SUPERVISING A REVOLUTION: BRITISH ORDNANCE COMMITTEES, PRIVATE INVENTORS, AND MILITARY TECHNOLOGY IN THE VICTORIAN ERA

A Dissertation

Presented to

The Faculty of the Department

of History

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

By

Daniel R. LeClair

May, 2015

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ABSTRACT

This project is a study of the changes in military technology and administration in Great Britain between 1855 and 1907. After a period of quiescence following the end of the Napoleonic Wars, the major militaries of the world began transitioning away from *ancien regimé* muzzle-loading weapons, wooden sailing ships, and precision-drill tactics. England stubbornly lagged behind, however, until the Crimean War triggered an intense period of military technological development. For the next five decades, the nation struggled to understand and harness improvements in ordnance and small-arms, armor for ship and fortress defense, mechanization of materials production, and the myriad other changes brought about by the ongoing Industrial Revolution. The British public played a surprising but largely unexamined role in these changes, making thousands of suggestions for new weapons and other military material to the British War Office.

The British ordnance committees charged with evaluating new ideas and inventions related to military hardware compiled their findings in annual *Abstracts of Proceedings*, published in bound format from 1857 to 1897. From these and other sources, I have built a database that allows the compilation of statistics on the number of inventors and projects brought before the War Office for consideration, as well as to provide an index to the various topics examined. In addition, I have drawn heavily on many online resources, including the *British Newspaper Archive*, *House of Commons Parliamentary Papers*, and texts available from Google Books and other sites.

Using such information, the dissertation examines the British public's interest and participation in weapons development during the second half of the nineteenth century. In addition, the project seeks to put such participation, along with ongoing changes in military administration, in the greater context of the political and financial considerations of the time, as well as Britain's activities on the world stage. Ultimately, it argues that the Victorian era saw the convergence of three different social revolutions: the British governmental revolution, the Industrial Revolution, and the European military revolution. This convergence produced a period of unprecedented public participation in the British weapons development process and fundamentally altered civil-military relationships in the Empire.

Acknowledgements

This project quite literally came to me in a box.

In 1976 my father took me to my first gun show. Dad, being a big Civil War buff, wanted to find examples of the cartridges used back then, and while at the show we met a long-time dealer in collectible small-arms ammunition. Tom Dunn had tables full of all kinds of ammunition, and I was absolutely fascinated. He also published a mail-order catalog, and for the next several years I eagerly awaited every new edition and studied it religiously, not just to see what I could afford, but to learn about cartridges in general. I sent Tom orders as often as a young lad's allowance could support, and over the next several years we met regularly at cartridges shows in Houston and elsewhere.

My interest in small arms ammunition continued to grow over the following years, and in 1992, dozens of my fellow collectors and I made our annual pilgrimage to the Chicago International Cartridge Show. While there, Tom asked me what I was focusing on at the time. Although interested in military ammunition of all types, I found cartridges for the Snider and Martini-Henry rifles particularly interesting. Known amongst collectors as “Boxer” cartridges, they differed from most other ammunition in their manner of construction. Made from rolled brass foil with an attached metal head, rather than a single piece of drawn metal, this form of cartridge had been adopted by the British military in 1865 for their first breech-loading rifle, the Snider. Several different variations existed; I had a few and wanted to complete the set, I told Tom that I really liked “Boxer” cartridges, in the hopes he had the couple others I needed, and didn’t give it much more thought.

Two years later, Tom handed me a cigar box full of different Boxer-style metal foil cartridges – rifle, pistol, shotgun, and things I had no clue about. Floored, I spent the rest of

the day examining them all, picking out the obviously different for my collection (and probably returning several I should have kept, in hindsight!). Tom and I later struck a deal, and I returned home with a completely different direction for my cartridge collecting interests which has continued to this day. But I also returned home with questions. How on earth, I thought to myself, did this fragile style of cartridge case get so popular in England, when better cartridge cases were being made in America? Who was Boxer, and how did he develop his invention? Who else made cartridges like this? Such questions have driven me both as a collector, an amateur historian, and as a graduate student on my return to the University of Houston in 2008.

Tracking the history of Edward M. Boxer and his inventions has taken me all over the United States, into Great Britain and Belgium, and by the magic of the Internet to many other portions of the former British Empire. Along the way I have been privileged to meet some tremendous people, especially the "three Petes:" Peter Davis, Pete deCoux, and Peter Skala, of Australia, Pennsylvania, and South Africa respectively. The first, a business partner and very good friend, died too young in 1997; two years ago Peter Skala also passed into the ranks of absent friends. Pete deCoux is fortunately still kicking, and I would like to thank both him and his wife Gaye for their many years of friendship and support. Pete gave me some much needed encouragement after Peter Davis's death, without which you might not be reading this today. Another couple that I would like to thank is Bill and Beth Woodin. The Woodin Laboratory has been a valuable source of information over the years, and the pair have always been gracious hosts on my occasional visits.

Outside the cartridge collecting community, I must start by thanking my long-suffering advisor, Dr. Karl Ittmann, not only for his patience but his persistence in making

me take this project in directions I didn't particularly want to go, and I will be the first to admit it is a much better work for his efforts. Thanks also go to Maggie Boxer and her brother Charles, who have greatly helped me in reconstructing the life of the man whose inventions sparked this project, Edward M. Boxer. Although most of their contributions must wait for later publication, it was very exciting to meet living relatives of someone whose history I had become so familiar with. Special thanks also go to William S. Curtis of the Crimean War Research Society, who helped steer me into some useful information related to the weapons of that war; Ed Strazdes, owner of Inert-Ord.Net, who gave permission to use his photo of Civil War fuzes (found on page 104); Dr. Patrick Marder, for providing a very useful paper on the French ordnance system under Napoleon III; Paul Evans, Royal Artillery Librarian at Woolwich, who put up with a barrage of email questions regarding Boxer's career and other items, and Stuart Ivinson at the Royal Armouries Museum Library in Leeds. Kelsey Jackson and Joe Thompson also helped review very early sections of the project, and their feedback proved invaluable. The Murray Miller Foundation provided some much-needed financial assistance that allowed me to conduct research in Britain, for which I am very grateful.

There are dozens of other people who deserve thanks for their help along the way, but space – and my faulty memory – prohibits me from naming them all directly. These include cartridge collectors across the globe; my fellow graduate students at the University of Houston as well as much of the faculty there; the support staff of several different archives, especially the British National Archives in Kew, whose professionalism never ceases to amaze me. Finally, I owe a great debt of gratitude to my wife and family for their never-ending love and support during the writing of this project.

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To Mrs. Wombat

In 1854, Britons cheered in droves as their country declared war against Russia in defense of the Ottoman Empire. Allied with France – a deadly enemy only forty years before – Britain scraped together a hastily recruited and armed expeditionary force to fight "the first war in history…brought about by the pressure of the press and by public opinion."[1] Public opinion, via that press, also followed the British forces into battle, confident of a quick and glorious end reminiscent of the Battle of Waterloo in 1815. Within months, however, that same press shocked its readers with reports of frontline administrative and technological failures. The opening battles of the war resulted in thousands of casualties, as much from inept generalship as Russian bullets. The allied army lacked the heavy guns required to reduce the land defenses around the fortified harbor of Sevastopol, and the wooden sailing ships of the navy suffered a beating from Russian shore batteries.[2] The British logistical and medical systems proved far inferior to those of its French allies; stockpiled materials rotted in port, cholera ran rampant, and wounded men crammed into transport ships died by the hundreds en route to hospital.[3] The failure to quickly reduce Sevastopol meant a winter spent encamped in the Crimea; with its supply of cold-weather clothing sent to the bottom of Balaklava harbor by a freak storm, a disease-ridden and starving British Army nearly froze to death as well. By January of 1855, the number of able-bodied men in the expeditionary force had dropped to 11,000, half the number available only two months before.[4]

For a nation that prided itself on defeating Napoleon, these shocks resulted not only in the fall of then-prime minister Lord Aberdeen's government, but criticism of all practices of the British military from administration to procurement. Many of those duties fell under

[1] Orlando Figes, *The Crimean War: A History* (New York: Metropolitan Books, 2010), 147.
[2] Figes, 240.
[3] Geoffrey Wawro, *Warfare and Society in Europe 1792-1914* (Routledge, London, 2000), 60-61; Figes, 279-294.
[4] Figes, 280-290.

the purview of an aged relic of *ancien régime* administration: the 441-year-old, military-run Board of Ordnance. Britain was already in the throes of a “revolution in government,” which saw the increased replacement of an “amateur” bureaucracy based on aristocratic privilege and patronage with a professional one based on training and merit.[5] Blamed for the Crimean failures by government reformers, the antiquated Board of Ordnance clearly had to go. In 1855, Parliament therefore authorized the dissolution of the Board and the transferal of its administrative functions to the War Office. For the next fifty years battle raged between the civilian War Office and Army leadership for authority over military matters – including recruitment and discipline, promotion, training, and weapons procurement. Despite forcing a number of important reforms on an unwilling army, the War Office did not gain ultimate control until battlefield failures in the Second Boer War triggered further shakeups. Not until 1904 did its chief officer, the Secretary of State for War, become fully responsible “to His Majesty and to Parliament for all the business” of the army.[6]

The “revolution in government” coincided with the opening stages of a revolutionary change in Western military technology. The Russians, for example, had demonstrated the power of “shell cannon” – artillery firing explosive projectiles rather than solid shot – by destroying the Turkish fleet at Sinope, and French shell-fire proved decisive at the battle of Chernaya.[7] Britain’s first attempt at producing rifled cannon – the “much-vaunted” Lancaster gun – could not reliably fire explosive shells; three of eight guns burst during the siege of Sevastopol.[8] So, while newspaper reports from the Crimea demonstrated the importance of

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[5] Oliver MacDonagh, “The Nineteenth-Century Revolution in Government: A Reappraisal.” *The Historical Journal* 1, No. 1 (1958), 52-67; Figes, 310.

[6] Hampden Gordon, *The War Office* (London: Putnam, 1935), 81.

[7] Trevor Royle, *Crimea: The Great Crimean War, 1854-1856* (New York: St. Martin's Press, 2000) 94; Wawro, 61.

[8] Figes, 240; Sir James Emerson Tennent, *The Story of the Guns* (London: Longman, 1864; rep. The Richmond Publishing Co. Ltd., 1972), 81.

emerging battlefield technologies, a British public that had just recently marveled at their country's industrial prowess at the Great Exhibition of 1851 saw their military as hobbled by technology and leadership decades out of date. In the minds of inventors and entrepreneurs these failures coupled with the potential of the Industrial Revolution cast wide open the question of the best forms of all manner of technology, from ambulance wagons to heavy artillery, required for future conflicts.

As they responded with cash donations for relief of the average soldier's condition in the Crimea, concerned Britons responded with an outpouring of suggestions for improved weaponry, which overwhelmed the Board of Ordnance's evaluation procedures. As part of the administrative overhaul of the military, then, responsibility for weapons research and development passed from the Board to an entirely new entity, the "Ordnance Select Committee" (OSC).[9] The formation of this Committee marks the convergence of the British governmental revolution, the Industrial Revolution, and the European military revolution, producing a period of unprecedented public participation in the British weapons development process and fundamentally altering civil-military relationships. For the next fifty years, the OSC and its successors acted as the supervising authority over the technological half of Britain's military revolution, balancing army and navy interests against the efforts of inventors and politicians to influence technology decisions in the development of modern weaponry.

The story, however, is not one of unqualified success. Driven by crisis as much as scientific inquiry, throttled by a parsimonious financial system yet goaded on by public interest, Britain's nineteenth-century military revolution produced weapons technology

[9] Oliver F. G. Hogg, *The Royal Arsenal: Its Background, Origin, and Subsequent History* (London: Oxford University Press, 1963), 1087.

capable of winning the brush-fire colonial wars that the country found itself involved in throughout the second half of the nineteenth century – but usually after the war *du jour* was over. In addition, the army often failed to address issues of logistical support, soldier training, and tactical thinking regarding its new weapons to make them truly effective. Finally, despite millions of pounds and hundreds of thousands of man-hours expended in military modernization, Britain found itself as unprepared for a major European conflict in 1914 as it did in 1854. This, then, is as much a story of a revolution missed, as of one that occurred.

Military Revolutions: Theory and Debate

Michael Roberts introduced the idea of a "military revolution" as a discreet historical time-frame in a lecture presented at Belfast in January, 1955.[10] In that lecture, Roberts argued that tactical changes in European military practices from 1560 to 1660 increased the scale of warfare, requiring larger and larger armies to ensure victory. Such a transformation, Roberts argued, led "inevitably" to the rise of a centralized bureaucratic government, as only it "could supply the administrative, technical and financial resources required for large-scale hostilities."[11] In essence, Roberts argued, the military innovations introduced during this century laid the groundwork for the modern Europe state system.

Roberts's lecture, and the half-century of historical debate that followed it, is significant for many reasons, two of which are of importance to this project. First, Roberts's work is an early example of academic or "new" military history. In a move away from the "classic" military history concerned with battles and tactics, Roberts positioned a martial subject as part of the larger story of the human world, a "contextualization of the history" of

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[10] Michael Roberts, "The Military Revolution, 1560-1660" in *The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe*, ed. Clifford J. Rogers (Boulder, CO: Westview Press., 1995), 20.

[11] Geoffrey Parker, "The 'Military Revolution, 1560-1660' – A Myth?" in *The Military Revolution Debate*, 37.

military topics.[12] Although the term "new military history" had yet to be coined, Roberts's lecture showed that military historians could link their studies to the broader issues of the impact of militaries on societies other than through combat.[13] As historian Clifford Rogers noted, "the active and wide-ranging debate" ignited by Roberts's theory "brought the explanatory value of military history to the attention of the historical community as a whole."[14]

The debate that Roberts's lecture ignited is the second reason it remains significant, debate which continues to this day. On one side are the historians that clearly accept the notion of a "military revolution" as a distinct period in history, led chiefly by Geoffrey Parker – who, coincidentally, had Roberts as an external examiner for his dissertation.[15] Parker continued to explore and expand the concept, pushing Roberts's original boundaries by two centuries.[16] On the other side are historians such as Jeremy Black, who questioned how anything that occurred over the course of centuries could be called "revolutionary." "Military change arose from the absolutist state rather than causing it," Black wrote, and occurred in a fashion that left relatively little impact on the social structure of European states. While recognizing that military innovations took place in the late fifteenth through the seventeenth centuries, Black argued that "no military revolution occurred in post-medieval Europe." The same constraints on warfare in the fifteenth century – slow communications, horse-drawn transportation, disease, winter, the short range and massive smoke of black-

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[12] James J. Farley, *Making Arms in the Machine Age: Philadelphia's Frankford Arsenal, 1816-1870* (University Park, PA: Pennsylvania State University Press, 1994), xii.
[13] William P. Tatum, "Challenging the New Military History: The Case of Eighteenth-Century British Army Studies." *History Compass* 5, no. 1 (2007): 72-84; John Whiteclay Chambers, "Conference Review Essay: The New Military History: Myth and Reality." *The Journal of Military History* 55, no. 3 (1991): 395-406.
[14] Clifford J. Rogers, "The Military Revolution in History" in *The Military Revolution Debate*, 3.
[15] Geoffrey Parker, "In Defense of the Military Revolution" in *The Military Revolution Debate*, 337.
[16] Geoffrey Parker, *The Military Revolution: Military Innovation and the Rise of the West, 1500-1800* (Cambridge: Cambridge University Press, 1996)

powder weaponry – remained in force until the nineteenth century.[17]

If short duration, military innovation, social impact and constraint removal are the hallmarks of a "true" military revolution, then, one certainly occurred during the nineteenth century, as numerous scholars, including Black, have argued. [18] As with any group of historians collected around a central theme, there is considerable dissent, particularly as regards the starting point. Several writers have made a case for the French Revolutionary and Napoleonic Wars, with mass conscription and the dramatic increase in the scale of battle, as the start of "modern war."[19] All of the four components noted above may be seen at work between 1792 and 1815, although the area of military innovation is by far the weakest. The French revolutionary armies certainly introduced several innovations, refined by Napoleon and gradually copied by other nations. These included more effective infantry tactics, the development of the combined-arms division, and force concentration (particularly artillery) at specific points on the battlefield. The combatants of this age, however, all used weapons and logistics technology unchanged for decades. *Ancién regime* weaponry – the bayoneted musket, cavalry sabre, and smooth-bore cannon – had, tactically and technically, been perfected as far as they could go, and all sides in the Napoleonic Wars fought under the same constraints that had limited combat since the Thirty Years' War.

Weapons technology did not remain stagnant in the post-war era. The Russian shell

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[17] Jeremy Black, *A Military Revolution? Military Change and European Society: 1550-1800* (Hampshire: Macmillan, 1991), ix - 96.

[18] Examples include, in chronological order: William Hardy McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000* (Chicago: University of Chicago Press, 1982); Jeremy Black, *War and the World: Military Power and the Fate of Continents, 1450-2000* (New Haven, CT: Yale University Press, 1998); Geoffrey Wawro, *Warfare and Society in Europe, 1792-1914* (London: Routledge, 2000); MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution, 1300-2050* (Cambridge: Cambridge University Press, 2001); Max Boot, *War Made New: Weapons, Warriors, and the Making of the Modern World* (New York: Gotham Books, 2006); Antulio Joseph Echevarria, *Imagining Future War: The West's Technological Revolution and Visions of Wars to Come, 1880-1914* (Westport, CT: Praeger Security International, 2007)

[19] David Avrom Bell, *The First Total War: Napoleon's Europe and the Birth of Warfare as We Know It* (Boston: Houghton Mifflin Co., 2007), 7.

gun that would prove so devastating at Sinope actually originated in France in 1821, and European armies transitioned from the flintlock musket to the percussion cap in the 1830s. Prussia adopted a breech-loading infantry rifle in the early 1840s, and began experimenting with cast-steel instead of iron for ordnance in 1847.[20] In 1849, a French Army captain invented a new type of bullet that greatly facilitated the loading of rifled muskets – an important development in that rifles were much more accurate at much longer ranges than smooth-bores. Rapidly adopted by most European powers and the United States, the rifled musket extended the range of the infantryman to beyond that of smooth-bore artillery still in use – a potentially major change in the constraints of warfare.[21] The United States also pioneered the manufacture of small arms with interchangeable parts, so that by 1850 its major arsenal produced muskets made almost entirely by machine.[22] Even the British Royal Arsenal, which had long resisted the "oncoming tide" of the Industrial Revolution, finally introduced steam power into several of its manufacturing departments in 1848.[23]

What did remain stagnant were the military machines of Europe. With the exception of the rifled musket, French, British, and Russian armies fought in the Crimea with essentially the same technology, the same tactics, and in some instances under the same officers as had seen service in the Napoleonic Wars.[24] This, in turn, imposed the same constraints in 1854 as they did in 1815, and gave no clear advantage to any side.[25] The British Army was particularly handicapped. Parliament, intent on reducing government debt

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[20] Trevor N. Dupuy, *The Evolution of Weapons and Warfare* (Indianapolis: Bobbs-Merrill, 1980), 174; Hugh B. C. Pollard, *Pollard's History of Firearms* (New York: Macmillan, 1983), 251.
[21] Pollard, 173-186.
[22] David A. Hounshell, *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States* (Baltimore, MD: Johns Hopkins University Press, 1984), 44.
[23] Hogg 1963, 703-704.
[24] Lord Raglan, commander of the British army, is perhaps the most famous example, having lost an arm at Waterloo. See Figes, 176.
[25] Dupuy, 156-167.

incurred after two decades of war, drastically cut military expenditures over the course of forty years of peace after Waterloo, only begrudgingly approving fund increases during war scares.[26] In addition, what action the British Army did find itself in prior to 1854 was limited to small colonial wars, usually against technologically inferior opponents.[27] Although historian Hew Strachan has argued that civilian outsiders and "many half-pay and retired officers…[turned] their talents" towards military reform, "the Army thought small because it fought small." Reforms occurred at the regimental level, "to meet the demands of imperial garrisoning and home policing." Military administration remained divided between civil and uniformed authorities, a split that "prevented the formulation of a coherent military policy or a school of strategic thought."[28]

The British Military Revolution

Strachan, perhaps more than any other historian, has challenged the notion of a stagnant army devoid of any reform effort before the Crimean War.[29] 1854, however, marks a clear starting point for Britain's own military revolution, which should be examined separately from that occurring in Europe and the United States. For a British public newly interested in military subjects, the Crimean War acted as both a catalyst and accelerant, melding this interest with the reforming spirit of the ongoing governmental revolution. This in turn combined new mechanical knowledge from the Industrial Revolution and an entrepreneurial spirit eager to tap into the military market, to produce an explosion of new

[26] Figes, 178-181.

[27] The exception to this were the Sikhs, whose army had a strong artillery component that bedeviled the British during the First and Second Sikh wars in the 1840s. See Byron Farwell, *Queen Victoria's Little Wars* (New York: Norton, 1985), 23-60.

[28] Hew Strachan, *Wellington's Legacy: The Reform of the British Army, 1830-54* (Manchester: Manchester University Press, 1984), 262-270.

[29] In addition to *Wellington's Legacy*, see also "The Early Victorian Army and the Nineteenth-Century Revolution in Government" in *The English Historical Review* 95, no. 377 (1980), 782-809 and *From Waterloo to Balaclava: Tactics, Technology, and the British Army, 1815-1854* (Cambridge, Cambridge University Press, 1985).

ideas for military technology. To this mix must also be added a distinctly British element: an army increasingly focused on colonial defense and dependent on a tight-fisted Parliament for the resources required to perform this mission.[30] As a result, the British experience in the nineteenth century military revolution was much different from other Western powers, and bears studying as a separate event.

The common component for all participants in the larger nineteenth century military revolution is the evidence of two of the four hallmarks of a "true" military revolution: innovation and short duration. In less than forty years, the West moved completely away from *ancien regimé* weaponry – black-powder smooth-bore ordnance, small arms of limited range and long reloading times, and exclusive reliance on unpowered transport – to *fin de siècle* technology – smokeless-powder repeating rifles, machine-guns, and quick-loading artillery. Military equipment also coupled with "civilian" technologies to remove many of the constraints that limited warfare before 1854. The telegraph, and later the telephone, greatly facilitated communications; steam-powered ships and railroads improved transportation and expanded operating areas of military forces. Improvements in food preservation, water purification, and medical technologies helped overcome the ravages of disease and the limits imposed by weather. Britain and its imperial competitors could send their armies where they wanted, when they wanted, with a much higher expectation of effectiveness and much lower potential for non-combat casualties than ever before.

Where the British experience begins to diverge from the US and the rest of Europe is in the social aspects of its military revolution. Beginning with the Reform Act of 1832, the

[30] Correlli Barnett, *Britain and Her Army, 1509-1970: a Military, Political, and Social Survey* (New York: W. Morrow, 1970), 272-273, 346. John Sweetman has also argued the same position, in *War and Administration: The Significance of the Crimean War for the British Army* (Edinburgh: Scottish Academic Press, 1984).

British electorate became successively larger over the course of the nineteenth century. By 1885, sixty percent of British males had the right to vote – still far behind France, Germany, and the United States, but a vast improvement for a nation that still clung tenaciously to its aristocratic traditions. A growing newspaper industry, boosted by changes in printing technology and the repeal of the stamp duty in 1855, helped to inform this expanding voter base, but it also gave readers a venue for expression their opinions. Hans Speier defined public opinion to be "matters of concern to the nation freely and publicly expressed by men outside the government who claim a right that their opinions should influence or determine" government action."[31] Given such a definition and the vast amount of material now being made online by the ongoing digitization of the British Library's newpaper collection, this project will use press sources as a means to illustrate public concerns and opinions regarding military matters in this era.

In addition, Britain spent most of the second half of the century perpetually fearing a major European war, but not actively involved in one. Indeed, war scares were an all-to-common occurance both before and after the Crimean War, with France being the most common potential enemy. Visions of steam-powered warships, bristling with steel cannon and unleashed by the empire-thirsty Napoleon III, came together in the public mind in 1859 and drove a sharp debate over coastal defense. As the century progressed, however, Russia increasingly replaced France as the public's monster in the closet, especially given the ongoing "great game" under way for control of Asia. Such scares, coupled with ongoing campaigns in various corners of Victoria's expanding empire, meant that Britons of all stripes took interest in military matters, which the papers avidly fed. There were other

[31] Hans Speier, "Historical Development of Public Opinion." *American Journal of Sociology* 55, no. 4 (1950): 376-88; p. 376.

avenues of information on ongoing military developments as well, including military displays, the Royal Arsenal's own museum, and a number of industrial exhibitions held in England during this era.[32] Although a lack of scientific polling methods makes measuring the degree of this interest difficult, it is clear from the range of books, periodicals, and newspaper articles related to weapons technology that there was indeed a strong market for such information.

Public interest meant political action, and the dissolution of the old Board of Ordnance represented the first of several attempts to deal with what historian Correlli Barnett termed the "disastrous muddle" in British military administration. The departments that fielded, fed, and financed its land forces had come together haphazardly over the course of decades, if not centuries, and consisted of ill-defined and conflicting spheres of military and civilian control. Like a badly-mixed cocktail, however, the muddle could not be unmade; both military and political leaders proved reluctant to throw out the system altogether, despite the clamor of the press and the recommendations of several committees appointed to study the matter. Not until the near-disaster of the Second Boer War at the turn of the century did Government finally replace the muddle with a modernized military administrative system.

Public interest also meant public involvement, as witnessed by the thousands of inventors who attempted to interest the British military in doing business. Many of these inventors launched businesses to exploit their patents and otherwise market their wares both at home and abroad – pre-dating Dwight D. Eisenhower's "military-industrial complex" by over a century. As will be shown, these inventors, of both military and civilian background, kept abreast of technology through popular magazines and newspapers, rather than old

[32] Bob Clarke, *From Grub Street to Fleet Street: An Illustrated History of English Newspapers to 1899* (Aldershot, Hants, England: Ashgate, 2004), 239.

channels of patronage and connection. Even the British military kept track of new technology via the same media, and more than once used advertisement to make its wants known to the public. In short, the social impact of this military revolution out-shadows any previous era by an enormous – and measurable – degree.

This measurability is the unique aspect of the British military revolution. Although France, Germany and the United States proved fertile ground for inventors, Britain's lead in industrialization gave it an edge in technological innovation. This is quantifiable not only in the number of patents issued for military ideas in general, but also in the number of proposals made to the War Office. The committees responsible for evaluating such proposals compiled their findings into quarterly *Abstracts of Proceedings*, with an indexed list of persons making suggestions, no matter how ludicrous. As will be discussed in later chapters, some of the proposals submitted to the War Office demonstrate a distinctive eccentricity for which Englishmen are popularly known. Regardless of the utility of the suggestion, the evaluating committees went to great lengths to record who proposed what to the War Office from 1857 forward, along with the disposition of the proposal. Although much of the source documentation was lost to German bombs in World War II, the quarterly *Abstracts* did survive. These records illustrate a pattern of deliberate, methodical consideration of what defined a useful weapons system and the degree to which the British military allowed involvement by outsiders interested in marketing new weapons. Above all, however, the detail provided allows the compilation of useful statistics by which public participation in the military revolution may be measured.

Studying Society through Technological Change

Despite the important role played by the public in Britain's military revolution, very little has been written regarding it or the evaluation committees. Although numerous works have been published concerning the hardware – the cannon, rifles, pistols, swords, and other equipment made by the Royal Arsenal – most of these have been written by or for the weapons enthusiast. While valuable assets to the military historian, such works do not explore the deeper questions of what influenced Britain to make the technological choices it did, or did not, during this period. The evolution of the War Office as an institution is also a topic that has been overlooked. Only two histories appear to have been written, a 1914 work by Capt. Owen Wheeler, and a 1935 publication by Hampden Gordon as part of the "Whitehall Series" of books on the "great Departments of State."[33] Although John Sweetman has produced a good summary of the Board of Ordnance's history before the War and its expiration "with scarcely a whimper" in 1855, his examination of army administrative reforms mentions very little regarding the Ordnance Department afterwards.[34] Indeed, few secondary sources exist regarding the activities of the Royal Arsenal, the complex of government factories that produced the majority of British military supplies in this era. Only one history of the Arsenal at Woolwich has been written, a weighty two-volume set by O. F. G. Hogg that is concerned more with the physical buildings (and the occasional cow killed during artillery practice), and less with the activities of the tens of thousands of soldiers and civilians employed there over the course of the Victorian era.[35]

Historians of the British army in the nineteenth century such as Gwyn Harries-Jenkins and Edward Spiers have been very successful in using the "new military history" approach to position their subject within the larger context of Victorian history. Their work, however,

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[33] Owen Wheeler, *The War Office, Past and Present* (London: Methuen & Co., 1914); Gordon, endflap.
[34] Sweetman, 59-76.
[35] Hogg 1963, 670. The Arsenal had over 20,000 employees during the Boer War, the highest number of workers before 1914; see p. 1290.

concentrates more on army reform efforts in areas such as recruitment, training, and promotion within line units (the infantry and cavalry) as well as the changing relationship between the military and British society.[36] The new military technologies that the army struggled with, however, are only mentioned in passing: changes occurred, were important, but seemingly "happened" on their own accord. There are exceptions, of course; the idea of technology as a force multiplier in the colonial wars, in particular, has been the object of several studies.[37] On the whole, however, the technological history of Britain's military revolution is still a subject left unexamined by academics.

"Technology," despite popular conceptions, represents much more than hardware; it is the knowledge used by humans to shape and interpret the world around them, and is the most visible expression of any given culture; in essence, technology embodies culture.[38] As a subgenre of historical studies, technological history has long been established. As with "new" military historians, technology historians seek to position their subjects in the larger context of human affairs. The works of Merritt Roe Smith, John Ellis, Dennis Showalter and others have taken this "socio-technical" approach in the study of military technology, as will this project.[39] By focusing on the activities of the ordnance committees and their relationship with

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[36] Examples include Gwyn Harries-Jenkins, *The Army in Victorian Society* (London; University of Toronto Press, 1977); Edward M. Spiers, *The Army and Society, 1815-1914* (London: Longman, 1980) and *The Late Victorian Army, 1868-1902* (Manchester, UK: Manchester University Press, 1992); Byron Farwell, *Mr. Kipling's Army* (New York: W. W. Norton & Company, 1981).

[37] Two examples are Howard Bailes, "Technology and Imperialism: A Case Study of the Victorian Army in Africa." *Victorian Studies* 24, no. 1 (1980): 83-104; Ian F. W. Beckett, "Victorians at War - War, Technology and Change." *Journal of the Society for Army Historical Research* 81, no. 328 (2003): 330-38. David Headrick has devoted much work to technology and imperialism; see "The Tools of Imperialism: Technology and the Expansion of European Colonial Empires in the Nineteenth Century." *The Journal of Modern History* 51, no. 2 (1979): 231-63; *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York: Oxford University Press, 1981) and *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York: Oxford University Press, 1988).

[38] Melvin Kranzberg and Carroll W. Pursell, "The Importance of Technology in Human Affairs" in *Technology in Western Civilization*, edited by Kranzberg and Pursell (New York: Oxford University Press, 1967), 3-11.

[39] Merritt Roe Smith, *Harpers Ferry Armory and the New Technology: The Challenge of Change* (Ithaca, NY: Cornell University Press, 1977); John Ellis, *The Social History of the Machine Gun* (London: Purnell Book

the government and public, this project will show the evolution of military technology and the development processes at work in mid-nineteenth-century Britain.[40] Such an approach stresses the complex and intertwined relationship between people and technology, and illustrates the influence this relationship had on British culture and society.

There are a number of components of socio-technical history visible in the records of the British ordnance committee system. One such component is the very cyclical nature of the inventor-adopter relationship, evident in the back-and-forth between the Ordnance Select Committee (OSC) and Sir William Armstrong, an iron-monger turned arms-maker and inventor of Britain's first successful breech-loading rifled cannon. Marshall J. Bastable, in his examination of Armstrong, asserted that "it is individual inventors who transform ideas into working hardware."[41] As the *Abstracts* show, however, the development of new weapons technology required considerable participation by many others to work out the details. Few proposals received clearance for testing; for those that did, the ordnance committees oversaw experiments, consulted with the inventor, sought the input of the various heads of Arsenal departments, and occasionally made suggestions themselves, before finally approving an item's adoption into service. Complex systems such as ordnance required changes in a wide variety of materials, such as ammunition, gun carriages, material handling equipment, and so forth. Although suggestions for the same did come from Armstrong

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Services, 1975); Dennis E. Showalter, *Railroads and Rifles: Soldiers, Technology, and the Unification of Germany* (Hamden, CT: Archon Books, 1975). Barton C. Hacker wrote a very useful survey regarding military technology history, see "Military Technology and World History: A Reconnaissance." *The History Teacher* 30, no. 4 (1997): 461-87.

[40] The term is borrowed from Günter Ropohl's article, "Philosophy of Socio-Technical Systems," *Society for Philosophy and Technology*, Vol. 4 No. 3, Spring 1999, http://scholar.lib.vt.edu/ejournals/SPT/v4_n3html/ROPOHL.html. Ropohl identifies a *socio-technical system* as a "concept...established to stress the reciprocal interrelationship between humans and machines and to foster the program of shaping both the technical and the social conditions of work, in such a way that efficiency and humanity would not contradict each other any longer."

[41] Bastable, Marshall J. "From Breechloaders to Monster Guns: Sir William Armstrong and the Invention of Modern Artillery, 1854-1880." *Technology and Culture* 33, no. 2 (1992): 213-47; fn. 2.

himself in many cases, hundreds of other individuals brought forward proposals and recommended improvements, all of which the ordnance committees had to consider. Finally, in addition to evaluating a weapons system for initial adoption, the committees also monitored the performance of the system in the far corners of Britain's expanding empire, including reports of accidents and even resistance to change from local unit commanders.[42]

Another component of socio-technical history documented in the *Abstracts* is the degree of participation by civilian society in the proposal and production of new weapons systems. While private inventors had a long history of bringing ideas before the old Board of Ordnance, the Crimean War prompted a flood of proposals from an inventive and entrepreneurial public. Subsequent conflicts and war scares also prompted submissions of new inventions to solve perceived shortcomings in military gear. Mostly unsolicited, these proposals passed unfiltered to the ordnance committees, who spent considerable effort weeding the absurd from the useful. Statistical analysis of the *Abstracts* shows a pattern that corresponds with British militarization having "accelerated in the 1850s, declined in the 1860s and 1870s, [and] returned with a vengeance in the 1880s."[43] Such evidence directly challenges Martin J. Wiener's choice of this era as a starting point for the decline of British industry and inventiveness.[44] The records also show, however, that public participation tapered off to a trickle in the late 1890s, as weapons systems grew more complex and the

[42] How militaries handle technological change has been the subject of numerous academic studies, but for the most part such studies concentrate on 20th-century weapons, especially post-World War II. For a summary of the field, see Adam Grissom, "The Future of Military Innovation Studies," *Journal of Strategic Studies* 29, no. 5 (2006/10/01 2006): 905-34. For a broader historical scope, see Jeremy Black, "Military Organisations and Military Change in Historical Perspective," *The Journal of Military History* 62, no. 4 (1998): 871-92. Theo Farrell explored a number of factors that influence military innovation, that, while again based on recent history, can be used to build a model for Victorian Britain; see Theo Farrell, "The Dynamics of British Military Transformation," *International Affairs (Royal Institute of International Affairs 1944-)* 84, no. 4 (2008): 777-807.

[43] Marshall J. Bastable, *Arms and the State: Sir William Armstrong and the Remaking of British Naval Power, 1854-1914* (Aldershot, Hants, UK: Ashgate, 2004), 5

[44] Martin J. Wiener, *English Culture and the Decline of the Industrial Spirit, 1850-1980* (Cambridge: Cambridge University Press, 1981).

British military industrial facilities increased their own research abilities. Regardless, the public participation in harnessing the power of the ongoing Industrial Revolution is a key component of British militarization before 1914.[45]

Like civilian technologies, "miltech" (to use the industry buzzword) is open to negotiation between social elements seeking to influence the process of change. Military technology also embodies a society's ability to project force for whatever purpose is deemed important – thus expanding the number of social elements interested in its development. The ordnance committees, as the gatekeepers of British military technology, filled an essential negotiator role between military and civilian elements of British society and the changes made possible by the ongoing Industrial Revolution, and its choices reflect the embodiment of British culture in its military technology. The formation of the OSC in 1855 also signaled the rise of what David Edgerton has termed the "warfare state," a "pioneer of modern, technologically focused warfare…operated not just by bureaucrats but also by technicians."[46] The creation of a professional committee of technicians that answered to the bureaucrats of the War Office puts the origins of this "warfare state" far earlier than even Edgerton argues.

The ordnance committees also wrestled with increasingly difficult priority-of-invention issues unresolved by the patent laws of the time. Despite an overhaul in 1852, the Patent Office lacked a method for verifying the originality of a patent application.[47] Numerous inventors came forward claiming infringement of their ideas, and the committees delved, sometimes deeply, into their own archives investigating such issues. Despite an institutionalized desire for a military at the least possible cost, the committees did

[45] Geoffrey Best, "The Militarization of European Society, 1870-1914" in *The Militarization of the Western World*, edited by John R. Gillis. 13-29 (New Brunswick: Rutgers University Press, 1989), 14.
[46] David Edgerton, *Warfare State: Britain, 1920-1970* (Cambridge: Cambridge University Press, 2006), 1.
[47] Stephen Van Dulken, *British Patents of Invention, 1617-1977: A Guide for Researchers* (London: The British Library, 1999), 3-4.

occasionally, at times even generously, find in favor of the aggrieved inventor or his estate. The committees also judged new materials on their potential worth to the service, balanced against the cost of royalties or the potential of "embarrassment to Government" in cases of infringement. Lastly, the ordnance committees helped develop new rules regarding employees of the "manufacturing departments" of the Royal Arsenal, eventually prohibiting the obtainment of patents and the solicitation of reward money for work done in the course of their duties.

British borders did not limit the proposals and improvements considered by the ordnance committees, illustrating the growing importance of the international arms industry. Many foreign inventors stepped forward with their ideas, eager to tap into the British military market. These inventors disregarded any issues about trading with a potential enemy, as illustrated by the number of German nationals perfectly willing to sell details of the supposedly secret Prussian breech-loading rifle. British inventors, in turn, were not hesitant to do the same; many threatened to take their inventions to "other powers" if the British military declined to purchase them. The committees also showed no favor to British inventors over others, preferring only that a product prove superior to competing designs and could be licensed for manufacture by the Royal Arsenal at a reasonable cost. In addition, the committees kept a close eye on foreign military technology, via news articles, visiting-officer reports, or exchange of recently adopted weapons systems with other nations.

The Victorian Military-Industrial Complex

The *Abstracts* also complement a growing body of study regarding British military and industrial relations in the second half of the nineteenth century, a relationship that had many rough spots both before and well after the Crimean War. Prior to that conflict, the army relied on the "gun trade" for iron ordnance and infantry weapons. The heavy weapons came from large iron works such as Mersey Steel and Iron and the Carron Company, famous for developing the short-barreled carronade used by the British navy in the French Revolutionary and Napoleonic Wars.[48] Personal weapons, such as muskets, pistols, swords and bayonets, were still produced by hundreds of specialty artisanal shops, mostly located in Birmingham. Much as they had done for centuries, these shops produced all of the individual pieces of weapons – stock, barrel, screws, locks, etc. – which were then passed to other shops to be fitted together by hand. As James H. Lewis has argued, this gave the private trade a degree of flexibility that allowed it to cope well in producing weapons for the African, sporting, and military markets, the latter including both the Board of Ordnance and East India Company.[49]

The stress of the Crimean War led to a significant change in the relation between government and the "gun trade." Frustration with slow delivery of the new Enfield rifle, for example, led to the establishment of the Royal Small Arms Factory (RSAF) in 1855. This in turn led several leading Birmingham gun makers to band together to form the Birmingham Small Arms Company (BSA) in 1861, the first English private firm to produce small arms by machine.[50] Public funding helped Sir William Armstrong establish the Elswick Ordnance Co. in 1859, and the War Office appointed him head of the new Royal Gun Factory at Woolwich. Just as soon as the Arsenal had reorganized to make iron ordnance on its own, however, the British government cut its support for Elswick, which forced Armstrong to look abroad for

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[48] "Mersey Steel and Iron Co.," *Grace's Guide: British Industrial History*, 21 Jan 2014, http://www.gracesguide.co.uk/Mersey_Steel_and_Iron_Co, and "Carron Co.," *Grace's Guide*, 22 Nov 2014, http://www.gracesguide.co.uk/Carron_Co.

[49] James H. Lewis, "The Development of the Royal Small Arms Factory (Enfield Lock) and Its Influence upon Mass Production Technology and Product Design C1820-C1880" (PhD, Middlesex University, 1996), 66.

[50] Lewis, op.cit.; David O. Pam, *The Royal Small Arms Factory, Enfield and Its Workers* (Enfield: D. Pam, 1998). BSA later diversified very successfully into motorcycle manufacture, and most of its chroniclers concentrate on this aspect of the company rather than on its small arms history. See Donovan M. Ward, *The Other Battle: Being a History of the Birmingham Small Arms Co. Ltd*. (York: B. Johnson, 1946) and Owen Wright, *BSA: The Complete Story* (Ramsbury, Marlborough, Wiltshire, UK: Crowood Press, 1992).

new orders.[51] Both private companies, therefore, came to being because of government action. While they did produce weapons for the British military, government action also forced both to go abroad in search of new markets.

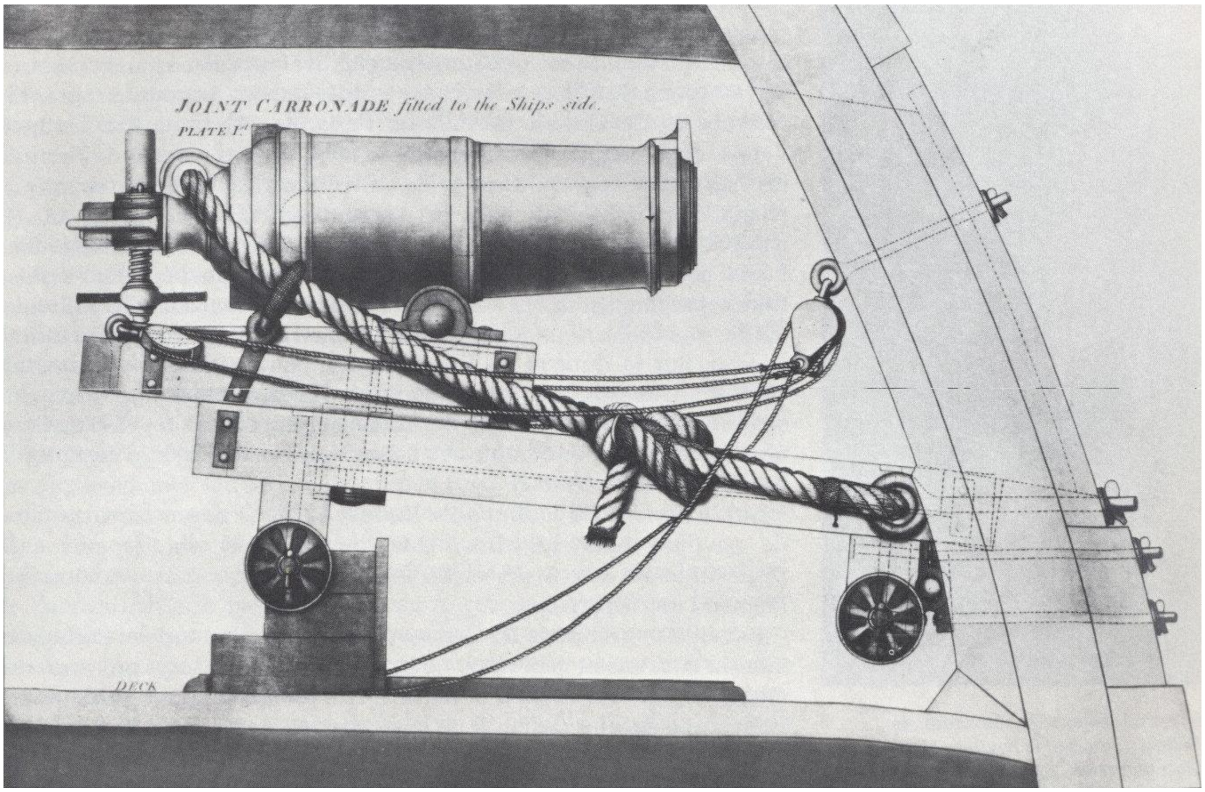

Figure 1: The short-barreled "carronade" developed by Carron Iron Works. Although range was extremely limited, the large bore made the weapon devastating for close ship-to-ship actions.[52]

Despite the launch of these two companies, over the next decades the War Office relied heavily on its own facilities for the manufacture of military hardware. RSAF historians Tim Putnam and Daniel Weinbren wrote that "in establishing a fully mechanized small arms factory, Government had wished to create a supply which could be turned on or off at will."[53]

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[51] "Elswick Ordnance Co., *Grace's Guide*, 14 Jan 2014, http://www.gracesguide.co.uk/Elswick_Ordnance_Co. See also Bastable, *Arms and the State*, and "From Breechloaders to Monster Guns."

[52] "Carronade (schematics)" by Unspecified - scanned from Vaisseau de Ligne, Time Life, 1979. Licensed under Public Domain via Wikimedia Commons, accessed 24 Mar 2015; http://en.wikipedia.org/wiki/Carronade#/media/File:Carronade_%28schematics%29.jpg.

[53] Tim Putnam and Daniel Weinbren, "The Royal Small Arms Factory and Industrial Enfield 1855-1914." *London Journal* 21, no. 1 (1996): 46-63.

This holds true for the manufacturing departments at Woolwich, which expanded considerably during the second half of the nineteenth century. Given the military budgetary process, in which monies were voted on a yearly basis and anything not spent had to be returned to the Treasury, having its own manufacturing facilities meant that the War Office could better control arms spending. They also gave it the means to estimate costs of production, a useful tool for controlling the prices for materials obtained on contract.

Such information came with a price, however. Royal Arsenal officials succumbed to the same "endemic disease" that plagues modern bureaucrats: "the irresistible urge to expand a department's size, budget and authority by asserting control over more and more key missions and initiatives."[54] The Royal Arsenal continued to grow and expand as it added more and more internal capabilities over the course of the second half of the nineteenth century; its acreage just at Woolwich doubled while its work force jumped by the thousands.[55] While it acted as an effective development facility and as a check on prices from private industry, the Arsenal also competed with that same industry for skilled workers. Peacetime reliance on the Crown facility also gave it a near-monopoly on increasingly complicated technologies such as artillery shell fuzes. The lack of familiarity with such items, however, meant that British private industry could not rapidly meet emergency requirements in times of war.

In addition, the War Office tended to use its various ordnance committees for weapons development, rather than just evaluation. This assumed a high level of technical knowledge on the part of the committee members, but left the body as a whole open to

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[54] Ron Arnold, "How the EPA's empire-building got in the way of its science." *Washington Examiner*, 01 July 2014, http://washingtonexaminer.com/how-the-epas-empire-building-got-in-the-way-of-its-science/article/2550395.

[55] The Arsenal stood at 446 acres and an estimated number of workers of 2,500 in 1855; this increased to 954 acres and an average of 15,434 employees and military personell by 1898; see Hogg 1963, 1289-1292.

personal prejudices and opinions on technical matters. Rather than simply license the best form of infantry weapon available, for example, small arms committees consistently took a "we-can-do-it-better" approach. Every new infantry rifle design, from the Pattern 1853 muzzle-loading rifle forward, took components from other designs: rifling from one inventor, an action from another, a cartridge from a third, and so forth. With the exception of the Snider breech-loader, which was a conversion of the already proven Pattern 1853, the "design by committee" method meant every new British rifle took years to go from initial design to adopted weapon.[56] By contrast, a U. S. evaluation board appointed in 1872 to select that nation's first purpose-designed breech-loader had a final decision within a year.[57] Such foot-dragging on the part of British meant that both the Crimean and Second Boer Wars caught their infantry not only with too few rifles, but also in the midst of a changeover in their primary weapon.

Finally, Parliamentary cheese-paring greatly complicated British weapons programs. Unlike France, Britain required hopeful inventors to fund the testing and initial development of any proposal brought before the War Office, due in part to a constant parade of charlatans who occasionally did get the better of the Board of Ordnance.[58] Such a policy kept

[56] In fairness, other major European countries held the same attitudes, the exception being Russia. Recognizing that it lacked the technical expertise to produce its own rifles, the Tsar turned to Colt in the U.S. for assistance. Russian arsenal officials worked closely with Col. Hiram Berdan in the design of its new small-bore breech-loader, and ordered the first 30,000 from the Colt factory. It also placed orders with BSA, but the Russian inspector at that factory reported a "shocking percentage of defects in the parts" made there because of a lingering reliance on manual finishing. See Joseph Bradley, *Guns for the Tsar: American Technology and the Small Arms Industry in Nineteenth-Century Russia* (DeKalb, IL: Northern Illinois University Press, 1990), 154-155, and George A. Hoyem, *The History and Development of Small Arms Ammunition* Vol. 2: Centerfire: Primitive, and Martial Long Arms (Tacoma: Armory Publications, 1982), 190.

[57] "Report of the Board for Selecting a Breech-System for the Muskets and Carbines of the Military Service." In *Ordnance memoranda No. 15* (Washington: Ordnance Department, United States Army, 1873), 7-8.

[58] In a case well known in its day, one Samuel Alfred Warner claimed that by means of his "invisible shell" and "long range" he could "in a few hours" depopulate the British stronghold of Gibraltar. Warner made pretensions to the naval rank of "captain" because of his supposed service aboard a secret vessel employed "in landing spies" during the Napoleonic Wars. Although Warner claimed he had completely destroyed two

speculative, immature, or absurd projects from consuming scarce public funds, but it also strangled worthy projects, such as the conversion of Navy revolvers from cap-and-ball to cartridge weapons. Much more importantly, it contributed to the termination of Britain's first effort at breech-loading field artillery. Had the country persisted in perfecting Armstrong's gun designs, the nation would have been several years ahead of its Continental counterparts in fielding an accurate and effective breech-loading gun. Instead, the Armstrong project suffered from bureaucratic jealousy on the part of the Arsenal, Parliamentary reluctance to spend money on the military, conservative military thinking, and imperfect technology. Britain therefore retained wrought-iron rifled muzzle-loaders well beyond when other world powers had moved on to steel breech-loaders.

Once England finally recognized the need to upgrade its artillery in the early 1880s, private industry and its allies in the House of Commons made a serious attempt to crack the near-monopoly held by the Royal Arsenal. The attack began with a protest regarding large cast steel ingots for guns. The nation's leading steel producers were reluctant to expand their works without assurances from the government that purchases would be forthcoming; Woolwich, meanwhile, had been surreptitiously increasing its own ability to cast steel. The issue came to a head in 1885; as discussed in Chapter 6, Liberals began a political effort to keep Woolwich out of the heavy steel business. Both the War Office and the Lords of the Admiralty sided with the steel producers; reassured that they would get government contracts, firms such as Vickers and Sons expanded their plant to produce the massive ingots

French privateers with his inventions during the wars, no trace of either his service, the vessel he claimed to have been on, or the destroyed French ships ever came to light. Warner found a Parliamentary backer to champion his projects, and managed to con the Board of Ordnance to out of £1,300. See "The Contemporary Press: The Long Range," *Taunton Courier, and Western Advertiser*, 07 August 1844, 7, and HCPP, "Mr. Warner's Invention. An Account of Public Money Placed at the Disposal of the Officers Appointed by Her Majesty's Government to Report Upon the Trials to Be Made of Mr. Warner's Invention Called 'Long Range,' to Enable Him to Exhibit Its Powers; &c.," 1847 (302).

needed for heavy naval guns.[59] Within a few years, Vickers had contracts with the government for completed guns as well.

Another company that fought its way into the private arms trade would that of Joseph Whitworth and Co. A mechanical engineer of considerable renown, Whitworth had a long and occasionally controversial relationship with the Royal Arsenal. In the 1860s he challenged Armstrong's breech-loading gun design with his own, as well as developing a unique hexagonal form of rifling. The lengthy "Armstrong-Whitworth trials" consumed thousands of pounds, hundreds of hours of the OSC's time, and inches of column space in the daily papers; ultimately the Armstrong designs prevailed. Undeterred, Whitworth returned to the scene again in the early 1880s with new guns designs as well as a new process for casting steel, ultimately restarting a several-year track record of gun sales to the Navy. Ironically, the Armstrong and Whitworth companies merged in 1897.[60]

To close out this section on the British military-industrial complex under development in the nineteenth century, mention must be made of the arsenal system developed by the East India Company. By the time of the Indian Mutiny of 1857, the three "presidencies," or regional governments, had their own ordnance factories under the supervision of their own officers, which produced "supplies of gunpowder, brass ordnance, gun-carriages and other vehicles, percussion caps, bullets, and many other stores."[61] By 1840, a new iron foundry began turning out shot and shell, and made attempts at casting guns as well, but for the most part the Company obtained its iron ordnance from the trade in England. For small-arms, the Company relied on the Birmingham gun trade, often paying

[59] "Sheffield Trade for 1885." *Times*, 5 Jan. 1886, 13.
[60] "Armstrong Whitworth," Grace's Guide, 12 Mar 2015, http://www.gracesguide.co.uk/Armstrong_Whitworth.
[61] Henry Alfred Young, *The East India Company's Arsenals & Manufactories* (Oxford, UK: Clarendon Press, 1937; rep. The Naval & Military Press Ltd, Uckfield, East Susses, 2006), 2.

better than the Board of Ordnance without as much fuss over finished quality.[62] Ammunition for small arms was produced locally, however; indeed, the Mutiny was sparked in part by the loading of the new form of cartridge required by the Pattern 1853 Enfield rifle, which required that an outer section of the cartridge be coated in some form of lubricant.[63]

With the take-over of the Company by the British government following the Indian Mutiny, Indian army and ordnance organization soon came under close scrutiny. By 1884, the separate ordnance departments had been consolidated into one, headed by a Director-General of Ordnance, stationed at the Indian Office in London. Under him came three Inspector-Generals of Ordnance, stationed in their respective presidencies and responsible for ordnance operations territory-wide.[64] The Indian Office also undertook considerable expansion of local arsenals and factories to decrease dependence on an uncertain and lengthy supply route, with the exception of ordnance development.[65] Left in the hands of the OSC and its successors, Indian requirements increasingly had to be taken into consideration in the design of new forms of ordnance, especially simplicity and ruggedness in the field. Such considerations helped contributed to the downfall of Armstrong's first breech-loading gun, and the lengthy retention of rifled muzzle-loading ordnance in British service.

A Successful – or Failed – Revolution?

Although the *Abstracts of Proceedings* left by the various ordnance committees can provide historians with considerable detail regarding the technology debates of the day, that information must naturally be combined with data from other sources. Extensive use has

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[62] David. J. Williams, *The Birmingham Gun Trade* (Stroud, Gloucestershire, UK: Tempus, 2004)
[63] Daniel R. LeClair, "The 'Greased Cartridge Affair:' Re-Examining the Pattern 1853 Enfield Cartridge and Its Role in the Indian Mutiny of 1857," 2014.
[64] Young, 40.
[65] Kaushik Roy, "Equipping Leviathan: Ordnance Factories of British India, 1859–1913." *War in History* 10, no. 4 (2003): 398-423.

been made throughout this project of newspaper articles and "letters-to-the-editor," for example, to build the argument for extensive public interest in all aspects of the British military. In addition, the official reports and minutes of testimony recorded by the various committees appointed to study British military administration have also been examined, as have relevant Parliamentary debates. What emerges from this mass of information is a record of mixed success in coping with the rapid changes in military technology by successive Victorian governments, as well as a clear failure to resolve the "disastrous muddle" in military administration before the Second Boer War.

Such mixed results were not experienced by the British alone; all large militaries had to grapple with the problems of rearmament as the Industrial Revolution spawned new technologies. Improved metallurgy and construction techniques allowed gunmakers to build rifled ordnance of immense size, made accurate by improved sighting instruments and recoil-absorbing gun carriages and forever altering the ship-versus-shore coastal defense debate. Generals struggled with changes in tactics and logistics brought by the faster-firing breech-loading rifle, and argued over the value of rudimentary forms of machine guns then under development. Decisions regarding armaments, however, were affected by much more than cold, rational choices based on the best available weaponry. Most major European powers as well as the United States adopted some plan for the conversion of their huge stocks of muzzle-loading infantry weapons, for example. Conversions were cheap, expedient, and easy to sell to budget-conscious governments while ordnance officers considered the question of the best form of rifle for the future. Battlefield experience also played a considerable role in technology decisions. The French, satisfied with the performance of their new rifled muzzle-loaders against the Austrians in 1859, chose to retain their bronze field-pieces well past their prime. The Prussians, greatly dismayed by the performance of their field artillery in 1866 in their own war with Austria, chose to completely rearm with Krupp steel breech-loaders firing improved shells.[66] The two different national choices became immediately apparent in the battlefields of 1870, when Prussian guns overwhelmed their French opponents.

Britain, on the other hand, had a different set of decision points at work regarding rearmament, including its own battlefield experience. Although involved in constant campaigns across the globe through the entirety of Victoria's reign, only two wars – the Crimean and Second Boer Wars – proved large enough to seriously strain Britain's military capabilities. In addition, British field artillery decisions were driven more by the need for simplicity and ruggedness– a lesson continually reinforced by campaign experiences in India, beginning with the Mutiny of 1857. A long overseas supply line also presented complicated logistics issues for remote outposts, meaning that improvements in the multifarious components of an artillery piece might be weeks or months en route. Both were contributing factors to the retention of rifled muzzle-loading guns by the Victorian military well beyond the point when other nations had adopted better weapons.

In addition, the social aspect of British military administration also affected technology decisions in this era as the War Office struggled to transition from an *ancien régime* to a more modern model. The chief obstacle to such a transition remained Prince George, Second Duke of Cambridge and Commander-in-Chief of the British army. Although he served in the Crimean War, on his assumption of the post in 1856 the Duke brought little practical experience to the office. He also felt that the relationship between the Crown and

[66] Geoffrey Wawro, *The Franco-Prussian War: The German Conquest of France in 1870-1871* (Cambridge, UK: Cambridge University Press, 2005), 58.

Horse Guards, the headquarters of the army, “could not be too strong or too close.”[67] Such a relationship would be directly threatened by reforms made in 1870, which made the Commander-in-Chief subordinate to the civilian Secretary of State for War. Coupled with the Duke’s thirty-nine year occupation of the post and an increasingly conservative approach to military matters, Cambridge proved an effective damper on reform efforts until his retirement in 1895.

Perhaps the biggest weakness suffered by Britain, and one that gravely affected all aspects of its military, was Government’s insistence on running the War Office as a peace-time establishment. As with other departments of the bureaucracy, this put emphasis on efficiency and frugality rather than preparedness for war.[68] Such treatment stemmed from a political reaction to the myriad social, technological and political changes in action from the middle of the century on. As detailed by H. C. G. Matthew, most British politicians felt they could maintain political, and hence social, stability in the nation through the proper balance of direct and indirect taxation, which impacted different strata of society. Although the Conservatives and Liberals approached the question from different angles, both subscribed to the basic tenets of Gladstonian finance – a “steady surplus of income over expenditure,” “relief of the people” through lower indirect taxes, and the “temporary character” of the income tax levied on those who qualified for the vote. Such goals could only be only be obtained by reductions in one or both of the two major expenditures of public money: defense spending and the national debt.[69] Rather than decrease the latter, Government

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[67] Sir Charles Petrie, “An Eccentric at the Horse Guards: ‘The Royal George 1819-1904,’ by Giles St. Aubyn,” *The Illustrated London News*, 09 Nov 1963, 769.
[68] HCPP, “Report of the War Office (Reconstitution) Committee, Part I,” 1904 (Cd. 1932), 3.
[69] H. C. G. Matthew, “Disraeli, Gladstone, and the Politics of Mid-Victorian Budgets.” *Historical Journal* 22, no. 3 (1979): 615-44. See also Angus B. Hawkins, “A Forgotten Crisis: Gladstone and the Politics of Finance During the 1850s.” *Victorian Studies* 26 (Spring 1983): 287-321; Graham Goodlad, “From Peelite Technocrat to People's William.” *Modern History Review* 16, no. 1 (2004): 17-20.

throughout the nineteenth century concentrated its cost reduction efforts in the arenas of military and naval spending, and helped perpetuate the "disastrous muddle" despite the best efforts of British military reformers.

Evidence of this continued muddle is shown throughout the *Abstracts of Proceedings* and related government documents, beginning with the 1868 decision to disband the Ordnance Select Committee. As far as can be determined, financial considerations were the only reason for removing what seemed to be a very effective tool for weapons development. Instead of a single body dedicated to the task, the OSC's work devolved to several smaller and occasionally overlapping committees formed as needed to consider topic-specific programs (see Appendix 3). The decision did eliminate the direct costs directly associated with the OSC, easily measured for a single supervisory body but not so when the work was spread out over numerous – and multiplying – evaluation committees. In addition, the model of topic-specific committees came from a flawed pattern: the Fletcher Committees, tasked with developing the .45-inch Martini-Henry rifle, Britain's first completely new breech-loading infantry weapon. Ultimately, perfecting that rifle involved the work of a dozen committees over the course of ten years, and its follow-on, the .40" Enfield-Martini, ended up being scrapped. Such issues show that the problems that plagued British military administration reached deep indeed.

The personal characters of the men involved in decisions about military technology also made a difference. Blessed with the talents of energetic Royal Artillery officers such as Edward M. Boxer and civilians such as Frederick Abel, Britain made tremendous strides in its weaponry in the first decade-and-a-half after the Crimean War. The actions and opinions of others, however, cost Britain its early lead in ordnance technology. Gen. Sir John Adye, appointed Director of Artillery in 1870, was one of a number of artillery and naval officers who argued for the retention of wrought-iron rifled muzzle-loading artillery in spite of the French battlefield experiences against Prussian steel breech-loaders.[70] Secretary of State for War Hugh Childers doomed the Enfield-Martini program with his insistence on retaining the single-shot Martini action, when other countries were investing in repeating rifles. Such demands and opinions retarded the progress of British armaments after the dissolution of the original Ordnance Select Committee, until a fatal accident aboard *HMS Thunderer* aroused considerable public debate about the state of British weaponry in 1879.

As with the Industrial Revolution, the military revolution of the nineteenth century saw changes in weapons technology grouped in waves. By 1870, "a new period of great guns" had transformed the world's major powers as the first wave crested.[71] Although the rate of proposals put before the ordnance committees dropped during the 1870s, military technological change continued, driven by government research, civilian inventors, and "a state system…clearly bent toward war and bound to live in constant preparedness for it."[72] Taking off again in the mid-1880s, a second wave saw many of the components of modern warfare adopted or being perfected by British weapons designers. By 1897 – the last year of the published *Abstracts of Proceedings* for the Ordnance Committee – the British army had adopted the Lee-Metford magazine rifle, the Maxim machine gun, and steel breech-loading artillery, tools that ensured its battlefield supremacy in the last of its colonial wars, the reconquest of the Sudan. The Battle of Omdurman in 1898 served to demonstrate the effectiveness of these tools. A massive Sudanese army charged straight into the teeth of

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[70] E. M. Lloyd, rev. James Lunt. "Adye, Sir John Miller (1819–1900), Army Officer." *ODNB*, 2004, http://www.oxforddnb.com.ezproxy.lib.uh.edu/view/article/176.

[71] Subj. 744, TNA, SUPP 6/4, "Abstracts of Proceedings and Reports of the Ordnance Select Committee for the year 1862," 343.

[72] Best, 14.

disciplined British and Egyptian fire, with catastrophic results: nearly 11,000 dead and thousands more wounded, against an Anglo-Egyptian loss of forty-eight men.[73] It would seem, then, that most if not all the old constraints on warfare had finally been removed.

The British public did not have long to celebrate such a lopsided victory, however. A scant year later, an expeditionary force sent to pacify the Boers in South Africa ran in to a rude surprise – an enemy not armed with swords and spears, but the latest in European firepower. The "Black Week" of December, 1899 saw three defeats of British forces and the near surrender of the garrison at Ladysmith; these were followed by further defeats in January and February of the next year.[74] For the public, it was a scandal reminiscent of 1854, with "almost all aspects of the British military system found wanting in a war against 50,000 farmers."[75] The early stages of the war made clear that the nation's primary restriction on warfare remained an internal one: the "disastrous muddle" of that still existed in a "military administration that had never been designed, but which had grown piecemeal, with piecemeal demolitions and re-building, ever since 1660."[76]

"Black Week" also triggered the third wave of the British military revolution, which eventually gave the army quick-firing artillery and a redesigned infantry rifle. In addition, Government finally threw out the muddled administrative system rather than try to repair it one more time. The reforms that emerged from post-war investigations led to a drastic overhaul in the War Office and army leadership from top to bottom. Changes included the elimination of the antiquated post of Commander-in-Chief (C-in-C), establishment of an Army Council to unify policy decisions and a general staff to assist in battlefield ones, and

[73] Boot, 167
[74] Barnett, 339-340.
[75] Barnett, 346.
[76] Barnett, 359.

reorganizations of subordinate departments. Initiated by the Esher Committee of 1904 and furthered by Richard Haldane, who assumed the post of War Secretary in 1906, such reforms produced a peacetime army "gripped with a sense of professional purpose" and designed to take the field in Europe within fifteen days – a capability unheard of for the Victorian army.[77] Citing Brig. Gen. J. E. Edmonds, historian Edward Spiers wrote that "in every respect the Expeditionary Force in 1914 was incomparably the best trained, best organized, and best equipped British Army which ever went forth to war" – a far cry from the disastrously ill-prepared force sent to the Crimea sixty years earlier.[78]

In terms of technology, administration, and the ability to project power outside of Europe, the British military revolution succeeded. Where it failed, however, was in preparing the British military – indeed the entire country – for the totality of modern warfare, despite what should have been among the lessons taught by the American Civil War.[79] Without conscription and over-reliant on the Royal Arsenal for weaponry, Britain had no means for rapidly assembling an army the size of potential Continental opponents, and could not arm one if it did. Instead, in the case of a large-scale war in Europe, Britain planned to play the naval power, using its small expeditionary force to assist where needed – "the traditional and ever-hopeful view" that a Continental war might be resolved without too much cost to the British taxpayer.[80] It was a plan that nearly produced disastrous results in World War One.

Regardless of how one views the success or failure of the British military revolution, the public participation in weapons development during this period remains a unique aspect, and offers historians much to study. For the military and technology historian, it is a story of

[77] Barnett, 360-367.
[78] Spiers 1980, 284.
[79] Jeremy Black has an excellent discussion of the concept of total war in his introduction to *The Age of Total War, 1860-1945* (Westport, CT: Praeger Security International, 2006).
[80] Barnett, 373.

incredible change in Britain's ability to project power and influence neighbors, driven in large part by public interest. For the social historian, it is one of important and incessant negotiations that occurred within a society undergoing a period of radical technological upheaval. For the British historian, it is a dichotomy of success and failure, inertia and change, that occurred as Britain found itself wrenched into a new era where the old, understood solutions to technological problems no longer applied, where an island nation could no longer hide behind the wooden walls of its Navy. For historians focused on colonial or imperial history, it is a story of the technologies that allowed Britain to control so much of the non-European world. In short, the military revolution launched in 1854 is a critical part of modern British history, and it is the public participation in that revolution which this project aims to explore.

