruction of a large part of the Bureau's records at war's end; see "Literature Overview" in the Introduction to this bibliography; this paper was also published in *Speleo Digest* [Gary E. McCutchen, editor], 1967, pp. 42-44, National Speleological Society, Huntsville, Alabama.).
- Plemons, Douglas W.  
1995 The Nitre Gardener's Guide and Home Companion: The Saltpeter Cave Survey, 1994. *Journal of Spelean History* 29(1):3-40 (a compilation of U.S. cave sites believed to have been mined for niter, comprising 669 caves located in 15 states; this survey was stimulated by a desire to improve upon the site survey reported in Hill et al. [1981]; unlike many other such surveys based largely on place name information, the author has attempted to provide site verification by use of a scale in which sites are ranked according to "Definitely Mined," "Suspected to Have Been Mined," and "Questionable Site"; Plemons acknowledges that one significant source of potential error in a survey of this nature derives from

a site being known under multiple names; he further observes that there are likely to be far more saltpeter caves in existence than have been reported).

Powell, Richard L.

1961 Caves of Indiana. *Circular No. 8*, Geological Survey, Indiana Department of Conservation, Bloomington (provides descriptive and locational data for known or suspected saltpeter caves in the following counties in southwestern Indiana; Crawford, Monroe, and Washington; see pp. 28, 34, 35, 39, 44, 76-78, 90, 102, and 115; 127 pp. + map).

Powers, John

1981 Confederate Niter Production. *The NSS Bulletin* 43(4):94-97. National Speleological Society, Huntsville, Alabama (during the Civil War, nitrates were obtained by the Confederate states from both cave and non-cave sources to answer a chronic shortage of gunpowder; as the war progressed, the Nitre and Mining Bureau expanded and increased saltpeter production so that the South would have been independent of importation if the necessary territory could have been held; according to Powers, "Confederate niter production was successful because of geographic, historic and economic advantages, governmental assistance and capable administration").

Price, G. W. F.

1862 *Artificial Production of Nitre: Containing Practical Directions Concerning the Formation and Cultivation of Nitre Beds, the Cost of the Fixtures Employed, and Estimates of the Productiveness of Capital Invested in Making Saltpetre*. Montgomery Advertiser Book and Job Printing Office, Montgomery, Alabama (23 pp.; an informative and detailed description of the process of establishing and working niter beds; a useful supplement to the better known guide on the topic authored by LeConte [1862]; the author notes [pg. 7] that "Beds have been founded in our own District [Nitre and Mining District No. 10 based in Auburn, Alabama], embracing Middle and Southern Alabama, in Mobile, Selma, Montgomery, Talladega and Tuscaloosa").

Procter, John R.

1898 The Mammoth Cave of Kentucky. *The Century Magazine* 55(5; March):643-658, New York (though largely concerned with the geology of the cave, the author notes [pg. 649] "The saltpeter vats erected in 1812, and the timbers which have remained in their present position since then, show no evidences of decay. In these vats the saltpeter was leached from the nitrous earth abounding in the upper and middle dry avenues, and was used for the manufacture of gunpowder. The War of 1812 was fought, on the

American side, with gunpowder made from saltpeter taken from caves, and Mammoth supplied the greater part").

Rains, George Washington

1861 *Notes on Making Saltpetre from the Earth of Caves*. Steam Power Press Chronicle & Sentinel, Augusta, Georgia (Rains, commander of the CSA powder mill at Augusta, Georgia, describes the process, using barrels as leaching vats, by which cave nitrates can be refined into saltpeter on a small scale: "...so simple that any one residing in the neighborhood of a cave in limestone rock ...can without any expense make at least a few pounds of the salt every day ...the individual who makes a pound of saltpeter each day, contributes more to the ultimate success of his country, than if he shouldered his musket and marched with all his sons to the tented field"; Rains notes that a refinery had been established at Nashville capable of purifying 5000 pounds of crude saltpeter daily, and that the Confederate government was then offering 35 cents per pound for saltpeter; the final section describes the process of purification on small scale, based on the method used by the British government powder works at Waltham Abbey).

1862 *Notes on Making Saltpetre from the Earth of Caves*. Chas. K. Wynne, Printer, Richmond, Virginia (15 pp.; reprint of 1861 above; other printings of this booklet likely appeared throughout the Confederacy).

Redman, John C.

1894 The Republic of Brazil. *The New England Magazine* 15(6; February):701-723, Boston (briefly notes [pg. 716] there "...exist important deposits of saltpetre..." in the state of Minas, Brazil).

Robin, O[scar]

1861 *Report of O. Robin, Special Commissioner Deputed to Ascertain Where Saltpetre Could be Procured*. Bulletin Book and Job Office, New Orleans, Louisiana (8 pp.; Robin notes that caves are the places most suitable for the formation of saltpeter, and comprise the richest sources; of those states within the Confederacy, saltpeter was abundant only in Arkansas, Alabama, and Tennessee, but the mines in the latter two had been worked nearly to exhaustion; Robin visited Arkansas to determine the state's potential for saltpeter production, and reported that there were many saltpeter caves with substantial nitrate deposits, particularly in the vicinity of the White River; only a few of these caves were being worked, and the region had great potential to supply the government).

Ross, W. H.

1914 The Origin of Cave Nitrate Deposits. *Popular Science Monthly* 85:134-145 (Ross presents a review of the various theories accounting for the origin of nitrate deposits in caves and in the soils of certain desert regions; he begins with a discussion of the derivation of inorganic nitrogen compounds [e.g., nitric acid, metallic nitrides, ammonium salts], but devotes the greater part to organic process, which "are by far the most important in bringing about the fixation of nitrogen and the formation of nitrates" [pg. 135]; nitrogen-fixing bacteria, some associated with leguminous plants, convert atmospheric nitrogen into nitrates; nitrifying bacteria in soils convert protein nitrogen from decomposing organic matter into nitrates; nitrate deposits in caves are generally attributed to the decomposition of animal remains and particularly to bat guano, but Ross notes that there are alternative theories such as the transport of surface-derived nitrates by seeping groundwater proposed by Hess [1900]; in discussing the theories accounting for the nitrate deposits of Chile, Ross observes [pg. 143] that the most widely-held views attribute the origin of these nitrates to "decomposition of organic matter brought into the basins in which they are found from outside sources"; those theories proposing an inorganic derivation have not received general acceptance; modern scholarship [see Mueller 1968] indicates an inorganic origin, salts being transported by groundwater from distant locations and accumulating near the surface in a stratified sequence through capillary action and subsequent evaporation).

Ruchhoft, Robert H.

1986 *Kentucky's Land of the Arches: A Descriptive Guide of Kentucky's Red River Gorge in the Daniel Boone National Forest and Natural Bridge State Park* (2<sup>nd</sup> edition). Purcell Press, Cincinnati, Ohio (168 pp.; the author notes [pg. 21] that two niter sites are known in the Red River Gorge area; attributing these sites to activities undertaken during the War of 1812 or the Civil War, he observes:  
- [pg. 21] "In recent times two such [niter] mines have been rediscovered. One of them is in Natural Bridge State Park. Unfortunately, vandals have either destroyed or carried off all evidence of the original mine";  
- [pg. 87] that "In 1959, three men accidentally discovered the huge rock shelter at the end of... [the Boon Hut Loop] trail. Although it is not the largest one in the area, it is the only monstrous one on public ground that requires considerably less than a mile walk before the hiker is under its stone canopy. The men also discovered the remains of a 'niter mine' in the shelter which is [now] protected by a

chain link fence... Due to the recent rediscovery, much of the original equipment of the mine is still intact"; located in the rugged terrain of Powell County, [eastern] Kentucky, it is believed that this shelter was mined "during the War of 1812 and possibly during the Civil War").

Schafer, Louis S.

1994 Colonel George Washington Rains Worked Wonders with the Confederacy's Nascent Nitre Bureau. *America's Civil War*, May issue, pp. 20-24 (Rains is perhaps best known for his association with the Augusta Powder Works [see esp. Savas 1991], but as part of his Herculean effort to provide the Confederacy with adequate stocks of gunpowder he also sought to increase the always scarce supply of saltpeter, the primary ingredient he needed to make gunpowder; Rains sent teams to investigate caverns throughout the South for niter production potential and organized corps of workers to dig saltpeter earth from privies and latrines, as had been done during the Revolution nearly a century earlier; one puzzling reference by Schafer is his statement [pg. 20] that "...Confederate laborers worked low grade nitre (or niter) deposits within the lengthy limestone caverns of Kentucky. However, the vast majority of these underground passageways were captured by invading Union forces in early 1862"; unfortunately, Schafer's account was written for a popular audience and contains no citations; though several writers have assumed niter mining took place in Kentucky during the Civil War, to our knowledge there exists no documentation of this, not in the *Official Records of the War of the Rebellion* or the *Southern Historical Society Papers*, nor in any contemporary accounts we have been able to locate; further, there is no evidence that any Kentucky saltpeter caves were captured by Union troops, although this did occur later in the war in some of the Confederate niter-producing regions; finally, it appears unlikely that Kentucky's niter deposits were, as a rule, more or less rich than those of other regions, certainly not to the extent of being "low-grade" by comparison; niter mining during the Civil War may have occurred in Kentucky, but likely only in border regions and of small-scale at best).

Schwab, J. C.

1901 *Confederate States of America, 1861-1865: A Financial and Industrial History of the South During the Civil War*. Scriber, New York (notes [pg. 270] the economic and administrative assistance given to the southern niter industry by the CSA government).

Secretary of the Treasury (CSA)

1863 *Report of the Secretary of the Treasury*,



January 10, 1863. Printed for the Confederate Government, Richmond, Virginia (Call number "1182 Conf.," Rare Book Collection, University of North Carolina at Chapel Hill Library; this report from CSA Secretary of the Treasury C. G. Memminger to Hon. T. S. Bocock, Speaker, House of Representatives, contains the following niter-related expenditures:

- [pg. 21] - "Estimates of appropriations required for the support of the Government, for the period from February 1<sup>st</sup>, to June 30, 1863, inclusive..." itemizes among other Ordnance Department expenses "For the purchase and manufacture of nitre - \$400,000.00".

- [pg. 55] - "An ESTIMATE of funds for the subsistence of C. S. Army from 1<sup>st</sup> January to 30<sup>th</sup> June, 1863, for, 475,000 men (181 days) making 85,975,000 rations" notes as a line item "Provisions for quartermaster, employees, and laborers under charge of Engineers and Nitre bureaux, \$5,000,000.00".

- [pg. 58] - "ESTIMATE OF FUNDS required for the Service of the Ordnance Bureau for the five months ending June 30<sup>th</sup>, 1863" notes among other items "For the purchase and manufacture of nitre, \$400,000.00".

Shanks, William F. G.

1868 Lookout Mountain, and How We Won It. *Harper's New Monthly Magazine* 37(217; June):1-15, New York (aside from a discussion of then recent Civil War era military activity near Chattanooga, Tennessee, the author remarks [pg. 13] "...the mineral wealth of this boundless mountain region is exhaustless... nitre is found in hundreds of caves of all dimensions distributed throughout the State...").

Shepard, C. A.

1857 Nitrammite. *American Journal of Science* 2<sup>nd</sup> series 24:124 (early report of nitrates in Nickajack Cave, Tennessee, a site subsequently mined by the CSA Mining and Nitre Bureau; see also Barr 1961:305-306; Blair 1986; Cornelius 1819).

Sheridan, Richard C.

1980 Production of Saltpetre from Alabama Caves. *The Alabama Review* 33(1):25-34 (documentary evidence indicates that saltpetre was mined from Alabama caves during the War of 1812 and the Civil War; Huntsville courthouse records show that Sauta Cave in Jackson County produced nearly 100 pounds of niter per day during the 1812 war, and an unnamed cave on the Hutchins plantation in Lauderdale County was mined in 1818; from 1818 to 1861, little mining took place but during the Civil War saltpetre was produced from more than 50

caves in northern Alabama; the largest operation was at Sauta Cave, employing about 60 slaves and a large number of civilian workers to produce about 1,000 pounds daily; Federal troops destroyed the works in 1863; other cave mining operations mentioned in the article are several unnamed caves in Blount County, Lady Cave and Blue Mountain Cave [Calhoun County], Keeton Cave [Colbert County], Manitou Cave [DeKalb County], Long Hollow Cave [Marshall County], and Talucah Cave [Morgan County]; by September 1864, the district of northern Alabama had produced 225,685 pounds of saltpetre, or about 13% of total production in the Confederate States).

Sides, Stanley D.

1985 Caves and the Saltpetre Industry in Kentucky. In: *Caves and Karst in Kentucky* (Percy H. Dougherty, editor), pp. 187-196. *Special Publication* No. 12, Series XI, Kentucky Geological Survey, Lexington (a general account of nitrate mining in Kentucky caves from the pioneer era through the end of the War of 1812; focused primarily on the operations at Great Saltpetre and Mammoth caves).

1992 Saltpetre Industry. In: *The Kentucky Encyclopedia* (John E. Kleber, editor in chief), University of Kentucky Press, Lexington (brief history of saltpetre mining in Kentucky from 1780 to War of 1812; pg. 794).

Singh, Narayan Prasad

1980 The East India Company's Monopoly Industries in Bihar with Particular Reference to Opium and Saltpetre (1773-1833). Sarvodaya Vangmaya, Muzaffarpur (267 pp.; Singh's work is a valuable contribution to understanding the global saltpetre trade, extensively documented with primary source materials, based largely upon unpublished documents preserved in the National Archives of India and the West Bengal Archives; Singh describes a period in which cottage industries in Bihar declined as the East India Company exerted ever greater control of the national and local economies; the Company's activities in regard to saltpetre and opium encouraged commercialization of agriculture in the region, stimulated trade with China, helped drain wealth out of Bihar to the benefit of England, and led to the exploitation of the poor; Singh shows how the local economy became entwined with the shifts in the global economy; this work provides a greater detail of the economies of the Indian saltpetre trade than can be found in almost any other account).

Smith, Joel M.

1984 The Acquisition and Protection of Kingston Saltpetre Cave, Georgia. *National Speleological*

*Society News* 42(7):229-231 (Kingston Saltpeter Cave, the largest source of nitrates in Georgia during the Civil War, suffered from heavy visitation and vandalism during the 20<sup>th</sup> century; this article documents the efforts to preserve the site from further damage).

Smith, Marion O.

1981 Confederate Saltpeter Mining in Northern Alabama. *The NSS Bulletin* 43(4):98-102. National Speleological Society, Huntsville, Alabama (summary of Confederate niter mining efforts in Alabama with an extended discussion of niter mining at Long Hollow Cave in Marshall County).

1987 The Identification of Horners and Heaton's Niter Works, Bath County, Virginia. *NSS Bulletin* 49(1):15-25. National Speleological Society, Huntsville, Alabama (documentary evidence is used to correlate two Civil War niter works in Bath County, Virginia, with sites known today as Williams and Mountain Grove Saltpeter Caves; surviving records of the Confederate Nitre Bureau provide information about the number, duties, and pay of the personnel employed at the two works, about the organization of Confederate Nitre District 4½, reports of Union raids, and estimates of the quantities of saltpeter produced).

1990a Saltpeter Mining and the Civil War in Jackson County, Alabama. *Journal of Spelean History* 24(2):3-47 (Jackson County, located in northeastern Alabama, contains more than 1,150 recorded caves, many of which were mined for saltpeter during the Civil War; in August 1862 Jackson County became part of the Confederate Nitre District No. 9; the largest mining operation in the county, and possibly in the Confederacy, was established at Sauta Cave; other producing caves in Jackson County discussed in Smith's article include Crossing Cave, Tumbling Rock Cave, the three Pseudo Lava caves, Steele Saltpeter Cave, Devers Cove Saltpeter Cave, Blue River Cave, Long Island Cave, Fabius Cave, Coon Creek Saltpeter Cave, Williams Saltpeter Cave, a Saltpeter Cave, and Beehive Cave; maps are provided for each cave, based on relatively recent surveys made by the Huntsville Grotto of the National Speleological Society; Smith's work is exhaustively researched, using extensive documentation to provide fine detail about the day-to-day operations at many of the caves, and biographical sketches concerning workers, administrators, and visitors).

1990b *Saltpeter Mining in East Tennessee*. Byron's Graphic Arts, Marysville, Tennessee (32 pp.; of 1,550 recorded caves in East Tennessee, Smith notes that physical evidence indicates at least 68 have

been mined for saltpeter, and likely more according to folk traditions; the greatest numbers of confirmed sites are found in Marion, Claiborne, and Sullivan counties; saltpeter mining had commenced in Tennessee by the late 1770s and soon was a well-established activity; the first powder mill began operation by 1777 in Carter County; saltpeter mining activity was widespread during the War of 1812, even in the southeast Tennessee lands then controlled by the Cherokee, whose councils permitted "skilled white artisans, including powder makers and saltpeter miners, to work within their lands" [pg. 3]; one of the best known of Tennessee's saltpeter caves, Nickajack Cave, was located within the Cherokee Nation; during the Civil War, the state legislature created a board to insure a steady supply of gunpowder and its components; a saltpeter refinery was set up in Nashville by CSA Major George W. Rains, who also visited several cave operations; following the establishment of the Confederate Niter and Mining Bureau, Tennessee was divided into two districts, numbers 7 and 8; Smith provides a lengthy partial list of known saltpeter makers and contractors for District 7; Nickajack Cave was the largest government saltpeter mining operation, employing a white labor force of up to 70 workers at times; next in importance was Battle Creek Cave; approximately half of the saltpeter made in Tennessee during the War was derived from caves, the balance from such traditional sources as the dry earth beneath buildings.

1992 New Data on Jackson County, Alabama, Saltpeter Workers. *Journal of Spelean History* 26(4):64 (notes archival discovery of documentary information concerning Zachariah Summers, employed at the Confederate niter works at Matthews Cave in Alabama).

1993a Saltpeter Miners of Coon Creek Cave, Alabama. *Journal of Spelean History* 27(2):36-37 (during the Civil War, the site then known as Wheeler Cave was mined for saltpeter by a J. M. Borin, under contract to the Confederate Nitre Bureau; available documentation indicates that at least 2,362 of the 3,982 pounds sold by Borin to the Bureau between March 31, 1863, and August 13, 1864, was mined from Wheeler Cave).

1993b The Confederate Saltpeter Works at Fort Payne (Manitou) Cave, DeKalb County, Alabama. *Journal of Spelean History* 27(3):47-54 (although little archaeological evidence remains concerning the mining operation of this cave, which was first brought into production in 1862 in what was then Confederate Nitre District No. 9, surviving pay

vouchers and invoices for supplies allow valuable insights about the labor forces; the names of individual workers are known, and Smith provides biographical sketches for each, including the successive caves in which each was employed and the positions held; according to Smith, the workers and guards at Fort Payne Cave were mostly non-local, the majority from Georgia who had been transferred from other saltpeter caves, as well as men from Tennessee and elsewhere in Alabama).

1996 T. J. Byrne: A Confederate Nitre Bureau Officer. *Journal of Spelean History* 30(3):85-86 (considerable documentary evidence indicates Byrne's involvement in the Confederate production of nitrates from his role as superintendent of Nitre District No. 8, beginning in September 1862, to his position in charge of the Blue Mountain Nitre Works at Bell Cave, Alabama, through December 1863).

Smyth, Clifford

1903 The Finding of Independence Cave, Powder Factory of Revolution. *Atlanta Constitution*, February 1, 1903, pg. 3, Atlanta, Georgia (a rather flowery account of some nitre caves in Pine Mountain, near Line Fork in Letcher County, Kentucky, reportedly mined during the Revolution but more likely dating to the War of 1812).

Squier, Ephraim G.

1852 Mr. Squier on Nicaragua. *The International Magazine of Literature, Art, and Science* 5(4; April):474-477, New York (in what is likely one of the most unusual sources for procuring nitre, Squier [pg. 476] notes: "In some of the Nicaraguan towns, especially in Leon, the pernicious practice of burying the dead within the walls of city churches is persisted in, even as in London, and, just as with us, against the opposition of all sensible persons, including the government itself. Fees to the church and attendant officials are at the root of the evil, and give it a vitality that defies all attempts at eradication. The priests of Leon have evaded all edicts about this nuisance, and have improved upon the practice of our metropolitan parishes; for not content with the revenues they derive from funerals, they charge according to the length of time [from ten to twenty-five years] the dead are to be permitted by them to rest in their graves. When the purchased time is up, the bones and the earth derived from the decomposed corpses are removed and sold to the manufacturers of nitre! The least war-like of citizens may thus in the end become a defender of his country, when converted into a constituent of gunpowder. The most quiet and unambitious of mortals may complete his career by making a noise

in the world, when fired off from a mortar").

1853 *Travels in Central America, Particularly in Nicaragua; With a Description of Its Aboriginal Monuments, Scenery and People, Their Languages, Institutions, Religion, &c...* D. Appleton & Co., New York (regarding interments in Nicaragua, Squire noted [pg. 384]: "The burials are made according to the amount paid to the [Catholic] church, for from ten to twenty-five years, at the end of which time the bones, with the earth around them, are removed and sold to the manufacturers of nitre!").

State of Georgia

1861 *Journal of the Senate of the State of Georgia, at the Annual Session of the General Assembly, Begun and Held in Milledgeville, the Seat of Government, in 1861*. Boughton, Nisbet & Barnes, State Printers, Milledgeville, Georgia (call no. "1539 Conf.", Rare Book Collection, University of North Carolina at Chapel Hill; 351 pp.; in an address dated November 6, 1861, to the state legislature, the governor of Georgia remarked [pg. 28]: "Soon after the State seceded from the Union, in view of our perilous condition, and the great scarcity of salt petre [sic] and sulphur in the State, I felt it my duty to use every exertion in my power to procure the material, without which it would be impossible to make the supply of powder absolutely necessary to our safety and the success of our common cause. After much exertion and great risk, I succeeded in procuring a supply sufficient to make several hundred tons of powder; which was landed in the State a very short time prior to the commencement of the blockade of our ports. A short time after its importation, I offered the powder ... to the [CSA] Secretary of War for the common cause, at [the] original cost to the State, without even charging interest on the money... This ... proposition was accepted and the market value of the powder material fixed by the Secretary himself at fifty per cent original cost. It was at the time worth in the market, over three hundred per cent upon the original cost, but as it was no part of my purpose to speculate for the State on that which was essential to the success of our common cause, I permitted the Secretary of War to take it at his own price. The State Treasurer had advanced the money to purchase the material at my request, without warrant, and after the sale, as no warrant had passed, I refunded to the Treasury the amount of money advanced by the Treasurer. By this transaction I not only obtained and turned over to the Confederacy at a price several hundred less fold than it could have been elsewhere obtained, a supply of material of very great value, but also made a clear



profit of \$22,133.70 for the State. As the drafts upon the military fund were much heavier than was anticipated when the appropriation was made, I found it necessary to use this net profit which I had made for the State, in the purchase of provisions and other necessary supplies for our troops. I therefore paid it over to the Quartermaster General of the State, and took his receipt for the amount, which he expended for the use of our troops, and for which he will account in his report”).

State of Mississippi

1864 *Journal of the House of Representatives of the State of Mississippi, December Session of 1862, and November Session of 1863*. Cooper & Kimball Steam Printers and Binders, Jackson (of note is a report [pp. 89-94] submitted by State Geologist E. W. Hilgard entitled “Memoranda Concerning the Geological Survey”; as noted therein [pg. 89], “In spring, 1862, at the request of Dr. Lemman, Chief of the Nitre District including this State, I undertook a special examination of the caves existing in this State, with reference to the production of saltpetre. The result, as anticipated, was unfavorable, these caves being too wet for the accumulation of nitre, though it is constantly forming in them”; Hilgard further observed [pg. 90] “Other substances also have been examined, such as copperas ores from various parts of the State, numerous specimens supposed to be, or contain, saltpetre, but mostly containing only Epsom or Glauber’s Salt”).

State of South Carolina

1862 *Journal of the Senate of South Carolina: Being the Session of 1862*. Charles P. Pelham, State Printer, Columbia, South Carolina (335 pp.; call number “1960 Conf. 1862-1863”, University of North Carolina at Chapel Hill Library; despite the 1862 date of publication, this volume covers state senate sessions from November 24, 1862, through April 10, 1863; of note are discussions concerning the state established saltpetre plantation”:  
- pp. 10-37 -Tuesday, November 25, 1862, in Message No. 1 to the legislature, Gov. F. W. Pickens states [pg. 25] that:

“The Council established a saltpetre plantation near this place [Columbia, South Carolina]. I believe it is the first of the kind ever established in our country. The expenses have been moderate, and I refer you to a report from Dr. Ford, the Superintendent, for all details. There was great danger of scarcity in the material for gun-powder, and it was deemed essential to put ourselves beyond difficulty as to this matter. It is hoped that it will soon begin to yield returns. As an experiment, it was eminently useful, in calling public attention to the enterprise. If it is

thought proper, I have no doubt the whole matter could be turned over to the Confederate Government without loss. In several countries in the north of Europe, taxes are partly paid in salt-petre, so essential is it to a country’s independence. Perhaps it might be proper to place it also directly under the supervision of the State Ordnance Officer, if the State retains it.”

- pg. 42 - Wednesday, November 26, 1862:

“Resolved. 1. That so much of the Message of his Excellency the Governor as relates to [among other topics] the saltpetre plantation... be referred to the Committee on the Military and Pensions.”

- pg. 208 - Monday, February 2, 1863: “A Bill to prohibit extortion and punish extortioners, and the resolution offered by Mr. Lesesne on the same subject. The Senate proceeded with the second reading of the Bill.

“Mr. GARLINGTON moved to strike out all after the enacting clause, for the purpose of inserting the following:

“That from and after the passing of this Act, any dealer or speculator in [among other materials] saltpetre... who shall, during the continuance of the existing war, sell or dispose of any of the said articles at exorbitant or unreasonable rates or prices... shall be deemed and held guilty of an extortion, and on conviction thereof in any of the Courts of the General Sessions of this State, shall be fined not more than one thousand dollars, and be imprisoned not more than twelve months...”

- pg. 223 - Wednesday, February 4, 1863, “Mr. GARLINGTON presented the report of the Committee on the Military and Pensions,

“On so much of the Message of his Excellency the Governor as relates to... the Saltpetre Plantation...”

- pg. 240 - Thursday, February 5, 1863, The Senate considered the report of the Committee on the Military and pensions,

“On so much of the Message of his Excellency the Governor as relates to... the saltpetre plantation...”.

1863 *Journal of the Senate of South Carolina, Being the Sessions of 1863*. Charles P. Pelham, State Printer, Columbia, South Carolina (184 pp.; call number “1960 Conf. 1863”, Rare Book Collection, University of North Carolina at Chapel Hill; the major niter related issue discussed by the South Carolina Senate in 1863 concerned the sale of a State owned “saltpetre plantation” [niter bed] to the Confederate government; the sequence of action in considering this proposal was as follows:

- pg. 46 - November 23, 1863, “Message No. 1:

from the governor of South Carolina to the legislature [pg. 46]: "The Confederate Government has expressed a willingness to take off the hands of the State, the Saltpetre Plantation, and her interest in the lead mine, at cost and charges... The working of the lead mine, I recommend to be abandoned, as it cannot, according to the report of Dr. LeConte, herewith communicated, be profitable. The Saltpetre Plantation, it is believed, can be made to pay well, and is a very interesting experiment" [note: Dr. LeConte's report was not published in this volume]; - pp. 53-54 - Wednesday, November 25, 1863, "At 1, P.M., the Senate proceeded to the Special Order for this hour, the reference of Message No. 1 of his Excellency the Governor.

"The reading was dispensed with, and Mr. McCaw offered the following resolution, which was immediately considered, and agreed to, and the several subjects of the Message were referred accordingly.

"Resolved, That Message No. 1 of his Excellency the Governor, be referred as follows... :

2. So much as relates to... the sale of the... nitre plantation and lead mine... [i.e., the Resolution concurred with the proposed sale]";

- pg. 89 - Saturday, December 5, 1863, among the "Papers from the House of Representatives" was included a "Report of the Committee on the Military, on the Governor's Message No. 1, on... lead mine, nitre plantation... which was referred to the Committee on the Military and Pensions";

- pp. 103-104 - Wednesday, December 9, 1863, among the "reports of Committees" received by the Senate was: "Mr. GARLINGTON submitted the report of the Committee on the Military and Pensions, on the Governor's Message No. 1, on... lead mine [and] nitre plantation...; which was ordered for consideration to morrow";

- pg. 116 - Saturday, December 12, 1863, "The report of the Committee on the Military and Pensions, on the Governor's Message No. 1, on... lead mine [and] nitre plantation... by substituting the following for the first resolution recommended by the Committee, viz:

"1. That his Excellency the Governor is hereby authorized to turn over to the Confederate Government, the saltpetre plantation, and the lead mine, and if that Government should decline to take the lead mine, that the Governor shall abandon the further working of it, and dispose of the State's interest therein in any manner he may deem best".

State of Virginia

1861 *Journal of the House of Delegates of the State of Virginia, for the Session of 1861-62.* William F.

Ritchie, Public Printer, Richmond (note - as this volume covers transactions extending well into 1862, the date of publication as it appears on the published journal is a typographic error; several of the bills discussed and/or passed are of interest regarding nitre production;

[pg. 57] In Senate, December 21, 1861: "Mr. Barbour submitted the following preamble and resolutions; and the question being on agreeing thereto, was put, and decided in the affirmative:

"Whereas the manufacture of saltpetre and other munitions of war is of prime necessity to the Confederate States; and whereas the general assembly are anxious to afford every facility in their power to enterprising and patriotic citizens engaging in said manufacture: and whereas it has been represented to the general assembly that the free negro population of the state may be used advantageously in said manufacture by persons residing outside of the limits of Virginia, by voluntary agreements on their part: Therefore,

"Resolved by the general assembly, that J. Marshall McCue, or any other citizen of the commonwealth engaged in the manufacture of saltpetre, or other munitions of war, be authorized to carry out of the state of Virginia to any other state in the Confederacy, any number of free negroes, for the purpose of manufacturing saltpetre or other munitions of war."

[pg. 65] In Senate, January 9, 1862 - "The senate have agreed to the resolution from the house of delegates authorizing free negroes to be carried out of the state to be engaged in the manufacture of saltpetre and other munitions of war."

[pg. 255] In Senate, March 11, 1862 - "Resolved, that the joint committee on exemptions enquire into the expediency of reporting a bill authorizing the governor to detail such persons as are now or may hereafter engaged in the manufacture of lead, iron, and saltpetre."

[pg. 266] In Senate, March 13, 1862 - Resolved "That the following persons shall be exempt [from active military service], under the proclamation, to wit: ...all persons whose services may be deemed by the board of exemptions to be indispensable in mining or manufacturing lead, iron, saltpetre, gunpowder, fire arms, or other implements or munitions of war...").

1862a *Doc. No. 1: Message of the Governor of Virginia, and Accompanying Documents.* William F. Ritchie, Public Printer, Richmond (In a message dated September 15, 1862, to a session of the Virginia state legislature, Gov. John Letcher remarked [pg. viii-ix] "Applications for details of

persons employed in procuring nitre, whenever they have been presented in the mode directed by law, have been granted. I know of no instance in which such an application has been denied"; see also Section II – State of Virginia 1862b).

Stiles, Rev. Joseph C.

1862 *Capt. Thomas E. King; or, A Word to the Army and the Country*. South Carolina Tract Society, Charleston, South Carolina (call number "4872 Conf.", Rare Book Collection, University of North Carolina at Chapel Hill; 56 pp.; in this patriotic tract exhorting all good citizens to do their duty, Rev. Stiles echoes the feelings of many when he speaks out against [pg. 30] "Ye heartless, worthless *exempts* in every corner of the land, who bribe the pliant surgeon to endorse your pretended disabilities. ... Ye base and infamous *skulkers*, who hide a coward heart behind some fraction of a Nitre contract..."; emphasis in original text; by law, niter workers and other tradesmen producing critical war supplies were exempt from military duty [see Deitrich 1862]).

Tarkington, Terry W.

1973 *Saltpeter Mining in the Tennessee Valley*. *Tennessee Valley Historical Review* 2:17-25 (Tarkington focuses upon Civil War-era saltpeter mining in the numerous caves of middle Tennessee and northern Alabama, noting that while many of the associated artifacts have rotted away, remnants of the Confederate niter mining industry are well-preserved in certain caves; cave mining operations described at length include those of Calfkiller Saltpeter Cave, Johnson Cave, and Sadler Cave, all located in Putnam County, north-central Tennessee, and Saunta Cave in northern Alabama; niter works in several other caves are mentioned briefly; of particular interest is a sampling of letters from a group of papers pertaining to the Confederate Nitre and Mining Bureau's operations in Alabama, donated to the Georgia Department of Archives and History by a descendant of the superintendent of the Long Hollow works in Marshall County, Alabama; see Smith [1981] in Section I and Georgia Department of Archives and History in Section III).

Thrun, Robert

1982 *Saltpeter Symposium: Discussion*. *The NSS Bulletin* 44(4):120. National Speleological Society, Huntsville, Alabama (responding to Powers [1981] and De Paepe [1981a, who quotes Brown 1809 on this subject], Thrun briefly notes his skepticism of the claim that marks made in soil rich in nitrate content will disappear in a short time, a phenomenon reportedly used as a test by saltpeter makers; Thrun also takes issue with Hill's [1981a]

correlation of saltpeter caves with hardwood forests, observing that this may simply be coincidental and more easily explained by the distribution of caves, settlement patterns, and boundaries during the Civil War).

Ure, Andrew

1842 *A Dictionary of Arts, Manufacturers and Mines, Containing a Clear Exposition of Their Principles and Practices*. La Roy Sunderland, New York (essentially an illustrated one-volume encyclopedia of technology, Ure's work provides early 19<sup>th</sup> century state-of-the-art descriptions of various manufacturing processes and the associated equipment and machinery; of interest in the context of this bibliography are very lengthy entries on the production of saltpeter ["nitrate of potash"] and gunpowder, as well as those associated items such as charcoal, sulfur, flints, and fulminates).

"V. & C."

1862 *The City Intelligencer; or Stranger's Guide*. Macfarlane & Fergusson, Printers, Richmond, Virginia (19 pp.; Call number "2667 Conf.," Rare Book Collection, University of North Carolina at Chapel Hill; this guide to Civil War-era Richmond notes [pg. 19] "Confederate States Nitre and Mining Bureau, office Bank Street, between 9<sup>th</sup> and 10<sup>th</sup> streets").

Walker, Juliet E. K.

1983 *Free Frank: A Black Pioneer on the Antebellum Frontier*. University of Kentucky Press, Lexington (most of what we know about the niter business derives from the upper end of the marketing hierarchy, through documentation associated with merchants, speculators, brokers, and operators of large works such as those at Mammoth Cave and Great Saltpetre Cave in Kentucky; Walker's thoroughly documented research sheds fascinating light nearer the bottom of the market chain in her account of the niter manufacturing activities of an entrepreneurial black in the cave region of southeastern Kentucky; Free Frank, born a slave in 1777, ultimately purchased the freedom of 16 family members including himself [in 1819] through diverse business activities; Frank was taken to Kentucky before 1800 and began hiring himself out by 1810; during the War of 1812, he established a saltpeter works in Pulaski County, mining and processing niter from local caves and sharing the profits with his owner; after the war, Frank added land speculation and commercial farming to his activities.; even though the domestic saltpeter market was drastically curtailed in the postwar market, Frank continued successfully in this manufacture and even greatly expanded the scale of his works.; during the 1820s, Frank opened a branch of his saltpeter works in Danville, Kentucky, strategically located with



respect to Pulaski County on the Wilderness Road; in 1829, Free Frank traded the Danville operation in exchange for the freedom of Frank, Jr., and in the following year moved to Illinois; see particularly pp. 34-38; 223 pp.).

Ward, Nahum

1816 Description of the Great Cave In Warren County, Kentucky. *Kentucky Gazette* n.s. 37(11), September 9, 1816 (although foremost a description of the scenic wonders of Mammoth Cave, Ward's account provides valuable primary documentation on the nature of the largest saltpeter operation ever conducted in the United States; while this lengthy account provides very little specific detail concerning the processing methods; there are numerous references to people, places, and significant events relating to niter mining in the cave; of particular interest are the descriptions of the effects of the New Madrid earthquake [December 1811 through February 1812] on the mining operation ["...about five minutes before the shock, a heavy rumbling noise was heard coming out of the Cave like a mighty wind..."], and of the discovery by miners of a mummified Indian ["...she was first found by some laborers, while digging salt-petre earth, in a part of the cave, about three miles from the entrance, buried eight feet deep, between four limestone slabs..."].)

Webb, William S. and William D. Funkhouser

1936 Rock Shelters in Menifee County, Kentucky. *Reports in Archaeology and Anthropology* 3(4), University of Kentucky, Lexington (includes a section [pp. 140-147] on niter mining and processing at sandstone rock shelters in east-central Kentucky and specific brief description of these activities at the Newt Kash Rockshelter in Menifee County; this report is the only purely archaeological study of a niter mining site ).

White, Wayne R.

1967 The Speleography of Great Salt Peter Cave. *National Speleological Society News* 25(9):169-174 (a history of Great Saltpeter Cave in Rockcastle County, Kentucky, focusing upon the niter mining operations conducted there before and during the War of 1812).

Whiting, William

1776 No title. *Boston Gazette*, January 1, 1776 (lengthy and detailed instructions for the manufacture of saltpeter, using soil from beneath "any old building ... where the earth has long been covered from the weather"; Whiting was the chairman of the saltpeter committee in the House of Representatives, and these instructions were ordered to be printed "in the several news papers").

Whittaker, Colin W.

1934 *A Review of the Patents and Literature on the*

*Manufacture of Potassium Nitrate with Notes on Its Occurrence and Uses*. U. S. Department of Agriculture, Washington (54 pp.); the USDA's interest in potassium nitrate derived from its potential utility as a fertilizer, reporting that only its present high cost has limited its use in agriculture; Whittaker notes the uses of potassium nitrate in many industries, and presents a very brief historical sketch which omits most of the history of saltpeter; he presents statistics on global imports and exports of saltpeter by country for the years 1913 and 1926-1931, observing that the principal suppliers to the United States were Chile and Germany; he also reports on prices paid for crude nitrate; subsequent sections discuss the value of potassium nitrate as fertilizer, the occurrence of nitrate deposits, and the commercial production of nitrate; the discussion of production methods occupies a significant proportion of this booklet and is divided into sections on extracting saltpeter from the soil, from organic material, and manufacturing potassium nitrate through various chemical reactions of which the interaction of sodium nitrate and potassium chloride has proved to be the most commercially viable; the book contains a very extensive multilingual bibliography of patents and literature concerning potassium nitrate).

Williams, A. R.

1975 The Production of Saltpetre in the Middle Ages. *Ambix* 22(2):125-133 (review of English public records shows increasingly larger purchases of gunpowder accompanied by a steady fall in the price; to the author this suggests mass-production of saltpeter to meet the growing demand for gunpowder; the first reference to English saltpeter manufacture occurs in 1490; by the end of Elizabeth's reign, exports of English saltpeter abroad indicate self-sufficiency in this article; Williams notes that treatises on the manufacture of saltpeter [Agricola 1556; Biringuccio 1540; Ercker 1574] describe extraction of saltpeter from nitrous earth, but do not provide information on artificial production of niter; production in artificial niter-beds was probably first discovered by the Germans in the 16<sup>th</sup> century and kept as a trade secret for some time; in 1561, two English merchants purchased from a German named Honricke or Honrick a ten-year license to make saltpeter by his method; a previously unpublished copy of Honrick's method for artificial niter-beds is attached to the agreement in the English State Papers; this recipe is reproduced in William's article; the remainder of the article is concerned with Williams's 1970 and 1972 experiments in artificial niter production using

cow manure and urine; from analysis of samples, he concluded that nitrates form first in the tops of piles and percolate downwards, indicating the need to turn the piles over frequently; that both urine and dung are necessary, along with earth and traces of calcium carbonate; and that the maximum yield after 1-1/2 years of the experiment was never more than one percent).

## II. GUNPOWDER MANUFACTURE

Abbot, Bvt. Brig. Gen. Henry L.

1868 *Siege Artillery in the Campaigns Against Richmond, with Notes on the 15-Inch Guns. Professional Papers Corps of Engineers No. 14.* D. Van Nostrand, Publishers, New York (reprinted 1986, Dean S. Thomas, Arendtsville, Pennsylvania; among many insightful comments about the role of artillery in the final days of the Civil War, Gen. Abbot makes the following remarks [pp. 136-137] about the powder magazines actually used by front line troops: "Our experience indicated that for siege guns a very simple plan, involving but what could be obtained upon the spot, answered all necessary purposes for magazines in upland soil like that of Virginia. We took great care to shelter them as much as possible by the parapet, and made the chamber entirely below ground, roofed by heavy logs, (sometimes resting on plates supported by uprights, and sometimes on horizontal logs notched into each other like the sides of a log house) and covered by earth about six feet thick. The entrance was straight and from the rear. Boards were seldom used either for the sides or the floor, which was made to drain into a hole (a barrel if practicable) sunk near the entrance. The usual dimensions in the clear were six feet wide by five or six feet deep, length to vary according to capacity required. In no instance was one of them blown up, although often hit by shells; and very little loss of ammunition occurred from dampness even in heavy rains...

"Where so much magazine room is required by modern rifled siege and field artillery is needed, it is not often practicable to construct magazines upon the elaborate plans laid down in the text-books. For the heavy James river [sic] water batteries, however, this was deemed necessary by both armies; especially by the confederates, whose magazines and bomb-proofs for this purpose were extremely substantial and well made"; 183 pp. + 6 foldout plates).

al-Hassan, Ahmad Y. and Donald R. Hill

1986 *Islamic Technology: An Illustrated History.* Cambridge University Press, Cambridge and London

(Section 4.8 [pp. 106-120] traces the diffusion of gunpowder and its military applications from China to Arab lands over a period of several centuries; one of the terms used to designate saltpeter was *thalj al-Sin*, or "snow of China"; gunpowder was used in Arabic incendiary devices by the 12<sup>th</sup> century AD and cannon by the middle of the 13<sup>th</sup> century; knowledge about gunpowder and cannon was transferred to Europe by way of Muslim Spain).

Anderson, William

1862 *Sketch of the Mode of Manufacturing Gunpowder at the Ishopore Mills in Bengal.* John Weale, London (Anderson's book is a detailed technical manual – rather than a mere "sketch" – covering every step of gunpowder manufacture from saltpeter production to testing and storage of the finished product and includes engineering diagrams of the various mill apparatus; the Ishopore powder mills were established by the British in 1799; 303 pp.).

Andrews, Eliza Frances

1908 *The War-Time Journal of A Georgia Girl, 1864-1865.* D. Appleton and Company, New York (call no. 973.78 A56 1908, Davis Library, University of Chapel Hill, North Carolina; Andrews was a witness to the last days of the fleeing Confederate government and describes meeting CSA President Jefferson Davis and the remnants of his cabinet when they stayed in Washington [Wilkes County], [northeast] Georgia; of interest are the following observations [pg. 210] concerning the storage of gunpowder by the demoralized and retreating Confederate forces still operating in the area: "The [Washington, Georgia] R.R. [Rail Road] depot is in danger of being blown up by the quantities of gunpowder scattered about there, mixed up with percussion caps. Fred says that when he came up from Augusta the other day, the railroad between here and Barnett [Georgia] was strewn with loose cartridges ... the soldiers had thrown out of the car windows").

Anonymous

1825 Baltimore. *The North American Review* 20(46; January):99-138, Cedar Falls, Iowa (of note is a table on pg. 119 entitled "Exports of Domestic Produce and Manufacturers to Foreign Countries from the Port of Baltimore, during the Years 1822 and 1823"; this table indicates that 1822 saw 39,000 lbs. of powder shipped, a figure that increased to 65,075 lbs. shipped in 1834).