Chapter 1: "Pregnant with Disastrous Muddle:" British Military Administration and Procurement before 1855

The nineteenth-century British army that developed across the centuries reflected two competing ideologies: a fear of a powerful standing army, beholden to the monarch and which might again challenge Parliament, and the need to defend the home Isles – and a growing overseas empire – against Continental neighbors equipped with such armies. The British military and its administrative system embodied these fundamentally opposite viewpoints. Indeed, the British "Army" of the Victorian era cannot be referred to in the same sense as the U. S. Army can; no such formal institution existed. Instead, Parliament annually authorized a standing army through the Mutiny Act, which gave permission for whatever size body of troops had been agreed on for the year, but never referred to the "army" as a distinct entity.[1] Any given British expeditionary force sent abroad existed *ad hoc*, built from a collection of independent regiments of infantry and cavalry, with detachments of Royal Artillery and Engineers as needed. Although nominally under one commander when in the field, officers of the independent branches – artillery, engineers, supply and medical - still answered to their service commanders in England.

In the same manner, the military administrative "system" also consisted of a patchwork collection of offices with overlapping – and often competing – duties and priorities. Built and extended as needed, the system in 1854 "remained much what it had been under [Queen] Anne:" an *ancien régime* bureaucracy that lacked any centralized

[1] Barnett, 166. This practice continued with the "Army Discipline and Regulation Act" which replaced the Mutiny Act in 1879; although still not referring to an "army" as an institution, the act expressly gave permission for "a body of Royal Marine forces [to] be employed in Her Majesty's fleet and naval service." See HCPP, "Army Discipline and Regulation (Commencement). A Bill to Bring into Force the Army Discipline and Regulation Act, 1879, and for Other Purposes;" 1878 (248).

directing authority and highly resistant to reform.[2] What changes that had taken place occurred in its individual parts, never to the system as a whole. Such a situation created a military "pregnant with disastrous muddle" that only worked under strong, experienced, and well-connected generals such as Marlboro and Wellington.[3] Unfortunately for the Crimean expeditionary force, its commander, the sixty-six year-old Lord Raglan, lacked such characteristics. The muddle simply overwhelmed him.

By 1854, an additional factor came into play regarding Britain's military: public opinion and public interest in things military. The Reform Act of 1832 expanded the size of the eligible voter pool from 400,000 to 650,000, and the number steadily increased to over a million by 1850.[4] The Act began the dissolution of the old political system that had existed since the reign of George III, moving it instead with a modern party-based electoral system that continued to develop into the 1870s.[5] As the system expanded, the opinions of the newly-franchised and mostly middle-class voting public became more important. Driven in large part by an expanding newspaper industry and fueled by tales of battlefield prowess in the Napoleonic Wars, this public opinion not only pushed for war with Russia, but also for change in the army on many different levels. Although reluctant to actually put on a uniform, the public at large enjoyed the spectacle of a well-turned-out military parade, the power displayed by the forges of the Royal Arsenal, and British military industry on display at the Great Exhibition of 1851. Mechanically-inclined Britons also sent hundreds of proposals to the Board of Ordnance for improvements in weaponry they were sure would give British

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[2] Barnett, 238.
[3] Barnett, 260.
[4] HCPP, "Parliamentary electors. Abstract of return of the number of parliamentary electors in Great Britain and Ireland, according to the registrations of 1848 and 1849, and 1849 and 1850;" 1850 (345).
[5] John A. Phillips and Charles Wetherell, "The Great Reform Act of 1832 and the Political Modernization of England." *The American Historical Review* 100, no. 2 (1995): 411-36.

forces an edge in battle.

To explore this complicated relationship between the army, the public, and the changes unleashed by the Crimean War, some background is required. This chapter lays out the state of British military administration before the war, as well as the political and military restraints on modernization. It also investigates the forms of public participation in military affairs, and in particular how the military responded to the submission of new ideas. This chapter, therefore, will also examine the mechanisms the British military used to examine new technologies, especially those suggested by the public, for possible adoption into the service. All of these aspects of British military administration would come under close scrutiny as a result of the Crimean War.

The British Military Administration Muddle

In 1849, *Blackwood's Edinburgh Magazine*, in reporting the opening of Parliament for the season, described the civil departments of Britain's forces as divided between "army, ordnance, and navy." [6] Telling in and of itself, *Blackwood's* description was also far too simplistic. Unlike the Royal Navy, whose administration fell solely to the Navy Board, the British army by 1854 labored under the direction of <u>six</u> different entities, divided between those with direct and indirect control.[7] The latter included the Home Office, who had approval authority over many military matters, control of the militia when reformed in 1852, and responsibility for "general military questions relating to Great Britain." It also included the Treasury, who approved military expenditure and had control of transport and provisioning through the Commissariat Department. Finally, the Secretary of State for War

[6] "The Opening of the Session," *Blackwood's Edinburgh Magazine* Vol. 65 (1849, 357-82), 361. *Blackwood's* paraphrased a speech by Lord Stanley, see also "Address In Answer To The Speech," HL Deb 01 February 1849 vol 102 cc5-72.

[7] Barnett, 19.

and Colonies answered to Parliament, in theory, for the general conduct of the army, and operations during wartime. The Secretary's office also determined the size of the force to be authorized by the annual Mutiny Act.[8]

The three departments that shared direct administrative control of the army included the civilian Secretary-at-War, the military Commander-in-Chief, and the mixed-breed Ordnance Department. The Secretary-at-War, a Member of the House of Commons, answered to Parliament in order to "control the expenditure of the army in the interests of the public purse." He also dealt with questions related to pay, pensions, interactions between military units and the civilian population, and had financial control of the Medical Department.[9] Both he and the Commander-in-Chief (C-in-C) held offices in the Horse Guards building, then headquarters for the British army. The latter officer, however, answered not to Parliament but directly to the monarch. The C-in-C held responsibility for the military operations of the army at home, as well as promotions and questions of discipline for the infantry, cavalry, and Medical Department.[10] Military control of the artillery and engineer branches fell to the Master-General of Ordnance. Although a political office whose holders changed when new governments came to power, the occupants were usually prominent army officers. Technically the head of the Ordnance Department, the Master-General also had charge of the Royal Military Academy at Woolwich, which trained future officers of Artillery and Engineers. Finally, the Master-General served as Ordnance's

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[8] Gordon, 40-50; Barnett, 282; A. Forbes, *A History of the Army Ordnance Services* (London: Medici Society, 1929), 259; Strachan, *Wellington's Legacy*, 9.

[9] Gordon 40-46; Barnett 239. It is important to note the difference between titles of "Secretary of State for War" and "Secretary-at-War." Secretaries of State were cabinet members and formed the highest rank of political office in Britain, short of the Prime Minister. Secretaries, such as the Secretary-at-War, ranked below Secretaries of State but were not necessarily subordinate to them. Answering directly to Parliament, the Secretary-at-War before Crimea "stood and acted still more than before as a *de facto* Secretary of State" (Gordon, 40).

[10] Gordon, 40-42, 50; Forbes, 259.

representative in Parliament.[11]

Having army administration spread across six different departments provided the main ingredients of the "disastrous muddle" waiting to swallow the Crimean expedition, and the lack of a central command authority kept those ingredients from forming a cohesive whole. Seated at the Colonial Office and concerned more with the expanding empire, the Secretary of State for War and Colonies made major military decisions but paid little actual attention to the business of the army. Those tasks fell to the Secretary-at-War, whose office had financial control over most aspects of the army and the militia but no command authority. The Commander-in-Chief, despite his title, did not have control of army units abroad, looked to the Home Secretary for approval of troop movements in Britain, and had no control over supplies at all. The Master-General, in contrast, retained command of artillery and engineer units wherever deployed. Treasury, through its Commissariat Department, handled supply in the field, but made no decisions regarding the weaponry used by the army. Such decisions came down from the Master-General's office, were implemented by the Ordnance Department, and approved by the Home Office.[12] The lack of a central directing entity, with authorities split between civilian and military departments, meant that the muddle remained just that – a chemical mixture that could not solidify into solid and effective performance of the British army in the field in 1854.

The muddle was further compounded by the uniquely British approach to military finance, which enforced the tripartite division of army, navy, and ordnance. The three

[11] Barnett 238-239, Gordon 50; Mike Comerford, "History & Arms of the Board of Ordnance: Ordnance Insignia of the British Army," April 2011, http://homepage.ntlworld.com/mike.comerford/ORDNANCE/01.htm.

[12] Gordon, 50; E. L. Woodward, *The Age of Reform: 1815-1870* (Oxford: Clarendon Press, 1962), 269; Strachan, *Wellington's Legacy*, 9. Curiously, in all of this was the distinct lack of any clear chain of communication and responsibility back to London for an expedition commander in the field; between the War of 1812 and the Crimean War, the issue never came up.

services were separately funded through yearly "estimates" which grouped various budgetary costs together into separate "votes" (see table below). Each vote had to be approved by Parliament, which provided Radicals such as Joseph Hume multiple opportunities to attack military spending. As a result, a considerable amount of administrative energy had to be expended in preparations of estimates that might – or might not – survive contact with Parliament. In addition, the annual nature of the estimates effectively prevented consideration of long term military needs. Such a financial system let politicians keep a close eye on military spending, but left the country without any form of strategic planning.

Table 1: Army, Ordnance, and Navy Votes, 1852

Department	Division	Vote	Description
Army[13]	Effective Services	1	Number of Men
		2	Charge of the Land Forces
		3	Staff Officers (exclusive of India)
		4	Public Departments
		5	Royal Military College
		6	Royal Military Asylum
		7	Volunteer Corps
	Non-Effective Services	8	Rewards for Distinguished Services
		9	Army Pay of General Officers
		10	Full Pay for Retired Officers
		11	Half Pay and Military Allowances
		12	Foreign Half Pay
		13	Widow's Pensions
		14	Compassionate List
		15	In-Pensioners of Chelsea & Kilmainham Hospitals
		16	Out-Pensioners
		17	Superannuation Allowances
Ordnance[14]	Effective Services	1	Pay, Allowances, and Contingencies for Personnel
		2	Commissariat and Barrack Supplies, Great Coats for the Army, and Clothing for Colonial Corps
		3	Ordnance Office
		4	Establishments (Ordnance, Barrack, Clerk of

[13] HCPP, "Army Estimates. Estimates of Effective and Non-Effective Army Services, from 1st April 1852 to 31st March 1853;" 1852 (50), 1.
[14] HCPP, "Ordnance Estimates. Estimates of Effective and Non-Effective Ordnance Services, for the Year 1852-53;" 1852 (69), 2.

			Works)
		5	Wages (Artificers, Labourers, &c)
		6	Ordnance Stores for Land and Sea Service
		7	Works, Buildings, and Repairs
		8	Scientific Branch
	Non-Effective	9	Non-Effective Services, Military and Civil
Navy[15]	Effective Services	1	Wages to Seamen and Marines, and Naval Reserve
		2	Victuals for above
		3	Admiralty Office
		4	General Register and Record-Office of Seamen
		5	Scientific Branch
		6	HM's Establishments at Home
		7	HM's Establishments Abroad
		8	Wages to Artificers at Home
		9	Wages to Artificers Abroad
		10	Naval Stores, &c., for the Building and Repair of Ships, &c.
		11	New Works, Improvements and Repairs in the Yards, &c.
		12	Miscellaneous Services
	Non-Effective Services	14	Half-Pay for Officers of the Navy and Royal Marines
		15	Military Pensions and Allowances
		16	Civil Pensions and Allowances
	External Services	17	Conveyance of Troops (Army and Ordnance)

"That Most Important Branch of the Public Service:" The Ordnance Department [16]

The Ordnance Department, the other branch of the civil administration named by *Blackwood's*, traced its origins to the creation of the "Office of Ordnance" by Henry V in 1414, who assigned to it the provision and maintenance of artillery and ammunition for both army and navy.[17] By 1854, Ordnance had become the second largest government department

[15] HCPP, "Navy Estimates for the Year 1852-53. [Account of Naval Old Store Moneys and Extra Receipts in 1851 Appended.];" 1852 (56), 2,

[16] "Board of Ordnance," *London Standard*, 09 Sep. 1833, 3.

[17] Hogg 1963, 27. Although the term "Office of Ordnance" still appeared in official notices made by the Board of Ordnance as late as 1852, the press and the military generally used the term "Ordnance Department." See "Barracks Contracts," *London Standard*, 23 Aug. 1852, 1.

(Treasury being the first) and straddled most aspects of British power projection.[18] Wide and far-reaching, the Department's duties centered on "the provision, custody and supply of every description of warlike stores…ordnance, carriages, small arms, ammunition, pontoons, tents and camp-equipage, entrenching tools; everything, in short which is required to arm a fleet or fortress [or] an army for the field."[19] The Department managed nearly 100 army storage depots at home and abroad (with the exception of India) as well as gun wharves that served the Royal Navy at every British port.[20] Ordnance also supplied non-military government entities, such as small arms for the Irish constabulary and Metropolitan Police, signal devices and rocket-propelled lifelines for the Board of Trade, and even tents to the Board of Health in times of civil emergency.[21] Non-government agencies looked to Ordnance for assistance as well, such as the Honorable East India Company, who bought from the Office what could not be produced by its own Indian arsenals or obtained from the trade.[22] The sprawling Royal Arsenal manufactured much of the "warlike stores" needed by the nation, supervised by Ordnance, which also oversaw inspection, storage, and the handling of contracts with outside suppliers. The Department also held responsibility for the building of barracks and fortifications on the home islands, and carried out cartographic surveys at home and in the Colonies to produce maps for both military and civilian use.[23]

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[18] Comerford.

[19] J. H. Stockqueler, as quoted by Strachan, *Wellington's Legacy*, 232.

[20] Forbes Vol. I, 190. Forbes noted that there were 92 army depots in 1849.

[21] Subj. 2321.5, The National Archives of the UK (TNA), SUPP 6/7, "Abstracts of Proceedings of the Ordnance Select Committee, 1865," 388; "A Village Encamped," *Bath Chronicle and Weekly Gazette*, 28 Aug. 1849, p. 2 noted that the Ordnance Department provided tents for the inhabitants of Megavissey, Cornwall "to live under whilst their village is being cleaned," probably during an outbreak of disease.

[22] HEIC also patterned nearly all firearms after those used by the British home army for the sake of conformity. This played a crucial role in the launching of the 1857 Indian Mutiny. See David F. Harding, *Smallarms of the East India Company, 1600-1856* (Four volumes: Foresight Books, 1997).

[23] George Raudzens, *The British Ordnance Department and Canada's Canals, 1815-1855* (Waterloo, Ont.: Wilfrid Laurier University Press, 1979), 16. Ordnance Survey still exists as an agency, functioning as "Great Britain's national mapping authority." See *Ordnance Survey*, accessed 10 Oct 2013, https://www.ordnancesurvey.co.uk/.

As noted above, the Master-General of Ordnance served as the titular head of the Ordnance Department and its chief military officer. This post also traced its origins to 1414, when Henry V appointed Nicholas Merbury as the first "Master of Ordnance."[24] Elizabeth I reorganized the entire Office of Ordnance in 1597, in the wake of widespread fraud and profiteering during England's war with Spain. Her reorganization placed "the whole business of Ordnance for land and sea" under the office of a Great Master of Ordnance, originally to be an appointment for life. The first and only Great Master, Robert, the 2nd Earl of Essex, lost his head for treason in 1601.[25] After the end of Elizabeth I's reign James I reorganized the Office again, replacing the Great Master and his Lieutenant with the Master-General and Lieutenant-General of Ordnance, posts that continued into the nineteenth century.[26] As a cabinet-level post as well as a military one, the occupants of the Master-General's office came and went with the rise and fall of governments. Six of the nine men that held the office after Waterloo left with a change of government; those who served after the Duke of Wellington's long tenure (1819 to 1827) held the post for an average of three years.

Much of the day-to-day business of the Ordnance Department fell to the Board of Ordnance, an institution that dated to Elizabeth I's reorganization. After a somewhat confused existence during the Civil War, a Royal Warrant issued on 25 July 1683 by Charles II re-established the Board, which consisted of the top four civilian officials in the Ordnance Department.[27] This included the Clerk of Ordnance, who purchased materials for the Department; the Principal Storekeeper, responsible for storage of all ordnance supplies; the

[24] Hogg 1963, 1036.
[25] Norman Skentelbery, *Arrows to Atom Bombs: A History of the Ordnance Board* (London: Norman Skentelbery, 1975), 12.
[26] Hogg does not state clearly what prompted the reorganization by James I, although it was most likely the result of an ongoing investigation into disagreements of authority between Ordnance officials. See Hogg 1963, 50-57.
[27] Skentelbery, 13-17; Hogg 1963, 1050-1051.

Surveyor-General, responsible for maintenance and quality control, and the Clerk of Deliveries for the issuance of material.[28] Nominally reporting to the Master-General, the Board in fact acted independently in most matters. It dealt with contractors, approved employment matters at Ordnance facilities, oversaw changes in patterns of military stores, and even handled such minutia as the granting of fishing rights on Ordnance properties.[29] Appointees to the Board were also affected by the fortunes of politics, with the notable exception of Edmund Phipps, who held the office of Clerk of Deliveries from 1812 to its abolition in 1831.[30]

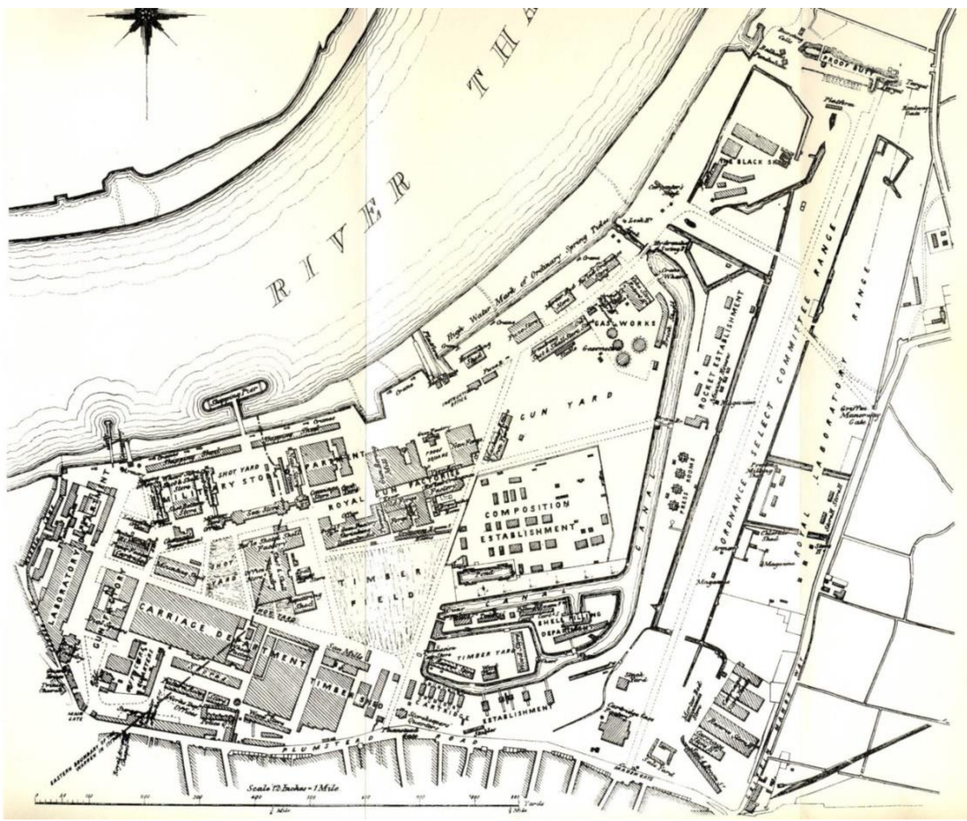

Figure 2: The Royal Arsenal at Woolwich, 1867.[31]

[28] Skentelbery, 13, and Raudzens, 13.

[29] TNA, War Office (WO) 47/2354, "Board of Ordnance Minutes, March 1853," Minute No. C/3611, 5 March 1853. Strachan noted that in 1848, over 32,000 items came to the Board for decisions (Strachan, *Wellington's Legacy*, 235).

[30] Hogg 1963, 1046. For a list of the Master-Generals and dates of their office, see Appendix 2.

[31] Hogg 1963, 868.

The supervision of the military manufacturing "establishments" or "departments" formed one of the principal duties of the Board of Ordnance. Several Crown facilities produced weapons and munitions for British military forces, most being located at Woolwich, a small town east of London along the Thames and also the site of the Royal Dockyards. Ordnance first built permanent works for the "proof," or test-firing of guns prior to their acceptance into service, near the town in 1651.[32] In 1696 the Crown's "fireworks" manufactory, known then as the "Laboratory," moved from Greenwich to Woolwich, becoming the first of many manufacturing facilities to be located in that town.[33] Originally known as "the Warren," having been originally built on the site of a rabbit farm, George III declared during a visit in 1805 that "the name of one of the tamest of all animals was certainly ill-suited to the nature of the place." He suggested that it be renamed the "Arsenal," which the Master-General of Ordnance agreed to immediately.[34]

As with the army administrative "system," the manufacturing establishments developed over the course of decades into a sprawling and somewhat chaotic network of facilities responsible for the production and storage of armaments. As noted, the oldest factory at Woolwich was the Royal Laboratory, whose name stemmed from its ancient task of mixing the chemicals necessary to produce munitions. The Laboratory manufactured "fire-works and cartridges, and [loaded] bombs, carcasses, grenadoes, and such like matters for the

[32] Hogg 1963, 177-185. All cannon and small arms required "proofing," which involved the firing of the piece with extra-heavy powder charges and projectiles. This proved that the quality of the metal casting could withstand normal usage – or even heavier-than-normal charges in the event of mistakes made during combat. A very hazardous operation, guns burst on occasion, often resulting in the injury or death of personnel and damage to buildings in the area.

[33] Hogg 1963, 222. "Fireworks," a generic term of the age, referred to any gunpowder product.

[34] Lt. G. E. Grover, RE, FSA, "Historical Notes on the Royal Arsenal at Woolwich" in *Minutes of proceedings of the Royal Artillery Institute* VI (1870: 231-47), 246; Peter Guillery, ed. *Survey of London* Vol. 48: Woolwich (New Haven, CT: Yale University Press, 2012), 350.

public service," and tested supplies of gunpowder received from Royal and private mills.[35] Products expanded during the Napoleonic era to include new inventions, such as the Congreve rocket, Shrapnel shells, and just about anything else that could be fired or flung at an enemy. Laboratory workers also broke down obsolete stores to recover metal and powder for remanufacture.

Another long-established department at the Royal Arsenal was the Inspector of Artillery. Although the title implies that this post was not connected with manufacturing, the Inspector of Artillery presided over the Royal Brass Foundry (RBF) as well as the proof of guns obtained by contract.[36] A fatal accident at a private cannon foundry in May of 1716 led the English government to establish its own facility at Woolwich for the casting of bronze field guns and howitzers for the army ("brass" being the term used for bronze gun-metal at the time).[37] The heavier cast-iron guns for the Royal Navy were obtained by contract from a variety of private iron foundries, a situation that did not change until 1856.[38] The Foundry worked occasionally with the other departments, such as a joint project between itself and the Royal Laboratory for the manufacture of small-arm percussion caps in 1842.[39]

The third facility located at Woolwich was the Royal Carriage Department (RCD), established in 1803. RCD's primary mission involved the manufacture and repair of land, naval, and transport carriages for artillery pieces of all makes and sizes. The first Arsenal facility to see the introduction of steam power, RCD installed an engine to drive wood planing machinery in 1805.[40] The department made all manner of other wood products as

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[35] Hogg 1963, 492.
[36] *Survey of London*, 164.
[37] Hogg 1963, 246-247.
[38] Hogg 1963, 664.
[39] Hogg 1963, 675
[40] Hogg 1963, 507-509, 521.

well, but oddly the construction of ammunition boxes and barrels fell to the Laboratory, because of its immediate need for such items to pack its products.

Woolwich also served as the headquarters of the Royal Artillery and Royal Engineer regiments. Known as the "Scientific Corp" for the much higher amount of training required, these two regiments had their barracks and hospital facilities at the Arsenal complex. It is important to note that these units differed greatly from "line units," meaning the infantry and cavalry regiments. In addition to being directly under the command of the Master-General, the two regiments differed greatly in their training. Potential officers for both enrolled in the Royal Military Academy, situated within the grounds of the Arsenal. Training for Royal Artillery gun crews also occurred there, under the aegis of the Royal Military Repository. In addition, the Royal Artillery promoted its officers in peacetime strictly by seniority, rather than by purchase as line officers did, although brevet ranks – a promotion in name and responsibility, without an increase in pay – were very common, especially in the field.[41]

Woolwich did not contain all of the government manufacturing facilities. Waltham Abbey, north of Woolwich, hosted the Royal Powder Mills, the factory that manufactured the gunpowder (and later explosives) required by the service.[42] Until 1854 this consisted exclusively of "black powder," a combination of charcoal, saltpeter, and sulfur that had been in use for centuries. By 1854 the manufacture of black powder had advanced to include various combinations of the base ingredients and finished grain sizes depending on the intended use. The Mills supplied much of the powder necessary during peacetime, but Government supplemented this supply with contracts to private firms such Curtis's and

[41] Purchase had been allowed of two officer ranks at the company level (Adjutant and Quartermaster) until 1783; see Capt. Francis Duncan, *History of the Royal Regiment of Artillery*,Vol. II (London: J. Murray, 1873), 25.

[42] Hogg 1963, 1063.

Harvey of London, who also manufactured high-quality powder for sporting purposes.[43]

The newest government manufacturing department, the Royal Armoury Mills, was also built away from Woolwich. Because of quality-control issues with weapons made by outside contractors, the government established a new small-arms factory for the manufacture of parts and construction of muskets, pistols, swords and bayonets at Enfield Lock, north of London, in 1816. Originally created to make musket barrels and gun locks, the factory had a tenuous existence during the "long peace," very nearly being shuttered for a want of work in 1832. Fortunately for the nation the Mills survived, and George Lovell, the long-reigning head of the facility, built it into a research and development model for civilian gunmakers as well as a weapons assembly, inspection, and repair facility.[44]

The Mills did not produce all the parts required for a finished musket, however, and could not meet the full needs of the military. The government continued to rely heavily on civilian gunmakers, centered in Birmingham, for much of its small arms. An 1851 census of workers in the city showed 5,167 men involved in gun manufacture there, divided into nearly fifty different specialties.[45] This army of craftsmen turned out both martial and sporting arms

[43] Formed in 1820, Curtis's and Harvey (C&H) purchased an existing powder mill in the London borough of Richmond upon Thames, an area associated with gunpowder manufacture for nearly 400 years. C&H invested heavily in expanding the facility, which eventually covered a hundred acres. The company's products were well known to shooters worldwide, and it remained an important supplier to the British military throughout the nineteenth century. See "The River Crane and Gunpowder Mills," http://www.richmond.gov.uk/local_history_river_crane.pdf, accessed 02 Dec 2014.

[44] Pam, 15-29; Lewis, 12. The Crown purchased a former armor plate mill at Lewisham in 1805 to manufacture musket barrels. Despite the installation of steam power in 1807, that factory proved unsatisfactory, leading to its relocation to Enfield Lock.

[45] De Witt Bailey, and Douglas A. Nie, *English Gunmakers: The Birmingham and Provincial Gun Trade in the 18th and 19th Century* (London: Arms and Armour Press, 1978), 17; "Gun Trades," *Birmingham Gun Museum*, 2010-2012, http://www.birminghamgunmuseum.com/Gun_Trades.php. Few of these workers were organized into formal companies; of the 113 entries under "gun makers" in the 1850 Birmingham postal directory, less than twenty were entries identifiable as non-individuals. Of those, T. & S. Phillips is listed as gun maker "to the Board of Ordnance" and J. Scott & Co. as "military." See *Post Office Directory of Birmingham, Staffordshire & Worcestershire, 1850* (London: W. Kelly & Co., 1850, via University of Leicester Special Collections Online, http://specialcollections.le.ac.uk/cdm/compoundobject/collection/p16445coll4/id/339983/rec/23), 610-611.

for sale around the world, and would be heavily engaged in the manufacture of weapons during the coming war. Relationships between Ordnance and the "gun trade," however, had become increasingly strained because of Lovell's expansion of the Enfield factory and its role as both a competitor and a check on prices. An 1852 article in the *Birmingham Journal* decried that "Government competition, if carried to any extent, will seriously injure many thousands engaged here," and denounced the Enfield factory as being "carried on at a loss to the country."[46] Such resistance to the new factory and continued reliance on hand-production methods meant that Britain lacked an efficient, modernized and mechanized small arms factory – an anachronism in a country that had otherwise thoroughly embraced industrialization.[47]

The muddle present in the top ranks of British military administration extended downward through the Board of Ordnance. Although subordinate to the Board, the manufacturing departments in fact operated as separate facilities. The head of the departments were posts considered to be "civilian" although held by a senior Royal Artillery officer. Each department head "had absolute control of the factory under him, and a free hand in its administration provided he did not exceed the financial sum allotted to him."[48] The departments maintained their own books, managed their own stores, had their own clerical staff, set their wages independent of one another, and communicated only on a formal basis.

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[46] "State of Trade. Birmingham, March 6." *Morning Post*, 08 March 1852, 8.

[47] France faced a similar situation; even though they did have arsenals dedicated to small arms manufacture, the facilities were very under-mechanized, and revolutionary war efforts to introduce new manufacturing techniques for the standardization of parts failed. See Ken Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763-1815* (Princeton, NJ: Princeton University Press, 1997). The United States, in contrast, had actively pursued mechanization of small arms production in both its military arsenals and private factories; for examples, see Merritt Roe Smith, *Harpers Ferry Armory and the New Technology* and James J. Farley, *Making Arms in the Machine Age*.

[48] HCPP, "Report of the Committee Appointed to Inquire into the Organization and Administration of the Manufacturing Departments of the Army; with Minutes of Evidence, Appendix, and Index;" 1887 (C.5116), xiv-xv.

The factory heads ran their facilities as if located in different cities rather than next door to each other at Woolwich, "separately produc[ing] guns, their carriages, and projectiles" in semi-ignorance of what the other facilities did.[49] Such an enforced separation resulted in "conflicts of opinion, diversities of system and delays, multiplication of correspondence, and needless formalities" bemoaned by the *Monthly Review*.[50] It also occasionally resulted in the continued manufacture of carriages that no longer fit their intended guns, for instance, or the shipment of obsolete ammunition to the army in the field.[51]

In addition, promotion by seniority meant that Royal Artillery officers held the same rank for much longer than line officers. A Royal Commission that investigated promotion within the regiment reported in 1854 that "the average age of the officers…of Ordnance corps is far greater than that of officers" in other arms of the service.[52] The average years in rank of colonels in the regiment went from thirty-six in 1818 to forty-eight by 1851, and lieutenant-colonels as well as captains could also expect to spend decades with the same rank.[53] Not only did this contribute to very lengthy waits for advancement by junior officers, it also meant that senior ones were "senior" in physical terms, with several octogenarians holding high-level posts in the pre-Crimean era. The same held true for selection of officers to head facilities at the Royal Arsenal. As a result, the department heads suffered collectively from a lack of imagination and a blind acceptance of traditional manners of doing business.[54]

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49 Hogg 1963, 828; HCPP, 1887 (C.5116), xiv-xv.
50 *The Monthly Review*,269.
51 HCPP, 1887 (C.5116), xv; *Supplement to the Synopsis of Reports and Experiments of the Ordnance Select Committee: Shrapnel Shells* (London, for HM Stationary Office, 1858), 6.
52 "Promotion in the Army," *Morning Post*, 11 July 1854, 3. The article refers to the "Report of Commissioners on Promotion in the Army" (HCPP, 1854 (1802)), appointed by royal commission to "[look] at the advanced Age of the great Majority of the Officers now in the Upper Ranks of Our Army," including the two Scientific Corps.
53 Charles J. B. Riddell, *Remarks on the Organization of the British Royal Artillery* (London: W. Clowes & Sons, 1852), 31-32.
54 Hogg 1963, 1433.

The late application of steam power to much of the Royal Arsenal illustrates this lack of imagination by ordnance factory heads. Well past the period when steam came into general use in private industry, most of the operations at the Arsenal relied on human or animal power. An 1840 memorandum by Sir Richard Vivian, then Master-General of Ordnance, lamented that "in very many instances the work is done in a primitive manner by manual labor, and at a very great expence; in the Carriage Department only is steam power employed as it should be." Indeed, as late as 1841, the Royal Brass Foundry still used horse-drawn machinery to bore out cannon.[55] Although this delayed mechanization may be partially explained by the tightfistedness of Parliament, the 35-year difference between the advent of steam power at RCD in 1805 and the *consideration* of it in 1840 for the other two departments smacked of Luddism on the part of certain department chiefs. Finally, in 1847 the Board contracted with James Nasmyth, an eminent Scottish engineer and inventor of the steam hammer, to inspect its facilities and recommend improvements. Nasmyth later wrote in his memoirs that what machinery the Arsenal did have "was better fitted for a Museum of Technical Antiquity than for practical use….Everything was certainly very far behind the arrangements which I had observed in foreign arsenals." He made several suggestions, and that year Royal Laboratory installed its first steam engine, "superintended by Captain [Edward M.] Boxer, an officer of the highest talent and energy" and whom we will hear more about later.[56] Although the gradual installation of more engines "[placed] the Royal Arsenal on a footing more in keeping with the commercial practice of that time," it remained

[55] Hogg 1963, 671, 681.
[56] James Nasmyth and Samuel Smiles, *James Nasmyth Engineer; an Autobiography* (London: J. Murray, 1883), 317-319.

woefully under-mechanized at the outbreak of the Crimean War.[57]

Public Interest in Military Technology

Regardless of its level of mechanization, the concentration of so much military activity into an area close to London made the Arsenal a point of interest for anyone visiting the city. British officials regularly granted tours to foreign dignitaries to show off the "vast industrial landscape that explained [British] battlefield glory."[58] Live-fire exercises, such as the bombardment of a mock fort conducted for the Prince of Saxe-Weimar in 1845, demonstrated "the destruction which would be effected in actual warfare" by British gun batteries.[59] Although fear of theft and espionage gradually restricted visits by the general public, an 1841 guidebook touted the cheap fares offered by steam vessels and rail transport and easy access to "the immense number of objects of attraction worthy of being seen in the Royal Arsenal, in the Dock Yard, and in the Royal Repository; and the grand military spectacles often exhibited on Woolwich Common."[60]

Such "grand military spectacles" were among the few points of contact that the average Briton had with the army. As historian Gwyn Harries-Jenkins has noted, for "the British public as a whole, the army was…an unknown institution."[61] Enlisted service remained an option of last resort for most British males, and the officer corps came for the most part from the ranks of the privileged and the aristocracy. Relatively few men had seen service, a number that dropped as the distance from 1815 widened. Most of the officers and men who served did so overseas and therefore out of sight, except for occasional police work

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[57] Hogg 1963, 703. Howard Blackmore noted that, as a result of inducements offered by Ordnance during the Napoleonic Wars, "many of the gunmakers began employing machinery," but did not detail the nature of such machinery. See Howard L. Blackmore, *British Military Firearms, 1650-1850* (London: Greenhill Books, 1994), 140.
[58] *Survey of London*, 164
[59] "Royal Visit to Woolwich," *London Standard*, 21 Jul. 1845, p.3.
[60] *Survey of London*, 164; John Grant, *A Guide to Woolwich* (Woolwich, 1841), 3.
[61] Harries-Jenkins, 5.

at home – a task that hardly endeared soldiers to the general public.[62] The military also had a distinct set of traditions, behaviors, and values that reinforced its sense of identity and separation from the general public.[63] All of these traits combined to make the army, in the words of Wellington, "an exotic in England."[64]

Still, military parades held a powerful appeal for Britons of all classes. As Scott Hughes Myerly pointed out in a 1992 article in the *Journal of Social History*, "a gratis public spectacle that involved hundreds or thousands of fancy-dress performers, complete with 'fireworks' was quite a treat for all," even to the point of becoming considered a public right. After discovering that a review supposedly to be held at Wimbledon in 1816 turned out to be a hoax, "the angry, disappointed crowd set Combe Wood heath on fire."[65] Military spectacles "helped to override the traditional dislike most Britons felt" towards their army, which military authorities encouraged. Large-scale maneuvers held at Chobham Camp in 1853 were open to the public, for example; even though this interfered with practice, army commanders hoped that public attendance and enthusiasm might also persuade Parliament to be a little freer with the purse strings.[66]

Technology naturally played a part in the military performances enjoyed by the public, but to get up close to military weaponry they could also visit the "Royal Repository" mentioned in the 1841 guidebook. This actually referred to the Royal Military Repository, a large section of ground used for the training of gun crews but which also hosted a weapons museum. Established in the 1770s by Capt. William Congreve, his first "Repository for

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[62] Spiers, *The Army and Society*, 76-81
[63] Farwell details many of the customs in Chapter 3 of *Mr. Kipling's Army*.
[64] Spiers, *The Army and Society*, 92.
[65] Scott Hughes Myerly, "'The Eye Must Entrap the Mind': Army Spectacle and Paradigm in Nineteenth-Century Britain." *Journal of Social History* 26, no. 1 (1992): 105-31, pp.108-109.
[66] Myerly, 114.

Military Machines" (for which he secured Royal patronage) functioned both as a museum and "teaching collection" which displayed specimens and models of artillery, including captured guns. Unfortunately, a fire in 1802 destroyed the original museum as well as adjacent workshops. In 1818, the Prince Regent authorized the movement of an unusual building to Woolwich for the "conservation of trophies…artillery models, and other military curiosities usually preserved in the Repository." Known as the "Rotunda" for its resemblance to the bell-shaped military tent used by British field commanders, the 110-ft diameter round building had been constructed as a ballroom to celebrate Napoleon's abdication in 1814. Once moved, workmen strengthened the building with a brick exterior, reinforced roofing, and a 50-ft tall central sandstone column. Completed in 1820, the Rotunda re-opened as a permanent museum free to the public. The museum's holdings expanded beyond military trophies to include George III's collection of model forts and dockyards and specimens of ammunition and firearms proposed by inventors.[67] While a popular destination for visitors, the Rotunda also proved a valuable reference collection for the various committees tasked with evaluating weapons proposals over the next several decades.

Those in search of more information on military technology were not restricted to parades and museums. The daily newspapers regularly published articles regarding all manner of military-related matters, including activities at the Royal Arsenal. Disasters, such as an explosion that killed seven in 1845, certainly grabbed the most column space.[68] The papers reported just about everything else as well, such as periodic bursts of activities in support of various military operations, results of experiments, or the scheduled adoption of

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[67] *Survey of London*, 155, 353-355.
[68] "Appalling Accident at the Royal Arsenal, Woolwich," *York Herald*, 20 Sep 1845, p.7.

new weaponry.[69] Periodicals, particularly *The Mechanics' Magazine,* carried information regarding advances not only in the weapons themselves but also in their manufacture. *Colburn's United Service Magazine* also regularly examined military technology. While written primarily for the military market, *Colburn's* noted that the magazine is "sold by all booksellers" on its frontispiece, making it available to a much wider audience. Clearly, then, the public had access to much regarding the weapons used by its military. But did it act upon that information?

Figure 3: The Rotunda, circa 1900. Only some of its massive collection of weapons and other materials still survives, and may be found at "Firepower," the Royal Artillery Museum at Woolwich.[70]

[69] Examples include the report of increased activity in the Royal Laboratory resulting in "nine days' work per week" per laborer (*West Kent Guardian*, 21 May 1842, p.4), "Interesting Experiments" regarding "Captain Chad's suggestion of employing two shots at one firing" (*Chester Chronicle,* 29 Dec 1848, p.4), and preparations for the manufacture of "war rockets, on an entirely new principle" (*Leeds Intelligencer,* 22 Oct 1853, p.9).

[70] "Rotunda, Woolwich Common, Woolwich, c.1900." *Ideal Homes: a History of South-East London Suburbs,* accessed 05 Dec 2014, http://www.ideal-homes.org.uk/greenwich/assets/galleries/woolwich/rotunda-1900.

"The Great Mass are Utterly Worthless:" Inventors and the Board of Ordnance

On 30 Oct 1841, a fire broke out at the Tower of London, rapidly spreading from one building to another. One of the Ordnance Department's major arms depots, the Tower held the nation's reserve supply of "Brown Bess" flintlock muskets, as well as the first several thousand arms converted to the new percussion priming system. In a short few hours, nearly 200,000 muskets "fit for immediate service [and] tastefully arranged in various forms and directions, present[ing] a most beautiful appearance," became so much smoke, ash, and twisted lumps of metal. [71] Covered extensively by the papers, the loss of so many weapons represented a huge blow to British military capabilities – but also a potential opportunity to those interested in advancing their ideas regarding the right sort of arm for the infantry. Shortly afterwards, such proposals began to filter into the War Office including one submitted anonymously by "RLL." "As I collect from the newspapers," he wrote a scant two weeks after the blaze, "that [as] a quantity of small arms will be required" to replace those lost in the fire, "I take the liberty of submitting…a little invention of my own…that [I] propose to call the rifle-musket."[72]

"RLL" represented just one of hundreds of individuals who pitched inventions and ideas to the Ordnance Department before the Crimean War. His reluctance to disclose his true name also suggests a motive common to some of these individuals: patriotism, and concern that British military forces had the best tools that British industry could provide. The range of motives, however, varied almost as widely as did the types of proposals themselves. Patent holders seeking to profit from their ideas, manufacturers seeking larger markets for their wares, military officers wanting to make names for themselves, all found ways to put

[71] "Destruction of the Tower of London by Fire," *Leeds Times*, 06 Nov. 1841, p.3.
[72] "RLL" to the Master General of Ordnance, 13 Nov 1841, TNA, WO 44/620, File 15. The inventor declined to give his name, stating that it would "add no weight to a recommendation" of his plan.

their ideas before the Master-General for consideration. This group included a handful of outright charlatans and scam artists, such as Guillaume Hole, who asked £200,000 – an incredible sum in 1854 – for an invention he insisted would "destroy an Enemy at the distance of Twenty Miles on the Sea and an Army on Land at a very long distance" without offering any particulars.[73]

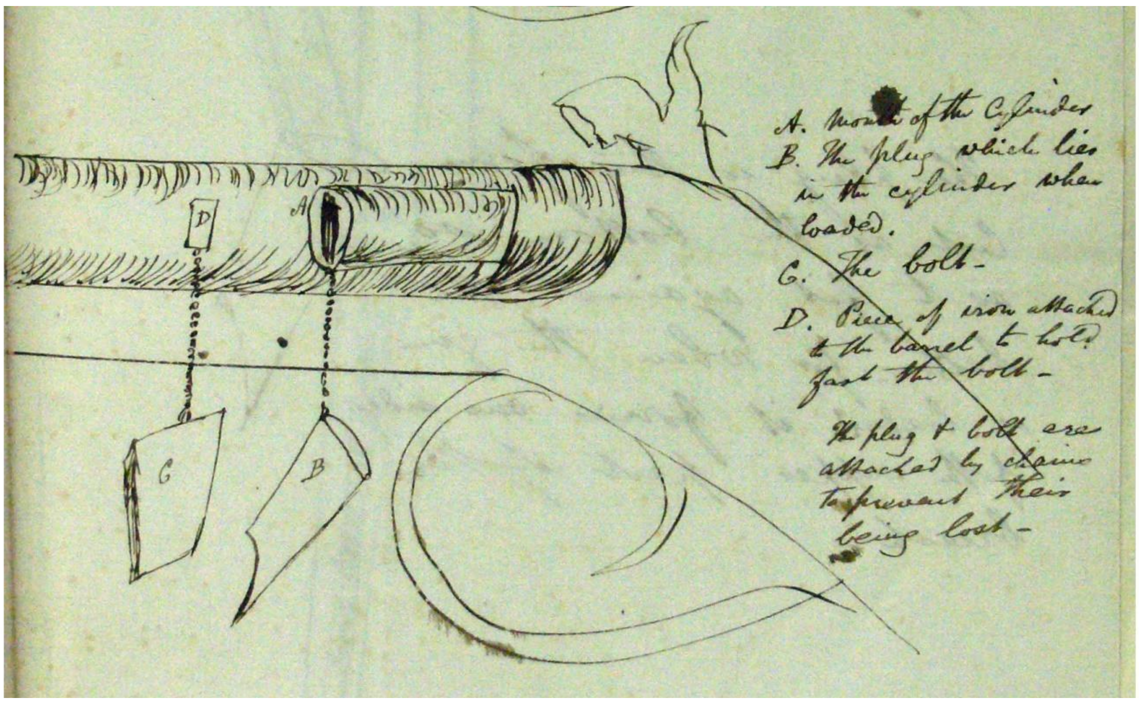

Figure 4: One of the sketches that "RLL" included with his proposal for a "rifle musket."

On 25 Oct. 1854, Charles Abbott addressed a letter to the Master-General of Ordnance, writing he had been advised by the Duke of Newcastle (Henry Pelham-Clinton, then Secretary of State for War) that "any suggestions which I may have to offer for the improvement in the method of constructing Shot and Shells should be forwarded to the Board of Ordnance."[74] Newcastle's advice to Mr. Abbott, however, was only partially correct. Prior to 1805, experimentation with new weaponry in the Ordnance Department fell to the

[73] TNA, WO 44/627, File 397. Mr. Hole requested a £50,000 down payment to reveal the secret of his wonder-weapon; his offer was declined.
[74] TNA, WO 44/620, File 1.

Surveyor-General's office, with assistance as needed by the Master Gunner of England. By 1805, however, the increasing numbers of new proposals, particularly those received from outside the military establishment (such as RLL's "rifle-musket"), led to the formation of a permanent committee for their evaluation: the "Select Committee of Artillery Officers."[75] As the name implied, seven senior artillery officers, including some heads of Royal Arsenal factories, sat on the committee, with the Director-General of Artillery serving as president.[76] Although experienced artillerymen, the committee could "whenever necessary…obtain the assistance and opinion of the most able scientific men in the country." This included many civilians, such as the Professor of Mathematics at the Royal Military Academy, Samuel Christie, whose "opinion is always available, if required." The Committee also consulted with Dr. Lyon Playfair, Professor of Chemistry at the recently established School of Mines, "on an important subject, with great advantage."[77]

Once the Master-General forwarded a proposal for review, the Select Committee placed it on the schedule for one of its weekly meetings and invited the inventor to attend, "with drawings or models, or to give any further explanation or information that he may

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[75] Hogg wrote that the original "Select Committee," named simply that, served until reorganization in 1852, when its name changed to the "Select Committee of Artillery Officers" but cited no document regarding this reorganization and name change (Hogg Vol. 2, 1434). The longer name is most likely the original name of the committee formed in 1805; the 1823 obituary of Gen. Sir Anthony Farrington mentioned his being assigned as "President of a Select Committee of Artillery Officers, 8th July, 1805." See "Obituary: General Sir A. Farrington, Bart.," *The Gentleman's Magazine and Historical Chronicle* Vol. 93, Part 2 (1823): 639-40.

[76] Hogg uses the title "Director-General of the Field Train," an incorrect and anachronistic title that obscures the scope and importance of the position. According to Forbes (Vol. 1, 188-194) the Ordnance Field Train "automatically ceased to exist" in 1815 with the end of the war, and the Ordnance Department changed Director's post to be the "Director-General of Artillery" in 1827. The 1834 memoir of Sir John MacLeod explicitly uses the title "Director-General of Artillery," see *Military Memoir of the late Lieutenant-General Sir John Macleod, G.C.H., Senior Colonel Commandant and Director General of Artillery* (R. and C. Byfield, London, 1834).

[77] TNA, SUPP 6/1, "Correspondence respecting the re-organisation of the Ordnance Select Committee," 5-7; Graeme J. N. Gooday, "Playfair, Lyon, first Baron Playfair (1818–1898)," *Oxford Dictionary of National Biography*, Oxford University Press (hereafter *ODNB*), May 2008, http://dx.doi.org/10.1093/ref:odnb/22368.

think necessary respecting his invention." After review and discussion with the inventor if he attended, the Committee drew up a report regarding the proposal and their opinion of it for the Master-General.[78] More often than not, inventors (often referred to as "projectors" in the lexicon of the day) left disappointed, the committee having ruled their proposals as "inapplicable to the service." The Committee could, for proposals regarding specific topics, refer them to subject-specific committees on small arms, coast defense, and so forth, "specially appointed whenever the Naval or Military authorities may require their assistance."[79] In the case of RLL's "rifle-musket," however, the Select Committee judged rather harshly that the sketches and attendant descriptions "do not…merit the attention" of the small-arms sub-committee."[80]

In a later memorandum outlining the history and duties of the Select Committee, Maj. Gen. William Cator remarked that of the proposals brought forward, "very few are new or superior" to current weapons or practices. "Some are ingenious, but impractical," he wrote, but "the great mass are utterly worthless, and it is often painful to witness a vast amount of ingenuity and skill, as well as expense, in the construction of beautifully-executed models and drawings, with minute and laboured descriptions, which are valueless…from the absence of all practical knowledge [of the subject] on the part of the designer." The list of the impractical included Mr. Abbott's asphalt artillery projectile, multi-barreled cannon, glass mortar shells, soldiers' caps that doubled as flotation devices, and steam-powered flying machines. Such proposals, while perhaps making perfect sense to those suggesting them, were useless for the military. The inventor could appeal the Committee's decision, in which case the Master-General returned the proposal for reconsideration along with any further

[78] "Correspondence," 5-6.
[79] "Correspondence," 5.
[80] TNA, WO 44/620, File 15.

information from the inventor. “Such appeals,” wrote Gen. Cator, were “always met in a spirit of fairness and justice to the inventor, with a due regard to the good of the service” but generally did not result in satisfaction for the inventor. [81]

For those proposals judged to have merit, the Select Committee devised and monitored experimental programs, generally at the expense of the inventor but occasionally paid for out of public funds. An example of the latter is Captain Edward M. Boxer’s 1850 plan for a new type of artillery projectile. Boxer, then an instructor of fortifications at the Royal Military Academy, proposed a new style of elongated shot for smoothbore cannon, “having the advantages of Rifled Projectiles,” such as longer and more accurate range, but “without the defects.” Following a limited test of four projectiles he constructed, Boxer wrote to the Master-General that the results “[gave] me great hopes of success.” After a personal interview, the Select Committee recommended his plan “be put to the test of Experiment.” One hundred each of both shot and shell of Boxer’s design were obtained by contract, and sent to the experimental artillery range at Shoeburyness for test firing. Unfortunately for Boxer, the new projectiles failed: some broke into pieces on firing, others tumbled in flight, “their Ranges being very uncertain.” Boxer, present at the test shoot, finally asked for a halt, “satisfied that no good could be gained from going on with the Experiment.” Although a failure, one Committee member noted on the final report that “I only wish that all Projectors were as reasonable as Captain Boxer.”[82]

One “projector” not quite as reasonable, or at least more troublesome to the Committee, was Capt. John Norton of the 34th Foot. A long-serving officer fascinated by firearms and explosives, Norton’s tinkering with things that blew up would warm the heart of

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[81] “Correspondence,” 6-7. There is little evidence, as of yet, of any successful appeal on the part of an inventor.
[82] TNA, WO 44/621, File 81.

anyone who ever lit off a firework. His 1860 collection of letters and notes included, for example, instructions on “how to make a hash of a wasps’ nest” using explosives. A prolific inventor, Norton submitted dozens of proposals to the Select Committee. After one particular interview, a Committee member testily remarked to Norton that “you make experiments for your amusement, and then you come before us to know our opinion of them.” Norton retorted “I do, and if by amusement I can add power to the arms of England, I shall be proud and happy for it.”[83]

Norton’s one brush with success illustrates that the Select Committee did, on occasion, reach out to non-artillery officers. In 1842, Norton brought before it a design for a “concussion shell” with a fuze constructed to detonate on impact. Although the Committee rejected the shell for land use, it did report that “the fuze…is well adapted for the purpose of horizontal fire, and a simple, safe, and efficacious method of exploding shells…striking solid substances.” As such shells were “chiefly calculated for naval warfare,” the Committee recommended “that a naval opinion should be obtained of the applicability of the fuze to that branch.”[84] Captain Hastings of the training ship *Excellent*, after trying the fuzes, recommended that Norton “be called upon to instruct the operatives in the laboratory at Woolwich” on the manufacture of his fuzes for further tests.[85] Apparently Norton did, as the *London Standard* followed up with a report of the next round of tests in November of 1844. “The firing was splendid,” the author reported, the shells wreaking havoc on the target ship. “We are decidedly of opinion,” the *Standard* continued, “that [Norton’s] shell is by far the

[83] John Norton, *A List of Captain Norton's Projectiles, and His Other Naval and Military Inventions: With Original Correspondence* (Gravesend: Caddel, 1860), 11-12.
[84] “To the Editor of the Standard,” *London Standard*, 21 Jun. 1843, p.3.
[85] “Concussion Shells,” *London Standard*, 12 Jul. 1843, p.1.

most deadly and destructive that we have ever seen."[86] Regardless of this successful trial, it appears the Navy did not adopt Norton's fuze or his shell, as no records exist of the manufacture of either.

A shameless self-promoter, Norton did not wait for the November test to notify the newspapers of his success. An article submitted to the *Times* reported that Norton had gone to Woolwich, that the Select Committee had "pronounced these fuzes to be simple, safe, and efficacious," and that "all batteries for the defence of the seacoast and the protection of asylum harbours (says a correspondent) should be supplied with these shells."[87] That "correspondent" was almost certainly Norton himself. The article also represents one of a long series Norton submitted sent to any magazine or newspaper he could reach, particularly the *Cork Examiner.* Not all were positive. After the Select Committee rejected yet another of his inventions in 1852, Norton complained to the *Examiner* that "my 'suggestions,' as *some* call them, but [which] I call…trusty and well proved arms, and projectiles" should be considered [instead] by "the British Empire (my Committee) through the British Press, its Secretary." "I write this," he continued, "in the hope that some nobleman or gentleman…may be induced to incur the expense of two or three pounds" to test his invention, an experimental compound shell. "I should not like that this shot or shell," Norton cautioned, "should be first adopted by a foreign power with whom we may be unfortunately at war."[88] As far as is known, no such "nobleman or gentleman" stepped forward.

Failed experiments did not always represent dead ends for inventors, as simply getting a trial by the Committee could be turned into good advertising. In 1828, Joseph Southby, an "Artist in Fireworks," proposed to the Master-General the use of rockets for

[86] "The Experiment at Portsmouth with Captain Norton's Shells," *London Standard*, 16 Nov. 1844, p.3.
[87] "The Norton Shell," *Berkshire Chronicle*, 27 Apr. 1844, p.4.
[88] "To the Editor of the Cork Examiner," *Cork Examiner,* 13 Dec. 1852, p.1.

messaging at night. The primary ingredient in his "Crimson Stars," Southby argued, "is only to be obtained in this country" and therefore "could not…*be imitated by any other nation*." The Select Committee, after witnessing a trial, reported that while they found Southby's rockets superior to service signal rockets, "no mode of telegraphing by night (and several have been tried) has hitherto been successful" and declined to adopt Southby's proposal. After Lt. John Hughes of the Royal Navy made a similar proposal in 1832, Southby sent copies of his correspondence with the Committee to the editors of the *United Service Magazine*. "Whatever merit belongs to the *originator* of the idea," Southby wrote, "belongs *to me* and *not* to Lieut. Hughes." Southby also emphasized that the Select Committee found his rockets "to be *excellent* and *very beautiful,*" praise not to be wasted by a fireworks manufacturer.[89]

Although the Committee rejected many proposals on the basis of their impracticality or uselessness to the service, it also refused to risk any financial investment in developing new technologies. In 1840, Thomas Beningfield approached the Committee with a plan for a novel "electric gun" dramatically named "Siva, or the destroying power." Beningfield's single-barreled weapon fired five-eighths inch lead balls "calculated to kill at the distance of a statute mile," propelled "not by steam, but by the application of gases exploded by galvanic electricity." Beningfield's printed circular claimed that "many Military and Naval Officers have declared it an engine much more to be feared, either on shore or afloat, than any weapon now in use," and demonstrations seemed to bear out the potential of the weapon. Firing exhibits for the Duke of Wellington and the Select Committee showed the machine capable of "a swift and effective discharge of a host of bullets," although inaccurate and

[89] J. Southby, "Correspondence: New Rocket Signals." *The United Service Journal and Naval and Military Magazine*, no. Part 1 (1832): 390-91; TNA, WO 44/628, File 411.

incapable of penetrating a wood target consistently at ranges over 30 yards. Although Wellington thought the weapon had potential and that "Government should not lose sight of it," Beningfield had not yet patented the device, and proved reluctant to disclose the exact details of how the machine worked.[90] This reticence led to a breakdown in negotiations with the Select Committee. Beningfield refused to divulge his "secret" without some guarantee of financial reward, which the Committee would not make before knowing how the machine worked. Had the Committee been willing to risk some financial involvement, Beningfield's "Siva" might have developed into a unique weapon offering a distinct battlefield advantage.[91]

The Failings of the Select Committee

Until the early 1850s, the Select Committee's duties "were comparatively of a routine character," Sir John Adye later wrote, "[as] artillery science had…been almost dormant for many years."[92] The number of new proposals remained at manageable levels, rarely exceeding three dozen a year. The two years prior to the Crimean War, however, saw a jump that did not recede for decades: forty-one proposals in 1852, sixty-three the following year, and 218 in 1854.[93] William Monsell, the last Clerk of Ordnance before the breakup of the Department, testified before Parliament that by July, 1855, "974 projects of inventions in all had been laid before the Committee during the last twelve months, of which 696 had been rejected, and there still remained for trial 123." [94] After the British cabinet dispatched a Royal Navy flotilla to the Dardanelles in June of 1853 with orders to support Constantinople in case

[90] "Electric Gun," *Littell's Living Age* Vol. 6 (1845): 168; "Mr. Beningfield's 'Electric Gun,'", *The Mechanics' Magazine, Museum, Register, Journal, and Gazette* Vol. XLIII, 5 July - 27 Dec. (1845): 16.; "The Electric Gun," *Kentish Gazette*, 13 Jan. 1846 , p.1.

[91] TNA, WO 44/620, File 41.

[92] TNA, WO 32/7126, "Copies of Minutes relating to the appointment of the Ordnance Committee 1880," 7.

[93] These counts are based on a survey of existing proposal files in WO 44/620 through WO 44/636. Files related to Armstrong's gun, Hale rocket and Minié rifle are not present in the collection, and later OSC records acknowledge others to be missing; therefore, the actual number of proposals may be considerably higher.

[94] "Ordnance Inventions – Questions." HC Deb 27 July 1855 vol 139 cc1458-9.

of Russian attack, demands on the Royal Arsenal steadily increased as the possibility of war became more likely. The simultaneous increase in invention proposals overwhelmed the Select Committee, whose members – being the supervising officers of the Arsenal – were "severely taxed to keep pace" with their normal duties, much less deal with a flood of inventions. Consideration of the suggestions "in the usual course was found to be impossible, without serious injury to the service."[95]

The Select Committee had other faults besides being swamped; it also suffered from the inability to devise experimental programs that produced useful results. Lt. Col. John H. Lefroy, then special advisor to the Duke of Newcastle on artillery, wrote a particularly scathing condemnation of past weapons trials.[96] "Unnecessary and futile experiments are tried," wrote Lefroy, "to satisfy or silence a particular inventor," or "stop short at the wrong moment, to grudge a very small outlay of time or money to make a conclusion permanently useful." A suggestion for "horse-borne" artillery provides one example of such a "futile experiment" tried by the Select Committee. An inventor suggested that "a small gun, strapped broadside across a horse's back and fired from that position, would be useful in mountain campaigns." The Committee decided this was worth trying, rather heedless of how the horse might react. With the weapon on its back and its head tied to a post, one of the firing party pointed the horse towards the target and lit a slow-burning fuze to set off the cannon. No one thought to secure the horse's tail-end, however. On hearing the burning fuze, the horse danced around the post, pointing the cannon at the Committee instead of the target. As a group, the Committee dived for the ground; the gun went off, the shot flew over the town of Woolwich, and the unfortunate horse ended up on its back several yards away.

[95] "Correspondence," 6.

[96] Hooker, Joseph D. "Obituary: General Sir John Henry Lefroy, RA., CB., KCMG., FRS., &C." *Proceedings of the Royal Geographical Society and Monthly Record of Geography* 13, no. 2 (1891: 115-22), 118.

Uninjured, "the Committee… gradually recovered their equilibrium, but reported unanimously against any further trial."[97]

In addition to such "futile experiments," the responsibility for conducting experiments often fell "in blind military rotation, to unsuitable hands," as in the case of English gun maker William Greener's proposal for an expanding musket ball. In 1834, Greener's invention "was referred to the Officer Commanding a Troop of Horse Artillery" who "saw nothing of the real novelty" that a bullet for a rifled musket held. [98] Fifteen years later, Britain would license a similar invention from a French officer, Captain Minié, at the cost of £10,000. Finally, Lefroy bemoaned the want of "superior military colleges, turning out…officers well trained in mathematical and physical science." A lack of such officers meant that "many of our experiments, so called, are ridiculously one-sided and inconclusive. No wonder they fail to satisfy the public, command little authority, and yield hardly any solid result for future guidance."[99]

The mostly *ex officio* Select Committee also suffered from the same lack of vision and vigor that affected the "Officer Commanding a Troop of Horse Artillery" excoriated by Lefroy, and which pervaded the Royal Artillery itself.[100] The Committee's first president, Lt. Gen. Sir Anthony Farrington, "was but 66" when he assumed the post, and held it to his death at the age of 83 in 1823. He was, at the time of his passing, "the oldest officer in the

[97] Sir John Adye, *Recollections of a Military Life* (New York: Macmillan and Co., 1895), 290. Adye does not give a date for this incident, stating only that it happened "many years ago." Only one project has been found for a "method of carrying and firing guns on horseback," that of Mr. T. C. Clarkson, first listed in 1870. The *Abstracts of Proceedings*, however, shows that a suggestion apparently submitted at the same time – that for an undescribed "explosive compound" - had first been before the Select Committee in 1852, most likely the original date for the "horse artillery" suggestion. See Subj 2509.4, TNA, SUPP 6/19: Abstracts 1870, 358.

[98] "Correspondence," 22-23. The Select Committee did conduct experiments with Greener's bullet two years later, and Greener re-presented his invention to the Committee in 1842, but nothing came of his efforts. See William Greener, "The Invention of the Minie Rifle," *Newcastle Journal*, 27 December 1856, 6.

[99] "Correspondence," 22-23.

[100] Only two members of the Select Committee were selected for reasons other than their positions within the Royal Arsenal; see "Correspondence," 7.

British service."[101] Farrington's successor, Lt. Gen. Robert Douglas, also died in harness at 83, as did the third president, Sir John Macleod, who passed away in 1833 at 81. "To put it bluntly," historian Oliver Hogg wrote, "the Select Committee was hidebound, steeped in traditional methods, lacking in imagination and opposed to change."[102] Hogg's charge may be unduly harsh; the Committee did recommend the adoption of several inventions by Captain Boxer, such as his parachute flare, improved artillery fuze and redesigned shrapnel shell. While important improvements, however, such proposals represented incremental rather than radical advancements in "artillery science." Nothing truly revolutionary was ever recommended.

In addition, the Select Committee could only pass opinion on the matters forwarded to it by the Master-General. As a body, it could not make proposals, although no prohibition existed against individual committee members doing so, provided they also went through the Master-General. The restriction forbade recommending improvements to materials that showed promise, or could be useful in some other role other than the topic under investigation. In the case of Joseph Southby's rockets, despite their proving more effective than the service signal rocket, they could not be considered as a replacement for the latter, his proposal being specifically for the use of rockets to send messages at night.[103] Prohibited from originating ideas, the Committee also lacked any incentive to explore technologies beyond those which its committee members were already familiar. Finally, the Committee operated under a semi-transparent veil of secrecy. Although reports often did get passed to the press, the Committee formally could not make its opinions on technology known to

[101] Hogg 1963, 1433; "Deaths," *The New Annual Register, or General Repository of History, Politics, Arts, Sciences, and Literature* (1832): 70.
[102] Hogg 1963, 1433.
[103] Southby, op. cit.

inventors. Such secrecy meant that inventors could not anticipate what the British military really needed. In effect, the rules the Committee operated under walled it off from the rapid changes in industrial knowledge that would have broken the somnolence of "artillery science" in the period before the Crimean War.

The Board, as the public face of the Ordnance Department, also came under fire for its treatment of inventors. One author, referring to Henry Shrapnel's famous invention, wrote that the Board "had...shown a degree of negligence disgraceful to themselves.... and that from ignorance or jealousy useful inventions have often been crushed."[104] In 1840, a "Sailor of Forty Years' Experience" charged in the *London Standard* that both the Boards of the Admiralty and Ordnance "are utterly unequal to judge of matters brought before them," especially regarding "certain novel inventions he had been appointed to examine." The writer decried having experiments conducted only at Woolwich or Portsmouth, where "it is impossible to preserve any secrecy whatever," and the lengthy delays that occurred in the experiments carried out by the Select Committee. "Had the invention to which I refer been adopted, the saving of money and time would have been enormous," and a fleet fitting out to fight "a new war…in a remote quarter of the globe" would have already been under way." The author ended by claiming that "the whole matter will shortly come before the public, and then all parties shall be judged."[105] Despite such a dire prediction, however, there is no evidence that the Ordnance Department considered any sort of overhaul of the Select Committee and the general process of weapons evaluation before 1855.

Reform Efforts before the Crimean War

The Ordnance Department proved resistant to change, symptomatic of the

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[104] Sinclair, pp. 243-244

[105] "A Hint to the Boards of Admiralty and Ordnance," *London Standard*, 21 Feb. 1840, p.2. The author did not specify exactly what invention he meant.

conservatism of the British army as a whole. Much of the latter stemmed from the Duke of Wellington's long years of influence. The "Iron Duke" had served as Master-General of Ordnance from 1819 to 1827, then as Commander-in-Chief from 1827-28 and again from 1842 until his death in 1852. In between years, he very actively participated in politics, and served briefly as Prime Minister from 1828 to 1830 and again for a month in 1834. Even when not in immediate charge of the army, Wellington retained considerable influence over its chief officers, many of whom had served under him and owed their positions to his decisions. The Duke's efforts during these lean years were "less to improve the Army than to save it from destruction" at the hands of a Parliament determined to reduce the burden of military spending on the tax-paying public.[106] He also fought hard against efforts to overhaul a military administrative system that he felt had worked during the Napoleonic Wars, and especially opposed putting more power into the hands of a civilian-led War Office. Such a change, he felt, would strip control of the army from the Crown and hand it to the House of Commons.[107]

Due in large part to the "mutual animosity" between soldiers and politicians, the British military, long a target for a penny-pinching Parliament, had also become very risk averse.[108] Indeed, for many army officers the word "reform" really meant further financial strangulation.[109] Gutted after the close of the Napoleonic Wars, British army ranks shrank from 190,797 in 1815 to 50,856 in 1830 – a seventy-three percent reduction done in a

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[106] Spiers, *The Army and Society*, 91; also J. W. Fortescue, *A History of the British Army*. Vol. XI: 1815-1838 (London: Macmillan and Co., 1930), 458.
[107] Spiers, *The Army and Society*, 90-91.
[108] Strachan, *Wellington's Legacy*, 234.
[109] K. Theodore Hoppen, *The Mid-Victorian Generation, 1846-1886* (Oxford: Oxford University Press, 1998), 175.

ruthless manner that gravely damaged the army's effectiveness.[110] "Guiding principles were cast to the winds," wrote one historian, "and we rushed to the demolition of our military…as if Satan had been bound for a thousand years and there was to be no more war." Satan had not been bound, however; revolution broke out in Canada the year Victoria became Queen, and "there was not a single year in [her] long reign in which somewhere in the world her soldiers were not fighting."[111] France remained one of the nation's primary threats, and Russia rapidly became another as the two countries struggled with each other in their "Great Game" of empire-building in Central Asia.[112] British armies found themselves involved innumerous "little wars" being fought on the fringes of an expanding British Empire. Gradually, over the course of four decades of colonial warfare, Parliament begrudgingly voted the funds that allowed the army to rebuild. By 1853, army strength stood at 102,283 – still a smaller force than in 1815, but considered adequate during peacetime.[113]

The forces ranged against military spending varied considerably. Joseph Hume, an ardent free-trade radical, vigorously opposed profligate spending by any government department but especially the military. In an 1837 speech regarding army estimates, for example, Hume questioned why Britain needed an army larger than the emaciated forces "deemed expedient" in the 1820s. "At a time when the government found it impossible to afford relief to the urgent wants of the people," Hume argued, "it appeared to him to be monstrous" that the public be asked to fund "a standing army nearly doubling in amount" of that in the decade before.[114] The "relief" he sought came in the form of reduced taxation;

[110] H. W. L. Hime, *History of the Royal Regiment of Artillery, 1815-1853* (London: Longmans, Green, and Co., 1908), 85; Barnett, 278-279.
[111] Farwell, *Queen Victoria's Little Wars*, 1.
[112] Peter Hopkirk, *The Great Game: The Struggle for Empire in Central Asia* (New York: Kodansha International, 1992), 1-8.
[113] Hime, 85.
[114] "Army Estimates," *Bradford Observer*, 17 Aug. 1837, p. 6.

“seventy per cent of the whole amount,” he argued, “fell upon the poorer, the working classes.” Given such a burden, Hume felt “it was the duty of the Government to curtail every expense as much as possible.”[115]

A vocal “peace movement” also complained about military spending. The movement, which stemmed from pacifist Quaker peace societies, included many who opposed any military spending at all, as illustrated by an article attributed to the *Manchester Times*. After the 1841 fire at the Tower of London, the paper raged that “military taste ought not to be predominant through Christendom” and hoped that the Tower “will never be rebuilt.” “The public money that has been spent in ordnance stores since 1815,” the paper claimed, “would have sufficed to feed all the poor in the United Kingdom for the next twelve months.”[116] The movement included middle-class industrialists such as Richard Cobden and John Bright, both Liberal MP’s from Manchester. Such members felt that the nation should only provide what military force would be required for defense. Cobden in particular argued that “savings on wasteful armaments’ expenditure and the resultant reduction in taxation would have almost as beneficial an effect on industry and trade as had repeal of the Corn Laws.”[117] Others agreed, such as the *Christian News*, who questioned what the military spent its money on. “On looking at the returns to Parliament in the Ordnance department,” the paper wrote, “an item of 26,000*l.* sterling appears for salutes. Can this be tolerated by the nation? The idea of

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[115] “Supply – Army Estimates.” HC Deb 05 April 1837 Vol 37 cc778-95.

[116] “Trophies in the Tower.” *Leicestershire Mercury*, 04 Dec. 1841, p.4. The original article could not be located.

[117] David Nicholls, “The Manchester Peace Conference of 1853.” http://www.hssr.mmu.ac.uk/mcrh/files/2013/01/mrhr_05i_nicholls.pdf, 13-14, and “Richard Cobden and the International Peace Congress Movement, 1848-1853.” *Journal of British Studies* 30, no. 4 (1991): 351-76. Cobden and Bright formed the Anti-Corn Law League in 1839 to fight protective tariffs on imported grains. When the Corn Laws were finally repealed in 1846, the pair continued to champion the idea that “free trade would give buyers and sellers all over the world so strong an economic interest in peace that they would prevent their governments from making war;” see William D. Grampp, *The Manchester School of Economics* (London: Oxford University Press, 1960), 7.

blowing away [that much] gunpowder in making a noise is really too irrational and absurd to be much longer submitted to by the taxpayers."[118]

Not every Briton agreed with those clamoring for military austerity. In an anonymous letter to the *Yorkshire Gazette*, writer "M." mockingly suggested that "the barrels of all our soldiers' muskets be converted into syringes… [and filled] with CHLOROFORM." Attacking the enemy in standard formation, "each man will fire (I beg pardon, liquidate,) at about the third button of his opposite antagonist's waistcoat…in a few seconds the whole of the enemy will be sprawling senseless on the ground." After disarming and looting the enemy of any valuables, "our gallant fellows…will shave off, in derision" their facial hair, as "nothing can be imagined more galling or insulting to the fine mind of a Frenchman." Such a plan, the writer claimed, would be extolled by Hume and others attempting to wish away military spending. The plan "will cost but a mere trifle," "M." wrote, "and the quaker disciples of peace need quake no longer…for no blood will be shed."[119]

In between such extremes stood many individuals who realized that British military administration, especially an Ordnance Department known for its labyrinthine and nearly unfathomable accounting, could be rationalized. The *London Daily News* argued, for example, that "the Board of Ordnance is full of abuses" and that consolidation of offices and greater centralization might free up enough funds so that "the Artillery could at once be almost doubled."[120] Reform efforts, however, invariably centered on financial, rather than administrative, issues. The Board of Ordnance actually served as a model for a successful reform of the Admiralty Office in 1831, a committee reporting the Board model to be "better for securing an efficient and economical dispatch of business." Ironically, the abolition of

[118] "An Absurdity," *Westmorland Gazette*, 04 Feb 1854, p.3.
[119] "The National Defences," *Yorkshire Gazette*,29 Jan 1848, 6.
[120] *London Daily News*, 09 Jan 1852, 4.

two top posts of the Department, recommended in 1828 as a cost-saving measure, served instead to weaken the Board. Membership dropped from five to three with the elimination of a civilian, the Clerk of Deliveries, and the Lieutenant-General, the one serving military officer on the Board and primary technical advisor to the Master-General.[121]

Efforts were made before the Crimean War to clear away the muddle in the administration of both the army and ordnance. Charles Gordon-Lennox, the Duke of Richmond and member of Earl Charles Grey's Whig cabinet, developed a plan in 1833 to break up the Board of Ordnance into its civilian and military components.[122] Richmond passed his plan to Col. Sir Alexander Dickson, then Deputy Adjutant-General of the Royal Artillery, for comment. Known as an outstanding artillery officer, Dickson was also a Wellington partisan, having been brevetted by the Duke from captain to lieutenant-general (a jump of several grades) and appointed overall commander of allied artillery during the Peninsular War. Dickson rejected Richmond's plan as not offering "any advantage that would arise to the public from it, either to expedite the service, or as a savings in expense." Instead, Dickson wrote, the duties of the Board "would be carried on with less efficiency, the progress of improvement would be retarded, and great waste or misapplication of the stores would ensue."[123]

Richmond's plan languished with the dissolution of Grey's cabinet the next year, but in 1835 the question of wholesale reorganization surfaced again during Lord Melbourne's

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[121] HCPP, "Second Report from the Select Committee on the Public Income and Expenditure of the United Kingdom. Ordnance Estimates;" 1828 (420). 10-12; Skentelbery, 16-17.

[122] Ironically, Richmond had been offered the post of Master-General of Ordnance by Grey on the formation of his cabinet. Army commanders, however, "were so indignant at the idea of a half-pay lieutenant-colonel being in command that the offer had to be withdrawn." Richmond ended up as postmaster-general. F. M. L. Thompson, F. M. L. Thompson, "Lennox, Charles Gordon, fifth duke of Richmond and fifth duke of Lennox (1791–1860)," *ODNB,* Jan 2008, http://dx.doi.org/10.1093/ref:odnb/16453.

[123] HCPP, "Report of the Commissioners Appointed to Inquire into the Practicability and Expediency of Consolidating the Different Departments Connected with the Civil Administration of the Army;" 1837 (78), Appendix B.

second Whig government. Parliament appointed a commission under Henry George Grey (Lord Howick) and Henry John Temple (Lord Palmerston) to investigate the "Practicability and Expediency of Consolidating the Different Departments connected with the Civil Administration of the Army." *The Monthly Review* used testimony from the commission's report to illustrate the Ordnance Department's role in the British military administrative muddle in an attempt to further public debate. "If a supply of arms is wanted for the troops," for example, the requesting officer did not go to a single central authority. Rather, "application is made by the Commander-in-Chief to the Secretary at War, and by him to the Secretary of State, to signify his Majesty's pleasure to the Master-General and Board of Ordnance for the issue of the arms." Since the Board supplied guns and gun carriages for the navy, a ships' captain "must notify his wants to the Admiralty, and the Admiralty to the Board of Ordnance, who transmit their directions thereupon to their officers" for issue, even for something as small as a missing bolt. Finally, the article noted what would become one of the biggest problems Lord Raglan encountered in the Crimea, the lack of an effective logistical command. "Commissaries-general with an army in the field are amenable to two authorities," the paper explained. "They receive their instructions…and money from the Lords Commissioners of the Treasury, and, at the same time, they are under the orders of the commander of the army to which they are attached." They also answered to Treasury auditors "for the expenditure of their cash, and to the Board of Ordnance for their stores." The "natural" results of the lack of a central administrative authority for the British military, the article continued, included "conflicts of opinion, diversities of system and delays, involving a multiplication of correspondence, and of needless formalities in the transaction of business." In contrast, the *Monthly Review* pointed out, "every military department [in

France] is subordinate to the War Minister," a single authority "responsible for the whole of the military expenditure" as well as the performance and conduct of the army.[124]

The commission ultimately brought forward a modified version of Richmond's plan, but with the added recommendation that the Secretary at War become a full-fledged Secretary of State and member of the cabinet. Presumably, the Secretary of War and Colonies, also a Cabinet member, would have given over all duties related to the army, to concentrate on "the civil administration of our numerous Colonies, with all their complicated interests." Such an arrangement would eliminate what the commission felt to be the "chief defect" in British military administration: "the want of some one authority having an efficient control over the whole military expenditure of the country." They also recommended that the military duties exercised by the Master-General remain with him, whereas the civilian in the Board of Ordnance should be made subordinate to the new Secretary's post.[125] Had the commission's recommendations been adopted, they would have effectively dissolved the muddle nearly twenty years before it bogged down Raglan and the Crimean expeditionary force. Instead, they met with "practical objections of a most forcible nature" from Wellington and other high-ranking army officers such as Sir Henry Hardinge and Charles William Vane, the Marquess of Londonderry.[126] Such a move, the Duke felt, would create a "new Leviathan" in the form of the Secretary of State for War's office, and would "transfer the effective command of the Army from the King to the House of Commons."[127] Faced with such opposition, the recommendations were ignored, victim to "a combination of tolerable

[124] "Art. X: Report of the Commissioners Appointed to Inquire into the Practicability and Expediency of Consolidating the Different Departments Connected with the Administration of the Army, 1837." *The Monthly Review*, Vol. II: from May to August Inclusive (1838: 266-81), 267-269.
[125] HCPP, 1837 (78), 8-11.
[126] "Supply – War Department." HC Deb 17 July 1854 Vol 135 cc317-42; Gordon, 45.
[127] Gordon, 45.

success in colonial campaigns, fears about the creation of an overpowerful military authority, bureaucratic inertia, and dedication to cheese-paring."[128]

Conclusion

In 1849, the *Morning Herald* reported, prematurely, that the "very expensive, very slow, and over-officered establishment, the Board of Ordnance, is no longer to be maintained in its separate and irresponsible existence." Rather wishfully, as things turned out, the *Herald* wrote that the Department would be broken up "as mere branch departments" attached to Horse Guards and the Admiralty.[129] Instead, Ordnance lumbered on, a major ingredient in a muddled "system" of military administration, production, and procurement practices that remained very much as it was at the close of the Napoleonic Wars. Paradoxically, this antiquated and divided system worked, insofar as it guaranteed a weak army that could not challenge Parliament for supremacy, yet provided just enough for the defense of the empire, a point related to who the "real" enemy was. Britain's wars between 1815 and 1855 were carried out against societies that lacked the resources, training, discipline, and organization of the British army, which made it possible for the British to ignore new weapons technology and military reform. In this sense, the imperial focus reinforced the stasis of the military. In addition, the accomplishment of Wellington and his army (not to mention his allies) at Waterloo had convinced the world of the supremacy of British arms for decades after the battle. Had Britain not chosen to get involved in the "Eastern Question" brewing between Turkey and Russia, this assumption of supremacy might have gone unchallenged for many more years.

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[128] Hoppen, 175.
[129] "The Board of Ordnance," *West Kent Guardian*, 03 Nov. 1849, p.6.

Although the nation in general proved content with the weapons that beat Napoleon, it is clear from newspaper reports and the files of the Select Committee that while the process was slow, changes were being investigated. It is also clear that many of these changes came into the procurement process from outside the military establishment. The British fascination with things military, the demand for information fed by a willing press, and ideas from the ongoing Industrial Revolution combined to raise questions regarding the technologies in use by the British army and navy. Such questions may have smoldered on for years; instead, the events of the Crimean War fanned the slow burn into a revolutionary change in military technology that continued for the next five decades. To illustrate how dramatic these changes were, it is worth spending some pages to review the state of British arms before the Crimea, and some of the emerging technologies being considered.

Chapter 2: "The War will not last a Month:" British Arms in the Conflict with Russia

The latter half of 1853 saw Britain increasingly consumed by war fever as an impending conflict between Turkey and Russia occupied both the headlines and the attention of the Queen's subjects. "The public mind has been greatly agitated," wrote *The Examiner*, by the Turkish Grand Council's declaration of war against Russia in October of 1853 and Britain's potential role in the upcoming conflict.[1] In the view of many, the British cabinet's decision to move the Mediterranean Fleet into the Dardanelles the previous May had "morally committed" Britain to protect Turkey. Not only were British ships "the guarantors of good faith, they could not be withdrawn without a tremendous loss of prestige."[2] Many also felt that Britain had an obligation to stand fast against the predations of a Russia determined "not only to subdue Turkey, but to domineer over all Europe, and extirpate all freedom."[3] "The Russians committed themselves to an overt act of war" by their June occupation of Moldavia and Wallachia, argued the *Worcester Journal*, and "if the Turks are unsuccessful in the coming struggle it is impossible to contemplate without dread the disastrous circumstances" to Britain.[4] If, however, "aid is given [to Turkey], as it ought to be, the war will not last a month" argued *Bell's Life*. For England and France to not to deliver this aid, the magazine continued, "would be treason…interests and honour alike require that the war should be brought to a speedy and satisfactory termination."[5]

Few in Britain really understood what the nation had committed to, however. Forty years of peace had dulled the public's remembrance of the costs of war, while events such as

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[1] "Turkey and Russia: War Advised by the Turkish Grand Council." *The Examiner* 08 Oct 1853, 6.
[2] Andrew D. Lambert, *The Crimean War: British Grand Strategy, 1853-56* (Manchester: Manchester University Press, 1990), 22.
[3] "Russia & Turkey - Peace or War." *Newcastle Guardian and Tyne Mercury*, 15 October 1853, 5.
[4] "The War with Russia." *Worcester Journal*, 22 Oct 1853, 5.
[5] "Turkey and Russia–War Begun." *Herts Guardian, Agricultural Journal, and General Advertiser*, 12 Nov 1853, 4.

the Great Exhibition of 1851and the grand military spectacle of the Duke of Wellington's funeral in 1852 sharpened Britons' sense of martial and industrial power.[6] The long peace had also generally stilled military innovation for most of Europe. While some important new technologies, such as steam-powered warships and rifled muskets, had emerged, the basic tools and tactics of land and sea warfare in 1854 remained much as they had been at the close of the Napoleonic Wars. Two years of fighting in the Crimea, however, would show the public the great limitations, if not outright obsolescence, of current military technology. It also cleared the way for a serious reconsideration of that technology in the years following the Peace of Paris in 1856.

In order to build a picture of the state of military technology employed during the Crimean War, this chapter will concentrate on a few specific engagements: the naval bombardments of Sinope and Odessa, the battle of the Alma, and the siege of Sevastopol Harbor. The intent is to examine the technologies involved, and not to detail the engagements themselves, which have been recently and excellently covered in works by Trevor Royle and Orlando Figes.[7] The picture that emerges from such an examination is of militaries armed with decades, if not centuries-old weaponry, but also struggling with new technologies and the appropriate tactics to use them. For Britain, the Crimean War marked its final act of *ancien regimé* warfare and its first industrial war, and heavily influenced weapons and tactics development for decades afterward.

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[6] Britain alone had 336 displays for "Class 8: Naval Architecture, Military Engineering, Guns, Weapons, &c." listed in the *Official Catalogue of the Great Exhibition of the Works of Industry of All Nations* (Corrected ed. London: Royal Commission, 1851, pp. 50-57). Spicer and Clowes, who contracted to print the catalog, also published a companion guide to '[indicate] the easiest course to be pursued in examining the contents of the Great Exhibition" (Robert Hunt, *Synopsis of the Contents of the Great Exhibition of 1851*, Spicer and Clowes, 1851). The Exhibition has been the subject of several studies on its impact on visitors and Britain herself; among the more recent is Jeffrey A. Auerbach's, *The Great Exhibition of 1851: A Nation on Display* (New Haven, CT: Yale University Press, 1999), and a collection of essays in *Britain, the Empire, and the World at the Great Exhibition of 1851* (Aldershot, England; Burlington, VT: Ashgate Pub. Co., 2008), edited by Auerbach and Peter H. Hoffenberg.

[7] Royle and Figes, ibid.

The "Massacre at Sinope" and a Revolution in Naval Warfare

On 21 November 1853, a Russian naval squadron under Vice-Admiral Nakhimov caught the Turkish Black Sea Fleet at anchor at Sinope. Although three capital ships formed part of his squadron, Nakhimov elected to blockade the Turks while summoning reinforcements from Sevastopol, a scant hundred miles away. Joined in a few days by six additional vessels, Nakhimov took advantage of heavy fog on 30 November to sail his line-of-battle ships into the harbor, leaving two sail and three steam frigates to guard the entrance. As a result of either the fog or Turkish complacency, Nakhimov closed within a mile and a quarter of his intended targets, and the Turks held their fire despite the approach of so many Russian guns.[8]

In addition to the standard cast-iron cannon that armed his warships, Nakhimov brought a weapon not yet tried in naval combat: the shell gun. Although explosive-filled shells had long been in use on land, the mortars that fired them did so in high, arcing trajectories. Shooting in such a manner posed considerable fire risk to normal warships which were crisscrossed with canvas and tarred rope, thus limiting their use to specially-designed bomb vessels.[9] The invention of French Col. Henri-Joseph Paixhans, however, removed this limitation. Paixhans argued that although the thick wooden sides of a then-modern ship of the line could adequately resist solid shot, a shell – lighter in comparison and therefore traveling at higher velocity – would instead punch through. Once inside, the resulting explosion would "scatter death and fire" amidst the decks of the shell's target.[10] Built with a specially-shaped powder chamber and reinforced body, tests against the retired 80-gun *Pacificateur* with two

[8] "The Massacre at Sinope – Destruction of the British Vessel Howard." *Lloyd's Weekly Newspaper*, 08 Jan 1854, p.7; "The Massacre at Sinope Investigated." *Stirling Observer*, 05 Jan 1854, p.4.
[9] James Phinney Baxter, *The Introduction of the Ironclad Warship* (Hamden, CT: Archon Books, 1968), 18.
[10] Baxter, 23-24.

prototype Paixhans shell guns in 1824 demonstrated their effectiveness. The commission overseeing the trials judged that the shells "wrought such havoc… [that] a similar explosion near the water line might have sunk the vessel."[11]

Adopted almost immediately by the French, the Paixhans gun underwent a number of modifications over the next several years. Standardized for naval use in 1842, the smooth-bore *canon-obusier de 80* fired a spherical 60.5-pound shell in its primary role, but could fire 86.5-pound solid shot when necessary.[12] Paixhans, however, also theorized that such a weapon, mounted in steam-powered warships, would initiate a naval revolution and neutralize Britain's command of the seas. Although an effective ship-killer, Paixhans's invention did not prove to be the decisive weapon that he predicted. "The only result," historian Walter Millis later wrote, "was that the potential enemy promptly appropriated the idea," and by 1853, Britain, Russia and the United States had adopted their own designs.[13]

The battle at Sinope marked the first time that shell guns fired in anger.[14] Either caught napping or deliberately holding fire, the Turkish commander Osman Pasha finally "signaled his fleet to fight bravely…and at noon a desperate action commenced."[15] For the next hour and a half, Nakhimov's larger warships poured fire into the sides of the smaller

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[11] Baxter, 25. The French equivalent of the OSC, known simply as the "Artillery Committee" (*le comité de l'artillerie*) dates to at least 1795, and had a variety of missions over the years, including supervision of ordnance experiments and oversight of the nation's arsenals. Although similar in that regard to the British Board of Ordnance, the Artillery Committee answered directly to the French Minister of War. See Pierre Nardin, "Le Comité de l'Artillerie et ses Réalisations des Origines à 1870," *Institut de Stratégie Comparée*, 2005, http://www.institut-strategie.fr/RIHM_82_NARDIN.html. Baxter mentioned that the commission evaluating the gun consisted of sixteen persons; whether it was a special committee or the Artillery Committee itself is unknown.

[12] Jeff Kinard, *Artillery: An Illustrated History of Its Impact* (Santa Barbara, Calif.: ABC-CLIO, 2007), 235. Wawro mistakenly states that the Paixhans gun was a "rifled cannon." Shell guns at the time of the Crimean War, however, remained smooth-bored. See Wawro, *Warfare and Society*, 53.

[13] Kinard, 236; Walter Millis, *Arms and Men: a Study in American Military History* (New York: Putnam, 1956), 88-89.

[14] German coastal batteries used shells to destroy two Danish warships at Eckernförde in 1849, during the First War of Schleswig (Baxter, 69). Purpose-designed shell guns, however, had yet to be used in combat.

[15] *Stirling Observer*.

Turkish frigates, corvettes, and transports. Solid shot smashed timber and bone; shells pierced hulls and exploded, setting wood, rigging, and clothing aflame. Spreading rapidly, the fires eventually reached powder magazines, blowing ships apart and spreading the inferno to shore. The Russian gunners then turned their attention to the town for several more hours. A later report by *HMS Retribution* put the loss of Turkish life at nearly four thousand dead, wounded, or captured, at a cost to the Russians of thirty-seven men. The attack left the town of Sinope "completely destroyed, either by shells or burning timbers, and the whole coast…strewn with dead bodies." Only one Turkish vessel, the steamer *Taif*, escaped.[16]

Adolphus Slade, British advisor to the Turkish Navy and escapee on the *Taif*, observed that Porte officials "listened, apparently unconcerned" to news of the destruction of the harbor as if "listening to an account…of a disaster in Chinese waters."[17] Such a lopsided victory for Russia, however, provided considerable grist for the mill of those clamoring for war in Britain. The papers quickly named the battle the "Massacre at Sinope,"and ignored the possibility the Sublime Porte had deliberately sacrificed the fleet to draw France and England into the conflict. Deliberate or not, the attack reinforced British arguments for intervention as a point of honor. It also prompted George Villiers, the Earl of Clarendon and Secretary of State for Foreign Affairs, to write that "the circumstances which have attended this disastrous affair are of the greatest importance." Villiers wanted no misunderstanding between London and St. Petersburg. If the British and French fleets dispatched to protect Constantinople had instead been at Sinope, they "would have protected it, and would have repelled the attack."[18] Sinope would have – or perhaps should have, in Villiers' mind – resulted in bringing France and Britain into the war.

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[16] *Stirling Observer;* Wawro, *Warfare and Society*, 53-54; Royle 93-94.
[17] Figes, 142-143.
[18] "Official Dispatch after the Massacre at Sinope." *Norfolk Chronicle*, 11 Feb 1854, p.7.

In addition to providing a *casus belli* for the allies, Sinope finally started the naval revolution that Paixhans had predicted. Previous experiments by the British Board of Admiralty from 1846 to 1851 had convinced many navies around the world of the unsuitability of iron for warship construction – experiments conducted with solid or hollow shot, but not shell.[19] The performance of the shell gun in combat, combined with the scope of the disaster at Sinope, proved to both naval authorities and the general public that the wooden warship had finally become obsolete. Only armor could resist the shell gun, only steam could propel an armored vessel, and only larger guns could defeat such ships – the classic cycle of offense versus defense that would drive naval armaments design into the twentieth century.

The Revolution's Next Lesson: The Bombing of Odessa Harbor

On the 21st of February, 1854, the Coldstream Guards left England for Malta, part of an expeditionary force the British cabinet authorized two weeks before and placed under the command of FitzRoy James Henry Somerset, then Lord Raglan and the Master-General of Ordnance.[20] The sixty-five year old Lord Raglan had won a reputation for bravery as "the companion in arms and Military Secretary of Wellington" during the Napoleonic Wars, famously losing his right arm at Waterloo.[21] Although he never commanded an expedition in the field, Raglan proved an able administrator during the long peace, and many in the army considered him "just the man for the job."[22] The cabinet originally authorized only a force of 10,000 men; Raglan, however, demanded that the number be doubled before he accepted the command. "As an old Peninsular officer of great experience," the *Morning Chronicle* reported, "he knew well how rapidly the ranks are thinned in a campaign from fatigue,

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[19] Baxter, 36-39.
[20] Royle, 112-119.
[21] "The Preparations for War." *Yorkshire Gazette*, 18 Feb 1854, 2.
[22] Royle, 112-113; E. M. Lloyd, "Somerset, FitzRoy James Henry, first Baron Raglan (1788–1855)," rev. John Sweetman, *ODNB, Sep 2014*, http://dx.doi.org/10.1093/ref:odnb/26007.

climate and a host of other diseases" – words that proved all too prophetic.[23]

On 28 Mar 1854 Britain and France declared war against Russia, two days after their ultimatum requiring the latter's withdrawal from the occupied Ottoman provinces of Moldavia and Wallachia expired.[24] Shortly after the declaration reached the allied fleet at Varna, HMS *Furious* steamed to the Black Sea harbor of Odessa. Once there, the *Furious* dispatched a boat and a lieutenant to collect the British consul. Stonewalled by the Russians, the lieutenant departed empty-handed. En route back to the *Furious*, the Russians fired a cannon ball at the boat, then several more towards the steamer. The British claimed both craft flew white flags, and demanded an explanation for "outraging a flag of truce… held sacred by all nations pretending to civilization." Such "unheard-of aggression" provided the excuse the Allies needed to open hostilities against the Russians. On 20 Apr 1854, a combined fleet of nine steamers made their way to the harbor in order to "exact reparation from the authorities" of Odessa.[25] Challenged to explain his actions, the Russian commander claimed he had not ordered fire against the boat, but only against the *Furious*, which he accused of "not heeding customary signals" and of entering the bay to spy on its defenses. Such an answer, which the *Times* labeled "unsatisfactory and untrue," did not mollify the Allied commanders. When a demand for the surrender of the merchant ships in the harbor went without reply, the Allies entered the bay to "punish this outrage on the law of nations."[26]

The bombardment of Odessa that commenced on 22 April represented not just the opening battle between the British, French, and Russians, but one fought with technology centuries apart. Steam power represented the newest of those technologies. One at a time, the

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[23] "The Preparations for War." *Morning Chronicle*, 16 Feb 1854, 5.
[24] Royle, 115, 127.
[25] "Bombardment of Odessa (from the Times)." *Dublin Evening Mail*, 12 May 1854, 2.
[26] *Dublin Evening Mail*.

Allied warships closed to within a thousand yards of the docks and ships at anchor in the harbor. At that range "each steamer delivered the fire of her enormous guns, then wheeled round in a circle of about half a mile in diameter" before coming back to fire again. "They kept wheeling and twisting about like so many waltzers," the *Times* reported, "without ever touching or getting into scrapes" with each other – a tactic only made possible because of steam power.[27] Firing on the move, however, posed a challenge for the British gunners, and they more often missed their targets, the shore-based Russian gun emplacements, than hit them. A writer for *Blackwood's Edinburgh Magazine* who visited Odessa after the war noted that the British ships had "spread their shot all over an open and harmless city." Such wild shooting, while it did considerable damage, gave the townspeople a much different impression of the battle's outcome than what the British sailed away with. "All the numerous shot-marks," *Blackwood's* reported, were painted with two black circles with "Holy Saturday, 1854" between them, "a memento…[of] an attack gloriously repulsed."[28]

During the next several hours both sides fired round after round at each other, including heated shot. An ancient technique shore batteries used against attacking ships, the gun crews placed solid iron shot in a special furnace and heated it red-hot before loading and firing. Such an operation carried considerable risk: a British 32-pounder loaded with heated shot burst at Gibraltar in 1852. The resulting explosion killed or wounded three officers, ten men, and threw fragments of the gun up to 140 yards away.[29] The effects of the weapon against wooden warships, already vulnerable to fire because of their construction, made taking such a risk worthwhile. One or two strikes could put an attacker out of the fight, and

[27] *Dublin Evening Mail.*
[28] "Iron-Clad Ships of War." *Blackwood's Edinburgh magazine.* American Edition, Vol. LI, Jul-Dec (1860): 616-32, p.618.
[29] Howard Douglas, *A Treatise on Naval Gunnery* (London: John Murray, 1860; rep. Kessinger Publishing, La Vergne TN 2010), 310.

this proved true for the unarmored steamers in action at Odessa. Within an hour, the French steamer *Vauban* withdrew from the battle to deal with a fire ignited by such a round. The Russians, however, were not alone in using such a weapon. At least one of the attacking steamers, *HMS Terrible*, had its own furnace, and a lucky strike with a heated round blew up a Russian powder magazine.[30]

Figure 5: Congreve rocket boats in action.[31]

The Russians reported "an incessant shower of bombs, rockets, and red-hot balls" fired against them from the attacking British squadron.[32] The rockets were launched by a detachment of special "rocket boats" assigned to the fleet. Congreve rockets had seen long service with the Royal Navy, but were too dangerous to use aboard the average warship.

[30] W. Laird Clowes, *The Royal Navy: A History from the Earliest Times to the Present*, reproduced at http://www.pdavis.nl/Russia.htm, accessed 11 Mar 2015, and Douglas, 310. Douglas considered the use of hot shot "exceptional" because of the risk of catastrophic accident. "There is already so much danger of fire in all ships" by incendiary devices, he wrote, "that it were better not to add another element to those perils."

[31] "Congreve's Rocket System," Nimitz Library, United States Naval Academy, accessed 08 December 2014, http://www.usna.edu/Library/sca/ve-collections/congreve/index.php.

[32] "Bombardment of Odessa." *Hertford Mercury and Reformer*, 13 May 1854, 4.

Instead, rocket launchers were installed on shallow-draft boats which allowed them to close "within musket shot" of the docks in order to fire their 24lb projectiles. Soon, however, they were taken under fire by a Russian horse artillery battery. "Happily nobody was hurt," the *Times* reported, "though a perfect shower of balls fell around" the boats, "knocking the oars about and ploughing up the water around them." [33] The rockets themselves "caused terrible destruction," setting the docks and part of the town aflame.[34]

With the destruction of the dockyards and merchantmen complete, the British finally sailed out of the harbor that evening, but Odessa would have one more lesson to deliver regarding ship-versus-shore combat three weeks later. Early in the morning on 11 May one of the British steamers that participated in the attack, *HMS Tiger*, became grounded during a heavy fog just a few miles away from the harbor. In an attempt to break free, the crew jettisoned all but one of her guns, to no avail. Stuck fast, she became a target for a Russian shore battery equipped with both shell guns and its own portable forge. "The frigate was thoroughly searched by the enemy's fire," *Blackwood's* later reported. "Shell from the howitzers…passed easily through her sides and decks, bursting and spreading destruction everywhere." Heated shot "lodged in sail-bins, storerooms, and amongst other inflammable matter" and set the ship ablaze. Mortally wounded, the British captain had no option but to surrender.[35] If Sinope was the first lesson of the naval revolution, Odessa was certainly the second; unfortunately for both French and British sailors, it would not be the last.

British Small Arms at the Battle of Alma

The British "regular army" – the infantry and cavalry – that landed at Calamita Bay on 14 September 1854 arrived with essentially the same weaponry they carried against the

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[33] *Dublin Evening Mail.* Royle (150) incorrectly wrote that the boats were a "new" development.
[34] *Hertford Mercury and Reformer*.
[35] Clowes, ibid; "Iron-Clad Ships of War," 617.

French forty years earlier. Infantry still fought with the bayoneted musket, and cavalry with the sword, lance, and pistol. Guns of all types, from heavy cannon to small arms, still required loading at the muzzle, or the mouth of the weapon. Infantrymen generally loaded their muskets while standing, an operation that exposed them to enemy fire. Single-shot weapons, muzzle-loaders required the soldier to reload before firing again – something impossible from horseback during an attack. The gunpowder used, known as "black powder," consisted of a composition of charcoal, potassium nitrate, and sulfur. When fired, it produced a tremendous cloud of smoke – quite literally the "fog of war" – and left a heavy deposit of soot in the barrel. Unless cleaned out, the soot built up to the point where loading a weapon became difficult, if not impossible. In addition, the sulfur in the residue combined with moisture in the air to produce sulfuric acid, which corroded metal quickly.

The British service musket had seen two important changes between 1815 and 1854. For nearly two centuries, military small arms used the action of flint striking steel to fire their charge. Although the mechanisms evolved over time, the basic operation remained the same. When the soldier pulled the trigger, a hammer holding a piece of shaped flint scraped against a steel catch. This not only produced sparks, but pushed the catch forward to expose a small pan full of gunpowder on the side of the barrel. The sparks ignited the powder, whose flame passed through a flash hole in the side of the barrel and hopefully ignited the weapon's main charge. Misfires due to weather, improper loading, or poor maintenance were common, as were 'hang-fires," delays between the ignition of the priming and the discharge of the weapon. Britain regiments in the 1600s and early 1700s obtained their own weapons, resulting in a confusion of styles with a more-or-less common bore size. In the 1720s the first standardized musket appeared, with colonels ordered to obtain new arms "according to the said Pattern and proved… by the Proper Officers of Ordnance."[36] The British service flintlock musket, affectionately known as the "Brown Bess," appeared the decade following, and remained in service for nearly a century.[37]

An early nineteenth-century development finally made the flintlock obsolete, and provides an interesting case study of British weapons evaluation of the period. In 1806, the Reverend Alexander Forsyth brought to London the first working percussion lock, the result of twelve years of experiment to overcome hang-fires in his hunting weapons. Forsyth's lock used the action of the hammer striking a charge of fulminate, an impact-sensitive compound, to detonate the main charge. Faster and more reliable, Forsyth's invention impressed Master General Lord Moira so much that he asked the reverend to adapt his lock to service weapons, particularly cannon, believing "that it may become a matter of great importance to the Military Service."[38] Given a workshop in the Tower of London, Forsyth attempted to do what Lord Moira asked, but met with considerable resistance by "ignorant and prejudiced, if not actively hostile" Tower workmen and chemists "so deeply suspicious of all fulminating compounds" that they refused to mix the chemicals.[39] Despite such obstacles, Forsyth soon constructed a lock and improved detonating compound capable of being used on cannon, only to be dismissed from the Tower when Lord Chatham, a Tory, took office after Lord

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[36] Blackmore, 44.
[37] Blackmore, 45.
[38] J. N. George, *English Guns and Rifles: Being an Account of the Development, Design, and Range of English Sporting Rifles and Shotguns* (Plantersville, SC: Small-Arms Technical Publishing Company, 1947), 247-248.
[39] George, 249. In fairness to the chemists of the age, the mercury fulminate that Forsyth experimented with had only recently been discovered by Edward C. Howard in 1800. The process required dissolving the toxic metal in nitric acid, which produced a highly explosive compound easily detonated by impact – a dangerous procedure resulting in an equally dangerous end product. See Frederick Kurzer, "Howard, Edward Charles (1774–1816)," *ODNB*, Oct 2007, http://dx.doi.org/10.1093/ref:odnb/71444.

Moira resigned as Master General on the fall of the Whig government in 1807.[40] Chatham peremptorily ordered Forsyth, also a Whig, to submit a final expense report, return all government property, and "immediately to remove his own 'rubbish' from the Tower."[41]

Undeterred, Forsyth patented his percussion lock in 1807, and over the next several years he and others continued to perfect several designs of percussion systems. In 1818 the first percussion cap – a small copper cup with fulminate deposited inside – appeared, although there is considerable controversy regarding the originator of the idea.[42] The cap proved the key to constructing a simple and effective percussion lock. After loading the weapon, the shooter placed a cap on a hollow nipple on the side of the barrel. When the shooter pulled the trigger, the gun's hammer struck the nipple and detonated the fulminate. As with flintlocks, the flame still had to pass through a flash hole to fire the gun's charge. Unlike flintlocks, however, the percussion lock offered a surer, safer ignition system with much less fire directly in the shooter's face. The percussion lock also made hang-fires exceptional rather than occasional, a definite plus in the minds of many frustrated sportsmen. In 1824, the *Hereford Journal* reported that "a large Seal… [which] had been a great annoyance to the salmon-fishing" at the mouth of the Don River for several years, had finally been shot and killed. The seal had learned to dive at the moment it saw the flash from a flintlock, "but the cunning animal was at last deceived [by] a gun with a percussion lock…

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[40] Roland Thorne, "Hastings, Francis Rawdon, first marquess of Hastings and second earl of Moira (1754–1826)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/12568.

[41] Chatham's decision may not have been all political; Blackmore "suggests that the action…was not entirely unreasonable" based on his examination of the remaining correspondence between Forsyth and the Board of Ordnance. In them, Forsyth admitted that his experimental gun locks had failed, but held that "they were for the purpose only of establishing the saving in powder." See Blackmore, 161; George, 249; James Burnley, "Forsyth, Alexander John (1768–1843)," rev. D. H. L. Back, *ODNB*, 2004, http://www.oxforddnb.com/view/article/9927.

[42] George, 258-259; Oliver Frederick Gillilan Hogg, *Artillery: Its Origin, Heyday, and Decline* (Hamden, CT: Archon Books, 1970), 202.

thus deprived of its usual signal of danger."[43]

The British military, however, hesitated to replace their stocks of the flintlock that defeated Napoleon, despite the entreaties of officers such as famed inventor Col. Frances Maceroni.[44] "A cap is put on much quicker than a flint-lock is primed," Maceroni wrote in an article to the *United Service Magazine,* "and there is no time lost in changing flints" which dulled rapidly after repeated blows against the catch. Service weapons could "be converted into copper-caps, at a trifling expense, and new copper-cap locks will cost less than flint ones," he continued. "The only objection to the change, (and I own it is a very great one indeed,) *is the blind prejudice of custom*."[45] Finally, in 1834, the Ordnance Department organized comparative trials between flintlock and percussion lock muskets. Six weapons of each type fired six thousand rounds in varying types of weather. The results could not be argued with: the percussion locks misfired only thirty-six times, compared to nine hundred and twenty-two for the flintlocks. Still, another five or six years passed before Ordnance launched a conversion effort, which proceeded slowly until the 1841 fire at the Tower of London wiped out the British stockpile of flintlock muskets scheduled for conversion.[46]

Forced to obtain new weapons, the "Pattern 1842" percussion musket adopted by Britain retained many of the flaws Col. John Mitchell pointed out in a letter written to the *United Service Gazette* just a year before. British muskets, the colonel wrote, were supplied by the private gun trade, constructed by workmen "who can hardly know much of musket practice" and who produced "a heavy, clumsy, unhandy weapon; but good, strong, and

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[43] "Friday's Post," *Hereford Journal*, 25 Jul 1827, p.1.
[44] H. M. Chichester, "Maceroni, Francis (1788–1846)," rev. K. D. Reynolds, *ODNB*, May 2008, http://dx.doi.org/10.1093/ref:odnb/17481.
[45] Col. Frances Macerone, "Rifle Cartridges, with Observations on Rifle Practice." *Colburn's United Service Magazine, and Naval and Military Journal*, 1831 Part 2 (1832): 513-21.
[46] George, 301.

substantial of its kind, without knowing that it is a bad kind." Mitchell pointed out that the standard infantry musket had only one sight, which made accurate aim impossible. The "Light Infantry" weapon had two, but so badly placed that the soldier tended to "fire high above the heads of the tallest sons of earth that ever sported Grenadier caps." "Our skill in the manufacturing of small arms is confined to the making of fowling pieces," Mitchell charged, "for gentlemen take an interest in the goodness of the implements intended for the destruction of hares and pheasants" but not in those "intended for the protection of national honour and interest." [47]

The smooth-bore barrel, however, remained chief among the weaknesses of the Pattern 1842 musket, still referred to as the "Brown Bess" even with the new lock. Accuracy was poor; even in the hands of well-drilled troops, hit rates dropped significantly after 100 yards. At longer ranges, "few shots found their marks, and not only was ammunition wasted...the enemy were encouraged by the fire's ineffectiveness, and one's own men were disheartened and became 'unsteady in the ranks'."[48] Accuracy could be improved by rifling the barrel, which involved cutting grooves inside that spiraled down its length. Rifling imparted spin to the projectile and stabilized it in flight, but required a much tighter fit between the bullet and the barrel wall. Rifle shooters of this era wrapped the round lead ball in a greased cloth patch, which engaged the rifling to get the spin desired and also partially cleaned the rifle bore of powder residue. Loading a rifle required additional motions, however, as well as considerable effort by the rifleman to force the ball down the barrel; this

[47] "The Arms of the British Troops and the Board of Ordnance." *London Standard*, 18 Oct 1841, 4. Mitchell served in the 1st Royal Scots in several campaigns during the Napoleonic Wars. After being placed on half-pay in 1826, he spent the rest of his years writing, publishing books on tactics, articles for various magazines, and a volume of biographies of prominent soldiers. See R. H. Vetch, "Mitchell, John (1785–1859)," rev. James Falkner, *ODNB*, 2004, http://dx.doi.org/10.1093/ref:odnb/18843.

[48] Harding, Vol. III, 274

not only slowed the soldier down but could affect his aim. Units of British riflemen fought the wars with France, but by and large they were specialized units. The average infantry regiment in all armies of the time carried smooth-bore muskets, with much more emphasis on close-order drill and firing by volley than shooting accurately.

A number of inventors in Europe devised alternative means of loading rifles in the early 1800s, but Captain Claude-Etienne Minié of the French Army developed the most effective solution for muzzle-loaders.[49] Instead of the traditional round ball, Minié used a cylindrically-shaped bullet with a rounded nose and a hollow base lined with a thin iron cup. On firing, the exploding gunpowder forced the cup into the base of the bullet, which flared out the side walls to engage the rifling. The bullet had a much flatter trajectory and considerably longer range than a round ball, extending the effective range of infantry fire out to 600 yards.[50] Since the bullet diameter was smaller than the rifle bore diameter, it required no lubrication for loading. Grease on the outside of the projectile, however, served as an anti-fouling agent, and helped prevent the build-up gunpowder residue in the rifling grooves and so improved accuracy.[51]

Prussia took a different and much more revolutionary path with the 1841 adoption of the Dreyse needle-fire rifle, the first breech-loading weapon fielded in large numbers by any European power. Named after its inventor, Johann Nicolaus von Dreyse, the weapon used a combustible cartridge containing the charge, bullet and primer in one unit. On firing, a long needle perforated the cartridge to strike the fulminate at the base of the bullet. Loading at the breech meant not only could the soldier load and fire from any position, but the single-piece

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[49] Hoyem, Vol. 1, 31.
[50] Wawro, *Warfare and Society,* 83.
[51] Arthur B. Hawes, *Rifle Ammunition; Being Notes on the Manufactures Connected Therewith, as Conducted in the Royal Arsenal, Woolwich* (London: W.O. Mitchell, 1859), 2.

cartridge made recharging the weapon much quicker. Prussia went to great lengths to keep its new weapon secret, to the point of misnaming it the "*Leichte Perscussions-Gewehr M1841*," or "Light Percussion Rifle Model of 1841."[52] Use in the 1848 revolution, however, brought the rifle to the attention of the rest of Europe.[53]

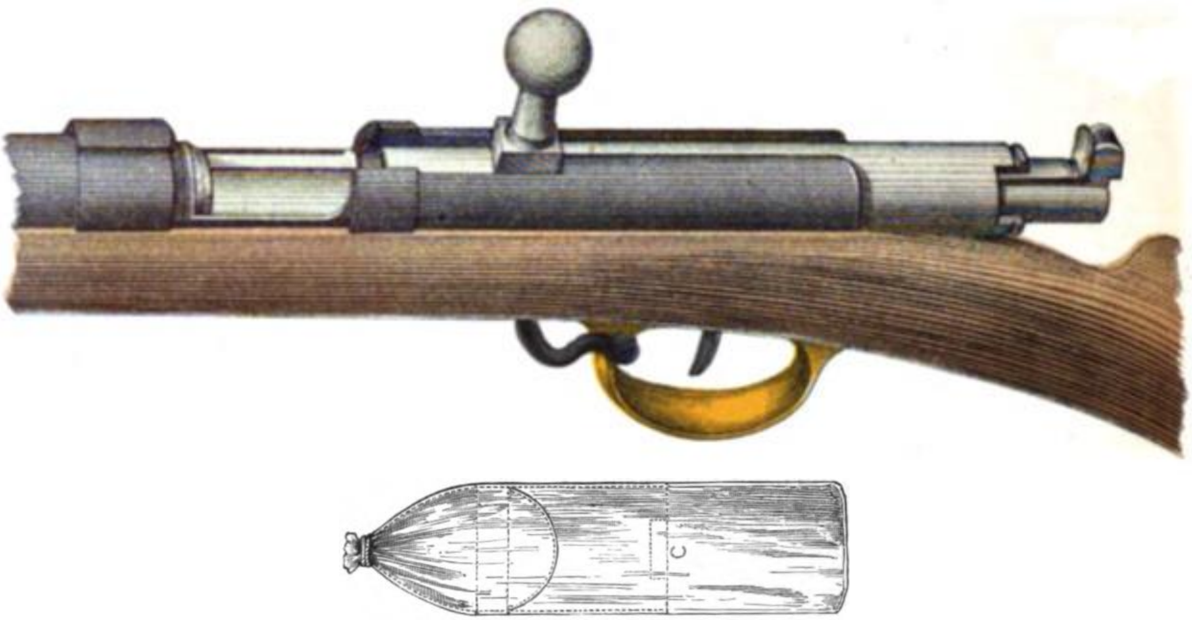

Figure 6: The Dreyse needle-fire and its cartridge. The latter contained its primer at "C", requiring the needle-like firing pin to pierce the base of the cartridge and travel through the powder charge. Ignition consumed the entire cartridge.[54]

With so many changes offering to put an effective rifle in the hands of every infantryman, Britain took a hard look at its military small arms in 1850. After testing the Dreyse and other weapons, the Small Arms Committee chose the Minié "system" which paired his bullet with a four-groove rifled barrel. Despite its potential, the needle-gun proved

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[52] John Walter, *The Rifle Story: An Illustrated History from 1756 to the Present Day* (London: Greenhill Books, 2006), 48.

[53] A fairly detailed description of the new rifle appeared in the Morning Post a year after the revolution ("Prussian Muskets," *Morning Post*, 18 Aug 1849, 8). Three months later, the Duke of Arundel brought a sample to England, with several papers reporting that "authorities have graciously given orders for [its] admission, duty free" ("The Prussian Rifle," *Dublin Evening Mail*, 15 Oct 1849, 3).

[54] Images from "The Needle Gun," In *Nature and Art*, edited by Francis Beckford Ward (London: Day & Son, Ltd., 1866), 92-93. Publication of the article in such a magazine also shows the eclectic tastes of the British reading public in the era.

"too complicated and delicate an arm for general service" in the opinion of the Committee. In addition, the rifle suffered from an ineffective breech-seal that allowed fire to flash into the face of the shooter, a problem that only grew worse with wear.[55] The Committee found the Minié to be simpler, more accurate at longer ranges than the Dreyse, and much more reliable. In 1851, Britain licensed Capt. Minié's invention for £10,000 and placed an initial order for 28,000 "Pattern 1851" rifled muskets with Birmingham gunmakers.[56]

Not all military authorities were happy with the decision. Sir Charles Napier, the army's Commander-in-Chief in India and famed veteran of the Napoleonic Wars, published a pamphlet entitled *A Letter on the Defence of England* decrying the new rifle. In it, he wrote that he was "much disposed to doubt the '*minie rifle*,' as a weapon of war, though it may suit the deer stalker…. We do not want fire-arms, in the infantry, for individual combat, but for combat in masses, where the *nice aim* of the deerstalker is not *wanted*." Raging that the Minié rifle "is not yet *proved*," Napier declared that "I would by no means 'be off with my old love'" the Brown Bess, "till the new one's temper has been better tried!"[57] Napier may or may not have been representative of the general attitude of army officers, as a period historian noted that once adopted on the Continent, "there was a strong popular *furor* created for [the Minié rifle] in England."[58] Still, Wellington himself had "an almost superstitious admiration for Brown Bess," according to one biographer, and it took a personal

[55] Hew Strachan, *From Waterloo to Balaclava*, 38; Wawro, *Warfare and Society*, 83.
[56] Strachan, *From Waterloo to Balaclava*, 40
[57] "Sir Charles Napier on the Defence of England." *Westmorland Gazette*, 21 Feb 1852, 3; Charles James Napier, *A Letter on the Defence of England by Corps of Volunteers and Militia: Addressed to the Members of Parliament* (London: Edward Moxon, 1852), 12, 24.
[58] William Cooke Stafford, *History of the Volunteer Movement, 1858-1863, and of the War with Russia, 1854-1856.* England's Battles by Sea and Land, Vol. 4 (London: The London Printing and Publishing Co. Ltd., 1865), xx.

demonstration of the weapon's accuracy to convince the Iron Duke to sanction its adoption.[59] Even so, he insisted that the new "Pattern 1851" rifle retain the same .702" bore as the Brown Bess, for the dubious purpose of firing smooth-bore musket ammunition in an emergengy.[60]

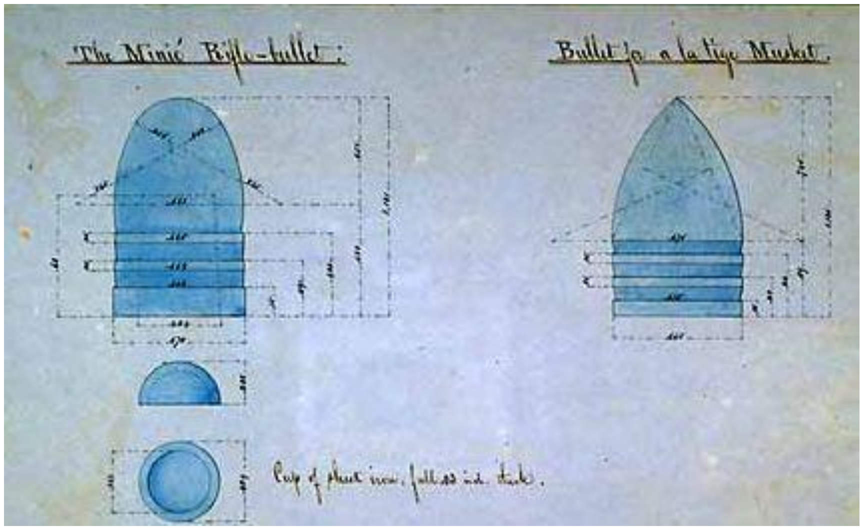

Figure 7: The original Minié bullet (left), showing the iron cup used to ensure the expansion of the bullet base to engage the rifling.[61]

There were a few issues with the new weapon, chief among them the tendency of the iron expansion cup to be forced all the way through the bullet, which left its perforated carcass blocking the barrel. The original sight also proved faulty in both construction and graduation. Such problems could be easily fixed; the iron cup proved unnecessary in later trials, and subsequent muskets had a redesigned sight. The large size of the cartridge gave it a heavy bullet, however, which meant that soldiers could only carry fifty rounds in their

[59] Sir Herbert Maxwell, *The Life of Wellington: The Restoration of the Martial Power of Great Britain, Vol. II* (Boston: Little, Brown and Co., 1899), 136; G. R. and Mary E. Gleig, *Personal Reminiscences of the First Duke of Wellington: With Sketches of Some of His Guests and Contemporaries* (New York: Scribner, 1904), 308.

[60] Strachan, *From Waterloo to Balaclava*, 41; Peter Smithurst, "The Pattern 1853 Rifled Musket -- Genesis." *Arms & Armour* 4, No. 2 (2007), 127.

[61] Source: "James Burton Drawings," *National Park Service*, 10 Mar 2015, http://www.nps.gov/media/photo/gallery.htm?id=299F15F7-1DD8-B71C-078F1E7357247D9C.

ammunition pouch instead of the regulation sixty.[62] This could not be fixed, but Lord Anglesey the Master-General of Ordnance, understood that the Pattern 1851 represented a temporary solution based on the state of the technology, and pressed ahead with his decision to arm the entire infantry force with the rifle. The bottleneck proved to be the Birmingham gun trade, still very much a cottage industry; problems in the manufacture of the rifle delayed the completion of the first order until November of 1853.[63]

Lord Hardinge, who replaced Lord Anglesey as Master-General with the 1852 change of government, also recognized the temporary nature of the weapon, and in April of that year advertised to "our most eminent Gunsmiths" for a lighter weapon of smaller caliber.[64] Such a move "was undoubtedly due to the persistent outcry made by the gun-makers and the sporting public that a better rifle was possible." The Small Arms Committee found faults with all of the rifles submitted, including one designed by George Lovell of the Royal Armoury Mills at Enfield. Setting a precedent followed by every small arms committee for the rest of the century, the Committee therefore decided to design its own rifle. The new design had a bore size of .577-inch, which retained the weight of the old Brown Bess bullet (480 grains, or just over an ounce of lead) but not its diameter.[65] Specifications were passed to Enfield for refinement, and what emerged would be "arguably one of the finest muzzle loading rifles ever to be put into the hands of a soldier."[66] The "Pattern 1853 Enfield Rifle" proved extremely reliable over its lifetime of service. Its lighter weight and lessened recoil meant that a far greater percentage of British infantrymen handled the weapon effectively; thirty-three percent of the force qualified as first-class shots, as opposed to only ten percent

[62] Strachan, *From Waterloo to Balaclava*, 41.
[63] Strachan, *From Waterloo to Balaclava*, 40.
[64] Strachan, *From Waterloo to Balaclava*, 40.
[65] Blackmore, 231-232.
[66] Smithurst, 140.

armed with the earlier rifle.[67] Finally, the smaller diameter bullet meant a lighter and equivalently smaller cartridge, which brought the amount of ammunition that could be carried back to the regulation sixty-rounds per man.

In twelve years, Britain had gone through three changes in its primary infantry weapon before finally arriving at what Lord Hardinge described as "the most deadly weapon ever invented." The Enfield shot farther than the 600-yard standard effective range of smooth-bored field artillery, and could fire twelve rounds in the time it took cavalry to cover 800 yards. Both Master-Generals recognized, however, that the physical weapon represented only one element of a larger system. Prior to the adoption of the new rifle, small-arms training had been indifferently conducted at the regimental level. In February of 1852, Ordnance began building a systematic approach to musketry training with the Minié rifle, resulting in the foundation of the School of Musketry at Hythe, Kent, in 1853. The next year, the School published the army's first official *Instruction of Musketry*, and the first detachment of trainees arrived in April.[68] The army was at a loss as to how best to harness the powers of the new rifled musket, however; the adoption of the Pattern 1842 smooth-bore did not require a change in tactics, only a change in the loading drill. The long range of the rifled musket, on the other hand, offered "a complete revolution in the art of war," but 1854 found British military authorities "only just beginning to digest the killing power of the Minié, without fully appreciating its tactical consequences."[69]

Unfortunately for the Crimean expedition, events in 1854 also caught its units transitioning between these three different types of muskets. Although Pattern 1851 Minié

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[67] Strachan, *From Waterloo to Balaclava*, 46.

[68] Strachan, *From Waterloo to Balaclava*, 50-51. The School, renamed the "Small Arms School Corp," is still in existence, having relocated from Hythe to Warminster in 1969. See "Small Arms School Corps," 2014, http://www.army.mod.uk/sasc/.

[69] Strachan, *From Waterloo to Balaclava*, 53.

rifles were to be issued for the first wave of infantry units departing for the Crimea, the low initial production order meant most reinforcements went out with the older Brown Bess.[70] Those first-wave units that did receive the Pattern 1851 Minié underwent hurried training at Gallipoli before shipping out to the front. Continued problems with the Birmingham gun makers, including a strike at the outbreak of the war, meant that very few soldiers were equipped with the Pattern 1853 Enfield. Most regiments at the front would not exchange their larger Pattern 1851 muskets until early in 1855 – with the curious exception of Royal Artillery gun crews, armed with the carbine version of the .577 Enfield.[71] This mix of three different weapons made the supply of proper ammunition a challenge. The Royal Navy, which retained many of its older muskets, had worse issues, to the point that the Admiralty issued a special circular to denote "the proper denominations of ball cartridges for each description" for the five different rifles in use in the Royal Navy.[72]

Sir Charles Napier, who so condescendingly dismissed the Minié as a deerstalker's rifle, did not live to see it proved in combat. Despite the problems caused by a major weapons transition, the British infantry wielded their Minié rifles with deadly effect in their first contest with the Russians at the Battle of the Alma. The British, firing as they advanced up the Kourgané Hill, inflicted heavy casualties amongst the Russians, many of whom were struck in the head.[73] The large, cylindrically-shaped Pattern 1851 bullet traveled at higher velocity than the smooth-bore round ball and "tore and broke all before it." "The common musket ball at such a range would have done no great damage," a British correspondent

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[70] Royle, 181; "The Minie Rifles," *Yorkshire Gazette*, 16 Dec 1854, 6; Strachan, *From Waterloo to Balaclava*, 40.

[71] William S. Curtis, email to the author, 10 Mar 2015. Mr. Curtis, a member of the Crimean War Research Society, based his information on reviews of daily orders from expedition headquarters in Balaclava, which detail the schedule of issue of Pattern 1853 weapons to the regiments in the Crimea. Copies of those records are forthcoming but were not available in time for this project.

[72] "Naval and Military Intelligence." *Morning Post*, 29 Aug 1854, 3.

[73] Royle, 220-227.

reported, "but here the balls had come out through the top of the skull, rending the bone as if done by a hatchet. The wounds were awful."[74] A Russian infantry officer, on the other hand, admitted that "the fire of the Minie rifles, with their long range, did us a good deal of mischief," but tellingly added that they "would have done us much worse if more of the enemy had had better shots among them."[75]

As a piece of infantry equipment, the Minié rifle represented a significant advance over the old smooth-bore musket. But as the Russian officer's opinion indicates, a weapon system is composed of more than just equipment. The new rifle required changes in logistical support, soldier training, and tactical thinking to truly be effective – areas that the British army either did not have time to address, or failed to consider completely, before marching off to war in 1854. In addition, although infantry played a considerable role in getting the allied army to the gates of Sevastopol, reducing that harbor's formidable defenses rested with a weapon the British army was most deficient in: artillery.

British Artillery and the Siege of Sevastopol

Having cleared the Alma heights on 20 September 1854, the allies approached the harbor fortress of Sevastopol at the end of the month. Defenses were far from complete, and Lord Raglan suggested an immediate assault. His chief engineer, Sir John Burgoyne, insisted on reducing the fortress's artillery before the infantry attacked, and the French commanders agreed. For the next eighteen days, the French and British dug assault trenches and struggled to emplace their siege cannon. The Russians, given a tremendous gift of time, reinforced their defenses, shelled the entrenching allies, and prepared for the coming battle.[76]

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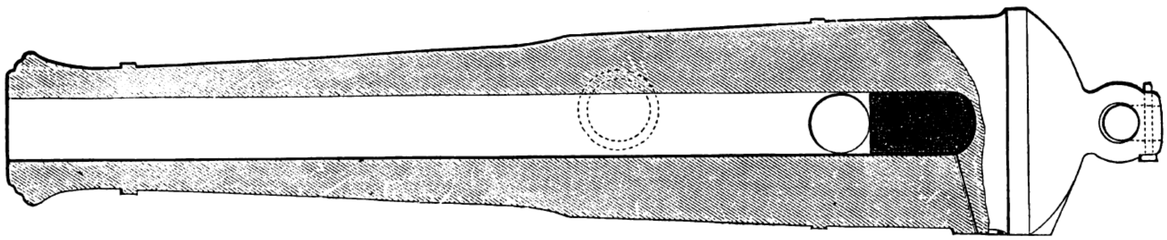
[74] "The Battle at the Alma." *Leicester Chronicle*, 14 Oct 1854, 4.
[75] "The Battle of the Alma." *Cork Examiner*, 18 Oct 1854, 2.
[76] Figes, 235-236.

FIG. 87.—British 68-pounder (8-in.) 95 cwt. Scale, $\frac{5}{16}$ in. to 1 foot.



British 8-in. shell gun. Scale, $\frac{5}{16}$ in. to 1 ft.

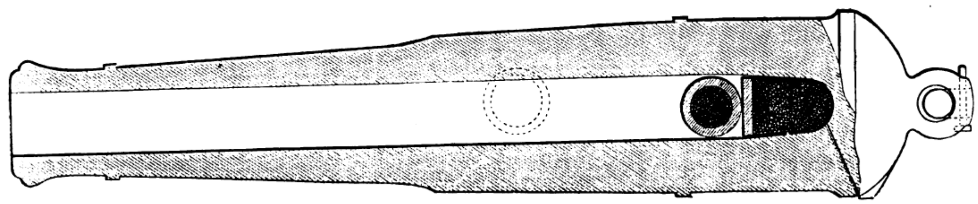


FIG. 88.

Figure 8: A British 68-pdr naval gun (above) compared to an 8-inch Millar shell gun (lower) with its specially-shaped powder chamber.[77]

The Royal Artillery siege train that landed at Balaklava included 24- and 32-pounder long guns for direct fire against the fortress walls, 10-inch mortars for dropping shells into the forts, and 8-inch shell guns, also for direct engagement but with shell instead of solid shot. Unlike the French Paixhans gun, the British Millar shell gun was too light at 52cwt to withstand the powder charge required to fire solid shot for battering down earth and stone defenses. Instead, the army borrowed several 68-pounder broadside guns from the Navy.[78] Weighing 9,500lbs each, these monsters required back-breaking effort – under fire – to haul into place. The guns had "to be taken all to pieces," wrote one artillery officer, as the small wheels designed for use onboard ship meant the carriages could not "be moved along by themselves."[79] With a maximum charge of sixteen pounds of gunpowder, however, the guns could throw either a sixty-eight pound solid shot or fifty-one pound explosive shell over four

[77] Alexander L. Holley, *A Treatise on Ordnance and Armor* (D. Van Mostrand, 1865), 122.

[78] Calthorpe, Somerset John Gough. *Letters from Head-Quarters; or, the Realities of the War in the Crimea, by an Officer on the Staff*, Vol. II (London: J. Murray, 1858), 445-449. It is very probable that some of the 32-pounder guns also came from the Navy, although this has yet to be confirmed.

[79] Figes, 235-236.

thousand yards distant.[80] Designed to smash through the thick timber sides of line-of-battle ships, such cannon were expected to wreak havoc on the walls of Sevastopol. Their use, the same officer optimistically predicted, "will tell more than any battery ever heard of at a siege before."[81]

Size notwithstanding, the cannon "were in all essential particulars much of the same type as those of the days of Queen Elizabeth:" cast-iron, smooth-bored, muzzle-loading pieces which required considerable engineering work to bring to bear against the fortress.[82] The complex process of loading the gun, done at the front of the weapon, required the construction of protective embrasures for the besieging gun crews to shield them from Russian retaliatory fire. Artillery of this era also lacked any means of controlling recoil; after firing, the crew had to roll the piece back into position and re-aim for the next shot. Wooden firing platforms had been sent from Britain, "of a new and ingenious structure, which… [served their ends] admirably when tried upon a perfect level at Woolwich." On the rocky ground around Sevastopol, however, the new design proved unworkable, and engineers pillaged timber from local houses to build new platforms.[83] Finally, the lack of mechanical means for moving equipment meant that the "heavy guns, great stores of ammunition, and the loads and loads of material required for the business of siege work" had to be hauled seven miles inland by a very limited number of horse and bullock carts available.[84]

The lack of rifling combined with the spherical shape of their projectiles meant that the shot and shell fired by smooth-bore guns rapidly lost velocity, which reduced their

[80] Douglas, 581; Royle, 264.
[81] Figes, 236.
[82] Adye, 284.
[83] Alexander William Kinglake, *The Invasion of the Crimea: Its Origin and an Account of Its Progress Down to the Death of Lord Raglan*. Vol. III (London: W. Blackwood and Sons, 1868), 313.
[84] Kinglake, 295-296.

striking power at long ranges. To open a suitably wide enough gap in the walls to allow for an infantry assault, the British had to get in close and pound the Russian fortifications hard. A pre-war experiment by the Royal Engineers calculated that to open a one-hundred-foot breach took over ten thousand rounds of 24-pounder solid shot, fired at full charge from 500 yards.[85] Unfortunately for the attackers, chief engineer Sir John Burgoyne "saw insuperable difficulties in carrying on his Engineer works within breaching distance… [given] the heavy fire which could be brought upon them" by the Russians, and placed the British batteries out further than their most effective range.[86] Burgoyne's conservative approach meant that the British had to "consider their position as principally one of bombardment" in support of the French on their left.[87] Despite being out of effective breaching range, however, *Times* correspondent William Russell hopefully reported that "the superior weight of our siege guns will more than compensate for the difference in distance."[88]

By the morning of 17 October, over one hundred and twenty allied guns, howitzers, and mortars stood ready to bombard Sevastopol, opposed by about one hundred and eighteen Russian pieces.[89] The Russian gunners, seeing the enemy embrasures cleared for action, fired first, and hammered away at the allied positions for a half hour before the French and British received the signal to jointly open fire at 0630. The clouds of smoke produced by the black powder quickly darkened the air over the battlefield and obscured targets on both sides. After

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[85] Strachan, *From Waterloo to Balaclava*, 129.

[86] Burgoyne was the eldest son of Lt. Gen. John "Gentleman Johnny" Burgoyne, and seventy-two on his appointment to Raglan's staff. Panmure recalled Burgoyne in February of 1855, not because of his performance, but to rescue "a man now far advanced in years from the sufferings of a Crimean winter, to resume his duties as Inspector-General of Fortifications." See John Sweetman, "Burgoyne, Sir John Fox, baronet (1782–1871)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/4014, and Whitworth Porter, *History of the Corps of Royal Engineers*. Vol. II (London: Longmans, Green and Co., 1889), 427.

[87] Kinglake, 307-308.

[88] Lambert and Badsey, 95-99.