1832 *Early American Artists and Mechanics.* No. II. Paul Revere. *The New-England Magazine* 3(4; October):305-314, Boston (it is noted [pg. 310] that: "In 1775, he [Paul Revere] engraved the plates,

- made the press, and printed the bills, of the paper-money, ordered by the Provisional Congress of Massachusetts, then in session at Watertown. He was sent by this Congress to Philadelphia to obtain information respecting the manufacture of Gunpowder. The only powder-mill, then in the colonies, was in the vicinity of Philadelphia. The proprietor refused to let Revere take any drawing or specification whatsoever, or any memorandum of the process of the manufacture, but consented to show him the mill in full operation. His mechanical skill was now brought into action. With the slight information thus obtained, he was able, on his return, to construct a mill, which was soon put in operation, and with complete success”).
- 1844 On Explosions and Explosive Compounds. *The Living Age* 3(25; November 2):43-45, New York (beyond being a brief but informative summary of the state of knowledge of explosives of the era, is the remark [pp. 43-44] that “The mixture of sulphur, charcoal, and nitre, called gunpowder, is well known. The elastic fluid produced by the firing of gunpowder is found, by experiment, to occupy a space at least 244 times greater than that taken up by the gunpowder from which it was obtained. But from the heat generated during its explosion, this elastic fluid is rarefied to upwards of four times its former bulk. The expansive force of this fluid is therefore, at the moment of conflagration, 1,000 times greater than that of common air. The granulation of gunpowder increases its explosive force. A charge is thus made sufficiently porous to allow flame to penetrate it, and to kindle every grain composing it at the same time”).
- 1845 Gunpowder. *The Living Age* 4(38; February 1):279-283, New York (informative discussion of the preparation of gunpowder ingredients, e.g., notes [pg. 280] the proper way to process cave niter and remarks “Very early in the history of gunpowder it was discovered that light woods, such as willow and alder, were infinitely superior to hard woods in yielding good charcoal”).
- 1846 Explosive Cotton. *The Living Age* 11(130; November 7):303-304, New York (one of the earliest announcements of the development of guncotton as a replacement for traditional gunpowder).
- 1850 Alchemy and Gunpowder. *Harper's New Monthly Magazine* 1(2; July):195-198, New York (brief biography of Roger Bacon, associated with the introduction of gunpowder in England in the 13<sup>th</sup> century).
- 1852 How Gunpowder is Made – Visit to Hounslow Mills. *Harper's New Monthly Magazine* 4(23; April):643-647, New York (clearly written and very informative description of the physical layout of and processes and safety procedures used at England's Hounslow Powder Mill; useful comparative information for the archaeological interpretation of other early powder mills).
- 1853 Early Manufacture in New England. *Scientific American* 9(14; December 17):106, New York (this brief but informative article notes:  
 “Powder was an article of much anxiety in regards to its manufacture. We find even as early as 1639 a record that Edward Rawson [of Massachusetts] ... was granted by the colony ‘500 acres at Pecoit so as hee go on with the business of Powder if the salt Peter come.’ But he did not succeed, as in 1748 [sic] he is granted 500 acres to indemnify for his losses. ‘In 1643 the General Court made an order about preparing houses for saltpeter that there might be powder made in the colony, but as yet it has not gone on.’  
 “In 1775 Gov. Richard Penn, who was in England charged with a petition for redress from the Continental Congress, state ‘that the Pennsylvanians perfectly understood the making of gunpowder...’ Probably the first powder mill erected in this part of the country was at Andover [Massachusetts]. It was built by Hon. Samuel Phillips, Jr., in 1776, and some remains of it are still to be seen. The colony supplied him with saltpeter and sulphur, and he was to receive eight pence per pound for manufacturing.  
 “The resolve under which the contract was made, is dated June 8, 1776, and requires him to give bonds for the faithful performance of the contract; also, he was to cause to be published all the discoveries he might make relative to the construction of the mill and the manufacturing of powder. During the year 1776, that mill turned out 30,000 pounds of powder. In 1778 the mill was blown up, and after that time the manufacture was given up... Subsequently, about 1794, a smaller powder mill was erected, which was blown up or burned down in 1796. That ended the manufacture in Andover.”; see also Downs 1896:499; and Taylor 1858:124-125).
- 1859 Washington at Morristown. *Harper's New Monthly Magazine* 18 (105; February):289-309, New York (this informative paper concerning the activities of Gen. George Washington in and around Morristown, New Jersey, notes [pp. 291-292] that: “Early in 1776, ... [Col. Jacob] Ford [Jr.] agreed with the Provincial Congress of New Jersey ‘to erect a powder-mill for the making of gunpowder, an article so essential at the present time.’ The Congress agreed to ‘lend him £2000 of the public money for one year, without interest, on his giving



- satisfactory security for the same, to be repaid within the time of one year in good merchantable powder; the first installment of 'one ton of good merchantable gunpowder' to be paid 'on the 1<sup>st</sup> of July next, and one ton per month thereafter till the sum of £2000 be paid.' I have reason to infer that Colonel Ford's 'good merchantable gunpowder' did service that winter at Springfield, Trenton, Princeton, and in many other places. This powder-mill at Morristown, projected and built by Colonel Ford, was an important affair, and deserves mention in conjunction with his name, and especially as this mill was one constant temptation to the enemy to attempt to reach Morristown, and as constant a reason why the citizens of Morris County so stoutly defended their strongholds that it is said a detachment of the enemy never did enter the county." [see also pp. 293, 295; and Downs 1896: 499].
- 1861 *Acts and Resolutions of the First Session of the Provisional Congress of the Confederate States, Held at Montgomery, Ala.* Enquirer Book and Job Press by Tyler, Wise, Allegrè & Smith, Richmond, Virginia (as noted on pg. 41: "An Act to exempt from Duty certain commodities therein named, and for other purposes.  
"SECTION 1. Be it enacted by the Confederate States of America in Congress assembled, That the following articles shall be exempt from duty and admitted free into said States, to-wit: ...gunpowder, and all the materials of which it is made; lead in all forms; arms of every description, and munitions of war and military accoutrements; percussion caps... "ADOPTED February 18, 1861").
- 1866 Gun-paper. *Scientific American* n.s. 15(1; June 30):2, New York (notes on an interesting product developed in England to replace blackpowder; said to be completely safe to manufacture).
- 1867 Another Gunpowder. *Scientific American* 16(April 6; 14):215, New York (this brief announcement notes "Nitrate of potash, 10 parts; picric acid, 10; bichromate of potash, 8.5 – intimately mixed – give, according to Dr. Borlinetto, professor of chemistry in the University of Padua, an excellent gunpowder of the best sporting quality").
- 1869 Gun-Cotton. *The Manufacturer and Builder* 1(1; January):14, New York (note on development of an early substitute for blackpowder).
- 1870a Compressed Gun-Cotton. *Harper's New Monthly Magazine* 40(239; April):777, New York (brief discussion of "...a method of using gun-cotton so as to produce an explosive effect equal to that of nitro-glycerine or dynamite, while much safer in the application").
- 1870b Carbon for Gunpowder. *The Manufacturer and Builder* 2(5; May):135, New York (note on use of Grahamite, a mineral mined in western Virginia, as a substitute for wood charcoal in blackpowder).
- 1870c Dualin, a New Explosive. *Harper's New Monthly Magazine* 40(236; January):308, New York (a brief announcement of dualin, an explosive which "consists mainly of saw-dust treated with nitro-sulphuric acid...").
- 1871 Combustion and Explosion. *The Manufacturer and Builder* 3(6; June):127-128, New York (notes [pg. 127] that "Gunpowder owes its power to the same cause [i.e., the near simultaneous burning of every particle], the nitre entering into its composition contains half its weight of oxygen, which is suddenly combined upon ignition with the sulphur and carbon, the other two ingredients, as sulphur combines with its own weight of oxygen, and carbon with nearly three times its own weight; and the proportions of the three constituents of gunpowder are arranged according to these relations...").
- 1872 Friction Pulleys. *The Manufacturer and Builder* 4(5; May):112, New York (this brief article notes "There is no more important branch of mill-work, or one requiring more careful consideration than the disengaging and reengaging of gearing. In starting ponderous equipment the utmost exactitude of construction is required to avoid endangering shafts and wheels. This is most strikingly exemplified in the case of powder mills, where trains of edge-stones are employed for grinding the gunpowder ... which requires well-fitted friction clutches, to communicate the motion by a slow and progressive acceleration from a state of rest to the required velocity").
- 1874 Editor's Historical Record. *Harper's New Monthly Magazine* 48(284; January):306-308, New York (notes [pg. 307] under "Disasters" that on November 4, 1873: "Powder-mill explosion at Gibsonburg, near Scranton, Pennsylvania. Three men killed"; such fatal explosions were not uncommon at many of the early powder mills).
- 1875 The New Gunpowders. *The Manufacturer and Builder* 7(2; February):48, New York (professional review of a product called Eberhardt's gunpowder which claimed to be safer than traditional blackpowder; review concluded it was inconvenient and weaker than what it hoped to replace).
- 1879 Special Uses for Different Peculiar Kinds of Woods. *The Manufacturer and Builder* 11(5; May):101, New York (extracted from the *London Timber Trades Journal*, this short article notes: "Horn Beam... It is an excellent fuel, perhaps the

- very best of all kinds of wood, burning surprisingly long and giving an excellent charcoal, preferred in
- 1882 The Manufacture of Gun-Cotton. *The Manufacturer and Builder* 14(6; June):129, New York (description of gun-cotton production in England).
- 1883 A New Water-Proof Gunpowder. *The Manufacturer and Builder* 15(4; April):86, New York (comments on English produced blackpowder which coated the granules of powder with paraffin, asphaltum, or pitch to protect them from moisture).
- 1884 Gun-Cotton. *The Manufacturer and Builder* 16(7; July):167-168, New York (journal staff notes "We know of no manufacturer of gun-cotton in this country [U.S.] ... [except] by the United States government at the torpedo station of Newport, but this is, of course, for the exclusive use of the torpedo service").
- 1885a The Earliest Use of Gunpowder. *The Manufacturer and Builder* 17(4; April):89, New York (attributes invention of gunpowder to the Chinese and its refinement to the Europeans).
- 1885b The Discovery of Gunpowder. *The Manufacturer and Builder* 17(10; October):239, New York (discusses appearance of gunpowder in Europe as early as the 13<sup>th</sup> or 14<sup>th</sup> century; it was definitely known there in 1326 and used by the Moors of Spain to propel cannon balls).
- 1889 Smokeless Powder. *The Manufacturer and Builder* 21(9; September):209, New York (brief comments on field tests in Europe of "Maxim powder," a variety of then-new smokeless gunpowder; aside from the obvious benefit of greatly reduced smoke at the time of ignition, is the observation that "Another advantage of the Maxim smokeless powder is that after being wetted and dried it is still efficient. Indeed a charge of this powder has been actually chewed, then dried, and afterwards fired").
- 1894 To Measure the Explosive Force of Gunpowder. *The Manufacturer and Builder* 26(9; September): 216, New York (discusses two methods for evaluating the strength of gunpowder).
- 1949 Modern Gunpowder. *American Rifleman* 97(10; October):26-30.
- 1952 *Du Pont: The Autobiography of an American Enterprise*. Charles Scribner's Sons, New York (138 pp.; lavishly illustrated, if self-promoting, history of the du Pont company; the first half of the book concerns du Pont's establishment as the foremost American manufacturer of explosives, beginning with the founding of the gunpowder mills in Delaware in 1804; the latter sections deal mostly with the production of synthetic fibers).
- 1980 Powdermills. *Quarterly of the Hart County [Kentucky] Historical Society* 12(2):3-5.
- 1990 *The History of the E. I. du Pont de Nemours Powder Company* (originally published 1912). Linday Publications, Inc., Manteno, Illinois (the du Pont company's modern role as an industrial giant in chemical manufacture can be directly traced to its origin as a manufacturer of gunpowder which began in the United States in 1802; the book begins with a brief history of explosives, then recounts founder E. I. du Pont's apprenticeship to Lavoisier in France, his term as superintendent of the Government Powder Works in that country, subsequent emigration to America, and establishment of the du Pont powder mills in Delaware in 1802; the firm played important roles in national security during the various wars in which the United States became engaged during the next 100 years, and was noted for the high quality of their gunpowder; late in the 19<sup>th</sup> century, the company was responsible for developing nitrocellulose or "smokeless powder" in this country, a European invention that quickly replaced the use of powder based on nitrates; 224 pp.).
- Baddeley, Major J. Fraser  
1857 *Pamphlet on the Manufacture of Gunpowder as Carried on at the Government Factory, Waltham Abbey*. E. Littler, Waltham Abbey, England (the information in this booklet had a great effect on the design and operation of the CSA powder mill at Augusta, Georgia).
- Bailey, Sarah Barter  
1996 The Royal Armouries "Firework Book". In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 57-86. Bath University Press, Bath, United Kingdom (403 pp.; the Fireworks Book in the Royal Armouries Library consists of three parts: [1] a version of the German Fireworks Book [see Kramer 1996]; [2] a series of incendiary recipes somewhat different from those in the German book; and [3] illustrations related to the second part; watermarks appear to provide a date for this book ca. 1450; of particular interest is Bailey's reproduction and interpretation of 25 of the 54 illustrations that appear in the work).
- Bas, Begonia  
1996 Fireworks for the Community: The Use of Windpower and Simple Techniques in Galicia. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 137-153. Bath University Press, Bath, United Kingdom (403 pp.; fireworks have historically been an important component of feasts and festivities in the Galicia province of northwestern Spain; Bas

recounts the history and operations of the gunpowder mill at Neda, established in 1888, a wind-powered mill where powder was produced by simple processes until the mid-20<sup>th</sup> century; the present owner of the property has taken special effort to preserve the buildings and equipment; the article is well-illustrated with b/w photographs of the milling equipment and a diagram of the mill layout).

Berg, Björn Ivar

1996 The Production and Consumption of Gunpowder at the Kongsberg Silver Mines, 1754-1865. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 219-236. Bath University Press, Bath, United Kingdom (403 pp.; the introduction of blasting to hard rock mining contributed to a revival of the industry ca. 1600 following a recession; at the Kongsberg silver mines in Norway, one of the most complex mining operations of the pre-industrial era, the use of gunpowder was firmly established by the early 18<sup>th</sup> century; a powder mill was erected in 1737 and operated almost without interruption until 1865, reaching a peak production of 64 tons in 1770; the Kongsberg mines were a superbly organized industry, for, as Berg notes [pg. 234], "Gunpowder production at the beginning of the production line and smelting and minting at the end of it, were all integrated into the structure of the Royal Silver Mines").

Biringuccio, Vannoccio

1943 *Pirotechnia* (translated and annotated by Cyril S. Smith and Martha T. Gnudi). American Institute of Mining and Metallurgical Engineers, New York (474 pp.; originally published in Italian in 1540; Biringuccio's [1480-1539] *Pirotechnia* is the earliest printed work on metallurgy, and went through nine editions in less than 150 years; parts of this work were plagiarized by Agricola; "I have no knowledge other than that gained by my own eyes" states the author [pg. 70], and indeed few works of this period are so utterly devoid of superstition; scornful of alchemists, Biringuccio's experimental approach notes those processes he observed to work and the materials that were used; detailed descriptions are provided for the processes of refining saltpeter and making gunpowder).

Bishop, Leander J.

1864 *A History of American Manufacturing* (2 vols.). Edward Young & Company, Philadelphia (organized chronologically, these volumes contain numerous references to the production of gunpowder in America; of particular interest are the following items:  
- Vol. I, pg. 592 - notes that the colony of Maryland

inserted an ad in the August 31, 1775, issue of the *Maryland Gazette* "...offering liberal encouragement to any one who would engage in the manufacture of fire-arms, or erect a gunpowder-mill near Baltimore, or salt or saltpetre works elsewhere, and inviting proposals for that purpose";

- Vol. II, pg. 23 fn. - extended discussion of General Court of Massachusetts attempting to establish gunpowder making facilities as early as 1639;

- Vol. II, pg. 144 - discussion of gunpowder mill established in 1809 by Brown, Page & Company near Richmond, Virginia; notes that this was the largest facility of its nature among the 53 powdermills in Virginia at that time;

- Vol. II, pp. 155-156 - states that saltpeter was being mined in 1810 in Virginia, Kentucky, "...and some of the other of the Western states and Territories, but principally came from the East Indies"; and

- Vol. II, pp. 752-753 - extended discussion of the equipment and operations of the Hazard Powder Company at Hazardsville [Hartford], Connecticut).

Blackwood, J. D. and F. P. Bowden

1952 The Initiation, Burning, and Thermal Decomposition of Gunpowder. *Proceedings of the Royal Society of London*, Series A 213:285-306.

Bragg, C. L.

1997 The Augusta Powder Works: The Confederacy's Manufacturing Triumph. *Confederate Veteran* n.s. 1:26-35 (informative summary of this impressive industrial facility located in Augusta, Georgia; also accessible at <<http://www.rose.net/~clbragg/apw.htm>>).

2001 The Augusta Powder Works: The Confederacy's Manufacturing Triumph. *American Rifleman* 149(5; May):58-59, 88-90. National Rifle Association, Fairfax, Virginia (clearly written brief history of this CSA facility; very informative illustrations depict the appearance of this large - two miles from end-to-end - state of the art powder mill).

Bret, Patricia

1996 The Organization of Gunpowder Production in France, 1775-1850. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 261-274. Bath University Press, Bath, United Kingdom (403 pp.; in 1775 the production of gunpowder in France was taken out of the hands of private enterprise and given to a newly created branch of the Ministry of Finance: the Régie des Poudres et salpêtres; the new state company inherited the private firm's industrial and commercial structure consisting of 17 saltpeter refineries and a dozen gunpowder factories; prior to 1775, saltpeter had been both imported from India and produced by more than 8,000 private workers;



under the able administration of Antoine Lavoisier, a noted chemist appointed by Minister Turgot, the industry was completely reformed; Bret attributes greatly increased saltpeter production in France after 1775 to three factors: the use of potash rather than wood ashes for leaching; the establishment of niter plantations for artificial production of saltpeter; and wise financial and fiscal policies which included higher prices and production bonuses paid to saltpeter makers; within a few years, the saltpeter warehouses were bulging, and France no longer imported any niter but instead was able to export to other nations; French powder mills also greatly improved in efficiency and technology; following the French Revolution, in a nation at war with most of Europe, citizens were mobilized for saltpeter production resulting in an amazing seven-fold increase over prior annual production figures; under Napoleon, every part of the Great Empire was exploited for war materials, and the French system for gunpowder production spread to all the newly annexed territories).

Bridgewater, Betty

1973 Foreword. In *Old Stone Fort* by Alexander Kocsis, pp. v-vi. Special Publication No. 1. Coffee County Historical Society, Manchester, Tennessee (speculates [pg. v] that an unlabeled structure appearing on a ca. 1870 Alexander Kocsis map of the Old Stone Fort, a prehistoric site near Manchester, Tennessee, is the site of the 1861-1862 CSA powder mill which stood here; site marked is situated south of an area called the "Ancient Canal" near the right bank of the Little Duck River [Bark Camp Fork] several hundred feet upstream from its confluence with the Big Duck River [Barren Fork]).

Broun, William Le Roy

1898 *The Red Artillery*. *Southern Historical Society Papers* 26:365-376 (as a Lt. Col. in the CSA Ordnance Department, Broun was extremely well informed regarding the availability of war supplies; of note is the comment [pg. 370]: "The old regulation shrapnel shells were filled with leaden balls and sulphur. The Confederacy had neither lead nor sulphur to spare, and used instead small iron balls and filled with asphalt"; this is a telling statement about CSA supplies of sulfur in the second half of the war; see also Mell 1902).

Brown, John Mason

1887 *The Kentucky Pioneers*. *Harper's New Monthly Magazine* 75(445; June):48-71, New York (of interest are the comments [pp. 56-57] on Monk Estill, slave in Boonesboro, Kentucky, in the 1770s: "A negro slave owned by Captain Estill was... a person of greatest importance from the ...fact that

he alone of all in the new country could make gunpowder. The cave where 'Monk' leached the earth for saltpetre, and combined his dangerous mixture, is one of the well-known spots of historic interest in Madison County. He possessed much intelligence, and was eccentric and reserved. He was treated with respect by whites and Indians alike. His freedom was given him in 1782 in recognition of his conspicuous bravery in an Indian fight. Thus, in addition to other points of interest, he was the first freed slave in Kentucky. His chemical secret – how to make gunpowder – was never divulged by him, and insured him a consequence proportioned to the value of that indispensable article in a settlement of hunters and Indian fighters").

Brown, M. L.

1980 *Firearms in Colonial America: The Impact on History and Technology, 1492-1792*. Smithsonian Institution, Washington (numerous comments on gunpowder scattered through this volume though remarks on the establishment of the first gunpowder mill in Massachusetts in 1666 [pg. 127] and extended discussion of gunpowder production [pp. 207-221] are particularly informative).

Buchanan, Brenda J.

1995 *Technology of Gunpowder Making in the Eighteenth Century*. *Transactions, Newcomen Society* 67:151-159, London.

1996 *Meeting Standards: Bristol Powdermakers in the Eighteenth Century*. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 237-252. Bath University Press, Bath, United Kingdom (403 pp.; gunpowder production was established in Bristol by the early 17<sup>th</sup> century, and the city became England's first and usually foremost center for commercial production of that article; Buchanan attributes this success primarily to the port facilities and the experience of the merchants in international trade; during the early 18<sup>th</sup> century, gunpowder production moved from the city to the surrounding countryside where new mills were established; the most important of these mills were at Wooley and at Littleton; these two mills, which were consolidated in the early 19<sup>th</sup> century, employed innovative production equipment and practices in advance of many other mills of the nation; from the earliest years, sales of gunpowder produced in the region had gone to private customers, to mines, merchant ships and privateers, but during the 1760s the Wooley Mill expended great effort in attempts to land a government contract; these efforts, for which there is ample documentation, were ultimately unsuccessful; sample after sample sent to London was rejected on

grounds of failing to meet proof standards; Buchanan suggests that a lack of personal connections may have handicapped the Bristol powdermakers; suppliers with established ties to the government may have had some lots rejected but not lost their contracts as a result).

Buchanan, Brenda J. (editor)

1996 *Gunpowder: The History of an International Technology*. University of Bath Press, Bath, U.K., (403 pp.).

Burdge, Franklin

1898 *A Second Memorial of Henry Wisner*. New York (an account of the life of Henry Wisner, an important manufacturer of gunpowder for the Continental Army during the Revolutionary War; contains many interesting details about making gunpowder during wartime, and refers to other powdermen of the period).

Burditt, George L.

1891 Sulphur. *The Manufacturer and Builder* 23(12; December):265, New York (short but informative article on the sources of sulfur and the processes used to extract it).

Cable, G. W. (editor)

1889 War Diary of a Union Woman in the South. *The Century: A Popular Quarterly* 38(6; October): 931-947, New York (the diary of this unnamed but obviously well educated and articulate lady provides valuable insight into the availability of gunpowder as a civilian commodity during the war; living and writing in or near New Orleans, the diarist notes that in the weeks and months following the fall of that city to Federal forces that:

- [pp. 937-938] April 30, 1862 - "Our stores are diminishing and cannot be replenished from without; ingenuity and labor must evoke the. ... The season for game is almost over, but an occasional squirrel or duck comes to the larder, though the question of ammunition has to be considered. What we have may be all we can have, if the war lasts more years longer..."

- [pg. 939] June 16, 1862 - "To buy provisions had proved impossible".

- [pg. 939] June 20, 1862 - "As soon as our intended departure was announced, we were besieged by requests for all sorts of things wanted in every family - pins, matches, gunpowder, and ink. One of the last cases H. and Max had before the stay-law stopped legal business was the settlement of an estate that included a country store. The heirs had paid in chattels of the store. The main contents of the cases were hardware; but we found treasure indeed - a keg of powder [and other items]. ... These were articles money could not get for us. ... H. filled

a tight tin case apiece with powder for Max and himself and sold the rest... Those who did not hear of this in time offered fabulous prices afterward for a single pound. But money has not its old attractions").

Carroll, Louise

1989 Tireless Josiah Gorgas Worked Wonders at the Richmond Arsenal, Arming a Fledgling Nation from Scratch. *America's Civil War*, November issue (accessible at: <<http://www.mdgorman.com/tireless.htm>>; brief but informative article about CSA Gen. Josiah Gorgas and his role in Confederate armaments and gunpowder production).

Chase, David W.

1974 Fort Mitchell: An Archaeological Exploration in Russell County, Alabama. *Special Publications of the Alabama Archaeological Society* No. 1, Moundville, Alabama (describes [pp. 11-13, 37-40] the history and construction of this ca. 1813-1814 era USA magazine; the walls of this semi-subterranean structure were built of horizontally laid logs; a sturdy pole roof was covered with sod; vii + 66 pp.).

Cheek, Charles D.

1976 *Honey Springs, Indian Territory: Search for a Confederate Powder House, An Ethnohistoric and Archeological Report*. Series in Anthropology No. 2, Oklahoma Historical Society, Oklahoma City (the Battle of Honey Spring was fought July 17, 1863, near the small town of Checotah in McIntosh County, Oklahoma; this study reports on efforts to locate a field magazine constructed by CSA troops)

Clephan, R. Coleman

1909 An Outline of the History of Gunpowder and That of the Handgun, from the Epoch of the Earliest Records to the End of the Fifteenth Century. *Archaeological Journal* 66:145-170.

Cocroft, Wayne D.

2000 *Dangerous Enemy: The Archaeology of Gunpowder and Military Explosives Manufacture*. English Heritage, Swindon, Wiltshire (320 pp.; 275 x 215 mm; 380 illustrations, plans, and figures; paperback).

Coffey, Brian F.

1997 Fertilizers to the Front: HAER and U. S. Nitrate Plant No. 2. *Industrial Archaeology* 23(1):25-42 (study of World War I era "nitrogen fixation" facility for the production of smokeless powder in Muscle Shoals, Alabama).

Comeaux, C. Stewart

1927 How the Confederacy Met the Powder Problem. *Confederate Veteran* 35 (10):366 (summary of history of Confederate powder making efforts largely extracted from a chapter in VanGelder and Schlatter

- [1927]).  
Confederate Provisional Congress  
1861 *Acts and Resolutions of the First Session of the Provisional Congress of the Confederate States, Held at Montgomery, Ala.*, Enquirer Book and Job Press/Tyler, Wise, Allegre & Smith, Richmond (of immediate note are the following acts adopted during the first days of the Provisional Congress:  
- [pg. 41] No. 20. AN ACT To exempt from Duty certain commodities therein named, and for other purposes. SECTION 1. Be it enacted by the Confederate States of America in Congress assembled, That the following articles shall be exempt from duty and admitted free into said States, to wit: ...gunpowder, and all the materials of which it is made; lead in all forms; arms of every description, and munitions of war and military accoutrements; percussion caps...  
Adopted February 18, 1861"  
- [pg. 42] No. 21. AN ACT To Provide Munitions of War and for other purposes, SECTION 1. Be it enacted by the Confederate States of America in Congress assembled, That the President or Secretary of War, under his direction, is hereby authorized to make... contracts for the establishment of powder mills and the manufacture of powder...  
Approved February 20, 1861"
- Confederate Treasury Department  
1861 *Tariff of the Confederate States of America Approved by Congress, May 21, 1861, to be of Force From and After August 31, 1861*. Steam-Power Presses of Evans & Cogwell, Charles, South Carolina (of interest is herein is Tariff Schedule G – items "Exempt from Duty – which includes [pg. 14] "Gunpowder, and all the materials of which it is made"; see also Confederate Provisional Congress 1861, above).
- Crocker, Glenys and K. R. Faircloth  
1998 Introduction of Edge Runner Incorporating Mills in the British Gunpowder Industry. *Industrial Archaeology Review* 20:23-37, Telford, England.
- Crowley, R. O.  
1898 The Confederate Torpedo Service. *The Century* 56(2; June):290-301, New York (as an interesting application of blackpowder in weapons other than small arms and artillery, this account traces the development of electrically detonated "torpedoes" – harbor mines in general terminology – and their deployment in the waterways of the South against Union watercraft; some of these devices used up to 50 lbs. of blackpowder; one such "torpedo" sank the USS Cairo, an ironclad, near Vicksburg, Mississippi).
- Crozier, Ronald D.  
1998 Guns, Gunpowder and Saltpetre: A Short History. *Faversham Papers* No. 58, The Faversham Society, Faversham, Great Britain (97 pp.; Faversham is home to the preserved Chart Gunpowder Mills which claim to be the "oldest of their kind in the world"; this connection led to sponsorship of Crozier's well-written and extensively documented history of saltpeter and gunpowder production which takes a global – rather than local – perspective; Crozier discusses the invention of gunpowder in China, the introduction of gunpowder to Europe, saltpeter and gunpowder production in England and on the Continent, the impact of the Industrial Revolution, Spanish colonial production, the significance of the Chilean nitrate industry, and blackpowders based on soda nitrate).
- Curtis, W. S.  
1996 The Deterioration of Gunpowder and Some of the Methods That Were Used to Combat It. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 253-259. Bath University Press, Bath, United Kingdom (403 pp.; the three ingredients of gunpowder are all subject to degradations in quality; sulfur may be rendered unfit by contamination with sulfuric acid; charcoal is highly variable, being dependent upon the type of wood used and the manner of preparation; saltpeter is the most critical part in terms of the ability to store gunpowder; if the saltpeter contains any form of nitrate other than potassium, such as calcium nitrate, it tends to absorb atmospheric moisture and become unfit; the introduction of pressing, probably in the late 18<sup>th</sup> or early 19<sup>th</sup> century, induced a greater density and greatly improved the storage life of gunpowder made this way; the manner of storage, by the types of containers used and the design of magazines, also influenced gunpowder deterioration; see also Hall [1996] on the introduction of gunpowder corning as a means to improve storage life).
- Davis, Jefferson  
1958 *The Rise and Fall of the Confederate Government* (2 vols.). Thomas Yoseloff, New York and London (originally published 1881; as a result of having graduated from West Point Military Academy, service as both a line officer in the US Army and later US Secretary of War, and ultimately as President of the Confederacy, Davis was amply qualified to coldly assess the state of readiness of the Confederacy to engage in a major war and all too well recognized the problems before him; his evaluation of the Confederacy's armament and war materiel is summarized in Volume 1, Chapters XII [pp. 471-483] and XII [pp. 471-483];



of present interest are his statements concerning the efforts of the Confederacy to secure saltpeter and establish both niter beds and gunpowder mills to aide in the war effort:

- [pp. 316-317] "It has been heretofore stated that we had no powder-mills. It would be needless to say that the new-born Government had no depots of powder, but it may be well to add that, beyond the small supply required for sporting purposes, our local traders had no stock on hand. Having no manufacturing industries which required saltpeter, very little of that was purchasable in our markets. The same would have been the case in regard to sulphur, but for the fact that it had been recently employed in the clarification of sugar-cane juice, and thus a considerable amount of it was found in New Orleans. Prompt measures were taken to secure a supply of sulphur, and parties were employed to obtain saltpeter from the caves, as well as from the earth of old tobacco-houses and cellars; and artificial niter-beds were made to provide for prospective wants. Of soft wood for charcoal there was abundance, and thus materials were procured for the manufacture of gunpowder to meet the demand which would arise when the limited quantity purchased by the Confederate Government at the North should be exhausted.

"It was our good fortune to secure the services of an able and scientific soldier, General G[eorge] W[ashington] Rains, who, to a military education, added experience in a large manufacturing establishment, and to him was confided the construction of a powdermill, and the manufacture of powder, both for artillery and small-arms. The appalling contemplation of the inauguration of a great war, without powder or a navy to secure its importation from abroad, was soon relieved by the extraordinary efforts of the ordnance department and the well-directed skill of General Rains, to whom it is but a just tribute to say that, beginning without even instructed workmen, he had, before the close of the war, made what, in the opinion of competent judges, has been pronounced to be the best powder-mill in the world, and in which powder of every variety of grain was manufactured of materials which had been purified from those qualities which cause its deterioration under long exposure to a moist atmosphere"

- [pg. 473] "The first efforts made to obtain powder were by orders sent to the North, which had been early done both by the Confederate Government and by some of the States. These were being rapidly filled when the attack was made on Fort Sumter. The shipments then ceased. Niter was contempor-

aneously sought for in north Alabama and Tennessee. Between four and five hundred tons of sulphur were obtained in New Orleans...

Preparations for the construction of a large powder-mill were commenced by the Government, and two small, private mills in East Tennessee were supervised and improved. ...we had no experience in making powder, or in extracting niter from natural deposits, or obtaining it by artificial beds";

- [pg. 474] "A refinery of saltpeter was established near Nashville [Tennessee] during the summer [of 1861], which received the niter from its vicinity, and from the caves in East and Middle Tennessee. Some inferior powder was made at two small mills in South Carolina. North Carolina established a mill near Raleigh; and a stamping- mill was put up near New Orleans, and powder made there before the fall of the city. Some quantities were also received through the blockade";

- [pp. 475-476] "It was, therefore... necessary that we should establish a Government powder-mill. It was our good fortune to have a valuable man whose military education and scientific knowledge had been supplemented by practical experience in a large manufactory... He, General G[eorge] W[ashington] Rains, ...returned to the land of his birth... The expectations which his reputation justified, caused him to be assigned to the task of making a great powder-mill... Not only was powder made of every variety of grain and exact uniformity in each, but the niter was so absolutely purified that there was no danger of its deterioration in service.

"These Government powder-mills were located at Augusta, Georgia, and satisfactory progress was made in the construction during the year [1861]. All the machinery, including the very heavy rollers, was made in the Confederate States. Contracts were made abroad for the delivery of niter through the blockade; and, for obtaining it immediately, we resorted to caves, tobacco-houses, cellars, etc. The amount delivered from Tennessee was the largest item in the year's supply, but the whole was quite inadequate to existing and prospective needs").

Davis, Tenny L.

1941-1943 *The Chemistry of Powder and Explosives*. (Volume 1 published 1941; Volume 2 published 1943; subsequently reprinted as single volume; publisher and place not given; see Chapter 2 for information on history and production of black powder; balance of book generally devoted to smokeless powder chemistry and manufacture).

DeVries, Kelly

1996 *Gunpowder and Early Gunpowder Weapons. In Gunpowder: The History of an International*

*Technology* (Brenda J. Buchanan, editor), pp. 121-135. Bath University Press, Bath, United Kingdom (403 pp.; according to DeVries, although gunpowder weaponry underwent rapid technological development during its first two centuries, there was little change in the gunpowder manufacturing process except for the introduction of corning; gunpowder was initially viewed as a mysterious substance imitating God's power, but by the 14<sup>th</sup> century was regarded as mundane stuff that must be made, supplied, transported, and stored; during the 15<sup>th</sup> century, more numerous and powerful guns led to increasing problems in these same functions).

Downs, Annie Sawyer

1896 *Historic Andover. The New England Magazine* 20(4; June):483-507, Boston (it is noted herein [pg. 499] that "The first principal of Phillips Academy [Andover, Massachusetts] was Eliphalet Pierson... Contemporaneous accounts say that Dr. Pierson was the first instructor in Phillips Academy, and the first man in New England to collect and prepare saltpetre from earth taken under the floors of barns and other buildings, for the use of the powder mill which Judge [Samuel] Phillips had just started to supply Washington's powderless army"; see also Anonymous 1853; and Taylor 1858:124-125).

Du Bois, W. E. Burghardt

1907 *Economic Co-operation among Negro Americans* ("Report of a Social Study made by Atlanta University, under the patronage of the Carnegie Institution of Washington, D.C., together with the Proceedings of the 12<sup>th</sup> Conference for the Study of Negro Problems, held at Atlanta University, on Tuesday, May the 28<sup>th</sup>, 1907"). Atlanta University Press, Atlanta (184 pp.; in referring to Africa, Du Bois [pg. 15] remarks: "Caillé found the Negroes in Bambana manufacturing gunpowder (1824-8) ...so, too, Negroes in Uganda and other parts have made guns after seeing European models").

Dutton, William S.

1942 *Du Pont: One Hundred and Forty Years*. Charles Scribner's Sons, New York (an expanded and far more detailed account of the du Pont company than Anonymous [1912]; Dutton focuses upon the company's first century of involvement in explosives manufacture but also presents a lengthy rendition of the firm's diversification into synthetics such as rayon and nylon; 396 pp.).

E. I. du Pont de Nemours & Company

1880 *Gun Powder*. Wilmington, Delaware (advertising broadside of then currently available gunpowders with a paper entitled "Description of DuPont's Gunpowder Works" revised from *Great*

*Industries of the United States* published in Hartford, 1872).

Evans, Gen. Clement A. (editor)

1899 *Confederate Military History: A Library of Confederate States History, in Twelve Volumes, Written by Distinguished Men of the South*. Atlanta, Georgia (of note within this informative series are the following biographical sketches relating to CSA ordnance production appearing in Vol. 1:

- [pg. 622] "Isaac Munroe St. John, commissary-general of the Confederate States during the closing days of the conflict, was a native of Augusta, Georgia, born November 19, 1827. He took a degree at Yale in 1845, studied law at New York city, and became an editor of the *Baltimore Patriot* in 1847. Then settling upon the profession of engineering he was engaged in railroad work, which brought him back to Georgia. At the outbreak of the war he entered the engineer corps, and was assigned to duty under General Magruder in Virginia, where he rendered valued service preparing the fortifications to oppose McClellan's first campaign. In May, 1862, he was made major and chief of the mining and nitre bureau, the sole reliance of our armies for gunpowder material. He was promoted through a colonelcy to the rank of brigadier-general, and was made commissary-general in 1865, in which position he established a system by which the supplies for the army were collected directly from the people and placed in depots for immediate transportation. After peace was restored he resumed engineering in Kentucky, was chief engineer of the Louisville, Cincinnati and Lexington railroad, built the Short Line to Cincinnati, was city engineer of Louisville, and from 1871 was chief engineer of the Lexington and Big Sandy railroad until his death, which occurred in West Virginia, April 7, 1880."

- [pp. 622-624] "Josiah Gorgas, distinguished as chief of ordnance of the Confederate States, was born in Dauphin county [sic], Pennsylvania, July 1, 1818. He was graduated at West Point as No. 6 in the class of 1841, and was assigned to the ordnance department of the United States army. In 1845-46 he was in Europe on leave of absence for the study of his profession in foreign lands, and in the year following his return he went into active service in the Mexican war. March 3, 1847, he was promoted first-lieutenant. He served with distinction in the siege of Vera Cruz and was subsequently in charge of the ordnance

depot at that point. On the return of peace he served as assistant ordnance officer at various arsenals until placed in command of Mt. Vernon arsenal, Alabama, in 1853. In December of that year he was married to the daughter of ex-Governor Gayle, of Mobile. He was promoted captain in 1855, transferred to Kennebec (Maine) arsenal in 1856, commanded the Charleston (S. C.) arsenal until 1860, and was then transferred to Pennsylvania. In the latter year he served as a member of the ordnance board. Resigning in April, 1861, he removed with his family to Alabama, and received from President Davis the appointment of chief of ordnance of the Confederate States, then 'the most important scientific and administrative office in the government.' Fully appreciating the great poverty of the South in this department, he promptly sent an efficient officer to Europe to procure arms, located arsenals, and made immediate preparation for the manufacture of powder and saltpeter, and the development of lead and copper mines, also preparing elaborate papers showing the proper distribution of heavy armament for effective defense against invasion. At an early date he insisted upon the use of cotton and tobacco to procure military supplies, and arranged for an effective service by blockade runners. Out of his suggestion and practical action grew the bureau of foreign supplies and the mining and nitre bureau. He displayed remarkable ability in the selection of officials for the work under his control, and impressed all those brought into intercourse with him, as an executive officer of remarkable energy and ability, though his modesty rendered him little known to the general public. 'He created the ordnance department out of nothing,' was the brief and comprehensive verdict of General J. E. Johnston. After the practical dissolution of the Confederate government at Charlotte, N. C., in the spring of 1865, he returned to Alabama, and promptly turned his activity into industrial channels as superintendent of the Briarfield iron works. Soon afterward he was appointed headmaster and later vice-chancellor of the University of the South at Sewanee, Tennessee. In 1877 he became president of the University of Alabama, but after a brief tenure was compelled by failing health to resign. The trustees desiring his continued presence, he accepted the office of librarian, and was thus connected with the university until his death, May 15, 1883").

Everson, Paul and Wayne Cocroft

1996 The Royal Gunpowder Factory at Waltham Abbey: The Field Archaeology of Gunpowder Manufacture. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 377-394. Bath University Press, Bath, United Kingdom (403 pp.; the Royal Gunpowder Factory at Waltham Abby, located about 15 miles northeast of London, England, was for generations one of the most famous of gunpowder production complexes, serving as inspiration for the large Confederate works at Augusta, Georgia; the mills began production in the mid-17<sup>th</sup> century as a private concern and was purchased by the government in 1787; following acquisition, large scale expansion and rebuilding was undertaken and further development occurred during the mid and late 19<sup>th</sup> century; by the end of the 19<sup>th</sup> century, new forms of explosives superseded gunpowder and during the 20<sup>th</sup> century Waltham Abbey became a research and development center for several propellants and high explosives; as the authors note [pp. 379-380], "The site encapsulates, as a combination of built and buried features, the physical remains of the development of gunpowder and other technologies of explosives manufacture over a 300-year period in a single monument"; in 1993, following closure of the government research establishment in 1991, the Royal Commission on the Historic Monuments of England carried out a combined archaeological and architectural field survey of the site; field remains, including excavations, were systematically recorded and related to an abundant documentary archive; emphasis is upon process and function, seeking "to grasp the linages between process components and to understand their supporting infrastructures" [pg. 393]; together with the physical and geographic changes over three years in this landscape of production; see also Crozier [1998] and Kelleher [1996] for accounts of English Royal Gunpowder factories contemporary with Waltham Abbey).

Frost, George E.

1990 *Ammunition Making: An Insider's Story*. National Rifle Association, Washington (see pp. 71-78 for discussion on production of contemporary nitroglycerin based "smokeless" powders).

Gaither, S.

1995 The World War II Ordnance Department's Government-Owned Contractor Operated (GOCO) Industrial Facilities: Indiana Army Ammunition Plant. Report prepared by Geo-Marine, Plano, Texas, for U.S. Army Corps of Engineers, Fort Worth, Texas (this Indiana facility produced half of the blackpowder used by the U.S. and all of its allies



during World War II).

George, Angelo I.

1986a Central Kentucky Gunpowder Factories. *Proceedings of the Symposium on Ohio Valley Urban and Historic Archaeology* 4:86-95 (synthesizes available historical data on eight 1800-1867 era powder mills in Adair, Barren, Cumberland, Edmonson, Green, and Hart counties, Kentucky).

1986b Central Kentucky Gunpowder Factories. *Journal of Spelean History* 20(2):28-34 (see above).

1987 Monk Estill and the Gunpowder Crisis at Fort Boonesborough. *Journal of Spelean History* 21(3-4):40-47 (Monk Estill, a Black slave of James Estill at Estill's Station near present-day Richmond, Kentucky, has often been credited as the first person to manufacture gunpowder in Kentucky; George's research shows that although a small lot was made by Daniel Boone in 1777, in 1780 Monk was the first to make saltpeter from a Kentucky cave [identified as Adams Cave in Madison County]; Monk, who had learned the art of gunpowder manufacture in the Greenbriar Valley of Virginia, made a sufficient quantity of powder to ease a critical shortage at the forts at both Boonesborough and Estill's Station).

Gillispie, Charles C. (editor)

1959 *A Diderot Pictorial Encyclopedia of Trades and Industry* (2 volumes). Dover Publications, Inc., New York (originally published 1763 in Paris; see Volume I, Plates 154-158 for discussion and illustrations of powder making processes and equipment).

Goodspeed Publishing Company

1886 *A History of Tennessee from the Earliest Times Up to the Present*. Goodspeed Publishing Company, Nashville (Goodspeed remarks [pg. 841] that: "In 1852 W. S. Whiteman erected a paper-mill on Barren Fork of Duck River, at Manchester [Coffee County, Tennessee], which was burned in 1871. He also erected a powder-mill in 1862 near the same site, and manufactured powder for the Confederate Army until the destruction of the mill and magazines by the Federal soldiers in 1863..."; in actuality, the mill began operations in October 1861 [Secretary of War 1900j:557] and was burnt by a Union patrol on March 26, 1862 [Secretary of War 1884b:48]; the involvement of Whiteman in this undertaking is verified by Rains [1882:7]).

Gorgas, Brigadier General Josiah

1876a Annual Report No. 1. *Southern Historical Society Papers* 2(1):59-60 (copy of report dated October 13, 1864, from CSA Gen. Gorgas to Secretary of War James A. Seddon regarding the

operations of the Confederate Ordnance Bureau; of note are his observations [pg. 59] that "The mechanical means of the Bureau for the production of powder are ample for a war conducted on any scale, and are so arranged as to be almost beyond casualty. The supply depends alone on that of saltpeter and sulphur, and for the present on the former. While we must still depend on importation as our chief supply of nitre, it will be indispensable that the efforts of the Nitre and Mining Bureau be sustained, in order that the home production may be assured. A certain force of white and black labor ought to be permanently assigned to this duty of procuring nitre and sulphur and the other operations of the Nitre and Mining Bureau").

1876b Special Report No. 2. *Southern Historical Society Papers* 2(1):61-62 (report dated December 31, 1864, from CSA General Josiah Gorgas to Secretary of War James A. Seddon in response to a request for "information as to the means of supplying munitions of war"; of note are his remarks [pg. 62] "As to powder - The manufacturing capacity at the disposal of the Bureau is ample for all purposes, viz:

Augusta Mills	5,000 lbs. per day
Selma Mills	600 "
Raleigh Mills	600 "
Richmond Mills (in a few weeks)	1,500 "
Total	7,700 " ).

1884 Notes on the Ordnance Department of the Confederate Government. *Southern Historical Society Papers* 12(1-2):67-94 (these posthumously published notes were intended to be developed into a more comprehensive history of the CSA Ordnance Department; following his death, they were released for publication by his widow; Gorgas was the single man who best understood the day-to-day logistics and problems associated with arming the South; among his many informative observations are his extended remarks concerning the production of gunpowder beginning in June 1861; of note is the comment [pp. 69-70]: "The first thing to be attended to was the supply of gunpowder. ...Of course all the ports were soon sealed off to such importations from the North. Attention was at once turned to the production of nitre in North Alabama and in Tennessee... An adequate supply of sulphur was found in New Orleans, where large quantities were in store to be used in sugar refining. The entire stock was secured, amounting to some four or five hundred tons"; 400 tons of sulfur would make ca. 3,200 tons [6,400,000 lbs.] of gunpowder; this was likely the largest inventory of sulfur ever held by the

- Confederacy).
- Guttman, Oscar  
 1906 *Monumenta Pulveris Pyrii: Reproductions of Ancient Pictures Concerning the History of Gunpowder, with Explanatory Notes*. Printed for the author at the Artists' Press, London (34 pp. + 102 plates; a very rare book of which only 270 copies were printed; the title, text, and plate captions are also in German and French; Guttman [1855-1910] was a distinguished chemist with a strong interest in explosives; after his death from an automobile accident, Pierre du Pont purchased the Guttman collection of some 800 books and 1,000 pamphlets related to fireworks and explosives; the introductory text to *Monumenta Pulveris Pyrii* contains numerous errors in fact and interpretation; Partington [1999:129] described the text as "useless"; the lasting value of Guttman's work is in the collection of illustrations from historical works on gunpowder).
- Hall, Bert S.  
 1996 The Corning of Gunpowder and the Development of Firearms in the Renaissance. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 87-120. Bath University Press, Bath, United Kingdom (403 pp.); "corning" is a technique to produce granulated gunpowder, differing from the finely ground or "serpentine" gunpowder made previously; corning produces a gunpowder that is faster-burning, more powerful, and less subject to spoilage; the addition of water to the ingredients being incorporated produces a paste which must be dried and crushed again, allowing different particle sizes to be separated; larger grains expose less surface area to the atmosphere and hence are subject to less damage from moisture; the German Fireworks Book [see Kramer 1996], originally written ca. 1400, mentions a process by which large lumps of powder are made from a paste, which should be broken up into crumbs before use in guns; storage of gunpowder in large "loaves" was a common practice to avoid spoilage; Hall notes, referring to Kramer's argument that early saltpeter was mainly calcium nitrate, that all nitrate forms are far more hygroscopic than potassium nitrate and calcium nitrate particularly so; this tendency to spoilage by calcium nitrate in early gunpowders was a strong stimulus to the adoption of corning, and to an additional step in the manufacture of crude saltpeter – treating the leachate with wood ashes to convert the calcium nitrate to potassium nitrate; early corning practice did not control particle size and produced grains that were irregular and rough; later, improved corning technique [first described in detail in 1562] and the adoption of glazing produced grains of uniform size and burn rate; the greater forces produced by corned powder required redesign of guns for increased strength, eventually resulting in widespread adoption of the single-piece, cast muzzle-loader; corned powder also allowed the development of small arms).
- 1997 *Weapons and Warfare in Renaissance Europe: Gunpowder, Technology, and Tactics*. Johns Hopkins University Press, Baltimore and London (detailed examination of the impacts of gunpowder on the evolution of firearms and European warfare; of present interest is his extended discussion [pp. 41-104] on the chemistry and manufacturing processes associated with blackpowder manufacture from the 14<sup>th</sup> through 16<sup>th</sup> century; extensive bibliography; index; xvii + 300 pp.).
- 1999 Introduction, 1999. In: *A History of Greek Fire and Gunpowder* by J. R. Partington, pp. xv-xxix. Johns Hopkins University Press, Baltimore and London (informative review of gunpowder chemistry and aspects of manufacturing processes).
- Hamilton, Douglas T.  
 1916 *Cartridge Manufacture*. Industrial Press, New York (of present interest, Hamilton provides a clearly written and succinct description of the ingredients and processes involved in the production of both blackpowder [pp. 10-14] and smokeless powder [pp. 14-18]; index; 167 pp.).
- Hancock, Harold Bell and Norman Beaumont Wilkinson  
 1966 A Manufacturer in Wartime: Du Pont, 1860-1865. *Business History Review* 40(2):213-236 (the E. I. du Pont de Nemours operation in Delaware was responsible for about 40% of US gunpowder production in 1860; in the months immediately prior to the outbreak of the Civil War, agents for the southern cause placed large powder orders with the firm and attempted to gain the company's expertise in setting up powder mills, assuming that Delaware would be aligned with the South; after the outbreak of hostilities, du Pont powder out on commission in seceding states was seized, amounting to about 325 tons for which only partial compensation was made; Delaware and du Pont remained aligned with the North, but the security of the powder mills from sabotage or direct attack was a constant source of worry; destruction of the Union's principal supplier would be a great triumph for the Confederacy; Du Pont managed to supply both large government contracts and his regular customers in the North, although as the war continued, raw materials became scarcer and caused the price of gunpowder to rise; the need to secure saltpeter from Britain was complicated by the Trent affair, which caused an

embargo to be temporarily imposed on export of all ordnance supplies to the U.S.; subsequently, 2,000,000 lbs. of Indian saltpeter were shipped to du Pont in January 1862, and this supply source continued through the war; the increased pace of production due to wartime demands led to some quality problems with the company's powder; during the war, du Pont also began to import more Chilean soda nitrate to make blasting powder; after the war, du Pont and other large northern powder makers lowered prices, sought to collect pre-war debts, and began to reestablish the market for their product in the southern states).