[89] Figes, 238; Lambert and Badsey, 96; Kinglake, 350-352. The actual number of Russian guns is in doubt. Russell reported "about 130" opposite British lines; Kinglake claimed the entire southern defenses of Sevastopol mounted 341 pieces, 118 of which could engage the French and British batteries; 160 further guns covered the land approaches to harbor.

an hour's bombardment by the British, "a breeze sprang up and cleared the smoke away for a short time," wrote Somerset Calthorpe, Lord Raglan's aide-de-camp. The top portion of the Malakov Tower had been "knocked to pieces" by the rightmost British battery, but on the whole, Calthorpe reported, "no great advantage had been gained by either party." The earthworks that surrounded the Russian positions absorbed the British fire with little lasting damage.[90] "Nearly 100 shot and shell are thrown per minute," reported Nicholas Woods, the correspondent for the *Morning Herald*, but "it produces little effect…. The instant a shot or shell strikes their works, the hole is filled up with sandbags – It seems impossible, under these circumstances, that we can make any impression on our foes."[91]

The limitations of smooth-bore cannon became ever more apparent when the Royal Navy joined the fray later that day, in what *Blackwood's Edinburgh Magazine* latter termed "the final experiment of wooden ships against granite and earthen walls."[92] Prevented from getting in close to the harbor by a line of sunken Russian ships, the allied fleet took position an average of twelve hundred yards from the Russian coastal bastions and opened fire. Over the next six hours, their 1,240 guns fired over 50,000 rounds against the 150 Russian shore batteries, the black powder throwing up so much smoke that Russian gunners took to "firing at the gun flashes of the invisible ships while shells crashed around their heads."[93] For all their fury, however, the British and French warships caused very little damage. As at Odessa, the long range combined with the motion of the sea served to greatly lessen the effective fire of the allied guns. The Russians, firing from land, could do so much more accurately; when

[90] Calthorpe, Vol. II, 111.
[91] "The Siege at Sebastopol." *Dublin Evening Mail*, 10 Nov 1854, 3-4; Joseph J. Mathews, *Reporting the Wars* (Minneapolis: University of Minnesota Press, 1957), 64.
[92] "Iron-Clad Ships of War." *Blackwood's Edinburgh magazine.* American Edition, Vol. LI, Jul-Dec (1860): 616-32, p.618.
[93] Figes, 239-240.

the allies broke off the engagement they sailed away with five badly-damaged ships, thirty dead, and over five hundred wounded. The true lesson of the "massacre at Sinope" was now made crystal clear to both British and French naval leaders. The age of the smooth-bore-armed, shot-firing wooden warships was over.[94]

Figure 9: Examples of American Civil War era time fuzes showing the unsupported powder column at the bottom.[95]

Another technological problem was the lack of a truly effective shell fuze. As with the Minié rifle, the Crimean War caught the British military transitioning between two different time fuzes designs, both intended to be ignited by "windage." The difference between the cannon bore diameter and the slightly smaller diameter of the shell, windage allowed the flame of the propellant charge to wrap around the ball and ignite the fuze, which would burn until it reached the internal bursting charge of the projectile. The older "common" fuze consisted of a wooden plug bored through, and filled with fine gunpowder. Depending on the amount of burn time required, several different lengths of fuze were available. For finer adjustments, however, the gunner either cut the fuze or bored out the bottom. Either action left the central column of powder unsupported, often resulting in

[94] Figes, 240.
[95] "Artillery Fuzes, 19th Century, Combustion Time and Percussion," *EJ's Ordnance Show & Tell Pages*, 03 Nov 2013, http://inert-ord.net/19cent/fuze/index.html.

“blinds” (shells that did not burst), late bursts, or premature explosions in the bore of the cannon – the latter being particularly hazardous to gun crews.[96]

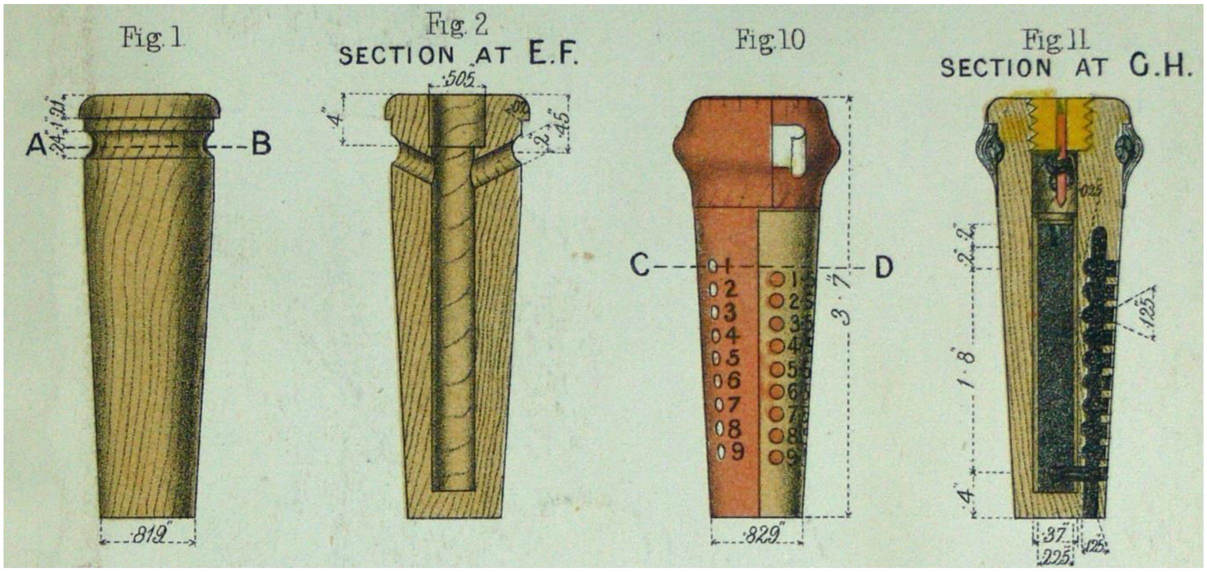

Figure 10: The Boxer Time Fuze circa 1871, with a percussion element in the head of the fuze.[97]

The problem of the fuze was solved by the inestimable Captain Boxer. Born in February, 1822, fifteen year old Edward M. Boxer enrolled as a “gentleman cadet” in the Royal Artillery, and graduated in 1839. After a short tour of Malta in 1841, Boxer found himself posted back to Woolwich the next year, eventually becoming an instructor on fortifications in 1847. Clearly his duties as instructor allowed Boxer sufficient time to indulge in other interests, as in 1849 Boxer proposed a new type of time fuze. Also made of wood, his proposed pattern had holes drilled into the side at specific intervals along its outer length; the artilleryman simply punched the hole desired to set the burn time.[98] This left the internal powder column supported at the bottom, resulting in far fewer shell failures. Brought before the Select Committee in 1850, Boxer’s fuze “passed with such flying colors that

[96] Hogg 1970, 186.
[97] TNA, SUPP 5/43, “Book of Photolithographs made in the Laboratory of drawings of shells and cartridges,” No. 67, Oct 1871.
[98] Hogg 1963, 1400-1401.

the…Committee recommended their adoption for all gun and howitzer shell." The first version was approved for adoption on 2 September 1850.[99] Boxer's fuze required a few more years of experimentation to perfect the design, and it is very possible that some of the earlier and more unreliable versions were sent to the Crimea. An 1852 modification added a head that projected above the shell surface, making the fuze vulnerable to damage and prone to dislodgement on ricochet, a tactic commonly used with shell guns. Some fuzes made before the summer of 1854 also suffered misfires because of grease seeping into the wood during manufacture.[100] Boxer continued to refine the fuze to overcome these deficiencies, however, and by the time of the first bombardment of Sevastopol, "England possessed probably the best fuze in Europe."[101]

Unfortunately for British gun crews, the batteries that participated in the initial bombardment had been sent out with the old common fuze, and the mortars in particular experienced an alarming number of premature bursts. As a stop-gap measure, London telegraphed an order for gunners to bore, rather than cut the fuzes, in an effort to at least decrease the problem until a supply of new fuzes could be sent out. Once Boxer's fuzes reached the theatre of operations, Royal Artillery historian Col. Julian Jocelyn laconically wrote, "there was no more trouble." Gen. Sir Richard Dacres, who rose to command all the British artillery in the war, called Boxer's fuze one of the "greatest improvements in artillery stores that …appeared during the war."[102]

Boxer's fuze, while efficient and reliable, detonated the shell strictly by time of the

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[99] Hogg 1963, 187.
[100] Hogg 1963, 187.
[101] Hime, pg. 243
[102] Col. Julian R. J. Jocelyn, *The History of the Royal Artillery (Crimean Period)* (London: J. Murray, 1911), 70-71; H. M. Stephens, "Dacres, Sir Richard James (1799–1886)," rev. Christine J. Kelly, *ODNB*, 2004, http://dx.doi.org/10.1093/ref:odnb/6996.

internal burn; it did not detonate the shell on impact with the target. Two different types of impact fuzes were then in service. The army adopted the wooden Freeburn fuze in 1846, designed by Quartermaster Freeburn of the Royal Artillery. As with the Boxer time fuze, this "simple and ingenious" fuze ignited by windage; the sudden stop of impact with the target drove the burning material into the body of the fuze, which in turn detonated the shell.[103] Its use in the Crimea is unknown, but likely. The navy, on the other hand, used a metal fuze designed by Lt. William Moorsom. Adopted in 1851, the Moorsom fuze had a complex, multi-chambered internal design. On impact, one or more of the hammers struck a percussion detonating compound, which then set off the main charge in the shell. Noted by an 1862 author as being "liable to accidents," the Moorsom fuze worked well when impacting solid objects – such as ships' sides.[104] Fitted to both the 68-pounder and Lancaster shells, the fuze often failed to detonate when impacting the packed earth surrounding the Russian defenses at Sevastopol.

Regardless of the type, a malfunctioning fuze turned an explosive shell into nothing more than a lighter, and less effective, shot round. Both the British and Russians suffered fuze misfires, littering the battlefield with unexploded ordnance, a particular hazard to the drunk or ignorant. One party of inebriated British soldiers lit a fire and put an unexploded shell into it, "then seated themselves around the fire, eagerly watching the result: the shell exploded, and every man was killed or fearfully mangled."[105] Another soldier of the 47th Regiment "had the foolhardiness to jerk the ashes of the tobacco in his pipe, which he had just finished smoking, into the fuze-hole" of a large shell whose fuze fell out during flight.

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[103] W. R. Barlow, *Treatise on Ammunition*. (London: H.M.S.O., 1874), 37; A. F. Lendy, *Treatise on Fortification, or, Lectures Delivered to Officers Reading for the Staff* (London: W. Mitchell, 1862), 16.
[104] Lendy, 16.
[105] *A Visit to Sebastopol a Week after Its Fall* (London: Smith, Elder and Co., 1856), 43.

"Both his legs were shattered" when it exploded, "and he was frightfully scorched about the head and face;" five other men were also wounded. Such behavior required "the greatest watchfulness on the part of the officers to make [the men] sufficiently thoughtful of their own safety, and that of others around them."[106]

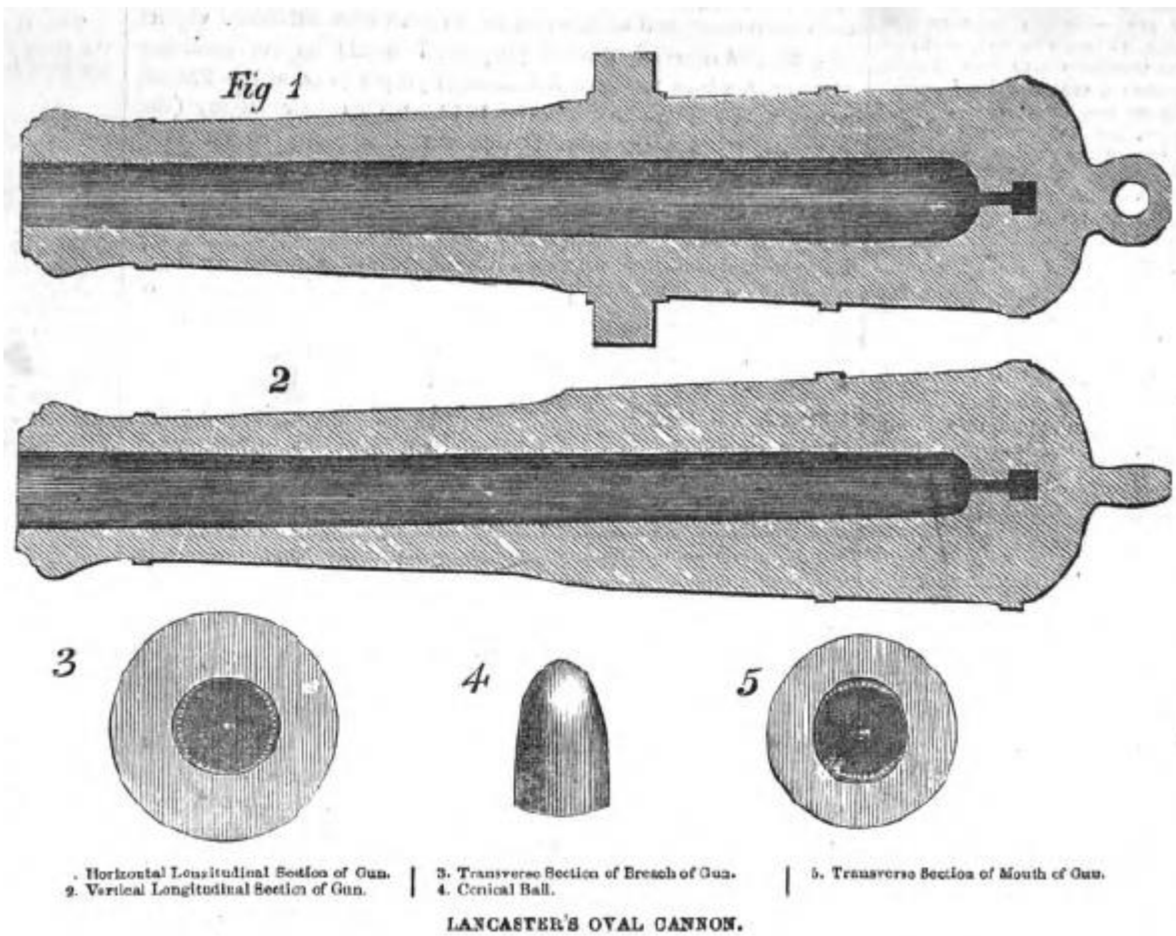

Figure 11: The Lancaster oval-bored cannon. The shell is inaccurately drawn; the real shell had a central band and a sharply-tapered base.[107]

Although smooth-bore cannon formed the vast majority of the artillery deployed by the British, the Royal Navy included four experimental 68-pounder "Lancaster" rifled guns in the equipment loaned to the siege effort. A recent invention of famed gun maker Charles W. Lancaster, these muzzle-loaders used an oval-shaped bore rotated along the axis of the

[106] "The Siege of Sebastopol." *Dublin Evening Mail*, 10 Aug 1855, 2.
[107] "Lancaster's Oval Cannon," *The London Illustrated News* Vol. 16, 02 Sep 1854, 201.

barrel to impart spin to their specially-shaped projectiles. Originally developed as a rifled small arm, Lancaster designed a full-sized 68-pounder artillery piece to display his rifling principle at the Great Exhibition of 1851. Instead, Government persuaded Lancaster to keep his new cannon under wraps and send it to Shoeburyness for trial. Impressed with the long range and accuracy of the weapon, the Royal Navy purchased several for use aboard its *Arrow*-class gunboats, which arrived in time to lend the guns to the siege efforts.[108]

Despite impressing naval and ordnance authorities, the new rifled gun did not live up to its promise. Reports from its use in the field were mixed. On the one hand is Wood's rather breathless description of its effects, who noted that its shot "rushed through the air with a noise and regular beat like the passage of a rapid express train." The peculiarity of the noise "excited shouts of laughter among our men, who instantly nicknamed it the express train." "The effect of the shot seemed most terrible," Woods continued. "A battery of twenty or thirty such guns would destroy Sebastopol in a week," but the short supply of ammunition meant the two guns "are only fired once in eight minutes." Still, "the delicate attentions of the Lancaster gun…effected a most unfavourable change" on Malakov Tower, he wrote. "Huge holes were visible on its side, where masses of the solid masonry were dislodged." Once the smoke cleared, "the Lancaster gun on our right redoubled its fire…I never saw such firing. Every shot told full upon the building, and the officers of all ranks…were speculating on how long the tower could stand."[109] Against the Russian earthworks, however, the Lancaster shells proved much less effective. Captain Stephen Lushington of the Royal Navy observed that the light Lancaster shells burrowed into the earth with little impact. "I fear the

[108] Antony Preston and John Major, *Send a Gunboat: The Victorian Navy and Supremacy at Sea, 1854-1904* (London: Conway, 2007), 20; G. C. Boase, "Lancaster, Charles William (1820–1878)," rev. Anita McConnell, *ODNB*, 2004, http://dx.doi.org/10.1093/ref:odnb/15958.
[109] "The First Attack upon Sebastopol," *Preston Chronicle*, 11 Nov 1854, 2.

Lancaster is a failure," he reported, "and we might as well fire into a pudding as at these earthworks."[110] William Russell of the *Times* was much more succinct. "The Lancaster guns made bad practice," he reported, "and one burst."[111] The latter unhappy trait, combined with the requirement for special ammunition, meant that the Lancaster shell guns played only a minor role during the siege. Of the seven deployed, three were rendered "unserviceable from use," and in total, fired only 1,542 shells – not even a percent of the total thrown against the Russians.[112]

Curiously, the British did not make use of what might have been a game-changing weapon during the siege, one that they themselves invented: the shrapnel shell. Into the Napoleonic Wars, field artillery fired two main types of projectiles: solid shot and canister. Solid shot, the primary type of ammunition for field artillery, consisted of an iron ball the diameter of the gun. Tactics dictated the use of solid shot for targets beyond 250 yards; if accurately pitched, the balls carved their way through the close-ordered ranks of infantry on approach to the battlefield. For closer targets gun crews used canister (also called case shot), consisting of a brass or tin case filled with iron balls, effectively turned the cannon into an enormous shotgun – devastating at close range, but only effective to about 400 yards or so, depending on the size ball in the case.[113] Despite Hollywood's depictions, field artillery generally did not fire explosive shells.

Although deadly as long as the ball kept rolling, solid shot could not effectively engage troop concentrations at distance. In 1784, then Lieutenant Henry Shrapnel proposed a

[110] Figes, 240. Lushington commanded the naval brigade that served the guns on loan to the army during the siege, see J. K. Laughton, "Lushington, Sir Stephen (1803–1877)," rev. Roger Morriss, *ODNB*, 2004, http://dx.doi.org/10.1093/ref:odnb/17214.
[111] Lambert and Badsey, 98.
[112] Calthorpe, Vol. II, 446-447.
[113] Donald E. Graves, "Field Artillery of the War of 1812: Equipment, Organization, Tactics and Effectiveness," *The War of 1812 Magazine*, Issue 12, November 2009, http://www.napoleon-series.org/military/Warof1812/2009/Issue12/c_Artillery.html.

remedy, what he called “spherical case shot.” This consisted of a thin iron shell filled with lead musket balls, with gunpowder poured into the gaps. The powder charge burst the shell open when detonated by a time fuze, gauged to fire before reaching the target. The bullets would continue forward at the same velocity and direction as the previously unbroken shell.[114] This would deliver a hail of lead at a considerably farther distance than case or grape shot, allowing the artillery to hit exposed troops harder and earlier than before and break up attacks before they became a threat.[115] In spite of its potential, Shrapnel’s proposed projectile did not appear before the Select Committee for evaluation until 1792, and another eleven years passed the Committee finally approved for service.[116] This may have been in part to Shrapnel’s importune description of his invention “as of equal importance with the introduction of gunpowder, which would hardly sit well with tradition-bound artillery officers.”[117]

First used against the Dutch at the battle of Fort Amsterdam, Surinam, in 1804, Major Wilson, the commander of the British artillery, reported that “shrapnel had so excellent an effect as to cause the garrison...to surrender after receiving the second shell.”[118] At the battle of Vimeira (Portugal, August, 1808), British 9-pounders firing spherical case shot routed the French infantry, who complained that “devils were in the British shells.”[119] The shrapnel shell in its original form suffered from a number of defects, however, made plain in testing after the close of the Napoleonic Wars. Experiments carried out in 1819 with the final pattern

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[114] Hogg 1970, 179.
[115] Sinclair, John, *Memoirs of the Life and Works of Sir John Sinclair, Bart*. Volume 2 (Edinburgh, 1837), 246.
[116] Hogg 1970, 180
[117] Sinclair, 244.
[118] “How Shrapnel Is Made and Used: Colonel Shrapnel of the British Army Invented This Hail of Death, So Important in the Present War -- First Used in 1804.” *New York Times*, May 30, 1915.
[119] *New York Times.*

of the shrapnel shell resulted in a twenty-three percent failure rate.[120] Boxer developed his improved time fuze in large part to correct this problem, but muzzle bursts remained common.

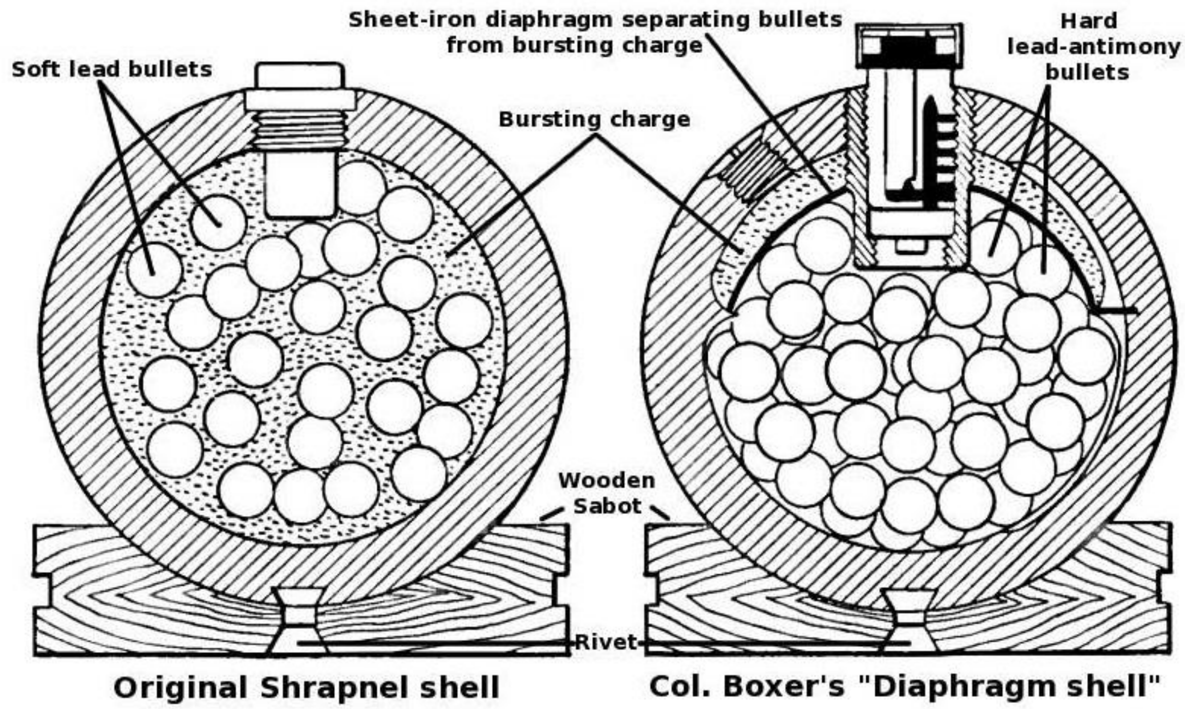

Figure 12: Comparison of Shrapnel and Diaphragm Shell [121]

In 1849, the inventive captain began experimenting with the means of separating the bursting charge from the bullets. After testing several different methods, he settled on a shell having a curved iron plate over the lead balls, with the bursting charge between the plate and the shell wall; grooves cast on the inside of the iron casing facilitated fracture when the bursting charge detonated.[122] Tests demonstrated the efficacy of his "diaphragm shrapnel shell;" when coupled with his new pattern of fuze, only six percent of the shells failed, a

[120] H. W. L. Hime, *Gunpowder and Ammunition, Their Origin and Progress* (London: Longmans, Green, 1904), 242-243

[121] Douglas T. Hamilton, *Shrapnel Shell Manufacture* (New York: The Industrial Press, 1915), 4.

[122] Charles Henry Owen, *The Principles and Practice of Modern Artillery: Including Artillery Material, Gunnery and Organization and Use of Artillery in Warfare*. Second ed. (London: J. Murray, 1873) 123-125; A. Marshall, "The Invention and Development of the Shrapnel Shell." *The Field Artillery Journal.* Vol. X (1920), 12-16.

significant decrease compared to the 1819 tests. Lord Hardinge approved manufacture of the diaphragm shell in 1853, and it should have been available for at least the field artillery.[123]

In combination, the improved fuze and shrapnel shell represented a significant advancement in artillery ammunition, one that Strachan properly identified as "the beginnings of a whole new era" rather than an evolutionary step in smooth-bore equipment. New tactics, such as overhead fire in support of advancing troops and counter-battery fire against opposing artillery evolved – post-Crimea – to take advantage of the greatly increased effectiveness of the weapon. Within ten years, the shrapnel shell would be referred to as "the most important part of [British] armaments at the present day," ultimately becoming the primary artillery shell of choice in the First World War.[124] Contemporary British military historian William F. P. Napier noted, however, that spherical case shot "was little prized by lord Wellington, who had early detected its insufficiency, save as a common shell."[125] Whether due to Wellington's aversion to new-fangled technology – the former Commander-in-Chief passed away only a year before Hardinge's approved the new shell design – or general British military apathy, the Royal Artillery that sailed off to the Crimea in 1854 went without one of its most effective weapons.[126]

Conclusion

The British expeditionary force that marched off to do battle with the Russians did so with a combination of weapons systems nearly as muddled as the military administration

[123] Strachan, *From Waterloo to Balaclava*, 117; Hogg 1963, 1400-01. The *London Standard* reported that that the 24-pounder howitzers traveling with the Royal Artillery batteries were particularly suited "for the use of spherical and common case-shot" (see "The Field Artillery for Turkey," *London Standard*, 13 Mar 1854, 1).

[124] HCPP, "Report from the Select Committee on Ordnance; Together with the Proceedings of the Committee, Minutes of Evidence, Appendix, and Index," 1863 (487), 104.

[125] William Francis Patrick Napier, *History of the War in the Peninsula* (Oxford: D. Christy, 1836), p. 444

[126] In reviewing a proposal regarding a new form of shrapnel shell in 1858, the OSC remarked "that the diaphragm shrapnel shell was not fired at all in the Crimea." Subj. 1498, TNA, SUPP 6/1: Abstracts 1858, 133.

such arms operated under. Although some improvements had been made, such the Pattern 1853 rifled musket, a reliance on outmoded manufacturing practices kept the army from rapidly fielding the new weapon. The nation's artillery in particular suffered from near-obsolescence; with changes in only a few items, such as Boxer's fuze, British gunners arrayed against the Russian fortresses of Sevastopol the same forms of cast-iron and bronze guns as the Russians pointed back at them. Conservative military thinking, bureaucratic inertia, and Parliamentary parsimony effectively mired the British army at its 1815 peak, despite the changes in technology and civilian society wrought by the ongoing Industrial Revolution.

The results of the opening bombardment of 17 October were telling. Although the artillery barrage continued all day – in fact, into the next day – the initial bombardment of Sevastopol failed to reduce the Russian defenses. While a chance hit on a French ammunition magazine early on significantly decreased their partner's ability to fight, the ineffectiveness of British fire against Russian fortifications lay in large part with the dormancy of artillery science between 1815 and 1854 – if not with the dormancy of British military science as a whole. The Minié rifle, despite its performance on the battlefield, could only play a supporting role in the breaching of the well-built and heavily reinforced walls of the Russian harbor. Manpower could not emplace heavy enough guns, and horse- and bullock-carts could not bring up enough ammunition to feed what guns were in place. The sacrificial use of the Russian fleet to blockade their own harbor negated the massive broadside weight of the allied navy, which could not get close enough to do any real damage. There were technologies that might have tilted the balance for the British, but the Lancaster gun failed in its first combat test, Lord Raglan's £500 purchase didn't buy enough rockets from Hale, and British tacticians simply forgot about the shrapnel shell. By November, the prediction of *Bell's Life* proved true. The war did not last a month. It lasted, to the great consternation of the public, much longer.

Chapter 3: "More Powerful than the Charge of Cavalry or the Thunder of Artillery:" Public Opinion, Political Reaction, and the End of the Board of Ordnance

As events in the Crimea unfolded before the eyes of the public, the scope of the "disastrous muddle" confounding British military administration became all too apparent.[1] The papers reported everything, from the numbers felled by cholera, to troubles with the medical and supply systems, to the failure of the first bombardment of Sevastopol. Then, disaster struck. On 14 November, following three days and nights of freezing rain, a fearsome winter storm sprang up and hammered the exposed allied forces. "In the memory of men," wrote William Russell, the *Times* correspondent, "such a hurricane has not desolated the Crimean shores."[2] Russell reported winds so great that the soldiers on the cliffs over Balaklava "lost tents, clothes – everything! the storm tore them away over the rocks and hurled them across the bay, and the men had to cling to the earth with all their might to avoid the same fate."[3] Russell later estimated the loss of men "cannot be less than a thousand."[4] The storm also caused tremendous damage to the fleet, with "forty-six transports and other vessels being destroyed, and many more injured."[5]

The greatest calamity, however, was the loss of the *Prince*, a new British screw steamer carrying "forty thousand suits of clothing, with under-garments, socks, gloves, and a multitude of other articles of the kind….the whole of the winter clothing for the British army." It also carried provisions, hospital stores, and "a vast quantity of shot and shell." The latter, along with 900 tons of gunpowder, formed the cargo of the *Resolute*, also sent to the bottom by the storm. The loss of the two ships, the *Times* later wrote, meant that "all the

[1] Barnett, 260.
[2] William Howard Russell et al. *The Crimean War: As Seen by Those Who Reported It* (Baton Rouge: Louisiana State University Press, 2009), 101.
[3] "The Storm in the Crimea." *Sussex Advertiser* 19 Dec 1854, 3.
[4] "Of the many and great losses suffered…" *Times* (London, England) 5 Dec 1854, 6.
[5] Russell, 101.

materials for carrying on the siege and providing against the severity of the winter have been carried off at one fell swoop….we are not in a condition to stand our worst foe, the coming winter."[6]

Despite the implications of such a disaster, the *Leeds Intelligencer* gamely reminded its readers that "we cannot expect to carry on war without loss….It must be submitted to with patience, and produce a greater exertion on our part." Ships must be replaced or repaired, the efforts of the army, navy, and civilian society redoubled. "In sounding the heroic deeds of our veterans abroad," the paper explained, "we at home must earn for ourselves the consolation that we have left no effort untried to bring them success."[7] Such a message reflected the mood of the British public: the country must stand behind their military forces and provide them all possible assistance. This translated into a much greater and more active level of participation in war efforts since the close of the Napoleonic Wars. Although the average British subject still disdained wearing a uniform, many volunteered to organize fund-raising campaigns for supplies or donations to the *Times* and Royal Patriotic Funds. Others travelled to the Crimea to donate their time and expertise, such as Florence Nightingale, famous for reorganizing the hospital at Scutari, and Chef Alexis Soyer, who overhauled the kitchens of the Balaklava Hospital and introduced several important improvements in British army culinary practices.[8] Concerned Britons also bombarded their favorite newspapers with letters regarding all aspects of the war, while writers with a more inventive streak – or a product to market - pelted the Board of Ordnance with their suggestions.

What the *Intelligencer* editorial did not imply, however, was uncritical support for a

[6] "Of the many and great losses suffered…" *Times* (London, England); Russell, 100. This later version differs from Russell's original dispatch and was, in all likelihood, rewritten by the *Times* editor, John Delane.
[7] "The Crimea." *Leeds Intelligencer*, 02 Dec 1854, 4.
[8] Figes, 302-303, 354-355.

government seemingly incapable of handling the war effort. Public opinion, which Lord Palmerston had once declared "more powerful than the charge of cavalry or the thunder of artillery," rapidly turned against the Aberdeen ministry – which had led the country to war at the behest of the public to begin with. [9] The loss of support coupled with the strain of a war Britain was clearly unprepared for, led not only to a change in government; it also led to the elimination of the antique Board of Ordnance, a process started under Aberdeen and completed by subsequent administrations. As part of this shakeup, the old "Select Committee of Artillery Officers" gave way to a new "Ordnance Select Committee" (OSC), also responsible for weapons evaluation but with a longer reach and more flexible mandate. Although little noticed by the greater public, the creation of the OSC was a crucial step in the professionalization of British military research and development, and critical to the nation's transition into the era of modern weaponry.

"The Board of Ordnance Ceased to Exist"

Both the public and Government were confident of a short, triumphant war in April of 1854, and the latter took few steps to deal with the military administration muddle. Lord Raglan, despite being dispatched to the front to coordinate with the French, retained his post of Master-General of Ordnance.[10] Lauderdale Maule, the Surveyor-General, traveled with him, which effectively left only two experienced members of the Board of Ordnance to coordinate war supply in London. On Raglan's recommendation, the seventy-five year-old Sir Hew Ross took over the recently resurrected post of Lieutenant-General.[11] Ross considered his duties limited to military affairs, however, and concentrated on getting the

[9] Kingsley Martin, *The Triumph of Lord Palmerston: A Study of Public Opinion in England before the Crimean War* (New York: Dial Press, 1924), 185.
[10] Royle, 113, 135-137.
[11] R. H. Vetch, "Ross, Sir Hew Dalrymple (1779–1868)," rev. John Sweetman, *ODNB*, 2004, http://www.oxforddnb.com/view/article/24119.

Royal Artillery ready for war. The remaining two members – William Monsell, the Clerk of Ordnance, and Principal Storekeeper Sir Thomas Hastings – quarreled constantly without effective supervision. "For all intents and purposes," wrote Arsenal historian Oliver Hogg, "the Board of Ordnance ceased to exist" before England fired its first shot in anger.[12]

In June of 1854 the Aberdeen government took an important first step to overhaul British military administration by splitting the overburdened Secretary of State for War and Colonies post in two. It made a crucial error in the creation of the new office, however: no "Order in Council, Minute, or other document was prepared, defining the special duties" of the new Secretary and his subordinate officials, except an estimate for funding the post. Aberdeen's cabinet felt the change to be "initiatory to [others]…which would necessarily follow," but never further considered the issue.[13] On 17 July Lord John Russell, minister-without-portfolio in the cabinet, presented the estimate for the new office and an explanation for its creation. He hinted at changes to come, such as an overhaul of the Board of Ordnance, and stated that the Commissariat would transfer from Treasury to the War Office. Otherwise, Russell left the definition of the new office hanging. After some debate, backbencher George Butt sarcastically summed up the government's position. Lord Russell, Butt claimed, "says 'appoint the new officer, and from time to time he will consider what duties it will be convenient for him to undertake,'" whereas Sir Sidney Herbert, then Secretary-at-War, "said 'we cannot tell what duties are to be assigned to this new officer, but give us time and we will find him something to do.'" Butt wrapped up with the hope that the new office "should

[12] Hogg 1963, 743; Forbes, 260-261.
[13] HCPP, "Fifth Report from the Select Committee on the Army before Sebastopol; with the Proceedings of the Committee, and an Appendix." 1855 (318), 5.

be intrusted with the superintendence of all our preparations for the conduct of the war."[14]

Despite such an amorphous definition of power, Henry Pelham Clinton, the Duke of Newcastle and Secretary of State for War and Colonies since 1852, became the new Secretary of State for War; Sir George Grey took over that of Colonies. The Parliamentary Under-Secretary post also split, with a Permanent Under-Secretary – an apolitical accounting and managerial position –created to assist the new Secretary.[15] Newcastle, a longtime politician with a reputation for hard work built over a long history of public service, must have been aware of the "disastrous muddle" that awaited him. Still, he took the post, and defined it along the lines that Mr. Butt had hoped for. Considering himself "officially responsible for the all the departments under his control" – the War Office, the Board of Ordnance and their subordinate departments, and now the Commissariat – Newcastle "issue[d] such orders as he though fit for their guidance."[16] He also "laboured indefatigably throughout the summer and autumn to see that the army was as well-equipped and prepared as the capabilities of the country allowed."[17]

June of 1854 also saw the appointment of Captain Boxer to the post of Firemaster of the Royal Arsenal, second in command and responsible for ammunition production. As with the rest of the British military, the Royal Laboratory proved woefully unprepared to meet wartime demands. As Boxer later wrote, "nothing could have been more unsatisfactory than the state of the Ordnance Department as regards...war *matérial*, or the means for their production." In particular, "it was found impossible to procure, by the ordinary means, a due

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14 "Supply – War Department." HC Deb 17 July 1854 Vol 135 cc317-42; John Prest, "Russell, John [*formerly* Lord John Russell], first Earl Russell (1792–1878)," *ODNB*, May 2009, http://www.oxforddnb.com/view/article/24325.

15 "Leadership." Civil Service, 2010 http://www.civilservice.gov.uk/about/leadership.

16 HCPP, 1855 (318), 5.

17 Darrell Munsell, "Clinton, Henry Pelham Fiennes Pelham-, fifth duke of Newcastle under Lyme (1811–1864)," *ODNB*, May 2009, http://www.oxforddnb.com/view/article/5686.

supply of efficient Shrapnel shells" for the field artillery units bound for the Crimea. Early in 1854 Boxer, still only an instructor at the Royal Military Academy, "undertook [on his own accord] to supply the deficiency, a service of no ordinary difficulty." By refurbishing old-style shells with his improvements, Boxer made ten thousand "efficient" shrapnel shells available in less than a month.[18] These shells played important roles in the battles leading up to the siege of Sevastopol, but ironically, the heavy guns used by the British to attack the Russian fortifications lacked such projectiles. That oversight deprived the Royal Artillery of its most effective anti-personnel weapons, one that might have drastically shortened the siege.

Boxer's success in providing shrapnel shells led to his formal transfer to the Royal Laboratory as Assistant Firemaster on 13 April 1854.[19] That same month, Monsell "saw clearly that in the event of any large expenditure of shell in any military or naval operations, [the Laboratory] should have been entirely unable to supply the wants of the service." A "man of action" who knew Boxer to be the same, Monsell sent for the energetic young officer and explained the situation to him. "If there is any one in the world who can get us out of our difficulties," he later testified saying, "I am sure you can." Boxer "pledged himself to place the department in five weeks in a position to supply any number of shells that would be required."[20]

Boxer drew up a list of £7,150 worth of machinery and supplies needed to establish a temporary factory in a storehouse. With the expenditure approved on 02 May, Boxer supervised the installation and operation of the machines and took over the production of

[18] E. M. Boxer, *Colonel Boxer and the War Department* (London: P.S. King, 1870), 40-41; HCPP, "Fourth Report from the Select Committee on the Army before Sebastopol; with the Minutes of Evidence, and Appendix," 1855 (247), 130.
[19] Hogg 1963, 1266. The "firemaster" supervised the manufacture of rockets, ammunition, and components.
[20] Jocelyn, 78-79; Boxer, 41; 1854 (247), 117.

Congreve rockets as well. By the end of the month he also received further funds for machinery to manufacture fuzes.[21] "Such was the energy and determination displayed," wrote Royal Arsenal historian Oliver Hogg, "that within the scheduled time [the shell] manufactory was in operation with two steam engines, many hundreds of feet of shafting, machines, tools, etc. producing a large increase in ammunition." In addition, the finished products cost £200 per day less than shells manufactured using older methods, a reduction that allowed the new factory to recoup the initial outlay within six months' time.[22]

Such a heroic effort by Boxer led to his June promotion to Firemaster. In that post, Boxer continued his drive to increase mechanization and efficiency at the Laboratory, and his efforts led the Board of Ordnance to direct him to establish an experimental shell foundry. The Board had long done business with foundries such as Low Moor Ironworks, but private industry could not rapidly expand to meet wartime needs.[23] Building its own foundry would allow the Arsenal to determine "the best mode of manufacturing…to meet sudden emergencies, and to control the prices" of shells supplied by contractors. For help with the project, Boxer approached John Anderson, the Inspector of Machinery at Woolwich who had already constructed a factory for the manufacture of shells for Lancaster guns "at great personal sacrifice, [and] in the space of only two months."[24] Given a budget of £10,000, Boxer and John Anderson set out to construct a model factory, "in which the great manufacturers of this country can learn…the best mode of overcoming the difficulties which

[21] Hogg 1963, 745-746, 781

[22] Hogg 1963, 782; Boxer, 41. Hogg wrote that the time-frame for the factory was two months, as opposed to five weeks quoted by Boxer.

[23] Charles Dodsworth, "Low Moor Ironworks Bradford." *Industrial Archeology* 18, no. 2 (1971); B. Thorpe, 2014, http://www.keepandshare.com/doc/4238280/low-moor-history-dodsworth-984k?da=y.

[24] Anderson helped design the successful Royal Small Arms Factory at Enfield, and spent many years at the Arsenal. He was eventually knighted for his service to the Crown; see Lionel Alexander Ritchie, "Anderson, Sir John (1814–1886)," *ODNB*, 2004, http://dx.doi.org/10.1093/ref:odnb/46572.

now exist in adapting establishments and machinery to the production of shells."[25]

Boxer and Anderson threw themselves into the effort, but building the foundry very nearly cost Boxer his job. Col. Julian Jocelyn, in his *History of the Royal Artillery,* described the young captain as a "mechanical genius endowed with a nervous energy…fully impressed with the vital importance of his work and grimly determined to trample on everything and everybody that interfered." Such spirit led Boxer to dismiss workers he felt were not giving their all to the project, usurping the power of hiring and firing that rested with the Master-General and Board of Ordnance for himself. The commanding officer of the Royal Laboratory, Col. J. A. Wilson – "an old and courteous gentleman thoroughly versed in routine" – charged Boxer with insubordination.[26] In his own defense, Boxer wrote to Wilson on 16 January 1855 that as there was "yet much, very much, to be done in the department…my endeavours will be of little avail" without the power to discipline his own work force. Gen. Hew Ross, the only member of the Board in London at the time of the incident, felt that Boxer's demand for such authority was "dictated more in the spirit of a foreman of mechanics… than…of an officer holding the rank of Captain in the Royal Artillery." Furthermore, Ross felt the tone of Boxer's letter disrespectful to Wilson, regardless of Boxer having made a formal apology. Ross warned Boxer that "a repetition of such disrespect will involve the necessity of return to the ordinary duties of his regiment, that he may learn what is due to discipline and to the rules of Her Majesty's service."[27]

On 24 January 1855, Boxer, "without any previous notice, or without having had any opportunity of saying one word in his own defence, received…a most severe reprimand" from Ross in the presence of Wilson and other Arsenal officers, "simply for writing the

[25] HCPP, 1855 (247), 121.
[26] Jocelyn, 79.
[27] HCPP, 1855 (247), 128-131.

letter" of 16 January. The censure included Ross's comparison of Boxer's actions to a "foreman of mechanics," an imputation against Boxer "as an officer and a gentleman" that Monsell felt would almost certainly lead to the young captain's resignation. While not "denying that, in the excitement and hurry of business, Captain Boxer has…paid too little attention to the rules of official routine," Monsell held that the services of the inventive officer were of vital importance. "Captain Boxer is the officer most distinguished for inventive skill and scientific knowledge that we have had for many years," Monsell wrote in his defense. Boxer had "saved the department from disgrace, and the country from imminent danger," with his shell factory, projected to save the country £40,000 over the first year's operation. Monsell "earnestly" called for his "colleagues to reconsider the whole matter, and to concur with me in withdrawing the Minute of censure." When they did not, Monsell threatened to take the matter before Lord Panmure, the newly-installed Secretary of State for War. Such a threat prompted Ross to reword the censure so as to remove any character references; Boxer retained his post, and eventually replaced Wilson as head of the Laboratory when the ordnance factories were reorganized later that year.[28]

Boxer's struggle over his continued employment at the Royal Laboratory highlights the dysfunctional nature of the Board of Ordnance. Where Monsell saw talent and potential, the established military authorities, Ross and Wilson, saw an unwillingness to defer to the accepted order of things. A serving officer, Boxer found himself caught between two competing chains of command. The military side rightly required obedience to orders, but the civilian side, under intense emergency pressure, required only the efficient production of materials needed for the prosecution of war. The split personality of the Board could not resolve such a dilemma, and the "disastrous muddle" very nearly consumed one of Britain's

[28] Boxer, 41; HCPP, 1855 (247), 128-131; 139-141.

rising technological talents. In addition, the incident most likely reinforced Panmure's determination to do away with the Board of Ordnance.[29]

"We erred in our confidence in common with the public at large"

The efforts of energetic young officers such as Boxer, while contributing to the overall war effort and the foundation of a new post-war administrative system, could not rescue the British expeditionary force from disaster over the winter of 1854-1855. Newcastle, despite his great efforts, was handicapped by the occupation of a new department with no separate office, no real staff, and ill-defined powers and responsibilities.[30] Neither he nor Lord Raglan could overcome the perfect storm of "disastrous muddle" and disastrous weather. The failure of the first bombardment of Sevastopol, the losses inflicted by the November storm, and the scenes of a frozen and forlorn British army painted by William Russell and his fellow correspondents proved too much for Britons at home. An editorial in the *Hereford Times* summed up the mood of the public. "The history of this country," the paper wrote, presented no "parallel where a war has been so thoroughly popular, where the Government was so thoroughly supported in every relation, and where the results, as a whole, have been so thoroughly unsatisfactory."[31]

Calls for the resignation of the Aberdeen government began shortly after news of the November storm reached London. In a particularly sarcastic editorial, the *Worcester Journal* reminded its readers that "the siege of Sebastopol does *not* continue. That Russian stronghold, taken by the *Times* on the 25th of September and securely held by our

[29] Despite the rewording, Monsell still forwarded the papers to Panmure at the latter's request; see HCPP, 1855 (247), 142.

[30] Hogg 1963, 743. The estimates for the office's first year of operation allowed for a total of only twenty-five people: the Secretary, two Under-Secretaries, several clerks, and five support staff, including a librarian, office keeper, and three porters; see HCPP, "Secretary of State for War. Class VIII. An Estimate of the Sum Required to Pay the Salaries and Other Expenses in the Department of Her Majesty's Secretary of State for War, from 12 June 1854 to 31 March 1855, " 1854 (359).

[31] "The Coming Session." *Hereford Times*, 20 January 1855, 5.

contemporary for several days, now remains in the hands of the enemy. The place is not likely to be *re*-taken this winter." "Is the Aberdeen Administration to continue its baneful existence?" the *Journal* continued. "We are indebted for our disasters to the policy and subsequent blunders of the Aberdeen Ministry. We have lost men, we have lost treasure, we have lost influence….Let it not be supposed that our present position and condition are due to any other cause than the conduct of the Government."[32] The *Herts Guardian* went even further, with an accusation that Aberdeen and his cabinet had been "anxious to harm Russia as little as possible," apparent through the "conduct of the war, and in the bungling attempts at treaties which preceded it." "It is the first time in the history of this country that England has been engaged in a war," the *Guardian* charged, "with the heads of the Ministry sympathizing with our foes. It is a most disgraceful and shocking fact but it is so."[33]

On 12 December, Queen Victoria called for a special joint session of Parliament "in order that by your Assistance I may take such Measures as will enable Me to prosecute the great War in which we are engaged with the utmost Vigour and Effect." [34] During the following debate, Conservative party leader Lord Derby charged that "from the very first to the very last, there has been apparent in the course pursued by Her Majesty's Government a want of previous preparation – a total want of prescience…[which] appeared to live from day to day providing for each successive exigency after it arose, and not before." In addressing Derby's accusations, Newcastle admitted that the siege of Sevastopol "was likely to be more protracted than I readily admit the Government at first expected." He also suggested that "if

[32] "The War and the Aberdeen Ministry." *Worcester Journal*, 02 December 1854, 5.
[33] "The War." *Herts Guardian, Agricultural Journal, and General Advertiser,* 9 December 1854, 4. The *Guardian* was referring to the negotiations that had occurred almost up to the moment that hostilities opened, which culminated with the "Vienna Note," which gave Russia the right to protect Orthodox Christians within the Turkish empire but which the latter rejected. See Figes, 125-126.
[34] "The Queen's Speech," HL Deb, 12 December 1854 Vol 136 cc1-3.

we were over-confident – I believe that we erred in common with many men of great experience in war, and men whose opinions were well worth having – and we erred in our confidence in common with the public at large."[35] *Blackwood's Edinburgh Magazine* pounced on Newcastle for this remark. "Good heavens! has it come to this, that a British minister…excuses himself and his colleagues for a hideous error in the conduct of a campaign, on the ground that 'the public at large' shared in that same delusion?" Government, before sending the army to "die before the fortress or carry it by breach and assault," should have known more about the intended target than "the best informed of the public." If not, the ministers "are answerable before God and man for every life that has been lost in the attempt."[36]

Applying what "Scientific Discovery and Invention have Supplied" to the War Effort

At the same time that the papers were calling for the heads of Aberdeen and his ministers, reports from the Crimea moved many British subjects to find some way to assist in the war effort. For most, this meant a contribution of money or time to one of two relief funds set up during the war. The month before the storm, the *Times* established its "Crimean Fund for the Relief of the Sick and Wounded" after receiving an outpouring of letters and donations as a result of Russell's report of hospital conditions at Scutari. The paper eventually gave control of the fund to Florence Nightingale, who used its monies in her efforts to overhaul British army hospitals.[37] That same month, Queen Victoria established the Royal Patriotic Fund to assist the families of fallen servicemen.[38] The Queen appealed to the

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[35] "Address in Answer to the Speech," HL Deb, 12 December 1854 Vol 136 cc4-91.
[36] "The Conduct of the War." *Blackwood's Edinburgh magazine.* 77, no. 381 (January 1855): 1-20, 12.
[37] Figes, 292.
[38] "The Royal Patriotic Fund, later the Royal Patriotic Fund Corporation: Records of the Fund's Administration," accessed 12 Dec 2013, http://discovery.nationalarchives.gov.uk/SearchUI/details?Uri=C16154.

public for support, and the response was tremendous. “Meetings are being held throughout the length and breadth of England, and of Scotland and Ireland too,” wrote the *Chelmsford Chronicle*, “in aid of the funds for the support…of the widows and orphans of those who have perished” from cholera or “the shot of the Russians before the stronghold of the Crimea.”[39] Such meetings raised enough money to allow the fund to establish two new schools for orphans of the war, as well as provide assistance to families left destitute by the loss of their soldier-fathers.[40]

Those with a more military or technical bent peppered their local papers with observations or suggestions regarding the conduct of the war, including the shortcomings of Britain’s military technology. The failure of the bombardments of Sevastopol proved particularly fertile ground for those with opinions to offer. A lengthy analysis by “A Prussian Engineer” to the *London Daily News*, for example, took apart the mistakes of the French and British besiegers piece by piece. After critiquing the entrenchments, transport issues, and tactics of the allies, the writer came to the technology. “A large proportion of the French artillery,” he wrote, consisted of undersized and underpowered cannon. “The English guns were more powerful,” he continued, but were “placed at such distances from the Russian works that correct aim and precise and effective firing were quite unattainable” because of “questionable notions” regarding the utility of long range fire. “The ‘long range’ idea has proved a bane throughout the siege…and never was powder and ball spent to less real purpose.” The writer blamed the rise of such notions on the illusory abilities of the Lancaster gun. Any of its faults - “excessively short barrel, a windage, a weak charge of powder, and a bullet of very questionable shape, wanting a correct centre of gravity” – would have been

[39] “Meetings Are Being Held...” *Chelmsford Chronicle*, 03 Nov 1854, 3.
[40] “The Royal Patriotic Fund.”

enough to prevent accurate long range fire. "But," he concluded, "this is not the first instance in military matters that the very best results have been expected from the greatest accumulation of defects."[41]

The Lancaster gun's predilection for bursting – and the measures the government took to cover up such a flaw – threatened what Newcastle later described as "embarrassment to the Government."[42] Even before news arrived of the cannon's performance at the opening bombardment, the *London Daily News* published a scathing report that questioned both the gun's worth and the behavior of Government as regards the weapon. Their 21 October article revealed that a burst Lancaster gun at Shoeburyness in September of 1854 had killed three sergeants, but the fact had not been made public. When questioned, an unidentified workman confirmed the men had been killed, but remarked that "they tries to keep them kind of accidents out of the papers." The very thin and oft-pierced veil of such secrecy surrounding the manufacture and trials of the gun put the *Daily News* on the offensive. "We claim and shall exercise," the paper wrote, "the right of questioning whether a siege, a campaign, or the grand problem of the whole war, is to be put to the hazard of such crude and unsafe instruments as the Lancaster gun."[43]

The exposé prompted debates in the *Daily News* between readers as to the exact cause of such bursting. Samuel Haughton, a professor of geology at Trinity College in Dublin, felt the fault lay in the use of too heavy a projectile. He suggested lengthening the barrel, as "the guns which I saw at Woolwich did not appear to have the requisite length for the very great diameter of the bore and great weight of the ball."[44] Other writers had differing theories, but

[41] "Our Artillery in the Crimea." *London Daily News* 11 April 1855, 5.
[42] TNA, SUPP 6/1, "Correspondence respecting the re-organisation of the Ordnance Select Committee," 1.
[43] "The Elliptical Gun - Two More Burst." *London Daily News*, 21 October 1854, 2.
[44] "Lancaster's Gun." *London Daily News*, 25 October 1854, 5.

in the habit of many who wrote to their favorite editor, declined to give a real name. "Conjecture" felt that "the oval shape of the bore, cut into a gun cast in a circular form, resulted in uneven thickness in the barrel." He suggested that "the defect [might] be obviated by giving an elliptical form to the outside as well as the inside of the gun."[45] "Papin" thought that "the least shifting of position by the explosive force of the powder must tend to fix the ball in the gun," a flaw which could be corrected using lead on the outside of the projectile, more giving than the bare iron of the shell.[46] "A. Landman" agreed, but thought such a proposal would be too expensive. Instead, he suggested using "patent felt, vulcanised India rubber, leather, or gutta percha" in a manner used by "many of the best riflemen, both here and in America."[47]

"Papin," however, did not stop with a contemplation of the cause of the Lancaster gun's bursting problem; he castigated British military authorities for not harnessing "all the appliances at command which scientific discovery and invention had supplied since the last European war." The operations at Sevastopol suffered from a blind adherence to "war conventionalities" on the part of allied commanders, "rules prescribed before the invention of rockets, of the Minie rifle, and the large pieces of ordnance now used for battering" fortress walls. For example, he recommended a scheme of simultaneously discharging several cannon at one target, something "accomplished with great ease by means of voltaic electricity." Vauban, the great seventeenth-century Italian authority on fortress warfare, "would gladly have availed himself of the means of accomplishing what he deemed so essential" – such as the speedy reduction of the defenses around Sevastopol with new technologies. "His

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[45] "The Lancaster Gun." *London Daily News*, 27 October 1854, 3.

[46] "The Siege of Sebastopol." *London Daily News*, 27 Oct 1854, 4. In actual fact, lead was already used on the outside of the shell; see Hew Strachan, *From Waterloo to Balaclava: Tactics, Technology, and the British Army, 1815-1854* (Cambridge: Cambridge University Press, 1985), 139.

[47] "The Lancaster Gun." *London Daily News*, 28 November 1854, 5.

disciples in the art of war hesitate to take advantage of the power conferred by science," "Papin" continued, "because it is not so set down." "If a novel invention be bound with red tape it may have a chance of being received with favour," "Papin" complained, but otherwise "it then becomes too visionary and impracticable a matter for serious consideration by the devotees of routine."[48]

Such letters, and the dozens – if not hundreds – of others like them show a segment of the British public not only interested but actively participating in discussions regarding military technology. They also show that inventors such as "Papin" were aware of the institutional wall constructed by the "devotees of routine" – the Master-General and the Select Committee – aimed at keeping out inventors and proposals that didn't conform to commonly accepted military thinking. It would take a revolution in military administration to bring down such a wall – a revolution very much on the horizon when "Papin" penned his letter to the *Daily News* in October of 1854.

From the "Select Committee of Artillery Officers" to the "Ordnance Select Committee"

With the War Department under siege by the press and public, Newcastle sought professional advice on military matters from Col. John Henry Lefroy, then secretary of the Royal Patriotic Fund. Early in his military career Lefroy had exhibited a keen interest in advancing the "science of artillery." In 1838, he and another young artillery officer, Frederick Eardley-Wilmot, helped establish the Royal Artillery Institution at Woolwich. After spending several years abroad conducting magnetic and meteorological observations for the British government, Lefroy returned to Woolwich in 1853 and helped re-animate a moribund Institute as well as outfit its laboratory. With war on the horizon, in 1854 Lefroy compiled the *Handbook of Field Artillery for the Use of Officers*, a textbook published by the

[48] "The Siege of Sebastopol." *London Daily News*, 27 Oct 1854, 4.

Institute for use in the field. The first three hundred copies were sent to the Crimea in July, 1854, and the book remained a staple of officer instruction until 1884.[49]

Newcastle appointed Lefroy his confidential "scientific adviser on subjects of artillery and inventions" in December 1854, and tasked him with examining military inventions at home and abroad, to include a review of the procedures by which the Ordnance Department handled inventions. Lefroy, concerned with the weaknesses of the Select Committee, persuaded Newcastle to reorganize the whole system.[50] In one of his last acts before resigning over the conduct of the war, therefore, Newcastle proposed replacing the "Select Committee of Artillery Officers" with a new "Ordnance Select Committee" (OSC).[51] This decision, shepherded by Lefroy and supported by Fox Maule-Ramsey (Lord Panmure), who replaced Newcastle at the War Office, proved of immense significance to the history of British military technology.

In letter dated 08 January 1855, Newcastle explained his primary reason behind the decision to Sir Hew Ross. "Appeals from the decisions" of the old Committee and "complaints against its mode of dealing with subjects brought before it," wrote Newcastle, were "of frequent occurrence, so much so as to threaten embarrassment to the Government."[52] Both Ross and Cator, however, objected to such a condemnation. The latter, in his defensive summary of the Select Committee's activities, wrote that "if complaints have been made, they have not reached the Committee in tangible form" – hardly surprising, since no mechanism existed for handling such complaints.[53]

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[49] R. H. Vetch, "Lefroy, Sir John Henry (1817–1890)," rev. Roger T. Stearn, *ODNB*, Sep 2012, http://www.oxforddnb.com/view/article/16343.
[50] Vetch, "Lefroy."
[51] Newcastle resigned his office on 01 February 1855. See Munsell, "Clinton, Henry Pelham Fiennes Pelham."
[52] "Correspondence," 1.
[53] "Correspondence," 6.

Anecdotal evidence of such complains, however, existed aplenty, which Cator and other Ordnance officers seemed willfully ignorant of. A 27 October 1854 letter to the editor of the *London Daily News,* written by Mr. Alexander Melville and prompted by "Papin's" correspondence two days before, provides one such example. In August of 1850, Melville and a Mr. Calloz received a patent for "improvements in cannon and small arms." "Our invention in several forms was submitted to the Board of Ordnance," Mr. Melville complained to the paper, but "you know too well the fate of most matters submitted to official notice, unless by some of the 'favoured few,'" most likely referring to Lancaster. Melville and his partner resubmitted their plan in 1852, but after attending the meeting of the Select Committee, "we saw in a moment how little chance we had" of overcoming the evident prejudice against inventors "being [neither] military men [nor] members of the government gun trade."[54] "Our plans and proposals," Melville wrote, "were laid quietly on the shelf alongside of many others, and we were politely bowed from the room." With the Baltic Fleet poised to set sail in 1854, Melville tried one last time to bring the proposals before "the 'old gentlemen' at Woolwich," but with the same results. "Not having time…to throw away on dancing attendance at the 'front' door of the Ordnance, and being unacquainted with the keeper of the 'back' entrance," Melville "despaired of ever [getting] my plans properly considered."[55]

Blaming such complaints on the small size, limited scope, and strictly military makeup of the Select Committee, Newcastle proposed nearly doubling its size from nine to over sixteen members made up of both military and civilian authorities. Such a construction

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[54] The Ordnance Department still purchased all cast-iron ordnance from private foundries at this point; work would not begin on an iron-casting foundry for Woolwich until 1855 (Hogg 1963, 778).

[55] "Long Range Cannon and the Lancaster Gun." *London Daily News*, 1 November 1854, 2; see alsoTNA, WO 44/630, File 529.

would endow the OSC with "the special knowledge and talents of individuals holding scientific and professional offices" in and outside the Royal Arsenal.[56] As with the original Select Committee, *ex officio* military officers formed the bulk of the first OSC, such as the Director-General of Artillery and the heads of the manufacturing establishments. Civilian officials such as the Professor of Mathematics at the Royal Military Academy, the Chemist to the War Department, and the resident Civil Engineer of the Royal Arsenal, also were assigned. Newcastle, however, proposed adding one or more "Associate Members, selected by the Government from the scientific professions." Such an expansion, he felt, would make participation on the committee "a less burdensome duty" for the chiefs of the various departments. At the same time, civilian members would give "the advantage of obtaining other than strictly military opinions upon questions of a mixed scientific and practical character." Newcastle also suggested that "the admission of officers, selected for their scientific attainments," would be "a measure which cannot but open a most honourable distinction to the junior members of the Corps of Artillery and Engineers." This latter appears to have been of particular importance, as Newcastle repeated this in a subsequent letter.[57] Finally, the OSC would report its findings directly to the Secretary of State for War, unlike the older Select Committee which reported to the Master-General of Ordnance.

Newcastle directed the OSC to be assembled forthwith, their first duty being to frame procedural rules and determine the meeting schedule. He also asked that they "report...the powers they may desire…and the arrangements that may seem...most suitable for considering, for testing if necessary, and for reporting upon the various matters that may be brought before them." After several meetings, the OSC reported back on 26 January 1855

[56] "Correspondence," 1.
[57] "Correspondence," 1-2

with suggestions that underscored the transition to a more permanent and professional organization. The OSC asked, for example, that the assistant secretary be "permanently employed as such," rather than having a junior member tasked with that duty, and that their clerks receive a raise and housing. "Increased accommodation" for the expanded committee should also "be immediately afforded." The OSC also requested the Director-General of Artillery be given authority "to obtain…such assistance, ammunition, and stores, as may be necessary for the purpose of carrying on the experiments and practice that may be required."[58]

In an effort to impose some limit on their workload, the OSC asked that "no subjects should be entertained…except as are referred to them" by the Secretary of State for War. Such a restriction would have made the OSC an evaluation committee along the lines of its predecessor. Newcastle replied that a similar proviso restricted the old Select Committee from originating proposals, a restriction that "must deprive the public service of one of the greatest advantages than can be derived from the great military experience and scientific knowledge of the officers and gentlemen composing the Committee." The OSC, therefore, would be "empowered to originate, and recommend for adoption, any improvements it may deem important," subject to final approval.[59]

The OSC also requested that some process be constructed to weed out the "vast proportion of inventions submitted for consideration…totally inapplicable to military service" in order to relieve the committee "from the useless expenditure of their time, which must otherwise be bestowed on the consideration of such subjects." Newcastle agreed, and suggested that a screening sub-committee could handle the task, "provided that a register be

[58] "Correspondence," 11.
[59] "Correspondence," 12.

kept, by number, of all the subjects considered, so that they can be at all times referred to."[60] This suggestion does not appear to have been put into action, as the records of the Committee's investigations contain numerous complaints regarding the useless expenditure of time and money on proposals of questionable value.

Finally, Newcastle emphatically dismissed Gen. Cator's hope that "the power of referring Artillery questions [be left] to officers of Artillery." None of "the most eminent English writers on gunnery, were Artillery officers," Newcastle pointed out, nor were many "inventors of important improvements in Artillery." "I am of opinion," he continued, "that many questions must arise upon which all the light that can be shed by general mechanical knowledge or high mathematical skill, will be of national importance."[61] By removing such a straightjacket, Newcastle ensured that the new committee could make the most of the intellectual resources available both in and outside the military establishment. Such a decision remains one of Newcastle's most important contributions to the advancement of British military technology.

One request made by the OSC that the War Department did grant was expansion of the artillery test range at Shoeburyness. In the 1840s, shooting at Royal Military Repository ranges became problematic, as inaccurate or accidental fire posed a grave threat to shipping on nearby Thames River. In 1849, the Board purchased land at Pig's Bay, the mouth of the Thames and near the town that gave the range its name. An isolated coastal site, the purchased land provided a safe impact area for experiments and practice shooting, coupled with access by river to Woolwich for transport. After five years of summer use, the threat of war led to more permanent development beginning in 1854. The OSC requested not only that

[60] "Correspondence," 12.
[61] "Correspondence," 12.

the facility be extended, but that the officer commanding, "having very great responsibility and important duties to perform," be provided an assistant officer and "experienced" sergeants, "in order to insure that accuracy which is requisite in conducting, as well as in ascertaining and recording the results of, important experimental practice."[62] The establishment of a permanent test facility, with a professional staff, represented a significant maturation of the "science of artillery" in Britain.

Replacing the "slow, jarring, and cumbrous machine" of the Board of Ordnance

Newcastle did not remain in office long enough to see his plans for reorganization bear fruit. On 29 January, the House of Commons passed a motion for a special committee "to inquire into the condition of our Army before Sebastopol, and into the conduct of those Departments of the Government whose duty it has been to minister to the wants of that Army."[63] The motion had been introduced by John A. Roebuck, who would eventually head the committee. It also effectively "expressed the mood of the nation" and led the Aberdeen government to resign the next day.[64] The first attempt to form a government under Derby failed, which prompted a gloomy comparison between the military and the political battlefield by the *Burnley Advertiser*. "Our prospects in the Crimea, that great Golgotha in which so great a portion of the flower of the British army have left their bones, are not a whit

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62 "The History of Shoebury Garrison," accessed 29 Aug 2013, http://www.southend.gov.uk/downloads/file/1843/detailed_history_of_shoebury_garrison; "Correspondence," 11. The range is still in operation, under contract for the Ministry of Defence by QinetiQ, see "Historic Images of MOD Shoeburyness," 2015, http://www.shoeburyness.qinetiq.com/about/Pages/mod-shoeburyness-timeline.aspx.

63 "Army (Crimea) - The Conduct of the War, and Condition of the Army. Adjourned debate. - (Second Night.)" *HC Deb 29 January 1855 Vol 136 cc1121-233.*

64 S. A. Beaver, "Roebuck, John Arthur (1802–1879)," *ODNB*, 2004, http://www.oxforddnb.com/view/article/23945; John Arthur Roebuck and Robert Eadon Leader, *Life and Letters of John Arthur Roebuck ... With Chapters of Autobiography* (London: E. Arnold, 1897). Beaver claimed Roebuck to be "determinedly independent of party ties," but Leader wrote that Roebuck "was recognized as a thorough-going Radical." Roebuck considered himself merely "a man born in the middle rank of society," and represented the Liberal party for Bath and Sheffield in Parliament. See Leader, 1, 219.

better than when last we wrote," moaned the *Advertiser*. "We are now rapidly approaching to as lamentable a state of disorganization and anarchy at home as still continues, and we fear will continue to prevail in the Crimea, minus only the starvation, diseases, misery and death." [65] Fortunately the state of political anarchy proved short-lived; on 06 February 1855, Henry John Temple, third Lord Palmerston and "for whom press and public were clamouring," became prime minister.[66] Fox Maule (Lord Panmure) and brother to the late Surveyor-General Lauderdale Maule, succeeded Newcastle as Secretary of State for War.[67]

The press, as may be expected, had not been unanimous in calling for the heads of the Aberdeen ministry. The *Elgin Courier*, for example, defended the outgoing government, and reminded its readers that the *Times* had only the year before "denounced Lord Palmerston as the greatest quack of modern times" for his opposition to the war. More importantly, however, the *Courier* pointed out that "the late Cabinet have been made the victims of a vicious military system – a system that had been long sanctioned and supported by the House of Commons."[68] Such a system had to be fixed, and the *Daily News* predicted Lord Panmure the man for the job. "To carry into effect the radical and sweeping reforms called for in the British army," it wrote, "a Minister is required who can, when necessary, do unpleasant things; and Lord Panmure has shown that he not only can do unpleasant things, but takes pleasure in doing them."[69]

Palmerston and Panmure came into office determined to finally deal with that most unpleasant of things, the "disastrous muddle" of military administration. Without waiting for

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[65] "We Scarcely Know What to Say of the War." *Burnley Advertiser*, 03 February 1855, 2.

[66] David Steele, "Temple, Henry John, third Viscount Palmerston (1784–1865)," *ODNB*, May 2009, http://www.oxforddnb.com/view/article/27112.

[67] John Sweetman, "Maule, Fox , second Baron Panmure and eleventh earl of Dalhousie (1801–1874)," *ODNB*, Sep 2014, http://www.oxforddnb.com/view/article/18365. Lauderdale Maule died of cholera at Varna in 1854.

[68] "The Late Ministry and Their Accusers." *Elgin Courier*, 09 February 1855, 2.

[69] "The New Ministry (from the Daily News)." *Elgin Courier*, 16 February 1855, 4.

the Roebuck committee's first report, Palmerson 'signed [the] death warrant" of the antiquated and often antagonistic post of Secretary-at-War "on half a sheet of note-paper" in early February.[70] What duties the post had passed to the Permanent Under-Secretary of State for War under Lord Panmure. In addition, plans were announced to divorce the military from the civil branches of the Ordnance Department. The Commander-in-Chief, then Lord Hardinge, assumed control of the Royal Artillery and Engineers, whereas control of the manufacturing departments and other non-military functions passed directly to the Secretary of State for War.[71]

An unsigned memo dated 17 February emphasized that the heads of the manufacturing departments were to remain serving Royal Artillery officers. "It is necessary that the person who is responsible for the work has a sound scientific knowledge of…the different articles manufactured," the memo argued, "and at the same time [have] an experimental acquaintance with their use." Placing such officers under a civil rather than military head eliminated the "evils that at present exist," such as the interference in manufacturing by a higher-ranking officer, or chain-of-command issues that nearly cost Captain Boxer his future at the Royal Laboratory. It would also encourage professional scientific education among the officer corps. The latter particularly vexed the author of the memo. "Although there is a considerable amount of talent among the officers of Artillery," the memo noted, few ever pursued such education, and none saw it as a means of advancement. "It has been by the sheer obstinacy of some able officers," such as Captain Boxer, "that the authorities have been forced to undertake works which were required for the

[70] Hogg 1963, 1087; "The New Cabinet." *Cambridge Independent Press*, 10 February 1855, 4. The Secretary-at-War post continued to exist, but remained vacant until its final abolition by an act of Parliament in May of 1863; see Hogg 1963, 1090.
[71] The new Secretary of State *for* War differed from the Secretary-*at*-War in being a cabinet-level post directly answerable to Parliament through the Prime Minister's office.

safety of the country."[72]

The authority in the matter of ordnance weapons and supplies, which formerly belonged to the Master-General of Ordnance, went to the Director-General of Artillery (DGA), then General Sir William Cator. Charged with supplying "a professional opinion on all subjects connected with the *matérial* of the Artillery Department," the DGA now decided the "nature of all armaments:" their size, intended use, construction, types of projectiles, and so forth. Panmure also tasked the DGA with gathering statistics regarding the "number, nature and condition of all guns, mounted or unmounted, in charge of the Artillery all over the world." Finally, the DGA presided over the Ordnance Select Committee in his supervisory role regarding changes of ordnance equipment and supplies.[73]

The transition in government both stalled Newcastle's reorganization of the OSC and opened a door for those wishing to keep civilians out of military matters. In March, Panmure heard from an inventor who "declined submitting an invention on discovering that no mathematician was present" at the review of his proposal. Col. Lefroy, on behalf of the War Department, wrote to Sir Hew Ross regarding the status of the committee in March, 1855. In the letter he pointedly remarked that "it was the intention of the Duke of Newcastle to guard against the want of mathematical skill on the Committee" by the inclusion of a civilian authority. Sir Ross responded with a memorandum "showing what will be necessary…to carry out fully the instructions conveyed in [Newcastle's] letter of 6th February last," largely a request for additional funding. After review, Col. Lefroy passed the request on to Panmure, along with a recommendation that travel expenses for the civilian associate members be reimbursed. The lack of authority to pay such expenses was most likely the tool that Sir Ross

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[72] TNA, WO 33/2B, "Memoranda on the Office of Ordnance," 01 May 1855, 12-14. The author was, most likely, Lord Panmure.

[73] TNA, WO 33/2B, "Past and Present Arrangements," 02 May 1855, 2.

used to keep the civilian gentlemen out of committee business.[74]

Panmure, however, had another battle to fight before giving final approval to the OSC's organization. Having been some weeks in office and dealing with the warring factions of the Ordnance Department, such as the fight he inherited over Boxer's future, Panmure had enough.[75] In a confidential Cabinet memo dated 02 May, Panmure wrote that "all experience in the administration of the War Dept. has convinced me of the necessity of getting rid of the Board of Ordnance altogether." A "slow, jarring, and cumbrous machine" with an ill-defined set of duties and responsibilities for its members, Panmure felt that the "constant system of compromises" required to keep the machine functioning "[made] it difficult for any one mind to make itself felt throughout the numberless ramifications of a Department which extends half round the world."[76]

By way of illustration, Panmure pointed to the continued problems with the supply of small arms. Despite placing large contracts both at home and with Belgian gunmakers, to whom the Board often turned when needing additional weapons, the army could not arm all of the regiments destined for the Crimea with the new Minié rifle. Reinforcements still shipped out with armed with the old "Brown Bess," with one unit reportedly told "they 'must take their chance of picking up stray muskets'" on the battlefield.[77] Panmure charged that the officers responsible for small arms procurement disagreed on the basic question of how fast

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[74] "Correspondence," 13-14.

[75] His decision may have been helped by the evidence being gathered by the Roebuck Committee, although it had only released two reports so far. The first, released early in March of 1855, consisted merely of a request that their proceedings be kept secret to prevent "the danger of injustice to individuals be prevented" and better protect the public interest, a request not granted by Parliament; see "First Report from the Select Committee on the Army before Sebastopol; with the Proceedings of the Committee," 1855 (86). The second report consisted of all of the evidence recorded by the committee through the end of March. The next two reports were issued after Panmure's decision, and the final – which contained the actual report and summary of evidence, was not released until 18 June.

[76] TNA, WO 33/2B, 02 May 1855, 1.

[77] "The Government Has Entered into Contract..." *Sussex Advertiser*, 02 January 1855, 8; "More Mismanagement in the War Department." *Dundee Courier*, 25 April 1855, 4.

the weapons could be obtained. One, "the officer who has charge of the store branch has always believed that our prospects of obtaining arms were good." The other "always felt [such prospects] to be alarming in the highest degree, and yet it was only by constantly interfering beyond his province, that, backed by the Minister of War, we have been able to make even the slight progress that has been made."[78]

Panmure detailed other "evils" as well. Considerable delay resulted from the internal conflicts within Ordnance, for example, where "the slightest delay may paralyse great undertakings. Three months have been lost in even taking the first step to supply an important article, and the country suffered a heavy pecuniary loss by its hasty preparation, consequent upon this delay." Patronage also weighed down the Department, with "many inefficient old men…kept in offices for which they are altogether unfit, by the traditions of the department, and by the memory of their former services." Finally, "in scientific acquirements our Artillery is much inferior to the French," owing to many factors, but especially "to a want of appreciation on the part of those that govern, of scientific as compared with military proficiency."[79]

Panmure's solution to these problems mirrored the ideas detailed in the unsigned memo of 17 February: dissolution of the Board of Ordnance, placement of the military duties into the hands of the Commander-in-Chief, and assignment of civil administration to Panmure's own office. The plan removed all the functions of the Master-General's office, which made that post redundant. On 18 May 1855, Queen Victoria, by Royal Letters Patent, eliminated the Board, all posts but the Clerk of Ordnance, and "under the Great Seal [vested]

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[78] TNA, WO 33/2B, 02 May 1855, 1-2. While not naming either "officer," this probably referred to Hastings and Monsell.

[79] TNA, WO 33/2B, 02 May 1855, 2.

the Civil Administration of the Army and Ordnance in the hands" of Lord Panmure.[80] An Order in Council, issued 06 June, further defined the offices responsible "for carrying on the duties hitherto performed by the Master-general and Board of Ordnance." This included a new Naval Director of Artillery, charged with "advising on all matters related to the material of ordnance intended for naval service" and an *ex officio* member of the OSC.[81] Although the new post gave the Admiralty some input, the War Office still held considerable control over naval guns, which proved a source of contention between itself and the Admiralty over the next several decades.

Although applauded by the *United Service Gazette* as having ended a department "extravagant in its outlay of public money and…not altogether free in doing so from the influence of nepotism and partiality," not everyone welcomed the change. Lord Raglan himself criticized it as the "reverse of beneficial to the public" and an "imperfect measure" that put military officers in "the disagreeable position of having two masters." Gen. Ross felt "astounded…that any gentleman new to a great office should consider himself [capable of] discharging the duties of Master-General, Minister of War, Minister for War, and Commanding in Chief…There never was such folly." Storekeeper Hastings, whose position the Patent eliminated, predicted that placing "the great manufacturing military departments in the hands of a civilian ignorant of military and naval requirements cannot work well." Such grousing, however, did not turn into influential opposition to Panmure's plan and in the end the Ordnance Department "expired with scarcely a whimper."[82] Because of the war and the

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[80] Hogg 1963, 1087-1088; HCPP, "Report from the Select Committee on Military Organization; Together with the Proceedings of the Committee, Minutes of Evidence, and Appendix." 1860 (441), vi.
[81] HCPP, "Army Civil Departments. Copy of an Order of the Queen's Most Excellent Majesty in Council (Passed on the 6th Day of June 1855), Regulating the Establishments of the Civil Departments of the Army." 1855 (307).
[82] Sweetman, 74-75.

need to amalgamate the Department's staff and duties with the War Department, the Board limped along for another year and a half handling routine business. Ingloriously, the last action of the centuries-old Board regarded "tenders accepted for emptying privies in Ireland" on 31 December 1856.[83]

"Hope that…inventions…will be received with due respect, and fairly tested"

The OSC had to hit the ground running, as "Papin's" wish that the application of the nation's capabilities of "scientific discovery and invention" came true in 1855. Gen. Cator noted that between the 10th and 26th of January, while the OSC struggled with defining its rules and desired powers, "upwards of 160 new inventions have been referred to the Committee for consideration and report."[84] And, although Britons generally remained unaware of Newcastle's reorganization, the *Times* took notice in a blistering article that appeared in July of 1855, the same month Panmure approved the final rule changes regarding the OSC. The paper charged that "the extent to which the Russians have matched us in their munitions of war" had not been "ingenuity and progress" on their part, but Britain's "perverse backwardness and neglect of the material facilities which we have so abundantly at command." The *Times* put the blame squarely on the outgoing "select committee of the Board of Ordnance, a piece of machinery carefully devised to shut out inventors." Their actions, the *Times* wrote, had kept the British army "dependent for its success upon deadly bayonet conflicts" and preserved "in the ranges of a small and costly service the traditions of war in its most barbarous and unskillful forms."[85]

The *Times* assured their readers, however, that "the mechanical resources of the country are every day being brought nearer to a practical bearing upon the prosecution of the

[83] Hogg 1963, 1087.
[84] "Correspondence," 11.
[85] "The Manufacture of Small Arms And Artillery." *Times*, 13 July 1855: 5.

war" through the efforts of the "eminent machinist," Joseph Whitworth.[86] The paper spent several column inches describing Whitworth's careful study of the characteristics of projectiles in flight, his hexagonally-bored small arms, and plans for scaling that design up for artillery. Such efforts had resulted in "several patents" regarding weaponry, which Whitworth had "placed freely at the disposal of Government," the *Times* reported. The paper suggested that "now that the Select Ordnance Committee has been enlarged there is some ground for hope that the inventions…will be received with due respect, and fairly tested." This hope included not only the inventions of Whitworth, but several other "eminent machinists… actively engaged in bringing the resources of their art to bear on the improvement of our present munitions of war." The *Times* also noted that "the obstinacy of the Birmingham manufacturers in resisting" mechanization had led to a rapid transfer of business to Manchester, where "bayonets and rifle sights and shells are being made…upon a great scale." "To those who know what the industry of this country is capable of," the paper regretted that "so much valuable time has been lost" harnessing the abilities of British inventors. Such men "alone had it in their power to back up with the requisite superiority in *matériel* the invincible courage of our troops."[87]

Along with the British press, inventors themselves formed another group of parties interested in the creation of the OSC. As before, many used notices in the papers to generate public interest in their proposals. Mr. Bashley Britten, for example, "[took] the liberty of sending" the editor of the *Times* "a few particulars" regarding his long-range artillery shell and rifled cannon, hoping to pressure the OSC into further action. Britten wrote that Monsell,

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[86] Thomas Seccombe, "Whitworth, Sir Joseph, baronet (1803–1887)," rev. R. Angus Buchanan, *ODNB*, Oct 2007, http://www.oxforddnb.com/view/article/29339.

[87] "The Manufacture of Small Arms and Artillery." The *Times* article was incorrect in one regard; Birmingham remained an important center of private small arms manufacture for many years.

in testimony before the House of Commons, noted “in July last my shells acquired an effective range of more than 1,000 yards beyond the service solid shot, with little more than half the usual quantity of powder.” Since those experiments, however, little more had been done with his inventions, and Britten claimed the reason to be “very curious.” On recovery, the fired shells “had not received the impression of the rifled grooves, as was naturally expected.” Based solely on that evidence, the OSC ruled “that the principle of my invention had not been proved,” attributing the long range to other reasons. Britten protested their decision, and defended his inventions in the letter. He also noted that although the shells cost “about 15 per cent. per ton [more] than ordinary shells, this would be compensated for by the saving of nearly 50 per cent. of the powder” as well as giving the army an effective rifled cannon without the defects exhibited by the Lancaster gun. “Such is a brief but true description,” Britten claimed, of his “extremely simple invention, but which will within a few weeks have now been 12 months under official consideration.”[88]

Some inventors used the papers to simply crow about their success before the Committee. William Greener, the frustrated inventor of an expanding musket ball similar to that used in the Minié rifle, took advantage of the change in military administration to appeal to Lord Panmure for some form of reward for his invention. Panmure turned to the OSC for their recommendation regarding Greener’s claim. After reviewing the evidence, the committee ruled that “although the principle which [Greener] advocated…is considered to be substantially the same as that upon which” the Minié bullet acted, the latter’s “adoption is not considered to have been due to [Greener’s] communication.” Panmure, however, “desirous of rewarding the ingenuity displayed” by Greener’s “first suggestion of the principle of

[88] Britten, Bashley. “Improved Artillery,” *Times*, 31 Oct. 1855: 10.

expansion," approved a rare £1,000 award "as a public recognition of [his] priority in bringing this invention before the War Department." Greener "respectfully submitted" Panmure's letter, with copies of the OSC's judgment, to the *Newcastle Journal*, who published the correspondence on 27 December, 1856.[89]

Greener's reward, Britten's appeal, and Whitworth's activities all point to two other interested parties: the British public, and because of it, the British government itself. Newcastle's concern over potential "embarrassment to Government" led to the creation of the OSC, but Lord Panmure took one final step in assuring the new entity's accountability. On 30 July 1855, Panmure approved the budget and rules regarding the committee's operation. Rather than a single annual report of proceedings, however, Panmure requested quarterly reports, as well as the construction of "a register of all inventions…showing the date of their reference, the time consumed in their examination, how eventually disposed of, and the name of the inventor."[90] This change meant greater – and more timely – civilian oversight of the Committee's activities, but also introduced the potential for political and financial interference in its operations. With the end of the war in late 1856, and the subsequent closing of the public purse, such interference would become a point of contention between the OSC and the parties interested in its operations.

"Restoring circulation to that military mass which is stagnant in the Crimea"

While the press lambasted the government over the war and pundits pronounced judgment on British tactics and technology, the siege of Sevastopol ground on. In January of 1855, Newcastle dispatched nine ships bearing construction crews and materials to build a railway at Balaklava, in order to clear the backlog of supplies and ammunition at the

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[89] William Greener, "The Invention of the Minie Rifle." *Newcastle Journal*, 27 December 1856, 6.
[90] "Correspondence," 15.

harbor.[91] Although the crews laid a mile of track per week over the next several weeks, the railway could not bring up enough materials to ensure the success of the bombardment that opened on 09 April – nor the two that took place in June.[92] The second June cannonade opened on the 17th in support of an assault planned for the next day, the fortieth anniversary of the Battle of Waterloo. Raglan, in a misplaced effort to symbolize the new spirit of cooperation with the French, "thought that it was essential for the British to storm *something*, even at the cost of unnecessary losses."[93] The Roebuck committee also thought the date significant, and scheduled the 18th for the release of their final report. It proved a day of futile gestures; the attack consumed over 5,000 allied soldiers with nothing gained. Meanwhile, the committee ineffectually blamed the conduct of the expired Aberdeen administration as "the first and chief cause of the calamities which befell our army" without making any recommendations for avoiding such fiascoes in the future.[94] Ill with dysentery, demoralized by the deaths of so many British soldiers, and depressed by criticism of his handling of the war, Raglan died on 28 June 1855.[95]

Raglan's position as commander of the expedition was unenthusiastically taken up by Major-General Sir James Simpson, Raglan's chief-of-staff and senior British officer on the spot. Simpson, who supposedly said that "they must indeed be hard up when they appointed an old man like me," despaired over his own health and found working with his allies "irksome and embarrassing."[96] Newcastle, who visited the front in July of 1855, harshly described the despondent Simpson as a "raving lunatic" without any real plan for further

[91] "The Balaklava Railway Corps." *Morning Post*, 03 January 1855, 3.
[92] "The Balaklava Railway." *Westmoreland Gazette*, 19 May 1855, 2.
[93] Figes, 364.
[94] HCPP, 1855 (318), 22.
[95] Royle, 397-398.
[96] Norman Rich, *Why the Crimean War? A Cautionary Tale* (Hanover, NH: University Press of New England, 1985), 128; Alan Palmer, *The Banner of Battle: The Story of the Crimean War* (New York: St. Martin's, 1987), 208.

prosecuting the siege.[97] The Russians changed the situation with their 16 August attack on the combined French, Sardinian, and Turkish positions along the Chernaya River, on the outskirts of Sevastopol. Hoping to break the coalition, the attack resulted in disaster for the Russians instead, shattering their field army and ending any hopes of lifting the siege. With the external threat eliminated, the allies opened their fifth bombardment on the defenses the very next day. Although officially ending on the 21st, with the "sixth" bombardment starting on 05 September, improvements in inland transportation meant the gunners kept up fire "with more or less intensity," unlike previous efforts.[98]

On 08 September, the allies launched their final assault at noon, which caught the Russians by surprise. The French, able to bring their trenches to within a few paces of their main target, the Malakov Tower, penetrated the defenses and took their objective after ten minutes of hard hand-to-hand fighting. The British effort against the Greater Redan, however, ended in panic and disorder, with men refusing to press home the attack. Despite this, the Russian commander recognized that the fall of the Malakov meant the eventual fall of Sevastopol itself, and ordered the evacuation of his forces across a prebuilt pontoon bridge during the night.[99] Although operations continued in other areas, the fall of Sevastopol pushed the combatants to the discussion table, and on 28 February 1856 signed an armistice that brought fighting to an end. Another month's negotiation ensued before a final peace treaty was signed on 30 March; a further month passed before the allies started evacuating the Crimea. The British departed last, with their final contingent leaving in July. "Not for the last time in the country's history," author Trevor Royle wrote, "British troops [left] a foreign

[97] Royle, 404.
[98] Jocelyn, 411.
[99] Royle, 412-414.

shore, uncertain whether all their courage and sacrifices had been worth the effort."[100]

Despite the ambiguous end of the war, the "courage and sacrifices" resulted in two important and far-reaching changes in British military administration: the replacement of the Board of Ordnance, and the construction of the Ordnance Select Committee. Although another fifty years passed before the civilian War Office finally emerged superior in the battle over control of the military, the dissolution of the antique Board represented a crucial first step in dissolving the "disastrous muddle" that had so long consumed the efforts of British political and military officials. Likewise, the creation of the OSC represented a crucial first step in the modernization of British military technology. For the next fifty years, the OSC and its successors functioned as an important gatekeeper between the British military and the ongoing industrial revolution. What remained to be seen, however, was if the gates that the British military went through would allow the nation to stay technologically competitive with rival powers on the Continent and across the Atlantic.

[100] Royle, 473-475.

Chapter 4: "Steering among the Designs of Rival Inventors:" The Activities of the Ordnance Select Committee, 1856 – 1868

The conclusion of the Crimean War in 1856 did not bring peace to the British Empire. By the end of the year, the *Liverpool Daily Post* opined that "England has quite enough on her hands just now:" war with China, the East India Company's involvement with Persia, and "affairs all over Europe demanding the fulfillment of promised intervention."[1] Then, in the middle of the summer of 1857, telegraph reports from India contained "disastrous news." "The mutinous spirit…in our Bengal native army has broken out into a formidable and extensive insurrection," reported the *Liverpool Mercury*, "accompanied by a fearful destruction of British life."[2] For the next eleven years – over the entire life of the Ordnance Select Committee – Britain would be actively engaged in warfare over much of the globe.[3]

This same period also saw a deepening and expansion of the ongoing Industrial Revolution. Many historians have argued that a mid-century quiescence in industrial development splits the Revolution into two distinct phases.[4] As the records of the OSC show, far from being quiescent military technology underwent astounding change during this time. . All of the weapons deployed against the Russians at Sevastopol in 1854 – some having

[1] "News of the Day." *Liverpool Daily Post*, 30 December 1856, 5.

[2] "Military Revolt in India." *Liverpool Mercury*, 29 June 1857, 8.

[3] Britain had only one year during this period free from active conflict: 1862, during the midst of the American Civil War. Britain evaluated its military options against the Union in case of war in 1861 and 1862, particularly during the diplomatic crisis triggered by the Trent Affair, and dispatched an expeditionary force to buttress the troops and militia in Canada just in case. See Kenneth Bourne, "British Preparations for War with the North, 1861-1862," *The English Historical Review* 76, no. 301 (1961): 600-632; for a timeline of British military operations, see Brian Bond, ed. *Victorian Military Campaigns* (New York: Praeger, 1967), 309-311.

[4] The splitting of the Industrial Revolution and the time frames for the parts are not universally agreed upon. Peter Mathias (*The First Industrial Nation: An Economic History of Britain, 1700-1914*. London: Methuen, 1983) does not split the Revolution into parts. Robert J. Gordon dates the First Revolution from 1760 to 1830, and the Second between 1860 and 1900; see "Does the 'new economy' measure up to the great inventions of the past?" *The Journal of Economic Perspectives, 14* (4), 2000: 49-74. Vaclav Smil (*Creating the Twentieth Century: Technical Innovations of 1867-1914 and Their Lasting Impact*, Oxford: Oxford University Press, 2005) stated clearly on the book jacket that "the greatest technical discontinuity in history took place between 1867 and 1914," what he called an "Age of Synergy" (25).

served the Empire in good stead for over four decades – were obsolete by 1868. The British public played a considerable role in this transformation, not just as passive consumers of technological news, but actively participating with their ideas or, in the case of several entrepreneurs, their money. Such engagement challenges Martin J. Weiner's choice of this era as a starting point for the decline in British industry and inventiveness.

Joel Mokyr has described the First Industrial Revolution as having "created a chemical industry without chemistry, an iron industry without metallurgy, and power machinery without thermodynamics" – in other words, without industry fully understanding the science behind the advances.[5] This was equally true of military technology, witnessed in the public guessing-game as to why the Lancaster gun burst. (See chapter 3) Although mathematics had long played a role in fortress design and trajectory calculation, much of the "science of artillery" remained based on received wisdom and tradition. The Industrial Revolution made new technologies available for the study of the action of guns when fired, for example, and the records of the OSC document the increased understanding of artillery that velocity- and pressure-measuring devices made available.

The OSC and its activities also illustrate the numerous and occasionally conflicting factors that could influence the weapons development process. The committee itself was not a static organization, and its makeup reflected the ongoing reorganization of the British military administrative system. The topics brought to the OSC's attention reflected new opportunities presented by industrial advances, but also more esoteric factors such as current affairs, overseas developments, and the desire for fame and fortune. And, while largely an apolitical organization, the subservience of the OSC to the Secretary of War meant that those

[5] Smil, 13.

with access to the latter could occasionally get their proposals before the Committee, whether the military was really interested in the project or not. This subservience to the authority of the War Office gave control of technology decisions to civilians, a control that many military authorities resented – and may have also laid the seeds for the OSC's later dissolution.

The records of the OSC also show that British ordnance authorities took an active interest in military developments around the world. The Committee gathered reports from British officers visiting abroad, tested equipment exchanged with foreign armies, and occasionally went so far as to purchase weapons to compare against those used by its own forces. Rifled ordnance, breech-loading small arms, and rudimentary machine guns were in use by most major powers, including Britain, by the close of the OSC's career. As a result of the OSC's investigations, the arms of the Empire in this era were equal to, if not better than what other nations had in their arsenals. What is also evident, however, is that in many cases the British were followers, not leaders, in arms innovation. Given the fast pace of change, events abroad continuously caught the nation with a stockpile of suddenly obsolete equipment. Although the country invariably caught up during this era, it is a pattern that would repeat itself over and over in the decades to come.

Finally, the trail of evidence left by the OSC makes painfully clear the dilatory effect that War Office micro-management had on British military improvements. Promising developments went underfunded or were terminated because of interference by Secretaries of State, while in the case of one famous program, the nation spent thousands of pounds for a spectacular failure due to such interference. Inventors had to absorb the costs of bringing their projects forward – not an unwise policy in an era plagued by cranks and charlatans, but one which certainly discouraged a few otherwise useful ideas. In the end, government parsimony also led to the dissolution of the OSC itself, a move that probably cost the nation more than it saved in the decade to follow.

The Evolution of the Ordnance Select Committee

As with any reorganization effort, the operations of the OSC in its first years of existence required some tinkering, beginning with the manner in which the OSC summarized its activities. In his 30 July 1855 approval of the OCS's rules of operation, then-Secretary of War Lord Panmure directed that "a register of all inventions…be kept, showing the date of their reference, the time consumed in their examination, how eventually disposed of, and the name of the inventor." He also requested quarterly, rather than annual reports, and asked the first report be "a resumé of [OSC] proceedings since the re-organization."[6] While that first report has been lost, a 16 February 1856 memorandum to Clerk of Ordnance Henry Monsell noted that Panmure viewed] with interest…the systematic prosecution of the important labours of the Committee," he found the report "far from satisfying the purposes for which it is required." "A mere diary of subjects considered," it did not "draw any distinction between trivial proposals dismissed at once, and those which have appeared to merit fuller consideration;" it also lacked any form of project classification or index.[7] Panmure either found the next reports for 1856 satisfactory, or failed to follow up on the matter; no further correspondence appears on the subject.

Panmure did, however, raise the question of greater dissemination of information regarding the Committee's activities. In a 6 June 1857 memo, Under-Secretary Sir J. Ramsden passed to the OSC Panmure's concern that newspaper reports of ongoing experiments could "lead to erroneous conclusions, and very false impressions" of the object

[6] TNA, SUPP 6/1, "Correspondence respecting the re-organisation of the Ordnance Select Committee," 15.
[7] "Correspondence," 20-21

being tested. Such reports, he felt, were "prejudicial to the public service" and tended "to create a spirit of partizanship for or against any particular invention or improvement" that might affect the impartiality of the OSC. Panmure made several suggestions, including "a system of publication…as will satisfy the natural desire of the public for information, and guide persons who are occupying themselves with improvements in Artillery." The OSC baulked at this, however. Such publication, Gen. Cator replied, would cause much controversy between the Committee and certain hopeful inventors, "many of whom would require to be taught the whole art of artillery before they could be convinced of the inutility of their projects."[8] Six years would pass before the OSC finally began publishing an official summary of changes recommended for adoption into the service.[9]

To help satisfy the War Office's demand for organized information and an effective summary of the Committee's activities, Gen. Cator ended his reply by stating the OSC "have lately commenced the preparation of a Synopsis of Reports and Experiments" to "give some information on each subject that has passed before them."[10] Beginning in 1857, then, the reporting of OSC activities became considerably more professional. Published in bound, printed format, the new *Abstracts of Proceedings* show not only the judgment of the OSC on every proposal, but also the progress of continuing experiments, indexed by inventor name and subject matter. With some variations, successors to the OSC continued this practice until 1897, an extraordinary compilation of the progress of British military technology during the

[8] "Correspondence," 26-27.

[9] Vol. 1, Part 1 of the first "Extracts from the Reports and Proceedings of the Ordnance Select Committee" (TNA, SUPP 6/11), covering the third quarter of 1862, appeared the following year. Publication continued through 1888.

[10] "Correspondence," 27. Gen. Cator noted that the "Synopsis" was to cover the first three years of the operations of the OSC, and that the full records on each subject would be supplied "to authorized persons desirous of consulting them." However, the summaries of 1855 and 1856, as well as the full records of the Committee from all years, are no longer available, presumably lost during World War 2.

nineteenth century.[11]

Panmure also recommended an expansion of the Committee's reports for subjects that required mathematical explanations. On 5 March 1857, the OSC asked a special subcommittee composed of Capt. Boxer and the two civilian associate members, Professors Wheatstone and Sylvester, to review a theory on the trajectory of shells proposed by Col. Philip Anstruther of the Madras Artillery. The sub-committee, after review, decided not to recommend any experiments to test the theory, "considering the scheme unsound in principle."[12] While the Secretary "accept[ed] with perfect confidence the conclusions" of Anstruther's theory as "unfounded and erroneous," Panmure thought it important that the OSC "should briefly show his fallacies by mathematical or physical reasoning" and asked for the sub-committee's report as well. In addition, he recommended that "when the subject is susceptible of it," such information be attached as appendices to the main OSC report on the proposal being examined. By doing so, "it would both strengthen the decisions of the [OSC]" through demonstrable logic rather than suspected bias against new theories by the military, "and place valuable information on record for the use of its junior members."

February of 1858 saw the finalization of the rules of operation of the OSC. As can be seen from Table 2, the preponderance of officers on the Committee came from the Royal Artillery, with the exceptions of one naval officer and one engineer. Its makeup, however, came under attack almost immediately from Sir John Burgoyne, the Inspector-General of Fortifications and primary advocate of the deliberate siege of Sevastopol. Burgoyne complained of the "inconvenience of referring all inventions and suggestions…to one

[11] By contrast, inventions presented to the Admiralty were recorded – by hand – only as part of the continuing business of the department. The compilation of statistics on such inventions will take considerable effort on the part of future researchers.

[12] Subj. 1270, TNA, SUPP 6/1: "Abstracts of Proceedings for the Ordnance Select Committee, 1858," 27 (hereafter abbreviated "Abstracts" plus the appropriate year).

Committee, composed chiefly of officers of…the Royal Artillery." Whether Burgoyne felt the OSC encroached on his own territory is unknown, but as a remedy he pitched having a separate committee "analogous to the [OSC]…for the sake of the instruction which will be afforded in the prosecution of experiments." Panmure agreed, and on 08 May 1857 divested the OSC of questions regarding the "improvement of the materials, processes, or engines" of fortress warfare, as well as troop housing, tools, and other articles used exclusively by the Royal Engineers.[13]

Table 2: Composition of the *ex officio* Ordnance Select Committee, Feb. 1858 [14]

Officer	Full-Time Position	OSC Membership
Maj. Gen. W. Cator, C.B., RA	Director-General of Artillery	President
Capt. J. C. Caffin, C.B., RN	Naval D.G.A	Vice-President
Col. F. M. Eardley-Wilmont, RA	Sup. Royal Gun Factories	Member
Capt. E. M. Boxer, RA	Sup. Royal Laboratory	Member
Col. A. T. Tulloh, RA	Sup. Royal Carriage Dept.	Member
Lt. Col. W. B. Gardner, RA	Sup. Royal Mil. Repository	Member
Col. J. Walpole, RE	Officer Commanding, RE	Member
Prof. Sylvester, F.R.S.	Prof. Math., RMA	Member
F. A. Abel, Esq., F.C.S., F.S.A	Chemist to War Dept.	Member
J. Anderson, Esq., F.S.A.	Inspector of Machinery	Member
Lt. Col. W. M. Dixon, RA	Sup. Royal Small Arms Fact.	Member
Col. W. H. Askwith, RA	Sup. Gov't Powder Works	Member
Col. J. W. Mitchell, RA	Sup. Shoeburyness	Member
Lt. Col. C. S. Henry, RHA	Sup. Riding House Establishment	Member*
Maj. C. H. Owen, RA	Inst. Practical Artillery, RMA	Member*
Lt. Col. P. J. Bainbrigge, RE	Prof. Fortifications, RMA	Member*
Prof. Wheatstone, F.R.S.[15]	Prof., King's College	Associate Member
C. H. Gregory, Esq., C. E.	Civil engineer	Associate Member
Col. W. H. Pickering, RA	(permanent OSC member)	Secretary
Lt. Col. F. A. Campbell, RA	(permanent OSC member)	Assistant Secretary

* Officers "especially selected for their mathematical and scientific attainments, from among those resident or holding appointments of instruction at Woolwich."

[13] "Correspondence," 43-44.
[14] "Correspondence," 29.
[15] Wheatstone, a professor of experimental philosophy at King's College, London, was the one of the primary developers of the electric telegraph, among many other inventions. See S. P. Thompson, "Wheatstone, Sir Charles (1802–1875)," rev. Brian Bowers, *ODNB*, Jan 2011, http://dx.doi.org/10.1093/ref:odnb/29184.

Presumably, this change removed one person from the lengthy roster of OSC members, although Panmure's memo did not explicitly state so. Regardless, the OSC still remained a collection of individuals whose occupations already demanded much of their attention. In addition, several of the superintendents of the Ordnance factories served as chairs of standing topic-specific sub-committees related to their departmental products. The time spent by OSC members on their full-time jobs and the burdens of duty on a Committee whose membership carried "no additional emolument" led to the OSC itself recommending a wholesale change. In May of 1859, therefore, the War Office authorized the dissolution of the *ex officio* Committee, and replaced it with "a small body of officers, who are to dedicate their time and attention exclusively" to questions of improvements in weaponry – and "salaried accordingly."[16]

The changeover to the smaller, professional Committee approved by then Secretary of War Maj. Gen. Jonathan Peel, who replaced Panmure earlier that year, pared the OSC down to six officers: two from the Royal Artillery, one each from the Royal Navy, Engineers, and an infantry regiment, plus the permanent Secretary. All of the standing sub-committees were eliminated, and their duties given to the revised OSC.[17] The reduction in committee members proved too drastic, however, and over the next several years the Committee's size crept back up to thirteen members by 1868. In addition, the 1859 change eliminated all civilian associate members from the OSC. On its face, the decision seemed a partial victory for Gen. Cator – the officer who entreated Newcastle to leave "Artillery questions to officers of Artillery" in

[16] "The Royal Ordnance Select Committee." *London Daily News*, 13 May 1859, 2.
[17] "Report from the Select Committee on Military Organization," 1860 (441), 69. The reorganization of the OSC included the dissolution of the special Royal Engineer committee. In 1862, a new sub-committee of RE officers "more conveniently placed than the [OSC] came together at Chatham to investigate pontoons for cross-river bridges. In 1866, its scope expanded to "consider questions of Military Engineering, on which…the S. of State for war should be specially informed," which effectively resurrected the committee of 1857. See Porter Vol. II, 204-207.

1855 – insofar as weapons decisions were to be left to military officers, and excluded technical experts from the civilian world. Civilian authorities continued to play critical roles in the evaluation of military technology, however. William Armstrong not only received a knighthood for his work on breech-loading cannon in 1859, but became Superintendent of the Royal Gun Factories as well. Frederick Abel, the Chemist to the War Department, also played a large role. A native of Woolwich, Abel had returned there in 1852 to become an instructor in chemistry to the Royal Military Academy. A talented individual with a published textbook already to his credit, Abel became the chemist to the Royal Arsenal in 1854, then to the War Department in January of 1856 as well as becoming a member of the original *ex officio* Committee. The post-1859 OSC frequently requested his opinion on subjects related to chemistry, and in 1865 complimented "his careful inquiries and his clear and practical report[s]" which helped in "furthering their view" on many subjects.[18] In 1867, the War Office approved Abel's reattachment to the OSC as Associate Member. In addition a non-commissioned officer, Quarter-Master H. Behenna, came on board in 1860 as "Acting Commissary of Stores," presumably to facilitate the acquisition of materials needed for experiments.[19] Behenna occupied this "temporary" position for at least eight years, and presented several proposals of his own before the OSC; he also made the very rare jump from the enlisted ranks into the officer corps as a result of his service and inventions.[20]

The Ordnance Select Committee in Operation

Regardless of its makeup, the OSC's process for evaluating a new invention remained consistent, and began when the Secretary's office forwarded a new proposal. It also sent to

[18] Subj. 2260, TNA, SUPP 6/7: Abstracts 1865, 615.
[19] TNA, SUPP 6/8: Abstracts 1868, Q1, xx.
[20] In 1872 Captain Behenna resubmitted a proposal he first suggested as a quartermaster in 1867. See Subj. 3240.B, TNA, SUPP 6/21: Abstracts 1872, 172.

the inventor (or his agent) a copy of the regulations regarding inventions and any request from the Committee for drawings, models, or other explanations on the workings of the proposal and its benefits to the service.[21] The OSC then scheduled the proposal to be reviewed at one of its weekly meetings. The proposer would be notified of the review date, and informed that he was "at liberty to attend…to give any explanation [he] may consider it necessary to afford."[22] OSC rules, however, forbade payment of any expenses related to "assisting the individual to bring forward his invention, unless expressly authorized." [23] Any request for advance funding, such as W. W. Hubbell's petition for £1,000 to travel from the U.S. to explain his inventions, practically guaranteed rejection of the proposal.[24]

More often than not, new proposals – like so many before 1855 – did not survive initial review. Some were simply impractical given the limitations of technology of the day, such as Mr. B. Byerley's 1859 proposal for "iron tungsten shot," hampered by "the metal in question [not being] manufactured at all upon a practical scale."[25] Others were dismissed as inferior to existing service items, such as H. K. Jackson's "patent vertical lever jack." While described by the OSC as "very ingenious," the jack offered "no advantages for military purposes over that now in service."[26] Others were dismissed because, in the view of the Committee, they simply could not be put into practice. The OSC judged, for example, that "no advantage would be gained" from William Fletcher's proposal to prevent the report and recoil of small arms, "even if it could be practically carried out (which appears very doubtful)."[27]

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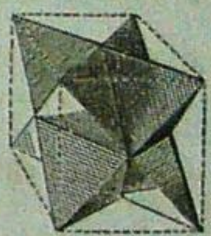
[21] "Correspondence," 30.
[22] "Correspondence," 33.
[23] "Correspondence," 32.
[24] Subj. 1607, TNA, SUPP 6/1: Abstracts 1859, 90.
[25] Subj. 1741, TNA, SUPP 6/1: Abstracts 1859, 223.
[26] Subj. 1323, TNA, SUPP 6/1: Abstracts 1857, 76.
[27] Subj. 1703, TNA, SUPP 6/1: Abstracts 1859, 101.

Report No. 3530. (14/11/64.)

Mr. Graves proposes a gun with a square bore, and a projectile which may be best described as a cube with a notch cut out of each edge, reducing it to the form of a solid, bounded by eight triangular planes, and on each plane a triangular point.



He seems to be under the impression that one point will always proceed foremost, and that such a form will be peculiarly favourable for battering purposes, but his letter is scarcely intelligible.

The Committee have only to report that a square bore is wholly inadmissible for guns, as there would be the utmost danger of their bursting at the angles. The form of shot, if it were possible to project it, would be among the worst possible for overcoming the resistance of air, and for penetration of any resisting medium, whether iron, masonry, or earth; and the whole proposal is based on complete ignorance of everything which should be known to gentlemen who pretend to make improvements in artillery.

Figure 13: J. W. Graves "projectile for penetrating iron plates," a rare illustrated report in the Abstracts.

Shielded from the inventor by the Secretary of State's office, the OSC had no qualms about identifying foolish projects for what they were. In reply to a continued effort by Col. Anstruther to promote his plan of calculating shell trajectories, for example, the OSC noted in 1862 that his theories "involve a contradiction of the simplest principles of mechanics, which have been admitted as axiomatic from the time of Galileo and Newton downwards, in all countries where mathematical evidence is cultivated."[28] J. Woodcock Graves' 1864 plan for a "projectile for penetrating iron plates" prompted the OSC to declare that "the whole proposal is based on complete ignorance of everything which should be known to gentlemen who pretend to make improvements in artillery."[29] Occasionally, however, their comments had to be more circumspect. General Sir J. G. Woodford insisted over several communications that the twist in the rifling of a barrel, a long-proven requirement to stabilize a projectile in flight to increase its accuracy, was a "needless complication." After rejecting

[28] Subj. 1270.2, TNA, SUPP 6/4: Abstracts 1862, 460.
[29] Subj. 2628, TNA, SUPP 6/6: Abstracts 1864, 735.

yet again one of his proposals, the OSC reported that they "feel seriously that their time is too valuable to be taken up by refuting views which if not held by a General Officer they should characterize as ignorant and absurd."[30]

Although removing the manufacturing department heads from the OSC trimmed its membership, and undoubtedly simplified the superintendents' lives, it did mean that the OSC had to formally request their input. In 1859, for example, the Committee passed a proposal for construction of small-arms ammunition to Capt. Boxer for comment. Boxer replied that he found the plan "quite unsuited to the making of a firm and serviceable cartridge," without explaining why. Recalling Panmure's 1857 directive, the OSC requested further clarification – but received the same reply from Boxer, who apparently did not like his professional opinion questioned. The Committee testily reminded the officer that "the directions of the Secretary of State for War... entitle them to receive more full and explicit information from the Head of a Department, than that afforded in this instance." Boxer finally sent a subordinate to visit OSC in person, who satisfactorily explained his rejection of the plan.[31]

In general, the OSC adhered to the recommendation of Arsenal superintendents, but this was not a hard-and-fast rule. Despite his request for an exorbitant amount of travel money, Hubbell's plan for an impact-detonating artillery fuze seemed promising, and the Committee passed it to Capt. Boxer for comment. Despite the latter stating that "in his opinion, no advantage would be derived from the arrangement proposed," the OSC requested the Royal Laboratory "prepare fifty fuzes for experiments, at a cost of 26*l*., 5*s*., 0*d*.," which the War Office sanctioned.[32] Unfortunately for Hubbell, the fuze did not perform well in

[30] Subj. 1368.4, TNA, SUPP 6/4: Abstracts 1862, 191.
[31] Subj. 1706, TNA, SUPP 6/1: Abstracts 1859, 219-220.
[32] Subj. 1607, TNA, SUPP 6/1: Abstracts 1859, 148-150.

testing, and the inventor never got the £1,000 travel money he hoped for.[33]

By and large, the OSC simply noted that "no encouragement" should be given to inventors of rejected proposals. On occasion, however, the Committee took more active steps. One gentleman presented a number of proposals before the OSC, until finally the Committee stated that all "appear to be equally ridiculous and impractical… [and] recommend that he should be discouraged from making any further communications on the subject of artillery and small arms, the elements of which he appears to be profoundly ignorant."[34] The OSC also complained that a particular Royal Artillery sergeant consumed too much of their time with "worthless proposals," and recommended "that a decided discouragement be to give to the ill-directed ingenuity of this Non-commissioned Officer."[35] In the case of several troublesome persons, the Secretary of War eventually declined to receive any further letters from them.

Rejected proposals were not always dismissed negatively. In 1859, a Sergeant Hunter submitted a recommendation for improvements in shrapnel shells; although his suggestion was not adopted, the OSC reported that the man deserved "much credit for having paid such attention to the subject."[36] Although it dismissed Colour-Sergeant G. Knapton's "instrument for measuring distances" without testing, the OSC recognized the "zeal and intelligence [displayed] in his endeavours" with a rare recommendation that he be allowed travel expenses which would "probably amount to 3*l*".[37] And, in the case of Sir W. Hamilton, the Committee congratulated him on submitting a proposal "with a clearness and completeness...highly creditable to him, and that they have perused and considered his

[33] Subj. 1607, TNA, SUPP 6/2: Abstracts 1860, 45-46, 290-292.
[34] Subj. 2740, TNA, SUPP 6/7: Abstracts 1865, 921-922.
[35] Subj. 2002.2, TNA, SUPP 6/4: Abstracts 1862, 410.
[36] Subj. 1503, TNA, SUPP 6/1: Abstracts 1858, 163.
[37] Subj. 1589, TNA, SUPP 6/1: Abstracts 1859, 88.

memoir with interest" (but, ultimately, decided not to adopt his suggestion).[38]

As illustrated by Hubbell's fuze, proposals the OSC thought worthy of trial then moved on to the experimentation phase. Private inventors would be requested to submit materials for testing, but at their own expense. Only if the proposal showed exceptional promise, or in the case of an in-house development, would the Committee request funding.[39] In such cases, OSC had to "state distinctly why that trial should be made at the public cost, and not at the risk of the inventor."[40] Department heads of the factories supplying materials would then be asked to provide cost estimates, which the Committee forwarded, along with the proposed experimental program, to the War Office – and which the latter audited with care. Such micro-management is evident throughout the records of the OSC. After reviewing an 1859 test of a new mortar carriage, for example, the Office noted a £57 difference between the costs of the ammunition required that it calculated, as opposed to the estimate of the OSC. Embarrassed, the Committee requested from the manufacturing departments revised price lists "of all articles manufactured by them for issue" so as to "prevent the recurrence of such discrepancies."[41]

Once approved by the War Office, the OSC then instituted and monitored the success of experiments, and reported the results back to the Secretary of War. Such experimentation contained no small degree of risk for the gun crews, and accidents did happen. A 7-inch gun designed by Mr. Lynall Thomas, for instances, "burst with great violence" during trials in 1863, shattering its breech and throwing the largest chunk 138 yards away.[42] No injuries

[38] Subj. 2160, TNA, SUPP 6/3: Abstracts 1861, 343.
[39] Subj. 1772, TNA, SUPP 6/2: Abstracts 1860, 76. In Hubbell's case, the small public outlay greatly offset the cost of his requested travel expenses.
[40] "Correspondence," 31.
[41] Subj. 1050, TNA, SUPP 6/1: Abstracts 1859, 12-13.
[42] Subj. 1916.2, TNA, SUPP 6/5: Abstracts 1863, 85.

were recorded, and the explosion seems not to have made the papers. One that did, however, was an 1868 incident involving Earl Spencer, a member of the Small Arms Committee (not the President of the OSC as reported). When test-firing a breech-loading infantry rifle submitted by "Mr. Wilson, of Birmingham," the *Royal Cornwall Gazette* reported, "the piece exploded, and several small fragments flew in his lordship's face." Spencer's injuries "were confined to a few cuts on both cheeks," but illustrate the risks that committee members themselves took when conducting experiments.[43]

If an invention or improvement proved itself in testing, the OSC would recommend adoption, and once approved, "seal the pattern" as a model to govern future manufacture. In general, the Secretary approved the Committee's recommendations, but such approval was not automatic. In 1857, Capt. Boxer proposed a new form of grape shot, which the OSC at first rejected as possessing no advantage over the service pattern, even though more accurate at longer ranges.[44] Undeterred, Boxer pointed out that his pattern better withstood careless handling, as might occur in the field, and which the Committee proved by dropping samples "from a height of about 15 feet, on to some rough stones." Boxer's pattern was undamaged, but the "service pattern…went to pieces."[45] After further tests, the OSC recommended adoption of Boxer's grape shot, but Sidney Herbert, the reigning Secretary of War, vetoed the adoption. "After a full consideration…on the comparative merits" of the Boxer's versus the service pattern shot, the War Office reported that Herbert was "unable to perceive that the new pattern (Boxer's) promises sufficient advantages to warrant the expense and inconvenience of a change."[46]

[43] "On Friday Afternoon…," *Royal Cornwall Gazette*, 01 October 1868, 3.
[44] Subj. 1298, TNA, SUPP 6/1: Abstracts 1857, 41 and TNA, SUPP 6/1: Abstracts 1858, 99.
[45] Subj. 1298, TNA, SUPP 6/1: Abstracts 1859, 20.
[46] Subj. 1298, TNA, SUPP 6/2: Abstracts 1860, 590-591.

Figure 14: Mallet's Monster Mortar, as it exists today in Woolwich, England. [47]

On the whole, the Secretary of War accepted the Ordnance Select Committee's opinion on the many proposals it considered, and there appear to be few cases of political pressure on the Committee to reconsider its decisions. Backing a failed proposal carried considerable risk, as demonstrated by the case of Robert Mallet's "monster mortar." Mallet, a civil engineer and Fellow of the Royal Society, first approached the Board of Ordnance in December of 1854 with a plan for an enormous 36-inch mortar made in sections for ease of transport. The OSC tabled his improved design in January, 1855, after which Mallet appealed directly to Lord Palmerston. Impressed with the potential, Palmerston took it upon himself, "as First Minister of the Crown, the full responsibility of carrying [the proposal] into

[47] "Top 10 Notable Large Artillery Pieces," *War History Online*, accessed 30 Dec 2014, http://www.warhistoryonline.com/wp-content/uploads/2013/04/Mallets-Mortar.jpg.

execution" and ordered the Board of Ordnance to arrange the construction of two mortars "without the slightest delay."[48]

Although the Board complied and had a signed tender by 7 May, design complications and the bankruptcy of the original contractor led to a two year delay. The completed mortars were not delivered until May of 1857, too late to assist in the war effort for which they were proposed. The OSC arranged for trials anyway, and "Palmerston's Mortar," as the newspapers referred to it, fired its first round on 19 October 1857. A crack in one of the external sections suspended practice after only seven rounds, and after costly repairs, the OSC resumed firing again on 18 December. After six rounds another component failed. The *Times*, in reporting the results, pointedly noted that Palmerston had, "without the previous sanction of the War Department and the Woolwich authorities," ordered the building of the mortar. "The latter," it continued, "are probably anxious to have it clearly understood that they have had no share in recommending the construction for so useless a piece of ordnance."[49] The OSC had the mortar repaired one more time in July of 1858, but a then third component failed. Although Mallet urged repairs, the Committee judged that no "practical advantage will accrue to the public service" by furthering the program.[50] In total, the gun cost £14,000 to build, with a further £675 spent for the nineteen shells it managed to fire, with little to show for the money but future museum displays.[51]

Despite the OSC's screening process, unusual proposals did make it to the testing ground, such as an "infernal machine" proposed by Spanish officer Col. M. Yturriaga. The OSC report described the machine as "an oblong iron box curved so as to fit to a man's waist

[48] David Moore and Geoffrey Salter, *Mallet's Great Mortars* (Fareham, UK: David Moore, 1996), 2.
[49] Moore, 4-9; "Mortars and Mortars." *The Times* (21 December 1857): 10.
[50] Subj. 1285, TNA, SUPP 6/1: Abstracts 1858, 99.
[51] Moore, 9. Both mortars built still survive, one at Ft. Nelson, the other outside Greenhill School in Woolwich.

[and consisting] of five compartments, each...having 12 chambers, arranged so that the operator is able to fire one compartment at a time." To demonstrate the machine, Colonel Yturriaga's son wore it around his waist and aimed at targets some yards distant. Although he intended to set off one chamber at a time, "at the word 'fire' 30 chambers accidentally went off, blowing away a part of the iron case, which took a backward direction, with considerable danger to the operators as well as the spectators…The Committee are of opinion that this machine is extremely dangerous, and do not recommend any further trial."[52]

The unfortunate experience of Col Yturriaga's son illustrates another aspect of the OSC's work. National borders did not limit the proposals considered, and demonstrate the growing importance of the international arms industry during this period. William Armstrong's Elswick Ordnance took a leading role in this trade, as it sought new markets for its famously effective wrought-iron muzzle-loaders after British government orders dried up in late 1862.[53] The American Civil War proved a boon to the English gun trade, but in turn brought American engineers, particularly small arms developers, into great prominence around the world. France successfully marketed the la Hitte system of rifled muzzle-loaders to Spain and Italy, and "it has been closely imitated by Austria, by Russia, by Holland, and…by Sweden and Denmark."[54] The Prussian firm of Krupp also began to make its mark in foreign sales, and tried repeatedly to get the English interested in his cast-steel guns, going to far as to offer to sell to the War Office the several models displayed at the 1862 London International Exhibition.[55]

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[52] Subj. 2337, TNA, SUPP 6/4: Abstract 1862. 439-440.
[53] Bastable, 100-101.
[54] "Rifled Ordnance in England and France." *Blackwood's Edinburgh magazine.* 119, no. 244 April 1864 (1864): 480-530, p. 496.
[55] The OSC already had some patterns of Krupp guns in trial, and the War Office declined the offer, as it considered "that the guns already supplied are sufficient to test both the material and the method of breech-loading advocated by Mr. Krupp." Subj. 1998, TNA, SUPP 6/4: Abstracts, 1862, 535-6.

This growing army of foreign inventors was eager to get their proposals before the OSC and hopefully into the English military market. They also seemed heedless of any issues about trading with a potential enemy – such as the German nationals perfectly willing to sell details of the supposedly secret Prussian breech-loading rifle. The OSC, in turn, showed no favor to British inventors over others, preferring simply that a product prove superior to competing designs and could be licensed for manufacture by the Royal Arsenal at a reasonable rate.[56] In addition, the OSC kept a close eye on foreign military technology, through news articles, visiting-officer reports, or exchange of recently adopted weapons systems with other nations. The *Northern Whig* and several other newspapers reported in 1858, for example, that a howitzer gifted by Napoleon III to the Queen had been forwarded to Woolwich, "where the gun is now being much admired."[57] The Committee even went so far as to recommend the purchase an American 15-inch Rodman smooth-bore in 1866 for comparison against Britain's own heavy guns. This very rare suggestion came with the proviso that the Ordnance Department's budget for the year "will cover the expenses of the proposed experiments" (which, fortunately, it did).[58]

Financing a Military Revolution on a Shoestring

The budgetary concern regarding the purchase of the Rodman gun is but one example of many that demonstrates the fiscal tension between the military and Parliament; the

[56] The compilations of statistics for foreign inventions are made difficult by inaccuracies within the *Abstracts*, as nationalities were not always identified. Of the over 5,000 inventors shown in the indices, only 284 are clearly noted or known to the author as from outside of England (such as Jacob Snider, whose American nationality is not listed in his first appearance in the *Abstracts*).

[57] "Major Melchoir," *Northern Whig*, 20 November 1858, 3. Melchoir was one of a party of three that accompanied the "beautiful brass gun" to England. Unfortunately for a French sergeant-major, also one of the presentation party, broke his leg while unloading an ammunition box for the piece. Her Majesty "gave orders that every necessary attention be paid" to the soldier, and "expressed a desire" to see him before he returned to France. See "The Emperor of the French's Present to Her Majesty," *Leeds Intelligencer*, 20 November 1858, 6.

[58] Subj. 2020.2, TNA, SUPP 6/8: Abstracts 1866, 604.

question of who should bear the costs of invention development is another. Unlike in France, where all experiments were conducted at the public expense, private inventors in England were expected to bear the cost of any trials made.[59] Such a restriction meant a person attempting to bring a proposal forward could find himself "unexpectedly thwarted and embarrassed by heavy expenses," complained Thomas Cattell in an 1855 letter to the *London Daily News*. "I ask, sir, is it fair that one member of the community should suffer in his endeavours to benefit the whole?" he continued. "Is it right that any discovery embracing the general good should fail of successful development, owing to a circumstance which is altogether an accident of the social economy?"[60]

Lord Panmure, the Secretary of State for War, answered Cattell's question with an emphatic "yes," as illustrated by a 20 February 1857 memo regarding experimental programs. In mid-January of that year, the OSC had recommended the construction of a portable furnace for heating shot, proposed by a Major Vandeleur of the Royal Artillery and to be built at the Royal Gun Factory at an estimated cost of £10. Panmure refused to authorize the expense on two grounds. First, he strongly objected to the "use of the public factories for experimental purposes not directly connected with the objects for which they are maintained," preferring instead that experimental items be procured by contract. Second, he reminded the Committee that "before recommending the trial of any invention, either of a Military Officer or of a civilian, the [OSC] should state distinctly why that trial is to be made at the public cost, and not at the risk of the inventor."[61] The War Office reinforced its stance

[59] Subj. 2168, TNA, SUPP 6/3: Abstracts 1861, 324.
[60] "The Official Boards of the State: Ordnance Select Committee and Inventors." *London Daily News*, 14 July 1855, 4.
[61] "Correspondence," 23-24. Ironically, Panmure felt that "facility should be given to an inventor who has already been the means of introducing a valuable invention in the public service," and approved, without the OSC's prior recommendation, a £37 advance to a Captain Addison, also for a shot furnace. The OSC rejected Addison's more expensive design after testing, whereas Vandeleur's cheaper one proved efficient

against the public funding of experiments in a further memo, dated 8 January 1858. In it, Under-Secretary Sir Benjamin Hawes stated that "the War Office cannot charge itself with any expense which may be incurred, either for travelling or any other purpose, with a view of assisting the individual to bring forward his invention, unless expressly authorized."[62]

Parliament kept such a close eye on War Office finances that it is difficult to determine how much was spent for weapons development in the first several years of the OSC's existence. In the estimates prior to 1863-1864, the budget for the Committee explicitly stated fixed costs only, such as officer and clerk salaries. Except for 1858, when £2,000 was set aside for "Contingent Charges incidental upon Experiments conducted by the Select and Small Arms Committees," the OSC had no allotment of monies under its control for weapons testing.[63] Rewards to inventors, such as the £5,000 granted to Boxer for his wartime exhortations, were carefully tucked into the 1857 vote under the line item for the United Service Institution, to give the appearance of the grants as coming from that organization.[64] Palmerston's Liberal government made the question of weapons development costs much more transparent with an 1863 restructuring of the estimates. Categories for "effective services," which formed thirteen votes on the amalgamation of the army and ordnance estimates in 1855, were reorganized into eighteen categories, to include Vote 17 for "Miscellaneous Services." The budget of the OSC formed a great part of that vote, which vote now included estimates for "experimental services," which consisted of the "purchase of

enough to be recommended for further experiments. See Subj. 214, TNA, SUPP 6/1: Abstracts 1857, 50-51, and Subj. 1225, TNA, SUPP 6/1: Abstracts 1858, 12-13.

62 "Correspondence," 32.

63 HCPP, "Revised Army Estimates of Effective and Non-Effective Services, for 1858-59," 1857 (206), 114

64 HCPP, "Army Estimates of Effective and Non-Effective Services, for 1857-58," 1857 (33), 114. The United Service Institute (now the Royal United Services Institute for Defence and Security Studies, or RUSI) was founded in 1831 by a group of distinguished army and naval officers, including the Duke of Wellington, and it remains the world's oldest think tank dedicated to military studies. See Damian P. O'Connor, *Between Peace and War: British Defence and the Royal United Services Institute 1831-2010* (London: Royal United Services Institute for Defence Studies, 2011).

Stores for Experimental purposes generally, and for incidental Expenses connected with Experiments" as well as rewards to inventors.[65] Estimates for 1862-63 were £31,220; for the OSC's final year, they had risen to £69,472.[66]

On the whole, the Victorian government preferred to spend as little as possible on military equipment, and there are numerous instances in the *Abstracts* where projects were put on hold for lack of money. The conversion of Navy cap-and-ball revolvers to breech-loaders in 1868 forms one such example. The OSC found the converted revolvers to be "superior…in accuracy, rapidity of fire, facility in working, and penetration" than the unconverted, and recommended the 7,000 pistols in Naval stores be altered. Sir John Pakington, then Secretary of State for War, approved of the recommendation, but not the timing, stating that "there are no funds available this year for carrying out this conversion." When presented with a cost estimate of £7,700 plus replacement ammunition, Pakington refused to make a special request to Parliament "for so large a sum as the conversion of these pistols would involve."[67] Considering the £25,500,000 actually voted for the military that year, the needed funds represented a mere fraction – but also represented a political fight that Pakington wanted to avoid.[68] Not until the Director of Stores pointed out that there had been "a saving of £5,000 on the vote for the conversion of the 1853 pattern rifles" did the Secretary authorize a limited alteration of 700 firearms.[69]

Despite the reality of a tight-fisted government, many inventors thought the War Department a source of considerable potential wealth, regardless of its warning that "no

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[65] HCPP, "Army Estimates of Effective and Non-Effective Services, for 1863-64," 1863 (40), 64.
[66] HCPP 1863 (40), 64; HCPP, "Army Estimates of Effective and Non-Effective Services, for 1868-69," 1868 (47), 77-78.
[67] Subj. 2170.2, TNA, SUPP 6/10: Abstracts 1868, 670-671.
[68] The votes for that year included £14,388,479 for army and ordnance, and a gross £11,177,290 for the Royal Navy. See HCPP 1867 (74), and HCPP 1868 (47).
[69] Subj. 2170.2, TNA, SUPP 6/10: Abstracts 1868, 883.

expectation of reward can be held out" except for inventions actually adopted. Even then, "the amount of reward…must be left to the decision of the Secretary of State for War."[70] The British military represented a huge market for products ranging from horseshoe nails to cannon. Many proposals – particularly from holders of patents – came with a stated price tag, often in the thousands of pounds. One plan for turning muzzle-loading rifles into breech-loaders carried a £1,000,000 cost for "assignment of the invention or patent to the Secretary of State." The OSC, however, found "the terms named...as absurd as [the] proposal."[71] Others approached the War Department with claims for reward based on previous proposals they saw being put into practice by Government. While dismissing most claims, occasionally the OSC did recommend rewards, but could be very stingy in doing so. When John Kellow, an employee of the Royal Carriage Department, pressed a claim for "small expenses necessarily incurred in the construction of models, &c." for two proposals adopted into service, the OSC recommended a paltry £20 as "a gratuity," on the grounds that "a higher motive than the hope of…reward should induce" every employee "to bring forward improvements that suggest themselves to him."[72]

Any reward – or even reimbursement for expenses – recommended by the OSC still had to be approved by the Secretary of War. More often than not, the latter denied or modified the payment, as in the case of Lt. Bolton and his patent "rifle stopper and sight protector" for the Pattern 1853 Enfield rifle. Sanctioned for adoption into the service in 1864, the conversion of Enfield muzzle-loaders into breech-loaders in 1865 made the stopper obsolete nearly overnight. Bolton appealed to the OSC in 1867 for some degree of financial relief, in light of his "having expended a large sum of money in machinery, in making

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[70] "Correspondence," 32.
[71] Subj. 2660, TNA, SUPP 6/7: Abstracts 1865, 226.
[72] Subj. 1616/1846, TNA, SUPP 6/4: Abstracts 1862, 356.

experiments, and in taking out patents" over the course of five years. The OSC recommended the payment of his expenses, less that for "taking out patent, and the value of old machinery and material at hand…and that he receive such further gratuity as the Secretary of State may see fit to award." The War Department, claiming that his invention had "not been sufficiently tested" and that no provision had been made for such in the year's budget, not only declined to make an award, but authorized only half the amount of expenses recommended.[73]

Bolton's case also shines light on the complicated dealings of the OSC with patents and patentees. Although Bolton's stopper combined some characteristics of other such devices, he possessed a viable patent on it. In ruling on his appeal for financial aid, the OSC stated that "the question now for consideration appears…to be the extent to which the government have involved themselves in patent rights" and recommended that Bolton should be dealt with "liberally."[74] In other cases the OSC took a harder stance, so as to stay out of patent disputes. In 1861, Capt. Boxer suggested that skin cartridges for revolvers could be made without infringing on a patent held by a Captain Hayes. The OSC ruled, however, that "although the validity of Captain Hayes' patent is questionable...it is not considered advisable to render the War Department liable to legal proceedings by adopting a cartridge so nearly resembling that of Captain Hayes".[75] The OSC also wrestled with increasingly difficult priority-of-invention issues unresolved by the patent laws of the time. Numerous inventors came forward claiming infringement of their ideas, and the OSC delved (sometimes deeply) into its own archives investigating such issues. Despite the institutionalized desire for a military at the least possible cost, the OSC did occasionally – and sometimes generously, in the case of William Greener – find in favor of the aggrieved inventor or his estate.

[73] Subj. 2220.2, TNA, SUPP 6/9: Abstracts 1867, 382, 980.
[74] Subj. 2220.2, TNA, SUPP 6/9: Abstracts 1867, 382, 980.
[75] Subj. 2170, TNA, SUPP 6/2: Abstracts 1861, 531, and TNA, SUPP 6/4: Abstracts 1862, 137.

The Rise and Fall of Armstrong's Rifled Breech-Loading Cannon

The *Times* December article that bemoaned the failure of the Mallet mortar also raised alarm about the general state of British artillery. "The [Crimean] war clearly enough demonstrated that the British army has not, as it ought to have, any conspicuous or decisive superiority over those of other countries in the artillery arm," the paper charged. At the time of the article, the Royal Artillery and Navy were still armed, as were many other European militaries, with cast-iron or bronze smooth-bore cannon, a situation that the Times felt clearly uncomfortable with. "Do our unrivalled mechanical resources offer us no escape from a position which the backward state of artillery science throughout Europe only renders the more humiliating?" it asked.[76] Gun-maker William Greener also lamented that "all great improvements in Gunnery in England have been forced upon the authorities by absolute necessity." "By the time our officials have discovered the best cast-iron for heavy guns," Greener continued, "French batteries on sea and land will be bristling with RIFLED STEEL CANNON of tremendous range and endless endurance. Woe betide this country if at the commencement of a war we should find ourselves just where we are."[77]

Greener's charge bore more than a little truth. With the apparent failure of British guns before Sevastopol, one of the most pressing questions for the British military should have been the future direction of artillery. Post-Crimea retrenchment and preoccupation with events in India, however, left the question simmering on the back burner until Gen. Jonathan Peel took over as Secretary of State for War in 1858, the only military officer to hold that post. For him and others, salvation seemed to lie with William Armstrong's rifled breech-loading cannon. Constructed of concentric "hoops" or "coils" of metal, built up around a

[76] "Mortars and Mortars." *The Times* (21 December 1857): 10.
[77] William Greener, *Gunnery in 1858: Being a Treatise on Rifles, Cannon, and Sporting Arms* (London: Smith, Elder and Co., 1858), iv-v.

central tube, the Armstrong gun and the shell designed for it seemed to be the total package. The construction of the gun lowered its comparative weight to a quarter of service pieces of similar bore size, decreasing the number of gunners required to handle the weapon. Rifling made it phenomenally accurate compared to smooth-bore guns, and loading from the breech gave the Armstrong cannon a much higher rate of fire.[78] The multi-purpose "segment shell," fitted with percussion fuze, could act as solid shot, shell, or canister as needed. Declared by Lord Panmure to be "a most valuable contribution to our Army," in November of 1858 a special committee recommended the "immediate introduction of guns tried on Mr. Armstrong's principle, for special service in the field." [79] In return for assigning his patents to the War Office, Armstrong received an appointment as "Engineer to the War Department for Rifled Ordnance" along with a £2,000 annual salary, and public capital to finance the privately-held Elswick Ordnance Company, which would produce his guns until Woolwich could manufacture them as well. To assist in that effort, Armstrong later took over as Superintendent of the Royal Gun Factory (formerly the Royal Brass Foundry) while it geared up to for its new mission of the manufacture of iron ordnance in addition to bronze guns.[80]

Then, in 1859, France deployed new rifled cannon against the Austrians with devastating effect. Developed in great secrecy by the French *Comité d'Artillerie* (its equivalent of the OSC) and named after that body's President, the new "la Hitte" system used studded shells that matched up with the rifling in the bore of steel guns. While still a muzzle-loader, the new gun could be fired without the necessity of sponging between rounds, greatly shortening its reload time. French government ordnance factories produced enough of the

[78] "The Armstrong Gun." *The Times* (28 February 1859): 12.
[79] TNA, WO 33/9, "History of Sir W. G. Armstrong's Introduction of his Gun, with Reports of Experiments, &c.," 1.
[80] TNA, WO 33/9, 3-5.

new la Hitte guns to equip all of its field batteries deployed to Italy, including a few large 30-pounders. At the Battle of Solferino on 24 June, the guns proved their great worth; “the extraordinary rapidity of the fire [of the French guns]…arrested the Austrian advance at a range which then appeared incredibly great,” the *Edingburgh Review* later reported.[81] Nearly overnight, the question of guns for the British army suddenly became of prime importance. As British army historian J. H. Stocqueler later wrote, “a perfect panic was aroused in England by the manifestation of the new power which her ancient foe had acquired.”[82]

The next several years saw a frenzy of activity by the Ordnance Select Committee related to “Subject No. 1671:” the perfection and fielding of the Armstrong gun. Any piece of artillery requires a host of supporting material to make it a successful weapons system, and this was no less true for nineteenth-century ordnance than it is today. Depending on the size of the gun – and the 1859 recommendation suggested thirteen different calibers – the OSC had to seal patterns of carriages, ammunition, loading and cleaning equipment, and so forth, as well as the guns themselves.[83] Three hundred and forty different proposals, requests, and questions from a variety of persons required consideration and judgment by the OSC over the course of the Armstrong breech-loader program.[84] While the majority came from Armstrong himself, superintendents of the Arsenal factories dealt with or made suggestions regarding changes to materials provided by their departments, as did officers involved with testing the

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[81] Frederick C. Schneid, *The Second War of Italian Unification 1859-61* (Oxford, UK: Osprey Publishing, 2012), 26; Jennings C. Wise, *The Long Arm of Lee: The History of the Artillery of the Army of Northern Virginia* (New York: Oxford University Press, 1959), 30; “Rifled Ordnance in England and France.” *Blackwood's Edinburgh magazine.* Vol. 119, no. 244 April (1864): 480-530, pp. 491-499.