Hanson, Lee and Dick Ping Hsu

1975 Casements and Cannonballs: Archeological Investigations at Fort Stanwix, Rome, New York. *Publications in Archeology* No. 14, U.S. Department of the Interior, National Park Service, Washington (discusses in detail [pp. 27-32] the four likely vertical log and earth covered magazines built in the bastions of this 1758-1781 British fort; xii + 177 pp.).

Hay, James A. C.

1878 The Manufacture of Gunpowder. *Engineering* 25:1-2, 37-38, 95-96, 137-138, 197-198, 235-236 (an excellent and detailed account of all the steps necessary in the manufacture of gunpowder as practiced in the late 19<sup>th</sup> century, an era when newer high explosives were becoming popular but venerable blackpowder was "still almost exclusively used for military and sporting purposes, and to no inconsiderable extent in mining and quarrying..." [pg. 1]; Hay reviews the refining of saltpeter and sulfur and the making of charcoal, and then describes the various machines and operations required to produce high-grade gunpowder; the account contains numerous b/w illustrations of what was then state-of-the art equipment).

Heldman, Donald P. and William L. Minnerly

1977 The Powder Magazine at Fort Michilimackinac: Excavation Report. *Reports in Mackinac History and Archaeology* No. 6, Mackinac Island State Park Commission, Mackinac Island, Michigan (privately constructed ca. 1750, this small rectangular magazine was built of closely spaced upright log posts packed with waddle; horizontal clapboards were attached to the posts and upright shingles were attached to the exterior of the clapboards; this was covered with earth to protect the powder from fire; the magazine was burned by British troops in 1781; 29 pp.).

Henshaw, Thomas

1959 [1667] "The History of the Making of Saltpeter," pp. 260-276, and "The History of Making

Gunpowder", pp. 277-283. In *History of the Royal Society* by Thomas Sprat. Reproduction of the original 1667 edition, edited with commentary by Jackson I. Cope and Harold W. Jones. Washington University Studies, St. Louis (Henshaw's papers, presented to the Royal Society in 1662, review the known history and current methods for production of saltpeter and gunpowder; for a highly critical contemporary review of Henshaw's essays, see Stubbe [1670]).

Howard, Robert A.

1975 Blackpowder Manufacture. *Industrial Archaeology* 1(1):13-28 (an important and detailed technological account of the manufacture of gunpowder in the U.S. from colonial times).

1976 Gunpowder in the American Revolution. *Arms Gazette* 3(2; July):20-21, 32-33 (in 1775, with only one recently constructed gunpowder mill operating in the colonies, the need for self sufficiency in arms and ammunition was of paramount importance; at that time, there were no known significant domestic sources of saltpeter, the primary ingredient needed to manufacture gunpowder, and the British controlled the importation of niter from India; accordingly, numerous recipes and instructions were published in the American press for obtaining saltpeter in small lots from the earth beneath houses and in barnyards, and for manufacturing gunpowder; the quantities of gunpowder that could be produced in the colonies proved insufficient to support the war effort, and it was only through the smuggling of gunpowder from abroad with French aid that the Revolution was successfully concluded).

1996 The Evolution of the Process of Powder Making from an American Perspective. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 3-24. Bath University Press, Bath, United Kingdom (403 pp.; according to Howard, the gunpowder manufacturing process evolved to meet certain needs; these needs were to produce gunpowder in a form that would allow transportation without degradation, the ability to produce and maintain specific particle sizes, and to achieve consistency through care in the selection and purification of ingredients; Howard discusses the evolution of the American manufacturing process from its crude colonial origins to its technological pinnacle at the beginning of the 20<sup>th</sup> century, represented by the industrial complex of du Pont's powder mills in Delaware; one weakness in this otherwise excellent presentation is Howard's obvious unfamiliarity with the American saltpeter industry; he notes [pg. 7], that "caves were here discovered ... which had several feet of bat droppings



that could be processed into saltpeter" understandably but erroneously adopting a largely discredited origin theory once popular [see Hill 1981a and 1992 for evaluation of saltpeter origin theories]; further, Howard briefly, but accurately, describes the steps required to leach saltpeter earth from caves and recover the nitrate content, but illustrates this process with an engraving of a large multi-story saltpeter refinery; this is misleading because the manufacture of cave saltpeter was largely a cottage industry conducted on a small scale with primitive equipment; a facility such as that shown could in America only represent a re-refinery used by large eastern mills [du Pont, for example] to purify saltpeter shipped to them from the west).

Howard, Robert A. and E. Alvin Gerhardt, Jr.

1980 *Mary Patton: Powder Maker of the Revolution*. Rocky Mount Historical Association, Rocky Mount, North Carolina (Mary Patton, 1751-1836, who as a child apprentice learned the art of gunpowder manufacture in England, carried on this business after her family emigrated to the colonies in the late 1760s, first in Pennsylvania and later in North Carolina; the Patton mill near Rocky Mount, North Carolina, was in operation from 1777 through the end of the Civil War, although never a large-scale producer, 500 pounds of powder donated or sold by Mary helped to win the battle of King's Mountain in 1780, a victory which has been called the turning point of the Revolutionary War; the sources of niter used by the mill were reportedly the nearby Hyder and Gourley caves; little documentation is available for this mill and most information was provided by oral tradition).

Jenkins, Howard M.

1889 *The Banks of Brandywine*. *Harper's New Monthly Magazine* 79(470; July):208-214, New York (an informative study of several hydropower facilities which had operated along Delaware's Brandywine River; of note herein are his remarks [pp. 213-214] on the history of the du Pont powderworks and lithographs of "The Old Powder-Mill" [pg. 211] and "Pierre Samuel du Pont" [pg. 212]).

Jixing Pan

1996 *The Origin of Rockets in China*. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 25-32. Bath University Press, Bath, United Kingdom (403 pp.; China, where gunpowder was invented, was also the first nation to develop military applications for this substance; a Chinese military treatise published in 1044 mentions "fire arrows" presented to the Emperor in the previous century, provides accounts of nine gunpowder weapons, and contains the three earliest precise recipes for gunpowder; while these

"fire arrows" may not have been true rockets, the *p'i-li p'ao*, or "thunderbolt missile" used in the 1161 battle of Ts'ai-shih was indeed a primitive rocket-propelled bomb from the description of its effects).

Jones, Charles C., Jr.

1874 *The Siege of Savannah in December, 1864, and the Confederate Operations in Georgia and the Third Military District of South Carolina During General Sherman's March from Atlanta to the Sea*. Joel Munsell, Albany, New York (x + 184 pp.; based upon his service as a CSA Lt. Colonel in the Artillery Corps, Jones makes the following comment [pg. 25] regarding plans to safeguard the Augusta {Georgia} Powder Works: "The enemy having abandoned any serious designs ... against the city of Macon, and it being deemed not improbable that the city of Augusta with its valuable powder mill [and other ordnance-related facilities] ... would attract the notice of Sherman, on the morning of the 21<sup>st</sup> of November [1864], General Hardee ordered the First Brigade, Georgia militia, ... to rendezvous at Augusta at the earliest practicable moment").

Jones, Charles Edgeworth

1918 *Confederate Powder Works at Augusta*. *Confederate Veteran* 26(5):208-209 (brief history of the construction and operation of the CSA powder mill in Augusta, Georgia, by Col. George Washington Rains).

Jones, Joseph

1876 *Explorations of the Aboriginal Remains of Tennessee*. *Smithsonian Contributions to Knowledge* No. 259, Washington, DC (though predominately concerned with prehistoric sites in the state, in his description of the Old Stone Fort, a prehistoric earthwork between the branches of the Duck River near Manchester, Jones [pg. 101] notes: "As the fort had been used by soldiers during a portion of the recent war ... for a camping ground, and as a [powder] mill had been erected on the Barren Fork, fragments of iron utensils and of copper are occasionally found, also lead bullets, but these are clearly of modern date").

Kelleher, Brendan

1996 *The Royal Gunpowder Mills, Ballincollig, County Cork*. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 359-375. Bath University Press, Bath, United Kingdom (403 pp.; according to Brendan, the Ballincollig mill complex, established at the end of the 18<sup>th</sup> century, is of international importance in the history of technology and of industrial archaeology; the remains of these mill can today be found on the southern bank of the River Lee west of Cork City; at its peak, the works occupied more than 400 acres and extended for several miles along the

river; initially a private concern, the mills were purchased by the British government in 1805 and a major expansion followed; following Napoleon's defeat at Waterloo the mills were closed for a time, and sold back into private hands in 1833 when the government decided to concentrate production at Waltham Abbey; for the next half-century, civil and military demands encouraged high production levels at the mills, but the demand for blackpowder declined in the late 18<sup>th</sup> century; the mills were closed permanently in 1905, after more than 90 years operation and an estimated production of 2,000,000 barrels of gunpowder; in 1973, the property was acquired by the Cork County Council, which, supported by grants, has undertaken archaeological investigations and limited restoration of the badly deteriorated site features; as Brendan notes [pg. 372], "What has been achieved is the conservation of a unique industrial archaeological complex, the provision of a public amenity, and the creation of a tourist attraction").

Khan, Iqtidar Alam

1996 The Role of the Mongols in the Introduction of Gunpowder and Firearms in South Asia. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 33-44. Bath University Press, Bath, United Kingdom (403 pp.); Khan's documentary research indicates that gunpowder weapons were introduced to South Asia from China before 1351 through several agencies and channels; the most important of these was the Mongols, whose invasions of the region took place from 1221 to 1351; Chinese texts indicate that the invaders, having learned gunpowder technology from the Chinese during the mid-13<sup>th</sup> century, were using explosive and pyrotechnic weapons; due to its ease of handling, long range, ready availability of materials, the rocket continued to be used throughout South Asia until the late 18<sup>th</sup> century, even after the introduction of artillery).

King, Edward

1874 The Great South. *Scribner's Monthly* 8(4; August):385-412, New York (this travelogue account of the post-Civil War South notes [pg. 389] "Augusta [Georgia], like Savannah, is a town built in the midst of a beautiful wood. ... On the road to Summerville, the pretty suburb on one of the sand hills three miles away, one sees the powder mill, once disused, which supplied the Confederates with ammunition for many a day...").

Kramer, Gerhard W.

1996 Das Feuerwerkbuch: Its Importance in the Early History of Blackpowder. In *Gunpowder: The History of an International Technology* (Brenda J.

Buchanan, editor), pp. 45-56. Bath University Press, Bath, United Kingdom (403 pp.); Kramer discusses the historical importance of the Firework Book, a practical text in manuscript form on the methods of the gunsmith, apparently written ca. 1400 and recopied many times with additions [first printed in 1529]; basing his analysis on the 1432 edition in possession of the University of Frieberg, Kramer concluded from internal evidence that the book was written by two authors; the older text dates from ca. 1380 and the younger from 1400-1410; the first part of the book contains a series of procedures [in the form of questions and answers] concerned with theory on gunpowder combustion, loading and firing procedures for the stonegun [an early form of cannon], chemistry and manufacture of lime saltpeter, chemistry and production of sulfur and charcoal, manufacture of gunpowder and remanufacture of damaged powder, and shooting and gun techniques; the newer section contains a preface, a central part with a report on Niger Berchtoldus [reputedly the inventor of the stonegun], and an epilogue; some evidence suggests that the older section of the manuscript may have been written by Berchtoldus; the Fireworks Book was concerned with calcium nitrate as the oxidizer in gunpowder and thus lost significance when potassium nitrate was discovered in the mid-16<sup>th</sup> century; Kramer notes that nowhere in the text is there any reference to potassium nitrate: "The Chinese and the Arabs did not know of it, or the Firework Book would have referred to it in the section on the purchase of imported saltpetre" [pg. 51]).

Lattimore, Ralston B.

1954 Fort Pulaski National Monument, Georgia. *National Park Service Historical Handbook Series* No. 18, U.S. Government Printing Office, Washington (situated on Cockspur Island in a swamp near the mouth of the Savannah River, the construction of this massive brick fort was assigned in 1829 to a young Lt. Robert E. Lee, recently graduated from the West Point Military Academy; construction efforts continued until 1847; of special note [pp. 33-35] is this facility's only military engagement, the April 10-11, 1862, contest between the occupying CSA troops and the USA attack using rifled artillery for the first time in modern warfare; in short order, the striking power of the elongated artillery rounds fired from the rifled weapons shattered many feet of solid brick wall and threatened to disintegrate the crumbling brick vaulted room used as the magazine and ignite 40,000 lbs. of gunpowder, enough powder to have leveled much of the fort; the surrender of the fort

after only two days in concert with the devastation of the fabric of the fort made all such military architecture effectively obsolete and ultimately prompting changes in magazine design; iv + 56 pp.).

Lenik, Edward J.

- 1975 A Preliminary Archaeological Survey of the Ford Powder Mill Site. In: *A Report on New Jersey's Revolutionary War Powder Mill* by Fred Barterstein and Isabel Barterstein, pp. 119-151. Morris County Historical Society, Morristown, New Jersey.

Lewis, Emanuel Raymond

- 1979 *Seacoast Fortifications of the United States: An Introductory History*. Leeward Publications, Inc., Annapolis, Maryland (though not directly discussing the powder magazines associated with these military facilities dating from ca. 1810 to World War II, this is an extremely useful study for understanding the evolution and architecture of these installations; xiv + 145 pp.).

Lucar, Cyprian

- 1588 *Three Bookes of Colloquies Concerning the Arte of Shooting in Great and Small Pieces of Artillerie, Variable Randges, Measure, and Waight of Leaden, Yron, and Marble Stone Pellets, Minerall Saltepeeter, Gunpowder of Divers Sortes, and the Cause of Why Some Sortes of Gunpowder are Corned, and Some Sortes of Gunpowder are not Corned*. John Harrison, London (this fascinating book consists of two sections; the first is a translation from the Italian of the works of Nicholas Tartaglia [1499-1557], which were dedicated by him to Henry VIII: *Nuova Scienzo, cioè Invenzione nuovamente trovata, utile per ciascuno, speculativo, matematico, bombardiero*, 1537 and later editions; and *Quesiti et Inventioni diverso*, 1550 and later editions; Lucar divides Tartaglia's works into three sections, comprising together 80 pages; the first concerns artillery and ballistics, the second concerns cannonballs of various materials, and the third is devoted to the manufacture of saltpeter and gunpowder; these are presented in the form of dialogues with various learned persons; the second and greater part of this book [120 pp.] is a synthesis by Lucar, titled simply "Lucar Appendix," of the work of many authorities to produce a detailed technical manual upon the uses of gunpowder in warfare; subjects covered include manufacture of saltpeter and gunpowder; recipes for various incendiary materials; manufacture and characteristics of cannonballs; manufacture and characteristics of artillery pieces; manufacture of artillery carriages; tools and equipment used by artillerymen; powder charges; numbers of horse or

oxen required to draw artillery pieces; manufacture of bombs and other explosive or incendiary ordnance; manufacture of fireworks for celebrations; and a lengthy section upon ballistics and the proper use of artillery against castles and ships; the book is illustrated with many excellent woodcuts; one, for example, occupies a full page and shows a castle bristling with cannons at every window; an oversize artilleryman standing on the rampart uses a quadrant to take a sighting on an approaching army [II, pg. 57]; another illustration shows a wooden barrel bomb captioned "An other Firewoorke which will bloe up walles, towers, fortes, and such like thinges, and spoyle many enemies" [II, pg. 91]).

Luke, Clive J.

- 1978 The Marshall Powder Mill Site: The 1973-74 Excavation. *Publications in Archaeology Report* No. 11, State Department of Highways and Public Transportation, Highway Design Division, Austin, Texas (report of excavations at the CSA Marshall, Texas, powder mill; x + 141 pp.; illustrations).

McMahan, Basil B.

- 1965 *The Mystery of Old Stone Fort*. Tennessee Book Company, Nashville (a map appearing on pg. 22 depicts the location of the CSA Manchester Powder Mill near the left [east] bank of the [Big] Duck River just above the confluence of that stream and the Little Duck River in Coffee County, [middle] Tennessee; this parcel is now preserved as part of the Old Stone Fort State Park).

Mallet, Lt. Col. John W.

- 1903 How the South Got Chemicals During the War. *Southern Historical Society Papers* 31:100-102 (includes brief comments on Confederate gunpowder production; notes [pg. 101] "There were no sulphur deposits in the South, but fortunately at the beginning of the war there was a large quantity of that article in New Orleans"; and that charcoal made from the cottonwood tree was preferred [pp. 101-102]).
- 1909 Work of the Ordnance Bureau of the War Department of the Confederate States. *Southern Historical Society Papers* 37:1-20 (among many insightful remarks on the production of war material, Mallet notes [pg. 10] that "As regards the materials for making gunpowder, search was made for nitre earth, and considerable quantities were obtained from caves in Tennessee, Georgia and North Alabama, as also from old buildings, cellars, plantation quarters and tobacco barns. Col. I. M. St. John was, in 1862, given separate charge of this work and developed it systematically on a large scale. He also established artificial 'nitre beds' at Columbia and Charleston, S. C., Augusta and



- Savannah, Ga., Selma and Mobile, Ala., and elsewhere. The end of the war had come before these beds had become 'ripe' enough to be leached, but it was estimated that by that time they already contained some three or four million pounds of saltpetre. In fact, much the larger part of the niter used at the Augusta powder mill came in through the blockade. Sulphur was early secured, as there were found at New Orleans several hundred tons intended for use in sugar making. For the third ingredient of powder, namely charcoal, recourse was had chiefly to cottonwood (mainly *populus heterophylla*) from the banks of the Savannah River. It was abundant and gave an excellent product").
- Mauskopf, Seymour H.  
 1996 From Rumford to Rodman: The Scientific Study of the Physical Characteristics of Gunpowder in the First Part of the Nineteenth Century. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 277-293. Bath University Press, Bath, United Kingdom (403 pp.; the 18<sup>th</sup> century was characterized by increasingly larger guns and more powerful powders, but also by a profound change in the social structure of scientific inquiry; research began to shift from individual musings to a more professional and institutional framework; within this context, Mauskopf focuses upon what he terms "interior ballistics," that is, characteristics of the gases formed by combustion of powder within a gun and the work that is performed during its expansion; the author reviews significant work that was conducted on this subject from 1742 to the 1850s, using as case studies Benjamin Thompson, Count Rumford, Guillaume Pibert, and Thomas Jackson Rodman).
- Maxim, Hiram Stevens  
 1899 Experiments with High Explosives in Large Guns. *The North American Review* 168(507: February):142-153, University of Northern Iowa, Cedar Falls (an informative paper on the status of cannon propellant studies by a highly respected armaments developer of the period; of note is Maxim's research on correlating powder efficiency with the time allocated to grinding and incorporating the ingredients).
- Mell, P. H.  
 1902 Dr. W. LeRoy Broun. *Confederate Veteran* 10(5):225 (obituary; Dr. Broun as a CSA Lt. Col. commanded the Richmond, Virginia, arsenal and had extensive involvement with the development and production of Southern ordnance).
- Milgram, Joseph B., Jr., and Norman P. Gentieu  
 1961 *George Washington Rains: Gunpowdermaker of the Confederacy*. Foote Mineral Company, Philadelphia (34 pp.; a well-researched account of Rains' involvement in production of niter and gunpowder for the Confederacy, based in large part upon primary documentation in the National Archives and the Rains Papers in the Southern Historical Collection; of particular interest is a list of the textbooks used by Rains while a student at West Point [1838-1842]; the booklet contains a bibliography but unfortunately lacks specific citations in the text; see Rains [1861; 1882]; J. Davis [1958]; Jones [1918]; Savas [1991]; Schafer [1994]; and George Washington Rains Papers).
- Milner, Peter  
 1996 Living Dangerously: Gunpowder and Other Explosives in Victoria, Australia, in the Nineteenth Century. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 309-327. Bath University Press, Bath, United Kingdom (403 pp.; following the discovery of gold in Victoria, Australia in 1851, mining was initially limited to alluvial wash and surface rubble; very soon, however, hard rock mining techniques were introduced along with a demand for large quantities of gunpowder; the importation of explosive powders averaged more than 1,000,000 pounds annually until 1890, declining thereafter as newer types of explosives – such as nitrocellulose – became more popular).
- Munroe, Charles E.  
 1888 Modern Explosives. *Scribner's Magazine* 3(5: May):563-577 (informative summary of explosive compounds of the era).
- Murphy, Joseph, Dwight Packer, Cynthia Savage, Duane E. Peter, and Marsha Prior  
 2000 *Army Ammunition and Explosives Storage in the United States, 1775-1945*. U.S. Army Corps of Engineers, Fort Worth District, Fort Worth, Texas (though some attention is directed to late 18<sup>th</sup> and 19<sup>th</sup> century powder magazines, the focus of this study is on World War II era; the authors note that the U.S. Army currently inventories over 20,000 magazines nationwide, most of World War II vintage; the many photographs and architectural plans facilitate field investigators properly identifying these commonplace structures; ix + 105 pp.).
- Mußmann, Olaf  
 1996 Gunpowder Production in the Electorate and the Kingdom of Hanover. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 329-350. Bath University Press, Bath, United Kingdom (403 pp.; gunpowder production went through several phases during the history of the Kingdom of Hanover, today

Lower Saxony in Germany; at first, the industry was associated with individual cities who produced for their own defense needs; elsewhere in Europe, as authority became more centralized so did defense production; beginning in the late 1600s, however, the number of mills and total production declined within the kingdom as the Hanoverian state, in contrast to other regional states, chose to import gunpowder or purchase from private manufacturers rather than to establish a state production infrastructure; in essence, the government of Hanover neither helped nor hindered the gunpowder industry but left it to the private sector to modernize; compare this account to Ruhman [1996] for an account of production in the city of Sopron, Hungary, and to Bret [1996] and Schulze [1996], for state-supported gunpowder production in France and Prussia, respectively).

Napier, George

1788 Observations on Gun-Powder. *Proceedings of the Royal Irish Academy* 1:97-117.

National Park Service

n.d. Castillo de San Marcos: A Guide to Castillo de San Marcos National Monument, Florida. *Handbook* No. 149, Division of Publications, National Park Service, U.S. Department of the Interior, Washington (of note within this guidebook are two excellent drawings [pp. 30-31] of the construction details and final appearance of this 1671-1695 Spanish fort in St. Augustine, Florida; the vaulted room architecture as a means of providing a secure storage area for powder was effectively replicated in the 1829+ engineering used at Fort Pulaski, Georgia [see Lattimore 1954]; 65 pp.; likely published 1990s).

Needham, Joseph

1981 *Science in Traditional China: A Comparative Perspective*. Harvard University Press, Cambridge, Massachusetts (Needham is the foremost expert on the technological history of China, and his research has included an enduring interest in the development of gunpowder; the second chapter in this book provides an account of the Chinese invention of gunpowder in the 9<sup>th</sup> century AD and its application to military uses; 134 pp.).

1985 *Gunpowder as the Fourth Power, East and West*. Hong Kong University Press, Hong Kong (Needham presents a history of the many uses of gunpowder, first invented in China about the middle of the 9<sup>th</sup> century AD; his primary thesis is that the invention of gunpowder has had implications that far transcend military history and, in fact, ultimately led to the development of both the steam engine and the internal combustion engine inasmuch as each is

based upon harnessing a confined explosion to produce work; 70 pp.).

Needham, Joseph, Ho Ping-Yu, Lu Gwei-Djen, and Wang Lin

1987 *Science and Civilization in China: Chemistry and Chemical Technology, Part 7: Military Technology; The Gunpowder Epic*. Cambridge University Press, Cambridge (this long-awaited volume in Needham's seminal series on Chinese science and technology provides a detailed account of the invention of gunpowder and its first military applications).

Newton, John

1883 Modern Explosives. *North American Review* 137(324; November):459-468 (clearly written summary of the burning attributes of various types of explosives including both blackpowder and more modern types such as gun cotton).

Nye, Nathaniel

1670 *The Art of Gunnery*. Originally published in London. University of Kentucky Library microfilm B77-100, Reel 797 (traces the development of gunpowder in Europe; of particular interest are significant changes in the relative proportions of the primary ingredients from the 14<sup>th</sup> through the 17<sup>th</sup> centuries AD).

O'Conner, Jack

1961 *Complete Book of Rifles and Shotguns*. Outdoor Life/Harper & Row, New York (see pp. 140-148 for discussion on types and applications of contemporary "smokeless" powders in small arms).

O'Dell, Gary A.

1988 The Spencer Cooper Powder Mill. *Journal of Spelean History* 22(2):12-14 (the highly successful powder mill established by the Rev. Spencer Cooper in Lexington, Kentucky, in 1818 was significant as one of the few such regional operations that flourished in a post-War of 1812 environment; the mill ceased operation upon Cooper's death in 1839).

1989 Bluegrass Powdermen: A Sketch of the Industry. *Register of the Kentucky Historical Society* 87(2): 99-117 (Lexington was both the center of population and transportation in Kentucky during the first decade of the 19<sup>th</sup> century and, furthermore, was centrally located with respect to the saltpeter production areas; in consequence, Lexington became both the most important regional market for the saltpeter trade and also a focal point for a local industry of gunpowder production; of 62 Kentucky powder mills listed in the 1810 census, 14 were in or adjacent to Lexington; the article traces the growth and decline of the industry and identifies many of the early powder operations).

1990 The Trotter Family, Gunpowder, and Early Kentucky Entrepreneurship, 1784-1833. *Register of the*

- Kentucky Historical Society* 88(4):394-430 (O'Dell traces the fortunes of the Trotter mercantile family after their arrival in Kentucky in 1784, focusing primarily on Samuel and George Trotter; the Trotter brothers established in Lexington the largest wholesale and retail business in the state, and were major purchasers of gunpowder made at several local mills for resale in both local and distant markets; in 1810 the Trotters constructed the largest powder mill ever to operate in Kentucky, and landed important military contracts during the ensuing war; the Trotter powder operation survived the postwar economic downturn that ruined most other powdermakers, and continued to produce powder until Samuel died in the 1833 cholera epidemic; the article also provides information about several other local powder makers, saltpeter brokers, and the activities of Army Quartermaster James Morrison).
- O'Dell, Gary A. and Nancy Foley Johnson  
 1999 The Foley Family and Their Role in Gunpowder Manufacture, pp. 268-273 in: *Archaeological Investigations at the 1795 Elijah Foley House, Fayette County, Kentucky*, by Michael Stotman and Charles D. Hockensmith. In *Current Archaeological Research in Kentucky: Volume Five* (Charles D. Hockensmith, Kenneth Carstens, Charles Stout, and Sara J. Rivers, editors), pp. 265-313. Kentucky Heritage Council, Frankfort, Kentucky (documentary evidence indicates that Richard Foley established the first commercial powder mill in Kentucky near Lexington in 1793; archeological excavations were conducted around son's Elijah Foley's two-story brick house prior to its demolition in 1994; this study chronicles the family's role in gunpowder manufacture).
- O'Dell, Gary A. and James R. Rebmann  
 1996 The Rescue of McConnell Springs Historic Site: A Partnership Between Local Government and the Citizens of Lexington, Kentucky. In: *Proceedings, 1995 National Cave Management Symposium* (G. T. Rea, editor), pp. 255-266, Indiana Karst Conservancy, Inc., Indianapolis (early gunpowder manufacturing site; see discussion following O'Malley 1996).
- O'Malley, Nancy  
 1996 The Culture History and Archaeology of the McConnell Springs Natural and Historic Site. *Archaeological Report* 365, Department of Anthropology, University of Kentucky, Lexington (the McConnell Springs Natural and Historic Site is a 25.51 acre tract in Lexington, Kentucky, owned and operated by the Lexington-Fayette Urban County Government as an educational and environmental resource, historic site, and passive recreational area; operated on this site from 1810-1833, the Trotter Gunpowder Mill and was an important supplier of powder to the U. S. Ordnance Department during the War of 1812; subsequent owners developed the site as a stock farm and dairy, and the spring water was used by a local distillery to produce bourbon whiskey; archaeological site survey documented a stone foundation associated with the gunpowder mill that was later converted to a pumping station for the distillery and a creamery for the dairy; other archaeological remains include a dairy barn foundation, and the remains of another gunpowder-related structure; iv + 54 pp.).
- Oman, Charles  
 1924 Gunpowder and Cannon. Book X, Chapter 12 in: *A History of the Art of War in the Middle Ages*, Volume 2, pp. 205-214. Burt Franklin, New York (originally published 1808; Oman's classic work on the history of war contains a chapter on gunpowder in which he erroneously ascribes the invention of gunpowder to European philosopher-scientists in the latter 12<sup>th</sup> century and first reported by Roger Bacon in 1249; according to Oman, accounts which credit the Chinese with originating gunpowder are mistranslations or misinterpretations of the effects of other types of incendiary compounds; more recent scholarship leaves no doubt as to the Chinese invention of gunpowder and its application to military usage; 459 pp.; see also Wang Lin 1947, Needham 1981, 1985, Needham et al. 1987;).
- Ordnance Bureau  
 1862 *The Field Manual for the Use of the Officers on Ordnance Duty*. Prepared by CSA Ordnance Bureau, Ritchie & Dunnivant, Richmond, Virginia (149 pp.; reprinted 1984, Dean S. Thomas, Gettysburg, Pennsylvania among the many insights on virtually all types of Confederate ordnance are these remarks [pp. 72-73] on the manufacture and – importantly – powder grading system used by the South: “Gunpowder should be of an even grain, angular and irregular in form; it should be so hard as not to be easily crushed by pressure with the fingers; it should, when new, leave no trace of dust when poured on the back of the hand, and should leave no beads or foulness when flashed, in quantities of 10 grains, on a copper plate. It is distinguished as *musket*, *mortar*, *cannon*, and *mammoth* powder. They are all made in the same manner, of the same proportion of materials, and differ only in the size of the grains.  
 “Proportions of materials. – All powder for the military service must be composed of the following proportions, by weight, viz.:  
 76 parts of nitre, 14 of charcoal, and 10 of sulphur;  
 Or 75 “ “ 15 “ “ 10 “



"*Size of grain.* The size of the grain is tested by standard sieves made of sheet brass pierced with round holes. Two sieves are used for each kind of powder: Nos. 1 and 2 for musket, 2 and 3 for mortar, 4 and 5 for cannon, and 6 and 7 for mammoth powder.

[standard sizes for grains passing through the sieves is given as:

musket powder 0.03-0.06 in.  
mortar " 0.06-0.10 in.  
cannon " 0.25-0.35 in.  
mammoth " 0.60-0.90 in.]

"The smaller the grain of powder, to a certain limit, the more nearly instantaneous is its conversion into gas. The object of using large grained powder is to avoid its *instantaneous* conversion into gas, which would burst the gun. As a general rule, in firing cannon, the heavier the projectile the larger the grain of powder used, and conversely. The *inertia of rest* of the projectile is proportional to its mass, and a *small interval of time* is required to impart to it, with safety to the gun, the velocity with which it issues from the muzzle"; italics appear in original).

Partington, James Riddick

1999 *A History of Greek Fire and Gunpowder*. Johns Hopkins University Press, Baltimore and London (originally published 1960, W. Heffer & Sons, Ltd., Cambridge (for more than 40 years, Partington's exhaustively researched study has been the definitive work on the subject, frequently cited by scholars; Partington, a chemist with a long string of published work, approached this task from the perspective of a chemist rather than a historiographer and so nonchemical aspects are somewhat neglected; he emphasized individual contributions to a scientific tradition, a linear progression similar to the paradigm shifts described by Robert Kuhn in *The Structure of Scientific Revolutions* [1962]; according to Bert Hall, who wrote the introduction to the 1999 edition, his account contains certain presumptions, among them: "...the belief that Greek fire and gunpowder represent premodern forms of 'scientific' knowledge. That is, these were subjects with a certain scientific content that could be contained in textual form, and these texts in turn can be studied by the modern scholar with the object of forming judgments about how nearly correct this or that ancient text writer might have been. Partington's second presumptuous belief is that the history of Greek fire and gunpowder is primarily to be understood through chemistry, that the formulas for various incendiaries and explosives were the most important things we could learn about them"; despite these limitations, apparent from the

viewpoint of modern scholarship, Partington's work provides a wealth of detail and remains an essential resource for any serious contemplation on the subject; extensive references; index; xxxiv + 381 pp.).

Pennypacker, Samuel W.

1882 David Rittenhouse. *Harper's New Monthly Magazine* 64(348; May):838-849, New York (this biography of David Rittenhouse of Pennsylvania notes [pg. 844] that "The Committee of Safety appointed him their engineer in October, 1775, and in this capacity he was called upon to ...view a site for the erection of a Continental powder mill, ...[and] to superintend the manufacture of saltpetre...").

Percival, A.

1968 Faversham Gunpowder Industry. *Industrial Archaeology* 5:1-42 (this article published in an English journal examines the physical remains of the powder making facilities in this area).

Philp, Brian

1983 *Dartford Gunpowder Mills* (2<sup>nd</sup>/revived edition). Kent Archaeological Rescue Unit, England (ISBN: 0947831037).

Porcher, Francis Peyre

1863 *Resources of the Southern Fields and Forests, Medical, Economical, and Agricultural. Being Also a Medical Botany of the Confederate States: With Practical Information on the Useful Properties of the Trees, Plants, and Shrubs*. Steam-Power Press of Evans & Coswell, Charleston, South Carolina (call number "3041 Conf." in Rare Book Collection, University of North Carolina at Chapel Hill; xxv + 601 pp., ill.; this volume is highly insightful regarding a number of aspects of niter production and gunpowder manufacture; applicable comments therein include:

- pg. 184 - "Indigo Vat. - Description - For every set of ten hands there should be what are called a set of works. These formerly cost about one hundred dollars or more, and were a vat or tank, made of plank two inches thick, well joined. This vat is twenty feet square, stands upon posts four feet from the ground, and is kept tight by wedges driven into the sleepers upon which the plank rests. The vat is three feet deep, and is called the steeper. Along-side of it is another vat, twenty feet by ten, occupying the space between the bottom of the steeper and the ground, into which the water is drawn in which the indigo is steeped when ready to be beat, or churned, as we may say"; [archaeologists will note the similarity to such features to niter leaching vats erected on sites removed from niter caves);  
- pg. 241 - notes "The willow, alder, and dogwood

[trees] are employed for preparing charcoal for the manufacture of gunpowder”;

- pg. 267 – “The English *Almus* (*A. glutinosa*) is planted along the side of water-courses... to prevent the encroachment of water... by the binding influence of the roots... Charcoal made of its timber has long been highly valued for the manufacture of gunpowder”;

- pg. 326 – “The ashes we may obtain by burning corn-cobs yield more potash than any other available substance; and the alkali from this source is rapidly converted into saleratus or good soap. Corn-cobs are mentioned because we often see them wasted in quantities where hogs are fed, and where much corn is shelled” [the extent to which Southern niter miners may or may not have used corn cob ash in the conversion of calcium nitrate to potassium nitrate is not known];

- pg. 328 – additional possible sources of potash included: “Most weeds furnish potash, in a greater or less degree, to every one hundred pounds. The following plants will furnish of potash:

- Oak wood..... 2 ½ lbs.
- Wheat straw..... 4 ¼ lbs.
- Barley straw..... 5 lbs.
- Potato stem..... 55 lbs.
- Corn-stalks..... 17 lbs.
- Oak bark and elm leaves.....24 lbs.”;

- pg. 329 – “In America, where timber is in many places an incumbrance upon the soil, it is felled, piled up in pyramids and burned, solely with a view to the manufacture of potashes....The more succulent the plant, the more does it afford; for it is only in the juices that the vegetable salts reside, which are converted by incineration into alkaline matter. Herbaceous weeds are more productive of potash than the graminiferous species, or shrubs, and these than trees; and for a like reason twigs and leaves are more productive than timber. But plants in all cases are richest in alkaline salts when they have arrived at maturity”;

- pg. 339 – “For making gunpowder charcoal, the lighter woods, such as willow, dogwood, and alder answer best; and in their carbonization care should be taken to let the vapors freely escape, especially toward the end of the operation, for when they are reabsorbed, they greatly impair the combustibility of the charcoal”;

- pp. 340-341 – “The light, porous, white woods afford a brittle, spongy coal, of less weight, and which may be easily reduced to powder; this coal consumes quickly in our fireplaces, but is useful for some purposes, particularly in the manufacture of gunpowder, for which use it is prepared by the

following process: a ditch of five or six feet square and of about four in depth is dug in a very dry soil; the ditch is heated by means of a fire made of split wood; the shoots and leaves are stripped from the young branches of elders, poplars, hazels, and willows, of which the coal is to be made, and as soon as the ditch is sufficiently heated the branches are thrown gradually in; when carbonization is at its height the pit is covered over wet woollen [sic] cloths. This charcoal is more light and inflammable than that of the denser woods, and is susceptible of being more easily and completely pulverized. M. Prout, who has made numerous experiments to ascertain the kinds of plants which furnish the best coal for powder, found that procured from the stalk of hemp to be preferable to any other”;

- pg. 342 – “The following advertisement appeared in the [news] papers during the year 1862:  
To Contractors. – Willow wood wanted. – Five hundred cords willow will be contracted for, to be delivered on the line of the canal, at the government powder factory, at Augusta, Ga., at the rate of not less than one hundred and fifty cords per month, commencing the 1<sup>st</sup> of December next. The willow may be of any size, the smaller branches being preferred; the larger sticks must be split into parts not longer than the arm. It must be cut into uniform lengths of three feet, and each cord will measure fourteen feet long, three feet high, and three feet broad, containing one hundred and twenty-six cubic feet. The bark must be carefully peeled off at the time of cutting”;

- pg. 362 – “The wormwood (*Artemisia*) of which there is a species (*A. caudata*) growing in Florida and northward, is said to be rich in potash. The *Chenopodium*, of which we have several species, although not belonging to the same natural family, is perhaps equally rich in he substance. The wormwood is highly recommended to be converted into charcoal, to be used in the manufacture of gunpowder”;

- pg. 363 – “I have several times stated that the allied *Artemisia*, worm-wood, was exceedingly rich in potash. The natural affinities are here borne out, for the family *Chenopodioceae* contains many plants furnishing soda in large proportion. Such are *Salsola*, *Salicornia*, *Atriplex*, and salt-marsh *Chenopodiums*; a notice of species of all these genera is included in this report. They should receive the attention of the nitre manufacturers. Nitrate of potash is found in the common horse-radish, in the nettle, and the sunflower”.

Quertermous, Grant

1999 A Summary of Excavations at Fort Star

- (15LV207): Archaeology of a Union Civil War Fortification. *Ohio Valley Historical Archaeology* 14:89-94. Wickliffe, Kentucky (brief discussion [pg. 92] of the remains of a possible magazine associated with this Civil War era earthen fort in Smithland, Livingston County, Kentucky).
- Rae, Ian D.  
1996 John Cyrus Martin and Australian Gunpowder in the 1860s. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 295-307. Bath University Press, Bath, United Kingdom (403 pp.; the discovery of gold in Australia in 1851 created a demand for explosives; John Cyrus Martin had worked in both American and English powder mills, and held several patents on explosives, but despite this background, was unable to establish a mill in Australia due to lack of support from the government).
- Rains, George Washington  
1882 *History of the Confederate Powder Works*. Chronicle and Constitutionalist Press, Augusta, Georgia (30 pp.; "An Address Delivered by Invitation Before the Confederate Survivors Association, at It's 4<sup>th</sup> Annual Meeting, on Memorial Day, April 26<sup>th</sup>, 1882"; Rains was the commanding officer of this CSA facility in Augusta, Georgia, and oversaw its design, construction, and daily operation; at the end of the war, some 70,000 lbs. of gunpowder was captured by Federal forces and praised for its high quality; this is the most detailed and accurate firsthand account available concerning this impressive industrial site).
- Raistrick, Arthur  
1972 *Industrial Archaeology: An Historical Survey*. Eyre Methuen, London (brief comments on English blackpowder production from ca. 1740 to 1937 in Westmoreland, North Lancashire, and Faversham; see pp. 256-257, 286-287).
- Ramage, C. Kenneth (editor)  
1975 *Blackpowder Handbook*. Lyman Publications, Middlefield, Connecticut (see pp. 14-19 for a very informative discussion of the processes and equipment used to produce gunpowder at America's last operating civilian blackpowder plant in Moosic, Pennsylvania; reloading data and ballistic tables in this volume are potentially very useful for interpreting projectiles fired in blackpowder revolvers and shoulder arms; 240 pp.).
- Rees, Abraham  
1819 *The Cyclopaedia; or, Universal Dictionary of Arts, Sciences and Literature* (39 vols.). Longman, Hurst, Rees, Orme & Brown, London (the original Cyclopaedia was a two-volume work published in 1728 by Ephraim Chambers; Rees [1743-1825], a Fellow of the Royal Society, undertook to revise and greatly expand this work; the first volume appeared in 1802 and was completed in 1820 with 45 volumes; the Cyclopaedia was primarily Rees' own work, although many learned specialists contributed essays on specific topics; Vol. 17 contains an essay on gunpowder, and saltpeter appears in Vol. 31; the gunpowder entry addresses the question of its first invention and application to weaponry and contemporary production; the saltpeter entry discusses the places where niter is found, the countries in which it is produced, and the various methods of production, both in artificial beds and as a mined substance).
- Rennick, Robert M.  
1984 *Kentucky Place Names*. University Press of Kentucky, Lexington (see comments [pg. 241] on the extinct community of Powder Mills in Hart County, Kentucky; 11 miles northeast of Munfordville; "...the site of Kentucky's first commercial powder mills. Built in 1811 by John Courts, these are said to have supplied Jackson's troops at the Battle of New Orleans and Union soldiers in the Civil War"; references; xxiv + 375 pp.).
- Rogers, Thomas  
1871 Unpublished reminiscences in the "Rogers Family" Family files, Kentucky Historical Society, Frankfort (a recollection of gunpowder-making for personal use by Thomas Rogers' father William and uncle Thomas Rogers ca. 1790 in Bourbon County, Kentucky).
- Ross, Charles D.  
2000 *Trial by Fire: Science, Technology, and the Civil War*. White Mane Books, Shippensburg, Pennsylvania (see Chapter 3 [pp. 54-80] entitled "George Washington Rains: Confederate Powder" for an informative study of the construction and operation of this important CSA facility in Augusta, Georgia).
- Ruhmann, Jenö  
1996 Gunpowder for the Defense of a City: Sopron from the Sixteenth Century. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 157-162. Bath University Press, Bath, United Kingdom (403 pp.; the literal and symbolic power inherent in gunpowder represented a potential threat to the increasingly centralized authority of nation-states, who placed strict controls upon its manufacture; in certain cases, however, gunpowder production was permitted in cities deemed sufficiently important and relatively isolated, such as Sopron in Hungary; Sopron, founded as a Roman city in the 1<sup>st</sup> century AD, became a Free Royal City in the 13<sup>th</sup> century with the duty of self-defense; Hungary's subsequent turbulent history included periods of invasion and



occupation, liberation, and civil war; documentary evidence indicates that some gunpowder milling was conducted during the 16<sup>th</sup> century under the direction of priests of the local Pauline order, and a gunpowder mill operated in Bánfalva, a nearby village subordinate to Sopron, from about 1650 to 1850; the gunpowder produced was strictly for local defense and not intended for sale).

Russell, Carl P.

1996 *Guns on the Early Frontiers: A History of Black Powder Weapons from Colonial Times to the Mexican War*. Barnes & Noble, New York (originally published 1957, University of California Press; see pp. 219-231 for extended discussion of early powder production, market prices, and shipping containers).

Salay, D. L.

1975 The Production of Gunpowder in Pennsylvania During the American Revolution. *Pennsylvania Magazine of History and Biography* 99(October): 422-442 (among the major problems facing the colonists during the Revolution was the lack of both the materials and the production facilities necessary to sustain an armed conflict; saltpeter in particular was in short supply and in 1774 only one gunpowder mill, located in Pennsylvania, existed in all the colonies; early in the war great effort was expended to build powder mills and obtain domestic supplies of both sulfur and saltpeter; a number of mills were constructed in Pennsylvania, and while production of gunpowder was low due to the scarcity of niter, the combined production was significant to the war effort; in the later years of the Revolution, dependence on domestic production of gunpowder declined as greater quantities were smuggled in from foreign countries).

1977 The Production of War Material in Pennsylvania for the American Armies of the Revolution. Ph. D. dissertation, University of Delaware, Newark (includes information on Revolutionary era gunpowder production; see above).

Savas, Theodore P.

1991 Bulwark of the Beleaguered Confederacy: George Washington Rains and the Augusta Powder Works. *Civil War* 9(5; September):10-20 (when the Civil War began, the South had a handful of small powder mills but not one establishment capable of war production; North Carolinian George Washington Rains became one of the Confederacy's most valuable assets, for as Savas observes, "In less than one year, an inexperienced major created a world-class gunpowder mill from scratch, perhaps doing more than any other man to prolong the War"; given the task of building a powder mill able

to supply the armies of the South, Rains selected Augusta, Georgia, as a site centrally located, safe from Northern attack, and at a rail nexus; despite having no prior knowledge of powder manufacture, Rains drew upon solid prewar experience as president and partner of an iron foundry in New York to erect one of the finest mills of the century; the Augusta mills began production only seven months after construction began, and were designed to emphasize speed and safety; the production process was characterized by numerous innovations; Rains developed more efficient methods of refining saltpeter, sulfur, and charcoal, and simplified each step of gunpowder manufacture while turning out a product of consistently high quality; Rains was so successful in his endeavor that the Augusta complex produced far more gunpowder than the South could expend in warfare; never did the Confederate armies lack for powder; see also Rains [1882])

Schultze, Manfred P.

1996 The Gunpowder Mill at Spandau. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 351-358. Bath University Press, Bath, United Kingdom (403 pp.; after Napoleon, the Prussian state began to concentrate its arms industry in the old fortress and garrison town of Spandau [near Berlin], building extensive new gunpowder works there and protecting it with an impressive defense system; new production techniques were introduced here, gleaned from France, England and southern Germany; when Alsace Lorraine in France was captured as a consequence of the Franco-Prussian War [1870-1871], the latest technology from the mills there was implemented at Spandau; in the late 19<sup>th</sup> century, reflecting new innovations in explosives, production began to change over to nitrocellulose and picric acid; the millworks at Spandau were demolished following World War I according to the terms of the Treaty of Versailles).