[82] J. H. Stocqueler, *A Familiar History of the British Army, from the Earliest Restoration in 1660 to the Present Time* (London: E. Stanford, 1871), 287.

[83] TNA, WO 33/9, 33.

[84] This figure comes from a survey of the *Abstracts* over the career of the OSC, and is based on a count of not only the sub-project numbers, but the combination of “inventor” name and the description of a “major” component or proposal under consideration (see Appendix 1 for details regarding the study). An exhaustive compilation of questions related to every component involved in the project would probably put the number much higher, but such a compilation remains a future effort.

new weapons.[85] The War Office, the Admiralty, and Horse Guards also initiated discussion over many components of the program. Sir Armstrong rightly deserves credit for this ingenious piece of ordnance, but it took the efforts of many individuals to bring it to perfection.

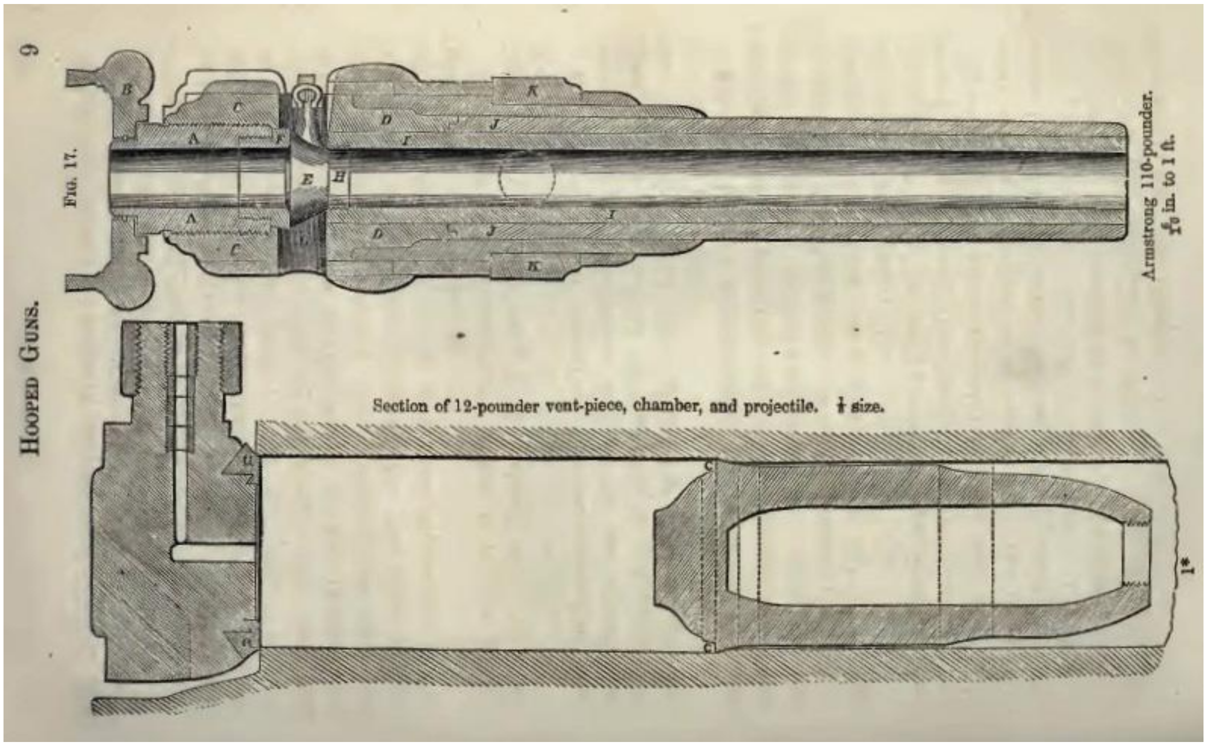

Figure 15: The Armstrong breech-loader. To load, the crew unscrewed the breech block via the balled handles, "B" in the upper drawing, then withdrew the vent-piece "E." The removeable vent-piece proved very problematic in the larger guns demanded by the Royal Navy.[86]

As field artillery, the Armstrong seemed without equal. Used with great effect during the 1860 expedition in China, the Duke of Cambridge believed the proof of its power "even

[85] Because of the method of transcription of the minutes of the OSC, it is difficult to know for certain how many proposals came directly from Armstrong, or from him as representative of Elswick Ordnance or the Royal Gun Foundry; the same holds true for superintendents of the manufacturing departments, who may have been passing forward ideas from subordinates. In at least one case, however, that of a fuze designed by Mr. W. Pettman, Boxer was careful to forward the design and clearly indicated it had been invented by Pettman, "a leading foreman of " the Royal Laboratory. See Subj. 1968, TNA, SUPP 6/2: Abstracts 1860, 214.

[86] Holley, 9.

more important than the whole expedition."[87] By 1864, then Secretary of State for War Spencer Cavendish (Lord Hartington), reported to the House of Commons that "the whole of [the British] field batteries [were] armed with the Armstrong gun," which were "now almost universally approved and liked by the troops who possessed them….they were a most excellent gun, and very far superior to those they had supplanted."[88] The *Times*, in reporting Hartington's comments, added that "our field artillery is as well armed and provided as we could wish it to be, nor do we know of any foreign models superior to our own."[89]

As a naval gun, however, Armstrong's invention fell short. The war scare with France in 1859 had been triggered not only by the performance of its artillery against Austria but also by the construction of *La Glorie*, France's first ironclad line-of-battle ship. Faced with its imminent launch, the Board of Admiralty requested "in the strongest manner" that the War Office "supply them with as little delay as possible with a large number" of heavier Armstrong guns.[90] By October, Armstrong had scaled his design up to produce a 7-inch, 110-pdr gun, although he personally had doubts about the ability of the breech mechanism to withstand the pressures produced by a large charge of gunpowder.[91] Rushed into production before the design could be properly tested, the gun experienced numerous failures during the short 1862 action against Japan.[92] In addition, tests by the Board of Admiralty showed the striking power of the 7-inch shot to be less than that of the 68-pdr smooth-bore. In an era when naval tactics still dictated fighting at close quarters, the Admiralty determined the 110-pdr Armstrong insufficient to serve as a broadside gun. Although the Armstrong shell may

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[87] Bastable, *Arms and the State*, 93.
[88] "Supply - Army Estimates." cc 1430-31: HC Deb 03 March 1864, Vol. 173; *Hansard's Parliamentary Debates*.
[89] "If the Question of the Guns Has yet to Be Solved." *The Times* (05 March 1864): 11.
[90] Bastable, *Arms and the State*, 59. *La Glorie*, the first of her class, was launched on 24 November 1859; see Baxter, 109.
[91] HCPP 1863 (487), v; Bastable, *Arms and the State*, 96.
[92] Bastable, *Arms and the State*, 95-96.

have been destructive against wooden ships, "the old 68-pounder," they determined, remained "the most effective gun in the service against iron plates."[93]

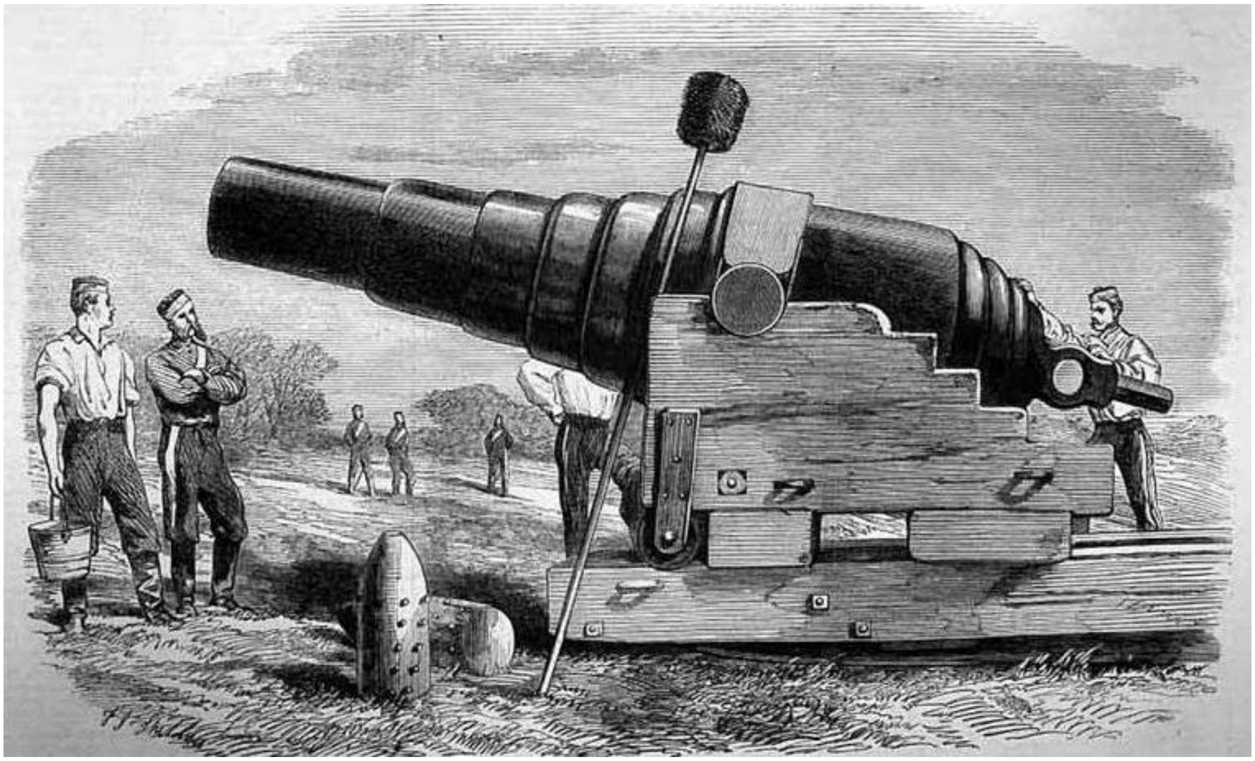

Figure 16: The Armstrong 600-pounder rifled muzzle-loader, showing the "built-up" construction of successive coils of metal shrunk around each other. Note the "la Hitte" style studs on the projectile, which engaged the rifling in the bore and required careful loading.[94]

With the increasing amount of armor being added to both ships and coastal forts, however, Armstrong knew that a gun heavier than the 110-pdr would be needed.[95] In 1860, Armstrong started developing rifled muzzle-loaders using his built-up method in ever increasing sizes, and by 1863 had constructed a massive 22-ton, 13½-inch gun that could

[93] HCPP, 1863 (487), v.

[94] Source: "Historical Firearms," 16 Feb 2013, http://historicalfirearms.tumblr.com/post/43264118681/ordnance-of-the-week-the-armstrong-gun-in.

[95] Capt. Cowper Coles, RN, whose iron cupola demonstrated the superiority of the 68-pdr, noted in an 1861 pamphlet that the Spithead Forts, built to protect the entrance to Portsmouth Harbour, "were devised hardly a year since to be of granite, are now to be built of 10-inch iron." See Cowper Phipps Y. A. Coles, *Spithead Forts: Reply to the Royal Commissioners' Second Report on Our National Defences* (London: Mitchell's Military Library, 1861), 9, and 1863 (487), vii.

throw a 600lb shell to a distance of over four miles.[96] Wrought-iron guns were costly, however, so when Captain (later Sir) William Palliser of the 18th Hussars passed to the War Office a plan for lining the bore of the existing stock of cast-iron guns with a wrought-iron reinforcement tube, the young captain found a willing audience. At first a plan simply for strengthening the older weapons, Palliser soon realized this could also turn them into rifled guns. Although it took some years to perfect, by 1868 the OSC recommended the conversion of "our present cast-iron smooth-bored guns into rifled guns….for secondary purposes of defence."[97] Such a plan greatly appealed to those who sought to solve the problem of rearming the British military with heavy rifled cannon at the lowest possible cost.

The battle over the future of British artillery was exacerbated by the battle between Armstrong and his major competitor, Joseph Whitworth. A mechanical engineer of considerable renown, Whitworth had been a member of the special commission dispatched to the United States in 1853 to report on that country's small-arms industry, and whose report led to the outfitting of the fledgling Royal Small Arms Factory with American machinery (see Chapter One). Aided by a government-sponsored shooting range constructed near his home, Whitworth undertook numerous experiments to determine the best size bore and shape of rifling for small arms, and in 1857 Whitworth put his 0.450," hexagonally-bored rifle against the Pattern 1853 Enfield in public trials, which "established the superiority of my weapon."[98] Scaled up, Whitworth went head-to-head against Armstrong and his system of rifling for muzzle-loading artillery, which used la Hitte-style studded projectiles matched to deep grooves in the barrel wall. Tests supervised by the OSC over the next several years

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[96] Bastable, *Arms and the State,* 72-80.

[97] TNA, WO 33/21A, "History of the Palliser System of Converting Cast-Iron Smooth-Bored Guns into Rifled Muzzle-Loading Guns," 6-26.

[98] Joseph Whitworth, *Miscellaneous Papers on Mechanical Subjects. Guns and Steel* (London: Longmans, Green, Reader, & Dyer, 1873), ii.

pitted both Whitworth and Armstrong systems against each other. As the guns fired their respective shells against ever-thickening armor at ever-longer ranges, partisans for both sides argued their cases in the papers and occasionally levelled charges of malfeasance against each other.[99]

To settle the increasingly acrimonious debate, in 1863 the War Office appointed – over the protestations of the OSC – a special committee to investigate not only the merits of the Armstrong and Whitworth systems, but the general question of breech- vs. muzzle-loading artillery.[100] For three years the special committee gathered evidence, not only of the performance of the guns in testing, but of the Armstrong breech-loader's performance in the field. The results showed what many opponents to the Armstrong gun argued: that the simpler rifled muzzle-loaders outranged, outshot, and were easier to work than the breech-loader, although the latter did have an advantage in rate of fire. In addition, the Armstrong breech-loader had more accidents, wore out more quickly, and cost more to manufacture.[101] A second committee, appointed in 1866 and headed by the reactionary chief of the Royal Horse Artillery, Gen. Sir Richard Dacres, declared that "the balance of advantages is in favour of M.L. field guns, and that they should be manufactured hereafter."[102] The decision to return to muzzle-loading ordnance put Britain back on par with most of its potential rivals. Only Prussia – then not a threat to British naval power – elected to continue development of breech-loading guns, due to the close relationship between its military and the Krupp steel

[99] Bastable, *Arms and the State*, 76-80.

[100] The OSC inferred from the WO decision "that they are considered unfit to be intrusted with the proposed inquiry," which "appears calculated to impair very seriously the authority which should attach to their professional advice and opinion" (Subj. 1991F, TNA, SUPP 6/5: Abstracts 1863, 109). The WO had no response.

[101] HCPP, "Report of the Special Armstrong and Whitworth Committee. Vol. I. Report." 1866 (3605), iii-xliv.

[102] *Minutes of Proceedings of the Royal Artillery Institution*. Vol. VI (Woolwich, England: Royal Artillery Institution, 1870), 105. Dacres not only disliked breech-loaders, but had previously testified in favor of the "beneficial inaccuracies" of smooth-bores, as unpredictably useful on the field of battle. See J. B. A. Bailey, *Field Artillery and Firepower* (Annapolis, Md.: Naval Institute Press, 2004), 189.

company that armed that nation's ordnance.[103]

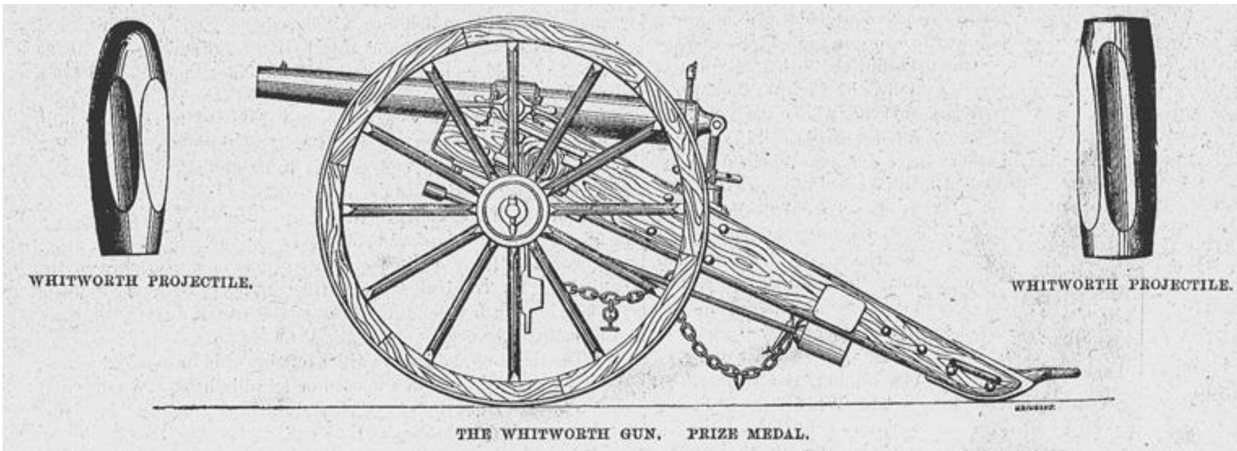

Figure 17: The Whitworth rifled gun and projectile, gold medal winner at the London International Exhibition, 1862.[104]

Despite such a decision, Armstrong breech-loaders remained in service for a number of years, and were not immediately withdrawn as has been claimed.[105] While the special committees deliberated, the OSC supervised numerous experiments designed to improve both the guns and their ammunition, and closely monitored quarterly reports regarding naval practice with the guns. By 1866, the Committee reported that "the absence of complaint from so many vessels [was] evidence that with the improvements that have been introduced…since the Armstrong guns were first issued to the navy, the equipment generally

[103] The Krupp firm began working on breech-loading ordnance in 1859; convinced of its design's superiority over that of the Armstrong gun, Alfred Krupp attempted to bring his gun before the OSC in 1860 with the condition that he be granted a "secret patent" to protect it, something not possible under English patent law. See Subj. 1998, TNA, SUPP 6/2: Abstracts 1860, 240, and Harold James, *Krupp: A History of the Legendary German Firm* (Princeton, NJ: Princeton University Press, 2012), 54-59.

[104] "Part 2: Industrial Technology Development – Seen from Exhibits: Arms (Cannon and Gun," *Expositions*, accessed 30 Dec 2014, http://www.ndl.go.jp/exposition/e/s2/10.html.

[105] "Breechloading Heavy Guns." *The Times* (16 January 1871): 4. Bastable (99) claimed that Armstrong breech-loaders were withdrawn in 1865, but as late as Nov. 1868 the *Pall Mall Gazette* complained that "the most convenient and economical manner" of changing back to muzzle-loading guns "would be not to carry them into effect at all" ("Field Guns at Home and Abroad." *Pall Mall Gazette*, 25 November 1868, 2-3), and the returns for 1868 on serviceable rifled guns show no muzzle-loaders for field artillery in use (HCPP, "Rifled Guns. Returns of the Present Number of Serviceable Rifled Guns and Carriages &C." 1868 (415), 3).

is satisfactory."[106] The next year, the Superintendent of the Royal Gun Factories suggested dispensing with such quarterly reports, as accidents "are now extremely rare, and when one does happen, there is almost invariably a *special* report of the circumstance," to which the OSC agreed.[107]

The success of the Armstrong rifled breech-loader required the inventiveness of Sir William Armstrong for its birth, the efforts of the Ordnance Select Committee to live through a difficult infancy, and public support to survive beyond that point. Through a number of technical issues and reactionary opinions, the gun lost – or never had – the backing of some powerful military authorities. An 1863 investigation into the costs of the Armstrong gun had alarmed Parliament; when coupled with the quick-fix offered by the Palliser converted gun, this frayed what political support the Armstrong breech-loader had.[108] Finally, the very public battle between Armstrong and Whitworth polarized debate over the two systems and sharpened the awareness of the failures – real or illusory – of the breech-loader when compared to muzzle-loading ordnance. Britain made the fateful decision to give up perfecting a gun which offered considerable advantage over foreign designs (Krupp being the exception), a decision not rescinded for well over a decade.

Hale's "Stickless Rocket"

Another type of ordnance that saw considerable change during the OSC's existence was the British war rocket. William Congreve, son of Maj. Gen. William Congreve (Controller of the Royal Laboratory), used captured Indian rockets as a pattern for a

[106] Subj. 1671, TNA, SUPP 6/8: Abstracts 1866, 44.
[107] Subj. 1671, TNA, SUPP 6/9: Abstracts 1867, 896. The Committee did ask that the reports for the last quarter "be transmitted to complete the year."
[108] For details regarding the Parliamentary investigation of costs, see HCPP 1863 (487).

redeveloped weapon he brought before the Board of Ordnance in 1805.[109] His first design used a 25-foot-long wood "guide stick" for balance and stability, mounted on the side of the rocket. Although used to set fire to Copenhagen in 1807 and in the famous bombardment of Fort McHenry at Baltimore in 1814, the notoriously-inaccurate rocket left much to be desired. [110] Originally fired from a tray resembling a ladder, launching early rockets must have been harrowing to the crew exposed to their exhaust.[111] Over time Congreve continued to refine the weapon, shortening the guide stick by ten feet and mounting it centrally along the rocket's axis to improve reliability and accuracy. He modified the launcher as well, changing to a tube very much resembling many modern-day military rockets. The tube offered better accuracy, and marginally better crew protection, than the earlier launch tray.

By the Crimean War, Congreve's weapon had a challenger: the stickless rocket designed by William Hale. Born in Essex, England in 1797, Hale had a long interest in mechanics. He received his first patent, for "improvements in propelling vessels" using an internal screw at the age of thirty. In 1832, he presented a paper on the invention to the Royal Society in London, later winning a gold medal from the Royal Society of Arts in Paris. Afterward, he submitted the invention for consideration to the Admiralty, but "by his own admission… lost interest in the project" and moved on to investigate "ordnance matters."[112] Hale relocated near Woolwich and began experimenting with improvements to Congreve's rockets. In September of 1843 he had made sufficient progress to put a new design before the Select Committee. Interested, the Committee approved trials at Hale's expense, setting a

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[109] Hogg Vol. 1, 518
[110] Frank H. Winter, *The First Golden Age of Rocketry: Congreve and Hale Rockets of the Nineteenth Century* (Washington: Smithsonian Institution Press, 1990), 20-28
[111] Winter, 58-59.
[112] Winter, 180-181.

pattern that bedeviled Hale for many years and through many improvements.[113]

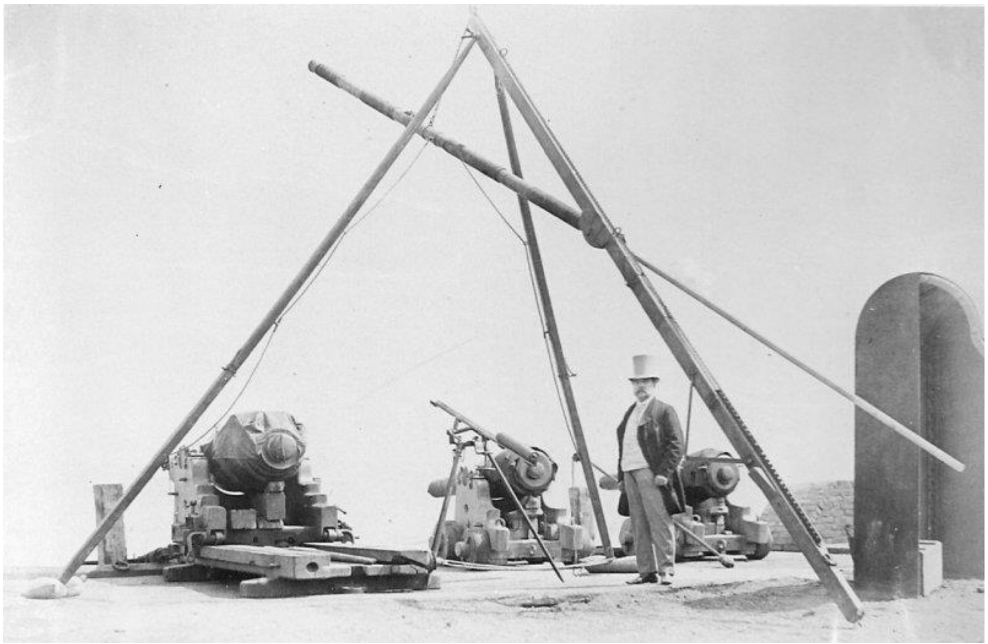

Figure 18: William Hale and his "stickless rocket," posed below a Congreve rocket in its launch tube.[114]

Although the Committee declined the weapon, Hale received his first patent for his "stickless rocket" on 11 Jan 1844.[115] As the name implies, Hale's weapon required no guidance pole, relying instead on directed exhaust ports for spin and stability. Although more complicated to manufacture, the Hale rocket required much less room to stow and handle and a much shorter launch platform, either a tube or an open tray. A period photograph (see Fig. 2) shows Hale standing next to his weapon on its four to five foot launch tray. Suspended well above him, from a high triangular support, is a Congreve rocket of the same weight with its long guide stick. The entire assembly occupies considerably more square feet than the visibly smaller Hale rocket – a factor that would have weighed heavily in Hale's favor.

Another advantage of the Hale rocket came from its manner of manufacture. The

[113] Winter, 182.
[114] "Historic Images of MOD Shoeburyness," *QinetiQ*, 2015, http://www.shoeburyness.qinetiq.com//about/TimelineLightBoxGalleryImages/02-large.jpg.
[115] Winter, 182.

Royal Laboratory used a manually-operated “monkey press” – in effect, a small pile-driver – to pack the propellant into the metal case of Congreve rockets. Inefficient and labor-intensive, manual pressing did not produce a uniformly-shaped charge that resulted in early burn-outs, inaccurate flight, or even premature explosions. Hale, on the other hand, used a hydraulic press which produced a much more uniform yet denser charge, increasing both reliability and range. An 1850 newspaper report comparing service rockets to Hale’s noted that with such a press, “[Hale] is able to put 4lb. weight of [powder] in the same space as 3½lb. can be put by the ‘monkey’ used at the Royal Arsenal.”[116] Although his role in the development of the hydraulic rocket press is unknown – Congreve himself having recommended it many years before – Hale used the hydraulic press to load all of his rockets.[117]

Hale made his first overseas sale to the United States in 1846, which bought the manufacturing license as part of their preparations for war with Mexico. Despite this success, a British committee appointed to consider his rockets “reported unfavourably upon them” after three different trials.[118] Hale’s business suffered, but despite a flirtation with bankruptcy between 1849 and 1850 he continued to market his rockets overseas as well as in Britain.[119] Prince Albert, who witnessed a demonstration in 1850, “was much pleased…both in a military and scientific point of view.”[120] The Prince’s opinion may have helped to advance Hale’s efforts; a June, 1850 letter to the Board of Ordnance requested that “a public trial of [his rockets] might be made preparatory to their being introduced into the service” along with

[116] “Experiments with Rockets, Shoeburyness, May 25.” *Chelmsford Chronicle*, 31 May 1850, 4.
[117] Winter, 202-204.
[118] “The Late Government Seizure of War Rockets.” *London Standard*, 29 April 1853, 1.
[119] Hale declared bankruptcy in 1849 (“Bankrupts,” *North Devon Journal*, 08 Nov 1849, 8), but had it annulled the next year (“Bankrupts,” *Gloucester Journal*, 16 Mar 1850, 4).
[120] Winter, 182-184; “Rocket Practice.” *Yorkshire Gazette*, 29 Jun 1850, 2.

designs for “a machine for firing them in salvos,” a concept ninety years ahead of its time. The Master General shortsightedly declined a trial of the launcher, however, as it did not fire “the sort of rocket used in the service.”[121]

Then, in 1853, disaster struck. Acting on a tip from an undercover informant, London police raided Hale’s Rotherhithe factory and seized his stocks of powder, shells, and rockets. Accused of manufacturing them for the Hungarian revolutionary Lajos Kossuth, Hale’s trial – styled by at least one paper as a new “Gunpowder Plot” – came at a critical time.[122] Instead of selling weapons to the allies preparing for the coming war with Russia, Hale had to fight his country in court. Eventually cleared of any collusion with revolutionaries, Hale pled guilty to the improper storage of gunpowder near London, resulting in the forfeiture of gunpowder in excess of 57 pound and a fine of 2 shillings “for each pound of this excess.”[123] Hale later appealed directly to Lord Palmerston, then Home Office Secretary, “to relieve him from the proceedings” and “humbly [submitted] that the law has been sufficiently vindicated” by his guilty plea. In large part because of war preparations, Lord Palmerston accepted his plea and “intimated that [Hale] will not be called up for judgment.”[124]

Hale also appealed for the release of the confiscated material, and wrote to Palmerston that “an opportunity now presents itself for bringing my Inventions into operation in Turkey,” to which the prime minister agreed.[125] Hale joined the Allied fleet at Varna in December, 1853, and although his rockets were not used at Odessa, he held several demonstrations in 1854. Lord Raglan, impressed with the weapon’s potential, bought what materials Hale brought with him for £500 and the inventor returned home to construct more.

[121] *London Standard.* Salvo rocket launchers saw considerable use during World War II.
[122] Winter, 184-188; “The Gunpowder Plot,” *Exeter Flying Post*, 05 May 1853, 7.
[123] *Exeter Flying Post.*
[124] “Mr. Hale's Rockets.” *Newcastle Guardian and Tyne Mercury*, 25 Jun 1853, 6.
[125] TNA, WO 44/627, File 354.

By the end of the year Ordnance finally relented, and the Royal Laboratory began small-scale manufacture.[126]

With the end of the Crimean War the future of the Hale rocket stalled; the first entry regarding Hale's products before the OSC appears in the 1861 Abstracts, which notes the failure of a "comet shell" brought before a special committee, but no further details are available.[127] His next batch of rockets failed in 1862, with several bursting shortly after launch; Hale withdrew the lot, and declared to the Committee that "he will never bring forward another rocket if they burst any more." The OCS had its doubts, as their "experience of Mr. Hale hardly warrants implicit confidence in this pledge."[128] True to his word, however, a new design brought forward the next year showed "so much promise…that further experiments are very desirable." The Committee recommended the immediate purchase of a hundred 24-lb. rockets, with launcher, for further tests, and inquired about the possibility of smaller rockets as well.[129]

Buoyed by his success, Hale proposed that the he be provided with space at the Royal Arsenal for the construction of his new weapons. At first, the OSC declined his request under the questionable justification that it was "undesirable to allow so dangerous a manufacture under other than official superintendence." After more negotiations, the Committee forwarded to the War Office the recommendation not only of a site for rocket construction, but also the supply of necessary materials, and the retention of his and several employees' services at an estimated £650 for six months. "Such an arrangement," they felt, would "not only materially expedite the enquiry, but will be found to be far more economical." It would

126 Winter, 188-189.
127 Subj. 368.2, TNA, SUPP 6/3: Abstracts 1861, 578.
128 Subj. 368.2, TNA, SUPP 6/4: Abstracts 1862, 453.
129 Subj. 368.2, TNA, SUPP 6/5: Abstracts 1863, 316.

also have reinforced the precedent, set with Sir William Armstrong, of hiring a talented outsider who could improve the nation's military technology. Instead, the War Office demurred; it did offer the use of government property, but chose to buy a hundred 24-lb rockets outright at £1,000 – a gamble that Hale might need more than six months to perfect his design.[130]

In the short run, the gamble paid off; experiments with Hale's rockets did go longer than six months; the first pattern would not be sealed until 1866. Hale continued to try to tempt the War Office into a longer-term relationship; in 1865 he again offered a salvo launcher "on which he is currently engaged" and other improvements "provided his services are retained…at a fair remuneration." When asked if such an offer would be of value, however, Boxer complained that he had "received no assistance from Mr. Hale beyond being supplied with his specification for the 24-pr. rocket, and…does not consider that any advantage would be gained" from such an arrangement.[131] Hale ultimately received a lump-sum payment of £8,000 the next year for his invention, but with manufacture and improvements now under the direction of the Royal Laboratory, the inventor found himself cut out of the future of a weapon he had labored so long to bring to perfection.

The "General Question of the Best Arm for the Infantry"

Although Greener and the *Times* feared that Britain was falling behind its Continental cousins in artillery in 1858, no similar apprehension surfaced regarding its infantry weapons. The Pattern 1853 Enfield rifle had proven itself in battle, and English military authorities were content with its performance. In addition, the Royal Small Arms Factory in Enfield served as a model example of a small-arms factory that attracted considerable attention in

[130] Subj. 368.2, TNA, SUPP 6/5: Abstracts 1863, 477-478
[131] Subj. 368.2, TNA, SUPP 6/7: Abstracts 1865, 497, 733.

and out of Europe. The Birmingham gun trade itself used the Enfield model of production when fourteen of its leading gunmakers decided to launch the Birmingham Small Arms Company (BSA) in 1861. Their efforts to build a mechanized small arms factory paid off two years later, when the company won a contract to supply Turkey with 20,000 infantry rifles.[132]

Given the relatively crude state of breech-loading rifles at this point, decisions by most powers to retain muzzle-loading weapons are unsurprising. British tests of the radical Prussian "Zündnadelgewehr," or "needle-ignition rifle," showed that the weapon – the first bolt-action breech-loader adopted by any nation – had serious flaws, as did practically every other plan of breech-loading small arm. Greener himself – no small authority on firearms technology – declared in 1858 that "breech-loaders do not shoot nearly so well, and are not half so safe, as muzzle-loading guns" because of the lack of an effective breech seal.[133] Still, the potential of the weapons was not lost on the OSC, and select infantry units were issued breech-loading carbine and rifle in the early 1860's supplied by noted private gun-maker Westley Richards.[134] In 1861, however, the Committee stated that "no present intention exists of providing the army generally with breech-loaders."[135] Hartington reiterated that position in 1863, when American William Mont Storm approached the War Office with a request to convert a handful of Enfield rifles to his system of breech-loading. The Secretary

[132] A. W. F. Taylorson, "The Manufacture and Proof of Firearms," in Hugh B. C. Pollard, and Claude Blair, *Pollard's History of Firearms* (New York: Macmillan, 1983), 472.
[133] Greener 1858, 335-337.
[134] Westley Richards had a considerable reputation for quality sporting firearms in this era. How he brought his weapons before the war Office is unknown; the first entry in the OSC Abstracts states that a member of the Small Arms Committee had made some trials, and that "Mr. Richards has been requested to furnish a rifle and ammunition" (Subj. 1645, TNA, SUPP 6/1: Abstracts 1859, 50). Information on the Westley Richards arms may be found in Subjects 1645 and 1739 of the Abstracts for 1859 through 1864. A limited number of breech-loading carbines and rifles were also in service with cavalry and volunteer Yeomanry outfits. See William W. Greener, *The Gun and Its Development* (London: Cassell and Company, Ltd, 1910, rep. 2002 National Rifle Association, Fairfax, VA), 128-129, and Hoyem Vol. 1, 72-75. The firm is still in business, and recently published a book celebrating its 200th anniversary. Unfortunately, a 02 May 2012 email from Simon D. Clode stated that company records on their military arms were "very few."
[135] Subj. 2246, TNA, SUPP 6/3: Abstracts 1861, 776.

approved, but only “on the distinct understanding that this step is not to be regarded as expressing any opinion in favour of the adoption of breech-loaders as an infantry arm.”[136]

As with the issue of rifled cannon, war brought the issue of breech-loading infantry weapons into very sharp focus in 1864. Tension between Denmark and the German Confederation turned into armed conflict on 1 February, when Austrian and Prussian forces crossed into Schleswig-Holstein.[137] The Prussians, noted a correspondent for the *Telegraph*, carried with them “the famous needle-gun, the qualities of which will now probably be put to the test for the first time on a large scale.”[138] By all accounts, the Dreyse breech-loader served the Prussians very well, allowing them to deliver higher rates of fire and reload from any position, in weather that reduced the Danish Minié to uselessness. Newspaper reports prompted at least one reader to suggest to the *Times* that “the proved excellence of the Prussian needle rifle should, and doubtless will, draw the attention of our own military authorities…to place some weapon on the same principle in the hands of our own soldiers.”[139]

Now headed by George F. S. Robinson (Earl de Grey and Ripon), the War Office did indeed have its attention drawn to the battlefield success of the breech-loader.[140] On 13 June, de Grey authorized the appointment of “a Committee of Practicable Officers to report whether it would be advisable to arm the Infantry, either in whole or in part, with breech-

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[136] Subj. 1631, TNA, SUPP 6/5: Abstracts 1863, 327.

[137] Michael Embree, *Bismarck's First War the Campaign of Schleswig and Jutland 1864*, Amazon Kindle Edition (Solihull: Helion, 2006); Chap. 3, “Across the Frontier.”

[138] “The War in Schlewig: Appearance of the Austrian and Prussian Troops.” *Dundee, Perth, and Cupar Advertiser*, 5 February 1864, 9.

[139] J. Brooke Brooke, “The Needle Gun.” *The Times* (27 April 1864): 13. Given the speed with which the conflict broke out, the relatively quick resolution of the war, and the ongoing conflict of the American Civil War, it is unlikely that British military officers were able to observe any of the fighting.

[140] Anthony F. Denholm, “Robinson, George Frederick Samuel, first marquess of Ripon (1827–1909),” *ODNB*, 2004, http://dx.doi.org/10.1093/ref:odnb/35792. American experience with breech-loaders in the Civil War appears to have factored very little in the War Office decision to form the committee.

loading arms." In particular, he directed the committee to take into consideration the long-standing objection that "troops thus armed might fire away their ammunition too rapidly," which could lead to supply problems in an era of animal-powered field logistics. The committee met four times over two weeks, beginning on 27 June 1864, and gathered testimony from a number of sources. Lt. Col. T. L. Gallwey and Capt. H. I Alderson had recently returned from a tour in America with "favourable reports" from Union officers of the breech-loaders in use, particularly the Spencer repeating rifle. "Mr. Burton, an American gentleman," stated that breech-loaders "are the favourite weapon in the Federal cavalry," and predicted that "the system will be universally adopted" in the U.S.[141] Reports from Col. Beauchamp Walker, a member of the committee who toured the Danish front in 1864, confirmed the needle-gun's superiority over the Minié rifle, especially in wet and snowy weather. At the last meeting, the British military attaché in Paris informed the committee "that the question…has been under consideration in the French army" and that "some distinguished officers have been pressing the question upon the Emperor" in spite of "the usual objection, of a too-rapid expenditure of ammunition." Given that three of the four potential powers Britain might have to engage in the next years – France, Prussia, and the United States – were either armed with or contemplating such weapons, the committee "[begged] to report their opinion in favour of arming the Infantry wholly with breech-loading arms."[142] This was a quick about-face on the issue, from a military that had only recently rejected the wholesale adoption of breech-loading rifles.

[141] "Mr. Burton" refers to James H. Burton, who assisted in the outfitting of the RSAF Enfield and was then trying to construct a small arms factory for the Confederacy; see Thomas K. Tate, *From under Iron Eyelids: The Biography of James Henry Burton, Armorer to Three Nations* (Bloomington, IN: AuthorHouse, 2005).

[142] HCPP, "Army (Breech Loaders). Copy of Report of the Committee upon Breech Loaders for the Army." 1864 (578).

Report in hand, de Grey added two associate members to the OSC "to assist in ascertaining the speediest and cheapest mode of placing a breech-loading rifle in the hands of the troops," specifically the conversion of the Pattern 1853 rifle. Although a stop-gap measure, conversion made sense in view of the large stock of serviceable muzzle-loaders on hand, and could be done cheaply and quickly.[143] Given the "urgent nature of the question," de Grey instructed the OSC to "lose no time" in contacting anyone whose arms or plans for conversion might be worth a try, including proposals previously brought before them such as Mont Storm's.[144] To do so, the OSC adopted a suggestion made by Maj. Gen. Hutchinson of the Small Arms Committee in 1859: a direct appeal to interested gun-makers by newspaper advertisement.[145] The notice, scheduled for printing on the 24th and 25th of August, stated that plans were due by 20 September, should cost no more than £1 per arm, with accuracy on par with the existing rifle. Six Enfields would be provided to anyone whose plans were judged worthy of trial, and altered arms with a thousand rounds of ammunition "ignited in such a manner as the competitors think suitable" to be delivered within five weeks.[146]

The 1864 "Call for Proposals" elicited considerable interest among the British press. The *Sheffield Daily Telegraph* wrote that "some of your Sheffield mechanicians and inventors…have a chance of making a fortune if they can only hit on the best way of converting the Enfield rifle into a breech-loader." "If any local genius in Steelopolis has a notion that he can do what is wanted," the paper recommended they get their plans into the War Office promptly. The paper did warn of "a shabby remuneration" of £20 for "time,

[143] Britain was not alone in this thinking; the United States, without funds to re-arm after the Civil War, elected to convert its million-rifle supply of muzzle-loading rifles, and France did the same thing to provide its reserve forces with a breech-loader beginning in 1867; see Hoyem, Vol. 2, 33, 132.
[144] Subj. 2560, TNA, SUPP 6/6: Abstracts 1864, 531-532.
[145] Subj. 1603, TNA, SUPP 6/1: Abstracts 1859, 109. In this case, the OSC demurred, and chose instead to draft a confidential memorandum "setting forth what is most required in the service" to be sent "at the discretion of the [OSC]" to select – and established – gun-makers.
[146] Subj. 2560.2, TNA, SUPP 6/6: Abstracts 1864, 532.

thought, labour, and outlay" for any inventor whose plans were rejected after trial. It also congratulated de Grey "for his energy in providing British soldiers with some rifle that will cope with the Prussian needle gun, and for his resolution to resort to open competition."[147] The *Times* also praised de Grey, since "the facts brought out in the Schleswig campaign prompted him to instant action." "There can be no doubt," the *Times* continued, that through "the ingenuity of our gunsmiths…we may soon hope to see the infantry armed with a weapon which will put them on equal terms with any enemies they may have to encounter."[148]

In all, the OSC received forty-seven different schemes for converting the Enfield, out of which thirty were summarily rejected. Of the remaining seventeen, eight were selected for trial in October of 1864.[149] The types of cartridges proposed varied as widely as the conversion plans, and herein arose one of the great hurdles: determining the best type of ammunition for breech-loaders. This question separated itself from the problem of how to convert the Enfield almost immediately, as one of the major advantages the Dreyse needle-gun lay with the self-contained ignition of its cartridge. Such a system meant that the soldier did not need to fumble around with a small copper cap – easily lost in the heat of combat – in order to fire his weapon. Just three months before, the OSC had rejected the Spencer repeater because the Duke of Cambridge judged "the circumstances of the arm requiring a cartridge containing its own ignition is sufficient to preclude its adoption for military purposes."[150] Of the eight finalist systems, three used self-primed cartridges, which forced the OSC to

[147] "Our Metropolitan Letter." Sheffield Daily Telegraph, 27 August 1864, 6.
[148] "Breech-Loaders for the Army - from the Times." *Birmingham Journal*, 27 August 1864, 7. Four of the seven plans selected for testing came from American inventors.
[149] Subj. 2560.2, TNA, SUPP 6/6: Abstracts 1864, 714. Proposals for conversion continued to come in, even after the conclusion of the trials; eventually, over seventy different plans were put forth.
[150] Subj. 2560.2, TNA, SUPP 6/6: Abstracts 1864, 523. Most likely, the Duke's opinion was influenced by that of Col. Dixon, Superintendent of the Royal Small Arms Factory. Dixon testified before the 1864 committee on breech-loaders that he objected "on account of the difficulty of storing…any ammunition which…carries its own means of combustion." See HCPP, 1864 (578), 2.

concede that, perhaps, this was an idea worth considering. When asked, Lt. Col. Boxer, the Superintendent of the Royal Laboratory, replied that "it is quite possible to make a safe metallic or strong paper cartridge" containing its own ignition. The key, according to Boxer, lay with keeping the detonating pin separate from the cap, "but so arranged as to be readily applied at pressure."[151] Boxer's remarks foreshadowed the invention for which he would later be credited with.

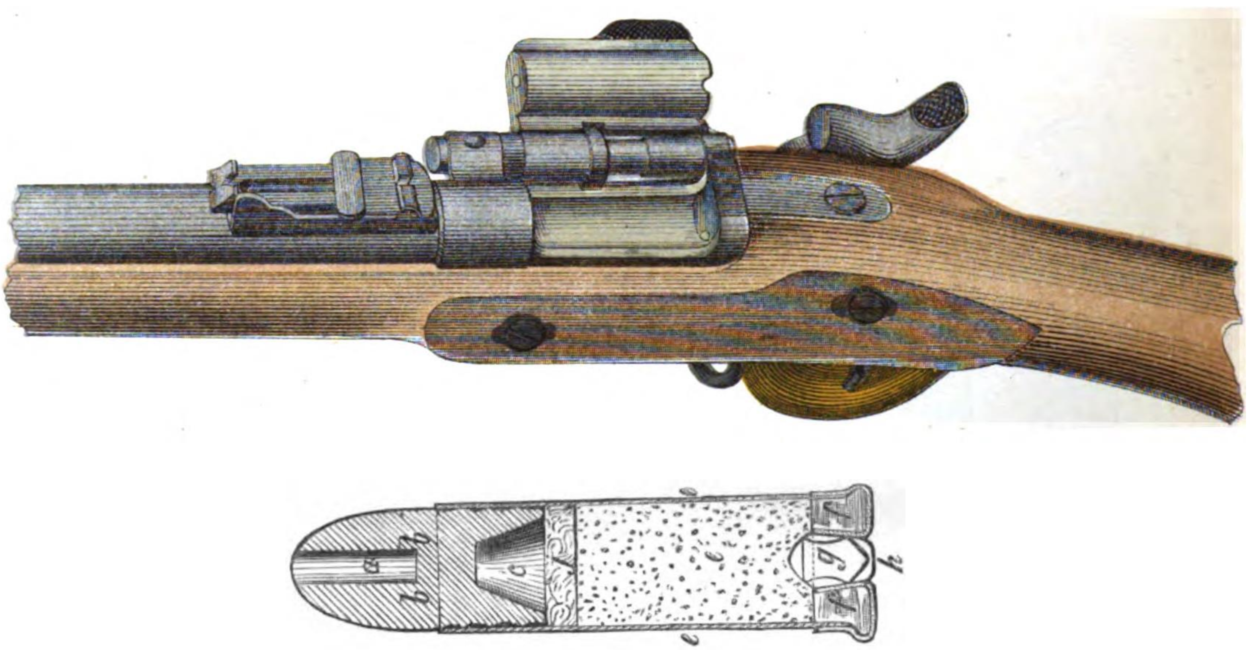

Figure 19: The Converted Snider Enfield and the Boxer-designed cartridge. The latter had the primer at the base, "G", and was made of rolled brass foil. The case required extraction after firing but gave a better gas seal and was more weather-proof.[152]

The Ordnance Select Committee commenced its experiments with the altered rifles on 09 January 1865. Three of the competing designs could not be tested; one was delayed in New York because of the U.S. government's refusal to grant an export permit, one because of flaws in the gun and the third due to the "dangerous nature of the cartridges." In tests that were as much about the ammunition as they were on the rifles themselves, the Committee

[151] Subj. 2560.2, TNA, SUPP 6/6: Abstracts 1864, 716.
[152] "The Needle Gun."

compared the converted arms for rapidity of fire, accuracy, durability, velocity and penetration. All of the systems had flaws of one type or another, but two of the remaining five stood out. The OSC judged Mont Storm's "on the whole, superior to the others," but had the disadvantage of requiring an external percussion cap. Jacob Snider's system, on the other hand, used a self-contained cartridge that, although imperfect, the Committee found "encouraging." Confident Snider could correct problems with both the altered rifle and the cartridge, the OSC recommended conversion of a further thousand rifles.[153]

The Committee hedged its bet, however, and continued experimentation with the Mont Storm rifle, under the dubious advantage that, in an emergency, it could be loaded from the muzzle using the cartridge for the Pattern 1853 rifle. The War Office placed an order for 3,000 rifles converted to the Mont Storm system in July of 1865, and the OSC sealed a pattern rifle in September.[154] Then, a month later, Col. Boxer reported that in response to a request from the Assistant Secretary of the OSC, "he has succeeded in making a cartridge for the Snider…which gives even better results as regards accuracy" than the original, or even the Pattern 1853 cartridge itself. Boxer's cartridge, fired from an improved Snider conversion, did indeed gave excellent results.[155] Impressed, the OSC ruled that, "pending the approval of a more efficient small-bore breech-loading rifle…they recommend the trial of the Snider…be resumed, with a view to an extensive conversion." They also recommended that the Royal Small Arms Factory take steps to prepare to carry out the conversion, discontinue manufacture of the Pattern 1853 Enfield, and to plan for production of newly-made Sniders "as may be necessary" to meet the needs of the military once the conversion was completed.

[153] HCPP, "Enfield Rifles. Copy of the Report of the Ordnance Select Committee on the Trials at Woolwich of Enfield Rifles Converted to Breech-Loaders." 1865 (462).
[154] Subj. 2560.2, TNA, SUPP 6/7: Abstracts 1865, 677-678.
[155] Subj. 2560.2, TNA, SUPP 6/7: Abstracts 1865, 894-895.

Research into a completely new rifle had begun shortly after de Grey's order for investigation into converting the Enfield. Maj. Gen. Sir John St. George, then the Director of Ordnance, requested in December of 1864 that the OSC open investigations into the "general question of the most perfect military weapon with which to arm the infantry." St. George laid down several conditions for the new weapon, the major requirements being a breech-loader using a self-primed cartridge, and a smaller bore than the service muzzle-loader.[156] The OSC used the same advertising tactic to invite proposals as it did with the issue of converting the Enfield, but noted that the breech-loading system, rifling, and cartridge type would be considered separately.[157] The response, however, was disappointing; although the OSC sub-committee chose four rifles for further examination, it "point[ed] out the inferiority of the whole collection" and asked "whether it may not be desirable to postpone the inquiry, and at present to go more largely into the conversion of the Enfield rifle on the Snider system." The OSC concurred, "to allow more time for the development of the many rival plans of this nature which are now engaging the attention of gunmakers at home and abroad." The improvements made to the Snider, coupled with Boxer "having designed an ammunition which has enhanced the shooting of the…converted Enfield to an extent which makes it positively superior to the unconverted arm" helped support the decision.[158] Only in 1869 would the successor to the OSC finally approve a new small-bore rifle for its infantry.[159]

Although never tested in direct combat against its European counterparts, the Snider conversion of the Enfield rifle, coupled with the Boxer cartridge, offered the British infantryman a number of advantages. Unlike the Prussian and later French "Chassepôt"

[156] Subj. 2560.3, TNA, SUPP 6/6: Abstracts 1864, 716.
[157] Subj. 2560.3, TNA, SUPP 6/6: Abstracts 1865, 679.
[158] Subj. 2560.3, TNA, SUPP 6/6: Abstracts 1865, 901-903
[159] Subj. 2560.3, TNA, SUPP 6/6: Abstracts 1869, 87-96.

cartridge, the Boxer was impervious to all but direct submersion in water, and even then could resist accidental dunking. The Snider action was relatively simple and soldier-proof, and the weapon did not suffer from the blow-back of gas into the soldier's face of the Prussian "Zündnadelgewehr", which forced many of its soldiers to fire inaccurately from the hip. Britain, therefore, ended the 1860's with an infantry weapon in many respects better than any other in the field. The search for "the most perfect military weapon with which to arm the infantry," however, would prove to be much more difficult in the years beyond.

Furthering the "Science of Artillery"

In 1855, when the Ordnance Select Committee came into being, the empirical tools available to evaluate new technology were limited to manual observation and measurement. The thirteen-year career of the Committee, however, saw a considerable improvement in such tools, leading to new understandings of the actions that took place when a gun fired. One of the first occurred in devices used to determine the velocity of projectiles. British mathematician Benjamin Robins had made velocity measurement possible with the invention of the ballistic pendulum in 1740, which allowed the proper calculation of a gun's range.[160] Robins's device measured the arc of a wooden pendulum when struck by a bullet fired from a stationary gun, from which the velocity at the point of impact could be determined. A slightly different mechanism, called a gun pendulum, measured the speed of the projectile as it exited the barrel, known as "initial muzzle velocity." In this device the gun itself formed the pendulum; hung from a frame and fired, the backward recoil equaled the initial velocity of the projectile leaving the muzzle. Scaled up, the ballistic and gun pendulums were used to measure the velocity of artillery projectiles as well as small arms. An 1816 newspaper report

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[160] Brett D. Steele, "Robins, Benjamin (1707–1751)," *ODNB*, Sep 2012, http://dx.doi.org/10.1093/ref:odnb/23823; Stephen Vincent Benét, *Electro-Ballistic Machines and the Schultz' Chronoscope* (New York: D. Van Nostrand, 1871), 5-6.

described the pendulum at the Arsenal as "about 7400 pounds" capable of withstanding the impact of a 24-pound shot. With such an immense device, the *Royal Cornwall Gazette* crowed, "the velocities with which balls move propelled from the heavier artillery will no longer remain a matter of mere induction, but a fair result of actual experiment."[161]

Figure 20: A ballistic pendulum for testing powder and explosives at the Royal Gunpowder Mills, Waltham Abbey, Essex. Behind it is a smaller ballistic mortar, used for the same purpose. The frames are of modern construction.[162]

Capt. Boxer, in his 1854 textbook on artillery, credited the data developed via the ballistic pendulum as forming "the basis of the whole science of artillery."[163] Robin's ingenious device, still used today, had many limitations however. As the *Gazette's* report indicates, big guns required a heavy and expensive device for measuring their performance. The wooden pendulum had to be repaired and rebalanced after every shot, and could only

[161] "The Army." *Royal Cornwall Gazette*, 10 February 1816, 4.

[162] Photobucket, accessed 20 Jan 2015, http://s282.photobucket.com/user/dundas56/media/Ballistic-pendulum.jpg.html; see also "Ballistic Pendula," *Royal Gunpowder Mills*, accessed 20 Jan 2015, http://www.royalgunpowdermills.com/must-see-attractions/ballistic-pendula/.

[163] "Gunpowder for Great Guns." *London Standard*, 16 April 1870, 2.

absorb so many projectiles before needing to be rebuilt. This greatly limited the number of tests that could be conducted in any experimental program.[164] The inaccuracy of smoothbore cannon also limited the distance at which velocity could be calculated to a hundred yards, far shorter than the increasing range of big guns.[165] In addition, such a heavy piece of gear could hardly be moved, unless laboriously taken to pieces and reassembled.[166]

In 1840, Prof. Wheatstone suggested that electricity might be used to determine velocities, and over the next few years he and others made several experimental devices.[167] Finally, in 1849, Belgian Army Capt. Navez developed an "electro-ballistic apparatus" that used magnets to release and trap a pendulum at the moment a projectile crossed two tripwires. On the recommendation of Prof. Wheatstone, the OSC requested the purchase of an improved version of Navez's apparatus in November of 1857, priced at £25.[168] For unknown reasons, Panmure delayed the purchase until April, 1858.[169] In a minor comedy of errors, the device arrived at Woolwich in January of the next year, but without instructions for assembly or use.[170] It took a further fifteen months to obtain a translated manual and arrange for copies to be printed. Finally, on 30 March 1860 the OSC "directed[ed] that the necessary arrangements be made for commencing experiments."[171]

The OSC assigned the task of conducting the first round of velocity experiments to an exceptional young lieutenant, William H. Noble. The twenty-two-year old Noble graduated

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[164] Charles Dupin, *View of the History and Actual State of the Military Force of Great Britain* (London: J. Murray, 1822), 249-265.

[165] W. N. Glascock, *The Naval Service: or, Officer's Manual for Every Grade in His Majesty's Ships* (London: Saunders and Otley, 1836), 49.

[166] The ballistic pendulum built at Shoeburyness in 1859 had two actual pendulums, a 6500- pound gun cradle and a target weighing 11,500 pounds. Moving the massive device to Woolwich cost £310. See Subj. 1016, TNA, SUPP 6/6: Abstracts 1862, 457-458, and TNA, SUPP 6/7: Abstracts 1863, 4.

[167] Benét, 5-7.

[168] Subj. 1321, TNA, SUPP 6/1: Abstracts 1857, 95-96

[169] Subj. 1321, TNA, SUPP 6/1: Abstracts 1858, 18 and TNA, SUPP 6/1: Abstracts 1858, 53.

[170] Subj. 1321, TNA, SUPP 6/1: Abstracts 1858, 150.

[171] Subj. 1321. TNA, SUPP 6/2: Abstracts 1860, 33.

with honors from the Trinity College in Dublin in 1856, where he studied experimental science. Just before graduating, Noble received a direct commission into the Royal Artillery, one of a small group of men offered a chance to do so because of the dire need for officers during the Crimean War.[172] Appointed an associate member of the OSC in 1861 specifically to supervise ballistic and other scientific experiments, Noble remained in that role for the duration of the OSC's existence.[173] In September and October 1861, Noble measured velocities for several guns and howitzers, including the Armstrong 110-pdr, and in December reported the velocities from experimental rifled cannon at both the muzzle and at thirty yards. Impressed with the results, the War Office approved £200 so "that the wires of the Navez apparatus may be extended" two days after receiving Noble's report – an exceptionally quick disbursement of funds for that age.[174]

A different Noble, Capt. Andrew Noble, contributed much to demystifying the actions that occurred inside of guns at the moment of firing, an important question in an era when larger and larger guns required more control in the burn speed of gunpowder.[175] Capt. Noble, who attended Edinburg Academy before joining the Royal Artillery at the age of sixteen, exhibited a keen interest in mathematics and science even after being posted to Canada on his graduation from the Royal Military Academy. After eleven years' service abroad, Noble returned to Woolwich in 1858 and became secretary to the Royal Artillery

[172] H. M. Chichester, "Noble, William Henry (1834–1892)," rev. Roger T. Stearn, *ODNB*, Sep 2011, http://dx.doi.org/10.1093/ref:odnb/20226. In 1855 and 1856, the War Department held three examinations "open to candidates from the Universities and public schools under certain rules as to age and character." Forty-five, presumably including Noble, received "provisional" commissions into either the Royal Artillery or Engineers, without having to attend the Royal Military Academy. They then received six months instruction in fortification, artillery, and other subjects under the direction of the Director of Artillery Studies. The Academy also accepted seventy-two lower-scoring but still promising young men as cadets in an accelerated instruction program. "Of the gentlemen thus admitted into the service," an 1874 committee reported, "many have proved to be valuable officers." See HCPP, "Report of a Committee on the Admission of University Candidates to the Scientific Corps," 1874 (C.935), iii.
[173] Chichester and Steam, *ODNB*.
[174] Subj. 1321, TNA, SUPP 6/3: Abstracts 1861, 589-590.
[175] Hogg 1963, 135-136.

Institute. A few months later he joined the special committee formed to test the Armstrong gun. Impressed with his mathematical skills and knowledge of artillery, Armstrong lured the young captain out of the Royal Artillery with a partnership in the new Elswick Ordnance Company in 1860.[176] That same year Noble constructed his first pressure measuring device, called a "crusher gauge", although it took several years to perfect.[177] Noble's gauge screwed into a hole drilled into the side of the gun barrel; the pressure of escaping gas into the device crushed a copper cylinder, and from the amount of deformation the pressure could be calculated. Aware of his work, in 1866 the OSC invited Noble, "a mathematician and mechanician of the first class," to assist them in experiments related to the changing nature of gunpowder.[178] Joined by Frederick Abel, Noble agreed, and although the final report would be some years in the making, the experiments by the pair greatly enhanced not only the efficiency of British artillery, but also changed, to use Boxer's words, "the basis of the whole science of artillery."

The Ordnance Select Committee and the "Progress of Military Science"

If the plethora of newspaper articles related to military technology is any indication, the British reading public followed the ongoing debates between arms manufacturers and before the Ordnance Select Committee with great interest. Both Whitworth and Armstrong, for example, wrote the *Times* to advance their position in "the Great Gun Question," as that newspaper labeled it.[179] An 1863 report on "various natures of improved ordnance," the Times noted, "is suggestive of furious encounters, not only on the battlefield…but in the

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176 Stafford M. Linsley, "Noble, Sir Andrew, first baronet (1831–1915)," *ODNB*, Sep 2013, http://dx.doi.org/10.1093/ref:odnb/35243.

177 Hodgetts, E. A. Brayley, and Tom Gregorie Tullock *The Rise and Progress of the British Explosives Industry* (London: Whittaker, 1909), 326.

178 Subj. 1641, TNA, SUPP 6/8: Abstracts 1866, 799-800.

179 "The Great Gun Question." *The Times* (01 September 1863): 6.

arena of Parliamentary debate and scientific controversy….The partisans of Sir W. ARMSTRONG and Mr. WHITWORTH," the paper continued, "have plied each other to such good purpose with destructive projectiles as to leave the public in doubt which is the greater master in the production and use of them."[180] A search of the *British Newspaper Archive* and *Times Digital Archive 1785-2008* websites for the words "Armstrong" and "Whitworth" garnered 6,500 articles, but interest did not confine itself just to that topic; a search on the phrase "Ordnance Select Committee" resulted in over 2,400 articles, and for "Snider Rifle," nearly 3,700.[181] Although these numbers must be tempered with the understanding that many regional newspapers simply reprinted *Times* articles or notices from the War Office verbatim, it still indicates a strong interest in the changing nature of military technology in that era.

The number of books and pamphlets, while much harder to count, also point to great public interest in military technology, as these were popular tools for persons interested in promoting their position or invention.[182] George Daw, who worked with Jacob Snider in developing the original cartridge for the latter's converted Enfield and who felt Boxer usurped his invention, used such a tactic to put his case before the public.[183] Gun-maker Westley Richards published an 1863 plea for "a fair and impartial trial for Breech-loading Ordnance of a large caliber…conducted in public previous to the adoption of any new

[180] "The Report of a Select Committee..." *The Times* (30 July 1863): 8.

[181] The first two searches were limited by date to between 01 January 1855 and 31 December 1868, the dates of the OSC's existence; the search for "Snider Rifle" used dates for 1864 to 1868. The numbers shown are approximate, with some leeway added for false hits such as advertisements.

[182] Unfortunately there is no comparative search available for books and pamphlets, even in the British Library's online catalog. Unlike the British Newspaper Archive, the Library does not include content in its searchable criteria. A search for "Snider rifle" returned only eleven hits, for example, and "Ordnance Select Committee" only 13; eliminating the word "Select" returned only 93 items. Searching for the word "ordnance," however, returned over 19,000 hits, but the results are not filterable by date.

[183] George H. Daw, *The Central-Fire Cartridge before the Law Courts, the Government, and the Public* (London: George H. Daw, 1867).

system," as was not done with the Armstrong gun.[184] Sir James Emerson Tennent's 1864 *The Story of the Guns*, although sympathetic to Whitworth, reminded his readers that, in addition to the inventors and the military, "there is *a third party* interested in the investigation; - the nation at large, who look to acquire an effective armament in return for the expenditure incurred."[185] Patrick Barry, in his muckraking volume *Shoeburyness and the Guns* took a similar line, but treated Whitworth much more harshly. "The public money has been spent on him – positively squandered on him – and, as far as I am aware, to no purpose" while "other inventors have been repelled, trifled with, injured," Barry wrote.[186] In addition, Barry charged that certain officers, most notably Boxer, were not the impartial participants they should be. Boxer, by then a full colonel, "should henceforth cease to divide his time between the public and [Whitworth's] Manchester Ordnance Company, and either throw the public or the Manchester Ordnance Company overboard."[187] Whitworth retaliated in 1866 by publishing the proceeds of the 1866 "Armstrong & Whitworth Committee" prefaced by a letter to Earl de Grey, "as a means of proving to my friends and the public that, while the competition has ended in a substantial victory to me, it has yielded results of great importance to our artillery service."[188] Although a very small sampling, these works show the wide range of subjects that authors interested in military technology brought before the reading British public during the reign of the Ordnance Select Committee.

[184] Westley Richards, *Loading at Breech, and Loading at Muzzle, for Military Weapons* (London: William Ridgway, 1863), vi.
[185] Tennent, v.
[186] Patrick Barry, *Shoeburyness and the Guns: A Philosophical Discourse*. (London: S. Low, Son, and Marston, 1865, repr. 2005 Elibron Classics), 112-113.
[187] Barry, 127. The *London Standard* noted that "the War Office has been exceedingly indulgent to Mr. Whitworth to an extent that is very creditable to Lord De Grey; and to an extent that is known to very few." To assist Whitworth in the development of explosive and shrapnel shells, De Grey "ordered that the whole of the Royal Laboratory resources" be made available, including Boxer, "certainly one of the ablest scientific servants of the Crown." There is no evidence that there were any commercial dealings between the two. "The Armstrong and Whitworth Trial – Seventh Day's Firing," *London Standard*, 14 Apr 1864, 5.
[188] Joseph Whitworth, *The Report of the Armstrong & Whitworth Committee, with a Letter Thereon to Earl De Grey, and Appendices* (Manchester: J. Thomson & Son, 1866), iv.

Perhaps no better measurement of the level of public involvement in military technology exists than the records of the Committee itself. Over the course of the eleven years for which the *Abstracts* were published, the OSC minuted 26,577 items, and issued 5,173 reports of findings to the War Office. 3,425 new proposals, questions, and requests for opinions appeared before the OSC; of those, 974 came from military officers, primarily British, and 699 originated with the War Office or some other government entity. The remainder - 1,752, or just over half - came from civilians, most unconnected with the military or the Royal manufacturing departments, with a very small handful from enlisted army or navy personnel. Granted, most individuals approached the War Office with pounds-sterling in their eyes, but an exceptional few – Sir William Armstrong among them – did so out of a sense of duty to their country. Regardless, such participation, for whatever reason, disproves any notion of these two decades serving as the start of the decline in British inventiveness.

If there was a lack of inventiveness or originality in British military technology in this era, the problem lay elsewhere, as illustrated by a September 1864 article in the *London Standard.* Published just after the War Office issued its solicitation for breech-loading small-arms came out, the *Standard* asked "how is it that with all our mechanical genius as a people we are content to take the leading improvements in our army and navy at second hand from other nations?" "The result is inevitable," the paper continued. "We are always a little behind, and sometimes more than a little." The article went on to list several British reactionary responses to overseas military development, beginning with the launch of *La Glorie* five years before, but more recently to news coming out of America. "When Federal and Confederate ships spit great shells at each other we conclude that solid shot is not the right sort of thing," for example. "We hear of torpedoes," but only when "the Confederates blow up an iron-clad bodily with one of these submarine contrivances…[do] we rub our eyes, and begin to think there is something in it.” The same situation had arisen with British military small arms, “The American evidence is striking,” the paper claimed, “as showing the value of the breech-loader to an army which is numerically weak in comparison with its opponents” such as the British when compared to the massive conscription armies of Europe. “Most decisive evidence comes from some of [the American] generals in favour of the breech-loader, and the only lingering objections appear to be those which arise rather from prejudice than from experience.”[189] The paper’s complaint would become all the more apparent in the following decade, as Britain stubbornly retained muzzle-loading artillery beyond when other nations had adopted breech-loaders.

The changes in British military weaponry shepherded by the Ordnance Select Committee, on the other hand, are nothing short of remarkable. Heated iron shot had been replaced by J. Martin’s shells filled with liquid iron in 1857; William Hale’s stickless rocket finally supplanted the unwieldy and less accurate Congrave; the Pattern 1853 Minié rifle gave way to the Snider in 1866, and rifled cannon – on whatever system would be finally selected – were now permanent fixtures in British artillery.[190] A May 1868 article in the *London Standard* remarked on “how wonderful is the progress made of late years in the military art….Chemistry has largely called in to the aid of our manufacturing departments,” resulting in changes in gunpowder, and “the manufacture of carriages…is going forward with wonderful strides.” “It is impossible,” the *Standard* wrote, “for any honest man to read [the minutes of the OSC] without acknowledging how difficult must be the tasks of steering among the designs of rival inventors… [and] the thousands of applicants for trials at the

[189] “How Is It That with All Our Mechanical Genius...”. *London Standard*, 01 September 1864, 4.
[190] For the Martin shell, see Subj. 779, TNA, SUPP 6/1: Abstracts 1857, 81; for Hale’s rocket, see Subj. 386.2, TNA, SUPP 6/7: Abstracts 1865, 731-733.

public expense." Rather breathlessly, the *Standard* went on to claim "how great a thing it is for the nation that so far beyond question is the honour of [the OSC] that no dissatisfied inventor, however much he may impugn their judgment, has ever ventured to breathe one syllable against the purity of their motives."[191]

Such a glowing endorsement of the Committee, however, could not prevent its fall by the basest of Victorian British political diseases: parsimony. On 03 December 1868, Gen. Lefroy, then President of the OSC, informed the attendant officers that the Secretary of War had decided to replace the Committee with "other arrangements" in order to eliminate its dedicated operating costs. Lefroy received a promotion to "Director General of Ordnance, with full powers for the conduct of immediate and necessary business pending the reorganization of the Department," while the rest of the Committee members went their separate ways. What remained to be seen, however, was if "the conduct of immediate and necessary business" could in fact be accomplished – a question perhaps not fully considered when Sir John Pakington decided upon the dissolution of the Ordnance Select Committee.[192]

[191] "The Progress of Military Science." *The London Standard*, 29 May 1868, 4-5.
[192] "Business of the Committee," TNA, SUPP 6/10: Abstracts 1868, 961.

Chapter 5: "A New Era of Great Guns:" The Technical Committee System, 1869 – 1880

In December of 1868, in one of his last acts as the outgoing Secretary of State for War, Sir John Pakington dissolved the Ordnance Select Committee. Although it saved a few thousand pounds a year in operating expenses, Pakington's decision cost the nation the services of a competent and generally well-regarded supervisory body that had successfully kept British arms on par with other European militaries. What replaced the Committee was, in effect, a miniature version of the muddle that crippled British forces in the Crimean War. While not nearly as disastrous, the new "Experimental Branch" consisted of a much smaller committee of Royal Artillery officers under the Director of Artillery, who also oversaw the actions of a number of subject-specific committees. Operating independently of one another, these committees often duplicated the efforts of each other and occasionally issued conflicting opinions on similar subjects. In addition, the Secretary of State had a separate "Ordnance Council" to which he could refer subjects related to military technology – or simply duck responsibility for making such decisions himself. Such a profusion of committees created a muddle that, coupled with reactionary military opinions and Britain's experiences fighting colonial wars abroad, put the nation at an increasing technological disadvantage compared to the rest of Europe in the 1870s.

The eleven-year duration of this smaller muddle remained a source of continued tension between competing interests over the future directions of British military technology. A number of important investigations passed from the OSC to the Experimental Branch, including the question of the British infantry's future rifle, new forms of gunpowder, and the best way to defend – and defeat – armored warships. Such topics continued to stimulate public debate, as did emerging technologies. A new type of explosive – dynamite – had obvious military potential, and the multi-barreled *mitrailleuse* fielded by the French in their war with Prussia brought many copycat proposals before the War Office. In addition, because of a growing number of public complaints, the War Office created a formal board of investigation into claims for reward and priority of invention, as well as new rules regarding inventions by public servants such as Edward M. Boxer.

The creation of the Experimental Branch ultimately concentrated considerable power into the hands of the Royal Artillery, and the experiences and training of those officers drove British ordnance development for the next several years. Britain's involvement in small-scale colonial wars, for example, kept the Royal Artillery wedded to muzzle-loading field guns because of their simplicity and ruggedness in the field, despite the battlefield experiences of a potential enemy: the newly-unified German Empire.[1] The Royal Navy, however, shares equal blame in Britain's retention of outdated artillery technology. Their preference for familiar technology meant the that British ships carried large, heavy wrought-iron rifled muzzle-loaders longer than France or Germany, even after Sir William Armstrong's private company perfected its breech-loaders.[2] It took the fatal explosion of a 12-inch gun on board *H.M.S. Thunderer* in 1879 to convince British ordnance authorities that the future of naval artillery lay with steel breech-loading, rather than increasingly heavy wrought-iron muzzle-loading guns. In addition, the investigation of the accident finally led to the dissolution of the ordnance development system introduced by Pakington, and the resurrection of a single oversight committee responsible for weapons technology questions – a throwback to the earlier OSC.

[1] Robert Hinds Scales, Jr. "Artillery in Small Wars: The Evolution of British Artillery Doctrine, 1860-1914." Ph.D. Dissertation, Duke University, 1976.

[2] John Beeler, *Birth of the Battleship: British Capital Ship Design 1870-1881* (Annapolis, MD: Naval Institute Press, 2001), 78-79.

A "Small Economy…Utterly Misplaced:" The Dissolution of the Ordnance Select Committee

In June of 1868 Gen. Sir Robert Napier wrapped up "the most astonishing feat of modern days;" the expedition into Abyssinia against its Emperor Theodore. As with all British military actions, after congratulations came calls for retrenchment. The expedition costs had doubled beyond the original estimate and been partially funded by a tax increase.[3] On 01 October 1868, the *Times* reported that "the authorities at the War-office, in conjunction with those at the Horse Guards, have determined on making a considerable reduction in the army" for the following year.[4] Originally rumored to consist of the elimination of battalions stationed at home depots and withdrawal of troops from Canada and Australia, by the next month the *Morning Post* reported that reforms included "the immediate abolition of the Ordnance Select Committee as at present constituted."[5] The *Pall Mall Gazette* confirmed the Committee's impending demise on 12 November, stating that "all new inventions, changes in war matériel, and the like will be referred to special committees appointed from time to time…as the occasions may rise."[6] The quote also illustrates a built-in flaw of the new technical-committee system: an assumption that technological change would slow down, rather than remain at the brisk pace of the previous fifteen years.

The papers reacted to the news with considerable misgivings. The *Gazette* reminded its readers that, although not free from defects, "on the whole the work of the committee has been well done" and that "the existence of some such body is indispensable." "Never," the paper continued, "has any one ventured to suggest that its judgments have been formed upon

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[3] David G. Chandler, "The Expedition to Abyssinia, 1867-8." In *Queen Victoria's Little Wars*, edited by Byron Farwell (New York: Norton, 1985), 151-152; John Arthur Ransome Marriott, *England since Waterloo* (London: Methuen, 1957), 306-307.

[4] "Military and Naval Intelligence." *The Times* (01 October 1868): 10.

[5] "Naval and Military Intelligence." *Morning Post*, 02 November 1868, 3.

[6] "Experiment in War Material." *Pall Mall Gazette*, 12 November 1868, 3.

any unworthy motives. Its reports have been official documents of a high character, eagerly sought after by foreign Governments." Certainly the OSC "has had too much to do," the *Gazette* continued, but "how is the work to be done without any committee at all?" The paper also wondered what person or body would decide which inventions should move forward, and who would decide what special committees were needed. "We trust these things have been well considered, and that in a search for economy efficiency will not be abandoned." [7] The *Morning Post* of 12 November 1868 questioned "if it is desirable to entirely suppress a body which has adequately performed very arduous and important duties at a time of transition." In addition, the *Post* blamed the House of Commons "which encourages the system of inventors and contractors and other interested persons pushing their views in that assembly" and pointed to the "the case of the wearisome and absurd ARMSTRONG and WHITWORTH competition" as an example. With Prime Minister Benjamin Disraeli's cabinet in political danger, the *Post* also cautioned that "governments…on the very eve of extinction should not undertake in a hasty manner any business to which objections can be raised, and which is not of an urgent and irrepressible character."[8]

Despite such a warning, Pakington ordered the dissolution of the OSC on 03 December 1868. In the letter announcing the change, Pakington noted that "he has not resorted to this step on the ground of any dissatisfaction with the Committee," but in favor of "other arrangements, by which it is hoped that the business heretofore referred to them will be conducted with greater economy and despatch."[9] If there were other reasons behind the decision besides economy, they were not stated overtly. It is very possible, for example, that the OSC fell victim to the ongoing turf war between the political and military branches of the

[7] "Experiment in War Material." *Pall Mall Gazette*, 12 November 1868, 3.
[8] "The Government Appears to Be Duly Maintaining...". *Morning Post*, 12 November 1868, 4.
[9] TNA, SUPP 6/10: Abstracts 1868, 961.

War Office. Pakington may have also been influenced by frustration on the part of military authorities, such as the Duke of Cambridge, with the ongoing dispute between Armstrong and Whitworth. In addition, Pakington had formed at least one special committee to reconsider the OSC's experiments regarding iron armor shields being installed at Gibraltar and Malta. This pattern of specialty committee may be the "other arrangements" that Pakington had in mind.[10]

In place of the OSC, Pakington created an "Experimental Branch," headquartered at Woolwich and under the control of the incoming Director-General of Ordnance, Col. John Lefroy. Composed of four Royal Artillery officers, this new entity included then-Capt. William H. Noble, who had previously served as an associate member of the OSC.[11] Responsible for initial screening of inventions, the much smaller committee received proposals from the War Office, and passed those worthy of consideration to topic-specific sub-committees in a manner sometimes used by the OSC. On paper at least, this allowed Pakington to claim £6,271 in savings by eliminating the operational costs of the Committee. Under the new arrangement, however, the number of sub-committees expanded rapidly, as did the costs associated with the Experimental Branch. By February 1870, eighteen separate committees had been formed to consider questions involving all manner of ordnance materials and the efforts of dozens of military officers, primarily from the Royal Artillery.[12] Over the next ten years, the budget of the new Branch crept to £4,462, still over a thousand

[10] HCPP, "Observations by Colonel Jervois, C.B., R.E., on the Report of the Special Committee on the Iron Shields Supplied for Malta and Gibraltar," 1867 (4003).

[11] TNA, WO 32/7126, "Copy of Minutes relating to the appointment of the Ordnance Committee 1880: 1. By the Director of Artillery and Stores (Sir F. Campbell) 2.10.80," 2; "The Ordnance Select Committee." *Birmingham Daily Post*, 25 November 1868, 4; RAL, "General Index to the Abstracts of Proceedings of the Department of the Director of Artillery for the Year 1870," ii.

[12] See Appendix 3.

pounds less than the OSC, but with the added confusion of so many different committees.[13]

Pakington's announcement met with some skepticism. The *Dublin Evening Mail* "supposed that there will be increased economy and efficiency" in the new arrangements, but reminded its readers that "the Ordnance Select Committee has done a great deal of very honest work."[14] The *London Standard,* echoing the original rationale behind the creation of the OSC, pointedly mentioned that the new "committee on inventions, or whatever it may be called" consisted of artillery officers only, with no representation from the navy or other branches of the army. In addition, the paper doubted "whether, considering the immense importance of the questions submitted," it would not be best to make the salaries of committee members good enough to draw "the highest talent and experience from all branches of the service. This is not at present the case," as one of the former OSC members (most probably Capt. Noble) transferred to the new committee at a reduced salary, and the department heads received no additional pay for their service whatsoever. Finally, the *Standard* warned that "we cannot conceive any department of the army where any small economy could be more utterly misplaced. We doubt if the present constitution of the committee will give complete satisfaction to the public."[15]

Because of the gains made in Parliament by the Liberal Party in the 1868 general elections, Disraeli's cabinet gave way to the Gladstone government on 03 December 1868. As Chancellor of the Exchequer under Palmerston, Gladstone had fought the prime minister over military spending, preferring to limit Britain to a defensive strategy reinforced with diplomacy, rather than build up the nation's offensive capabilities. Such a policy would allow

[13] TNA, WO 32/7125, "Cost of the Ordnance Select Committee (abolished in 1868), as compared with the present system of Experimental Branch and Special Committees," 1880.
[14] "Military Reductions." *Dublin Evening Mail*, 07 December 1868, 4.
[15] "The Ordnance Select Committee." *London Standard*, 27 January 1869, 5.

greater reductions in government spending and the final elimination the income tax, long one of Gladstone's chief political goals.[16] Now premier himself, Gladstone felt he could finally make that goal a reality, and to assist in the effort installed Edward Cardwell as Secretary of State for War on 9 December 1868.[17] Cardwell had a head for finance that Gladstone appreciated, having served as president of the Board of Trade in Aberdeen's government. In 1855 he had been tapped to succeed Gladstone at the Exchequer, but declined to serve in Palmerston's government, as had Gladstone himself.[18] Charged by the new prime minster to find reductions in military spending, Cardwell appointed a special committee under Thomas George Baring (Lord Northbrook) to do a complete review of the systems of financial supervision in place in the War Office. Cardwell, however, recognized the need for some form of advisory body to assist with changes in military technology. In March of 1869, therefore, he appointed a new "Council of Ordnance, whose duty it will be to advise him on such questions connected with Arms, Armaments, and Experiments, as he may refer to them." Similar to the *ex officio* OSC, the Ordnance Council consisted of designated heads of departments in the War Office as well as chief ordnance, engineer, and naval officers.[19] Unlike the OSC, however, the Council was not a permanent standing body. Although charged with the consideration of "any question…which involves consequences of serious importance" suggested by either the Director-General of Ordnance or the Lords of the

[16] Andrew Lambert, "Politics, Technology and Policy-Making, 1859-1865: Palmerston, Gladstone and the Management of the Ironclad Naval Race." *Northern Mariner / Le Marin du Nord* 8, no. 3 (1998): 9-38.
[17] Cardwell's many accomplishments in army reform, including the elimination of purchase and subordination of the Commander-in-Chief to the War Office are covered in depth in Spiers, *The Late Victorian Army*. Only Cardwell's actions as related to ordnance development will be considered here.
[18] Brian Bond, "Cardwell, Edward, first Viscount Cardwell (1813–1886)," *ODNB*, May 2009, http://www.oxforddnb.com/view/article/4620.
[19] The *Ordnance Council* should not be confused with the later *Ordnance Committee* or *Ordnance Board*; the Victorians were, unfortunately, not very imaginative in their committee naming practices.

Admiralty, the Council only met when specifically called by the Secretary of State.[20]

With the release of the second report from the Northbrook committee in May, 1869, the *Pall Mall Gazette* jumped to the conclusion that the OSC would "be revived on a somewhat improved and extended footing." The paper congratulated Cardwell for having "avoided the dangerous path" set by Pakington before leaving office. "We have always been puzzled to know how the duty of deciding upon the merits of different inventions would be carried out with the assistance of some such body," the paper continued. "Without a Select Committee of some sort our experiments must assume an intermittent, unscientific character, highly prejudicial to the interests of the service."[21] The *Gazette's* congratulations proved premature; Cardwell did not resurrect the OSC, and a close reading of the report shows no such recommendation. Such a proposal would also have met with considerable resistance on the part of the Duke of Cambridge. In an appearance before the Northbrook commission, the Duke testified that he "approved highly of the abolition" of the OSC, a body "interested in multiplying experiments, many of which were useless," or costly even if successful. "We were," he claimed, "experimenting for the benefit of the world."[22]

Ultimately, what the final Northbrook report recommended and what Cardwell presented in his "War Office Act" of 1870 was the division of the War Office into three distinct departments: Military, Finance, and Supply. The Commander-in-Chief would head the first, and serve as principal military adviser to the Secretary of State. Finance and Supply would be headed by the new posts of Financial Secretary and the Surveyor-General of Ordnance, respectively. The former would be responsible for the preparation of the annual

[20] TNA, SUPP 6/48, "Proceedings of the Ordnance Council, 1868-1871," "Ordnance Council," 1 – 2.
[21] "The Ordnance Departments." *Pall Mall Gazette*, 27 May 1869, 2-3.
[22] HCPP, "Reports of a Committee Appointed to Inquire into the Arrangements in Force for the Conduct of Business in the Army Departments," 1870 (C.54), 8.

army estimates, maintain army financial books, and audit of the accounts. The Surveyor-General would be in charge of logistics, clothing supply, fortification construction, and the procurement of ordnance and military stores, both through the Royal Arsenal and by contract. Holders of both offices could, if elected, occupy voting seats in the House of Commons, which served to extend representation of the War Office in Parliament.[23]

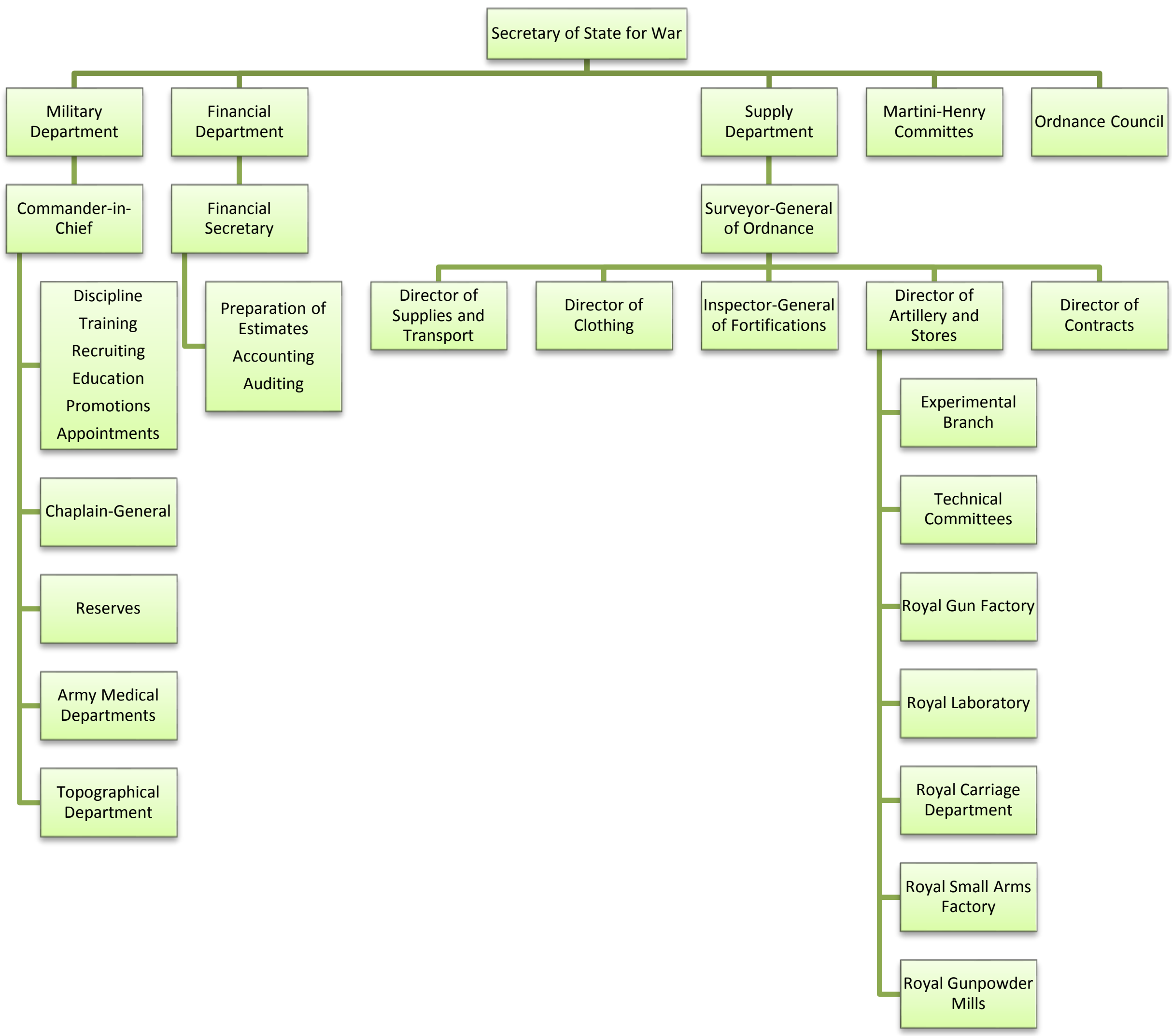

Figure 21: Organization of the War Office after Cardwell's Changes, 1870

[23] HCPP, "War Office. A Bill for Making Further Provision Relating to the Management of Certain Departments of the War Office," 1870 (30). See also Spiers, 6-8. The original bill called for the recreation of the post of "Clerk of Ordnance" but in the third reading before Parliament, Cardwell suggested the new title of "Surveyor-General" (War Office Bill: Third Reading. HC Deb 25 April 1870 Vol 200 cc1742-69).

Cardwell also abolished the Director-General of Ordnance position created by Pakington and replaced it with the "Director of Artillery and Stores," responsible for the manufacture and supply of all ordnance materials for the British military. This included oversight of the manufacturing departments of the Royal Arsenal, as well as supervision of experiments. Similar directorships, also answerable to the Surveyor-General, were appointed for Supplies and Transport, Clothing, and Contracts.[24] When announced, at least one writer questioned the decision. "By clubbing all manner of different services together under one head," "Mus Urbanus" noted in the *Grantham Journal*, "we are assured that there is not only a reduction of expenses but an increase of efficiency. It may be so, but to insure success it may be as well to keep as long as possible on peaceable terms with other nations."[25]

The first man selected to fill the new post of Director of Artillery and Stores, Maj. Gen. Sir John Adye, had served with distinction in the Crimean War and spent many years in India.[26] Adye testified before the Northbrook committee that "some such machinery" like the OSC "is indispensable" and predicted that "its re-organization is only a matter of time." Adye put that opinion into practice soon after his appointment to the new post.[27] Concerned over the possible "diverging decisions and ultimate confusion" the mushrooming sub-committees might produce, in April 1870 Adye proposed the resurrection of the *ex officio* OSC of 1855 in all but name. Noting that "the best advisers the Government can have are the Heads of the Manufacturing and Store departments," Adye proposed that he "should personally confer, once a week, or oftener if necessary" with the department heads of the

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[24] Hogg 1963, 828.

[25] "Observations of a Citizen." *Grantham Journal*, 16 April 1870, 4.

[26] E. M. Lloyd, rev. James Lunt. "Adye, Sir John Miller (1819–1900), Army Officer." *ODNB*, http://www.oxforddnb.com.ezproxy.lib.uh.edu/view/article/176. Adye later wrote that Cardwell, whom he had never met before, "unexpectedly offered the appointment."

[27] HCPP 1870 (C.54), 71.

Royal Arsenal. "Points of manufacturing detail and minor changes could be decided at once," Adye wrote, "whilst others involving experiments and larger issues would be discussed, and Sub-committees, if necessary, named to carry them out." Adye also pointed out that "the scheme in its general working will involve no addition to present establishments, and therefore no additional expense" – an important consideration in the penny-pinching atmosphere of the War Office.[28]

Adye's reorganization put considerable power and responsibility into the hands of the Director of Artillery, a position only held by himself and Maj. Gen. Sir Frederick A. Campbell over the next ten years. Adye's years of campaigning, especially in India, convinced him of the need for simplicity and reliability in military hardware. He also had strong views on the importance of commonality in equipment for the British military. "We are a great naval, military, Indian, and colonial empire," he later wrote, "with fleets, troops, fortresses, and reserves of munitions to maintain in every quarter of the world." "It is essential," he continued, that the armaments of the army and navy "be identical in pattern, and that the reserves at home and abroad be available for both."[29] By contrast, Campbell brought technical expertise to the post. Sent overseas only once (to Canada, from 1838 to 1846), Campbell sat on the OSC from 1860 to 1863, then as served as Superintendent of the Royal Gun Factory at Woolwich until 1875, when he took over the Directorship.[30] While the long tenures of these officers brought a degree of stability to their post, it also contributed to the stagnation of thinking in British military technology during this period, illustrated by Adye's own hand. His April 1870 reorganization memo contained his comment that "the

[28] TNA, SUPP 6/10: Abstracts 1870, 280.
[29] Adye, 249.
[30] John Kane and William Harrison Askwith, *List of Officers of the Royal Regiment of Artillery from the Year 1716 to the Year 1899* (London: Royal Artillery Institution, 1900), 52.

great changes which commenced about 12 years ago, by the introduction of rifled ordnance, may be considered for the most part at an end." [31] Such an opinion suggests Adye brought a relatively closed mind to his post along with his military experience.

Finally, Adye helped cement the control that the War Office had over ordnance development, even for the Royal Navy. With the elimination of the Board of Ordnance, the Navy lost its own Bureau of Ordnance, which had up to that point designed the guns required by the service. Responsibility for naval ordnance fell to the OSC, which included a naval officer but was firmly under the control of the War Office.[32] With Adye's expansion of the Experimental Branch, the Ordnance Council – which also had naval representation – stopped consideration of all but questions of remuneration to inventors.[33] By relying on Royal Arsenal department heads for opinion, Adye eliminated any voice the Navy had in the consideration of new proposals brought before the War Office except in cases where the Director of Artillery specifically requested the opinion of the Director of Naval Ordnance. Then, in June of 1870 Adye complained of "the inconvenience likely to arise from two departments communicating with gentlemen on the subject of their inventions" in response to the Admiralty's discussions with Joseph Whitworth regarding the trial of a 9-inch gun of his design.[34] Despite protestations that the adoption of a single-communication rule "would lead to delay and serious inconvenience," the Admiralty agreed to the new restriction, ceding to the War Office – and Adye – oversight of its ordnance for the foreseeable future.[35] The Admiralty may have felt that it had no option in the matter, as the monies for naval guns and

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[31] TNA, SUPP 6/10: Abstracts 1870, 280.
[32] Beeler, 78.
[33] For the composition as initially proposed, see "Ordnance Council," 1-2. The members that actually sat in Council meetings varied by topic and existence of the post.
[34] TNA, SUPP 6/10: Abstracts 1870, 329-330.
[35] TNA, SUPP 6/10: Abstracts 1870, 412.

stores were included in the yearly army estimates, rather than the navy's. That curious anomaly in British military financing would not be changed for nearly two more decades.

The Experimental Branch in Action

As with the OSC, the path for a hopeful inventor began with getting his proposal to the War Office. Individuals and companies alike often did this by direct communication or through an agent or third-party representative, a common occurrence for persons outside of England. Military officers also approached the War Office directly; enlisted men generally went through their chain of command. Occasionally, the route was not so direct, as in the case of "a young German" who took the drastic step of enlisting in the army "for the purpose of bringing his invention into notice." Apparently unable to get any assistance, the young man joined a different regiment whose commander "he heard spoken of as a man who would help him" – only to end up in prison for desertion from the first regiment.[36] There were also the occasional anonymous submissions. In what would be a headline-making incident in today's era, the Duke of Cambridge turned over to the Experimental Branch an incendiary grenade "with rather a dangerous detonator" for examination. Col. T. W. Millward, then superintendent of the Royal Laboratory, defused the device, and speculated it to be "one of the numerous inventions proposed during the Ashantee war." When asked its origin, His Royal Highness "[could not] recollect who gave it to him."[37]

Adye's reorganization added a step between the War Office and the consideration of new projects. Once received, the Director of Artillery turned the proposal over to a new "Secretary of Experiments." That officer searched the Ordnance archives for anything similar; if found, the matter would be returned to the Director with remarks on any previous

[36] "An Inventor's Experiences of the War Office." *The Star*, 13 July 1880, 4.
[37] Subj. 2108.4, TNA, SUPP 6/23: Abstracts 1874, 246.

judgment. The archives were deep; the dismissal of R. J. Watson's plan for a fifty-barrel "rifle battery" noted that "a very similar [proposal] may be found in 'The Gunner,' published [in] 1628."[38] For proposals judged to be original and which "seem[ed] to present some prospect of advantage to the service," the Secretary then forward the item to the relevant head of an Arsenal manufacturing department. Together the two officers would furnish a short report. If judged to be a trivial matter, the Director of Artillery could handle it at once; otherwise, the question would be discussed at the weekly meeting with department heads.[39]

As with many propositions that came before the OSC, inventors were motivated by a wide range of factors. War scares, particularly the threat of French invasion stemming from their war with Prussia in 1870, drove many to bring ideas before the War Office. Mr. J. Macintosh used the war to press for reconsideration of his "plan for the use of incendiary materials in warfare," rejected by the OSC in 1859. Macintosh fretted that "knowing the terrible power of his system," made him "anxious…that [Britain] become the sole possessor of his invention."[40] Mr. T. Smith resubmitted his 1862 plan for a "locomotive battery," essentially a steam-powered armored car, "in consequence of the uncertain and alarming state of the country" in 1870.[41] Continued unrest in India also led Major. F. Hinton, late of the 1st Dorset Artillery Volunteers, to submit a plan for a form of incendiary shrapnel shell. Maj. Hinton claimed that it would "be most valuable in the *coming* rebellion in India;" his prediction, however, never came to pass.[42]

The possibility of reward continued to motivate inventors, and as before, some of the

[38] Subj. 3272.W, TNA, SUPP 6/23: Abstracts 1874, 103.
[39] TNA, SUPP 6/19: Abstracts 1870, 411.
[40] Subj. 1297, TNA, SUPP 6/19: Abstracts 1870, 284. Reconsidered at the weekly meeting, to which the Director of Naval Ordnance and Chemist to the War Department were invited, Macintosh's proposal was rejected once again.
[41] Subj. 2345, TNA, SUPP 6/19: Abstracts 1870, 344. The entry notes that "the late [OSC] did not think anything of this proposal" and Adye rejected it as well.
[42] Subj. 3284.H, TNA, SUPP 6/20: Abstracts 1871, 410.

demands were extravagant. Americans I. and J. A. Joseph demanded “one million dollars in gold” for a secret composition that they promised “will destroy anything it touches” but that “only exploded when lighted or fired from a gun.”[43] Carl Deutsch asked “for a fee of £500,000, or less if a title be conferred on him, for a cartridge composition, along with information on the latest mode of construction of the Prussian breech-loading guns.”[44] Both proposals were rejected, but not all requests for funds were dismissed outright. Samuel Goddard, whose competing proposal for breech-loading cannon lost out to Armstrong’s in the late 1850s, wrote to the War Office in 1877 “begging government to purchase his 6-pr rifled breech-loading gun, submitted for trial…in 1854, and still at Woolwich Arsenal.” Perhaps partly in sympathy for Goddard, who had claimed a loss of £5,000 in developing his cannon, then Director of Artillery Maj. Gen. F. A. Campbell “consider[ed] the gun an interesting relic of past experiments,” and recommended £100 for its purchase, which the War Office approved.[45]

Although many potentially useful suggestions came before the Experimental Branch, cranks and dreamers continued to plague the War Office. Lt. Col. Heyman, the Secretary of Experiments, found a plan for cannon by a Mr. Neilsjen of Denmark, “most absurd, and thoroughly impractical.”[46] Heyman also judged Swiss Artillery Lt. H. Studer’s proposal for disc-firing artillery “one of the wildest [proposals] ever brought to notice,” and wrote that Mr. A. Ciofti’s plan for cannon “only exists in the proposer’s head.”[47] Col. H. H. Lloyd, formerly of the Bengal Army, forwarded drawings and specifications for a steam-powered

43 Subj. 3181, TNA, SUPP 6/19: Abstracts 1870, 407.
44 Subj. 3337.D, TNA, SUPP 6/24: Abstracts 1875, 262
45 HCPP, “Army (Rewards to Inventors). Copy of Reports and Correspondence Explanatory of Item C (Rewards to Inventors) in Vote 15 of the Army Estimates for 1870-71.” 1870 (266), 5; Subj. 323.2, TNA, SUPP 6/26: Abstracts 1877, 201.
46 Subj. 3198, TNA, SUPP 6/19: Abstracts 1870, 555.
47 Subj. 3261.S, TNA, SUPP 6/21: Abstracts 1872, 305; Subj. 3261.C, TNA, SUPP 6/22: Abstracts 1873, 93.

“cycloidal field gun” whose “deadly and exterminating fire will greatly contribute to, if not entirely, produce the extinction of war.” That fanciful claim, plus the £10,000 requested to develop the gun, led to the shelving of Lloyd’s plan.[48]

Once determined to be impractical or of no use to the service, the proposal then went back to the inventor, usually with a simple statement that it was “not required for the service.” Occasionally, however, the Director of Artillery weighed in on the subject, as in the case of a system of breech-loading “for guns of all calibers” by Lt. W. Sedgwick of the Royal Engineers. Heyman noted that it was the third such plan received from the lieutenant, and after conferring with the head of the Royal Gun Factory, judged it to have major defects. When Sedgwick requested further information to allow him to remedy the issues, Adye rather harshly replied that “his system is so faulty in principle, and open to such grave objections, that no modifications would render it applicable to the service, and that the Secretary of State decline[d] to enter upon any discussion.”[49] The rebuke was enough to keep Sedgwick from troubling the War Office for the next decade.

The unfortunate lieutenant’s proposal illustrates one of the principal flaws in the Experimental Branch system of weapons evaluation: the degree of control that a single member of one branch of military service had over the weapons development process. Both Adye and Campbell were conservative in their opinions, and the lack of vision retarded British military technological progress. Despite American experience in the Civil War, for example, Adye saw no need for improving British hand grenades, and thought the weapon

[48] Subj. 3288.L, TNA, SUPP 6/21: Abstracts 1872, 73
[49] Subj. 2981.6, TNA, SUPP 6/19: Abstracts 1870, 389.

"almost out of date for European warfare" although possibly useful in colonial conflicts.[50] Campbell felt the same way, and dismissed an 1879 proposal with the remark that he found "the notion of a soldier laying aside his rifle in order to light a hand grenade…and of light cavalry riding about with bags of bomb shells…curiously absurd."[51] Such attitudes illustrate a mindset towards technology that extended throughout the Experimental Branch system. When Lt. E. Donnithorne, a cavalry officer with the Royal Scots Greys, proposed a combination time and percussion artillery fuze in 1871, the Special Committee on Fuzes replied that "they are satisfied that the [Boxer] wood time fuze is the best in the world." They also felt that a separate percussion fuze "already proposed for adoption [appeared] likely to answer satisfactorily." By not investigating the potential of Donnithorne's or similar combination fuzes, the Committee missed the opportunity to reduce the number of fuzes British artillery units had to carry into the field.[52]

Adye's interference did not limit itself to weapons. In 1872, the commander of the 42nd Highlanders submitted a sample cooking stove designed by Armourer-Sergeant Warry, a member of his regiment. Trials of the smallest design, capable of cooking for twenty-five men, showed the stove to be "light, compact, simple, efficient, and consuming very little fuel," and the Duke of Cambridge recommended its partial adoption. Adye, however, complained that "Warry's stove, though very well adapted to peace maneuvers or for picnics, [was] too complicated for war purposes." Overall, he felt it "inferior to the ordinary camp kettles" which the army had in considerable numbers. Using the latter as justification, Maj. Gen. Sir Henry Knight-Storks, then the Surveyor-General of Ordnance, "decided that no new

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[50] Subj. 3001.M, TNA, SUPP 6/23: Abstracts 1874, 196. For information on both Union and Confederate grenade usage, see Jack Coggins, *Arms and Equipment of the Civil War* (Garden City, NY: Doubleday, 1962), 97-98, and Joseph G. Bilby, "Grenade!" *America's Civil War*, Nov. 2007, 38-43.
[51] Subj. 3001.P, TNA, SUPP 6/28: Abstracts 1879, 367.
[52] Subj. 3290.D, TNA, SUPP 6/20: Abstracts 1871, 91.

description of cooking apparatus could be entertained at that time."[53]

Proposals that managed to get the approval of both the appropriate special committee and Director of Artillery, however, were not assured of survival. A steam cooking wagon, designed by a Mr. Fraise, had been recommended for adoption after trial in July, 1873. Gen. Knight-Storks, however, "decided that none could be purchased as there were no funds" provided for it in the army estimates for that year.[54] The War Office also quashed projects, such as one for a "reflecting pocket level" brought forward by Lt. W. de W. Abney of the Royal Engineers and approved in 1870. When Lt. Abney brought an improved version forward along with an appeal for a reward, Lord Northbrook, then the Under-Secretary of State, took a closer look at the matter. Although the Royal Engineer Committee thought the improved version "superior in many points to the original," Northbrook felt that "instruments of the kind are only rarely required…and the best article should be obtained in the market" as needed. Not only did Northbrook deny Lt. Abney's request for reward, but also ruled that "the pattern already sealed should be cancelled."[55]

The reluctance to spend money coupled with an insistent reliance on in-house industry contributed to the financial strangulation of at least one business: the Hale's Rocket Co., started by the inventor of the country's service rocket. The company had passed to William Hale Jr. on the death of his father in early 1870, and in August he approached the War Office looking for orders. Hale offered improved 12- and 24-pdr rockets with "greater range, velocity and accuracy of flight" than those of his father's pattern then being manufactured at the Laboratory. He also "[submitted] for inspection an 8-inch shell rocket, which, when filled, will weigh nearly 250lbs…." and "asked for an order for 100 prepared

[53] Subj 3345, TNA, SUPP 6/23: Abstracts 1874, 110
[54] Subj. 3345, TNA, SUPP 6/23: Abstracts 1874, 110
[55] Subj. 3215, TNA, SUPP 6/20: Abstracts 1871, 399.

for firing, at a price of £1,850, which included the stand with all fittings complete." No such orders were forthcoming, however; Col. Millward of the Royal Laboratory tersely told the War Office that "rockets of any size which may be required can be manufactured…without any assistance from Mr. Hale.[56] Hale's Rocket Co. struggled on, but finally shut down in 1876.[57]

Another problem with the Experimental Branch system lay in the proliferation of special committees. Adye, in his proposal for weekly meetings with department heads, noted that the first year of the Branch's existence saw the creation of "a series of independent Sub-committees, about 13 of which [were] now sitting" by June of 1870.[58] This did not end with the Adye's reorganization; between 1869 and 1880, the two Directors of Artillery saw fit to create forty-six different sub-committees, excluding those related to small arms, engineer equipment, and other topics outside the scope of the Director's office (see Appendix 3). The Committee on Explosive Substances, for example, remained in existence beyond 1880; its work greatly improved the efficiency of British gun powder, and kept Britain abreast with new forms of chemical- rather than charcoal-based explosives.

A Horse Designed by Committee: The Camel that was the Martini-Henry Rifle

Perhaps no other project illustrates the War Office's predilection for special committees than the development of the Martini-Henry rifle, a completely new weapon rather than a converted muzzle-loader like the Snider. In 1866 Secretary of War Gen. Jonathan Peel authorized the creation of a "Special Sub-Committee on Breech-Loading Arms," attached to the OSC, to head the effort to rearm the military with a modern rifle. Unlike the committee that selected the Snider action to marry to the Enfield rifled barrel, the

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[56] Subj. 368.2, TNA, SUPP 6/19: Abstracts 1870, 281-282.
[57] "Last Night's Gazette: Winding-up Notice." *Western Daily Press*, 19 January 1876, 3.
[58] TNA, SUPP 6/19: Abstracts 1870, 280.

"Fletcher Committee," named after its president Lieut. Col. H. C. Fletcher of the Scots Fusilier Guards, had a much more complex task, as all the components of the weapon – the breech action, the form of rifling, and the form of cartridge – were thrown open for consideration.

As with the competition for the Enfield conversion, the Fletcher committee released an advertisement offering a reward for the best design, and listed the criteria desired for the new rifle. These included all the usual requirements for a military arm: sturdiness in the field, bayonet and sling attachments, designated weight and length limits, and so forth. Inventors could submit guns of any caliber and form of cartridge, as long as the latter carried its own ignition and "be as little liable to injury by rough usage, damp, and exposure in all climates as the Boxer cartridge." The committee also specified mean figures of accuracy, trajectory, and penetration better than those of the Enfield, but at an increase in recoil of no more than ten percent.[59]

The rewards offered by the War Office were substantial, and divided into several categories. Each competitor whose weapon survived initial screening would receive £300 to provide six rifles and a thousand rounds of ammunition for further evaluation. The arm which the Committee judged to best meet all the requirements would receive an award of £1,000; the best breech mechanism would receive £600. Cartridge designs were to be judged separately, with the winner in that category to receive £400. Repeating arms designs were also welcome in their own category, with a first-place purse of £300, but none were submitted for competition. Finally, the advertisement noted that "the Secretary of State will take care that no ingenious novelty produced in answer…shall be adopted in the service

[59] TNA, SUPP 5/889, "Reports of Breech-Loading Arms by a Special Sub-Committee of the Ordnance Select Committee, 1868," 2-3.

without proper acknowledgement" and promised that the inventor's name would be associated with it.[60]

Of the 120 rifles submitted, sixty-seven were eliminated outright as not in compliance with the terms of the advertisement; a number of gunmakers, however, elected only to compete for the breech action prize, as they could adapt their design "to any barrel which may be approved.[61] Of the remaining thirty-seven rifles, only nine were judged worthy of further trial, which after numerous delays finally took place in February of 1868. Using the Snider for comparison, the Fletcher Committee fired the different rifles against each other for accuracy, trajectory, and penetration, and ran them through tests to determine susceptibility to jamming by sand or exposure to weather. None of the weapons met all the specifications laid down by the War Office, which "proved by experiment to have been very high, and in some particulars far beyond the attainment of the [Snider]."[62] The Committee therefore did not recommend anyone receive the grand prize; Scottish gunsmith Alexander Henry received that for the best breech action.[63] London gunmaker George Daw received the prize for the best cartridge even though the Committee considered "the [improved Boxer] ammunition at present in use in the service is…superior to that submitted by Mr. Daw."[64]

Even before the competitive trials finished, however, the War Office extended the purview of the Fletcher Committee to consider all the characteristics necessary for an efficient and accurate breech-loader. The Committee spent much of early 1868 taking testimony from "distinguished gunmakers" from the Britsh private arms trade, as well as "others who had studied the subject of military arms" such as Col. Boxer. "All," the

[60] TNA, SUPP 5/889, 3, 13.
[61] TNA, SUPP 5/889, 14.
[62] TNA, SUPP 5/889, 32.
[63] TNA, SUPP 5/889, 34.
[64] TNA, SUPP 5/889, 57.

Committee reported, “were of opinion that the principal qualifications were…strength, lightness and safety, flatness of trajectory, and accuracy.” It also decided to re-examine the many forms of breech mechanisms brought before it in 1866, as well as those received afterwards, and tested several types of rifle barrels adapted to fire Boxer cartridges of various bullet diameters and powder charges.[65] Work on all of these components of Britain’s future rifle continued during the transition of the OSC to the Experimental Branch; the “Special Sub-Committee” became one of several “special committees” loosely connected to the Experimental Branch, with membership remained intact but now answering directly to the Secretary of State.

On 11 February 1869, Fletcher presented the committee’s decision: Alexander Henry’s barrel of .45-inch bore would be married to the breech mechanism of Swiss gun designer Friedrich von Martini, whose rifle had recently been adopted by that nation. The cartridge would remain the Boxer composite centerfire case then in service in Britain, loaded with a Henry-designed 480-grain solid lead bullet. In keeping with Gen. Peel’s original directive that inventor names be associated with the finished product, the new arm would be called the “Martini-Henry,” and ammunition to be known as “Boxer-Henry.” The Committee also requested that both Martini and Henry receive awards for their contributions.[66] The British insistence on producing a completely new weapon, rather than license an existing design, was in keeping with most other major militaries of the era. Remington successfully sold rifle systems to several nations, as did the Providence Tool Company of Rhode Island, who held the patent for the Henry O. Peabody’s action that Martini based his design on.[67] In every case, however, the adopted weapons system required adaptation to local requirements.

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[65] TNA, SUPP 5/890, “Reports of a Special Committee on Breech-Loading Rifles,” i-xxv.
[66] TNA, SUPP 5/890.
[67] Charles B. Norton, *American Breech-Loading Small Arms* (New York: F.W. Christern, 1872), 83.

As far as can be determined, England was the only nation that took such a “mix-and-match” approach, pairing a barrel from one inventor with the action of another.[68]

Figure 22: From left to right: the French Chassepot, British Snider, and the “Long Chamber” and “Short Chamber” Martini-Henry cartridges.[69]

Consideration of the question then went before a special conference of the Ordnance Council, one of the few topics reviewed by that body that did not center on questions of priority of invention or reward. The Council, satisfied with the Fletcher committee’s work, recommended further experiments with the new weapon by both the army and navy. It also recommended that “no other expenditure of public money be made for the trial of any other arm” in the meantime, closing the door on any alternatives that the rapidly-changing world of small arms might develop. The Council also recommended manufacture of two hundred arms

[68] Although it is entirely possible, a survey of the weapons cataloged in Hoyem Vol. 2 shows no similar instance.
[69] Source: author’s collection.

by hand for the experiments, while the Royal Small Arms Factory at Enfield underwent modification of its machinery for full-scale production, at a cost of £4,500, with an expectation of new machine-made arms by the end of the year. The Council finally recommended that "minor questions referring to the Martini-Henry arm…be settled by the [standing] Committee on Small-Arms," which should have put that body in the loop regarding the nation's new rifle.[70]

The two hundred hand-made weapons went out for troop trials with one known and major flaw: the cartridge. In an effort to match the long range of the Chassepot, the design committee specified a powder charge nearly equal to that of the French rifle. Standard English military rifle powder, however, was courser grained than that used in the Chassepot cartridge, and the Henry bullet was heavier and longer as well. The result was a cartridge of excessive length: 3.25" for the Martini-Henry, as opposed to only two inches for the Snider (see Figure 22). Such a long case proved easy to bend out of shape, and the edge of the chamber often tore the outer paper wrapper of the cartridge; both could prevent proper loading of the ammunition.[71] Aware of such a problem even before the first batch of rifles went into production, the Committee sought a remedy, which came from William T. Eley of the Eley Brothers firm, the nation's largest private ammunition company.[72] Instead of the paper-and-foil design originally proposed by Boxer, Eley used plain wrapped foil, and

[70] TNA, SUPP 6/48, "Proceedings of a Committee held at the War Office on the 23rd March, 1869," 5-6.
[71] B. A. Temple, *The Boxer Cartridge in the British Service* (Wynnum Central, Australia: B.A. Temple, 1977), 61.
[72] The Eley family had long been involved in the London silver trade before brothers William and Charles formed a company in 1828 to exploit a patent for a wire-bound shot load for muzzle-loading shotguns. On William's death in 1851, his sons William T., Charles, and Henry Eley took over the firm, renamed it "Eley Brothers," and continued to expand its offerings of percussion caps, and patent cartridges. By the early 1860s advertising broadsheets for the company showed a wide range of products, including Enfield rifle cartridges, Congreve rockets and shrapnel shells for sale to other governments. Boxer transferred his patent for centerfire ammunition to Eley in 1867, and it remained a fixture in Eley advertising until the turn of the century. See C. W. Harding, *Eley Cartridges: A History of the Silversmiths and Ammunition Manufacturers* (Shrewsbury: Quiller, 2006).

shortened the overall length by forming the cartridge with an enlarged lower portion to hold the same size powder charge. This "bottle-necked" design resulted in a shorter yet stronger cartridge that, while still damageable, resisted deformation better than the original Boxer design.[73]

Tests of both the original "long chamber" rifle and the newer "short chamber" continued into 1871, overseen by yet another committee: the "Special Committee on Martini-Henry Breech-Loading Rifles," The Committee published its first report summarizing feedback from field testing on 12 July 1870. Another seven months passed, however, before any further report surfaced. In the meantime, the public and the press became increasingly agitated by both the delay in the adoption of the rifle and rumors of fatal flaws, spread by disgruntled inventors or others whose opinions on the proper type of weapon weren't matched by the design of the Martini-Henry. An article in the *London Standard*, published in March of 1871, summarized much of the public clamor surrounding Martini-Henry, especially the delay of the rifle's adoption. "The public," the paper wrote, "ignorant of the occult processes of reasoning in the Liberal Circumlocution Office," had become suspicious of a supposed "improvement in the national armament which demanded such extraordinary efforts to become of use." "The press has teemed with arguments" that the Martini action "ought to and *must* break down," although the reports of the Committee showed that it did not. Finally, "noble lords wrote to the Times to press this or that pet system on the attention of the public, and to war it against the Martini's incurable defects." "In the meanwhile," the *Standard* charged, "we have added some 300,000 to our store of Sniders, and are still turning out a virtually discarded weapon at the rate of about 1000 a week."[74]

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[73] Temple, 63. Eley received British Pat. No. 166, Jan. 1869 for his design.
[74] "Our New Service Arm.* - No. I." *London Standard*, 23 March 1871, 2.

Figure 23: The two British infantry rifles of the 1870s.[75]

The *Standard* article raised a very valid charge of foot-dragging on the part of Gladstone's government, something even the Special Committee recognized. In its final report of 8 February 1871, the Committee, still headed by Fletcher, took pains to note that "the various trials…since the issue of the report which first recommended [the rifle's] adoption, have now extended over a period of more than 18 months," with only minor alterations to the final form of the rifle. "After full consideration of the whole question," the Committee reported that they were "of the opinion that the short-actioned Martini-Henry rifle is admirably adapted for a military arm" and recommended its adoption.[76] The War Office, rather than rely on such a judgment, punted the question once more to the Ordnance Council, who on 30 March concurred with the Committee's decision "that the short-actioned Martini-Henry Rifle…with Short-chambered Boxer-Henry Ammunition, be adopted" for both army and naval use.[77] A final pattern of the rifle and its accoutrements were sealed to govern

[75] "The Non-Smoking Gun: History and the Roles Played by Guns." http://nonsmokinggun.wordpress.com/, accessed 12 Jan 2015.

[76] TNA, SUPP 5/892, "Reports of Special Committee on Martini-Henry Breech-Loading Rifles," 6.

[77] TNA, SUPP 6/48, "Proceedings of a Committee assembled at the War Office, on Thursday, the 30th March, 1871."

manufacture on 03 June 1871.[78]

The acceptance of the Martini-Henry rifle into the service did not silence its critics, however. The month after the Ordnance Council decision, Sir Walter Barttelot rose in the House of Commons to propose that yet another "Select Committee be appointed to inquire into the merits of the Martini-Henry Rifle," Bartellot, a Conservative MP and former infantry officer, clearly had doubts "whether it is the most suitable rifle as compared with others now manufactured to arm our troops with." His motion, after much debate, went down in defeat.[79] A July article in the *Field* and republished by several newspapers noted that "the celebrated, or perhaps we should rather say the notorious, Martini-Henry rifle" had shown a number of problems at the National Rifle Association match at Wimbledon. "Unfortunately for the country," the paper reported, "our fears as to the demerits of its [breech action] have been confirmed," although it did not state exactly what those fears were, except for an overly sensitive trigger. Regardless, the *Field* urged reconsideration of the rifle, "even at this eleventh hour."[80] These supposed defects led a Mr. Osborne to press Cardwell in Parliament to "consent to an independent inquiry into the cause of the defects." Cardwell, however, stated that no such adverse opinions regarding the weapon had reached him. "I am of opinion," he replied, "and this opinion the House after full debate has confirmed, that there is no ground for disturbing the decision of the [Fletcher] Committee in favour of the Martini-Henry rifle."[81]

Full-scale production of the service pattern rifle began in 1872 at the Royal Small-

[78] B. A. Temple and Ian D. Skennerton. *A Treatise on the British Military Martini: The Martini-Henry, 1869-C.1900*. (Burbank, Australia: B. A. Temple, 1983), 85.
[79] "Motion for a Select Committee," HC Deb Vol 205 cc1872-910, 28 April 1871; see also G. Le G. Norgate, "Barttelot, Sir Walter Barttelot, first baronet (1820–1893)," rev. H. C. G. Matthew, *ODNB*, May 2006 http://www.oxforddnb.com/view/article/1608.
[80] "The Martini-Henry at Wimbledon." *Western Times*, 24 July 1871, 4.
[81] "Questions." HC Deb Vol 208 cc216-7, 25 July 1871.

Arms Factory (RSAF) at Enfield, once the factory retooled – no small process, and one that idled a considerable portion of its workforce. Initial manufacture rates were low; no more than five hundred rifles per week, many of which failed inspection.[82] Still, enough trickled out to begin arming infantry units on an experimental basis. By November, production had increased to 1,200 rifles per week, and Enfield closed out its fiscal year in March of 1873 with over 60,000 rifles manufactured.[83] Alterations ordered by a yet another committee slowed production the next year, especially regarding a controversial "locking bolt" or safety, dismissed by the Superintendent of RSAF as "difficult, and consequently costly to make, and…liable to get out of order." Added by the original Special Committee to prevent accidental discharge of the firearm when loaded, a "conference" or committee called by the War Office to consider field reports on the Martini-Henry eliminated the bolt in October of 1873. It also recommended a lengthening of the stock of the rifle to help lessen what some soldiers found to be excessive recoil.[84]

The October 1873 conference was the first of seven called over the next three years to guide the future of the Martini-Henry, rather than turn the program over to the Committee on Small Arms as the Ordnance Council had recommended. The decisions made by these conferences generally improved the weapon, but as in the case of the "locking bolt," delayed production and often required previously-manufactured rifles to be recalled for alteration. The *United Service Gazette* was not happy with the delays. "It appears somewhat strange," the magazine wrote in October of 1874 that "after 150,000 stand of the arm having been made, and after these having been distributed nearly over the whole Service, we should still

[82] "Royal Small Arms Factory." *London Standard*, 15 May 1872, 2; Pam, 76-77.
[83] Pam, 77; HCPP, "Army (Manufacturing Establishments). Return of the Annual Accounts of the Several Manufacturing Establisments under the War Office, for the Year 1871-72 (in Continuation of Parliamentary Paper, No. 128, of Session 1872)." 1873 (111), 115.
[84] TNA, SUPP 5/893, "Conferences on Martini-Henry Rifles," 3-8.

be merely in the experimental stage as to its utility." Questions remained over problems with sighting, recoil, and barrel heating. "Seeing that we have it admitted that the recoil…is so great as to bruise and cut the face and hands of the men who use it, and that it becomes so hot after the firing of ten rounds…we have hit two blots which ought to be seriously looked at."[85]

In the end, neither the recoil nor the barrel heating issues were corrected. In December of 1874 by a committee headed by Adye proposed reducing the recoil with ammunition using a lighter bullet and powder charge; five months later another committee, also headed by Adye, judged such a change unnecessary.[86] A leather guard shield for the barrel had been tested and a pattern sealed in early 1874, but with the caveat that, at 1 shilling each, no supply should be ordered unless "found absolutely necessary." Two years later a committee headed by Maj. Gen. J. W. Armstrong decided that such shields were not required.[87] The rifle, however, had yet another defect, potentially fatal on the battlefield: a weak extractor that, when combined with the composite construction of the Boxer-Henry cartridge, could result in a jammed cartridge case. An 1875 report noted that if a soldier left a fired cartridge in the chamber for any length of time, the barrel cooled to the point that the case could not be ejected. The extractor tended to rip the head of the case off, leaving the body in the chamber and requiring the soldier to ram it out with the cleaning rod. Both Fraser and his successor, Col. T. W. Milward, felt that this was simply a matter of training and experience with the arm – as perhaps was learning to handle the recoil and to keep one's hands off a hot barrel.[88] Unfortunately for British infantrymen fighting in the sands of Egypt and the Sudan in the next decade, the problems with the Boxer composite case – and the

[85] "The Martini-Henry Rifle." *The Star*, 20 October 1874, 4.
[86] TNA, SUPP 5/893, 18, 28.
[87] TNA, SUPP 5/893, 16, 40.
[88] TNA, SUPP 5/893, 26.

British military's stubborn insistence in retaining it well beyond when other nations had adopted solid-cased ammunition – proved much more than a simple training issue.[89]

In April of 1877, the "Rifle, Martini-Henry, Mark II" – actually the fourth pattern of the service rifle to be adopted – became approved for manufacture, after having passed through the hands of a dozen committees and nearly ten years of development.[90] The lengthy delay in getting just the first pattern Martini-Henry into the hands of its soldiers put Britain behind most other powers in Europe, including Russia, who in 1868 chose simply to license both the rifle and the solid-case cartridge designed by American Gen. Hiram Berdan.[91] When offered, free of charge, a hundred Remington rifles of the pattern already adopted by Spain and other countries for comparison against the nascent Martini-Henry in 1870, then Director-General of Ordnance Gen. Lefroy cited "defects of ammunition" noted in the now four-year-old original evaluation of that arm.[92] Such a rejection illustrates both a willful ignorance of the speed of change in military technology, and a dogged determination by the British military establishment to perfect its own chosen weapon. Britain's committee system, tasked with producing the "best rifle in Europe," did indeed end up with a hard-hitting and accurate weapon that saw service until the end of the black powder era. The weapon, however, had intrinsic flaws and was technically only on par, not superior, to weapons being adopted in the rest of Europe.[93]

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[89] For a summary of reports of cartridge jamming, see Min. 42,319, Subj. 3301, TNA, WO 33/44, "Abstracts of the Proceedings of the Department of the Director of Artillery, 1885," (hereafter "AP-DDA"), 283-284. No other European army adopted the composite cartridge on the scale that Britain did. The French used them for converted muzzle-loaders, and Belgium adopted the case for its infantry arm, but replaced it with solid-drawn cases by 1876. See Hoyem Vol. 2, 131-132 (France) and 152-158 (Belgium).

[90] Temple and Skennerton, 111-116.

[91] Hoyem Vol. 2, 190, and Bradley, 108-113.

[92] Subj. 2757.2, TNA, SUPP 6/19: Abstracts 1870, 138-139.

[93] "The Martini-Henry Rifle." *Huddersfield Chronicle,* 23 February 1876, 2.

From the Battle of the Sedan to the Battle of Dorking

While British ordnance officers debated the future of their infantry arm, the question of the best form of artillery arose again with the outbreak of hostilities between France and Prussia in 1870. As they had with Prussia's two previous wars in the 1860s, Britons watched events on the Continent from the sidelines via their newspapers. Crimean War correspondent William Russell returned to the field for the *Times*, for example, embedded with Prussian Crown Prince Friedrich's 3rd Army.[94] In addition to covering the movements and clashes of armies, the papers also discussed at length the various technologies employed. Comparisons between the French Chassepot and Prussian Dreyse rifles generally concluded that the former had considerable advantages, including a much more effective breech seal and longer range, although the *Manchester Evening News* took pains to remind its readers that in recent tests "the accuracy of the Martini-Henry far excelled the Chassepot."[95] One correspondent "who has studied abroad the character and performance of the Chassepôt" declared the long range of the rifle to actually be a liability. French infantry "[fire] away rapidly from twelve hundred to a thousand yards' distance, and by the time their enemies have closed in upon them" had heated the barrels of their rifles so "as to prove no longer serviceable."[96] Still, the Prussian Crown Prince decreed that the French weapons "should be seized at every opportunity, [as they] may be advantageously used by good marksmen."[97]

Despite their advantage in infantry weapons, however, French artillery proved woefully inadequate, and by reflection reopened debate within the British press regarding the

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[94] Roger T. Stearn, "Russell, Sir William Howard (1820–1907), Journalist" *ODNB*, www.oxforddnb.com.ezproxy.lib.uh.edu/view/article/35889.
[95] "The Chassepot and the Martini-Henry Rifles." *Manchester Evening News*, 01 August 1870, 4.
[96] "The Chassepôt in the Field." *Pall Mall Gazette*, 09 November 1870, 11.
[97] David Stone, "*First Reich:" Inside the German Army During the War with France 1870-71* (London: Brassey's, 2002), 127.

right form of ordnance for the Royal Artillery. After their war with Austria in 1866, Prussia and the other major German states rearmed with Krupp-manufactured steel breech-loaders, which could fire faster, farther, and much more accurately than the nearly obsolescent la Hitte bronze muzzle-loaders. Coupled with new, massed-weapon tactics – the Germans fielded hundreds of guns against the fortress city of Sedan on the first of September – such weapons gave their artillery arm a crushing advantage.[98] Russell toured the battlefield at Sedan after the fall of the city, and described the "prevailing expression" on the faces of the dead to be "one of terror and of agony unutterable." He mused that "there must have been a hell of torture raging within that semicircle" of unseen German ordnance pounding the city, "in which the earth was torn asunder from all sides with a real tempest of iron hissing, and screeching, and bursting into the heavy masses" of French soldiers. "I cannot," he continued, "imagine anything so trying to the bravest man as to meet death almost ingloriously… nothing so maddening to soldiers as to be annihilated without a chance of vengeance – nothing so awful to the fugitive as to see his comrades blown to fragments all around him."[99] Unbeknownst to Russell, he had described a scene that would become a common aspect of industrialized warfare in the future.

Russell also had a warning for "our soldiers and statesmen at home." Sedan "was decided solely and entirely by artillery fire… [and] won at a comparatively small expense" by the German armies, he charged. "I know the able director of our artillery at home is bent on making a radical change in our system of ordnance," Russell wrote, but if "Adye had seen the battle-field of Sedan…I think he would have been shaken in his strong conviction" to return the British army to muzzle-loaders. "I speak of him with the greatest respect, but I

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[98] Kinard, 227; Wawro, *The Franco-Prussian War*, 58.
[99] William Howard Russell, "The War." *Times*, 1870, 7.

entreat him to stop and inquire before he carries a vital change," Russell continued. "It is quite clear that any attempt to adopt the French muzzle-loading system, or anything like it, ought to be resisted strenuously until a careful inquiry has established its superiority."[100] *The Examiner and London Review* agreed with Russell. "It is, perhaps, no secret that many artillery officers in this country, disgusted with the complicated manipulation and eccentric performance of the Armstrong cannon, entertain a serious prejudice to breech-loading artillery," the paper wrote. Just because that gun was "a pig in a poke," however, "it does not follow that good breech-loading artillery cannot be obtained." "We have no wish to see the Martini-Henry business repeated over again on a larger scale," the paper opined. "If the War Department have nothing worthy of trial among the things locked up" at the Rotunda Museum or in their archives, "let them invite plans and specifications, and let two or three practical soldiers, *with two or three practical mechanics* (for we have no faith with one without the other) decide which, if any, is the best."[101]

Others disagreed with Russell's conclusion. The *Morning Post*, in a report of comparative tests between the new 9-pdr bronze muzzle-loading gun designed for India and the service breech-loading Armstrong gun, noted that "if the great bulk of our artillery officers have been urgent in condemning the breech-loading as compared with the muzzle-loading field guns, there must be good practical reasons at the bottom of their opinion."[102] The *Pall Mall Gazette* went further, reminding its readers that "the essence of the argument against the breech-loading Armstrong guns [is] that their equipment will not continue good and serviceable under the trying conditions of service" in the field. "Even the *Times* correspondent with the Prussian army would…have found it hard to defend" the service gun

[100] "Last Week's Battles." *Cork Examiner*, 09 September 1870, 3.
[101] "Our Own Artillery." *The Examiner and London Review*, 10 September 1870, 2.
[102] "Mr. Cardwell Yesterday...". *Morning Post*, 04 October 1870, 4.

in such a case, the *Gazette* wrote. The defects of the system “have been fully recognized by at least three independent committees, and have been repeatedly pointed out in these columns,” which the *Gazette* then went at length to repeat again. The paper did remind its readers, however, not to assume that “the science of artillery has stood still since 1859.” “Many minds have been engaged upon the question [of the best form of artillery for England] for many years,” it continued, “and the natural consequence is that other guns have been designed which present all the advantages of the breechloader without its attendant complications and difficulties.”[103] Even as Prussian artillery pounded French fighting men into hamburger at Sedan, however, the British army remained at least two months away from fielding such an improved gun. Not until December of 1870 could the *Gazette* announce that “a beginning has at last been made” of switching the Royal Artillery from the older Armstrong breech-loaders to new pattern rifled muzzle-loaders “made of steel, with coiled iron exteriors instead of bronze.”[104]

While the papers argued the merits of rifled breech- versus muzzle-loaders, France continued what was becoming a rather one-sided struggle with Prussia. German forces crushed one French army after another; Paris fell after a prolonged siege on 28 January, and Napoleon III, who had been captured at Sedan, left for exile in England in March.[105] The end of an active war, however, did not diminish public interest in military events, as witnessed by the reaction to an imaginary conflict. In May, *Blackwood’s Edinburgh Magazine* electrified its readers with “The Battle of Dorking: Reminiscences of a Volunteer,” a fictitious and anonymously-written narrative of an England invaded and defeated by a newly-unified Germany. An article in the Morning Post on 04 May gave a brief sketch of the story. “One

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103 “Breech-Loading and Muzzle-Loading Field Guns.” *Pall Mall Gazette*, 15 October 1870, 10-11.
104 “We Are Glad to Hear...”. *Pall Mall Gazette*, 05 December 1870, 4.
105 Wawro, *The Franco-Prussian War*, 296-299.

morning war was declared against Germany," the paper wrote, but with both the Royal Navy and regular army engaged around the world, defense of the home isles fell to what ships and volunteer infantry units could be scraped together. A sudden torpedo attack took out the British fleet in the Channel; the Germans landed at Portsmouth, and shattered the volunteers armed with too few rifles or even antiquated "Brown Bess" muskets. "Overrun by the enemy, the whole country was laid waste," the *Post* continued. "The battle of Dorking was the death-warrant of England's supremacy as a nation."[106]

The *Post* concluded with the warning that "the [*Blackwood*] article should be read and re-read by everyone; for a stronger argument in favour of being always prepared against the enemy could not be put into words."[107] "Everyone" seemed to agree; *Blackwood's* May edition went through six printings; by July, when the *Pall Mall Gazette* finally identified Col. George Chesney of the Royal Engineers as the author, a separate sixpenny pamphlet been published, which sold over two hundred thousand copies by August.[108] The *Post* later attributed the story's "extraordinary circulation and popularity" to it having "[given] expression to a wide-spread feeling of insecurity and trust" in Britain, aroused by the unexpected fall of France and rise of a unified German Empire.[109] Translated into several different languages, the Chesney article spurred numerous alternative versions in English, including the *Times*' own "Second Armada" story in which the German invasion fleet "shared the fate of the first."[110] *Punch* tried to reassure the public in a satirical poem that

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[106] "The Magazines." *Morning Post*, 04 May 1871, 3.
[107] "The Magazines."
[108] I. F. Clarke, *The Tale of the Next Great War, 1871-1914 : Fictions of Future Warfare and of Battles Still-to-Come*. (Syracuse, N.Y.: Syracuse University Press, 1995), 14-15; "Latest General News." *Western Daily Press*, 19 July 1871, 3; "Literary, Scientific, and Artistic Notes." *Bucks Herald*, 19 August 1871, 3.
[109] "The Second Armada." *Morning Post*, 29 June 1871, 5.
[110] "The Second Armada." *Times*, 22 June 1871, 5. The article series eventually was published in book format as *The Second Armada: A Chapter of Future History; Being a Reply to the German Conquest of England in 1875, and Battle of Dorking* (London: Harrison and Sons, 1871). Another example is Charles John Stone's

"*this* Dorking bird seems to be a cross between a Dung-hill Cock and *Canard*," and "if the British Lion's asleep, 'twill prove no joke to wake him."[111] One British company even devised a board game based on the story.[112]

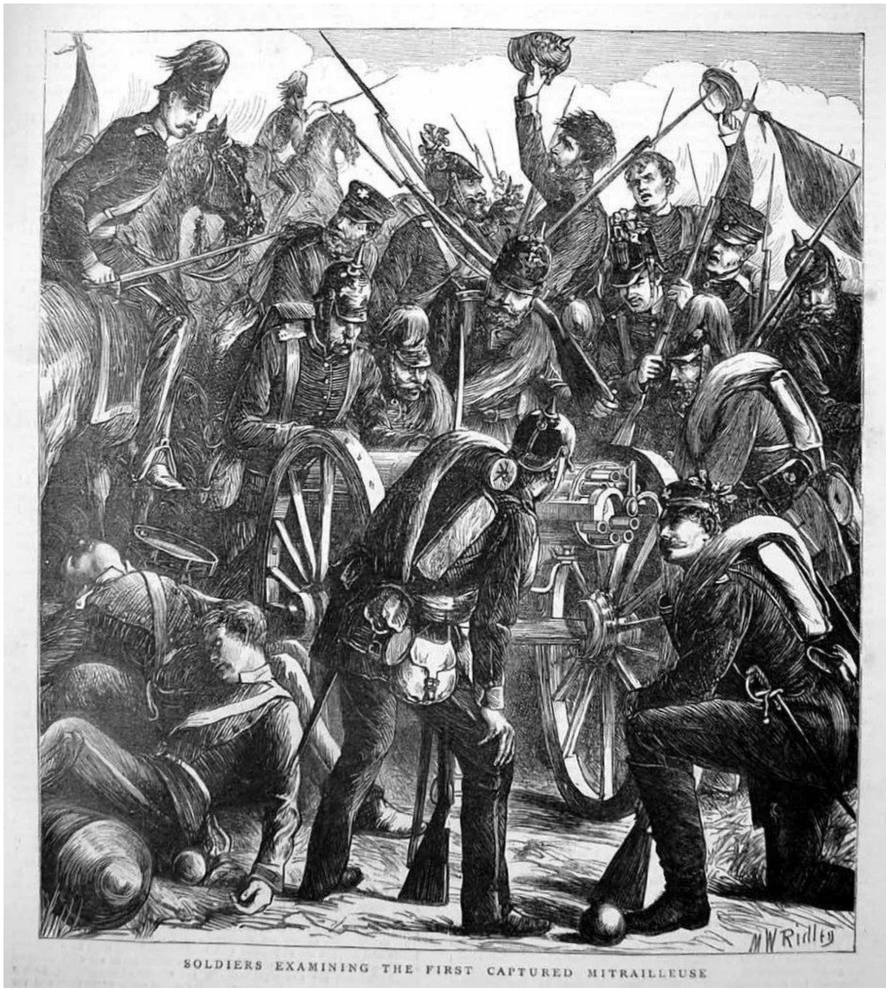

Figure 24: "The First Captured Mitrailleuse." Unfortunately for the editors of the Graphic weekly newspaper, the gun depicted is actually a 1-inch Gatling, not used by the French.[113]

Concerns raised by press coverage of the Franco-Prussian War and the publication of "The Battle of Dorking" translated into suggestions for improvements in England's

What Happened after the Battle of Dorking: Reminiscences of a Volunteer; Being an Account of the Victory at Tunbridge Wells (London: G. Routledge, 1871).