Smith, Marion O.

1991 McSpadden's Powder Mill and the Nearby Saltpeter Cave: A Genealogical Assessment. *Journal of the Jefferson County [Tennessee] Genealogical Society* 6:7-9 (brief account of the Samuel McSpadden powder mill thought to have been in operation as early as the War of 1812 and later [1861] put into service during the Civil War by David M. Caldwell and several other grandsons of Samuel McSpadden; the actual output of this mill was likely "small").

1997 In Quest of a Supply of Saltpeter and Gunpowder in Early Civil War Tennessee. *Tennessee Historical Quarterly* 56(Summer):96-

111 (very informative and extensively documented study of these industries largely focused on Middle Tennessee).

Smyrl, Vivian Elizabeth

1996a Anderson Mill, Texas. In *The New Handbook of Texas* (6 vols.; Ron Tyler, Douglas E. Barnett, Roy R. Barkley, Penelope C. Anderson, and Mark F. Odintz, editors). Texas State Historical Association, Austin (situated on Cypress Creek in northwestern Travis County ca. 16 miles from Austin, a powder mill was constructed here early in the Civil War by Thomas Anderson; following the war, the facility was converted to a gristmill).

1996b Longhorn Cavern. In *The New Handbook of Texas* (6 vols.; Ron Tyler, Douglas E. Barnett, Roy R. Barkley, Penelope C. Anderson, and Mark F. Odintz, editors). Texas State Historical Association, Austin (situated about nine miles southeast of Burnet, Texas, in southwestern Burnet County, "...the Confederate Army ...used the cavern as a place to manufacture gunpowder").

Speir, Tom and Dave Journey

1996 Archaeological Investigations at the Marshall Powder Mill (41HS17), Confederate States of America 1863-1865, Harrison County, Texas: 1994 Season. *Journal of Northeast Texas Archaeology* No. 8:1-50 (continued excavations at the largest powdermill in CSA Texas; see also Luke [1978]).

State of Pennsylvania

1852 *Minutes of the Provincial Council of Pennsylvania, from the Organization to the Termination of the Proprietary Government* (16 vol.). Theodore Fenn & Co., Harrisburg (references to saltpeter and gunpowder importation and production are widely scattered through the early volumes in this series, until during the opening phases of the Revolutionary War when such references increased acutely as the colonists desperately sought the means to conduct military operations; Volume 10, which includes the proceedings of the Philadelphia Committee of Safety from 30 June 1775 through 12 November 1776, is of particular interest, painting a dramatic picture of the Herculean efforts to mobilize the population and create an entire industry – gunpowder manufacture – virtually overnight where little had existed before; an index has been produced [1860] which includes this series and also the Pennsylvania Archives [see citation, 1853], but the index is woefully inadequate and overlooks numerous references; although the records of the Provincial Council also contain innumerable mentions of transshipment, storage, and distribution of gunpowder, the selections below are generally limited to those dealing with

production of saltpeter and gunpowder; citations from meetings of the Philadelphia Committee of Safety are designated CS; from the Provincial Council as PC; the Supreme Executive Council as SEC; the citation lists volume number, page number, and date of the meeting.

- 3:242 9 March 1725, PC: Notice of petition of the inhabitants of Philadelphia, who view the proposed erection of a powder mill as dangerous to the city; council members are to go view site.

- 3:244 13 March 1725, PC: Report of members on viewing proposed mill site that the inhabitants are "very uneasy." The Governor returned the Bill and petitions to the House for further consideration.

- 10:282 3 July 1775, CS: The Committee resolves that members Robert Morris, Robert White, and Thomas Wharton, Jr., should endeavor to obtain powder and saltpeter.

- 10:301 11 August 1775, CS: Members of the Committee are to prove [test] powder made by Lush and Oswell Eve.

- 10:314 23 August 1775, CS: Reference is made to saltpeter purchased from Joseph Sims by the Powder Committee at £15 per hundredweight.

- 10:315 25 August 1775, CS: The Committee has received powder made by George Havener from the saltpeter delivered to him by the City Committee.

- 10:330 2 September 1775, CS: Ord & Thompson are to be paid £15 for powder they imported, and a rate of £4 additional as an encouragement for importation of gunpowder.

- 10:384 30 October 1775, CS: The person sent by the York Committee of Safety "to instruct the Committee for the Manufacture of Salt-Petre in his mode of carrying on that Process, is now ready to undertake that Business."

- 10:430 18 December 1775, CS: The Committee decides to defer the issue of allowing makers of saltpeter part payment in gunpowder.

- 10:443 3 January 1776, CS: A subcommittee is formed to "appoint the proper persons to instruct the inhabitants of the different Counties in the manufactory of Salt Petre, and to do what other matters they may think proper for the more speedy obtaining [sic] the making of that necessary article; And to fix upon the number of hand bills to be printed and distributed in English & German languages, setting forth the process for extracting and refining Salt Petre, as published in Dunlap's Paper of the 1st inst."

- 10:456 13 January 1776, CS: Refers to payment for sundry articles furnished to the saltpeter makers of this province.

- 10:459 17 January 1776, CS: The Committee

order advertisements to be placed in the Philadelphia newspapers, stating "Such persons as are willing to erect Powder Mills in this Province, within fifty miles distance of this City, are desired to apply to the Committee of Safety, who will lend them Money, on Security, if required, for that purpose, and give them other encouragement."

- 10:479 8 February 1776, CS: The member appointed to consider places to erect gunpowder works reports that he has received several proposals from different persons willing to erect powder mills. The Committee resolves to send representatives to Congress to urge the importance of erecting such mills.

- 10:478 7 February 1776, CS: Refers to a letter written to the Committee of Safety of the Province of Maryland offering to instruct such persons as they recommend in the manufacture of saltpeter.

- 10:480 9 February 1776, CS: A Mr. Blith, who was so recommended, has produced an account of his expenses.

- 10:481 9 February 1776, CS: John Miers of Berks County is to be advanced £100, taking security from him, for the purpose of saltpeter manufacture.

- 10:482 10 February 1776, CS: The Committee receives a proposal that it should encourage six powder mills on the following terms: (1) to lend up to £150 to each person, giving good security, to erect a powder mill, the loan to be repaid in work or money; (2) the Committee is to supply 50 tons of saltpeter to these mills in proportion to the amount of powder delivered each week; (3) the Committee will pay eight dollars per hundredweight for powder; (4) when unrefined saltpeter is delivered to the mills, an allowance of 10 per hundredweight is to be given to the makers to allow for refining; (5) cash premiums will be given for the swiftest manufacture, 100 dollars to the first, 50 to the second, and 30 to the third mill to deliver one ton of finished powder; (6) The original six mills under contract will have preference to supplies of saltpeter over those erected later; and (7) powder makers under contract to the Committee are bound to sell only to the Committee.

- 10:491 22 February 1776, CS: Capt. Joseph Cowperthwaite is to join with Clement Biddle to build powder mills, "to purchase or rent suitable seats for that purpose, and do every other thing necessary for effecting it expeditiously."

- 10:495 27 February 1776, CS: The Assembly has considered the motion for immediate erection of a powder mill and resolved that this is "a necessary and proper measure and should be carried out immediately."

- 10:498 28 February 1776, CS: Representatives of

the Committee are to inspect the location purchased by Cowperthwaite and Biddle where a powder mill is to be erected; persons from Northhampton County have arrived to be instructed in making saltpeter.

- 10:501 2 March 1776, CS: Jacob Lorch is to be loaned £150 to erect a powder mill; he has provided a security bond.

- 10:519 16 March 1776, CS: Thomas Bedwell proposes to refine crude sulfur, erecting furnaces for this purpose at his own expense, providing good refined sulfur for 20 shillings per hundredweight. The Committee agrees to the proposal and advances him £25.

- 10:524 25 March 1776, CS: 2,200 lbs. of saltpeter are delivered to Dr. Harris to manufacture gunpowder.

- 10:527 27 March 1776, CS: Notice that William Montgomery has been appointed by the Committee of Safety of Chester County to receive and pay for saltpeter made in that county.

- 10:530 30 March 1776, CS: The Committee will pay 45 shillings per hundredweight for "good merchantable Brimstone."

- 10:540 13 April 1776, CS: Payment in powder and cash to be made to Col. Slough for manufacture of saltpeter in this province; a powder magazine for the province is to be erected, capable of holding 1,000 barrels.

- 10:543 16 April 1776, CS: Two designated members are to prepare a plan for the powder magazine; payment is authorized to Owen Biddle for 301-1/2 lbs. saltpeter made at the works in Philadelphia.

- 10:549 23 April 1776, CS: One ton of crude sulfur is to be delivered to Bedwell for refining.

- 10:561 9 May 1776, CS: 2,000 lbs. of saltpeter is to be delivered to Thomas Heinberger to manufacture gunpowder. The Committee resolves to lend him £100 "to assist compleating the Powder Mill he is now building."

- 10:581 25 May 1776, CS: Persons are appointed to look out for the military stores including saltpeter in Germantown, that may need to be sent there from the city in case of attack.

- 10:589 30 May 1776, CS: One ton of crude sulfur to be delivered to Bedwell & Walter for refining; one ton saltpeter and a proportionate quantity of sulfur to be delivered to William Thompson to manufacture powder at his mill in Warwick Township, Bucks County.

- 10:593 3 June 1776, CS: 500 lbs. Brimstone to be delivered to Heinberger to make powder; two wagon loads of Brimstone to be sent to Germantown for storage.



- 10:597 8 June 1776, CS: Committee to arrange for storehouses in Germantown for storage of saltpeter and other items.
- 10:599 12 June 1776, CS: One ton saltpeter to be delivered to Robert Harris to manufacture gunpowder.
- 10:600 13 June 1776, CS: One ton saltpeter to be delivered to Jacob Lush to manufacture gunpowder.
- 10:604 15 June 1776, CS: One-half ton saltpeter and 150 lbs. sulfur to be delivered to Henry Hoover to manufacture gunpowder; Dr. Robert Harris to be paid £100 for gunpowder.
- 10:608 19 June 1776, CS: All crude sulfur on hand is now to be delivered to Bedwell & Walter for refining.
- 10:621 1 July 1776, CS: Two tons saltpeter is to be delivered to Dr. Harris to manufacture gunpowder.
- 10:626 2 July 1776, CS: The Continental Powder Mill is to be furnished with ten tons saltpeter and two tons sulfur.
- 10:634 6 July 1776, CS: £1,400 to be paid to Cowperthwaite and Clement Biddle for account at Continental Powder Mill.
- 10:644 15 July 1776, CS: £100 is to be paid to Dr. Harris for gunpowder he has manufactured.
- 10:647 16 July 1776, CS: Reference is made to 855 lbs. saltpeter made at Lancaster.
- 10:650 19 July 1776, CS: Payment is to be made to Peter DeHaven for saltpeter made at the Provincial works.
- 10:665 1 August 1776, CS: One ton saltpeter and 300 lbs. sulfur out of the Germantown stores is to be delivered to Henry Huber.
- 10:700 26 August 1776, CS: Joseph Ferree of Germantown is to deliver to Dr. Harris one ton of saltpeter from the stores in his care.
- 11:49 13 December 1776, CS: Gunpowder and other military supplies are to be removed from the "New Powder Mills" at French Creek and Norrington and sent towards Lancaster.
- 11:115 6 February 1777, C: A powder magazine 24 by 36 feet is to be built at Lancaster.
- 11:184 15 March 1777, CS: Examination of evidence regarding the burning of the powder mills at French Creek in the presence of Mr. Beck, one of the powder makers; deemed insufficient evidence to imprison any of the persons taken on suspicion of firing the mills and Beck and mill workers are released.
- 15:433 15 April 1788, SEC: Joseph Stiles, superintendent of the Gunpowder Magazine, reports that the magazine is full and a vessel has just arrived in the harbor with a shipment of gunpowder; he

- requests permission to store powder in the small house next to the magazine, which is granted.
- 16:327-328 14 April 1790, SEC: Committee appointed to assess value of lot on Walnut Street bordering Schuylkill River for erection of powder magazine.
- 16:337 16 April 1790, SEC: Committee reports back that value of lot is £565; they are authorized to negotiate purchase of the lot.
- 16:367-368 22 May 1790, SEC: Discussion of plans for powder magazine, approved by the Council. The magazine is to be forty by 60 feet, gable-end walls two feet thick of stone, side walls two feet six inches of stone, height from floor to spring of the arch to be eight feet, and the floor to be raised six inches above the level of the yard. A small two-story house is to be built for the keeper adjacent to the magazine.
- 16:387 24 June 1790, SEC: A memorial from the Mayor, aldermen, and citizens requests that construction of the magazine be suspended.
- 16:390 29 June 1790, SEC: Committee to meet with the Mayor and others concerning the memorial.
- 16:532 8 December 1790, SEC: Refers to the lot sold to the Commonwealth for the powder magazine, 4-3/4 acres located between Walnut and George streets and formerly the property of John Patton).

1853 *Pennsylvania Archives, Selected and Arranged from Original Documents in the Office of the Secretary of the Commonwealth* (multivolume). Joseph Severns & Co., Philadelphia (the documents included in this series derive from a broader range of sources than those from the Provincial Council [see State of Pennsylvania 1852] and contain far fewer references to saltpeter and gunpowder; those that are found, however, usually contain much greater detail than the abbreviated minutes reported in the 1852 series and can often be linked to events mentioned therein; like the former series, however, citations are most numerous for the period 1775-1776; citations are listed with the volume number first, page number, and date.

- 4:584 19 October 1774. Copy of Minutes at the Court of St. James. Refers to an act recently passed that empowers the King to prohibit export of Saltpeter, Gunpowder or any other form of arms and ammunition out of the kingdom. Notice is given that His Majesty, with the advice of his Privy Council, now commands that no person shall, during a period of six months from this date, presume to transport out of the kingdom any gunpowder or other ordnance and supplies.
- 4:585 19 October 1774. Letter from Earl

Dartmouth to Governor Penn. The Earl, enclosing a copy of the Order in Council prohibiting export of gunpowder, orders Penn to "take the most effectual Measures for arresting, detaining & securing any Gunpowder, or any sorts of Arms or Ammunition which may be attempted to be imported into the Province under your Government..."

- 4:668 20 October 1775. Letter from the Committee of York County to Philadelphia Committee of Safety, notes that the bearer will stay in Philadelphia to instruct in saltpeter manufacture: "he is confident in any large Town he can get materials enough for making Salt-petre until beds can be ripened; one kettle will make 50 or 60 lb per week." The writer reports that they have sent a saltpeter-maker to Maryland, and that "it is amazing to us that Virginia has not made 20 tons." Of particular significance to our understanding of those engaged in saltpeter manufacture is the observation: "'Tis a shame for America, when we have so many people who have wrought many years at making Salt-petre in Germany, and understand it as well as any of our old Women do making soft Soap, that so much has been said and so little done in an Article so essential to the safety of America; it is true, they are but mechanicks, and don't understand Theory, but let them make a sufficiency for our present wants, and let the Theorists improve and amend their defects at leisure."

- 4:702-703 24 January 1776. Letter from Henry Wynkoop, Bucks County, to Philadelphia Committee of Safety. In response to request of the Philadelphia Committee to promote saltpeter-making in the country, the Bucks County Committee has appointed James Wallace, Andrew Kichlein, and Joseph Fenton to visit the works in Philadelphia and set up saltpeter works at their own homes upon their return. According to the writer, these are persons of reputation and influence who will be able to induce others to undertake this production. James Wallace has also been appointed to receive the saltpeter made in this region. Wynkoop notes that the proposed system of payment will be very discouraging to saltpeter-makers, who will have to travel to Philadelphia before they can be paid. He proposes that Wallace be supplied with funds to purchase saltpeter from local makers.

- 4:727 30 March 1776. Letter from Jonathon Kearsley to the Philadelphia Committee of Safety. Kearsley reports that he has been employed at saltpeter-making for five weeks with three men, but that the earth he has gathered is so lightly impregnated with niter that he has obtained only 15 lbs. of saltpeter. His equipment consists of 14 tubs,

four 200-gallon boilers and "Receivers ashers, Stand Coolers, &c." He wishes to know if any new methods or materials have been discovered that he could attempt. "PS," he writes, "I intend to try one month longer."

- 4:743 2 May 1776. Letter from Zantzinger & Kuhn to Philadelphia Committee of Safety. The writers note they have sent seven cakes of refined saltpeter to Philadelphia for the Committee's approval.

#### State of Virginia

1862b *Doc. No. 1: Message of the Governor of Virginia, and Accompanying Documents*. William F. Ritchie, Public Printer, Richmond (In a message dated December 2, 1861, to the Virginia state legislature, Gov. John Letcher discusses at length niter and gunpowder production:

[pg. vii] "The war now in progress must be prosecuted with energy and spirit... We have, scattered throughout the state, vast deposits of saltpetre, which have been but partially developed. ... We have the means and materials for the manufacture of gunpowder.

"The question then arises, what is necessary to be done to render all these articles of prime necessity immediately available? In 1775, 1776, and 1777, our forefathers passed ordinances providing for... procuring saltpetre and sulphur, and stimulating the manufacture of gunpowder... The mode adopted was, the payment of proper bounties – such, for example, as fifty cents per pound (bounty) for saltpetre, and sixteen cents per pound for sulphur, when used in the manufacture of gunpowder. [pg. xxi] I have received from the secretary of the navy, Hon. S. R. Mallory, an interesting correspondence relating to the supply of nitre, the mode of preparing nitre beds, and their probable production. The subject is of the first importance to every citizen of the Southern Confederacy, involved as we are in a war which may continue for years to come. Wars cannot be carried on without gunpowder, and gunpowder cannot be fabricated without nitre. A supply of this indispensable article must be procured speedily; and I bring the subject to your attention, in the hope, nay with the confident expectation that you will offer such inducements as will stimulate our people to engage in its production, and in the manufacture of gunpowder. Whatever action you may determine upon in regard to this subject, should be taken with as little delay as practicable.

"Powder mills have been or are being erected in the counties of Page, Pendleton, Greenbrier, and perhaps in other sections of the state, as I have been

informed. What amount of powder they will manufacture daily, I have not been able to ascertain. Any encouragement that can be given to the manufacturers should be afforded promptly, in order that we may keep up the supply, and gather a sufficient amount ahead to relieve all anxiety on the subject, and to give full assurance of an abundant supply of this indispensable article"; see also Section I - State of Virginia 1862a).

Steuart, Richard D.

1996 Gun Manufacturing During the Civil War. In *The New Handbook of Texas* (6 vols.; Ron Tyler, Douglas E. Barnett, Roy R. Barkley, Penelope C. Anderson, and Mark F. Odintz, editors). Texas State Historical Association, Austin (Steuart notes that at the beginning of the Civil War, "Powder mills were established at Marshall and Waxahachie").

Stewart, Richard W.

1996 The English Ordnance Office 1585-1625: A Case Study in Bureaucracy. *Royal Historical Society Studies in History Series*, No. 73. Woodbridge, UK and The Boydell Press, Rochester, New York (Stewart's scholarly analysis of the Elizabethan arms supply system from 1585-1625, when combined with Tomlinson [1979] and West [1991], provides a detailed picture of the operations of the English Ordnance Office during three different centuries; during the Elizabethan era, nearly constant warfare encouraged centralization and efficiency in the arms procurement system, using materials and products supplied by a mixture of private, contractor and government sectors; efficiency declined during in the more peaceful early Stuart England, with the tendency toward centralization suspended due to various political and economic pressures; as the likelihood of war increased after 1620, the former system was discarded in 1625 for a supply system intended to be entirely controlled by the central government; although political conditions favored a centralized system, administrative and bureaucratic mechanisms were lacking; the book's chapter on saltpeter and gunpowder is significant in its portrayal of early English dependence on a corps of saltpetermen and artificial means of niter production, since importation of Indian saltpeter did not begin until about 1620; 181 pp.).

Stovall, Bates M.

1964 American Gunpowder Makers. *American Rifleman* 11(5; May):50-53. National Rifle Association, Washing, DC. (Stovall presents a brief popular history of gunpowder production in the United States, moving rather swiftly through the colonial and revolutionary periods and covering the Civil War in four short paragraphs; the greater part

of Stovall's article is devoted to the development of modern smokeless powder and accounts of late 19<sup>th</sup> and 20<sup>th</sup> century powder companies and the most popular powder brands they produced).

Stubbe, Henry

1670 *Legends No Histories, or, A Specimen of Some Animadversions upon the "History of the Royal Society"*. London (181 pp.; among other sources, this work is available at University of Kentucky Library, microfilm B77-100, Reel 298, Lexington, Kentucky; contains:

- [pp. 35-88] "Animadversions upon the History of Making Salt-Petre" by Thomas Henshaw;
- [pp. 89-97] "Animadversion Upon the History of Making of Gun-powder", also by Henshaw;
- [pp. 97-109] "The discourse of Pietro Sardi About Salt-petre, & Gun-powder, in his book L'Artigleria",
- [pp. 110-119] "The Third Book of the Various Questions and Inventions of Nicolas Tartaglia: Of Sal Nitre, and the Various Compositions of the Gun-Powder - Of the Propriety or the Particular Office Which Each of the Materials Hath in That Composition, and Other Particulars".

Sprat's *History of the Royal Society* [see Henshaw 1959] was presented to the Society in 1667, and generated a storm of controversy; Henry Stubbe, an "enthusiastic empirical physician" known for his wit and writing ability, was hired to attack the *History* and assaulted the Society with seven books and pamphlets on virtually every aspect; according to Cope and Jones, whose commentary appears in the 1959 reproduction of Sprat's book, Stubbe's attack was guided by two general charges, ignorance and disingenuity; the essays in the *History*, he claimed, exhibited a general ignorance of the history of science; further, the writers were not even competent in their own highly praised experimental method; his most acid analyses were reserved for Thomas Henshaw's histories of saltpeter and gunpowder manufacture; the critique takes four forms: "First, there is evidence of a considerable amount of research on Stubbe's part to locate earlier sources for Henshaw's allegedly 'modern' discoveries concerning his topics; second, there is the allied charge that Henshaw plagiarized from Johann Glauber's then recent *Prosperity of Germany* [evidenced by incorporation of many of Glauber's errors] rather than trouble with firsthand investigation; third, Stubbe suggests important and fertile questions on topics which Henshaw had failed to raise in the organization of his materials; finally and most important, he presents counter-evidence to many of Henshaw's conclusions, based on extensive personal investigations into the production of



saltpeter in Warwickshire" [in Sprat 1959:70-71]; the depth of Stubbe's scholarship is revealed by inclusion of his translations of portions of two significant Italian works in support of his premises: Sardi's *L'Artigleria* [1629] and Tartaglia's *Questi et Inventioni Diverse* [1546]).

Tartaglia, Niccolò

1546 *Questi et Inventioni Diverse*. Venice (132 pp.; in Italian; see Lucar [1588] and Stubbe [1670:110-119]).

Tascón, Ignacio González, Juan Carlos Jiménez

Barrientos, Dolores Romero Muñoz and Amaya Sáenz Sanz

1996 The Manufacture of Gunpowder in Spain and Latin America from the Sixteenth to the Eighteenth Centuries. In *Gunpowder: The History of an International Technology* (Brenda J. Buchanan, editor), pp. 183-202. Bath University Press, Bath, United Kingdom (403 pp.; according to the authors, documentation of the production of gunpowder in Spain, and of the Crown's interest in controlling and protecting the industry, first begins to appear in the 15<sup>th</sup> century; in 1608, the government forbid the open sale of saltpeter and established a system of privileges and State concessions; by 1747, the liabilities of this system led the government to undertake gunpowder production; Spanish powdermills from the 16<sup>th</sup> century onward ranged from simple mills with a few buildings separated for safety to huge industrial complexes; powdermills were located in the provinces of Ciudad Real and Murcia and in the cities of Granada, Seville, Malaga, Pamplona and Manresa; the most important center for gunpowder production during the 18<sup>th</sup> century was located in the province of Saragossa; details of the equipment and processes are given for several of these mills; gunpowder technology was rapidly transferred from Spain to the New World, because of the great demand occasioned by warfare and hunting; the relative abundance of gunpowder's components favored its production in Latin America and its manufacture is documented from the 16<sup>th</sup> century onward).

Taylor, Rev. John L.

1858 A Memoir of His Honor Samuel Phillips, LL.D. *The North American Review* 87(180: July):119-143, Cedar Falls, Iowa (this article notes [pp. 124-125] that "The powder-mill which he erected [in Massachusetts] in the winter of 1775-6, when Washington was compelled to lie inactive at Cambridge for want of ammunition, ... was blown up in 1793"; see also Anonymous 1853; and Downs 1896:499).

Taylor, General Richard

1879 A Statesman of the Colonial Era. *The North American Review* 128(267; February):148-161, Cedar Falls, Iowa (of interest is the observation [pg. 152] that James Mason, among other tasks associated with the colonial government was, assigned to a committee "...for the encouragement of the manufacture of salt, saltpetre, and gunpowder").

Temple, Robert K. G.

1986 *China: Land of Discovery*. Stephens, Wellingborough (contains a lengthy account of the invention of gunpowder and its application to military uses in ancient China; 254 pp.).

Thomas, Dean S.

1997 *Round Ball to Rimfire: A History of Civil War Small Arms Ammunition - Part One*. Thomas Publications, Gettysburg, Pennsylvania (ix + 334 pp.; ISBN-0-57747-015-X; this detailed and extensively research volume will undoubtedly become a standard reference in its field; however, despite the title the sole focus of this study is on Union ammunition production efforts; of note is a detailed discussion [pp. 127-134] of the development of gun-cotton in Switzerland in 1846 and subsequent trials by USA Ordnance officers both prior to and during the Civil War; also of particular interest is the full text of "Captain Alfred Mordecai's Report on Experiments with Gun-Cotton, 1846" [pp. 281-283] and "Major T. T. S. Laidley's Report on Gun-Cotton for Military Purposes, 1864" [pp. 284-287]).

Tomlinson, H. C.

1979 Guns and Government: The Ordnance Office Under the Later Stuarts. *Royal Historical Society Studies in History Series*, No. 15. Royal Historical Society, London (the English Ordnance Office, established during the Tudor era, greatly expanded its size and scope under the later Stuarts and began to develop into a true civil service of the modern mold; because of the large volume of documentation available for 1660-1714, author Tomlinson has chosen this period as the focus of an intensive and scholarly study of the Office; as a key industry, the manufacture of gunpowder is specifically addressed in a chapter on ordnance stores.; because imported Indian saltpeter was less expensive and of better quality than domestic production, commissions to English saltpetermen for home manufacture were terminated in 1670; initially, the Ordnance Office contracted directly with the East India Company and individual merchants for niter, which was then delivered to English powdermakers; the uncertainty of dependence on importation led to the creation of niter stockpiles; Tomlinson's account also includes information on powdermills and powdermakers; see also Stewart [1996] and West [1991] for accounts of

the Ordnance office during earlier and later eras; 268 pp.).

Vandiver, Frank E.

1994 *Ploughshares Into Swords: Josiah Gorgas and Confederate Ordnance* (2<sup>nd</sup> edition). Texas A & M University, College Station, Texas (1<sup>st</sup> edition published 1952, University of Texas Press, Austin; ultimately promoted to the rank of CSA Brig. Gen., Gorgas was highly respected for his organizational abilities; of all officers in the CSA Ordnance Department, Gorgas was the "kingpin" who organized, produced or purchased, and distributed so much to feed the Confederacy's hunger for armaments; among other war materiel, his department was responsible for mining lead, iron ore, copper, and niter, and producing gunpowder, bullets, artillery projectiles, and the cannons themselves; an understanding of Gorgas and his role in the production of Southern ordnance is essential to better understanding the organization and operating efficiency of both the Nitre and Mining Bureau and the CSA powder mill network).

Van Gelder, A. P. and Hugo Schlatter

1927 *History of the Explosives Industry in America*. Columbia University Press, New York (reprinted 1972, Press, New York; 1132 pp.; this work probably represents the most comprehensive history of explosives ever undertaken; the book chapters are organized into six major sections: blackpowder [pp. 3-314]; nitroglycerine and dynamite [pp. 315-720]; blasting supplies [pp. 721-766]; smokeless powder [pp. 767-928]; military explosives [pp. 929-958]; and "explosives in the making of America", i.e. mining, construction, demolition, etc. [pp. 959-1080]; significant space is devoted in most sections to individual histories of some of the major explosives manufacturers such as du Pont and Hercules Powder Company; the first section of the book, on blackpowder, is well-researched and contains much valuable information on many small regional powder mills of the United States and the development of the gunpowder industry from the colonial period into the early 20<sup>th</sup> century; the coverage of the industry during the American Revolution and the Civil War is quite detailed; for the interwar period the authors depend heavily on the 1810 US manufacturers census; the primary weakness in the gunpowder history is an almost total lack of discussion of the raw materials, such as saltpeter).

Vernidub, Ivan Ivanovitch

1996 One Hundred Years of the Russian Smokeless (Nitrocellulose) Powder Industry. In *Gunpowder: The History of an International Technology* (Brenda J.

Buchanan, editor), pp. 395-400. Bath University Press, Bath, United Kingdom (403 pp.; smokeless powder was first produced in Russia in 1890 at the Okhtinsky State powder mill in Petersburg; Vernidub traces complementary developments in Russian and European explosives sciences, beginning with the simultaneous independent discovery of guncotton in 1845, that led to a superior nitrocellulose powder propellant suitable for military applications; although the Russian military lagged behind Western nations in adopting smokeless powder, Vernidub attributes the invention of a widely adopted nitrocellulose powder known as pyrocollodian powder to the noted scientist Mendeleev in 1893, the secret of which was stolen and patented in America in 1895 by Bernado and Konvers; Lieutenant Bernado was the military-naval attaché in Petersburg and a frequent visitor to Mendeleev's laboratory; ironically, as the author notes, during the first World War huge quantities of pyrocollodian powder were produced in the United States; thousands of tons were sent to Russia during this period since the powder industry there lacked sufficient production capacity and raw materials).

Vivian, Julia L.

1996. Military Board of Texas. In *The New Handbook of Texas* (6 vols.; Ron Tyler, Douglas E. Barnett, Roy R. Barkley, Penelope C. Anderson, and Mark F. Odintz, editors). Texas State Historical Association, Austin (following the secession of Texas from the Union and the approval of the state legislature on April 8, 1861, the Military Board of Texas made contracts "...with firms in Waxahachie and Corpus Christi for the manufacture of gunpowder, but one mill blew up and the other was abandoned, so no powder was delivered").

Wang Lin

1947 On the Invention and Use of Gunpowder and Firearms in China. *Isis* 34. Parts 3 & 4, Nos. 109 & 110, pp. 160-178 (an account of the invention of gunpowder in ancient China and its application to military uses).

Waselkov, Gregory A.

1989 Introduction: Recent Archaeological and Historical Research. In *Fort Toulouse: The French Outpost at the Alabamas on the Coosa* by Daniel H. Thomas, pp. vii-xlii, University of Alabama Press, Tuscaloosa and London (in the process of describing the structures archaeologically excavated at Fort Toulouse, a 1717-1763 era French outpost in central Alabama, Waselkov notes [pg. xvii] "The fifth structure (Building D) located in the fort interior was a small building (8 feet 9 inches by 11 feet 7 inches) situated in the center of the northwest

bastion. The wall footing trenches, which had been dug very neatly, held widely spaced, vertical wall posts set in 28 inches into the ground. Outside the main trenches were additional footings for buttress posts placed 20 inches deep. The structure is thought to have been the fort's powder magazine, based on analogy with other French forts in North America. Time and again the French chose to locate powder magazines in bastions... A powder magazine was typically one of the smallest, but also one of the most substantial buildings within any fort. At Fort Maurepas ...the wooden magazine's side wall supported an arched roof: the floor sills rested on piers and the sides were propped with short buttresses. Vaulted powder magazines also were built at La Balise, Fort Tombeché, Fort Michilimackinac, and Fort de Chartres ...the Fort Tombeché magazine was roofed with shingles").

Weaver, Dwight

1971 Early Gunpowder Making and Saltpetre Mining in Missouri Caves. *Journal of Spelean History* 4(1):5-11 (French settlement of the Missouri region occurred much earlier, beginning in 1763, than the English settlement of the lands just west of the Appalachians, and accordingly cave saltpeter mining and gunpowder manufacture by French pioneers predates that in Kentucky and Tennessee; although documentation is scant, Philip Renault is credited with the discovery of Meramac Caverns shortly after his arrival in 1720, and is reported to have mined niter there; better documentation is available for the early 19<sup>th</sup> century, when the stimulus provided by the War of 1812 resulted in the exploitation of numerous caves and the erection of powder mills, despite strong competition from powder made in Kentucky and Virginia; Weaver observes that little is known about any saltpeter mining that may have taken place in Missouri during the Civil War; it is unlikely that any large scale mining was conducted, for Missouri, like Kentucky, was a border state where neutrality was enforced).

Webb, William S.

1935 Old Millstones of Kentucky. *Filson Club History Quarterly* 9(4):209-221 (prior to about 1810, nearly all millstones used in the United States were imported from England, but the trade disruption brought about by the War of 1812 caused a switch to stones of French manufacture; locally-made millstones were generally crude; millstones were primarily used to produce flour from grain, and the article is amply illustrated with photographs of one-time millstones now used as lawn decorations; Webb notes that millstones were used in gunpowder

mills during the period of the War of 1812, citing the example of a millstone found on the site of the former McCoy powder mill in Lexington; this assumption is probably incorrect, since early 19th century powder mills in Kentucky relied upon wooden mortar-and-pestle establishments for incorporation [see 1820 Census of Manufacturers, National Archives]; the McCoy millstone was probably associated with that family's venture into hemp milling during the 1850s).

West, Jenny

1991 Gunpowder, Government and War in the Mid-Eighteenth Century. *Royal Historical Society Studies in History Series* No. 63, Woodbridge, UK and The Boydell Press, Rochester, New York (unlike other volumes dealing with the Ordnance Office [Stewart 1996; Tomlinson 1979] in the RHS series, West's focus is specifically upon niter and gunpowder rather than the entire range of ordnance supplies; this scholarly work concentrates upon the period 1740-1770 and upon the water powdered powdermills of southeastern England; the scope of the work includes greatly contrasting periods of war and peace, most notably the Seven Year War [1756-1763] which brought about an unprecedented demand for gunpowder; prior to the 1759 purchase of the Faversham mills, all powder mills in England were privately run and supplied powder under contract; of interest are the appendices, which contain descriptions of powder makers and mills and quantities and prices of niter and new and reworked gunpowder purchased by the government; ISBN 0-86193-221-8; 242 pp.).

Whitten, Maurice M.

1990 *The Gunpowder Mills of Maine*. M. M. Whitten, Gorham, Maine (324 pp.; Whitten documents the manufacture of gunpowder in Maine at four different mills, with detailed descriptions of the processes involved; illustrated by Alston R. Wormwood).

Wigginton, Eliot (editor)

1979 *Foxfire 5*. Anchor Books - Anchor Press/Doubleday, Garden City, New York (see particularly pp. 242-261 including information on blackpowder, gunflint, and bullet making; of note, while the manufacture of homemade gunpowder is discussed [pp. 245-248], consistently the informants relied upon for this study reported that the required saltpeter and sulfur were purchased from commercial sources reinforcing the collapse of commercial niter mining in Appalachia even in the context of "cottage industry" production).

Wild, Heinz Walter

1996 Blackpowder in Mining: Its Introduction, Early Use, and Diffusion over Europe. In *Gunpowder: The*



*History of an International Technology* (Brenda J. Buchanan, editor), pp. 203-217. Bath University Press, Bath, United Kingdom (403 pp.; according to Wild, documentary evidence indicates that the first use in mining was probably in Northern Italy in 1573, and in certain isolated circumstances through the half century; the systematic use of blackpowder in mining, however, was not reported before the first half of the 17<sup>th</sup> century; shotfiring was introduced in Schemnitz (present-day Slovakia) in 1627 and the innovative practice soon spread to Germany, Austria, and Norway; during the first half of the 18<sup>th</sup> century shotfiring was introduced in all other European mining districts and reached the United States; the use of blackpowder in mining was superseded by the invention of dynamite in 1867 by Alfred Nobel).

Wilkinson, Henry

1841 *Engines of War, or, Historical and Experimental Observations on Ancient and Modern Warlike Machines and Implements, Including the Manufacture of Guns, Gunpowder, and Swords, with Remarks on Bronze, Iron, Steel, &c.* Longman, Orme, Brown, Green, and Longman, London, England (Chapter 6 notes the global sources of the primary ingredients of gunpowder, i.e., saltpeter, sulfur, and charcoal, and the processes used in the manufacture or refining of each; describes in detail the various steps in the making of gunpowder, including the organization of buildings and the machinery or processes that take place in each structure; describes methods of determining the proof or quality of gunpowder).

Wilkinson, Norman B.

1966 *Explosives in History: The Story of Black Powder*. Rand McNally Classroom Library. Rand McNally, Chicago, and Hagley Museum, Wilmington, Delaware (63 pp.; Wilkinson's book is a rather well-done popular account evidently intended for a high-school audience, and covers not only the history and methodology of gunpowder production but highlights the significant contributions of explosives in the infrastructure development of the United States; the author's research was based on the facilities available through the Hagley Library and Museum, and he acknowledges an emphasis upon the history of Hagley's sponsor, the du Pont Company; given du Pont's major role in blackpowder production in this country since 1802, this is not necessarily a fault, nor does the author entirely neglect other American powder manufacturers).

Wilson, P. N.

1964 *The Gunpowder Mills of Westmoreland and*

*Furness. Transactions of the Newcomen Society* Vol. 36 (examination of the physical remains of the powder making facilities in these English towns).

### III. ARCHIVES AND EXTENDED SERIES

The following materials are intended to serve as but an extended sampling of the types of information to be gleaned from various archival and extended published sources. There are many private collections of pertinent materials in the hands of libraries and historical societies too numerous to name. These resources have been alphabetically organized as follows:

- Burton S. Faust Collection - Western Kentucky University
- George Washington Rains Papers - University of North Carolina at Chapel Hill
- Georgia Department of Archives and History - Atlanta
- Hagley Museum, Wilmington, Delaware
- Knopf Series
- National Archives, Washington, D. C.
- Newspaper advertisements and notices
- Southern Historical Society Papers
- U. S. Forest Service
- War of the Rebellion (Official Records) Series - Army
- War of the Rebellion Series (Official Records) - Navy

#### **Burton S. Faust Collection - Western Kentucky University**

Burton Faust, an early and noted member of the National Speleological Society, pursued a lifelong research interest in saltpeter and saltpeter caves which is reflected both by numerous published articles on the subject and in a substantial collection of relevant material in the Manuscripts/Folklife Archives of Western Kentucky University, located in Bowling Green, Kentucky. The collection consists of 22 boxes, 5.2 cubic feet of material. Though the contents of the boxes are varied, by far the majority concerns one aspect or another of saltpeter, particularly in regard to production from caves. Material represented includes copies and extracts of writings about saltpeter dating from ancient times to the American Civil War, correspondence with various persons about saltpeter history, descriptions of various saltpeter caves, drafts of Faust's articles, and his abundant notes and unpublished writings on the subject. The Faust collection is an invaluable resource for any person interested in the history of nitrate production.

**George Washington Rains Papers**. In the aggregate, these papers cover the period 1843-1949 (bulk 1843-1864). Principle author: George Washington Rains (1817-1898). They are on file in the Southern Historical Collection, University of North Carolina at Chapel Hill (#1510). In part, typed transcriptions. Description: papers, chiefly

1843-1864, of Rains in the USA and CSA armies, written from Virginia, Texas, Mexico, and Georgia, and pertaining to the War with Mexico and to Confederate ordnance. There are references to the defense of Augusta, Georgia, and Charleston, South Carolina, to rifles and powder, and to the general progress of the war. The Civil War letters include two from James Henry Hammond (1807-1864), nine from Confederate Chief of Ordnance Josiah Gorgas (1818-1883), and one from Confederate General Benjamin Huger. Beginning in 1893, there are miscellaneous family papers, some written from New York. Also included is a biographical sketch of Rains.

**Georgia Department of Archives and History - Atlanta.**

Smith (1980:99-100) observes:

[Official Records] reports deal with [niter mining] sites, generally on or near the Tennessee River, that were located by Union patrols. While interesting, little is learned about the individual operations. Who worked these sites, when they were started, how large and how productive they were are questions not easily answered. Some of the answers, for a few of these caves, are revealed in a collection of papers donated to the Georgia Archives in 1971, which give the largest amount of detailed information about Confederate saltpeter mining in Alabama known to date.

John Riley Hopkins, a prominent citizen of Gwinnett County, Georgia, was an officer at several niter works in Alabama. Within his papers are about 200 documents pertaining to that service, mostly dated 1864, including time sheets, lists of arms, types of tools used, names of workmen and slaves, ration and forage lists, requisitions, receipts, monthly reports, and various messages between sites. Although a few references are made to Sauta Cave in Jackson County and Blue Mountain Cave in Calhoun County, the bulk of the material pertains to the Long Hollow and Blue Springs works in Marshall and four sites in Blount County: Nixon's, Culpepper, Little Warrior, and Cedar Mountain. A close examination of these records reveals many of the daily struggles of Hopkins and his fellow workers to produce saltpeter.

These papers are filed with the Manuscript Section, Georgia Department of Archives and History, Atlanta.

**Hagley Library, Wilmington, Delaware.** The Hagley Museum and Library, established as a non-profit foundation by the du Pont Company to collect and preserve historical information concerning American industry, comprises one of the most valuable sources of primary documentation on niter mining and gunpowder production. E. I. du Pont de Nemours & Company established

America's largest gunpowder manufactory in Delaware in 1802 and was the major purchaser of domestic saltpeter during the early 19<sup>th</sup> century. The Hagley archives contain a wealth of correspondence between suppliers and purchasing agents for the firm and many other types of records, including internal company notes and monographs. In addition, the institution has collected a wide range of documents and publications on gunpowder and niter from other sources. A sample of this material follows, consisting primarily of correspondence between Archibald McCall and the du Pont firm during the years 1809-1815, when the saltpeter industry in Kentucky was in its heyday. McCall had been one of the original investors in the du Pont firm, but his shares were soon purchased by Peter Bauduy, du Pont's early partner. McCall, a Philadelphia merchant, retained a close connection to the du Pont firm, acting as a purchasing agent for needed supplies. He thus spared du Pont considerable headache in his role as middleman between the Kentucky saltpeter brokers and the mills on the Brandywine. The letters, which focus on wartime domestic saltpeter production, are perhaps more informative than any other source as to the everyday operations of the saltpeter market. The analysis of the Kentucky saltpeter market in O'Dell (1995) is largely based upon these documents. These unpublished letters are from the Longwood MSS: the 1809 letter from Group 3, Series A and the remaining letters 1810-1815 from Group 5, Series A; collected and transcribed by Gary O'Dell. The letters written from 11 June 1815 through 22 June 1815 were published in du Pont (1926). The following materials appear courtesy of the Hagley Museum and Library.

1809

- 27 November. Charles Wilkins (Lexington) to McCall. Wilkins was a Lexington merchant and wholesaler and acted as broker for the du Pont company in Kentucky, purchasing large quantities of saltpeter for shipment to the Delaware mills. In 1810, Wilkins purchased Mammoth Cave and established what became, for a brief period, the largest niter mining and processing operation in the state. In this letter, Wilkins answers some complaints by du Pont about the quality of the niter sent to them, stating that some of the miners will mix sand and gravel with the saltpeter, or put a layer of high-quality saltpeter on top to conceal what lies beneath. The niter miners "have been so numerous & generally living in caves and mountains on our frontiers that I should have no knowledge of them even if they were to attempt to impose on me a second time."

1810

- 22 January. McCall to E.I. du Pont. McCall refers to two recent letters from Charles Wilkins, who informed him that there are several purchasers of saltpeter in the Lexington market and the price had risen to 20 cents/lb.



As fast a wagon load was put together Wilkins would send it to the Kentucky River to be shipped to New Orleans.

- 10 February. Callender Irvine to Secretary of War William Eustis. Irvine refers to samples of sulfur given to a Mr. Cloud for examination, who reported it of good quality. A Mr. Godon, "a french gentleman, whose chemical knowledge is held in high estimation," also examined the sulfur and pronounced it of good quality and suitable for making gunpowder.

- 19 February. McCall to E.I. du Pont. Wilkins' latest letter to McCall reports shipment of saltpeter to New Orleans, 5,256 lbs., and that his total purchase amount to 16,245 lbs. The shipment from New Orleans to Philadelphia is to be made aboard the ship *Kentucky Gazette*, master John Lewis, at a freight rate of one cent per lb.

- 20 March. McCall to E. I. du Pont. In his latest letter to McCall, Wilkins reports purchase of 35,000 lbs. saltpeter. McCall notes Wilkins must now have received his letter directing him to cease purchasing.

- 24 March. McCall to E. I. du Pont. McCall notes that orders were given to Wilkins for three parcels each of 30,000 lbs. saltpeter; the first order was completed the previous autumn and the account settled. The 35,000 lbs. recently reported purchased by Wilkins is in regard to the remaining two orders. McCall reports that 8 casks and 2 half-barrels saltpeter were sent from Alexandria yesterday by the Wilmington boat *Julia*.

- 30 March. McCall to E. I. du Pont. Wilkins' latest letter reports 56,000 lbs. saltpeter purchased and the balance would be obtained in a few days; a bill for \$3,000 was enclosed. McCall notes that a person in Philadelphia offered him two barrels of saltpeter for 30 cents/lb. Upon examination, McCall found the saltpeter appeared "to be from Kentucky & pure and dry, but rather of a dark color."

- 9 April. McCall to E. I. du Pont. Yesterday a letter from Wilkins reported that he had completed purchase of 61,240 lbs. saltpeter two days before receiving McCall's letter directing him to cease purchases. McCall inquires of du Pont whether he wants the additional 1,240 lbs. Wilkins observes that large quantities of saltpeter will probably be made during the months of April and May, the price likely to continue at 20 cents/lb.

- 20 April. McCall to E. I. du Pont. McCall reports that he wrote Wilkins agreeing to accept the additional 1,240 lbs. saltpeter, and has requested him to keep him informed as to the state of the Lexington saltpeter market as to price, quantity, and number of purchasers.

- 22 April. McCall to E. I. du Pont. McCall forwards information received from Wilkins regarding the shipment of saltpeter; part has been sent down to New Orleans and part north to Limestone (present-day Maysville, Kentucky) from where it will be sent on to Pittsburgh and thence Philadelphia. Wilkins reported that there were then no

purchasers of saltpeter in the market and large quantities might be had at 20 cents/lb.

- 14 May. McCall to E. I. du Pont. McCall refers to the potential effects on the gunpowder market of the current slight moderation of the political tension existing between Britain and the United States. He does not believe that Britain is likely to allow export of saltpeter even though the Non-Intercourse Act has been repealed. Du Pont's powder has such a well-known reputation for quality that sales are not dependent upon price, and should not lower his prices to that of "common American Powder." Should saltpeter and gunpowder again be available from Britain, perhaps du Pont should then "accommodate yourselves to the Market price," but in the meantime should not reduce the price to common retail customers, although bulk quantities might be discounted a bit so as not to loose the sale.

- 23 May. McCall to E. I. du Pont. McCall reports an offer of \$13.50 per keg for 3,000 lbs. cannon powder. Wilkins has written from Kentucky to report a large quantity of saltpeter available for 16-2/3 cents/lb: "There are no large purchasers in the market and the manufacturers keep it in the country - but it is ascertained that a considerable quantity is made." Also, 2,969 lbs. saltpeter were shipped from Philadelphia to du Pont today via the Wilmington boat.

- 29 May. Richard Cain (for McCall) to E. I. du Pont. A list is provided of weights of 30 barrels saltpeter, received from Pittsburgh, shipped to du Pont via the Wilmington boat *Julia*; two more barrels will be shipped tomorrow on the boat *Hope*.

- 2 June. McCall to E. I. du Pont. McCall asks du Pont to send the 3,000 lbs. cannon powder just manufactured up to the state magazine immediately. He also requests du Pont's decision about the saltpeter of General John Wilkins (Charles's brother, resident at Pittsburgh) that was sent to him by mistake.

- 5 June. McCall to E. I. du Pont. McCall repeats his request to immediately ship the cannon powder to the state magazine. He refers to du Pont's decision to send back John Wilkin's saltpeter, asking him to keep it since McCall has provided Wilkins with an equal quantity of saltpeter intended for du Pont in exchange, which Wilkins has already sold.

- 9 July. McCall to E. I. du Pont. McCall has received word that Charles Wilkin's saltpeter has arrived in New Orleans and was loaded aboard the ship *Mary*, commanded by Captain Probeson. McCall has not heard of any powder arriving from England.

- 24 July. McCall to E. I. du Pont. Yesterday, by the Wilmington boat, McCall reports forwarding to du Pont 86 casks of saltpeter received from New Orleans; the expenses at New Orleans including freight from Kentucky were



\$416.41, and the freight from New Orleans to Philadelphia \$360.15.

- 4 August. McCall to E. I. du Pont. McCall incloses invoices for the last order of Charles Wilkins' saltpeter totaling \$16,667.48; he has not lately heard from Wilkins. He notes that he is not aware of any saltpeter that has been received from London.

- 16 August. McCall to E. I. du Pont. McCall acknowledges du Pont's order for 15,000 lbs. saltpeter, and will let Wilkins know. He has not heard from Charles Wilkins for some time, and understands he is purchasing saltpeter for other persons.

- 31 August. Charles Wilkins to McCall. He has received McCall's letter of 16 August. McCall apparently expects the 15,000 lb. purchase to be made at 15 to 16 cents/lb., but the price of Kentucky saltpeter at the Lexington market has increased to 20 cents per pound. Wilkins has received an order from his brother John in Pittsburgh for 50,000 to 60,000 lbs. saltpeter, and although wanting to accommodate du Pont he does not want to disappoint his brother. He is unsure whether he will be able to complete the du Pont order, and asks McCall to write his brother and make an arrangement by which both parties may be satisfied.

- 3 September. McCall to E. I. du Pont. McCall reports on a letter just received from Charles Wilkins in Kentucky, who has evidently not yet received McCall's August letter ordering 15,000 lbs. saltpeter. Wilkins has received an order for 20,000 lbs. from New York. He has been giving 15 to 18 cents/lb. but had only been able to purchase about 20,000 lbs. during the entire summer: "He thinks at 20 cts a considerable quantity may be had during the Autumn and Winter."

- 14 September. McCall to E. I. du Pont. McCall reports he has just heard from Wilkins concerning the 15,000 lbs. McCall ordered to be purchased last month, and encloses a copy of Wilkins' letter of 31 August, noting that there seems to be some doubt as to whether Wilkins will be able to complete the order.

- 18 September. McCall to E. I. du Pont. McCall has written to General John Wilkins, asking him to urge his brother Charles in Kentucky to give first priority to completing the 15,000 lb. du Pont saltpeter purchases, and to purchase an additional 15,000 lbs.

- 3 October. McCall to E. I. du Pont. McCall encloses a copy of a letter, just received, from General Wilkins, who has directed his brother to complete the du Pont purchases.

- 16 October. William Lorman (Baltimore) to Jno. Dorr & Co. (Boston). Lorman regrets that the saltpeter brokers in Boston insist on such a high price; he wishes to purchase 150,000 lbs. but does not care to give more than 30 cents/lb. At 30 cents, Lorman is "now receiving from the Back Country a full supply for our several Mills."

- 17 October. William Lorman to McCall. Lorman

acknowledges receipt of a letter from McCall, also notes receiving a letter from Dorr & Co., indicating their belief that a purchase of 40 to 50 tons saltpeter could be had at 35 cents/lb. He encloses a copy of his 16 October reply to Dorr & Co. He proposes a large joint purchase for price advantage, sharing the saltpeter equally with McCall, Lorman's own concerns, and those of a Mr. Levering & Co. Unless the owners of the saltpeter choose to sell to them, he notes, they might expect to hold it a very long time - this is the impression he wishes to give to the sellers. He has had no luck importing saltpeter from England.

- 19 October. McCall to E. I. du Pont. McCall encloses copies of Lorman's two letters dated 16 and 17 October. McCall wishes direction, noting that the Kentucky saltpeter has lately been selling in Philadelphia at 37 to 39 cents per lb. In other news, McCall notes receipt of a letter from Charles Wilkins, who expects to complete the du Pont saltpeter purchases by 20 October; the price has been steady for some time at 20 cents/lb.

- 3 November. McCall to E. I. du Pont. In a lengthy letter, McCall reports writing to Charles Wilkins, ordering an additional 20,000 lbs. saltpeter and stating their intent to continue placing orders with him but wanting assurance that these will be given priority. He corrects du Pont's impression that Wilkins would give preference to others, stating that he only meant that Wilkins would purchase for others if he found himself without an order from du Pont. In other business, McCall reports on the negotiations for the Boston saltpeter (see letters for 16,17,19 October). The deal could already have been closed, he notes, if not for the stipulation to reject fine ground saltpeter. From what has been seen of it, it appears to be good quality.

- 4 November. Charles Wilkins to McCall. Wilkins reports concluding purchases for du Pont and has sent all of it to Limestone for shipment on the river. Should du Pont wish additional, he can purchase at least 50,000 lbs. and have it ready to ascend the Ohio River in March when the ice clears.

- 11 November. Charles Wilkins to McCall. Wilkins is thankful that he may give a higher price in his saltpeter purchases; if he had but known, he might have completed du Pont's orders in time to go upriver before the ice set in. He had closed his purchases for the season and it will take some weeks for word to reach the caves, so doubts he will be able to send any more off "before the Ice will be a float... when this happens boats cannot ascend the river." It will be early March before he can again ship upriver.

- 13 November. Jno. Dorr & Co. (Boston) to McCall. From this letter it is clear that Dorr & Co. are acting as agents for McCall, Lorman, and Levering in the attempted purchase of a large quantity of saltpeter available in Boston. They have thus far purchased 10 tons, and will attempt to get the saltpeter which was unloaded from the

ship first, since that closer to the bottom of the hold did not appear to be as good quality. The entire cargo was 240 tons saltpeter, of which 40 tons remains uncommitted and available for purchase.

- 29 November. McCall to E. I. du Pont. McCall has written to Dorr & Co. to order an additional 10 tons, directing them not to close a deal until the saltpeter can be inspected by du Pont's Peter Bauduy ( partner in the du Pont firm until 1815). copy of Charles Wilkins' 11 November letter is enclosed.

### 1811

- 13 January. Charles Wilkins to McCall. Wilkins is responding to a letter from McCall dated 23 December, reminding him that he wrote on 16 December to inform him of an arrangement he had made with the other saltpeter buyers in Lexington. These buyers would allow Wilkins to purchase all the saltpeter on the market until he had completed the order for du Pont, and in turn he would afterward desist until they had made purchases of an equal quantity. "The object of this arrangement was to prevent competition & to keep the price at 20 cents..." Accordingly Wilkins does not expect to be able to purchase more saltpeter for du Pont until April; if this arrangement does not satisfy du Pont will have to engage another agent since he cannot violate his agreement.

- 26 January. McCall to E. I. du Pont. McCall encloses Wilkins' 13 January letter, noting it would be best to let the arrangement stand and not attempt to employ another agent: "Indeed I am not acquainted with any person there in whom I have the same confidence that I have in him."

- 25 March. McCall to E. I. du Pont. McCall sends an extract of a letter from Charles Wilkins, who reports that since du Pont is eager to obtain a large supply of saltpeter he has made substantial engagements for April and May, expecting to ship 20,000 lbs. monthly "as long as the river continues open." Wilkins expects considerable competition now, stating "There are persons in every direction buying and sending it to the southward in Waggon's."

- 5 April. McCall to E. I. du Pont. McCall has forwarded du Pont's order for 40,000 lbs. saltpeter to Wilkins in Kentucky.

- 5 June. McCall to E. I. du Pont. McCall reports that he declined to allow Dorr of Boston to purchase another 10 tons of saltpeter at 40 cents, and encloses a letter from Charles Wilkins. Wilkins informs him that saltpeter in the Lexington market is scarcer than he has ever known it to be. He notes that of the 12,000 lbs. he has obtained, half is from his own cave (Mammoth Cave), which carries the brand G&W (Gratz & Wilkins). This saltpeter will require 1-1/2 cents more per pound, or 22 cents.

- 18 June. McCall to E. I. du Pont. McCall corrects du Pont's impression that the saltpeter from Wilkins' cave would be a half cent higher than the customary price,

noting that the figure is 1-1/2 cents more than "that from other Caves." He has heard nothing further from Dorr & Co. regarding the 10 tons saltpeter in Boston.

- 30 June. Charles Wilkins to McCall. Wilkins informs McCall that considerable quantities of saltpeter arrived last week, and his purchases amount to 47,000 lbs., leaving 23,000 lbs. yet to complete the order. Wilkins advanced \$400 on 29 June to a saltpeter manufacturer who promised to deliver in ten days.

- 2 July. McCall to E. I. du Pont. McCall has received a letter from Charles Wilkins, who informs him that he now has obtained a total of 52,165 lbs. saltpeter without adding any of the more expensive niter from his own cave. McCall notes that he wrote Wilkins last month requesting him to use the saltpeter from Mammoth Cave, at 1-1/2 cents more per lb., to complete the order. In other business, McCall sent five barrels of saltpeter to du Pont on the sloop *Ann*.

- 29 July. McCall to E. I. du Pont. McCall encloses an invoice from Charles Wilkins, and notes that he has insured the 136 kegs gunpowder on the sloop *Betsy* for \$1,200 at 2 percent, the lowest available premium.

- 3 October. McCall to E. I. du Pont. McCall encloses a statement of accounts due from du Pont, mainly charges for saltpeter delivered.

- 7 October. Charles Wilkins to McCall. Wilkins has received McCall's order for 60,000 lbs. saltpeter, but states acceptance will depend upon the arrangements his brother makes with McCall. It has become difficult to purchase large quantities of saltpeter: "It has become the custom to purchase it up on the frontiers...22 to 25 cents are now the current prices in the neighborhood of the caves," and Wilkins suggests an arrangement by which McCall purchases the entire production from his cave until May or June 1812.

- 15 October. McCall to E. I. du Pont. McCall notes he has not yet had a response from Charles Wilkins concerning the 60,000 lbs. saltpeter du Pont wishes him to furnish during the winter, but a man from Kentucky has just arrived with 23,000 lbs. allegedly "of a very superior quality," offered at 37 cents/lb. McCall believes it can be had for 36 cents.

- 21 October. McCall to E. I. du Pont. McCall encloses a copy of a letter just received from Charles Wilkins (this is the letter dated 7 October), noting that the price of saltpeter in Lexington has increased to 24 to 25 cents/lb., a price confirmed by other persons with whom McCall has been in contact. McCall has spoken with General John Wilkins recently, who offered to contract "all the Salt Petre which shall be made at his Brothers Cave after the 1st of November at 25 Cents per lb...." John Wilkins offers to supply this saltpeter free of commission and to forward it from Pittsburgh free of storage charges. McCall notes that in this deal, even though required to give 1-1/2 cents more



per pound for the saltpeter, the overall savings would be 2-3/4 cents.

- 24 October. McCall to E. I. du Pont. Enclosed is copy of contract between McCall and Wilkins for "...all of the Salt Petre which shall be made at the cave belonging to the said J&C Wilkins," on average 10,000 pounds per month, at the rate of 25 cents per pound, until the 60,000 lbs. ordered has been sent. No charge is to be made for commission and storage, but transportation costs from Lexington to Philadelphia are to be paid by McCall. Should production at the cave be insufficient in the allotted time, the quantity is to be made up by other saltpeter of an equal quality.

#### 1812

- 8 January. McCall to E. I. du Pont. McCall encloses a copy of a contract for 24,000 lbs. saltpeter with a Robert McNair of Kentucky, a saltpeter maker, at the rate of 25 cents/lb. delivered to Lexington free of commission. McNair claims his saltpeter always brought the highest price in Lexington; McCall has taken security on the contract.

- 22 February. McCall to E. I. du Pont. Letter refers to monies owed by du Pont on several accounts with McCall, including a note for \$5,000 to John Wilkins that becomes due on 27 February.

- 10 March. McCall to E. I. du Pont. McCall informs du Pont that a parcel of sulfur is available at \$6.25 per 1,000 lbs. McCall also notes that the man he proposed to buy saltpeter (in Lexington) in Wilkins' place is ready to begin purchases. A letter has also been just received from Charles Wilkins, who "informs me that but little business has been done at his Cave during the Winter" as a result of the earthquakes and numerous aftershocks; the workers were badly frightened, and the manager refuses to go back into the cave. Wilkins does not think he will be able to fulfill the contract in time and has begun purchases on the market, but "There is but [little] Salt Petre at Market in Lexington. The [earthquake] has had the effect of stopping the workment all thro the [cou]ntry." See George and O'Dell (1992).

- 18 March. McCall to E. I. du Pont. The Maccoun firm in Lexington is purchasing saltpeter on behalf of du Pont; the competition is great and "none of the article came then to Lexington unsold." Maccoun is required to send advances to the saltpeter makers to insure receiving niter, and hopes soon to complete the order for 60,000 lbs.

- 10 April. McCall to E. I. du Pont. McCall expects to receive substantial quantities of Kentucky saltpeter soon from Wilkins, McNair and the Maccoun firm.

- 21 April. McCall to E. I. du Pont. McCall, responding to a previous letter from du Pont, does not think the Kentucky saltpeter will arrive within two weeks, and probably has not yet reached Pittsburgh. He sees no difficulty in

obtaining 10,000 lbs. locally, although at a cost between 33-36 cents/lb.

- 4 May. McCall to E. I. du Pont. McCall has receipts for 10,000 lbs. of Wilkins' saltpeter, enroute from Pittsburgh and expected in Philadelphia about mid-month. More is daily expected, and after two weeks "should arrive as fast as you will have occasion for it."

- 12 May. James Hall (for McCall) to E. I. du Pont. McCall notes receipt from Pittsburgh of 28 barrels of saltpeter on the boat *Tryphenia*. A list of the individual, numbered barrels is appended, with the weight of niter and the tare weight for each. These barrels contained, on average, 365 lbs. saltpeter.

- 14 May. James Hall (for McCall) to E. I. du Pont. A list of 8 barrels saltpeter, shipped aboard the *Julia*, is provided.

- 29 May. McCall to E. I. du Pont. McCall has received a letter from John Wilkins in Pittsburgh forwarding a receipt for five double and seven single barrels of saltpeter enroute to Philadelphia. Since it is likely not from the Wilkins' cave, "it is to be presumed it is no better than the common Salt Petre of Kentucky."

- 11 June. McCall to E. I. du Pont. McCall has received invoices from Maccoun for 36,000 lbs. saltpeter; some has already been received at Philadelphia and the balance expected soon. Fleming Gatewood has sold out his interest in Wilkins' cave and has purchased another, offering his saltpeter production to Wilkins. Gatewood expects to receive the same 1-1/2 cent premium as the Mammoth Cave saltpeter.

- 12 October. McCall to E. I. du Pont. McCall this day received a letter from Maccoun, who wish to know if du Pont wishes to receive the remainder of their 180,000 lb. saltpeter order this autumn while the river is still open to shipping. To date, McCall has received 393 barrels of saltpeter from the Maccoun firm.

- 16 October. McCall to E. I. du Pont. McCall has written to Lexington concerning du Pont's recent directions concerning further saltpeter purchases.

- 23 October. McCall to E. I. du Pont. According to du Pont's request, McCall will write to the Maccoun firm to have them suspend all further purchases once the 180,000 lb. order has been completed.

- 30 December. McCall to E. I. du Pont. McCall recently received a letter from Charles Wilkins concerning difficulties at his saltpeter cave: "having been obliged to repair their works they had made but very little Salt Petre this season...." Wilkins hoped his brother could supply the balance due on the contract from purchased saltpeter, but when McCall contacted John Wilkins, he was told he had sold all that which had been purchased and sent to Pittsburgh by Charles. John swore to urge his brother Charles to send on as much as possible as soon as possible, but McCall had little expectation of any reaching



Philadelphia at this time of year, nor was McCall accustomed to keeping any in storage.

1813

5 March. McCall to E. I. du Pont. McCall reports that the sloop *Sarah Anne* will depart for Wilmington tomorrow with three single and one double barrel of saltpeter, received from Maccoun. There is none in storage in Philadelphia nor in Pittsburgh.

- 27 April. McCall to E. I. du Pont. McCall has heard from John Wilkins; his brother is beset with production problems at the Mammoth Cave saltpeter works: "...during the last winter, the pipes in the cave for the conveyance of water burst, & that the quantity of Salt Petre made was not more than sufficient to defray the expences [sic] of the works." John proposes that Charles purchase Kentucky saltpeter to complete the contract and deduct the 1-1/2 cent premium from the previously contracted price. If agreed, however, the saltpeter would probably not reach Philadelphia before August.

- 10 September. McCall to E. I. du Pont. McCall has received a letter from a contact in Kentucky, who reports the price of saltpeter has fallen; the contact can purchase it from 19 to 22 cents/lb.

1814

- 5 January. Charles Wilkins to McCall. Wilkins has received a letter from McCall informing him that the balance of the contracted saltpeter had not been received. Wilkins had thought his brother John had resolved the contract problems. "I no longer have control over the Salt Petre made at the Cave..." he writes, noting that Gratz & Bros. (of Philadelphia) now had an ownership interest in the cave. All of the saltpeter made at the cave until May 1812 had been sent to McCall. Wilkins asks to be allowed to purchase saltpeter to complete the order: "I will be careful in purchasing it of good quality."

- 27 January. McCall to E. I. du Pont. McCall encloses a copy of Wilkins' 5 January letter, noting that he has written to both Wilkins brothers several times and this is the only reply. "You certainly have much cause to complain of the manner in which you have been treated in this business," he informs du Pont. "I believe the most prudent thing you can do is to get out of it as well as you can & therefore that you had better take the Salt Petre w'ch M Ch. Wilkins offers to purchase...."

- 12 April. McCall to E. I. du Pont. McCall suggests to du Pont that it might be a good idea to order purchases of saltpeter at a fixed price, "say 12 to 15 cents pr lb," and then place the order in the agent's hands.

- 27 June. McCall to E. I. du Pont. McCall has heard from "my friend in Kentucky," who reports that saltpeter cannot be bought for less than 20 cents/lb. The manufacture of gunpowder in Kentucky has greatly increased and a great

deal of saltpeter is now used locally. Further, "...a number of persons have declined making Salt Petre & we have no doubt but it will be generally declined if after the expence of waggoning it to this place [Lexington] 20 cents cannot be had for it." McCall's contact offers to supply 200,000 lbs. at 20 cents/lb.

- 1 August. McCall to E. I. du Pont. McCall encloses an extract of a letter from the Maccouns. They have contracted with a saltpeter maker for a quantity, "made at his own Cave," for 18 cents/lb., after purchasing about 6,000 lbs. from him at 19 cents. The owner, who had hauled the niter more than 200 miles to Lexington, "had determined to seek a market for it amongst the powder makers here, or store it, rather than take less than that price." They note that if they have any doubts as to the quality of the saltpeter they buy, they "shall get a Chemist who refines S-Petre here, to judge...."

- 11 August. McCall to E. I. du Pont. McCall has written to the Maccouns to inform them of his approval of the 18 and 19 cent/lb. purchases and would accept saltpeter at this rate. He encloses an extract of a letter from them dated 24 July in which they express the hope to purchase saltpeter at 18 cents but request liberty to exceed that rate if necessary. Also enclosed is an invoice of saltpeter purchased on commission by Maccouns Lane & Co., including cartage.

- 19 August. McCall to Maccouns Lane & Co. McCall informs them that the government has completed its purchases of saltpeter and are "fully supplied for some time to come." Gunpowder sales are slow and the makers have large stocks on hand. There are great quantities of saltpeter now available in the market and sales are slow. McCall believes that the price of saltpeter in Kentucky must therefore fall to 14-15 cents/lb. He directs the Maccouns to "suspend your purchases for some time ...long enough to let the owners of the Caves feel the effect of the Market being glutted with Salt Petre which may induce them to lower their price." Under no circumstances are they to give more than 18 cents.

- 1 October. Maccouns Lane & Co. to McCall. A bill for saltpeter is enclosed. Another 9,000 lbs. is ready to ship as soon as packed.

- 5 October. Maccouns Lane & Co. to McCall. They have not been able to obtain barrels to pack all of the 9,000 lbs. mentioned in their last letter.

- 8 October. Maccouns Lane & Co. to McCall. They have received the copy of the Wilkins contract mailed to them and have stopped purchasing saltpeter as ordered. Wilkins is currently out of town; "...as soon as he returns the business with him shall be attended to...."

- 21 October. McCall to E. I. du Pont. McCall encloses copies of the Maccoun letters. He has checked the accounts and it appears that the Maccouns have drawn too much money too fast and have not completed the entire order. McCall asks for direction, advising that an accusation

would be "a serious thing, & as they have yet much in their power you should weigh the matter well...." He notes shipment of Maccoun saltpeter to Wilmington scheduled for tomorrow aboard the *Sarah Ann*.

1815

- 10 January. James Maccoun (Lexington) to McCall. Maccoun attributes the overdrafts against McCall to the error of a clerk. The Maccouns are now separated from "our Friends & late partners" Lane and Taylor, and suggest that future saltpeter orders be given to them. "We were unfortunate last season in advancing money to two men who failed to deliver us Salt Petre one of them went home to Connecticut & took \$700 of the money advanced with him."

- 1 February. McCall advises 64 barrels of Maccoun saltpeter are in storage in Philadelphia. He encloses a copy of James Maccoun's 10 January letter, noting "Any observations on the futility of the reasons he offers would now be useless - they speak for themselves."

- 18 March. McCall to E. I. du Pont. He has heard nothing further from either the Wilkins or the Maccouns, but he has heard that they are all of good reputation in Kentucky and appear "to be considered as ultimately safe." A acquaintance of McCall has embarked for Kentucky and will confront Wilkins. Another man, "who is intimate" with Lane and Taylor, has promised to write to them and urge them to complete the order. The saltpeter brokers in Kentucky have been unable to fill their contracts and have "...beged [sic] very hard for time. There is great embarrassment among them," but he believes no danger of ultimate loss to du Pont.

- 14 April. McCall to E. I. du Pont. He has heard nothing from the Maccouns or Wilkins, but expects John Wilkins to be in Philadelphia next week. He suggests that du Pont might wish to have him arrested before he leaves the city, if the saltpeter is not forthcoming, and to bring suit against the Maccouns. Saltpeter is now in short supply, though "great quantities" are expected in from Tennessee at any time. "I am told that in Kentucky and Tennessee almost all the Salt Petre makers have stopped making the article..."

- 1 May. McCall to E. I. du Pont. McCall advises sending drafts against Charles Wilkins in care of Antoine Bidermann, if he is to be sent to Kentucky.

- 13 May. McCall to E. I. du Pont. McCall is pleased to report that Maccouns, Lane & Co. have begun to purchase saltpeter again, and "His character from every account I can get stands very fair." He suggests that Maccoun's bill be accepted for half the amount until he has paid off the old balance.

- 24 June. McCall to E. I. du Pont. An invoice for saltpeter purchased from Gratz is enclosed.

- 11 June. Pittsburgh. Antoine Bidermann to E. I. du Pont. Bidermann plans to travel to Louisville by boat, procure a

horse and be in Lexington by early July. There is very little saltpeter available in Pittsburgh. A Mr. Beelen is willing to act as agent in Pittsburgh for du Pont gunpowder, and believes he can get \$13 to \$14 per keg: "Kentucky powder, which Mr. B. says is very good, sells at \$12 to \$12.50."

- 16 June. Pittsburgh. Antoine Bidermann to E. I. du Pont. Bidermann commiserates with his father-in-law over news of a "terrible explosion in the stamp mill" at the du Pont facility; "it is horrible to think that [the workers] died in our service." He urges du Pont to provide a pension for the family of each worker. He has been to see John Wilkins, who told him that "the Kentucky caves show signs of exhaustion."

- 6 July. Louisville. Antoine Bidermann to E. I. du Pont. It appears, from what Bidermann has learned here, that some of the saltpeter comes from the direction of St. Louis and Vincennes. In contrast to what John Wilkins had told him in Pittsburgh, "It is said here that it is not probable that the caves are giving out; and that even if they are, the banks of the Green River are full of it and only need to be worked." He plans to visit the Green River area when he travels to Nashville. Bidermann saw gunpowder made by S & G Trotter of Lexington for sale in Louisville: "It looks very good and the hunters are said to think it excellent." The major market for Trotter powder, he relates, was not in Kentucky, where there were many other makers, but for the Indian trade toward St. Louis and up the Wabash. The Trotters have an agency for that market at St. Louis.

- 11 July. Lexington. Antoine Bidermann to E. I. du Pont. Bidermann has learned that Samuel Thompson, who had accepted an order from du Pont for saltpeter, has not begun to fill the order "because no more saltpetre is to be had in Kentucky. It is not because the caves are exhausted for new ones are found every day, but because the price has become so low since the peace that no one will work them ...they will not start again until the price is 20c."

- 13 July. Lexington. Antoine Bidermann to E. I. du Pont. Bidermann urges his father-in-law to write and provide guidance. To obtain saltpeter in Kentucky, he will have to raise the limit price for their agents there; he needs to know whether E. I. hopes to obtain saltpeter anywhere else. If it cannot be bought from India, he fears that the mills will have to be closed. Tennessee is his last hope. "This business used to be easy," he reports, "because all the merchants from the towns near the saltpetre works used to load their wagons with it when they came here to get their merchandise. Now the price is so low that it does not pay to work it or bring it in." Even Samuel Trotter, "who should know all about it, cannot get any."

- 22 August. Nashville. Antoine Bidermann to E. I. du Pont. Bidermann reports that Taylor in Lexington has purchased about 6,000 lbs. saltpeter and put a large number of men to work to obtain more. In Tennessee, the du Pont agent made no purchases because no saltpeter was



available due to the low price.

**Knopf Series.** This multivolume series consists of documents carefully transcribed from original sources and contains numerous references to the procurement, shipment and allocation of various ordnance supplies in the context of events in the northwest territory; the primary limitation of the series is its focus on a single era (the War of 1812) and region (the Northwest). References specific to saltpeter and gunpowder are thinly scattered through most of the series and generally of little consequence, generally merely noting shortages or shipments. Significant letters about these items, however, are concentrated in Volume 6, Parts 1-4, particularly the letters from James Morrison of Lexington, Kentucky, army contractor and later Deputy Quartermaster to General William Henry Harrison. Listed below are the individual volumes that comprise the series, with notes as to the source of the original documents. Following this are summaries and extracts of the most relevant documents related to gunpowder or saltpeter.

Knopf, Richard C.

1957-1962 *Document Transcriptions of the War of 1812 in the Northwest* (10 v. in 17, index). Ohio Historical Society, Columbus.

This series contains the following volumes and parts thereof:

- Vol. 1 (1957) William Henry Harrison and the War of 1812. Source: Harrison Letterbooks, Library of Congress (105 pp.).
- Vol. 2 (1957) Return Jonathan Meigs, Jr. and the War of 1812. Sources: Files of Ohio State Library and Ohio State Museum (242 pp.).
- Vol. 3 (1957) Thomas Worthington and the War of 1812. Source: Worthington Papers, Library of Congress (233 pp.).
- Vol. 4 (1957) Anecdotes of the Lake Erie Area, War of 1812. Sources: multiple (63 pp.).
- Vol. 5:1 (1958) The National Intelligencer Reports the War of 1812 in the Northwest. Source: Library of Congress (295 pp.).
- Vol. 5:2 (1958) The National Intelligencer Reports the War of 1812 in the Northwest. Source: Library of Congress (264 pp.).
- Vol. 6:1 (1959) Letters to the Secretary of War, 1812. Source: National Archives (245 pp.).
- Vol. 6:2 (1959) Letters to the Secretary of War, 1812. Source: National Archives (144 pp.).
- Vol. 6:3 (1959) Letters to the Secretary of War, 1812. Source: National Archives (209 pp.).
- Vol. 6:4 (1959) Letters to the Secretary of War, 1812. Source: National Archives (155 pp.).
- Vol. 7:1 (1961) Letters to the Secretary of War, 1813.

Source: National Archives (210 pp.).

- Vol. 7:2 (1961) Letters to the Secretary of War, 1813. Source: National Archives (189 pp.).
- Vol. 7:3 (1961) Letters to the Secretary of War, 1813. Source: National Archives (136 pp.).
- Vol. 8 (1961) Letters from the Secretary of War, 1812-1813. Source: National Archives (245 pp.).
- Vol. 9 (1961) Fort Fayette Freight Book 1812-1813. Source: John E. Reynolds Collection, Allegheny College, Meadville, Pennsylvania (Fort Fayette was located at Pittsburgh; 81 pp.).
- Vol. 10:1 (1962) Western Reserve Historical Society War of 1812 Collection. Source: Western Reserve Historical Society, Cleveland (246 pp.).
- Vol. 10:2 (1962) Western Reserve Historical Society War of 1812 Collection. Source: Western Reserve Historical Society, Cleveland (231 pp.).
- Index and Finding List (1962) (160 pp.).

The following extracts relate to the production and acquisition of gunpowder during the war:

- 1959a Letter dated January 8, 1812, from James Morrison (Lexington, Kentucky) to William Eustis, U.S. Secretary of War. Morrison notes that he has tested the gunpowder samples given to him by Mr. Fenwick of the War Dept., and that the local powder makers stated they would make powder of equal proof. Morrison has no doubts as to their ability, but observes that since few of the powder makers have capital, an advance equal to the cost of the necessary saltpeter would be advisable (Volume 6, Part 1, pg. 8).
- 1959b Letter dated January 25, 1812, from James Taylor (Frankfort, Kentucky) to William Eustis, U.S. Secretary of War. Taylor informs Eustis that he has made a contract for a thousand pounds of glazed powder of 15 degrees proof with J & D Maccoun "to be delivered at New Port in Keggs & Coverd with tow cloth..." He suggests that damaged powder now in the Newport magazine might be reworked to make good powder again. J & D Maccoun have made good on a previous contract by providing 100 lbs. of gunpowder that had been shorted (Volume 6, Part 1, pg. 30).
- 1959c Letter dated March 4, 1812, from Morrison (Lexington, Kentucky) to Eustis concerning proposed purchase of "certain Munitions of War" including 1,000,000 pounds of niter and 500 tons of lead. Morrison states "I know of no place where these articles can be procured within the U States, save in this section of country." Henry Clay is to make a contract in Morrison's name to Eustis for above articles, niter to be delivered at Philadelphia or Baltimore and the lead to New Orleans (Volume



- 6., Part 1, pg. 71).
- 1959d 6(1). Letter dated March 15, 1812, from Morrison (Lexington, Kentucky) to Eustis, Morrison, having received \$15,000 from the War Dept. against drafts he had made for military supplies, thanks Eustis, noting that he still remains overextended. "...for God sake don't cramp my arrangements - either send forward drafts on the Cashier of the Kentucky Bank, or I will draw on you for what I suppose the public will ultimately owe me. If I am importunate on this subject I hope Sir, you will pardon me, for I assure you that at this time I have only \$3000 in the hands of my Agents the Messrs. Gratz's and am under acceptances to the amount of \$24,000" (Volume 6, Part 1, pg. 95).
- 1959e Letter dated March 23, 1812, from Morrison (Lexington, Kentucky) to Eustis, Morrison directed by Eustis to send samples of gunpowder to Capt. Swan at New Orleans, notes his intention to send 1000 lbs made "by one of our best manufacturers" to Swan for approval; reports that good quality powder can be had in Kentucky at a cost of 45 cents/lb, transportation to be added (Volume 6, Part 1, pg. 103).
- 1959f Letter dated April 12, 1812, from Morrison (Lexington, Kentucky) to Eustis. Morrison reports powder samples, which he received last evening from the powder mill, in transit to Eustis, representative of that available in Kentucky. The cost of powder has risen to 48 cents/lb, due to an increase in the price of saltpeter to 27 to 30 cents/lb. He is "...satisfied the Government have never had a quantity of powder from Dupont Nemours & Co, - or from any other house equal to these samples." Morrison intends to have 20,000 lbs of Lexington gunpowder made for the War Dept, provided he receives money advances as needed (Volume 6, Part 1, pg. 128).
- 1959g Letter dated May 8, 1812, from General William Hull (Cincinnati, Ohio) to Eustis. Hull reports there is not enough gunpowder at the Cincinnati arsenal to make more than 20,000 cartridges: "I have this morning directed the military agent to send an express to Lexington, with orders to purchase three thousand pounds, and have it sent here immediately" (Volume 6, Part 1, pg. 190)
- 1959h Letter dated May 13, 1812, from Morrison (Lexington, Kentucky) to Eustis acknowledging a recent letter from Eustis, Morrison will engage to have 50,000 lbs. gunpowder made at Lexington for 50 cents/lb. The powder will be delivered to the Newport Arsenal or to Shippingport [near Louisville]. In order to obtain superior powder, he has been required to give 5-1/2 cents more per pound than has been customary in Lexington. He notes that he has proved samples of all the powdermakers with an *eprouvette* and thus "cannot be deceived" as to quality. Morrison urges Eustis to send a cash advance, "because Nitre and Sulphur are both cash articles - the former has advanced three cents in value per lb since my last letter..." (Volume 6, Part 1, pg. 209).
- 1959i Letter dated May 16, 1812, from James Taylor (Newport) to Eustis. Taylor has been directed by General Hull to purchase 2,000 pounds additional gunpowder for this post (Volume 6, Part 1, pg. 218).
- 1959j Letter dated May 17, 1812, from Morrison (Lexington, Kentucky) to Eustis. Morrison reports insufficient sulfur at Lexington to make 50,000 pounds gunpowder, has ordered 6,000 pounds from Gratz of Philadelphia (Volume 6, Part 1, pg. 224).
- 1959k Letter dated May 24, 1812, from Taylor (Newport) to Eustis. Taylor reports he has received 838 lbs. gunpowder from J & D Maccoun; notes receipt of the 2,000 lbs. referred to in his 16 May letter and also of the 1,000 lbs. mentioned in his 25 January letter. General Hull, he writes, upon departing for Dayton, Ohio, made a requisition for three tons gunpowder rather than one ton, and so Taylor requests approval from Eustis. The troops at Newport are engaged in making up cartridges from the powder, and he is having a second ammunition wagon readied. In a postscript, Taylor notes he "thought it best to direct the two additional tons to be made as soon as possible" (Volume 6, Part 1, pg. 236).
- 1959l Letter dated May 29, 1812, from Morrison (Lexington, Kentucky) to Eustis. Morrison acknowledges Eustis' directive ordering 4,000 lbs. gunpowder to Newport (Volume 6, Part 1, pg. 243).
- 1959m Letter dated June 24, 1812, from James Taylor ("Camp Necessity," Ohio) to Eustis. Taylor reports that Hull had informed him that he had made a mistake, requesting three tons of gunpowder when he meant 3,000 lbs. Accordingly, Taylor wrote to J & D Maccoun to delay the manufacture of this quantity, though expecting it will be soon needed; "I can assure you that the last Powder this Company furnished is of the *first quality* [original emphasis]." War with Great Britain had been declared on June 18 (Volume 6, Part 2, pg. 56).
- 1959n Letter dated July 19, 1812, from Richard M. Johnson (Great Crossing, Kentucky) to Eustis. Samuel Trotter, Lexington merchant and powdermaker, "has the means from his arrangements of procuring more salt petre than any individual perhaps in the state ...he is in the habit of supplying the people of Kentucky Ohio and

- Pittsburg with great quantities of powder.” According to Johnson, the government should encourage powder making in Kentucky as it would soon become a staple manufacture. Johnson was a future Vice President of the United States (Volume 6, Part 2, pg. 111).
- 1959o Letter dated August 8, 1812, from Robert Scott (Lexington, Kentucky) writing for Morrison to Eustis. Morrison acknowledges order to deliver 50 barrels cannon powder and 10 barrels musket powder to Thomas Buford, Deputy Commissary, and thanks Eustis for a Treasurer’s check on the Bank of Kentucky for \$20,000, requesting an additional like sum to meet his current contract engagements (Volume 6, Part 3, pg. 18).
- 1959p Letter dated August 23, 1812 from R. M. Johnson (Blue Spring, Kentucky) to Eustis. Johnson reports that he has received two “tin cylinders” of gunpowder from Samuel Trotter of Lexington, “I suppose, in consequence of my letter to you.... But as yet have recd. no letter & of course I do not know what determination you have performed.” The Trotter firm was in fact awarded two substantial government contracts for gunpowder; see National Archives (Volume 6, Part 3, pg. 55).
- 1959q Letter from R. M. Johnson (Blue Spring, Kentucky) to Eustis. “I have just recd. your favour respecting the encouragement you are willing to give to the making powder in this neighbourhood – for which I thank you. The proposals will be sent on” (Volume 6, Part 3, pg. 56)
- 1959r Letter dated August 25, 1812, from I. Van Horn (Zanesville, Ohio) to Eustis. Van Horn reports having received numerous dispatches within the last 36 hours from various outposts in the region, regarding the surrender of General Hull and his army and urgently requesting arms and ammunition. Van Horn yesterday dispatched \$600 to Lancaster, Marietta, and Wheeling to purchase powder and lead, to be sent on to Pittsburgh if supplies not available in those places: “It is remarkable that no powder is to be purchased at this place or any where West or North” (Volume 6, Part 3, pg. 69).
- 1959s Letter dated August 30, 1812, from Lt. James W. Bryson (Newport) to Eustis. Bryson acknowledges order to make up 150,000 cartridges, reporting that 25,000 had already been issued to troops in transit through Newport, now expecting a detachment of 2,500 men from Kentucky. He encloses an invoice for supplies, including 400 cartridge boxes, 5,300 lbs. gunpowder “in good order,” 2,500 lbs. damaged powder, and 145 dozen “Ball & Buck Shot cartridges” (Volume 6, Part 3, pg. 89).
- 1959t Letter dated September 2, 1812, from Morrison (Lexington, Kentucky) to Eustis. Morrison discusses at length the financial difficulties existing in Kentucky, noting that the Bank of Kentucky yesterday refused to honor the Treasurer’s draft to him for \$20,000. According to Morrison, the problem is a lack of specie (hard coin) in the western country: “Without specia and that in advance, I find it impossible to get powder, and from appearances the article will be in demand” (Volume 6, Part 3, pg. 99).
- 1959u Letter dated September 16, 1812, from Major Amos Stoddard (Pittsburgh, Pennsylvania) to Eustis. Stoddard, recently arrived at Pittsburgh, will soon send supply wagons, including 30,000 musket cartridges in their loads, to General Wadsworth at Cleveland. He will endeavor to have made 150,000-200,000 more cartridges, noting that a large number of men will be needed for this. “Some of the Volunteer Rifle Companies,” he writes, “have applied for Rifle Powder [original emphasis]; they decline the use of musket powder.” Stoddard has directed Lt. Johnson to purchase 1,000-1,200 pounds of rifle powder; “...it is not only required by the men on the route, but is deemed necessary for the Riflemen on the frontiers” (Volume 6, Part 3, pg. 159).
- 1959v Letter dated September 24, 1812, from Stoddard (Pittsburgh, Pennsylvania) to Eustis. Stoddard reports that most of the 100 barrels of powder he is just now receiving has been requested by Generals Harrison and Wadsworth and will be immediately sent to them. Since this will leave him very short of powder for the artillery necessary to defend the fort, he requests an immediate shipment of 10,000 pounds to Pittsburgh (Volume 6, Part 3, pg. 190).
- 1959w Letter dated September 27, 1812, from Morrison (Lexington, Kentucky) to Eustis. Morrison is engaged in the process of shipping 6,000 lbs. Lexington-made powder to Newport according to Eustis’ order, having already sent most of it. He notes that he has sent receipts for 10,445 lbs. powder delivered to Newport, amounting to \$5,263.25; powder is now selling at 55 cents/lb. in Lexington. Morrison has sent 1,000 lbs. gunpowder to Shippingport, in case it is needed in the Indiana or Illinois territories. In a postscript, Morrison notes he has just been informed that Maccoun has made a contract to deliver powder to Louisville for 60 cents/lb (Volume 6, Part 3, pg. 200).
- 1959x Letter dated September 30, 1812, from Stoddard (Pittsburgh, Pennsylvania) to Eustis. Stoddard reports that “the making of tubes, fuses for



- shells, slow match, and Cartridges, is the more difficult for the want of the proper tools." There is still an urgent need for powder at the fort, only 3-4,000 lbs. are expected from "Frederick town." He notes again the whole of the 100 barrels ordered from Philadelphia is needed in the northwest, and "should think it imprudent" to send 50 barrels to New Orleans, at least until sufficient powder has been sent to Pittsburgh (Volume 6, Part 3, pg. 209).
- 1959y Letter dated October 8, 1812, from Morrison (Lexington, Kentucky) to Eustis. Morrison thanks Eustis for his commission as Lt. Col. of Volunteers and appointment as Deputy Quartermaster General with General William Henry Harrison's army of the northwest (Volume 6, Part 4, pg. 8).
- 1959z Letter dated October 28, 1812, from Morrison (Lexington, Kentucky) to Eustis. Morrison discusses arrangements for supply transport, and notes the poor quality of cartridge boxes sent to Harrison that do not protect from dampness. The 100 barrels of powder ordered to be made at Lexington for shipment to New Orleans are ready to be sent (Volume 6, Part 4, pg. 73).
- 1959aa Letter dated October 31, 1812, from Morrison (Newport) to Eustis. Morrison reports that lack of suitable transport has allowed only part of the supplies ordered to be sent to Natchez. On 27 October, 60 barrels gunpowder, along with muskets, bayonets and cannon balls, were sent on toward New Orleans. The rest of the cannon balls are to be sent as soon as more powder arrives. The low state of the river hinders shipping (Volume 6, Part 4, pg. 77).
- 1959bb Letter dated November 6, 1812, from Lt. H. Johnson (Fort Fayette, Pittsburgh) to Eustis. Johnson reports that "five waggoners have been here several days with an hundred & fifty three Barrels of Navy powder & could find no one authorized to receive it." The wagoneers were on the point of selling the powder to the highest bidder when Johnson intervened, paid the transportation and placed the powder in storage: "Be pleased to tell me what I should do with it?" (Volume 6, Part 4, pg. 91).
- 1959cc Letter dated December 24, 1812, from Morrison (Franklinton, Ohio) to Henry Clay (Lexington, Kentucky). Morrison describes the difficulties that have beset Harrison's army but remains optimistic. He complains bitterly about the failure of the government to support the army financially; referring to Eustis, he observes: "The expense of this army will exceed all your calculations and treble that of the Secretary of War - I believe I would speak more correctly were I to say thousands where he has only thought of hundreds..." The \$400,000 sent out to Kentucky and Cincinnati "is but a drop in the Bucket": in his opinion, at least \$1,000,000 is needed to supply the army during the winter (Volume 6, Part 4, pg. 146).
- 1961a Letter dated June 13, 1813, from Morrison (Lexington, Kentucky) to Secretary of War John Armstrong. Morrison refers to his order dated April 12, 1812, to supply 50,000 lbs. gunpowder to the War Dept., noting that he had delivered 10,445 lbs. prior to his appointment as Deputy Quartermaster. At that time he transferred the arrangements to J & D Maccoun for completion of the order, which they since fulfilled plus an additional 3,000 pounds for which they have not been compensated. When he receives a receipt from them he will forward it to the War Dept. Morrison wishes to know if he still has authority to furnish supplies of gunpowder, and, if so, what price per pound is allowed and what quantity will be needed (Volume 7, Part 2, pg. 34).
- 1961b Letter dated September 11, 1813, from Morrison (Lexington, Kentucky) to Armstrong. By comparing accounts, Morrison has discovered that there were 59 kegs of gunpowder delivered to Newport by J&D Maccoun for which they were not paid. He has drawn upon the War Dept. the sum of \$3,191.62 for satisfaction of this account, which he requests Armstrong to honor (Volume 7, Part 3, pg. 74).
- 1961c Letter dated September 19, 1812, from Eustis to Amos Stoddard (Pittsburgh). The Secretary of War informs Stoddard that cannon and musket powder have been ordered to be sent to him from Philadelphia and Frederick town (Volume 8, pg. 90).
- 1962a Letter dated September 2, 1812, from J. R. Hannon and John McDanagh (Warren, Ohio) to General Elijah Wadsworth, pg. 70. An offer is made to sell to the government powder, lead, and flour purchased by the citizens of the town of Beaver, stored at Warren, originally intended for a corps of volunteers. The powder can be had for 87-1/2 cents/lb. (Volume 10, Part 1, pg. 70).
- 1962b Letter dated February 1, 1813, from General John S. Gano (Cincinnati, Ohio) to Lt. James W. Brysen (Newport). Gano directs Bryson to furnish Quartermaster Thomas Thompson materials and instructions to make up 20,000 cartridges in Cincinnati, to be packed in tight kegs (Volume 10, Part 1, pg. 177).
- 1962c Letter dated September 22, 1812, from Jeremiah Brooks (Warren, Ohio) to "Gen Woodworth" [Wadsworth]. See above letter of September 2, 1812, [1962a]. Brooks wishes to purchase hides from the army, and offers in payment "flower by the barrel," "lead by the bar," and



"powder by the kegg," the latter at 87-1/2 cents/lb. (Volume 10, Part 2, pg. 134).

**National Archives, Washington, DC.** The National Archives contain many important primary documents relating to commerce and military affairs, spheres in which the production and shipment of articles such as saltpeter and gunpowder are significant. The documents presented below as examples of the material available in the Archives were extracted from two sources: Ordnance Department correspondence related to the era of the War of 1812, and the manufacturer's census of 1820. Although these specific examples focus upon the early 19<sup>th</sup> century and the Ohio Valley region, the Archives naturally encompass a far broader range for the interested researcher. The items below were collected by Marion O. Smith and transcribed by Angelo I. George.

Contract Dated April 5, 1813. Contract with S & G Trotter of Lexington, Kentucky. Record Group 156, Entry 78, Contracts for Ordnance and Ordnance Supplies, Vol. 1, 1813-1828, pp. 1-2. Contract for 70,000 pounds of "good and approved Cannon, musket & Rifle powder" for which they will receive 55 cents per pound. The powder is to be packed within barrels containing 100 pounds and delivered within twelve months to designated locations. To Pittsburg is to be sent 50 barrels of cannon, 150 of musket, and 50 of rifle powder; to Newport (KY) go 70 barrels of musket and 80 of rifle powder; and to New Albany (IN) are to be shipped 150 barrels of cannon, 40 of musket, and two of rifle powder. A second contract for 70,000 pounds gunpowder with the Trotter firm was executed on 2 April 1814 (*ibid.*:9-10) and, on the same date, a contract for 60,000 with Morrison, Taylor & Co. of Lexington and Winchester, Kentucky (*ibid.*:8-9).

1820 United States Census of Manufacturers. The census provides information about the establishments and operations of powder mills, but responses vary widely as to the amount of detail. The earlier census of 1810 was the basis for the 1812 Coxe compilation (which see, this bibliography) but reportedly exists today only in fragmentary condition at the Archives. From the phrasing of answers, the census evidently asked the following questions:

1. What are the raw materials used in manufacture?
2. What is the quantity of product manufactured?
3. What is the cost of raw materials?
4. What is the number of persons employed?
- 5 & 6. These questions apparently refer to the number of slave workers; men, women and children.
- 7 & 8. These questions refer to the machinery or equipment used in production.

9. What is the value of the capital investment in buildings and equipment?
10. What is the total amount of annual wages paid to workers?
11. What is the annual total amount of contingent expenses?
12. What is the nature and names of articles produced?
13. What are the selling prices for articles produced?
14. General remarks.

For Kentucky, 11 manufacturers of gunpowder and one saltpeter maker responded to the census. The powder mills reported production ranging from 500 to as much as 140,000 pounds annually, some employed only two or three persons whereas the larger establishments, such as that of Samuel Trotter or Spencer Cooper, ten or more persons. Responses indicated that powdermills continued to use wooden pestles for incorporating ingredients, with smaller firms having a single pestle building with as few as five pestles, larger firms having several pestle houses in which 20 to 40 pestles were operated by animal or water power. The responses to "General Remarks" provide significant insights into the condition of the market for Kentucky gunpowder. Many manufacturers complained about competition from foreign (English) gunpowder, stating that their mills had capacity to produce far more than they were presently able to sell. A Garrard County powderman succinctly stated the situation: "present Demand Dull." A Hart county respondent noted "This establishment is on the decline at this time," further reporting that "There are three Powder Mills standing idle and two that has been blown up and saw mill all out of repair and going to Destruction." The saltpeter maker, in odd contrast, reported from Hart County that his business was in "a flourishing situation," the demand for his production being "Tolerable good." He employed six men and a boy at "One Saltpeter Cave and Saltpeter making establishment."

Civil War. Applicable records of interest are to be found in Record Group 109 entitled "Confederate Papers Relating to Citizens or Business Firms" and "Confederate Mining and Nitre Papers." Extracts are cited in Powers (1981). These documents contain important information on Confederate niter production and the organization and operation of the CSA Nitre and Mining Bureau. See also "Confederate Papers Relating to Citizens or Business Firms" on Microfilm Copy 346 - Rolls 128, 194, 330, 390, 438, 926, 971, and likely others.

Newspaper advertisements and notices are important primary sources of information about the marketing of saltpeter and gunpowder, as well as furnishing the names

and, often, some detail concerning persons and firms involved in the trade. The purpose of such advertisements differed according to the article, in that gunpowder was offered for sale but supplies of saltpeter were usually solicited for purchase. The majority of advertisements were placed during the period just prior to and during the era of the War of 1812. After 1815, notices were seldom concerning domestic saltpeter because the nitrate mining industry collapsed after the war with the importation of saltpeter from abroad at a cost far less than the domestic product could be obtained. The availability of cheap foreign gunpowder of good quality also devastated American manufacturers; most of the gunpowder producers who had become established during the war period did not survive the economic depression that followed. Only the largest and most efficient survived, such as the Trotter firm in Kentucky or E. I. du Pont in Delaware, and so we see a scattering of advertisements for domestic gunpowder up to the time of the Civil War.

The following selection of advertisements originally appeared in regional newspapers in and near Kentucky. A close examination of newspapers elsewhere in the eastern U. S. during the 18<sup>th</sup> and 19<sup>th</sup> centuries should reveal similar information about local firms involved in production. These advertisements were collected by Angelo I. George, Marion O. Smith, and Gary A. O'Dell.

*Kentucky Gazette* (hereafter KG) May 11, 1793. Richard Foley's ad offering gunpowder for sale at his mill at South Elkhorn near Lexington is evidence for the first commercial powder mill to operate in Kentucky. His gunpowder was priced at 3 shillings 9 pence per pound, "with an allowance to those who purchase a large quantity."

KG May 10, 1803. William Berry announces that he is erecting a powder mill near Lexington and will give "Cash for Salt Petre."

KG February 21, 1804. Deceased Richard Foley's son John is now operating the Foley mill at South Elkhorn, offering powder for two shillings per pound when purchased in quantities of 25 pounds or more.

KG November 13, 1804. Brown, Hart & Co. wish to hire 15 or 20 black workers, "to be employed at their Salt Petre works in Madison county [Great Saltpeter Cave in present Rockcastle County, Kentucky]."

KG and *American Statesman* (hereafter AS), various dates 1809-1813. Advertisements by several parties wishing to purchase saltpeter, but most placed by Charles Wilkins (Lexington merchant and saltpeter broker for E. I. du Pont)

and the firm of S & G Trotter, offering "the highest price, in cash."

AS December 12, 1812. A saltpeter cave is offered for sale, at "one half its value."

KG December 15, 1812. Notice of estate sale for the late Thomas Turnham of Woodford County, Kentucky, "who lost his life by the blowing up of [his] powder mill."

*Louisville Public Advertiser* (hereafter LPA) November 3, 1819. Notice by E. I. du Pont warning of "inferior Gun Powder of other manufactories...offered for sale as ours, even sometimes in kegs branded DUPONT..." This ad was placed simultaneously in newspapers throughout the Midwest region.

LPA June 17, 1820. Bentley & LeGrand offer for sale gunpowder from two Lexington mills in "kegs and half kegs, pound and half pound canisters."

KG December 21, 1820. Report of explosion at Eagle Mills near Lexington, which took the life of the "superintendent of the pestle room."

LPA September 18, 1824. Fitzhugh & M'Donald offer 20,000 pounds "crude saltpeter" to "powder makers."

LPA October 1, 1825. Ad for the Phoenix Powder Works, on Corn Island near Louisville. Powder is offered for sale in kegs of 25 lbs., 12-1/2 lbs., and 6-1/4 lbs. weight.

LPA December 28, 1825. Two firms, Buchanan & Starkey and Wilson & Chambers, offer for sale 150 lb. and 250 lb. bags, respectively, of saltpeter "...just received from New-Orleans"; an indication of importation of foreign niter.

LPA December 31, 1825. At Brooking & Co's Powder Works in Hart County, Kentucky, "...this manufactory is under the superintendence of the subscriber, whose attention is almost exclusively confined to the interest of the establishment, which possess [sic] a great abundance of water power, and from the favorable construction of the factory...will enable the concern to make gunpowder cheaper than any other establishment west of the mountains."

LPA December 27, 1826. Brooking again advertises gunpowder, "for the rifle, shot gun, or cannon of the most powerful kind." This lengthy ad provides valuable information about his operation, powered by a large spring of water "with upwards of fifty feet fall allows the application of power at detached rooms, so as to prevent exposure of the workman to the danger of an explosion of a large parcel of powder at once..."



*Lexington Observer-Reporter* June 3, 1835. Report of the explosion of the Cooper Powder Mill near Lexington, in which a black slave worker was killed: "Mr. Cooper...had given positive orders to all the hands employed about his works, never to enter the mortar room without first stopping the pestles, but unfortunately they were not in this instance strictly obeyed."

**Southern Historical Society Papers.** Published in Richmond, Virginia, at typically irregular intervals from 1876-1959, the 52 volumes of the Southern Historical Society Papers provide critical insights into the Confederacy's war efforts and represent an invaluable supplement to the resources published in the War of the Rebellion series devoted to Union and Confederate Army and Navy records (see below). Aside from the articles and memoirs appearing in the early issues of the Papers, the later volumes 44-52 (1923-1959) of this serial were devoted to chronicling the day by day proceedings of both houses of the Confederate Congress throughout the Civil War. The following extracts (arranged chronologically) from this series relate to the evolution, establishment, and operations of the Nitre and Mining Bureau, an agency crucial to the production of saltpetre and gunpowder within a nation hard pressed to supply war matériel.

Volume 44 [1923; Douglas S. Freeman, George L. Christian, and H. R. McIlwaine, editors]

- Wednesday, March 12, 1862 (page 151)

"Mr. Conrad, of Alabama, introduced a bill to encourage the manufacture of saltpetre and small arms."

- Wednesday, March 12, 1862 (page 155)

Amendment proposed by Mr. Chilton of the CSA Congress to a bill on military exemptions then before that body: "That the Secretary of War be empowered to detach from military service persons necessary to... the manufacture of arms, saltpetre, and munitions of war, so long as they shall be actually employed."

- Wednesday, March 19, 1862 (page 188)

"Mr. Pugh reported from the Committee on Military Affairs a bill encouraging the manufacture of saltpetre and small arms. Passed."

- Thursday, March 20, 1862 (page 190)

"Mr. Miles, from the Committee on Military Affairs, reported a bill in accordance with a recommendation of the Secretary of War. A bill to organize a corps of officers for inspecting nitre caves and establishing nitre beds. Passed."

Volume 45 [1925; Douglas S. Freeman, Col. William H. Palmer, and H. R. McIlwaine, editors]

- Thursday, April 3, 1862 (page 69)

"Mr. Sparrow, from the same committee [Committee on Military Affairs] also reported back House bill to encourage the manufacture of saltpetre and small arms,

with an amendment."

- Wednesday, April 9, 1862 (page 106)

"Mr. Sparrow, Chairman of the Military Committee, reported back to the House bill to encourage the manufacture of saltpetre and small arms."

- Friday, April 11, 1862 (page 117)

"The House bill encouraging the manufacture of saltpetre and small arms was taken up, amended, and passed."

- Tuesday, April 15, 1862 (page 133)

"Mr. Conrad, from the Committee on Naval Affairs, reported back a House bill which had been amended by the Senate, entitled 'An act to encourage the manufacture of saltpetre and small arms.' The committee recommended that the amendment of the Senate be concurred in by the House, which was agreed to, and the bill was passed."

- Saturday, April 19, 1862 (pages 159-160)

"The bill relating to the manufacture of saltpetre and small arms... was referred to the Military Committee."

Volume 48 [1941; Douglas Southall Freeman, editor]

- Monday, March 9, 1863 (page 273)

"Mr. Boteler, of Virginia, moved a suspension of the rules to enable him to report an important bill from the Committee on Ordnance and Ordnance Stores.

"Mr. Conrad, of Louisiana, demanded the yeas and nays, which were called, and the motion was agreed to - yeas 55, nays 11.

"Mr. Boteler, then reported a bill a bill to establish a Nitre and Mining Bureau, which was laid upon the table and ordered to be printed."

Volume 49 [1943; Douglas Southall Freeman, editor]

- Thursday, March 26, 1863 (page 35)

Bill to establish the Nitre and Mining Bureau passed by the CSA House of Representatives.

- Monday, April 13, 1863 (page 132)

Mr. Sparrow of the Military Committee of the CSA Senate recommended the passage of the bill establishing the Nitre and Mining Bureau.

- Thursday, April 16, 1863 (pages 151-151)

The following bill was taken and passed by the CSA Senate:

"A Bill to be Entitled an Act to Establish a Nitre and Mining Bureau

Section 1. *The Congress of the Confederate States of America do enact*, that the officers authorized and appointed under the act entitled "An Act for the organization of a corps of officers for the working of Nitre Caves," etc., passed April 11<sup>th</sup>, 1862, together with such additional officers as are authorized by the provisions of this act, shall constitute an independent bureau of the War Department, to be entitled "the Nitre and mining Bureau."

Sec. 2. *Be it further enacted*, That said bureau shall have charge of all the duties prescribed in the second section of



said act, and shall besides be charges with all duties and expenditures connected with the mining of iron, copper, lead, coal, *etc.*, so far as it shall be deemed necessary to supply the military necessities of the country, and the superintendent thereof shall, under the Secretary of War, have full power to make such leases of real estate and purchases of fixtures as are necessary or pertinent to any mines it may be deemed expedient to open or work on Government account; and may also contract, subject to the approval of the Secretary of War, for such supplies by purchase or otherwise of all copper, iron, coal, zinc and other minerals as may be required for the prosecution of the war.

Sec. 3. *Be it further enacted*, that said bureau shall consist of one lieutenant colonel as superintendent, three majors as assistant superintendents, six captains and ten lieutenants, in which shall be included the officers of the present Nitre corps, who shall have the same pay and allowances prescribed for officers of cavalry of the same grades.”

- Wednesday, April 29, 1863 (page 254)

“Mr. Wigfall, of Texas., by leave, introduced a bill to authorize the President to appoint officers in the Nitre Bureau and Engineers Troops during the recess of Congress, to be confirmed by the Senate at the next session of Congress, which was taken up.”

- Friday, May 1, 1863 (page 273)

“A Senate bill, authorizing the President to appoint officers in the Nitre Bureau during the recess of the Senate was approved.”

Volume 50 [1953; Frank E. Vandiver, editor]

- Monday, December 7, 1863 (page 2-3)

“Mr. Clark, of Missouri, offered the following, which was read and referred to the Committee on Military Affairs: An act to amend the several acts now in force exempting certain persons from military duty and for other purposes.” Among other occupations such as ministers, apothecaries, and professors of theology, this proposed act exempted “all persons employed by any State in manufacturing iron, coal, saltpetre, salt, or munitions of war of any kind.”

-Thursday, January 14, 1864 (page 236)

Appropriation bill before the CSA Congress allocated, among other proposed expenditures, \$9,500,000 for the Nitre and Mining Bureau.

Volume 51 [1958; Frank E. Vandiver, editor]

- Tuesday, May 24, 1864 (page 135)

In the CSA House of Representatives, “Mr. Chambers, of Miss., introduced a bill to amend the act establishing the nitre and mining bureau. Referred to the Military Committee.”

- Saturday, June 4, 1864 (page 188)

CSA Senate passed a bill to amend the act establishing the Nitre and Mining Bureau.

Volume 52 [1959; Frank E. Vandiver, editor]

- Monday, February 20, 1865 (page 375)

Bill passed by CSA Congress required, among other provisions, that: “It shall be the duty of all officers and others employed in the service of the Confederate States, and not actually in the field nor attached to any army in the field, including [the] nitre and mining and medical bureaux... to make certified monthly returns to the nearest conscript officer of the names, ages and physical condition of all persons in their service...”

U. S. Forest Service. The unpublished files of the U. S. Forest Service office in Stanton, Kentucky, contain individual reports of archaeological investigations of several hundred sandstone rock-shelters in eastern Kentucky that were mined during the era of the War of 1812. Many of these natural shelters still contain extensive mining artifacts preserved from deterioration both by the overhanging cliff face and from impregnation with nitrate salts. These files are part of an ongoing methodical investigation of literally thousands of shelter sites in the Daniel Boone National Forest.

War of the Rebellion (Official Records) Series – Army

Records. Produced at an original cost in excess of \$2,500,000 between 1880-1901, this massive undertaking (in excess of 110,000 pages) represents the single most readily accessible source of invaluable primary documentation concerning the actions of both the Union and Confederate armies in the Civil War. This compendium is organized into the following four series:

<u>Series</u>	<u>Vols.</u>	<u>Parts</u>	<u>Contents</u>
I	53	111	Union and Confederate Battle Reports
II	8	8	Prisoner of War and State Records
III	5	5	Union Non-battle Reports
IV	3	3	Confederate Non-battle Reports
--	<u>1</u>	<u>3</u>	Index
	70	130 parts	

The following items represent an extended sampling of the information relating to sulfur, niter and niter mining, gunpowder production, and the Union blockade contained therein. These materials have been chronologically indexed by general topic in **Table 2**.

Secretary of War

1880-1901 *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies* (128 volumes in 4 series + 2 volume index). Government Printing Office, Washington.

1881 Letter dated August 26, 1861, from CSA Maj. Gen. Leonidas Polk to Gen. Hardee observing “If the

TABLE 2. INDEX TO NITER, SULFUR, AND GUNPOWDER REFERENCES FROM OFFICIAL ARMY RECORDS (ORGANIZED BY TOPIC AND YEAR).

<u>Topic/Location</u>	<u>1861</u>	<u>1862</u>	<u>1863</u>	<u>1864</u>	<u>1865-1866</u>
<u>Niter mining/ powder making</u>					
Alabama	1900g	1884d	1889c	1891a-c; 1891q-s; 1892a-b	1897c-e
Arkansas	1881; 1882a-b; 1898d; 1900i	1883b; 1885a-c; 1898i	1887	1891h; 1891j-k	---
Georgia	---	---	1890j	1891m-p	---
Missouri	---	1883a	---	1891i	---
North Carolina	---	---	---	---	1897a-b
South Carolina	---	---	---	---	1895b-c
Tennessee	1898a-c	1884a-b; 1886b-c; 1898e	1889a-b; 1890i	---	---
Texas	---	---	1888	---	1896a-c
Virginia	---	1884c	1889d; 1890d	---	---
West Virginia	---	---	18890c; 1890e; 1890g-h	1891d-g	1894
<u>Niter (general)</u>	1900j	1899a-b; 1900m-s	1890f; 1890k	1900v	1895a; 1897f
<u>Gunpowder (general)</u>					
Confederate States	1900h	1900k-l	1890b	1900w	1900x
United States	---	---	---	1900a-c	1900d-e
<u>Larger Powder Mills</u>					
du Pont (Delaware)	1897h-j	---	1899d	---	---
Hazard (Connecticut)	1900f	---	---	---	---
Augusta (Georgia)	---	---	1898h; 1900t-u	1893	1895d; 1897g
New Orleans (Louisiana)	1882f-o; 1882q-z; 1882aa-bb; 1882kk	1882d-e; 1882p; 1882cc-jj	1882c	---	---
<u>Blockade</u>					
South Carolina	---	1898f-g	---	---	---
Texas	---	1883c; 1886a; 1899c	---	---	---
General	---	1890a	---	1891l	---

working of the saltpeter mines on White River [Arkansas] was not an object of the greatest consequence to us, I should repeat the advice given in my dispatch by Colonel Borland to abandon your line altogether. ... They are our chief dependence for the material for making powder, and they should be protected by an adequate force somewhere in the neighborhood." (Series I, Volume III, pp. 682-683).  
1882a Letter dated October 17, 1861, from CSA Maj. Gen. Leonidas Polk to Judah P. Benjamin, Acting Secretary of War, noting "We are greatly pressed by want of powder. Saltpeter, the article chiefly needed

for its manufacture, is now being delivered in increasing quantities from the mines in Arkansas, but the work does not go on as it might, nor will it until the Government makes a contract with parties of capital and character to furnish a supply of manufactured powder. I strongly urge the making of a contract for powder with a company, to be headed by Mr. Sam Tate, of Memphis. This company ... would go into the matter for the sake of the cause..." (Series I, Volume IV, pg. 455).  
1882b Letter dated October 28, 1861, from A. T. Bledsoe, CSA Chief of Bureau of War, to Maj. Gen.

- Leonidas Polk noting "In reply to your letter of the 17<sup>th</sup> instant the Secretary of War directs me to say that he thinks nothing could be gained by entering into a contract with Colonel Tate for the manufacture of powder. Three capitalists of Memphis have undertaken to get from the caves of Arkansas a large amount of saltpeter, and if this object be accomplished there is no fear as to the production of powder." (Series I, Volume IV, pg. 479).
- 1882c Testimony of CSA Major Gen. Mansfield Lovell on April 8, 1863, in the Proceedings of the Court of Inquiry upon the Fall of New Orleans noting (pg. 560) that "Obtaining sulphur and saltpeter wherever it could be found, I pressed to completion a large powder-mill, under charge of Messrs. Hobart & Foster, and soon commenced the manufacture of powder, which was submitted to the *épreuve* test before it was received" (Series I, Volume VI, pp., 559-564).
- 1882d Letter dated March 9, 1862, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Maj. Gen. Braxton Bragg reporting "Yesterday I sent 10,000 pounds of musket powder to Richmond, which leaves me none to make up [into cartridges], and I have no caps. The powder that came from Cuba is all inferior, and has to be reworked, but I can get no saltpeter, that which comes from Memphis has been sent to Augusta [Georgia], and if the raw materials are sent elsewhere, the requisitions must be made in the same direction. ...If you can push some saltpeter here I will try to help you..." (Series I, Volume VI, pp. 648-649).
- 1882e Letter dated April 12, 1862, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Secretary of War George W. Randolph reporting "With powder-mills that have an abundance of sulphur and charcoal and facilities for making 3,000 pounds of powder per day, saltpeter has been sent from Arkansas to Georgia, while Memphis and Corinth were making requisitions on me for powder. Not a pound of saltpeter has been sent here for three months" (Series I, Volume VI, 653-654).
- 1882f Letter dated September 12, 1861, from CSA Maj. Gen. D. E. Twiggs in New Orleans, Louisiana, to Secretary of War L. P. Walker noting "I hope to have in operation within two or three weeks a powder-mill, now erecting at the barracks. This is my only real dependence for powder, and yet its success hangs upon an uncertain promise of a supply of niter" (Series I, Volume VI, pp. 729-730).
- 1882g Letter dated September 22, 1861, from Thomas O. Moore of New Orleans, Louisiana, to Judah P. Benjamin, CSA Acting Secretary of War, remarking "I am anxious for saltpeter. I am alarmed to death for want of powder. Aid us in these materials, as we could fight but a short time with present supply" (Series I, Volume VI, pp. 741-742).
- 1882h Letter dated September 25, 1861, From CSA Secretary of War Judah P. Benjamin in Richmond, Virginia, to John Forsyth, mayor of Mobile, Alabama, stating "I have ordered 50 barrels of cannon powder sent from Nashville to Mobile, also 100 barrels to New Orleans, also 12 tons of saltpeter to New Orleans for immediate manufacture. Further supplies will be sent at the earliest possible moment" (Series I, Volume VI, pg. 744).
- 1882i Letter dated September 25, 1861, from Judah P. Benjamin, CSA Acting Secretary of War in Richmond, Virginia, to Gen. David E. Twiggs in New Orleans, Louisiana, noting "[I] Have ordered 10 more tons of saltpeter from Augusta [Georgia] to New Orleans, and 100 barrels of cannon powder from Nashville [Tennessee] to New Orleans and 50 to Mobile [Alabama]" (Series I, Volume VI, pg. 745).
- 1882j Letter dated September 26, 1861, from CSA Maj. Gen. David E. Twiggs in New Orleans, Louisiana, to Secretary of War noting simply: "We are ready to make powder at once if we get saltpeter" (Series I, Volume VI, pg. 746).
- 1882k Letter dated September 28, 1861, from A. T. Bledsoe, CSA Chief of Bureau of War in Richmond, Virginia, to Thomas O. Moore, governor of Louisiana in New Orleans, noting "In reply to your letter of the 22<sup>nd</sup> instant I am directed by the Secretary of War to say that 12 tons of saltpeter and 100 kegs of powder have been ordered to New Orleans in compliance with your request for those articles" (Series I, Volume VI, pg. 747).
- 1882l Letter dated September 29, 1861, from Thomas O. Moore, governor of Louisiana in New Orleans, to Judah P. Benjamin, CSA Secretary of War, noting "I am now waiting for the saltpeter, as I am informed the [powder] mill is ready, but everything by rail moves so slowly. ...The amount of powder here is very small compared to what is necessary..." (Series I, Volume VI, pg. 747-748).
- 1882m Letter dated October 18, 1861, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, Secretary of War, remarking "I am greatly in need of two things, viz, an assistant adjutant-general... and some saltpeter for the manufacture of powder. While the first would greatly facilitate matters here, it is not indispensable; the latter is" (Series I, Volume VI, pg. 753).
- 1882n Letter dated October 25, 1861, from CSA Maj.



- Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, Acting Secretary of War, reporting "I am hurrying into operation two [powder] mills which will give us 6,000 or 8,000 pounds per day if we can get saltpeter, and have sent an agent to contract for working some of the idle saltpeter caves in the adjoining States. Of sulphur and charcoal we have a supply. The want of powder is our only glaring deficiency. I do not allow an ounce to be burned unnecessarily, and am straining every nerve to add to our supply. If I can get saltpeter, and the enemy will give us a few weeks, which I think he will do, we shall be pretty well prepared to defeat him" (Series I, Volume VI, pp. 754-755).
- 1882o Letter dated October 29, 1861, from Judah P. Benjamin, CSA Acting Secretary of War, to Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, noting "I anxiously await your letter about the supply of powder and saltpeter. I cannot conceive what has become of the quantity recently sent to New Orleans, say within the last six weeks. I hope your demand for supply was based on erroneous information from persons who did not know the facts" (Series I, Volume VI, pg. 758).
- 1882p Letter dated October 31, 1861, from Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to President Jefferson Davis reporting "The works for the defense of this city are progressing rapidly, and I think in a couple of weeks we can defeat any force ...if we can provide ourselves with powder. I have now one mill in operation which will turn out 1,200 pounds per day, another which can make 1,500, and in two weeks hope to have a third in full blast which will make 3,000 or 3,500 pounds per day. I have your dispatch about saltpeter and am looking for it daily, but we ought to have to-day 50 tons of cannon powder on hand besides what we can make" (Series I, Volume VI, pp. 760-761).
- 1882q Message dated October 24, 1861, from CSA Maj. Gen. Mansfield Lovell in New Orleans forwarded by Gen. Albert S. Johnston in Bowling Green, Kentucky, to Judah P. Benjamin, Secretary of War, in which Gen. Lovell reports "There is an absolute, immediate necessity for powder or saltpeter for the defense of New Orleans, and the ordnance officer at Nashville reports 15 or 20 tons of saltpeter at each of the mills, and 20 tons on the way from Georgia; also 1,500 pounds of cannon powder on hand now..." (Series I, Volume VI, pg. 761).
- 1882r Letter dated November 1, 1861, from Judah P. Benjamin, CSA Acting Secretary of War, to Gen. Albert Sidney Johnston in Bowling Green, Kentucky, stating "Your dispatch received. Send nothing to General Lovell without orders from this Department. I have ordered 10 tons of saltpeter sent to him from Augusta [Georgia]" (Series I, Volume VI, pg. 762).
- 1882s Letter dated November 4, 1861, from Judah P. Benjamin, CSA Acting Secretary of War, to Gen. Mansfield Lovell in New Orleans, Louisiana, noting "I ordered 10 tons of saltpeter sent to you by express from the Augusta [Georgia] arsenal" (Series I, Volume VI, pg. 764).
- 1882t Letter dated November 8, 1861, from Thomas O. Moore, governor of Louisiana, to Judah P. Benjamin, CSA Secretary of War, noting "[Powder] Mill now ready. Can make 3,000 pounds of powder per day, but without an ounce of saltpeter. Cannot you send it from Memphis [Tennessee]?" (Series I, Volume VI, pg. 765).
- 1882u Letter dated November 8, 1861, from Judah P. Benjamin, CSA Acting Secretary of War, to Gov. Thomas O. Moore of Louisiana informing him that "It is impossible for me to comprehend what has become of the saltpeter sent to New Orleans. I have sent 24 tons, and cannot learn that one pound has been received or one pound of powder made. On September 26 [1861], 3 tons were sent by freight; on September 27 [1861], 1 ton was sent by express; on October 1 [1861], 3 tons were sent by express; on October 2 [1861], 7 tons were sent by express; on November 2 [1861] 10 tons were sent by express. All this was sent from Augusta [Georgia], and I cannot get the acknowledgment that one pound was ever received, and you now say you have not one ounce. This mystery must be explained before I can send any more" (Series I, Volume VI, pg. 765).
- 1882v Letter dated November 8, 1861, from Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, CSA Secretary of War, reporting "Governor Moore has just handed me your dispatch of today relative to saltpeter. The amount named therein (24 tons) will all have been received when the 10 tons now on their way from Augusta [Georgia] shall arrive. ...Every pound we have on hand is being made up into powder, but a good deal of it is so mixed with foreign matter that it does not give more than pound for pound of powder; but when all made up it will only make about 50,000 pounds..." (Series I, Volume VI, pp. 765-766).
- 1882w Letter dated November 17, 1861, from Judah P. Benjamin, CSA Secretary of War, to Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, remarking that "I ...am happy to learn that the saltpeter has been received in New Orleans. I beg your special attention to the manufacture, as from imperfect refining of the saltpeter, much of the

powder made at different points absorbs moisture so rapidly as quickly to become worthless. Our supply of powder and of material for its manufacture is so small, that it would be really a calamity to exhaust our material and find the powder valueless..." (Series I, Volume VI, pg. 767).

1882x Letter dated November 19, 1861, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, Secretary of War, reporting "We shall have in operation in a few days three powder mills, two of which are private property and one belong to the city. They will turn out more than 3 tons a day. The powder is proved; and rejected if much under range. We will want all the saltpeter that can be had, as we will be able to work up about 3 tons a day" (Series I, Volume VI, pp. 769-770).

1882y Letter dated December 5, 1861, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, Secretary of War, reporting "The two powder mills are in running order, one at the barracks and one at the old Marine Hospital. Major [George Washington] Rains came down last week, and after a full inspection reports that they can easily turn out 2 tons of powder per day, and I am making a contract with responsible parties here for 200 tons of saltpeter. Sulphur and charcoal we have in abundance. The new marine hospital is being fitted up at a small cost, one-half for a hospital and the other for a laboratory and store-rooms for munitions of war, implements, arms, &c. With a sufficiency of powder I should consider myself in a position to hold New Orleans for an indefinite length of time" (Series I, Volume VI, pp. 774-776).

1882z Letter dated December 23, 1861, from Judah P. Benjamin, CSA Secretary of War, to Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, remarking "Please inform me how the powder factory is getting on and what quantity of powder have you have. Major [George Washington] Rains tells me that the mills thus far are not making over 1,500 pounds a day, although capable of making twice that quantity" (Series I, Volume VI, pp. 785-786).

1882aa Letter dated December 27, 1861, from CSA Maj. Gen. Mansfield Lovell in New Orleans, to Judah P. Benjamin, Secretary of War, noting simply "I have made into good powder all the saltpeter sent. Can you spare any more?" (Series I, Volume VI, pg. 788).

1882bb Letter dated December 29, 1861, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Secretary of War J. P. Benjamin reporting that "At 12 o'clock last night Hobart &

Foster's powder-mill, in the old Marine Hospital, exploded. One charge of powder (4,000 pounds) was in the drying-room, and another of the same amount was in the cylinders, all of which was lost. I had taken out 4,000 pounds the same day. The mill was turning out this amount daily. The mill that I brought over from Handsborough will be put up in twenty days, and this, together with the city mill, will enable us to turn out 2,500 or 3,000 pounds daily. Hobart & Foster will proceed immediately to rebuild their mill, and I shall drive it through with all the means at my control, and hope to have it in operation again in six weeks. The total amount of saltpeter invoiced to this point since the middle of last September is 82,506 pounds gross, of which only 62,000 ever came to hand. The weight of the casks and sacks is to be deducted, besides which some of it was very impure. Hobart & Foster had three days' supply on hand at the time of the explosion (10,000 pounds), which was not injured" (Series I, Volume VI, pg. 790).

1882cc Letter dated January 1, 1862, from CSA Secretary of War Judah P. Benjamin, to Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, stating "Can give you no more saltpeter, but expect large supply very soon. Send me return of your entire stock of ammunition: (Series I, Volume VI, pg. 791).

1882dd Letter dated January 6, 1862, from Judah P. Benjamin, CSA Secretary of War, to Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, stating "I am sorry to hear of the destruction of the powder-mill, with its contents, as we have not a pound to spare. You will be good enough to send me at once a statement by which I can discover which of the saltpeter shipments have failed to reach you, as you seem to be short at least 20,000 pounds by your letter of the 29<sup>th</sup>" (Series I, Volume VI, pp. 796-797).

1882ee Letter dated January 15, 1862, from CSA Major Gen. Mansfield Lovell in New Orleans, Louisiana, to Secretary of War J. P. Benjamin reporting (pg. 808) that "When our large powder-mill blew up we got to work upon the machinery of the mill that I ordered to be removed from Handsborough, and yesterday a charge was put in. This mill turned out on its old site about 1,200 or 1,500 pounds per day" (Series I, Volume VI, pp. 807-808).

1882ff Letter dated January 20, 1862, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, Secretary of War, observing "Saltpeter in Europe is 10 cents per pound, here 40 cents..." (Series I, Volume VI, pg. 813).

1882gg Letter dated January 30, 1862, from Judah P.



- Benjamin, CSA Secretary of War, to Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, noting "...I sent you a dispatch in relation to the [vessel] *Tennessee*, and now repeat the authority to make the best bargain you can with the owners for sharing in this adventure, so that we may have half of the return tonnage for saltpeter" (Series I, Volume VI, pg. 818).
- 1882hh Letter dated February 12, 1862, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, Secretary of War, remarking "You have never sent me any orders about the distribution of the [vessel] *Vanderbilt's* powder. General Hebert has one-half, and a part of the remainder arrived here lately. On proof, it was found to lack 15 per cent. of saltpeter; but I can work it all over in twelve days and make it into good powder. We shall have about 40,000 pounds" (Series I, Volume VI, pg. 825).
- 1882ii Letter dated March 6, 1862, from CSA Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, to Judah P. Benjamin, Secretary of War, stating (pg. 841) "I received your telegram directing 20,000 pounds of cannon powder to be sent to Richmond. All the powder that came in the [vessels] *Vanderbilt*, *Victoria*, and *Miramón* is small-grained, not cannon powder, and that by the first and last of these vessels requires to be reworked, with an addition of 15 per cent. of saltpeter. This department is being completely drained of everything, and I trust that the arrival of the *Nashville* will enable you to leave here all the powder that we have on hand." Gen. Lovell further notes (pg. 843) "I am hunting all over the Confederacy to procure saltpeter to rework the powder lately arrived from Cuba. They are sending it from Memphis [Tennessee] to Augusta [Georgia]. I have, however, sent an agent to Texas to get some that I heard was at Houston, and there is a lot of 6,000 pounds *en route* here from Georgia. Until I get some the powder must remain *in status quo*" (Series I, Volume VI, pp. 841-843).
- 1882jj Letter dated March 22, 1862, from Judah P. Benjamin, CSA Secretary of War, to Maj. Gen. Mansfield Lovell in New Orleans, Louisiana, stating (pg. 864) "There is saltpeter in Mexico, and Mr. Oliver came here to make contracts with me, but I could do nothing with him. He wanted large advances and to bind himself to nothing. He was so fearful of responsibilities, that it was impossible to agree on anything. See his agents, Messrs. Avendain Brothers, in New Orleans. They may, perhaps, procure you a supply of saltpeter" (Series I, Volume VI, pp. 863-864).
- 1882kk Letter dated November 23, 1861, from CSA Maj. Gen. Mansfield Lovell to Gen. A. Sidney Johnston in Bowling Green, Kentucky, stating "I learn that there are 90 tons saltpeter at Nashville [Tennessee]. I have powder-mills here, but a dearth of saltpeter. Can you spare me 30 tons of that at Nashville? If so, please order it sent by rail, or the mills here will have to stop by the end of next week" (Series I, Volume VII, pp. 693-694).
- 1883a Letter dated March 23, 1862, from USA Maj. Gen. H. W. Halleck in St. Louis, Missouri, to Gen. Samuel R. Curtis stating "It is reported that the enemy has about 100 negroes engaged in the saltpeter works in Marion County [Missouri], a little east of Worth. They are guarded by only one company. A detachment of cavalry from Springfield could destroy these works and free the negroes, as being employed in the enemy's service" (Series I, Volume VIII, pp. 636-637).
- 1883b Letter dated March 24, 1862, from USA Brig. Gen. Samuel R. Curtis in Cross Timber, Arkansas, to Capt. N. H. McLean noting "The general's dispatch [see above] about saltpeter works received. Had sent two spies two days before preparatory to the purpose suggested. Will attend to it" (Series I, Volume VIII, pg. 640).
- 1883c Letter dated January 2, 1862, from Mr. John M. Coe in Zacatecas, Mexico, to Mr. Franklin Chase in Tampico reporting "On my arrival here yesterday, I was informed that... J. E. Schenck, a German by birth, and an American citizen, was actively purchasing ammunition of war for the Southern Confederacy. Today I met the same person at one of the commercial houses of this place, where he has purchased 130 flasks of quicksilver, some saltpeter, sulphur, and all the percussion caps he has been able to obtain....I have thought it my duty to communicate this intelligence to you as a representative of the United States" (Series I, Volume IX, pp. 642-643).
- 1884a Letter dated March 23, 1862, from USA Col. James P. T. Carter near Flat Lick in eastern Tennessee to Brig. Gen. Carter reporting (pg. 20) that "Learning there was a manufactory of saltpeter in the neighborhood, I sent a detachment of cavalry with orders to destroy the same. They destroyed about 1,000 pounds of saltpeter, broke up the kettles, burned up the shed..." (Series I, Volume X, Part 1, pp. 19-21).
- 1884b Letter dated March 28, 1862, from USA Col. Jno. Kennett to Brig. General O. M. Mitchell reporting (pg. 48) "Lieutenant-Colonel Burdsal, with 27 men, reached Manchester [Tennessee] at 10 p.m. on the night of the 26<sup>th</sup> [March 1862] ...proceeding 3 miles below the town of Manchester,



- made the keeper [of the powder mill] deliver up the keys and show him the premises. He found the log cabins of the soldiers, who had occupied them as guards, but upon crafty examination found them empty. He emptied the powder found in the work and set fire to five buildings, burning the machinery, houses, and material" (Series I, Volume X, Part 1, pp. 46-50).
- 1884c Letter dated May 11, 1862, from William Ballard Preston of Richmond, Virginia, to CSA President Jefferson Davis observing (pg. 512) "Southwestern Virginia comprises a most fertile country. It furnished a large part of the supplies and horses of an army. It contains almost the only deposits of salt, lead, and saltpeter relied on for prosecuting the war" (Series I, Volume X, Part 2, pp. 512-513).
- 1884d Telegram dated May 4, 1862, from USA Maj. Gen. O. M. Mitchel in Huntsville, Alabama, to Secretary of War Edwin M. Stanton reporting (pg. 161) "An expedition from Bridgeport [Alabama] crossed the [Tennessee] river on May 1... they destroyed a saltpeter manufactory in a cave..." (Series I, Volume X, Part 2, pp. 161-161).
- 1885a Letter dated April 24, 1862, from USA Maj. Gen. Samuel R. Curtis encamped near Vera Cruz, Missouri, to an unidentified captain reporting "A detachment, under Captain Drummond, crossed White River near Yellville, Ark., and destroyed extensive saltpeter manufactories, burning the building" (Series I, Volume XIII, pg. 59).
- 1885b Letter dated April 25, 1862, from USA detachment commander L. F. McCrillis at West Plains, Missouri, to Maj. Gen. Curtis reporting "As ...instructed ...I moved my command over to Little North Fork, thence down to Bratton's store, directly east of Forsyth. There I heard that the Confederates were manufacturing saltpeter, 8 miles blow its mouth, south side of White River, protected with a guard of 50 Confederate troops. I sent Captain Drummond ... to ascertain if the works could be destroyed from this side... Captain Drummond found the caves lightly guarded, and arrested 3 men he supposed to be pickets ...and ordered them to cross 8 of his men and Mr. Doyle, our guide ...in three canoes, under cover of 8 of his best rifle-man ...and succeeded in destroying the works, which were very extensive" (Series I, Volume XIII, pp. 59-60).
- 1885c Letter dated April 27, 1862, from USA Brig. Gen. W. Scott Ketchem at St. Louis, Missouri, to Maj. Gen. Halleck remarking "General Curtis reports from Vera Cruz on the 24<sup>th</sup> instant our cavalry from Forsyth destroyed extensive saltpeter manufactory near Yellville, Ark., and burned the buildings" (Series I, Volume XIII, pg. 366).
- 1885d Letter dated May 7, 1862, from USA Maj. Gen. Samuel R. Curtis at Batesville, Arkansas, to Brig. Gen. W. Scott Ketchum reporting "Yesterday my cavalry destroyed another extensive saltpeter manufactory, which I discovered about 14 miles northwest of this place" (Series I, Volume XIII, pg. 371).
- 1885e Letter dated June 9, 1862, from CSA Maj. Gen. T. C. Hindman at Little Rock, Arkansas, to Gen. S. Cooper reporting (pg. 833) "I have sent agents in every direction to collect arms and ammunition by purchase or impressment; am engaged in repairing those on hand and in making cartridges; have commenced the manufacture of saltpeter; opened lead mines; will soon be mining copper, and thereby getting a sufficiency of sulphur, and hope within sixty days to be making small-arms and cannon" (Series I, Volume XIII, pp. 832-833).
- 1886a Letter dated November 30, 1862, from CSA Brig. Gen. H. P. Bee in San Antonio, Texas, to Lt. Col. S. S. Anderson commenting (pg. 882) that "The commanding general is doubtless aware of the great advantage we are deriving from the trade with Mexico. With the glittering attraction of our cotton the whole available resources of Mexico are being brought to us. Shoes, blankets, cloth, powder, lead, saltpeter, sulphur, &c. are now coming in quantity which will soon supply our wants" (Series I, Volume XV, pp. 881-883).
- 1886b Message dated August 2, 1862, from J. B. Anderson to USA Maj. Gen. D. C. Buell requesting permission (pg. 248) "to take from the saltpeter works at Nashville [Tennessee] a stationary engine" (Series I, Volume XVI, Part 2, pg. 247-248).
- 1886c Letter dated August 2, 1862, from USA Maj. Gen. D. C. Buell to J. B. Anderson responding "You will take from the saltpeter works at Nashville [Tennessee] a stationary engine for the use of the Government in the engine shop at Nashville..." (Series I, Volume XVI, Part 2, pg. 248).
- 1887 Letter dated January 16, 1863, from USA Captain Milton Burch to Colonel Crabb reporting (pg. 193) on a scouting mission "to destroy a powder-mill situated on Crooked Creek, Carroll County, Arkansas" (Series I, Volume XXII, Part 1, pp. 193-194).
- 1888 Letter dated October 22, 1863, from CSA Major Thomas G. Rhett in Shreveport, Louisiana, to Major J. P. Johnson reporting (pg. 1141) that "At Marshall, Tex., I am having buildings erected for manufacturers of small arms, smiths' and carpenters' shop, powder-mill and magazine, and

- am concentrating at that point large supplies of heavy material, such as saltpeter, sulphur, lead, and iron, and I intend it to be a depot for supplies arriving from Mexico." Major Rhett continues with the comments (pg. 1142) that "There are ordnance workshops at Houston, Tex., and an arsenal of construction at San Antonio. There is a powder-mill at this last-named point belonging to a contractor, of no great value, as far as I am able to learn" (Series I, Volume XXII, Part 2, pp. 1141-1142).
- 1889a Letter dated June 23, 1863, from USA Col. W. P. Sanders at Boston, Tennessee, to Gen. Ambrose E. Burnside reporting that near Strawberry Plains, Tennessee, "I captured 3 pieces of artillery, some 200 boxes of artillery ammunition, over 500 prisoners, 1,000 stands of arms, and destroyed a large amount of salt, sugar, flour, and saltpeter, and one saltpeter works and other stores" (Series I, Volume XXIII, Part 1, pg. 385).
- 1889b Letter dated July 26, 1863 from USA Col. W. P. Sanders in Lexington, Kentucky, to Lt. Col. Lewis Richmond reporting (pg. 388) that near Strawberry Plains, Tennessee, "...on the 21<sup>st</sup> [June] I... destroyed the machinery of a gun factory and a saltpeter factory" (Series I, Volume XXIII, Part 1, pp. 387-389).
- 1889c Letter dated April 4, 1863, from USA Brig. Gen. G. M. Dodge at Corinth, Mississippi, to Henry Binmore, Assistant Adjutant General, advising (pg. 215) that "...if practicable, [I will] push my cavalry to Decatur [Alabama], [and] destroy the saltpeter works..." (Series I, Volume XXIII, Part 2, pp. 214-215).
- 1889d Letter dated February 13, 1863, from USA Maj. W. H. Medill near Edge Hill, Virginia, to Col. William Gamble reporting (pg. 13) that in the process of a scouting expedition to the county seat of Westmoreland County, Virginia, "We captured near the court-house a quantity of smuggled tobacco, sugar, and coffee, some saltpeter, and nearly 50 barrels of villainous whiskey. The saltpeter and whiskey I destroyed..." (Series I, Volume XXV, Part 1, pp. 12-13).
- 1890a Memorandum dated July 29, 1863, from CSA Brig. Gen. Thomas Jordan on behalf of the Niter and Mining Bureau to John Fraser & Company, et al. requesting that the blockade runners operated by these firms import "...an average of 20 tons of these munitions on each voyage, saltpeter and lead being most needed at present" (Series I, Volume XXVIII, Part 2, pg. 243).
- 1890b Letter dated October 3, 1863, from CSA Col. Josiah Gorgas to Gen. S. Cooper reporting (pg. 389) "The stock of saltpeter and powder is not so much as to admit of material supply to Charleston [South Carolina] without hazarding too much the supply of the army in the field" (Series I, Volume XXVIII, Part 2, pp. 388-389).
- 1890c Letter dated August 30, 1863, from USA Brig. Gen. William W. Averell in Huttonsville, Virginia, to Brig. Gen. Kelley reporting that in the course of a raid into West Virginia "We drove General Jackson out of Pocahontas and over the Warm Springs Mountain in a series of skirmishes, destroyed their saltpeter works..." (Series I, Volume XXIX, Part 1, pg. 32).
- 1890d Report dated September 1, 1863, from USA Brig. Gen. William W. Averell to Brig. Gen. Lorenzo Thomas noting (pg. 33) that a saltpeter works was destroyed on August 19 "...5 miles above..." Franklin, Virginia. He further recorded (pg. 34) that "...on the 25<sup>th</sup> made a rapid march of 25 miles to Callaghan's, in Alleghany County [West Virginia], destroying the saltpeter-works on Jackson's River on my way. ...Some wagons of the enemy were captured near Covington, and the saltpeter works in that vicinity destroyed" (Series I, Volume XXIX, Part 1, pp. 33-38).
- 1890e Letter dated August 12, 1863, from Thayer Melvin on behalf of USA Brig. Gen. Kelley to Brig. Gen. Averall directing the destruction of all saltpeter and powder works in Pendleton County, West Virginia (Series I, Volume XXIX, Part 1, pp. 38-39).
- 1890f Report dated February 18, 1864, from USA Brig. Gen. B. F. Kelley in Cumberland, Maryland, to Brig. Gen. G. W. Cullum observing (pg. 501) "The additional damage inflicted by the capture of horses and cattle, and the destruction of camps, equipage, stores, ordnance, saltpeter-works, and machinery, will be the more ruinous and discouraging, occurring, as it does, at the beginning of the inclement season..." (Series I, Volume XXIX, Part 1, pp. 499-501).
- 1890g Report dated November 21, 1863, from USA Col. John H. Oley at New Creek, West Virginia, to Lt. L. Markbreit noting (pg. 516) that during his movements in West Virginia "On the 10<sup>th</sup> [November 1863], I sent a company to destroy some saltpeter-works near Gatewood's, in the Back Creek Valley. They were found to have been in operation the day before, and were quite extensive. On the 12<sup>th</sup>, my advance guard again destroyed the saltpeter-works near Franklin, which we had burned before in August. They were being repaired for immediate operations. A smaller work nearby was also destroyed" (Series I, Volume XXIX, Part 1, pp. 515-516).

- 1890h Letter dated August 18, 1863, from USA Brig. Gen. B. F. Kelley in Clarksburg, West Virginia, to Brig. Gen. Cullum noting (pg. 69) that Gen. Averell "Will destroy the saltpeter and powder works in Pendleton as he goes through" (Series I, Volume XXIX, Part 2, pp. 69-70).
- 1890i Letter dated August 3, 1863, from USA Maj. Gen. George H. Thomas in Bolivar Springs [likely Tennessee] noting "General Brannan reports that a party of mounted men were sent to saltpeter cave and works in Harris' Cove, Marion County, Tenn., and destroyed the buildings and apparatus erected there by the so-called Confederate Government. They found in and near the cave the following enumerated property, which was destroyed: 7 log houses, formerly used as offices, barracks of the conscripts, &C.; 1 log shed, 7 large furnace-kettles, 1 bridge, leading from the foot of the hill to the entrance of the cave. They also destroyed a large number of hoppers (about 40) and troughs, ladders, &c., in the cave. The 7 furnace-kettles were found buried near the entrance of the cave" (Series I, Volume XXX, Part 3, pg. 250).
- 1890j Letter dated August 31, 1863, from USA Col. Hans C. Heg to Col. Thruston reporting "There is said to be a saltpeter works 8 miles from here [Trenton, Georgia], worked until a few days ago" (Series I, Volume XXX, Part 3, pg. 254).
- 1890k Letter dated September 4, 1863, from USA Col. Edward M. McCook to Maj. W. H. Sinclair noting "The scout I sent to Rawlingsville [state not specified] returned this evening. ... Two miles the other side, at the spring, they found the Confederate saltpeter works, and captured the agent of the niter bureau, Mr. Douglas. They had just got the works ready to go into operation" (Series I, Volume XXX, Part 3, pg. 354).
- 1891a Report dated March 10, 1864, from USA Maj. Gen. George H. Thomas at Chattanooga, Tennessee, to Brig. Gen. L. Thomas noting (pg. 8) "...our troops withdrew to Sand Mountain [Jackson County, Alabama], taking possession of saltpeter cave, near Fort Payne" (Series I, Volume XXXII, Part 1, pp. 6-12).
- 1891b Report dated April 16, 1864, from USA Brig. Gen. Jno. W. Geary at Bridgeport, Alabama, to Brig. Gen. W. D. Whipple noting (pg. 665) that "At Wild Goat Cove [likely Jackson County, Alabama], discovered places for manufacturing saltpeter..." (Series I, Volume XXXII, Part 1, pp. 663-668).
- 1891c Letter dated February 7, 1864, from USA Maj. Gen. George H. Thomas at Chattanooga, Tennessee, to Brig. Gen. John A. Rawlings noting "U. S. forces fell back to Sand Mountain [Alabama]; took possession of saltpeter cave near Fort Payne..." (Series I, Volume XXXII, Part 2, pg. 349).
- 1891d Letter dated January 30, 1864, from USA Lt. Col. M. S. Hall to Gen. Kelley observing (pg. 447) "I also learn by all the deserters that the saltpeter-works on Black Creek, above Gatewood's [West Virginia], that General Averell destroyed, are reopened, and now worked by 100 slaves, under Captain Heaton. Over 300 pounds of niter are made here daily now. The works are not guarded by any military force" (Series I, Volume XXXIII, pp. 446-447).
- 1891e Letter dated March 6, 1864, from USA Brig. Gen. B. F. Kelley to Brig. Gen. G. W. Cullum reporting "A cavalry scout... has just returned from Hardy and Pendleton Counties [West Virginia]. They effectively destroyed all the saltpeter-works near Franklin, in the latter county" (Series I, Volume XXXIII, pg. 648).
- 1891f Letter dated March 6, 1864 from USA Brig. Gen. B. F. Kelley to Brig. Gen. Sullivan reporting "Lieutenant-Colonel Root, of the Fifteenth New York Cavalry, returned to-day from a scout of five days in Pendleton County [West Virginia]. ...Destroyed valuable saltpeter-works in Pendleton County" (Series I, Volume XXXIII, pg. 648).
- 1891g Report dated March 8, 1864, from USA Lt. Col. A. L. Root near Burlington, West Virginia, to Lt. M. J. Russell remarking (pg. 228) "...on the 2<sup>nd</sup> instant [March 1864], I moved forward and arrived at Franklin [West Virginia] a little after daylight on the 3<sup>rd</sup>. Finding no enemy there I moved forward, with one squadron, to the saltpeter-works, 4 miles south of the town, and completely destroyed the buildings and all the materials for carrying on the work." He further observed (pg. 229) "...the destruction of the saltpeter-works must have been a loss to the Confederate Government of \$8,000 or \$10,000" (Series I, Volume XXXIII, pp. 228-229).
- 1891h Letter dated January 23, 1864, from USA Colonel R. R. Livingston to Col. William Baumer with orders "On the North Fork of Sylamore [near Sylamore, Arkansas] you will find and destroy a powder-mill operating there" (Series I, Volume XXXIV, Part 1, pg. 63).
- 1891i Report dated February 16, 1864, from USA Lt. John E. Phelps at Cassville, Missouri, to Brig. Gen. Sanborn remarking (pg. 93) that during a recent traverse in the vicinity of Point Peter and Cave Creek, Missouri, "Here, about the ruins of the saltpeter-works of the Southern Confederacy, I remained in camp one day" (Series I, Volume XXXIV, Part 1, pp. 91-93).
- 1891j Abstract from Record of Events of a USA



- scouting expedition from Yellville to Buffalo River, Arkansas, during March 1864: "March 13 – Capt. Samuel E. Turner ...marched from Yellville, Ark., to Buffalo River; came in contact with numerous small squads of guerillas; destroyed some extensive saltpeter-works on Tomahawk Mountains..." (Series I, Volume XXXIV, Part I, pg. 640).
- 1891k Letter dated June 1864 from USA Lt. Colonel Adolph Dengler in Little Rock, Arkansas, to Col. Allen C. Fuller reporting (pg. 731) the destruction on March 29, 1864, of "...a powder mill, different machine-shops, and the valuable saltpeter and salt works" in Arkadelphia, Arkansas (Series I, Volume XXXIV, Part 1, pp. 731-737).
- 1891l General Orders No. 69 dated February 22, 1864 ("A Proclamation" by USA President Abraham Lincoln) stating in part: "This proclamation does not authorize or allow the shipment or conveyance [to the southern states] ...of the following prohibited articles, namely: ...powder, saltpeter, sulphur, balls, bullets..." (Series I, Volume XXXIV, Part 2, pp. 391-392).
- 1891m Report dated August 1864 from USA Brig. Gen. R. W. Johnson near Atlanta, Georgia, to Capt. A. C. McClurg noting (pg. 522) "May 20 [1864], marched by the Cassville road four miles [south of the Etowah River], passing the Confederate saltpeter works, which I caused to be destroyed by my rear guard..." (Series I, Volume XXXVIII, Part 1, pp. 518-525).
- 1891n Report dated September 8, 1864, from USA Lt. Col. William O. Halpin at Atlanta, Georgia, to Capt. J. W. Ford stating (pg. 545) "On the morning of the 17<sup>th</sup> [May 1864] we resumed our march after the retreating foe across the Oostenaula River, through Calhoun and Adairsville [Georgia], reaching Kingston in the afternoon of the 19<sup>th</sup>, and bivouacked a few miles south of that point (after burning the saltpeter works) until the morning of the 23<sup>rd</sup>..." (Series I, Volume XXXVIII, Part 1, pp. 544-547).
- 1891o Letter dated July 18, 1864, from USA Colonel W. W. Lowe to Lt. D. F. How reporting that a scouting party lead by Captain Estes had "...burned a foundry and powder-mill, which were in active operation" near Canton, Georgia (Series I, Volume XXXVIII, Part 2, pg. 867).
- 1891p Letter dated May 20, 1864, from USA Brig. Gen. K. Garrard to Maj. Gen. Sherman reporting on action near Cartersville, Georgia, that "The saltpeter works were destroyed to-day by our troops" (Series I, Volume XXXVIII, Part 4, pg. 268).
- 1891q Letter dated May 29, 1864, from USA Lt. Gen. C. H. Jackson in Whitesburg, Alabama, to Lt. C. L. White noting "There are about fifty [Confederate troops] at a saltpeter cave about one mile from here on the south side of the [Tennessee] river" (Series I, Volume XXXVIII, Part 4, pg. 348).
- 1891r Letter dated May 31, 1864, from USA Lt. Col. C. H. Jackson in Whitesburg, Alabama, to Lt. C. L. White reporting "I found about thirty men at the saltpeter works. They all fled to the mountains. We destroyed all their works, which were near, and fire in their furnaces" (Series I, Volume XXXVIII, Part 4, pg. 370).
- 1891s Report dated June 1, 1864, from USA Capt. William A. Naylor aboard gun boat at Bridgeport, Alabama, to Col. W. Krzyzanowski noting (pg. 384) that near Whitesburg, Alabama, he "Landed at Mr. Williams' at 11 a.m., crossed the [Tennessee] river and landed the infantry to destroy some saltpeter works situated about two miles from the river, which were reported quiet extensive, and men working them" (Series I, Volume XXXVIII, Part 4, pp. 384-385).
- 1892a Letter dated August 16, 1864, from USA Maj. A. B. Wade at Triana, Alabama, to Capt. H. H. Rowe reporting that an expedition from Triana to Valhermoso, Alabama, "...resulted in ...the destruction of two saltpeter works. There are other works in the neighborhood, but I did not discover them. The saltpeter manufactured here is shipped to powder-mills at Blue Mountain, according to information from citizens" (Series I, Volume XXXIX, Part 1, pg. 463).
- 1892b Letter dated August 16, 1864, from USA Major A. B. Wade at Triana, Alabama, to Lt. Charles T. Hewitt reporting that after crossing the Tennessee River near Triana, Alabama, "I marched south-southwest two miles and a half, to the plantation of James Grantlin, and destroyed a saltpeter-work belonging to the Confederate Government. ...I then marched the command as rapidly as possible to Valhermoso Springs, six miles from the river. Here ...I effectively destroyed another saltpeter-work located at this point, breaking the kettles and burning the building" (Series I, Volume XXXIX, Part 1, pg. 464).
- 1893 Letter dated November 30, 1864, from George D. Sheldon to USA Major Eckert with texts of various then recent newspaper articles concerning the war including the following piece from the *Augusta Chronicle* for November 24, 1864: "The grand prize, which was to be obtained in case Augusta was captured, has been removed. The powder-works, arsenal, armories, and machine shops, located at this place, have been removed to a location of safety not threatened. The last carload,

- we understand, left today. The machinery was sent away merely as a matter of precaution" (Series I, Volume XLIV, pg. 588).
- 1894 Report dated June 15, 1865, from USA Col. W. Owens near Clarksburg, West Virginia, to Maj. T. Melvin noting "Three miles southeast of Huntsville [West Virginia] I detached a squadron, under Captain Bechtel, to proceed to Gatewood's; then northeast, through the saltpeter-works, up Back Creek Valley..." (Series I, Volume XLVI, Part I, pg. 1325).
- 1895a List of ordnance captured at Greensborough, North Carolina, attached to letter dated July 25, 1865, from USA Col. T. G. Baylor to Maj. Gen. W. T. Sherman. In part, this list notes (pg. 186) "Miscellaneous stores. - 12,500 pounds sulphur, 37,000 pounds saltpeter" (Series I, Volume XLVII, Part 1, pp. 185-186).
- 1895b Letter dated April 1, 1865, from USA Major Gen. O. O. Howard to Major L. M. Dayton reporting (pg. 199) that "During the 18<sup>th</sup> and 19<sup>th</sup> [of February 1865] the command remained in the vicinity of Columbia [South Carolina] and were engaged in destroying the public buildings, such as ...a powder mill that had everything in running order, three large store-houses for ammunition and ordnance stores, &c" (Series I, Volume XLVII, Part I, 191-209).
- 1895c Letter dated February 20, 1865, from USA Lt. Colonel L. E. Yorke to Major Gen. John A. Logan reporting (pg. 503) the destruction of "Twenty-five powder mills. These comprised all the powder mills along the Congaree River [South Carolina]; the machinery was destroyed and the mills blown up" (Series I, Volume XLVII, Part 2, pp. 502-503).
- 1895d Letter dated February 12, 1865, from "Nora Winder and her son" (Union spies) to USA Maj. Gen. W. T. Sherman including a discussion of the state of defenses around the Confederate powder works at Augusta, Georgia (Series I, Volume XLVII, Part 2, pg. 395).
- 1896a Letter dated February 20, 1865, from USA Capt. S. M. Eaton at New Orleans, Louisiana, to Lt. Col. C. T. Christensen reporting recently received information regarding Confederate activities in Texas: "Large deposits of saltpeter in Llano, Burnet, and Bexar Counties; saltpeter works in operation in Burnet County" (Series I, Volume XLVIII, Part 1, pg. 918).
- 1896b Report from C. S. Bell, a USA scout, of his activities in the spring of 1865 in which he remarks (pg. 401) "A manufactory for percussion-caps has been established at Houston, Tex. The machinery was built and put in operation by a mechanic from a Northern arsenal. A large powder-mill and armory has been established near Marshall, Tex." (Series I, Volume XLVIII, Part 2, pp. 398-403).
- 1896c Letter dated June 16, 1865, from J. J. Williamson to USA Capt. J. W. Todd discussing among other topics a large Confederate powder works at Marshall, Texas (Series I, Volume XLVIII, Part 2, pg. 965).
- 1897a Report dated April 13, 1865, from USA Maj. Gen. George Stoneman at Statesville, North Carolina, to Maj. Gen. George H. Thomas noting (pg. 324) "Following is a partial list of the public property captured mostly at Salisbury [North Carolina] and destroyed by us: ... 70,000 pounds of powder ... 10,000 pounds of saltpeter..." (Series I, Volume XLIX, Part 1, pp. 323-325).
- 1897b Report dated April 25, 1865, from USA Brig. Gen. Alvan C. Gillem at Greenville, Tennessee, to Maj. G. M. Bascom relaying (pg. 332) the destruction on March 6 of 10,000 pounds of powder near Reedy Creek and Max Meadows, North Carolina, and (pg. 334) the destruction of an additional 10,000 pounds of powder at Lynchburg, Virginia (Series I, Volume XLIX, Part 1, pp. 330-337).
- 1897c Report dated April 7, 1865, from USA Lt. Col. E. Kitchell at Selma, Alabama, to Capt. O. F. Bane noting (pg. 452) that while engaged in action near Plantersville, Alabama, "...I rallied my regiment to resist what seemed to be a threatened cavalry charge by the enemy, who were forming by the saltpeter works." Later that day, the troops "Went into camp near saltpeter works at 10 p.m." (Series I, Volume XLIX, Part 1, pp. 451-453).
- 1897d Letter dated April 9, 1865, from USA Brevet Brig. General E. F. Winslow to Major E. B. Beaumont reporting (pg. 484) on the destruction in Selma, Alabama, of "Nitro Works; these works consisting of 18 buildings, 5 furnaces, 16 leaches, and 90 banks. Powder mill and magazine, consisting of 7 buildings, 6,000 rounds of artillery ammunition, and 70,000 rounds of small-arm ammunition" (Series I, Volume XLIX, Part 1, pp. 483-484).
- 1897e Letter dated March 15, 1865, from USA Major A. M. Jackson to Lt. Colonel C. T. Christensen reporting that "There is at Selma [Alabama] a large powder mill. It has now been in operation about five months, and turns out a large quantity of powder" (Series I, Volume XLIX, Part 1, pg. 923).
- 1897f General Field Orders No. 1 dated March 15, 1865, issued by Headquarters, 13<sup>th</sup> USA Army Corps and signed by Capt. F. W. Emery by order of Maj. Gen. Granger stressing the need (pg. 927) for officers to collect information on (among other items

- of military interest) "powder-houses" and "saltpeter-works" (Series I, Volume XLIX, Part 1, pp. 924-927).
- 1897g Letter dated April 30, 1865, from USA Maj. Gen. Q. A. Gillmore to Secretary of War Edwin M. Stanton noting the destruction by Federal troops of (among other items) powder works in Savannah, Georgia (Series I, Volume XLIX, Part 2, pp. 525).
- 1897h Letter dated April 19, 1861, from Henry du Pont to U.S. Secretary of War Simon Cameron requesting arms for the protection of the du Pont powder works at Wilmington, Delaware (Series I, Volume LI, Part I, pp. 328-329).
- 1897i Response letter [see above] dated April 29, 1861, from USA Adjutant-General L. Thomas to Mr. Henry du Pont noting "In reply to your letter of the 19<sup>th</sup> instant, asking for arms to arm the citizens to protect the powder mill at your place, I have to inform you that there are no arms now available for that purpose" (Series I, Volume LI, Part 1, pg. 341).
- 1897j Letter dated April 25, 1861, from Mr. Charles du Pont Bird to Gov. Wise of Virginia advising the capture of the du Pont powder mill in Delaware by Confederate troops (Series I, Volume LI, Part 2, pg. 46).
- 1898a Letter dated August 5, 1861, from J. E. Bailey of Tennessee Military and Financial Board to CSA Maj. Gen. Leonidas Polk regarding the available stores of gunpowder; letter notes that "We have as yet but little saltpeter on hand, and but faint hopes of getting it for some time in any considerable quantities." (Series I, Volume LII, Part 2, pg. 130).
- 1898b Report dated October 1, 1861, from Neill S. Brown, W. G. Harding, and James E. Bailey, members of the state Military and Finance Board, to the General Assembly of the State of Tennessee discussing a variety of ordnance related topics including (pg. 159) "On the subject of powder, the undersigned have encountered the greatest difficulty. By timely action a large amount of sulphur was obtained by purchase at different points, but the supply of saltpeter was limited, and not to be had in the markets of the South. To supply this indispensable article, resort was had to the caves of Tennessee, Georgia, Alabama, and Arkansas, and, at considerable expense and delay, contracts were made in all these localities which, with varied success, promise in the aggregate to afford a sufficient amount for the current demand. In many instances liberal advances had to be made to induce the investment of capital and labor in that uncertain and precarious business, and it has been impossible to procure the manufacture of the article at all, except at high prices. The undersigned also, by advances, procured one powder mill that had been out of use for some time to be outfitted with increased capacity, and it has been in operation for several weeks past. They procured also in like manner to be erected a new mill, which is now about completed, with large capacity. These two mills, if they meet with no accident, it is believed will be able to furnish powder enough to meet the current demands of the whole Government during the war" (Series I, Volume LII, Part 2, pp. 158-162).
- 1898c Letter dated October 9, 1861, from CSA Lt. Colonel J. Gorgas to Adjutant and Inspector General S. Cooper observing that "...relative to the powder mills near Nashville [Tennessee], I have to say that these mills are at present supplied in a great measure with materials furnished by the Confederate States through this Bureau" (Series I, Volume LII, Part 2, pg. 170).
- 1898d Letter dated November 6, 1861, from Samuel Tate in Memphis, Tennessee, to CSA Gen. Leonidas Polk stating "I learned from Mr. Morgan, at Nashville on Saturday last, that they were making 2,800 pounds of powder there daily. Mr. Thomas Lee, of New Orleans, assures me they are making 6,000 pounds daily at that place. The only fear is want of saltpeter, and we have enough of that to keep things going for thirty or forty days, by which time we will have some of our largest caves in operation in Arkansas, besides many of smaller note at other points. Besides this, I think our ports will be open in forty days, and we will be able to get what we want" (Series I, Volume LII, Part 2, pp. 199-200).
- 1898e Letter dated June 23, 1862, from James A. Nisbet at Lookout Valley, Georgia, to CSA Secretary of War G. W. Randolph noting "If Chattanooga falls ...The Confederate States will be cut off from its main supply of saltpeter" (Series I, Volume LII, Part 2, pg. 324).
- 1898f Letter dated May 24, 1862, from CSA Maj. Gen. J. C. Pemberton at Charleston, South Carolina, to Gen. S. Cooper reporting "The steamers *Kate* and *Cecile* just arrived, running the blockade and bringing ...350 barrels of powder ... 2 kegs gunpowder... 24 bags saltpeter..." (Series I, Volume LIII, pg. 245).
- 1898g Letter dated July 24, 1862, from CSA Asst. Adjutant General J. R. Waddy in Charleston, South Carolina, to General S. Cooper reporting "The steamer *Hero* ran the blockade and arrived here this morning, bringing 50,000 pounds of powder, 60 tons of saltpeter..." (Series I, Volume LIII, pg. 256)
- 1898h Letter dated February 10, 1863, from CSA Lt. Col. George W. Rains to Brig. Gen. T. Jordan



- concerning the status of defenses for the Confederate powder works at Augusta, Georgia (Series I, Volume LIII, pg. 282).
- 1898i Letter dated March 30, 1862, from USA Maj. Gen. S. R. Curtis in Cross Timber, Arkansas, to Capt. N. H. McClean noting "My scout visited saltpeter works. They are in Newton County, Ark. The hands mostly gone. I shall watch the opportunity for taking" (Series II, Volume III, pg. 411).
- 1899a Letter dated May 3, 1862, from USA Brig. Gen. James W. Ripley to Secretary of War Edwin M. Stanton stating "I have the honor to acknowledge the reference to this office of a letter from the Secretary of State, inclosing one to him from Whitney Bros. & Co., of Calcutta, who propose to furnish saltpeter, delivered at New York in bond, for 7 ½ cents a pound, and asking your views on the subject. In obedience to your instructions indorsed on said letter I have to report that we have at this time in store of our stock and recent purchases about 7,556,091 pounds of saltpeter. This will produce 94,445 barrels of powder. The amount of powder purchased by this department during the year 1861 is about 30,500 barrels. Taking this as a basis, we have on hand a sufficient quantity of saltpeter for carrying war on the present gigantic scale for a period of three years after the manufacturers of powder for Government shall have exhausted their means of supply. In view of these facts, and also of the want of sufficient and safe store-room for preserving this dangerous crude material, I am of the opinion that our present supply of saltpeter is ample and that no more should be purchased at this time" (Series III, Volume II, pg. 29).
- 1899b Report dated November 21, 1862, from USA Brig. Gen. James W. Ripley to Secretary of War Edwin M. Stanton noting (pg. 853) "The only article of ordnance supplies for which we depend in a great measure on importation from abroad is saltpeter. Long previous to the breaking out of the rebellion, and simply as a prudent precaution, the Ordnance Department had been collecting a stock of that article, and had in its arsenals on the 4<sup>th</sup> of March 1861, a supply of 3,822,704 pounds. Notwithstanding the very large quantities of gunpowder which have since been obtained, and which we are still obtaining without difficulty, it has not been found necessary to draw upon that reserve stock; but on the contrary it has been increased, and now amounts to over 9,000,000 pounds, sufficient to make 12,000,000 pounds of gunpowder" (Series III, Volume II, pp. 849-854).
- 1899c Letter dated October 29, 1862, from USA Vice-Consul M. M. Kimmey in Monterey, Mexico, to Secretary of War Edwin M. Stanton reporting (pg. 950) "Large trains are leaving daily for the different points on the Rio Grande, though most of them go to Eagle Pass, loaded with [among other supplies] ... powder, saltpeter, sulphur... and, in fact, almost everything needed to supply the wants of the rebels" (Series III, Volume II, pp. 949-951).
- 1899d Letter dated November 17, 1863, from P. H. Watson (Assistant Secretary of War) to Henry du Pont noting that "The [U.S.] supply of powder now exceeds the current consumption, and there is little or no probability of our being under the necessity of resorting to importation to maintain an adequate supply, and we shall not in any event obtain supplies in this way except as a last resort." (Series III, Volume III, pp. 1074-1075).
- 1900a Letter dated August 6, 1864, from Brig. Gen. George D. Ramsey, Chief of Ordnance, to Secretary of War Edwin M. Stanton concerning the quantities of gunpowder and saltpeter (and prices thereof) purchased by the Federal government during the period January 1, 1861, to June 30, 1864; letter notes that 18,569,100 pounds of gunpowder had been purchased at prices ranging from \$.18 to \$.31½ per pound; letter also notes that Federal forces had on-hand a stockpile of 4,819,648 pounds of refined saltpeter and 4,490,031 pounds of crude saltpeter purchased at prices ranging from about \$.085 to \$.165 per pound (Series III, Volume IV, pg. 582-583).
- 1900b Letter dated August 15, 1864, from USA Brig. Gen. George D. Ramsay, Chief of Ordnance, to Secretary of War Edwin M. Stanton including comments on the millions of small arms cartridges (both paper and metallic) in inventory and notes "Of gunpowder we have on hand 13,000 barrels of all kinds, and outstanding contracts for 5,156 barrels more. Owing to the excessive drought of this season, and to the explosion of some of the mills, our receipts have been considerably reduced, and the great consumption of musket and mortar powder has greatly reduced our stock of these two kinds; but of cannon powder we have an ample supply, and the inspector of powder has been instructed to urge the manufacturers to increase the delivery of powder of these kinds - mortar and musket." (Series III, Volume IV, pp. 618-619).
- 1900c Letter dated October 22, 1864, from Samuel Breck, USA Ordnance Office, to Secretary of War Edwin M. Stanton discussing among topics the danger of storing large quantities of gunpowder in closely populated areas and recent Ordnance Office experiments with gun cotton (Series III, Volume IV,

- pp. 799-804).
- 1900d Letter dated March 1, 1865, from U. S. Secretary of War Edwin M. Stanton to President Abraham Lincoln noting among other topics (pg. 1208) the purchase or production of 8,409,400 pounds of gunpowder during the Fiscal Year 1863-1864 and the purchase or production of 7,544,044 pounds of gunpowder during the Fiscal Year 1864-1865 (Series III, Volume IV, pp. 1206-1215).
- 1900e Letter dated November 14, 1866, from U. S. Secretary of War Edwin M. Stanton to President Andrew Johnson detailing the efforts to disband the Union army and (pg. 1042) the status of post-war gunpowder storage facilities (Series III, Volume V, pp. 1031-1045).
- 1900f Letter dated February 21, 1861, from CSA President Jefferson Davis to Capt. R. Semmes with the instructions (pg. 107) "Of the proprietor of the Hazard Powder Company, in Connecticut, you will probably be able to obtain cannon and musket powder, the former to be of the coarsest grain, and also to engage with him for the establishment of a powder mill at some point in the limits of our territory. The quantity of powder to be supplied immediately will exceed his stock on hand, and the arrangement for further supply should, if possible, be by manufacture in our own territory" (Series IV, Volume I, pp. 106-107).
- 1900g Letter dated May 7, 1861, from CSA Secretary of War L. P. Walker to Howell Cobb, President of the CSA Congress, notes the exploration of caves in Franklin and Blount counties, (northern) Alabama, as sources of niter and discusses the firm of Cheatham, Watson & Company near Nashville, Tennessee, which was prepared to produce 1,000 pounds of gunpowder a day for the Confederacy upon receipt of adequate supplies of saltpeter and sulphur (Series IV, Volume I, pp. 292-294).
- 1900h Letter dated July 31, 1861, from L. P. Walker, CSA Secretary of War, to Howell Cobb, President of the CSA Congress, reporting (pg. 510) "...this Department has made contracts for the manufacture of powder of the different grades and varieties required in the military service of the Confederate States in quantities believed to be sufficient for the probable exigencies of the service... The Government is in Possession of large quantities of sulphur and saltpeter, and it is hoped that it will not be long before the Confederate States will be independent of foreign supplies in this important munition of war" (Series IV, Volume I, pp. 510-511).
- 1900i Letter dated August 7, 1861, from CSA Gen. Leonidas Polk in Memphis, Tennessee, to President Jefferson Davis reporting "I have just seen two New Orleans chemists, to whom I gave facilities for examining the saltpeter caves on the White River. They have made the examination, and report to me that any amount may be had there, that the mines are badly worked, and that private enterprise cannot work them. They report that the Government is now paying 25 cents per pound for that which it can itself make for 10 cents, and that if this succeeds it must be done by the Government, as powder, also in possession, is now the great want. I submit that these caves be taken possession of immediately and worked on Government account" (Series IV, Volume I, pg. 535).
- 1900j Report dated August 12, 1861, John Tyler, Jr., CSA Ordnance Office to the CSA Congress stating (pg. 555) that his office had at that time "Sulphur - Three hundred tons ... equal to the production of 3,000 tons of powder; Saltpeter - Two hundred and forty tons of saltpeter are in possession of the State of Georgia, and ready to be turned over to the Confederate States." A separate summary (pp. 555-556) of powder, sulphur, and saltpeter procurement efforts is also presented. Of note is the inclusion of an extract (pg. 557) of a letter dated July 25, 1861, by CSA Maj. George W. Rains on the status of equipping powder mills in Nashville and Manchester, Tennessee (Series IV, Volume I, pp. 555-557).
- 1900k Letter dated January 22, 1862, from CSA President Jefferson Davis to the Congress of the Confederate States concerning a pending bill before the congress [see below]: "As an example of the disadvantageous operation of the bill herein returned, the attention of the Congress is called to the contemplated case of the manufacture of gunpowder. Our present necessity is not for an increase of powder mills, but for a supply of the materials for the manufacture of gunpowder. The mills now in existence, and which could be readily put to work, far exceed in their capacity to manufacture our ability to supply the requisite material" (Series IV, Volume I, pp. 863-864).
- 1900l "An Act to Encourage the Manufacture of Small-arms, Saltpeter, and of Gunpowder within the Confederate States" approved by CSA Vice President Alexander H. Stephens attached to letter dated January 22, 1862, to President Jefferson Davis. Act allowed for interest free government financing of up to 50 percent of the expected construction costs of niter and gunpowder manufacturing facilities (Series IV, Volume I, pp. 864-865).
- 1900m Letter dated February 1862 from CSA Secretary of War Judah P. Benjamin to President Jefferson



- Davis concerning numerous ordnance related activities including the comment (pg. 959) that "Independently of contracts for the importation of 2,000 tons of saltpeter from different points, our own citizens have engaged to furnish 1,105 tons, manufactured at home. We are already supplied with sulphur in abundance for working up the whole quantity of saltpeter, and there are powder mills in the Confederacy capable of affording at least ten tons of powder per day if supplied with the raw material. The manufacture of powder has recently been at the rate of three tons per day, and no increase of that quantity will be made until some of the cargoes ordered from abroad are received." (Series IV, Volume I, pp. 955-962).
- 1900n Letter dated March 12, 1862, from Judah P. Benjamin, CSA Secretary of War, to President Jefferson Davis stating (pg. 988) "Saltpeter ... may, it is believed, be made at home in sufficient quantity for our service, as the process is simple and readily learned, and the deposits in caves abundant enough to last for some years" (Series IV, Volume I, pp. 987-989).
- 1900o Announcement dated May 1, 1862, signed by Maj. Isaac M. St. John of the CSA Nitre Bureau in Richmond, Virginia: "From this date until further notice 75 cents per pound will be aid for niter by agents of the Government. Deduction will be made for impurities exceeding 10 per cent. For lead and sulphur special instructions as to price will be given" (Series IV, Volume I, pg. 1108).
- 1900p CSA War Department General Orders No. 41 dated May 31, 1862, stating "All persons in the employ of the Niter Bureau, whether contractors for manufacturing saltpeter, or laborers in their employment, are exempt by law from enrollment [military draft]" (Series IV, Volume I, pg. 1139).
- 1900q Letter dated July 31, 1862, from CSA Major Isaac M. St. John to Secretary of War G. W. Randolph containing a very informative summary of saltpeter production and niter mining activities throughout the Confederacy and the status of knowledge of geologic forces on the occurrence of niter rich cave deposits; also of note is the comment [pp. 26-27] "Under instructions from the Chief of Ordnance especial attention was first given to the home production of niter, after that to lead, next to sulphur..." (Series IV, Volume II, pp. 26-30).
- 1900r Letter dated December 3, 1862, from CSA Maj. Isaac M. St. John of the Niter and Mining Bureau to James A. Seddon, Secretary of War, stating (pg. 223) "The incursions of the enemy are becoming serious. In the Pendleton [West Virginia] district several of our establishments have been broken up, kettles smashed, some of the workmen taken prisoners, and all dispersed. The yield for November in this and the adjoining Greenbrier district will be reduced from this cause at least 10,000 pounds. In Tennessee and Upper Alabama our works are frequently interrupted and in a recent case with loss of life. ... The supply of powder and saltpeter now on hand is considered ample for all contingencies of three months, and probably for the winter. But the supply thereafter becomes the subject of concern..." (Series IV, Volume II, pp. 222-223).
- 1900s CSA General Orders No. 99 dated December 5, 1862, and signed by Inspector General S. Cooper reads "The superintendent of the Niter and Mining Bureau is authorized and directed to press the home production of niter from plantation and domestic sources. Where indisputable the labor of conscripts is authorized in interior districts, and details will continue to be made as at present; but officers and agents of the Bureau will exercise especial caution to use this labor as a last resort. Resignations of the Niter and Mining Corps must be placed upon the same footing with resignations in the line in front of the enemy. Faithfully executed, this service is second to no other engages in the public defense" (Series IV, Volume II, pg. 228).
- 1900t Letter dated January 30, 1863, from CSA Lt. Col. George W. Rains to Secretary of War James A. Seddon concerning the appointment of Col. August to the staff of the Savannah powder works (Series IV, Volume II, pg. 378).
- 1900u Letter dated July 23, 1863, from CSA Lt. Col. George W. Rains to Secretary of War James A. Seddon concerning suggestions for the defense of Augusta, Georgia, and the powder works located there (Series IV, Volume II, pp. 660-661).
- 1900v Report dated October 1, 1864, from CSA Colonel Isaac M. St. John, Chief of Nitre and Mining Bureau, Richmond, Virginia, to Secretary of War James A. Seddon; this document is likely the single most informative item concerning the Nitre and Mining Bureau to appear in the pages of the *Official Records*; St. John clearly enumerates the Bureau's network of facilities, production figures for these mines, the number and location of nitrieries ("niter beds") established throughout the South; incidental information on domestic sulfur production ("deliveries at present averaging about 4,000 pounds per month"); and the roster of Niter and Mining Bureau officers and their assignments; this document is must reading for any serious study of the efficiency and operations of the Bureau at a critical period of its existence (Series IV, Volume III, pp. 695-702).



1900w Letter dated October 13, 1864, from J. Gorgas, CSA Chief of Ordnance, to James A. Seddon, Secretary of War, reporting (pg. 733) "Powder – The mechanical means of the Bureau for the production are ample for a war conducted on any scale... The supply depends alone on that of saltpeter and sulphur, and for the present on the former. While we must still depend on importations as one chief source of supply of niter, it will be indispensable that the efforts of the Niter and Mining Bureau be sustained, in order the home production may not be lessened. A certain force of white and black labor ought to be permanently assigned to this duty of procuring niter and sulphur and the other operations of the Niter and Mining Bureau" (Series IV, Volume III, pp. 733-734).

1900x Undated report entitled "C. S. Niter and Mining Bureau – Iron Returned from January 1, 1863, to January 1, 1865" prepared by CSA Lt. Col. Richard Morton with the comment [pg. 990] "Sulphur – The sulphur supply holds out, but to guard against fire and other contingencies sulphur furnaces have been established and preparations made to bring the production up to 20,000 pounds per month" (Series IV, Volume III, 989-991).

**War of the Rebellion (Official Records) Series – Naval Records.** Produced between 1894-1922 in two series consisting of 30 volumes containing approximately 30,000 pages, this series continues and expands the documentary efforts initiated in the related War of the Rebellion Army series (see above). The focus of the series is the actions and operations of the Union and Confederate navies in the Civil War on both the high seas and the inland waters of the United States. This compendium is organized into the following two series:

<u>Series</u>	<u>Vols.</u>	<u>Contents</u>
I	27	Operations of the naval forces
II	3	Statistical data and correspondence
30 volumes		

The following items represent an extended sampling of letters and reports concerned with Confederate efforts to procure gunpowder, niter, and sulfur in Europe, Union high seas and coastal (blockade) interdiction efforts, and other gunpowder-related topics. An index for these records organized by topic and year appears as **Table 3**.

**Secretary of the Navy**

- 1894-1922 *Official Records of the Union and Confederate Navies in the War of the Rebellion* (published in 2 series consisting of a total of 30 volumes). Government Printing Office, Washington.
- 1894 Entry for January 18, 1862, from the journal of Commander Semmes, C. S. Navy, commanding

C.S.S. *Sumter*, noting [pg. 737] "We entered the Strait of Gibraltar... We gave chase to two barks that looked American, which proved to be, and which we captured. The first was the bark *Neapolitan*, of Kingston, Mass., from Messina to Boston, laden with ...50 tons of sulphur. The whole cargo was stated by the master in his deposition to belong to the Baring Brothers, consigned to their agent in Boston – a falsehood, no doubt. ...It was enough that the sulphur was contraband... I destroyed both ship and cargo. ...Having burned the *Neapolitan*, I steamed for Gibraltar..." (Series I, Volume I, pp. 691-745).

1896a Letter dated October 11, 1864, from Thomas T. Craven aboard U.S.S. *Niagara* off Beachy Head, English Channel, noting "Yesterday afternoon, when lying in the roads of Flushing, a steamer without name, under the Spanish flag (mercantile), passed us... I immediately got underway and started in chase and... boarded her... A copy of her manifest or bills of lading is herewith enclosed. ...sulphur, and saltpeter are evidently contraband of war, but as they are consigned to a house in Matamoras it seemed doubtful whether I can seize her on that score" (Series I, Volume III, pp. 342-343).

1896b Letter dated April 20, 1861, from Jno. A. Dahlgren, U.S. Navy Yard, to USA Secretary of the Navy Gideon Welles, noting "Conformably to your orders of yesterday... I... put on board the *Anacostia* such incendiary material as was on hand... viz: 40 barrels of gunpowder..." (Series I, Volume IV, pp. 287-288).

1896c Letter dated April 23, 1861, aboard the USS *Anacostia* from Lt. Thomas Scott Fillebrown to Secretary of the Navy Gideon Welles: "Yesterday... I took the steamer *Jerome* alongside and conveyed her to the Washington Arsenal. ...She had on freight – 144 barrels of gunpowder and other stores for the Government" (Series I, Volume IV, pg. 422).

1897a Letter dated May 31, 1861, aboard USS *Flag* off Sandy Hook, Delaware Bay, from Lt. L. C. Sarori to Secretary of the Navy Gideon Wells reporting "I... am now on my way to sea, in obedience to your order of the 24<sup>th</sup> instant, having in tow the sloop *Iowa*, with 500 barrels of gunpowder for Fortress Monroe..." (Series I, Volume V, pg. 686).

1897b Letter dated June 21, 1861, from H. Wilding of the U. S. Consulate in Liverpool, England, to Secretary of State W. H. Seward reporting "The English bark *Ariel*, which cleared 17<sup>th</sup> June of Ceara, had on board the following contraband articles: Ten cases, 12 quarter boxes, and 300 quarter barrels gunpowder, ...3 casks, 12 barrels saltpeter, 1 barrel sulphur..." (Series I, Volume V,

TABLE 3. INDEX TO NITER, SULFUR, AND GUNPOWDER REFERENCES FROM OFFICIAL NAVAL RECORDS (ORGANIZED BY TOPIC AND YEAR).

<u>Topic</u>	<u>1861</u>	<u>1862</u>	<u>1863</u>	<u>1864-1865</u>
<u>Gunpowder</u>				
US - General	1896b; 1897a	1898d-e	---	---
CSA - General	---	1898m; 1921i	1902; 1921n	---
CSA Columbia SC powder mill	---	---	1921o	---
CSA - New Orleans powder mills	1921a-f	---	1921g	---
CSA Niter - General	---	1921l	---	---
CSA Gun Cotton Reports	---	1921m; 1922c-i	---	---
<u>Blockade - Coastal</u>				
Alabama	1903a	1904a	1905a	1903h; 1906a
Florida	---	1903f	1903g	1903i
Louisiana	---	1903b-e; 1917	1905b	---
South Carolina	---	1898h; 1898j; 1899a; 1901d-e	---	---
Texas	---	1904b-c	---	1906c
<u>Blockade - High Seas</u>				
USA Interdiction	1896c	---	---	1896a;
CSA Interdiction	---	1894; 1921h	---	---
<u>Blockade - Inland Rivers</u>	---	---	---	1914a-b
<u>Blockade - Reports</u>				
CSA - Reports	1922a	1921j-k; 1922b	1921p	1921q; 1922j
USA - Reports	1897b-k; 1901a-c	1897l; 1897a-c; 1898f-g; 1898i; 1898k-l; 1899b-c; 1901f-i	---	---
USA - General	---	---	---	1906b

pg. 783).

- 1897c Letter dated August 16, 1861, from Hy. Wilding, US Consulate in Liverpool, England, to Asst. Secretary of State F. W. Seward noting [pg. 170] "During the week ... 151 quarter barrels and 49 quarter boxes gunpowder [have been cleared] for Montreal..." (Series I, Volume VI, pp. 169-170).
- 1897d Letter dated September 6, 1861, from Charles Francis Adams of the Legation of the United States in London, England, to Secretary of State William H. Seward stating [pg. 265] "There is no doubt that the house of Fraser, Trenholm & Co., of Liverpool ... has been the mail channel through which the purchase and equipment of the *Bermuda*, which sailed on the 18<sup>th</sup> ultimo, were conducted. The dispatch of that vessel is the most effective thing that has been done here, and if her 70 tons of gunpowder reach their destination it would be a most important agent in continuing the war..." (Series I, Volume VI, pp. 265-266).
- 1897e Letter dated September 30, 1861, from Jeremiah Olney in Thompson, Connecticut, to US

Secretary of the Navy Gideon Welles reporting "From information perfectly reliable in my possession, a new screw steamer, *Bermuda*, ironclad, from Liverpool... arrived at Savannah September 16, 1861. Her cargo... 180 barrels gunpowder... and other... stores..." (Series I, Volume VI, pg. 279).

- 1897f Letter dated October 10, 1861, from US Secretary of the Navy Gideon Welles to Flag Officer L. M. Golsborough at Hampton Roads, Virginia, noting "The consul at Liverpool ... states that large shipments of gunpowder, sulphur, lead, shot, etc. are being made to Rio do Sul, Belize [Honduras], Charlottetown, Prince Edward's Island, Aspinwall, and Montreal [Canada]" (Series I, Volume VI, pg. 305).

- 1897g Letter dated October 17, 1861, from Charles Francis Adams, Legation of the United States at London, to Secretary of State William H. Seward, noting "Since the date of my last [letter] the steamer *Fingal* ... has sailed in company with a smaller vessel, the bark *Amelia*, containing cartridges and gunpowder" (Series I, Volume VI, pg. 406).

- 1897h Letter dated October 18, 1861, from H. Wilding, Vice-Consul at US Consulate in Liverpool, England, to Hon. F. W. Seward noting [pp. 411-412] "Entries were made at the custom-house on the 14<sup>th</sup> of ...204 barrels gunpowder [and other supplies] ...Thirty barrels gunpowder have been shipped for Jamaica" (Series I, Volume VI, pp. 411-412).
- 1897i Letter dated November 20, 1861, from US Secretary of the Navy Gideon Welles to Flag-Officers William W. McKean, Samuel F. du Pont, and L. M. Goldsborough noting "The English bark *Pernana*, with 50 tons gunpowder, cleared from Liverpool for Valparaiso, October 22, 1861" (Series I, Volume VI, pg. 447).
- 1897j Letter dated November 1, 1861, from H. Wilding, US Consulate in Liverpool, England, to Asst. Secretary of War F. W. Stewart noting "The *Margaret Ridley*, which cleared for Harbor Grace, Newfoundland, and sailed on the 28<sup>th</sup>, had 150 quarter barrels gunpowder.." (Series I, Volume VI, pg. 450).
- 1897k Letter dated December 6, 1861, from Thomas H. Dudley, US Consul in Liverpool, England, to Secretary of State William H. Seward reporting "The Danish or Swedish brig *Carl Emil*, 172 tons, sailed on the 28<sup>th</sup> of November for St. Thomas, West Indies.. Two days after she sailed 80 bags and 16 cases gunpowder were entered at the custom-house for St. Thomas, and were most likely for her" (Series I, Volume VI, pg. 510).
- 1897l Letter dated February 14, 1862, from Ed. Brennan in Bristol, England, to J. Pollaky reporting "The *Gambia*, loaded with gunpowder... is a brig of about 300 tons... She is said to be bound to the west coast of Africa, but I have ascertained that she is about to attempt running the blockade" (Series I, Volume VI, pg. 685).
- 1898a Letter dated February 15, 1862, from F. H. Morse, US Consul in London to Secretary of State William H. Seward noting "The bark *Windward* and brig *Gambia* have sailed for the West Indies, both said to have cargoes for the South, the later considerable gunpowder... I herewith send the invoice of the *Southwick's* cargo, so far as it has been received at the custom-house. It has not all gone in yet, although the steamer has sailed, by which you will see 104,600 pounds gunpowder, valued [at] £3,800 [and other supplies].... The cargo of this vessel [is] of great importance to the rebels and ought not be allowed to reach there" (Series I, Volume VII, pg. 89).
- 1898b Letter dated March 11, 1862, from Herbert Davy, US Vice-Consul, Newcastle-upon-Tynes, England, to Secretary of State reporting "I have to inform you that the British steamer *Bahama* ...is now nearly loaded and is expected to sail from West Hartlepool docks in a few days. She is entered out for Hamburg and the West Indies. Her cargo consists of shot, gunpowder, and other munitions of war..." (Series I, Volume VII, pg. 183).
- 1898c Communiqué dated March 12, 1862, from US Consul in Liverpool, England: "The *Fanny Lewis* ...sailed on Monday last. ...Her cargo consists of about 900 bags saltpeter, ...40 barrels and 10 casks soda ash, 28 barrels caustic acid, ...625 barrels gunpowder ... The powder was put on in the river just before she sailed" (Series I, Volume VII, pg. 217).
- 1898d Letter dated April 11, 1862, from H. K. Lawrence of Washington to Secretary of the Navy Gideon Welles proposing to destroy the CSS *Virginia (Merrimack)* stating [pg. 249] "The Government is to furnish me with 2,000 pounds of gunpowder for the purpose..." (Series I, Volume VII, pp. 248-249).
- 1898e Letter dated April 19, 1862, from H. K. Lawrence to Secretary of the Navy Gideon Welles proposing to destroy the CSS *Virginia (Merrimack)* stating "The [Navy] Department shall furnish me with 1,500 pounds gunpowder..." (Series I, Volume VII, pg. 249).
- 1898f Communiqué dated May 16, 1862, from US Consul in London, England, reporting : "The *Melita* is in the Thames, about 30 miles below London, taking in gunpowder. She will take on 450 barrels of powder there and then proceed to sea for Nassau. You may rely on the amount above given as the quantity she will have on board ...besides ...saltpeter [and other supplies]" (Series I, Volume VII, pg. 465).
- 1898g Letter dated August 4, 1862, from Commander William A. Parker aboard the USS *Cambridge* off Beaumont, North Carolina, to Flag-Officer L. M. Goldsborough, Norfolk, Virginia, reporting "... the large steam propeller which ran the blockade off Wilmington, N. C. on the morning of the 27<sup>th</sup> of June last. ...her name is the *Modern Greece* and her cargo consisted of 1,000 tons of gunpowder [and other supplies]" (Series I, Volume VII, pg. 516).
- 1898h Letter dated August 7, 1862, from Rear-Admiral L. M. Goldsborough aboard US Flagship *Minnesota*, Norfolk, Virginia, to Secretary of the Navy Gideon Welles reporting "I have the honor to inform the [Navy] Department that... the steamer *Modern Greece*, which was sunk off New Inlet, Wilmington, N.C. ...was loaded principally with gunpowder, all of which was destroyed when she went down..." (Series I, Volume VII, pp. 517-518).



- 1898i From an enclosure of dispatch of US Consul at London dated June 20, 1862: "...the *Phebe*, which has been under observation since April last ...has again shipped [loaded] ...600 cases of small-arms chests, each containing 20 each, making a total of 12,000 stand of arms [and other supplies] ...I expect, as she shipped hands, she will clear in a day or two and go down the river to ship gunpowder" (Series I, Volume VII, pg. 554).
- 1898j Report dated July 22, 1862, from Senior Officer O. S. Glisson aboard the USS *Mount Vernon* off Wilmington, North Carolina, to Flag Officer L. M. Goldsborough stating: "...two contrabands [former slaves] came on board this morning... They... state that the steamer *Modern Greece*, that was sunk off New Inlet by the U.S. steamers *Cambridge* and *Stars and Stripe*...was principally loaded with gunpowder, all of which was lost when she went down" (Series I, Volume VII, pp. 588-589).
- 1898k From dispatch dated July 18, 1862, from US Consul at Liverpool, England, it is noted [pg. 629] that "The ship *Sola*, a Spanish vessel, which cleared for this port for Havana on the 7<sup>th</sup> instant, took 10 tons of gunpowder intended for the Rebels. It was shipped by J. P. Harding; is in half barrels (400) and marked G. H. Much of her cargo ...is intended for the Southern States" (Series I, Volume VII, pp. 628-629).
- 1898l Letter dated August 8, 1862, from Thomas H. Dudley, US Consul, Liverpool, England, to Secretary of State William H. Seward stating "Referring to ...the steamer *Gladiator*. ...You will recollect she sailed on the 30<sup>th</sup> July. ...I have obtained a copy of her manifest so far as the cargo has been entered at the custom-house. You will see that her cargo is of a nature that fully justified me in saying that she ought to be captured wherever found. There are already entered 675,000 cartridges, 2,940,000 percussion caps, 106,000 pounds gunpowder, 11,570 rifles, 9,840 muskets, 18 brass cannon, and 6 steel rifled cannon, 86 tons saltpeter, with swords, pistols, etc. ...In dispatch of August 6 reference is made to the sailing of the screw steamer *Sunbeam*. This vessel is intended to run the blockade. Her cargo consists of gunpowder, muskets, etc. ...Large quantities of arms, gunpowder, and military stores of all kinds are now being shipped by the merchants at this place to Havana..." (Series I, Volume VII, pg. 683).
- 1898m Letter dated April 24, 1862, from Commander George Minor, CSA Navy, in Richmond, Virginia, to Commander John R. Tucker of the steamer *Patrick Henry* near City Point, Virginia, stating "In reply [to your letter of April 21, 1862] I have to state that all the powder now at the disposal of this office is at the navy yard, Norfolk. Our powder mills at Petersburg are now idle for want of niter. In the course of a short time a supply will probably be received" (Series I, Volume VII, pg. 774).
- 1899a Letter dated September 28, 1862, from Commander James F. Armstrong aboard the USS *State of Georgia* off New Inlet, North Carolina, to the Judge of the US District Court for the Eastern District of New York noting "In dispatch of August 6, reference is made to the sailing of the screw steamer *Sunbeam*. This vessel is intended to run the blockade. Her cargo consists of gunpowder, muskets, etc. They are all intended for the rebel Government. Large quantities of arms, gunpowder, and military stores of all kinds are now being shipped by the merchants at this place to Havana in the packets that sail weekly for that place" (Series I, Volume VIII, pg. 96).
- 1899b Communiqué dated November 12, 1862, from US Consul in Liverpool, England, noting "The *Justitia*, in addition to the description of goods heretofore specified by me ...has since taken in at this later place [Erith, 20 miles below London] 80 tons of gunpowder, and in all probability went to sea this morning" (Series I, Volume VIII, pg. 266).
- 1899c Communiqué dated November 11, 1862, from US Consul in Liverpool, England, noting "The steamer *Antonia*, which cleared from this port some days ago, sailed from Queenstown to-day. While there she took on board 100 tons of gunpowder, in addition to the 100 barrels she took from this port. ...The *Nicholas III* has also sailed; before sailing took on board 1,320 quarter barrels of gunpowder" (Series I, Volume VIII, pg. 268).
- 1901a Letter dated October 24, 1861, from US Secretary of the Navy Gideon Welles to Flag-Officer S. F. DuPont stating [pp. 226-227] "...information has been received that a large quantity of rifles, powder, swords, and munition of various kinds were shipped near London on board the steamer *Colletis*, which left the Thames on the 29<sup>th</sup> ultimo for Greenock, Scotland, where her cargo was to be transferred to the new iron screw steamer *Fingal*. ...Her [*Fingal*] cargo consists of 31,000 pounds powder, 525,000 cartridges, 1,550,000 percussion caps, 1,500 rifled "Brown Bessies," 300 sword bayonets [and other war supplies]" (Series I, Volume XII, pp. 226-227).
- 1901b Letter dated October 8, 1861, from William Cook, US Vice-Consul, Glasgow, Scotland, to Secretary of State William H. Seward stating "...the steamer *Fingal*... has been rapidly loading arms and ammunition at Greenock, ostensibly for Jamaica and

- Honduras. The steamer ...has on board ...[among other supplies] about 300 cases of rifles and 150 cases of pistols, some cannon (3 or more), and gunpowder" (Series I, Volume XII, pp. 227-228).
- 1901c Letter dated October 12, 1861, from Ed. Brennan, Greenock, Scotland, to J. Pallaky noting "I have succeeded ...in ascertaining particulars of the *Fingal's* cargo from an official source here. It comprises [among many supplies] 24,100 pounds gunpowder [valued at] £805" (Series I, Volume XII, pg. 331).
- 1901d Letter dated May 28, 1862, from Flag-Officer S. F. DuPont aboard US Flagship *Wabash* at Port Royal Harbor, South Carolina, to Secretary of the Navy Gideon Welles stating "I have the honor to report the capture of another steamer by Commander Mullany, of the *Bienville*, off Bull's Head Island yesterday morning. She was an English iron screw steamer of 300 tons, called the *Patras*... The cargo ... consists of 1,400 barrels of gunpowder [and other supplies]" (Series I, Volume XIII, pp. 45-46).
- 1901e Letter dated May 7, 1862, from Commander J. B. Marchand aboard USS *James Adger* off Charleston, South Carolina, to Flag-Officer S. F. DuPont reporting "I have the honor to inform you that the *Bienville*, Commander Mullany, this morning, off Bull's Island, captured the English iron screw steamer *Patras* ...I learn that the cargo consists of 1,400 barrels of gunpowder, 50 boxes of arms [and other supplies]" (Series I, Volume XIII, pg. 46).
- 1901f Letter dated August 2, 1862, from B. T. Reed, in Boston, Massachusetts, to US Secretary of the Navy Gideon Welles noting "...the name of the steamer to which I referred as having arrived at Charleston, S.C., or Wilmington, N.C., is the *Memphis* ...She may not have had 1,000 tons of gunpowder, but certainly a very large quantity on board" (Series I, Volume XIII, pg. 225).
- 1901g Letter dated August 8, 1862, from F. H. Morse, US Consulate, London, England, to Secretary of State William H. Seward reporting "In my dispatch ...I stated that the steamer *Sylph* had arrived in the Thames from Hamburg and was discharging her cargo of arms mainly into the *Harriet Pinckney*. That operation was completed on Wednesday morning ...and the *H. P.* was this morning, the 7<sup>th</sup>, taking in gunpowder at Purfleet, and will go to sea immediately, probably this evening or tomorrow. ...August 9 - She took in 75 tons of powder and sailed last evening" (Series I, Volume XIII, pg. 283).
- 1901h Letter dated August 8, 1862, from Thomas H. Dudley, US Consulate in Liverpool, England, to Secretary of War William H. Seward reporting "Referring to ...the sailing of the steamer *Gladiator* ...on the 5<sup>th</sup> instant [August 5, 1862] the official publication of the clearance of this vessel was made. ...The first publication of her cargo was made today. ...There are already entered 675,000 cartridges, 2,940,000 percussion caps, 106,600 pounds gunpowder, 11,570 rifles, 9,840 muskets, 18 brass cannon, and 6 steel rifled cannon, 86 tons saltpeter [and other supplies]. ...In dispatch of August 6, reference is made to the sailings of the screw steamer *Sunbeam*. This vessel is intended to run the blockade. Her cargo consists of gunpowder, muskets, etc. They are all intended for the rebel Government. Large quantities of arms, gunpowder, and military stores of all kinds are now being shipped by the merchants at this place [Liverpool] to Havana in the packets that sail weekly for that place" (Series I, Volume XIII, pg. 285).
- 1901i Letter dated November 20, 1862, from Charles D. Cleveland, US Consulate, Cardiff, Wales, to Secretary of the Navy Gideon Welles stating "I have just ascertained that the bark *Hero*, of Yarmouth, Nova Scotia, which is loading here with coal, will stop at Cork [Ireland] and take in 30 tons of gunpowder and sail for Nassau" (Series I, Volume XIII, pg. 455).
- 1902 Attachment to letter dated April 21, 1863, from CSA Commander J. R. Tucker aboard the CSS *Chicora* at Charleston Harbor, South Carolina, to Lt. W. G. Dozier itemizing among other materials needed for constructing and placing a series of "torpedoes" (marine mines) "3,617 pounds powder, quantity of sulphur" (Series I, Volume XIV, pg. 692).
- 1903a Letter dated December 29, 1861, from CSA Major General Braxton Bragg in Mobile, Alabama, to Army Adjutant -General, Richmond, Virginia, noting "On that morning [December 27, 1861] a small vessel from Havana attempted to run the blockade with supplies for us. Pressed by the enemy, she was beached under the guns of Fort Morgan ...a small unarmed steamer went to her assistance ...and brought her in. She brought in 150 bags of coffee, with some sulphur and other small stores" (Series I, Volume XVII, pg. 16).
- 1903b Letter dated February 3, 1862, from Commander W. M. Walker aboard U.S.S. *De Soto* off Isle Derniere, Louisiana, to Secretary of the Navy stating "...the somewhat notorious schooner Major Barbour, [was] seized by the boats of this vessel... The Major Barbour has a valuable cargo, comprising 8 barrels and 198 cases gunpowder, niter, sulphur, percussion caps, etc." (Series I, Volume XVII, pg.

- 88).
- 1903c Letter dated January 30, 1862, from Acting Master William L. Martine aboard U.S.S. *De Soto* off Caillou Island, Louisiana, to Commander W. M. Walker of the U.S.S. *De Soto* stating [pg. 89] "...on the 29<sup>th</sup> instant [January 29, 1862], while lying at anchor inside of Raccoon Point, at 1 p.m., made a schooner to the northwest; remained concealed under the point until we had her safe inside of Oyster Bayou Bar, where [we] made all sail after her; she having grounded on Grand Caillou Bar, boarded here... took possession of the schooner, which proved to be the somewhat famous *Major Barbour*, from Havana, with an assorted cargo, including gunpowder, sulphur, nitrate of soda, percussion caps, and other contraband of war" (Series I, Volume XVII, pp. 88-89).
- 1903d Letter dated February, 1862, Surgeon J. S. Dungan et al. aboard US Sloop of War *Portsmouth* off Boca Chica, Louisiana, to Commander S. Swartwout, Commanding U.S. Ship *Portsmouth* stating "A list of articles transferred from the prize [captured] steamer *Labuan* to this ship, viz.: ... 1 copper powder tank, 12 cylinders containing gunpowder, 2 canisters containing gunpowder, 12 packages containing pistol-ball cartridges, 1 package containing gunpowder, 1 tin box containing percussion caps [and other supplies]" (Series I, Volume XVII, pg. 104).
- 1903e Letter dated March 4, 1862, from Acting Volunteer Lieutenant Jos. P. Couthouy aboard US Bark *Kingfisher* off South West Pass, Louisiana, to Secretary of the Navy Gideon Welles reporting "...on 25<sup>th</sup> ultimo [February 25, 1862] ...I boarded, after chasing her 420 miles during three days and nights ...a schooner under British colors. ...She proved to be the *Lion*, formerly the *Alexander*, of Parkersville, Tex. ...She ...sailed from Havana February 20 for Matamoros, with the following cargo: ... 2 barrels niter, 100 boxes of 1 quintal each gunpowder [and other supplies]" (Series I, Volume XVII, pp. 181-182).
- 1903f Letter dated May 1, 1862, from Lt. A. F. Crosman aboard US Gunboat *Tahoma* off Sea Horse Key, Florida, to Lt. Commanding J. C. Howell reporting [pg. 224] "In obedience to your order, on the afternoon of the 25<sup>th</sup> ultimo [April 25, 1862] I started in the tender ...and the launch in pursuit of a schooner seen that morning off St. Martin's Keys. ...At daylight of the 26<sup>th</sup> [April 26, 1862] I discovered the sail on shore and ...put the howitzer in the launch and pulled toward her. It was a fore-and-aft schooner with topmasts down, a French flag flying at the forestay. One man was seen leaving over the bows, and a column of black smoke commenced to pour up from her stern. ...When within about 800 yards she blew up with a loud, heavy report. ...The tremendous force of the explosion, which in a moment reduced the schooner to a floating mass of timber ...leads me to conclude that the bulk of her cargo was gunpowder. ...upon opening two barrels I discovered in each two kegs of cannon powder carefully packed in oakum. Quantities of saltpeter, pearl ash, sulphur, still lay partially immersed in the water and being without facilities for removing all of them I staved the barrels and emptied them [the name of the vessel is not reported]" (Series I, Volume XVII, pp. 224-225).
- 1903g Letter dated March 25, 1863, from Acting Lt. Commanding E. Y. McCauley aboard the USS *Fort Henry*, cedar Keys, Florida, to Secretary of the Navy Gideon Welles, reporting "The sloop *Ranger*, of Clay landing, Suwanee River, from Havana, was captured this day, by the *Fort Henry's* armed boats off Crystal River ...Her cargo is composed of ...gunpowder, etc." (Series I, Volume XVII, pg. 395).
- 1903h Letter dated February 5, 1864, from Captain G. H. Scott aboard USS *De Soto* off Mobile, Alabama, to Acting Rear-Admiral Theodorus Bailey reporting "...I have been successful in capturing the steamer *Cumberland* on [this date] ...She has for one article 100 barrels of gunpowder" (Series I, Volume XVII, pg. 643).
- 1903i Letter dated January 21, 1865, from Acting Master James J. Russell aboard USS *Honeysuckle*, Cedar Keys, Florida, to Secretary of the Navy Gideon Welles reporting "I at once dispatched ...two armed boats ...After a toilsome pull of over seven hours, on the afternoon of the 17<sup>th</sup> instant [January 17, 1865], they succeeded in overhauling a schooner at the entrance to Suwanee River... She proved to be the English schooner *Augusta*. ...The cargo consists of pig lead [and other supplies]. The lead was consigned to Edward Hobart, special agent of War Department, Niter and Mining Bureau, Tallahassee, Fla." (Series I, Volume XVII, pp. 802-803).
- 1904a Letter dated April 17, 1862, from Lieutenant Jno. C. Febiger aboard US Gunboat *Kanawha*, Ship Island, Mississippi, to Secretary of the Navy Gideon Welles reporting "I have the honor to report the capture, on the 10<sup>th</sup> instant [April 10, 1862], off the port of Mobile, Ala., ...the [schooner] *Cuba* ...laden with an assorted cargo, amongst which is gunpowder and lead ...from Havana, with clearance to Matamoros, Mexico. ...The powder (5,250 pounds) taken from the *Cuba* I have deposited on



- board the army powder vessel, subject to the orders of Flag-Officer Farragut" (Series I, Volume XVIII, pp. 117-118).
- 1904b Letter dated June 3, 1862, from Lieutenant Charles Hunter aboard USS *Montgomery* off the Rio Grande to Secretary of the Navy Gideon Welles reporting "I have the honor to inform you that I have seized and sent to Key West for adjudication the English schooner *Will-o'-the-wisp*... a partial examination disclosed kegs of gunpowder in fish barrels and in bags, percussion caps [and other supplies]" (Series I, Volume XVIII, pp. 525-526).
- 1904c Letter dated June 3, 1862, from Lieutenant Charles Hunter aboard USS *Montgomery* off the mouth of the Rio Grande to L. Pierce, US Consul, Matamoros, Mexico stating "I have seized the English schooner *Will-o'-the-wisp*, having gunpowder on board, and shall tomorrow send her to Key West for adjudication. I inform you, that those interested in her may send her papers or [anything] else that may be beneficial as against the captors before the prize court" (Series I, Volume XVIII, pp. 526).
- 1905a Letter dated January 8, 1863, from Commodore R. B. Hitchcock aboard USS *Susquehanna* off Mobile, Alabama, to Secretary of the Navy Gideon Welles reporting [pg. 497] "Captain Gamble ... on the 6<sup>th</sup> instant [January 6, 1863] captured the English steamer *Antoona*, last from Havana, which port she left January 1... A portion of her cargo is gunpowder, small arms [and other goods]" (Series I, Volume XIX, pp. 497-498).
- 1905b Letter dated October 26, 1863, from Lieutenant-Commander W. H. Dana aboard USS *Cayuga* off Sabine, Pass, Texas, to Secretary of the Navy Gideon Welles reporting "...on the morning of the 7<sup>th</sup> instant [October 7, 1863], while off Calcasieu River, Louisiana, saw a schooner and a sloop, both under sail ...made a sail to the eastward and stood for her (a schooner trying to get into Mermentau River). I fired several shots ...She went ashore three-fourths of a mile from the beach and dropped her main peak. ...After firing one shell, which struck very near her, she immediately went about and the next moment blew up, leaving nothing in sight but some burning fragments. ...I judge she must have had a large amount of powder on board, from the concussion and great cloud of smoke which hung over her, and her being blown to atoms.  
"I immediately stood ...as near as I could approach the other vessel, which proved to be the *Pushmataha*, from Havana, with a cargo of rum, claret, and gunpowder. On our boat's crew getting on board of her, it was discovered that she had been set afire by her crew, which had left her a few minutes before and were pulling for the shore. One of a number of kegs of powder had been opened, and a match, which was inserted in the hole, was on fire; this was taken out and, with the keg, thrown overboard... The cargo was all taken out by boats, and ...finally set fire to her, leaving 2 kegs of powder, which blew the after part of the vessel to pieces and burned her to the water's edge. ...The powder found on board was of French manufacture (10 kilograms to the keg)" (Series I, Volume XX, pg. 615).
- 1906a Letter dated February 5, 1864, from Captain G. H. Scott aboard USS *De Soto* off Mobile, Alabama, to Secretary of the Navy Gideon Welles reporting "...I captured at 10:30 a.m. this day the British steamer *Cumberland*, side-wheel iron steamer of 700 tons... She has an assorted cargo consisting of [various goods], also 100 barrels of gunpowder, and a large number of arms" (Series I, Volume XXI, pg. 72).
- 1906b Proclamation signed February 18, 1864, by US President Abraham Lincoln officially extending the then-ongoing naval blockade of Southern ports; among the items classified as contraband were [pg. 112] "...powder, saltpeter, sulphur..." (Series I, Volume XXI, pp. 111-112).
- 1906c Letter dated February 22, 1864, from Acting Volunteer Lieutenant Charles H. Brown aboard USS *Virginia* off San Luis Pass, Texas, to Secretary of the Navy Gideon Welles stating "I have to report the capture by this vessel of the English schooner *Henry Colthirst*, from Jamaica, bound ostensibly to Matamoros, with a miscellaneous cargo, comprising 200 kegs of gunpowder, etc." (Series I, Volume XXI, pg. 113).
- 1914a Letter dated March 23, 1864, from Fleet Captain A. M. Pennock, Cairo, Office Mississippi Squadron, Illinois, to unnamed Admiral reporting [pg. 195] "The *Fairy* [one of the US naval river fleet] has arrived and has part of a crew on board. She is doing police duty here, watching for smugglers, as I have reason to believe that attempts are made to smuggle powder, etc., into Kentucky" (Series I, Volume XXVI, pp. 194-195).
- 1914b Letter dated July 1, 1864, from USA Rear-Admiral David D. Porter, Mound City, Illinois, to Stephen J. W. Tabor, Treasury Department, Washington, stating "...I have just received reliable information that Levy & Brothers, doing business at Metropolis, Ill., have been for some time past engaged in smuggling goods to the rebels to a very large amount. Yesterday several boxes were seized on the Kentucky shore, marked with their name,

- containing supplies of various kinds, amongst which, I am told, was a quantity of gunpowder" (Series I, Volume XXVI, pg. 454).
- 1917 Letter dated February 3, 1862, from Commander M. Woodhull aboard USS *Connecticut* off South West Pass, Louisiana, to Flag-Officer W. W. McKean et al. reporting "I have made enquiry as to the possibility of taking the prize cargo of the steamer *Calhoun* on board this vessel. ...I could not begin to take one-half of it. The first article on the list furnished to me is 491 cases of gunpowder, each case is represented to me to contain 100 pounds, which would give, in the aggregate, nearly 50,000 pounds" (Series I, Volume XXVII, pg. 407).
- 1921a Letter dated October 25, 1861, from CSA Major Gen. Mansfield Lovell in New Orleans, Louisiana, to Acting Secretary of War Judah P. Benjamin explaining "I have received your telegram relative to the amount of powder and saltpeter sent to this point within the past month... Your dispatch says that the equivalent of 500 barrels of [gun] powder has been sent here within a month. I find no correct returns of ordnance and ordnance stores from the various posts... I am hurrying into operation two [powder] mills, which will give us six or eight barrels per day, if we can get saltpeter, and have sent an agent to contract for working some of the idle saltpeter caves in the adjoining States. Of sulphur and charcoal we have a supply" (Series II, Volume I, pg. 642).
- 1921b Letter dated October 29, 1861, from CSA Acting Secretary of War Judah P. Benjamin, Richmond, Virginia, to Major Gen. Mansfield Lovell, New Orleans, Louisiana, remarking [pg. 643] "I anxiously await your letter about the supply of powder and saltpeter. I can not conceive what has become of the quantity recently sent to New Orleans, say, within the last six weeks" (Series II, Volume I, pp. 642-643).
- 1921c Letter dated October 31, 1861, from CSA Major Gen. Mansfield Lovell, New Orleans, Louisiana, to President Jefferson Davis noting [pg. 643] "I have now one [powder] mill in operation which will turn out 1,200 pounds per day, another which can make 1,500, and in two weeks hope to have a third in full blast which will make 3,000 or 3,500 pounds per day" (Series II, Volume I, 643-644).
- 1921d Letter dated November 20, 1861, from CSA Major Gen. Mansfield Lovell, New Orleans, Louisiana, to Secretary of War Judah P. Benjamin pointed asking "Do you want any more sulphur seized for the Government?" (Series II, Volume I, pg. 648).
- 1921e Letter dated November 25, 1861, from CSA Secretary of War Judah P. Benjamin, Richmond, Virginia, to Major Gen. Mansfield Lovell, New Orleans, Louisiana, noting "I think it best to avoid seizure whenever possible. If you can buy sulphur at a price not exceeding \$200 per ton, I prefer that to seizing. Buy all the nitric and sulphuric acid you can find at any reasonable price. If extortion is attempted, seize it and have it valued" (Series II, Volume I, pg. 648).
- 1921f Letter dated December 5, 1861, from CSA Major Gen. Mansfield Lovell, New Orleans, Louisiana, to Secretary of War Judah P. Benjamin relaying [pg. 651] that "The two powder mills are in running order, one at the barracks and one at the old marine hospital. Major [George Washington] Rains came down last week and, after a full inspection, reports that they can easily turn out 2 tons of powder per day, and I am making a contract with responsible parties here for 200 tons of saltpeter; sulphur and charcoal we have in abundance" (Series II, Volume I, pp. 649-651).
- 1921g Investigation report dated February 20, 1863, report on fall of New Orleans prepared by CSA Navy Department in which Commander Minor is asked [pg. 775] to "State your efforts, if any, under the orders of the Secretary of the Navy, to have ordnance manufactured in New Orleans"; he testifies [pp. 775-776] "Orders were sent to Commodore Hollins from time to time to use every exertion to have ordnance and ordnance stores manufactured at New Orleans for the defense of the Mississippi River, to establish a laboratory on an economical scale, and to manufacture powder. ...The Department made contracts for niter. Powder was manufactured on a small scale..." (Series II, Volume I, pp. 754-809).
- 1921h Letter dated January 23, 1862, from Captain R. Semmes aboard CSS *Sumter* off Gibraltar, to Lieutenant J. H. North reporting "on the morning of the 18<sup>th</sup> [January 18, 1862], in the Strait of Gibraltar, I captured two more Yankee ships; one of them I was obliged to liberate, the other I burned. The burned ship had on board 50 tons of sulphur, so that I have spoiled the manufacture of a lot of Yankee gunpowder" (Series II, Volume II, pg. 136).
- 1921i Report dated February 27, 1862, from CSA Secretary of the Navy S. R. Mallory to President Jefferson Davis, stating [pg. 152] "...in our Confederacy, the manufacture of... powder... supplies of niter, sulphur... and the establishment of laboratories for the preparation of all classes of ordnance stores, have been satisfactorily commenced, by contract and otherwise..." (Series II, Volume II, pp. 152-153).

- 1921j Letter dated April 1, 1862, from CSA Captain of Artillery Caleb Huse in Liverpool, England, to Major Josiah Gorgas, War Department, reporting [pg. 179] "The steamer *Minna* sailed while I was in Hamburg. It was intended that she should take 500 barrels of gunpowder. I found on my return to London, however, that the powder had all been left on account of the vessel being full. Had I been in London, I should have sent powder in preference to anything else" (Series II, Volume II, 177-180).
- 1921k Letter April 11, 1862, from James D. Bullock in Liverpool, England, to CSA Secretary of the Navy S. R. Mallory stating [pg. 185] "In about a fortnight I will ship 1,000 barrels of gunpowder to Nassau..." (Series II, Volume II, pp. 183-185).
- 1921l Letter dated May 2, 1862, from John Gill Shorter, Executive Department, Montgomery, Alabama, to Alabama Governor Pickens noting [pg. 189] "The resources of this State for the manufacture of almost every requisite for war purposes are perhaps unsurpassed, but they are to a great extent undeveloped. The war has done much for us; capitalists are investing largely in manufactories of arms of every kind, of saltpeter, and sulphur, and the working of lead mines" (Series II, Volume II, pp. 188-190).
- 1921m Letter dated August 25, 1862, from CSA Secretary of State Judah P. Benjamin in Richmond, Virginia, to Secretary of the Navy S. R. Mallory stating "I have the honor to transmit herewith for the information of the ordnance Bureau of the Navy Department a copy of a dispatch, dated June 23 last, from the Hon. James M. Mason, commissioner to London, and the papers which accompanied it, relating to a newly invented gunpowder. Copies of the latter reports, it is understood, are also in the hands of the Ordnance Bureau of the War Department" (Series II, Volume II, pg. 253).
- 1921n Report of operations of the CSA Navy; report dated November 30, 1863, prepared by Secretary of the Navy S. R. Mallory for President Jefferson Davis stating [pg. 534] "The powder mills at Columbia, S. C., under skillful superintendence have produced an ample supply of powder for the Navy... [pg. 535] The establishment of the Niter and Mining Bureau has been eminently advantageous to this branch of the public service by greatly increasing the supplies of iron and coal" (Series II, Volume II, pp. 528-536).
- 1921o Report dated November 25, 1863, from CSA Commander John M. Brooke, Ordnance and Hydrography, to Secretary of the Navy S. R. Mallory stating [pg. 549-550] "The powder works at Columbia, S. C., under the supervision of Mr. P. B. Garesché have been conducted with singular skill and with commensurate results. Improvements are being made in accordance with plans proposed by Chief Engineer T. A. Jackson, which will increase the capacity of the works, and facilitate the manufacture of different kinds of powder... Niter has been supplied as required in quantities amply sufficient for naval purposes by the niter and mining bureau"; [pg. 550] "The establishment of the Mining and Niter Bureau has proved eminently advantageous to the Naval Ordnance Department, facilitating its operations by providing supplies of coal, iron, and niter to an extent not anticipated. The well-directed efforts of Colonel St. John, the chief of that Bureau, have relieved this office from much embarrassment in this respect" (Series II, Volume II, pp. 547-552).
- 1921p Letter dated December 3, 1863, from CSA Secretary of the Navy S. R. Mallory to Commander James D. Bullock, CSA Navy, Liverpool, England, noting [pg. 564] "I have also drawn upon [you] for £6,000 in favor of Lieutenant-Colonel J. [sic] M. St. John to pay for niter purchased for this department abroad..." (Series II, Volume II, pp. 564-565).
- 1921q Letter dated January 24, 1864, from James D. Bullock, Liverpool, England, to CSA Secretary of the Navy S. R. Mallory noting [pg. 576] "Your drafts in favor of G. A. Hopley & Co, agents for George Wigg, for £21,000, and in favor of Lieutenant-Colonel St. John, of the Niter and Mining Bureau, for £6,000, have been presented and paid" (Series II, Volume II, pp. 575-578).
- 1922a Letter dated September 3, 1861, from William M. Browne, CSA Assistant Secretary of State, Richmond, Virginia, to J. A. Quintero commenting [pg. 254] "Your prompt attention is especially requested to the most diligent enquiry as to the possibility of purchasing small arms, powder, lead, sulphur, saltpeter, and all other articles necessary for the Army of the Confederate States" (Series II, Volume III, pp. 253-255).
- 1922b Letter dated May 20, 1862, from Ple. De Lassus, Liverpool, England, to CSA Secretary of State Judah P. Benjamin, Richmond, Virginia, noting "If you require Army clothing or other stores besides arms and gunpowder, we are quite in a position to obtain the requisite articles in the quickest manner possible" (Series II, Volume III, pg. 426).
- 1922c Letter dated June 3, 1862, from A. Dudley Mann, Brussels, Belgium, to CSA Secretary of State Judah P. Benjamin, Richmond, Virginia, noting [pg. 430] "I herein enclose an interesting printed



statement of the recent improvements which have been made in the manufacture of gun cotton. I will add that information arrived here yesterday that Austria has now 30 batteries with which she is experimenting successfully with this article. It is believed by many scientific men that it will yet entirely supersede gunpowder" (Series II, Volume III, pg. 429-430).

1922d Letter dated June 23, 1862, from J. M. Mason, Confederate States Commission, London, England, to Secretary of War Judah P. Benjamin stating "Mr. Samuel Riker, late consul of the United States at Frankfort-on-the-Main ... sent me recently a sealed communication which contained, as he said, instructions for the preparation of a newly invented explosive powder containing neither niter nor sulphur, but equal, if not superior, to gunpowder in all the uses to which the latter is applied...

"Mr. Ricker said in his note ... that the invention was a secret, and desired to be kept so pending negotiations with the Governments of Europe regarding its introduction, but that it was placed at the command of the Confederate States, should they approve its use, on terms; a just compensation should be made at a future day to the inventors" (Series II, Volume II, pp. 448-449).

1922e Letter dated July 19, 1862, from L. Heyliger, Nassau, to CSA Secretary of State Judah P. Benjamin, Richmond, Virginia, noting "Mr. F. Mohl of Texas, leaves by this conveyance [steam ship], and carries dispatches to you from Europe. He has also with him the secret of a new invention for making gunpowder, and represented to be of exceeding value" (Series II, Volume III, pg. 461).

1922f Manuscript dated June 14, 1862, signed by Riker, Frankfort on the Main, Germany, concerning "Directions for Making the Recently Invented R K R Gunpowder":

"Put into a cooking vessel,  
38 parts in weight of water;  
2 parts in weight of finely pulverized charcoal,  
which are to be boiled together, so that the charcoal becomes wholly dissolved in the boiling water. As soon as this is done add:  
20 parts in weight of chlorate of potash  
(chlorsaurer kali):  
6 parts in weight of mixture A (see below), which is soon dissolved when stirred awhile. By this addition the boiling is interrupted; therefore the mixture must be brought again into a state of boiling; and then add thereto:

7 parts in weight of well-sifted fine sawdust of beach oak or other similar wood; and then boil again together for about five minutes, so that the wood is

thoroughly soaked and becomes a part of this solution.

The mixture A referred to above consists of:  
10 parts in weight of half-calcined sea grass.  
5 parts in weight of finely pulverized charcoal.  
Whilst the foregoing operations are being performed an iron evaporation pan is to be very strongly heated, and then the whole wood impregnated mass poured into it; the mixture is then to be often stirred, so as to promote uniform evaporation, and so soon as the water has somewhat disappeared the vessel must be put on a less heated plate (or fire) for the purpose of safely and entirely drying the powder. The making of the powder in the manner described is entirely free from danger, as everything is prepared in a *wet way*. The pan for the process of evaporating can be very strongly heated so long as the mixture remains moist; as soon, however, as it begins to show the least tendency toward a dryness, the pan must be taken from the strongly heated stove, fireplace, or plate and be put on one less heated.

The mixture A can be replaced by the following materials to the same weights of others

1. 10 parts in weight of nitrate of soda, 2 parts in weight of powdered charcoal; or,
2. 10 parts in weight of nitrate of lead, 2 parts in weight of pulverized charcoal; or,
3. 10 parts in weight of saltpeter, 2 parts in weight of pulverized charcoal" (Series II, Volume III, 517-518).

1922g Letter dated September 15, 1862, from A. Dudley Mann, Brussels, Belgium, to CSA Secretary of State Judah P. Benjamin, Richmond, Virginia, stating [pg. 529] "...I [recently] took occasion to inform you of the experiments which had been made and were being made in Austria with gun cotton. I have now to communicate the following additional information, just received from Verona, relative to the employment of this article as a substitute for gunpowder.

"We have just been present at some very remarkable experiments, executed with artillery loaded with gun cotton. A fortress named Wratislaw was cannonaded at distances of 600 and 1,000 yards, and the result proved highly satisfactory.

"The relative explosive force of gun cotton compared with ordinary powder is in the relation of the 9 to 4. It has been further ascertained that solid shot thrown by the agency of gun cotton produced on hitting the mark the same effect as loaded shell discharged by ordinary gunpowder (Series II, Volume III, pp. 528-529).

1922h Letter dated November 21, 1862, from CSA

Secretary of State Judah P. Benjamin, Richmond, Virginia, to Major Isaac M. St. John, Chief of Niter Bureau, Richmond, stating "I enclose for the use of your bureau papers just received from the commissioner of the Confederate States at Paris, containing the particulars of a recent invention for the production of saltpeter, which has received the patronage of the French Government.

"The Commissioner in his letter appears to attach much importance to this invention, and says 'should the invention be used by the Confederate States, a patent should be secured for Solomon, and a liberal seigniorage allowed to him on all saltpeter manufactured by this process'" (Series II, Volume III, pg. 610).

1922i Letter dated December 9, 1862, from A. Dudley Mann, Brussels, Belgium, to CSA Secretary of State Judah P. Benjamin, Richmond, Virginia, remarks [pg. 615] "More than once I have had occasion to advert, in my dispatches to the efforts of the Government of Austria, to render gun cotton a reliable substitute for gunpowder. It now seems that her steady perseverance has been attended with success..." (Series II, Volume III, pp. 614-615).

1922j Letter dated January 16, 1864, from Henry Hotze, Confederate States Commercial Agency, London, England, to CSA Secretary of State Judah P. Benjamin, Richmond, Virginia, remarking [pg. 1002] "The experiments thus far made by the Ordnance, Niter, and other Bureaus, as also the Navy Department, demonstrate that the government can run the blockade with equal if not greater chances than private enterprise" (Series II, Volume III, pp. 1001-1004).

#### **IV. INTERNET SITES OF RELATED INTEREST**

Beyond the auxiliary links contained within certain of the sites noted below, those desirous of searching for additional web sites relating to niter mining and gunpowder manufacture will likely find the Dogpile and Google search engines particularly useful research tools. In marked contrast to other search engines, these sites simultaneously examine the online universe of electronic indexes and cover such popular sites as Yahoo, Lycos, AltaVista, and others thus saving a tremendous amount of time in examining each topic file in turn. Dogpile is accessible at <<http://www.dogpile.com>>. Google is accessible at <<http://www.google.com>>.

The following two Internet sites afford virtually instant access to a wealth of information on both the tangible and intangible aspects of American society as it existed in the 19<sup>th</sup> century. The mass of information available from these

sites should prove to be a veritable gold mine of information to researchers on a wide variety of topics.

Site: Documenting the American South

Accessible at:

<http://metalab.unc.edu/docsouth/dasmaint.html>

Sponsor: University of North Carolina at Chapel Hill Library

Description: Online texts of 700+ books and manuscripts relating to the history of the southern states. All titles were originally authored or published 1920 or before.

Site: Making of America

Accessible at: <http://library5.library.cornell.edu/moa/>

Sponsor: Cornell University

Description: Online holdings presently cover 907,750 pages, 267 monographs, and 955 serial volumes (representing over 100,000 journal articles).

Note: Researchers should be aware that web sites are particularly ephemeral resources due to being discontinued or electronic addresses changing without notice. When at all possible, it is highly advised to make a hard copy of sites (or portions thereof) of potential interest to insure that the information therein is available when needed.

The following web sites were confirmed as being online as of 20 August 2001.

"Ballincollig Gunpowder Mills Text"

Accessible at <<http://www.corkcoco.com/cccomm/services/amenity/gunpowder/right.htm>>

Summary of the history (established 1794, closed 1903) and operation of this English powder mill.

"Blackpowder Journal; Vol. 2, No. 2, Ammunition Supply in Revolutionary Virginia; Part 1"

Accessible at:

<<http://ezine.firelands.net/BlackpowderJournal/Vol2No2/Articles/BPJ22-5.htm>>

Portion of article reproduced from January 1965 issue of *The Virginia Magazine of History and Biography*.

"Blackpowder Journal; Vol. 2, No. 3, Ammunition Supply in Revolutionary Virginia; Part 2"

Accessible at: <<http://www.blackpowderjournal.com/Vol2No3/Articles/BPJ23-4.htm>>

[continuation of above].

"Blackpowder Journal; Vol. 2, No. 4, Ammunition Supply in Revolutionary Virginia; Part 3"

Accessible at:

<<http://www.blackpowderjournal.com/Vol2No4/Articles/BPJ24-6.htm>>

[continuation of above].

**"Brief History of Gunpowder"**

Accessible at: <<http://www.argonet.co.uk/users/cjhicks/gphis.html>>

Focuses on blackpowder production techniques.

**"Brief History of Rocketry, A"**

Accessible at: <<http://science.ksc.nasa.gov/history/rocket-history.txt>>

Notes on use of blackpowder as a propellant in early (ca. 9<sup>th</sup> century AD) rockets; also discusses the use of such rockets during the Civil War by both Federal and Confederate troops.

**"Caverns of War: Confederate Saltpeter Cave Operations in Western Virginia"**

Accessible at: <[http://gsa.confex.com/gsa/2001SE/finalprogram/abstract\\_3598.htm](http://gsa.confex.com/gsa/2001SE/finalprogram/abstract_3598.htm)>

Abstract of paper presented April 6, 2001, by Robert C. Whisonant. Notes that "At least 25 Virginia saltpeter caves were active over the course of the war..."

**"Caveman to Chemist Projects: Gunpowder"**

Accessible at: <<http://cator.hsc.edu/~kmd/caveman/projects/gunpowder>>

Discussion of chemical properties of gunpowder.

**"Cave Research Foundation"**

Accessible at: <<http://cave-research.org/>>

The Cave Research Foundation is a private non-profit organization originally dedicated to research and exploration concerning the caves in and around Mammoth Cave National Park, but which has lately expanded its interests to include several other cave regions. CRF research has frequently concerned historic saltpeter mining activity.

**"Chart Gunpowder Mills"**

Accessible at: <<http://www.faversham.org/attractions/chartmills.html>>

Brief overview of the water powered Chart Powder Mill, established ca. 1560, in Faversham, England.

**"Chronology of Blackpowder, A"**

Accessible at: <<http://www.rdf.frantz.com/rdf/shootingsports/history/Chronologies/HistBp.htm>>

Extended discussion by Richard D. Frantz of the evolution and technical improvements on blackpowder from ca. 1200 to the present with an emphasis on American production.

**"Civil War Blackpowder Handguns"**

Accessible at: <<http://www.geocities.com/Yosemite/Falls/6983/>>

Informative historical information on a sampling of weapons that used blackpowder.

**"Elephant/Swiss Blackpowder"**

Accessible at: <<http://elephantblackpowder.com/>>

Very informative site with numerous subdirectories and links to related topics. Of particular note are the well illustrated subdirectories of both the Elephant and Swiss brand blackpowder mills showing the equipment and processes used in the manufacture of blackpowder.

**"GOEX, Inc.—home page" [commercial site]**

Accessible at: <<http://www.goexpowder.com/>>

Web site of America's only commercial manufacturer of blackpowder. Business established by du Pont in 1908 in Pennsylvania and sold to new owners in 1970s; presently located in Doyline, Louisiana.

**"Great Saltpetre Cave Preserve"**

Accessible at <<http://www.caves.org/conservancy/gsp/>>

The historic Great Saltpetre Cave site near Mt. Vernon, Kentucky, is co-managed by regional chapters of the National Speleological Society: the Greater Cincinnati Grotto, Blue Grass Grotto (Lexington, KY), and the Dayton Underground Grotto. The website is well designed and contains links to articles about the site, a photo gallery, maps, and the cave management plan.

**"Greenville Saltpeter Cave"**

Accessible at: <<http://www.geocities.com/~caves/ed3.htm>>

Brief discussion of this well known saltpeter cave in West Virginia; includes several photographs of formations and features within the cave but little information on saltpeter mining activities there.

**"Gunpowder!"**

Accessible at: <<http://www.dangerouslaboratories.org/powder.html>>

Instructions for the production of gunpowder reproduced from *Godey's Lady's Book*, June 1861.

**"Gunpowder Bibliography"**

Accessible at: <<http://www.argonet.co.uk/users/cjhicks/gpbib.html>>

Brief listing of sources relating to British gunpowder production.

**"Gunpowder Invention"**

Accessible at: <<http://www.wargm.co.uk/abbey0.htm>>

Summary of gunpowder production at Waltham Abbey Royal Gun Powder Mills near London.

**"Gunpowder Manufacture"**

Accessible at: <<http://www.usd.edu/~jwortham/chough/>>



gunpowder.html>

Informative article on the manufacture of gunpowder copied from Chamber's Library of Universal Knowledge published in 1880.

"Gunpowder Mills Introduction"

Accessible at: <<http://www.argonet.co.uk/users/cjhicks/gpint.html>>

Includes several directories with links to other sites relating to gunpowder manufacturing facilities; primarily oriented toward British industrial archaeology sites.

"Gunpowder Works"

Accessible at: <[http://www.rchme.gov.uk/thesaurus/mon\\_types/G/69152.htm](http://www.rchme.gov.uk/thesaurus/mon_types/G/69152.htm)>

Organized as a thesaurus, the various entries in this site briefly define the various contributing elements of a gunpowder mill.

"Hagley Museum: Welcome to Hagley Museum and Library"

Accessible at: <<http://www.hagley.lib.de.us/>>

Covering 230 acres, this facility in Wilmington, Delaware, includes the Henry Clay Mill and other features and displays relating to the du Pont powder works. Researchers should direct particular attention to the "Library" subdirectory at this site.

"Making Gunpowder"

Accessible at: <<http://www.dangerouslaboratories.org/foxfire5.html>>

Text reproduced from *Foxfire 5* edited by Elliott Wigginton.

"Musée A&M: Le Revue: Lavoisier the Gunpowder Specialist"

Accessible at: <[http://www.cnam.fr/museum/revue/ref/r06a06\\_a.html](http://www.cnam.fr/museum/revue/ref/r06a06_a.html)>

Brief history of the involvement of chemist Antoine Lavoisier in the development of the French saltpeter and gunpowder industry in the late 18<sup>th</sup> century.

"Niter (Potassium Nitrate)"

Accessible at: <<http://www.galleries.com/minerals/carbonat/niter/niter.html>>

Summary of chemical attributes of potassium nitrate (KNO<sub>3</sub>) also known as niter or saltpeter.

"Origin of Japanese Gunpowder Production"

Accessible at: <<http://www.wao.or.jp/smiwa/powder/miwa/>

e\_kayafirst.html>

Brief remarks on gunpowder production in Japan in the 16<sup>th</sup> century.

"Powder Manufacturers" [commercial site]

Accessible at: <<http://www.hornady.com/links/powderlinx.html>>

Internet links to various gunpowder manufacturers.

"Powder Mills"

Accessible at:

<<http://www.mysu.edu/~cwtech/powder/Powder.html>>

Short listing of known gunpowder mills in seven Tennessee counties; includes no references to same.

"Saltpeter"

Accessible at: <<http://www.mtsu.edu/~cwtech/saltpeter/Saltpeter.html>>

Brief but incomplete listing of known saltpeter caves and works in Tennessee.

"S - Sulfur"

Accessible at: <<http://chemlab.pc.maricopa.edu/periodic/S.html>>

Scientific data on elemental sulfur.

"Sulfur"

Accessible at: <<http://pearl1.lanl.gov/periodic/elements/16.html>>

Notes on sources, production, properties, isotopes, compounds, uses, and handling of sulfur.

"Technical History of Gunpowder Manufacture"

Accessible at: <<http://www.argonet.co.uk/users/cjhicks/gpdet.html>>

Short description and glossary of blackpowder production.

"USGS Minerals Information: Sulfur"

Accessible at: <<http://minerals.usgs.gov/minerals/pubs/commodity/sulfur/>>

Commercial data on sulfur production.

"Waltham Abbey Royal Gunpowder Mills"

Accessible at: <<http://royalgunpowdermills.com/>>

History of the Waltham Abbey Gunpowder Mill in town of Waltham Abbey about 16 miles northeast of London. Mill was established in 1665 and decommissioned in 1991. This historic facility opened to the public in April 2001. The design of this mill greatly influenced Confederate powder production during the Civil War.