[111] "The Battle of Dorking," *Punch, or the London Charivari*, 20 May 1871, 207.

[112] "The Battle of Dorking." *Morning Post*, 02 January 1872, 6.

[113] *The Graphic*, 24 Sep. 1870, cover illustration.

weaponry. The year before the outbreak of the war, 154 proposals came before the new Experimental Branch; this jumped to 273 in 1870, and fell slightly the year that "The Battle of Dorking" came out, down to 214. Between 1872 and 1877, the numbers averaged 143 per year; in 1878 they started to climb again, peaking at 234 in 1879 during the midst of the 2nd Afghan and Zulu Wars. Other influences also brought inventors to the War Office beyond active or imaginary combat, however, especially advances in technology. Torpedoes and sea mines – the "deadly engines" that destroyed the British fleet in Chesney's story – account for forty-four separate proposals; dynamite and other new explosives, forty-one. The problem of accurately measuring distances to targets netted sixty-seven suggestions, and various plans for improving gunpowder and guncotton (a primitive form of nitrocellulose, used in modern smokeless powders) amounted to thirty-six. All totaled, the eleven years of weapons development shepherded by the Director of Artillery saw 2,031 separate proposals or inventions, with thousands more recorded minutes of investigations and decisions connected to long-running programs. Gen. Adye's opinion that the "great changes" in ordnance "may be considered for the most part at an end" was clearly off the mark.[114]

One of the weapons that *really* exercised the imagination of the British reading public, however, was the *mitrailleuse*, a multi-barrel predecessor to the modern machine gun that the French had put great faith in. Invented in Belgium and perfected by gunsmiths Louis Christophe and Joseph Montigny, the weapon consisted of a number of rifle barrels grouped together in a single tube, operated by a hand crank. The original version had fifty barrels; Christophe and Montigny's improved version had thirty-seven, and the gun fielded by the French decreased that number to twenty-five barrels of 13mm diameter each. The size of a small field artillery piece, the gun had a crew of four that could load and fire five full volleys

[114] TNA, SUPP 6/19: Abstracts 1870, 280.

in under a minute and send the bullets out to a considerable range; a stray shot accidentally killed a peasant 3,000 yards away during testing.[115] The French had developed their version in great secret, but Christophe and Montigny shopped their weapon around the world; an 1867 report by the OSC noted that "specimens have been purchased by the Russian, Prussian, and Austrian Governments."[116]

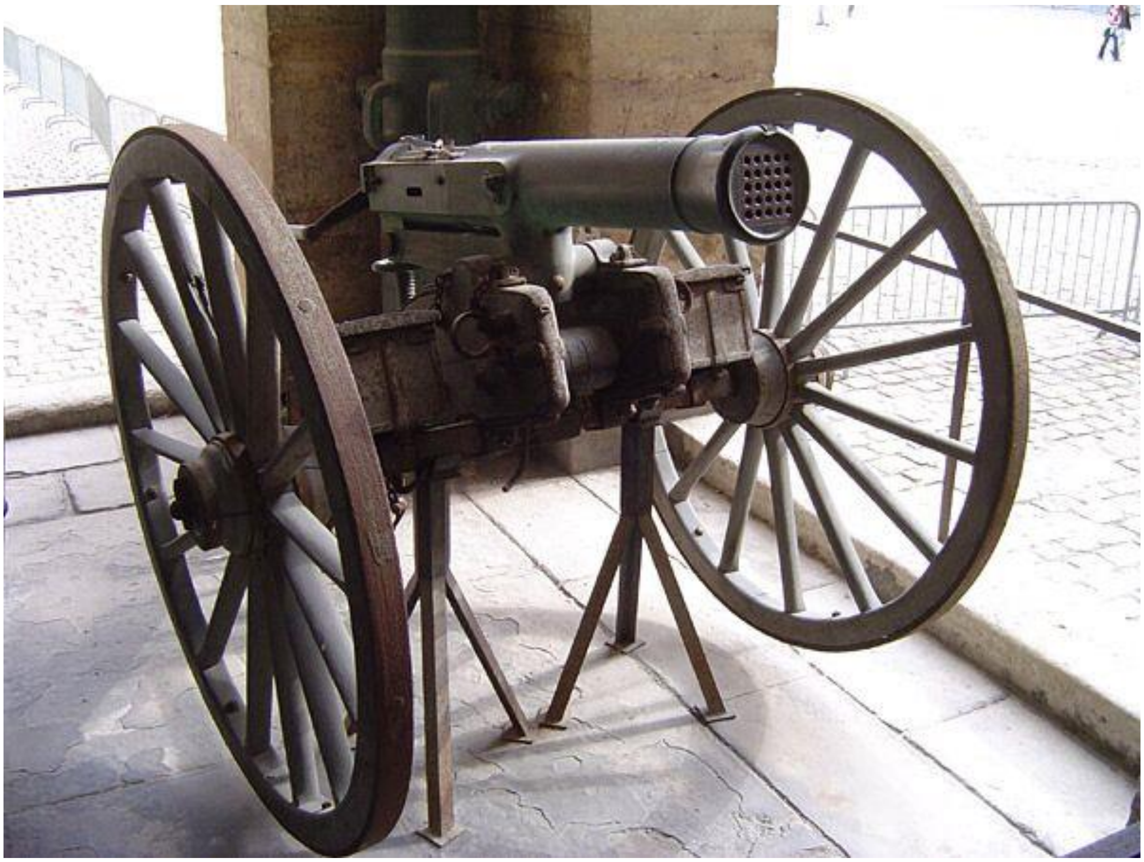

Figure 25: A "de Reyffe" *mitrailleuse* of the type used by France during the 1870 war with Prussia, named for the French general that supervised its development.[117]

If used properly, the *mitrailleuse*, or *Höllenmaschine* ("hell machine") in German, could be a fearsome weapon. British correspondent Archibald Forbes, covering the opening

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[115] Stone, *First Reich*, 291; Wawro, *The Franco-Prussian War*, 53; Ellis, 63-64. *Mitrailleuse* literally means "grapeshot shooter" in French, although since the invention of the weapon the word has also come to mean "machine gun."

[116] Subj. 943.2, TNA, SUPP 6/9: Abstracts 1867, 591.

[117] http://en.wikipedia.org/wiki/File:Mitrailleuse_front.jpg, accessed 05 Oct 2014.

battle near Saarbrücken, reported the first German contact with the machine when the French used it to clear a bridge. The sound of its firing, he wrote, "was very curious and distinctive… [and] gave one a lively sensation of his coat being torn down the back." The weapon "swept the bridge thoroughly; nothing could live where its hail fell."[118] The *mitrailleuse* had two distinct flaws, however. Mechanically, the gun carriage lacked any sort of traversing mechanism. As historian Geoffrey Wawro graphically noted, fire from the weapon "tended to fix on a single man and pump thirty balls into him, leaving nothing behind but two shoes and stumps."[119] In addition, such secrecy surrounded its development that the French had no time to develop proper tactics. The army tended to use it in place of the weapon it most closely resembled: a field artillery gun, but with a shorter effective range of 1,200 yards. This left the crews exposed, and its large size prevented quick reposition of the gun. German forces rapidly learned that their Krupp cannon outranged the *mitrailleuse* and often smothered the guns with artillery fire before the French could bring them into action.[120]

Although a battlefield failure, the concept of the *mitrailleuse* appealed to seasoned gun designers and amateurs alike. The War Office received seventy proposals related to various forms of the weapon in the next ten years; two dozen came in 1870 alone, and ranged from the practical to the fantastic. Noted gunmaker Joseph Needham, for example, submitted a photograph of his thirteen-barrel, swivel-mounted gun, although the Special Committee already investigating such weapons felt his design "far inferior to others under consideration."[121] Mr. H. R. Addison claimed to be "the original inventor of the weapon

[118] Stone, *First Reich*, 52-53.
[119] Wawro, *The Franco-Prussian War*, 99.
[120] Ellis, 64; Wawro, *The Franco-Prussian War*, 53.
[121] Subj. 2563.2, TNA, SUPP 6/19: Abstracts 1870, 511.

termed the 'Mitrailleur,'" and submitted a description of a lightweight weapon that "can be worked and transported in pieces from place to place by four men," but without much further detail.[122] Mr. J. Black forwarded "sketches of a revolving field piece of his invention" with an improbable "600 to 1,000 barrels," whereas Mr. A. Bryant's design required ten men to operate – but had the added bonus of "elements of a war chariot."[123]

Unfortunately for these hopeful arms inventors, the Experimental Branch already had the Montigny *mitrailleuse* and its closest rival, the American Gatling gun, under consideration for some time. Experiments with the two systems began in August of 1870, leading the *Pall Mall Gazette* to remark that "it is not often that the quiet, dispassionate inquiries of the practice ground are carried on contemporaneously with the ruder trials of actual warfare." Comparative shooting took place between the Montigny gun, Gatlings of four different calibers, case shot and shrapnel from 9- and 12-pdr rifled breech- and muzzle-loading guns, and rapidly-fired Martini-Henry and Snider rifles, at various ranges against both dummies and wooden targets. "Of the two systems of machine guns," the Special Committee reported, "the Gatling has proved to be far superior" despite a report from two years earlier in favor of the Montigny. The Committee therefore recommended the "immediate introduction of the small Gatling gun for employment in the field," with the understanding "that they do not for a moment contemplate [machine guns] supplanting or displacing a single field gun."[124]

Refinement of Britain's first machine gun continued into 1871. Sir William Armstrong's firm, which represented Gatling's interests in Britain, worked with the "Special Committee on Mitrailleurs" to reduce the overall weight of the gun and produce appropriate

[122] Subj. 3226, TNA, SUPP 6/19: Abstracts 1870, 565.
[123] Subj. 3228 & 3229, TNA, SUPP 6/19: Abstracts 1870, 566.
[124] Subj. 943.2/2873, TNA, SUPP 6/19: Abstracts 1870, 416-426.

carriages.[125] What should have been an off-the-shelf purchase, however, was needlessly complicated by the Committee's decision to use the Boxer-Henry cartridge in the small Gatling, in an effort to have a common type of ammunition for both rifle and machine gun. The soft brass foil that covered the cartridge and the great difference between the diameters of the neck and body made the service Martini-Henry cartridge extremely prone to jamming inside the gun's drum magazine. Eley Brothers, the nation's largest private ammunition company, approached the War Office in April, "prepared to submit suitable cartridges for the Gatling gun, which will be found to fulfill every condition required." When asked if they wanted samples, however, the presiding officer of the Gatling committee replied that "the Royal Laboratory is capable of doing all that is necessary." In fact, the Laboratory failed to develop a satisfactory .45" Gatling cartridge based on the Boxer case, and the Committee elected to adopt a special solid-cased cartridge, one *not* interchangeable with the Martini-Henry rifle.[126]

"A Frightful Accident:" The Return of Breech-Loading Artillery

Although Britain had elected to revert to muzzle-loading ordnance for the Royal Navy, breech-loaders continued to serve alongside the new wrought-iron muzzle-loading guns in the Royal Artillery. Adye used the opening of hostilities between France and Prussia to press for replacement of the heavier siege train and coastal defense Armstrong guns with muzzle-loaders. In November of 1870, however, he also authorized the preparation of a number of batteries of 12- and 20-pdr Armstrong breech-loaders as well as the new 9-pdr

[125] Subj. 2873, TNA, SUPP 6/19: Abstracts 1870, 163-164.
[126] Subj. 2253.3, TNA, SUPP 6/20: Abstracts 1871, 124; Peter Labbett, *British Small Arms Ammunition, 1864-1938: Other Than .303 Inch Calibre* (London: P. Labbett, 1993), 67-77.

rifled muzzle-loading bronze guns recently adopted for service in India.[127] Despite such a move, Adye and the Royal Artillery clearly preferred to return to muzzle-loaders for all their ordnance. In 1871 the Germans arranged to exchange an example of their 4-pdr cast steel Krupp breech-loading gun "with carriage and equipment of latest pattern" in return for the new British 9-pounder. The German field piece arrived at Woolwich in early June.[128] Although judged "an efficient weapon," in firing trials the "Special Committee on Shell Guns" found the Krupp weapon "complicated in construction and inferior in power" when compared to the new British muzzle-loader via velocity tests by electric chronograph.[129]

The development of a less-expensive method of wrought-iron ordnance construction contributed to the British military's reluctance to part with their front-loading cannon. Designed in 1865 by R. S. Fraser, the principal executive officer at the Royal Gun Factory, this system simplified the Armstrong principle of building up a gun with successive wrought iron tubes wrapped around an inner steel barrel. Unlike Armstrong's, the Fraser design used cheaper iron and fewer but longer tubes. Such a design allowed the Royal Arsenal to manufacture muzzle-loaders of extraordinary size and strength at £70 per ton of weight, as opposed to £100 for the Armstrong version.[130] For an empire with an inventory of thousands of heavy guns, the cost of ordnance upgrades played a large role in making arms-related decisions. In 1871 Britain adopted a 35-ton gun with a 12-inch bore; from there the guns became larger and larger as the armor on board ships increased. The largest actually produced was a monster 17.72-inch, 100-ton cannon, although designs of 160-, 190-, and 220-ton weapons were drawn up in 1878 on the Navy's request for a gun capable of

[127] Subj. 3168, TNA, SUPP 6/19: Abstracts 1870, 545-553. A battery consisted of six guns with limber and various support wagons.
[128] Subj. 2020.2, TNA, SUPP 6/20: Abstracts 1871, 32, 121.
[129] Subj. 2861.2, TNA, SUPP 6/21: Abstracts 1872, 157-158.
[130] Hogg 1963, 904-905.

defeating yard-thick armor.[131]

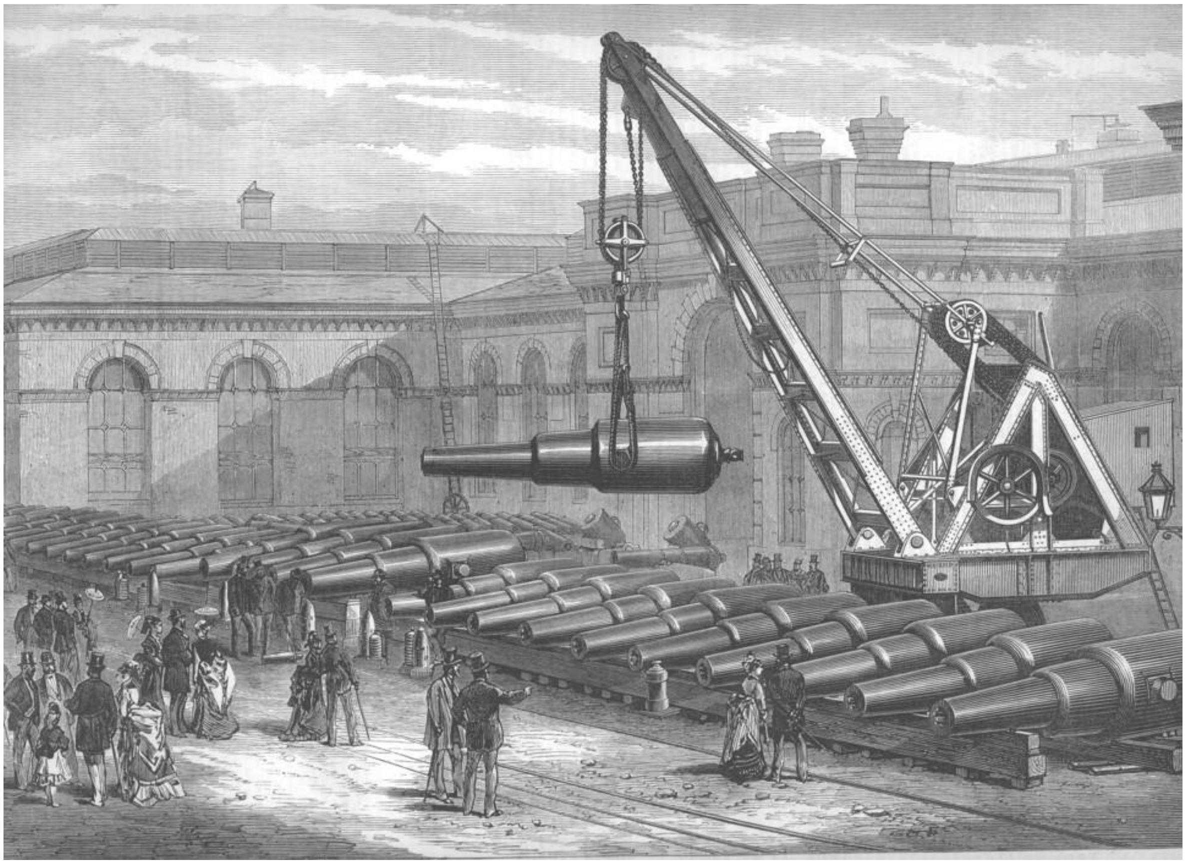

Figure 26: The "Woolwich Infant School." Lined up for inspection by the Czar of Russia, these include guns from 20 tons up to the largest, a 38-ton being dangled from the crane.[132]

Even as the Arsenal underwent development of the "Woolwich Infant," as the press later nicknamed the new 35-tonner, Krupp tried to "call attention to the principal advantages that his system of breech-loading for heavy ordnance" had over muzzle-loaders. In 1870 he suggested that Britain order "an 11-inch gun, such as he has supplied to Russia and other countries" for comparison against the service RML gun "as to ease in working, range, accuracy, and power against an iron shield." Maj. Gen. Lefroy, then Director-General of Ordnance, noted that "the mistrust of breech-loading guns in the Naval Service is very

[131] Subj. 2578.2, TNA, SUPP 6/27: Abstracts 1878, 72-73.

[132] "The 'Infant School' at Woolwich Arsenal." *The Illustrated London News*, 27 June 1874, reproduced at http://www.londonancestor.com/iln/woolwich-arsenal.htm, accessed 14 Oct 2014.

strong," and felt it "needless to open the question" at that time. Krupp repeated the suggestion in 1872, offering to supply one of his 12-inch, 34-ton breech-loaders "such as he is at present making for several continental governments" for tests "against any other class of gun." Adye also saw "no reason at present for re-opening this question," although he did think "it would be desirable at all events to obtain full details of the gun referred to."[133]

By 1874, Germany had taken advantage of improvements in gunpowder and gun construction to upgrade their 4- and 6-pdr field guns, mostly worn out from the war with France, to a more advanced 88mm design. With nearly twice the effective range of their older guns and firing redesigned ammunition, the new "C-73" gun could outrange and outfight the field artillery of any other European power.[134] Britain, in the midst of updating its own field guns, discovered that its new 13-pdr muzzle-loader, intended to supplant the lighter 9-pounders, were now "inferior in ballistic effects to that of some continental nations," again through chronographic velocity tests. The following year, the Superintendent of the Royal Gun Factory proposed to adapt the French-designed "interrupted-screw" breech to a 12-pdr gun, but no action seems to have been taken on the idea for the next four years.[135]

British recalcitrance in the face of the new French and German guns can only be explained by its reluctance to take risks in weapons programs unless absolutely required to, driven in part by the unwillingness of Parliament to adequately fund its military. Concerned about the nation's increasing artillery backwardness, on 05 April 1875 Royal Navy Capt. Philip Nolan rose before the House of Commons to "call attention to the present exceptional position of the country as regarded the manufacture of muzzle-loading ordnance, a system

[133] Subj. 3261.K, TNA, SUPP 6/21: Abstracts 1872, 304-305.
[134] Eric Dorn Brose, *The Kaiser's Army: The Politics of Military Technology in Germany During the Machine Age, 1870-1918* (Oxford: Oxford University Press, 2004), 31.
[135] Subj. 3163.5, TNA, SUPP 6/28: Abstracts 1879, 548-550. The *Abstracts* do not indicate which Superintendent proposed the design.

abandoned by the Continental Powers of Europe." The question was answered by Lord Eustace Cecil, the Assistant Secretary of War, and illustrates the unwillingness to risk all but the tried-and-true. Cecil defended the government's decision to retain muzzle-loaders by reciting a list of previous judgments on the matter. He also claimed that "the Artillery opinion of Woolwich was quiescent upon the subject at this moment…[without] any very strong opinion one way or the other." "The Government," Cecil added, had "committed itself entirely to the muzzle-loading system; the plant at Woolwich was adapted to the sole manufacture of that system of gun, and it would now require an immense superiority in the breech-loader to induce them to adopt that system."[136]

Krupp tried once more to interest Britain in his heavy breech-loaders that same year. During June debate over the reconstitution of the OSC, a member of the House of Commons charged that the German gun-maker had never offered to sell an example of his guns to Government, perhaps out of "fear of the severity of the test to which it would be put."[137] In response, Krupp essentially demanded an ordnance shoot-off. He stated that on order of the Government he would make "a breech-loading steel gun of any desired calibre, and to weigh up to 150 tons, with all the latest improvements…to be tested in any reasonable manner" against an English gun of similar size." Krupp asked, however, that the test take place at his own practice grounds in Germany "on account of the inexperience of the Woolwich Staff in working such guns, and also because of prejudice against breech-loaders." The Assistant Director of Artillery responded by noting that, although he had seen the Krupp guns exercised and recommended obtaining one for testing, a thorough comparison "of different systems of guns is not so simple a matter." The three-year trial of the "relatively light"

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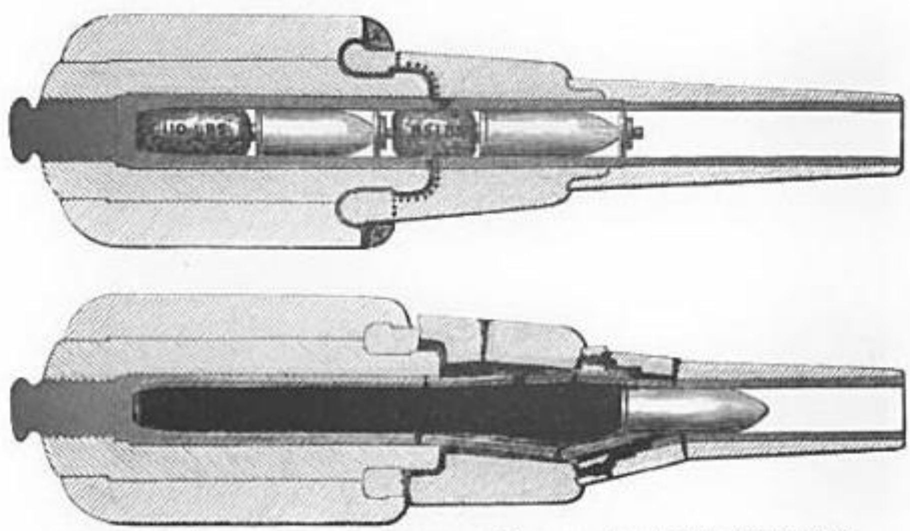
[136] "Army – Artillery – The Woolwich System Of Rifling – Questions," HC Deb 05 April 1875 vol 223 cc303-19; see also Beeler, 74-75.

[137] "Resolution," HC Deb 22 June 1875 Vol 225 Cc317-50.

Armstrong and Whitworth guns had cost £32,000, “much less than would be the case in trying the guns now proposed.” Finally, “muzzle-loading wrought iron guns have been introduced [into British service] after exhaustive trials, and both the Navy and the Royal Artillery appear satisfied with them.”[138] Krupp’s challenge went unanswered.

Figs. 76 and 77.



SECTIONS OF THE TWO 'THUNDERER'S' GUNS (SHOWING PROBABLE MODE OF BURSTING).

Figure 27: The Burst Gun from the *Thunderer*.[139]

On 03 January 1879, a “frightful accident” aboard one of the ships armed with the “Woolwich Infant” forced the British nation to reconsider its choice of ordnance. During a live-fire exercise in the Mediterranean, one of the 38-ton 12-inch guns in the forward turret of *H.M.S. Thunderer* burst explosively, killing eleven men and wounding another thirty-six. The “Woolwich Correspondent” for the *London Standard* wrote the next day that officials at the Royal Arsenal received the news “mingled [with] consternation and incredulity. That one of the Woolwich guns…should burst passed comprehension and belief.” “It had become a fundamental principle in the Royal Gun Factories,” the author continued, “that, by fair

[138] Subj. 1998/3261.K, TNA, SUPP 6/24: Abstracts 1875, 368.
[139] Sir Thomas Brassey, *The British Navy: Its Strength, Resources, and Administration*, Volume 2 (London: Longmans, Green, and Co., 1882), 84

means, it was not possible to burst one of its guns." Yet the impossible had happened, and "the authorities at Woolwich refuse to attribute the accident to any fault of the gun itself…it may be stated that any gun in existence may be destroyed by careless loading."[140]

A special committee investigating the accident reported on 13 February that, in fact, the theory postulated by the "Woolwich Correspondent" was correct. The gun had unknowingly been double-loaded, a situation that arose from the unfortunate combination of several factors: a misfire that left the previous charge in the barrel, the crew drill used to work the gun, and hydraulic loading equipment without a barrel obstruction indicator of any sort.[141] Ultimately, all of these factors traced back to the Navy's insistence on retaining muzzle-loading ordnance. To confirm the committee's findings, the Admiralty returned the surviving 38-ton gun to Woolwich, which was turned over to the "Special Committee on the Construction of Ordnance" appointed in May for further tests. Housed in a specially-built "bursting cell" constructed at the cost of £2,100, the special committee drew up plans to test the alternate theories of why the gun burst, including that of the gun having been double-loaded. One by one, all were proved wrong except for the latter. Loaded with a duplicate double charge as determined by the investigating committee, the other gun finally burst in a manner nearly identical to that aboard the ship.[142]

The *Thunderer* accident followed hard on the heels of a war scare with Russia the year before, which had worried Parliament into purchasing three partially-completed iron-

[140] "Bursting of a Thirty-Eight Ton Gun." *London Standard*, 04 January 1879, 5.

[141] HCPP, "Report of the Committee Appointed to Inquire into the Cause of the Bursting of One of the 38-Ton Guns in the Turret of H.M.S. 'Thunderer,' 13th February 1879." 1879 (C.2248), 16.

[142] Subj. 3288, TNA, SUPP 6/28: Abstracts 1879, 390-393, 584-585, and TNA, SUPP 6/29: Abstracts 1880; "HMS Thunderer – and the End of Muzzle-Loaders in the Royal Navy," accessed 14 Oct 2014, http://site-5.brussels.dinkycms.com/hms-thunderer-and-the-end-of-muzzleloaders-in-the-royal-navy

clad warships originally commissioned by Turkey just the year before.[143] Fortunately for Britain, Sir William Armstrong's ordnance company had pressed forward with the development of breech-loading cannon, and stood ready to bring new designs forward. In August of 1879, the Admiralty forwarded to Gen. Campbell an offer from Sir Armstrong of a new 8-inch breech-loading gun. Armstrong had "kept on hand for many months the particular gun, in the hope of its being tried by the Government," but without orders prior to the accident had decided to sell the original. Armstrong, however, had "in progress, a considerable contract for these guns" with various foreign governments, and stated if an "early trial" could be arranged, one could be made available – to which the president of the Special Committee readily agreed.[144] By the end of the year, the Navy evinced interest in Armstrong's 12- and 10-inch guns as well, along with a 20-pounder for boat service.[145]

Breech-loading guns also returned to the Royal Artillery. In September 1879, as work neared completion on the new 13-pdr muzzle-loading field piece, the heads of the manufacturing departments sat down for their weekly meeting. In light of the *Thunderer* accident and the Admiralty's new-found interest in breech-loaders, the Arsenal's chief officers decided that "before the manufacture of any larger number of [muzzle-loading] guns is undertaken," the forgotten 1875 breech-loading design needed to be put to trial. A crash development program ensued, with as many of the main features of the new gun made to match the muzzle-loader as far as possible, including a common bore size to allow it to fire the same ammunition.[146] By 1880 the first six-gun battery was ready, and the Royal Horse

[143] Jon Tetsuro Sumida, *In Defence of Naval Supremacy: Finance, Technology, and British Naval Policy, 1889-1914*. (Naval Institute Press, 2014, https://books.google.com/books?id=ZVT5AgAAQBAJ), and "Reported Purchase of the Turkish Ironclads by the English Government." *Western Daily Press*, 12 February 1878, 8.
[144] Subj. 3288, TNA, SUPP 6/28: Abstracts 1879, 393.
[145] Subj. 3288, TNA, SUPP 6/28: Abstracts 1879, 584-589.
[146] Subj. 3163.5, TNA, SUPP 6/28: Abstracts 1879, 548-550.

Artillery took possession of Britain's new breech-loading field guns "to ascertain [their] suitability…for the knocking about amidst dust and mud and bad weather which they must expect on active service."[147]

Although Woolwich had perfected wrought-iron muzzle-loading guns as far as possible, such weapons were a technological dead end. By 1879 the Committee on Explosives had several years of research into different shapes and compositions of black powder based on a better understanding of its action on explosion. Krupp's all-steel cannon also pointed the way towards the future of ordnance, especially as British metallurgical methods improved. Rifled muzzle-loading artillery remained in service for nearly two more decades, but the *Thunderer* accident had finally broken the fascination that British ordnance authorities had with a centuries-old method of loading cannon.[148] Although unfortunate that it cost the lives of eleven sailors, had the British met the Germans in battle beforehand – or the Russians, or any other of Krupp's major customers – the cost of the lesson would have been much, much worse.

A Dysfunctional Military-Industrial Complex?

Dwight D. Eisenhower, in his farewell speech to the American public, introduced the phrase "military-industrial complex" to describe the relationship between government, the military, and private industry.[149] Tracing weapons development through the *Abstracts of Proceedings* in this era makes clear that such a complex was in development in Victorian Britain. While most - but not all - of the proposals brought before the War Office came from

[147] "The New Breech-Loading Field Guns." *Western Daily Press*, 06 September 1880, 7.

[148] The *Abstracts* for 1895 shows some of the last questions related to heavy RML ordnance, including the monster 17.72-inch gun emplaced at Malta; see Subj. 2641, TNA, SUPP 6/95: Abstracts 1897, xix. Presumably they were all retired between then and 1900, when the *Minutes of Proceedings* resumed including an index.

[149] "Military-Industrial Complex Speech, Dwight D. Eisenhower, 1961," *Public Papers of the Presidents: Dwight D. Eisenhower, 1960*, accessed 12 Jan 2015, http://coursesa.matrix.msu.edu/~hst306/documents/indust.html.

outside of Woolwich and Armstrong's Elswick Ordnance, several other firms participated in the weapons development process. Generally, the work done by such companies formed part of long-running programs under the supervision of the appropriate special committee. The engineering firm of Easton & Anderson worked with the Royal Arsenal in developing the Moncrieff disappearing carriage and other projects, and steelmakers such as Vickers & Sons and John Brown & Co. supplied a variety of steel products such as shot, shell, and artillery targets.[150] Such contracts, however, were for things either outside the expertise of the Royal Arsenal, such as casting steel, or for small numbers of items needed on an occasional basis.

A nascent "military-industrial complex" therefore existed in Britain during this period, resting primarily in the relationship between the Arsenal and Elswick but with the participation of other companies. The lack of a central controlling committee to oversee weapons development, however, made the relationship unstable. The *Abstracts* demonstrate that the War Office had no conscious desire to foster military industrial growth at home, as witnessed by its refusal to give orders to the Hale Rocket Company, Eley Brothers, and others. Indeed, the British military's preference for developing its weapons in-house grates against a professed policy of "free trade" by Government, to the point of handicapping its armed forces. The prolonged birth and perfection of the Martini-Henry rifle serves as a good example; by laboring so long to construct the best possible weapon, Britain could just kept pace with its potential rivals. This coupled with a refusal to admit it had fallen behind in some areas – as in the case of the composite Boxer cartridge case – meant that British infantrymen went into battle with a weapons system that could, and sometimes did, fail.

[150] E. I. Carlyle, rev. Ian St John. "Anderson, Sir William (1835–1898), Director-General of the Royal Ordnance Factories." *ODNB*, 2004, http://www.oxforddnb.com.ezproxy.lib.uh.edu/view/article/507, and "Easton and Anderson." Grace's Guide, 21 Jan 2015, http://www.gracesguide.co.uk/Easton_and_Anderson.

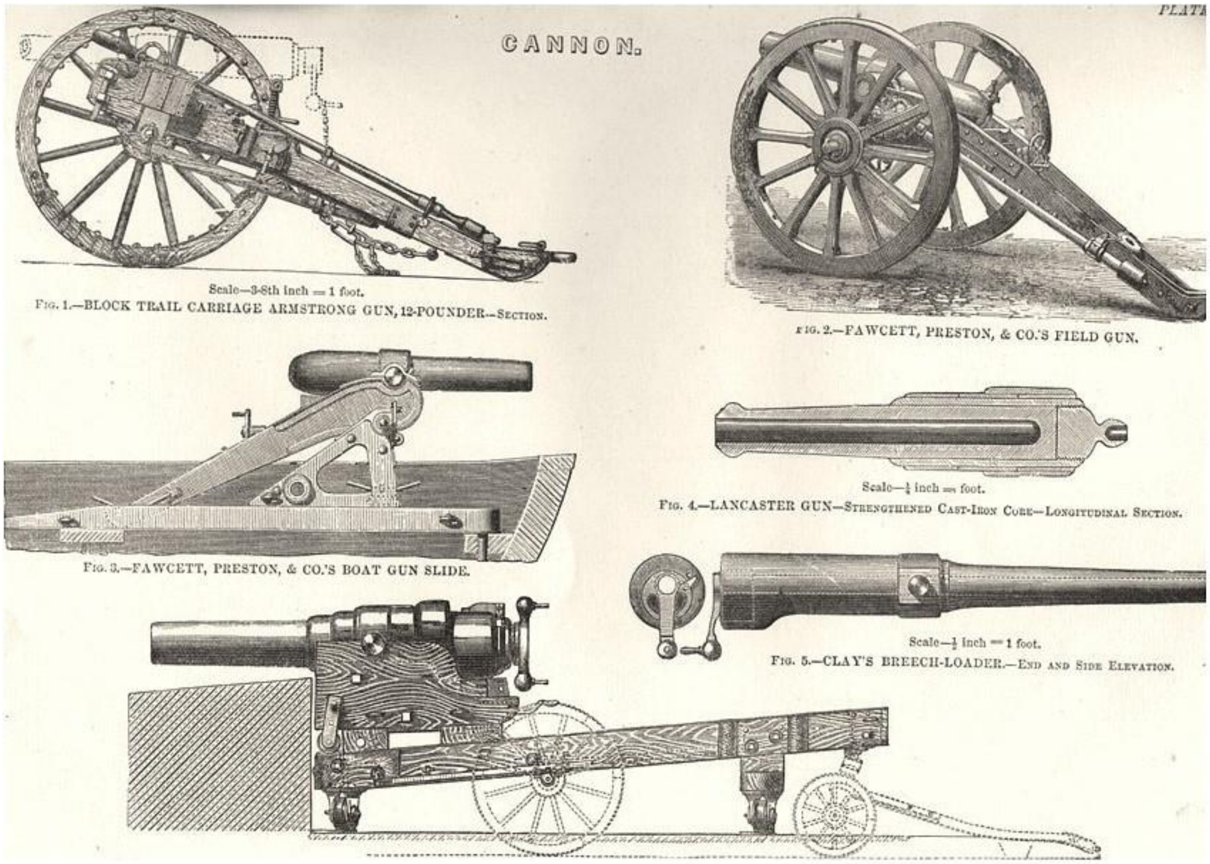


Figure 28: Various forms of guns and carriages from different British manufacturers circa 1875.[151]

The committee "system" also contributed to the muddle constraining British military technology in this era. Although work continued through the 1870s on all manner of projects, unless actively supervised by a special committee things occasionally fell by the wayside, such as the 1875 design for a breech-loader to match the German "C-73." Even when directed, decisions on weapons were not timely, as in the case of the Martini-Henry rifle, which also suffered from the introduction of conflicting ideas and prejudices into the refinement phase of the program. The Duke of Cambridge's lack of practical experience and position as the nation's highest military authority (as Commander-in-Chief) also led to

[151] *The National Encyclopædia: A Dictionary of Universal Knowledge*, Library Edition, 1875, Plate 1.

questionable decisions, such as the elimination of the rifle's safety mechanism in 1873.[152] It also led to continued resistance to the introduction of repeating rifles into the service, proven in battle in the American Civil War, by the Turks at the siege of Plevna, and under serious consideration by other European nations. When offered an example of the new magazine arm being fielded by Austria, Campbell commented that "we do not contemplate introducing repeating arms into the service, and do not…think we should ask the Austrian Government to give us a specimen."[153]

Another area of dysfunctionality lay with the money that Parliament made available. The British military services, charged with defending an increasing empire, lived in feast-or-famine mode during the 1870s, as shown by the emergency acquisition of half-finished Turkish ironclads during the war scare of 1878. Gladstone slashed over £3 million from army and ordnance expenditure between 1868 and 1870, reducing spending to £12.1 million – the lowest amount since 1854. Although spending increased in 1872, expenditure remained relatively flat until the war scare of 1878. The Navy's budget was squeezed even harder, with Parliament only begrudgingly increasing it from a paltry £9 million in 1871 to a high of £11.8 million in 1879.[154] Such an existence, coupled with the sheer size of the Empire, made the appeal of cheap solutions – such as the Fraser wrought-iron muzzle-loading gun and the Boxer cartridge – irresistible in an era still dominated by the tenets of Gladstonian finance. In

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[152] Two years later, this decision baffled the Duke of Cambridge. He could not believe that any rifle "can be considered safe in the hands of the troops, unless a half-cock can be introduced" - a physical impossibility, since the weapon had no external hammer as did every previous British military small arm. He had to be reminded of this and that he signed off on the change. See TNA, SUPP 5/893, 61.

[153] Subj. 3301.K, TNA, SUPP 6/29: Abstracts 1880, 280. Turkey had purchased 50,000 Winchester repeaters in 1869 and used them to devastating effect against the Russians in their 1877-1878 war. In the opening battle of the siege, the Turks lured their Russian attackers into Plevna and ambushed them at close range. The Russians lost over 2,800 men, mostly to Winchester fire, compared to only forty-two on the Turkish side. See "The Plevna Delay: Winchesters and Peabody-Martinis in the Russo-Turkish War." *Man at Arms Magazine*, 1997 Vol. 19 No. 4, reprinted at http://www.militaryrifles.com/turkey/Plevna/ThePlevnaDelay.html.

[154] Brian R. Mitchell, and Phyllis Deane, *Abstract of British Historical Statistics* (Cambridge, UK: University Press, 1962), 396-398; see Appendix 4.

addition, demands for materials routed through the Director of Artillery's office, whether for experiment or otherwise, were routinely scrutinized and occasionally reduced. The Special Committee on Ordnance, in drawing up a program to test Armstrong's 8-in. RBL gun in 1879, suggested a firing program of "at least 500 rounds," but Campbell replied that "only 200 rounds were to be obtained at Government expense."[155] In the case of a request from Malta for special railroad trollies used for moving artillery shells from the island's magazine to its heavy gun emplacements, Campbell approved only four out of the two dozen originally requested.[156]

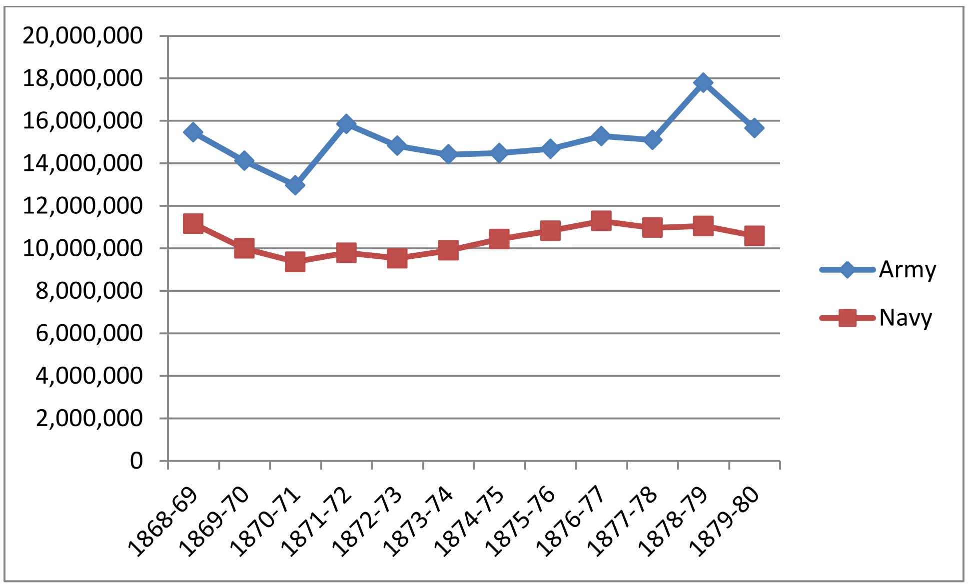

Figure 29: Comparison of Army and Navy Estimates, 1869 - 1880

Parliament and the War Office complicated matters through an ill-defined system of awards, which caused no end of friction between Government and inventors. Sir William Palliser received £22,500 in rewards for his system of converting cast-iron smoothbores into rifled guns, for example, which made two different inventors jealous.[157] Perceval M. Parsons, who had approached the OSC with a similar proposal in 1860, badgered the War Office

[155] Subj. 3288, TNA, SUPP 6/28: Abstracts 1879, 393.
[156] Subj. 2156.60, TNA, SUPP 6/28: Abstracts 1879, 317.
[157] Subj. 1913.2, TNA, SUPP 6/10: Abstracts 1868, 591 and TNA, SUPP 6/17: Abstracts 1869, 35;

incessantly, finally being awarded £1,000 after arbitration.[158] Col. Boxer also appealed for further rewards, only to have a financial deal between himself and Eley Brothers for his cartridge patent uncovered in the process. Cardwell requested his resignation after Boxer refused to disclose details of the arrangement.[159] Boxer at least had been allowed to apply for patents; not so R. S. Fraser, whose request to patent his method of gun construction "was refused, on the grounds that [he] was to be adequately rewarded."[160] Fraser put a claim forward for reward before the OSC in 1867, and although it judged that "all the risks of failure" in the development of his system "have been borne by the Government," recommended a flat sum reward of £6,000 and a raise. Although he received the raise, then Secretary of War Sir John Pakington lowered the flat sum by £1,000. Both Fraser and then-Col. Campbell, who worked together on the project, felt the money to be inadequate, and Fraser brought the subject up again in 1876 during Campbell's tenure as Director of Artillery, who passed the matter to the Ordnance Council with a strong recommendation for "the most favourable consideration."[161] Noting that Fraser's method of construction had saved the country £800,000, the Council "recommended an immediate additional grant of £10,000, and a final payment of £5,000 at the end of further five years of service." Although approved by then-Secretary Gathorne Hardy, the Treasury refused any further payment four times; in April of 1880 it relented, but agreed only to the final payment.[162]

The changing attitudes of the various Secretaries of War towards patents and rewards only exacerbated Fraser's case. In 1867, then-Secretary General Peel remarked that he did

[158] TNA, SUPP 6/48, "No. 2: Mr. Parson's Case."

[159] HCPP, "Copy of Papers Relating to the Dismissal of Colonel Boxer from the Office of Superintendent of the Royal Laboratory," 1870 (60). Boxer did receive an honorary promotion to Major-General for his years of service at the Royal Arsenal.

[160] TNA, SUPP 6/49, "Ordnance Council, Proceedings, 1872-1888," "No. 37: Mr. Fraser's Claim."

[161] "No. 37: Mr. Fraser's Claim."

[162] TNA, SUPP 6/749, "Ordnance Council: Abstracts of Proceedings, 1-202," 15.

"not think it would be politic to lay down as a rule that officers of the Department should not be rewarded for any inventions." Such a rule, Peel felt, "would lead to your losing the services of some of your cleverest men, who would not consider the *pleasure* of inventing a sufficient reward." Cardwell, however, "considered it to be the duty of Officers employed in the Manufacturing Departments to suggest any improvements which may occur to them… [without claiming] a reward for such improvements as their *right.*"[163] Finally, in 1872 the War Office prohibited any "officer or other person…employed in the manufacturing or experimental departments" from obtaining or holding "any Letters Patent for articles needed for the use of the Government.[164] Apparently this applied only to military officers and managerial civilian employees, as a foreman in the Royal Laboratory, Mr. T. Jackson, received a patent in 1875 for a machine that wrapped the paper patch around Martini-Henry bullets.[165]

Although in many ways dysfunctional, the military-industrial complex then growing up in Victorian Britain could operate well. Once the *Thunderer* accident forced British military authorities to re-evaluate their chosen style of ordnance, Sir William Armstrong's company rapidly stepped up to offer remedies. In addition, the long history of military technical intelligence started by the OSC kept Arsenal authorities abreast of foreign developments, allowing it to react quickly in the face of new developments. This included the adoption of the Gatling gun, and the crash development of a new field gun based on the nearly-forgotten 1875 plan. It also included a radically new piece of naval ordnance, the Whitehead self-propelled torpedo. Brought into the country for demonstration in 1870, the potential of the weapon led to Britain's purchase of the license and right of manufacture the

[163] "No. 37: Mr. Fraser's Claim."
[164] TNA, SUPP 6/21: Abstracts 1872, 318.
[165] TNA, SUPP 6/749, 28.

next year.[166] By 1880, Woolwich technicians had materially increased both the speed and range of the "fish torpedo," and had begun testing a variety of methods for guidance.[167]

Despite such success, the fatal explosion on board the *Thunderer* led many Britons to question the condition of the nation's military technology, and the system which developed it. The questioners included one of the system's very architects: Sir John Adye, promoted to the post of Surveyor-General of Ordnance in 1880. Adye came to his new office with an understanding of the strengths and weaknesses of the system from his five years as Director of Artillery. Adye also brought a new-found appreciation for the rapid pace of change in military hardware then underway, a pace that would not let up any time soon – and one that Britain needed a better mechanism for coping with.

[166] Charles William Sleeman, *Torpedoes and Torpedo Warfare: Containing a Complete and Concise Account of the Rise and Progress of Submarine Warfare* (Portsmouth: Griffin, 1889), 177.

[167] "A Problem Solved." *Alnwick Mercury*, 24 January 1880, 2.

Chapter 6: An "Epoch of Change and Improvement?" The Ordnance Committee, 1881-1889

The *Thunderer* accident drew considerable public attention to the state of British ordnance in 1879, and illustrated a disturbing fact: Great Britain, Europe's leading industrial nation, had fallen behind the rest of the Continent in its choice of ordnance. The long experiment with separate technical committees had failed; to stay current the country needed a full-time committee dedicated to weapons development. Reconstructed in 1881, the new Ordnance Committee added this needed second tier to the War Office's mechanism for technology evaluation. The Director of Artillery and his Experimental Branch sifted out the practical from the unworkable, and handed the former to the new committee for testing and implementation. Most questions related to new ordnance came from the War Office itself, but the public's continued efforts to bring forth new ideas made the screening function, which the older OSC lacked, an important part of the process. Although weaponry had advanced beyond where the average civilian or soldier could suggest a useful change without extensive technical education, hopeful inventors continued to try, especially as newspapers spread information about new and potentially useful weapons. If chemically unstable compounds, such as early forms of dynamite, couldn't be fired from guns, why not use giant crossbows or compressed-air cannon? Why couldn't infantrymen, such as those slaughtered by the Zulu at Isandlwana, use portable iron shields for defense? These questions and more were among the hundreds that came before the Ordnance Committee over the next several years. On the whole, the process worked; although rifled muzzle-loading artillery remained in service for some years – Victorian governments being nothing if not frugal – by the end of the decade both the army and Royal Navy were taking delivery of modernized breech-loading guns of much greater range and power.

In addition, the *Abstracts of Proceedings* published by the Ordnance Committee show the ripple effect that even a small change in military stores could have in a far-flung empire. With the changeover from black powder to cordite – a new form of propellant that emitted no smoke, yet resulted in much higher velocities than black powder – came questions in both small-arms and ordnance. Would guns sighted for black powder have the same aim point when using cordite-based charges? Would barrel life be the same? Would fuzes perform differently using the two types of propellant? How would cordite react to storage conditions ranging from extreme cold to excessive heat and humidity? Such questions occupied a considerable amount of the Ordnance Committee's time in considering the future direction of its nation's ordnance.

In the larger scope of history, however, the *Thunderer* accident serves as a bookend to two decades of highly active change in British military administration as well as its weaponry. Driven by public concern regarding combat performance abroad and the need to secure India against a covetous Russian empire, in 1886 the Conservative Salisbury government launched commission after committee to examine army administration from all angles. Such investigations included questions regarding the "warlike stores" deployed by the British military, especially – and perhaps more importantly to British politicians – the value received for the money spent. Were the millions voted annually buying the best available weaponry? Who designed the fighting men's tools, manufactured them, inspected and assured their usefulness, and delivered them into the hands of the brave lads defending British interests in far-off places? Armed with results of these investigations, Salisbury's second Secretary of War, Edward Stanhope, tried to clear out the muddle that still pervaded British military administration; his effort stopped short of a complete rebuild, however.

Although separating mixed military and civilian responsibilities in a clearer manner, one of the more potent ingredients of the muddle not only remained in place but was strengthened by Stanhope's reorganizations: the post of Commander-in-Chief, held by the increasingly reactionary Duke of Cambridge. Still responsible to the Secretary of War, Cambridge would be given direct control of the military functions of the War Office, reinforcing his position as the highest military authority in the nation. This gave him considerable influence over the civilian politicians he supposedly answered to. In addition, the duel between military and civilian authorities over war *matériel* production would be sharpened in 1888 when the Treasury Department assumed direct control of the Royal Arsenal factories. Altogether, the Stanhope reforms merely postponed the drastic overhaul that British military administration required.

Reconstituting the Ordnance Select Committee

Efforts raised in Parliament to bring back the OSC show that the idea retained the support of both Liberal and Conservative politicians. Charles Hanbury-Tracey, a Liberal representing the Montgomery borough district, rose in the House of Commons to make an unsuccessful call for its return in 1875.[1] The *Thunderer* accident, however, lent considerable urgency to the state of the nation's ordnance, and the question of resurrecting the OSC came up again in February of 1879. In a Commons debate over Maj. John Nolan's resolution for a "careful examination" of foreign systems of ordnance, Conservative MP Sir John Hay replied "he desired to see the [OSC] re-established" on a permanent basis, but with more frequent rotation of members than during its original existence. "Instituting such [a] permanent

[1] "Resolution," HC Deb 22 June 1875 Vol 225 cc317-50; see also "Hon. Charles Hanbury-Tracy," Hansard 1803-2005, accessed 20 Jan 2015, http://hansard.millbanksystems.com/people/hon-charles-hanbury-tracy/, and "The Sudeley Bankruptcy and its Contemporary Significance," *Forum for Stable Currencies*, accessed 20 Jan 2015, http://www.monies.cc/forum/backgrnd/lsudeley.htm.

Committee," Hay argued, "would give confidence and convey an assurance to the officers of both Services that the result of an impartial scientific investigation would be adopted."[2] Hanbury-Tracey, by then Lord Sudeley and a member of the House of Lords, restated his desire for a return of the OSC in debate over the *Thunderer* accident the next month. "I am told that the Admiralty propose to reappoint the Ordnance Select Committee," he said, "and, indeed, after the occurrence of this calamity, I think it is absolutely necessary that it should be re-appointed." He hoped that unlike what the earlier OSC became, any new committee "will be a judicial…and not an inventors' one; and that if any officer on that Committee became an inventor, he should at once retire from it." Lord Elphinstone replied that Government had indeed decided to bring back a permanent committee, to a "general expression of approval" among the Lords.[3] Edward Cardwell, also having been promoted to the peerage, responded with neither approval nor argument, but instead capped the debate with the "hope that it will be a Committee composed of persons in whom the country will have unbounded confidence."[4]

Despite the announcement in the House of Lords, it took a change of government to see the reconstitution of the committee. The Conservative Lord Eustace Cecil, then the Surveyor-General of Ordnance, stated before the Commons on 22 April 1879 that the new committee would "consist of four Artillery officers, including one who shall represent the India Office, two Naval officers, and one Engineer officer," but that "the names [were] not yet decided upon."[5] Occupied by the ongoing war in Afghanistan, the War Office took no

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[2] "Army – the Artillery – Breech-Loading and Muzzle-Loading Guns – Resolution," HC Deb 27 February 1879 Vol 243 cc1861-72; see also Andrew Lambert, "Hay, Sir John Charles Dalrymple, third baronet (1821–1912)," *ODNB*, 2004, http://dx.doi.org/10.1093/ref:odnb/50213.

[3] "Parliamentary Review: House of Lords." *Pall Mall Gazette*, 18 March 1879, 2.

[4] "Navy - Explosion on Board H.M.S. 'Thunderer.' – Observations," HL Deb 17 March 1879 Vol 244 cc999-1018.

[5] "Question," HC Deb 22 April 1879 Vol 245 c837.

further action in the matter; while it dithered, however, the country prepared for general elections. In a series of speeches in Midlothian, Scotland, Gladstone lambasted the Disraeli government for its willingness to use force in the expansion of the empire at the cost of millions of pounds and a high tax rate. "Beaconsfieldism," as the press called it, tangled up the country in South Africa and again in Afghanistan, which Gladstone labeled "a war as frivolous as ever was waged in the history of man.'"[6] The voting public agreed, and the Liberals recaptured the government in April of 1880. Gladstone replaced Disraeli as Prime Minister; Hugh Childers replaced Frederick Stanley as Secretary of State for War, and Sir John Adye replaced Lord Eustace Cecil as Surveyor-General of Ordnance.[7]

In October of 1880, Adye and the Director of Artillery and Stores, Sir Frederick Campbell, marshaled their arguments for recreating an ordnance oversight committee. In a minute to Adye dated 02 October, Campbell wrote that "the subject of changes in our Ordnance, Carriages, &c, is exciting much controversy." The reappointment of an ordnance committee had to be considered, he continued, "especially bearing in mind that every Foreign nation of any importance had a standing Committee to consider such subjects." Rather than the current system of multifarious committees answering to one man, "the Public perhaps would feel more confidence in decisions arrived at on the recommendations of a recognized Committee appointed expressly for the purpose of advising on such subjects."[8] Adye agreed, and passed Campbell's minute along with his own memo to the War Office on 25 October. In it, Adye remarked that the pace of change in ordnance had been such that "even now we do

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[6] Disraeli had been granted the title of Lord Beaconsfield in 1876; see Jonathan Parry, Disraeli, Benjamin, earl of Beaconsfield (1804–1881)," *ODNB*, May 2011, http://dx.doi.org/10.1093/ref:odnb/7689. "Beaconsfieldism." *Sheffield Independent*, 01 December 1877, 6; David Brooks, "Gladstone and Midlothian: The Background to the First Campaign." *The Scottish Historical Review* 64, no. 177 (1985): 42-67; 61.

[7] "The New Ministry." *Oxford Journal*, 08 May 1880, 7.

[8] TNA, WO 32/7156, "Copies of Minutes relating to the appointment of the Ordnance Committee 1880," 1-6.

not appear to have arrived at finality" in the size and power of artillery. "It is not only…Ordnance alone that has required constant study and experiment," he continued. "…Every article of military armament and equipment has…undergone consideration" in an "epoch of change and improvement." Having spent five years in the office, Adye also felt the lack of a supervisory committee meant that "the Director of Artillery is not only overworked but too much responsibility is laid on his shoulders." The Director had "not only to advise on the introduction of improvements, but to supervise their manufacture, and the distribution of Reserves for the Army and Navy all over the world."

Adye therefore recommended "that a permanent Ordnance Committee be re-established, and…if properly composed, the Public Service will be greatly benefited." He proposed naming a Royal Artillery general as president, with an engineer, two artillery, and two naval officers as permanent members; one of the latter would be vice president. He also suggested one or two civil engineers, in the manner of the original OSC as envisioned by Lord Panmure in 1855. Campbell suggested that an infantry or cavalry officer be included, but Adye did not carry that recommendation forward. Adye did, however, make specific suggestions as to pay scales for permanent members and special duty pay for associate or temporary members, "all to receive the usual traveling allowances."[9] Adye also envisioned a more restricted role for the Committee. Instead of "being vested with power to deal with all the multifarious subjects of Armament and Army Equipment," he suggested its scope be limited to "Ordnance, their Ammunition[,] Carriages and equipments and inventions connected therewith." Separate committees would still consider questions related to small arms and engineer equipment, and temporary ones could be appointed as necessary, or specialists might be attached to the permanent Committee if required. Decisions regarding

[9] TNA, WO 32/7156, 5-12.

what subjects or proposals to be considered would still rest with the Director of Artillery "who will of course consult the Military Authorities and get the sanction of the Secretary of State [for experiments] in the usual way.[10]

Two hurdles had to be cleared before a new committee could be established: the Duke of Cambridge and the Lords Commissioners of the Treasury. The Duke, who had favored the dissolution of the OSC in 1868, "strongly object[ed] to the re-establishment of [it] on its original basis" – meaning a broad-scoped committee of invention rather than a narrow one designed for evaluation. He approved Adye's plan, but only under the proviso that "it is distinctly understood that [the Committee] confines itself to the consideration" of "inventions and the conduct of experiments connected with Artillery."[11] The Lords Commissioners were even more reluctant. In a 21 January 1881 reply to the War Office, they clearly stated their "unwillingness…to concur in the revival of a Committee, which was abolished…chiefly on the score of its expensiveness." The case made by both the Secretary of State for War and the Board of Admiralty of "the absolute necessity of keeping pace with the rapid development of warlike inventions, which is so striking a feature of the present time," persuaded the Lords "not to withhold their general sanction" to recreation of the Committee.[12]

Adye issued the order forming the new Ordnance Committee (OC) on 11 March 1881, and passed to it the formal rules for the Committee received from the War Office.[13] The "General Instructions for the Guidance of the Ordnance Committee" charged the new body with "considering and reporting upon such questions as may be referred to them" by the

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[10] TNA, WO 32/7156, 7-11.
[11] TNA, WO 32/7156, 13.
[12] Skentelbery, 282.
[13] Subj. Y, RAL, "Abstracts of the Proceedings of the Ordnance Committee, 1881," 69. To differentiate between the *Abstracts* issued by the Ordnance Committee and the Director of Artillery in this era, the abbreviations "AP-OC" and "AP-DDA" will hereafter be used.

Secretary of State. Such questions related to “improvements in…ordnance and machine guns; including the method of construction” of the guns, equipment, ammunition, range-finders “and other instruments required for the efficient working of ordnance” as well as “questions connected with gunpowder and explosives generally.” Secretary of State Childers added the “Ordnance consulting officer for India” as an *ex officio* member, and stipulated that both civilians “be members of the Institution of Civil Engineers.” Unlike the OSC, the new Committee would strictly be one of evaluation; the rules expressly stated that “no new subject will be entertained…and no experiments will be undertaken by them without express authority from the War Office.” In addition, the committee members were specifically prohibited from taking out patents on any article or improvement “in any way connected with their duties.”[14] The *Times*, in reporting on the creation of the Ordnance Committee, noted that “officers of the Government manufacturing establishments will not be appointed.” “This is entirely satisfactory,” the paper said, as the Woolwich-designed gun that failed aboard the *Thunderer* “is on its trial, and those responsible for that system cannot properly sit among those who are to pass judgment upon it.”[15] The Director of Artillery and Stores remained the contact between the War Office and the Committee, responsible for handing down instructions and receiving its reports, which he would “…deal with…as the Secretary of State may direct.” The War Office also required the continued compilation of quarterly abstracts of Committee proceedings, as well as separate extracts that “omit details of private inventions and confidential information partaking of a controversial character.” Finally, Childers directed the President to “make an annual report to the War Office…stating briefly the inquiries in which the Committee have been engaged, and the general progress of artillery

[14] HCPP, “Army (Ordnance Committee). Copy of the Instructions Given to the Ordnance Committee by the Secretary of State for War,” 1881 (161), 1-3.
[15] “We are glad to be able to state that the long-.” *Times*, 25 Nov. 1880: 9.

science." This last rule formalized the Committee's role in the gathering of technical intelligence from abroad, something that the Director of Artillery's office had continued after the end of the OSC.[16]

Table 3: Membership of the Ordnance Committee, 1881

President	Gen. Sir Collingwood Dickson
Vice-President	Rear-Adm. E. H. Howard
Members	Col. H. A. Smyth, Royal Artillery (RA) Capt. Morgan Singer, Royal Navy (RN) Col. C. B. P. N. H. Nugent, Royal Engineers Capt. A. G. Cyprian Bridge, RN Major W. H. Noble, RA
Civil Members	W. H. Barlow F. J. Bramwell
Secretary	Maj. C. H. Fairfax Ellis, RA
Asst. Secretary	Capt. E. Bainbridge, RA
Associate Members	Frederick Abel (Explosives) Lt. Col. Nairne, RA (Field Artillery Equipment) Capt. J. F. Lewis (Range Finders; Machine Guns)

At the end of March, Adye gave the President of the OC, Gen. Sir Collingwood Dickson, the new committee's marching orders. All of the "special committees" whose work related to the topics of ordnance were directed to wrap up their business on the 31st, with "the final reports…submitted to [the OC] as soon as printed."[17] "The subjects to which the Committee should direct their early attention," wrote Adye, centered on "the new breech-loading guns" of all types, the carriages and platforms required for both land and sea service, and "the pattern of projectiles and powder, descriptions of cartridges, &c." Adye reinforced this with a second minute on 8 April. "The Secretary of State is desirous that the first consideration should be given to the future types of ordnance," he wrote, and "the Committee [is] to proceed without delay with the necessary experiments" on the several sizes of breech-

[16] HCPP, 1881 (161).
[17] The committees included those on Ordnance, Heavy Guns, Iron Plates and Projectiles, Explosives, Range Finders, Machine Guns, Rockets, Friction Tubes, and Siege Carriages.

loading guns and types of carriages passed to them by the Committee on Ordnance. The OC's first year of existence therefore, promised to be busy, and within weeks its original membership expanded with the addition of three associate members, as shown in Table 1.[18]

From the "Best Managed Expedition" to Disaster in Khartoum: Britain, Egypt, and the Sudan

While the Director of Artillery and the Ordnance Committee wrestled with the development of new ordnance for Britain, the nation's military remained engaged across the globe. Despite his election-year vitriol against "Beaconsfieldism," Gladstone could not keep the nation out of imperial entanglements, especially in Africa. In 1882 Britain involved itself in what historian Correlli Barnett arguably termed "the first purely imperialist British military expedition:" the invasion of Egypt.[19] Britain had a considerable financial stake in that country by 1882, beginning with Disraeli's purchase of the Egyptian government's shares in the Suez Canal in the previous decade.[20] When Egyptian nationalists threatened revolution, Gladstone sent a British fleet to support the Egyptian government in Alexandria. After an anti-foreign riot in that city claimed over a hundred Europeans killed or injured, British Admiral F. Beauchamp Seymour requested – and received – permission to intervene on 11 July.[21]

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[18] Subj. Y, RAL, AP-OC 1881, 70-72.

[19] Barnett, 319.

[20] Ismail, the perennially cash-strapped *khedive* of Egypt, had sold his shares in the Canal to Disraeli's government in 1875; five years later, as a result of consolidation of Egyptian public debt, many French investors chose to sell their bonds to London as well. See P. J. Cain and A. G. Hopkins, *British Imperialism: Innovation and Expansion, 1688-1914* (London; New York: Longman, 1993), 364, and R. C. K. Ensor, *England, 1870-1914* (Oxford: Clarendon Press, 1936), 77-79.

[21] Ensor, 77-79; M. J. Williams, "The Egyptian Campaign of 1882," in *Victorian Military Campaigns*, edited by Brian Bond, 243-78 (New York: Praeger, 1967), 242-247; Juan R. I. Cole, "Of Crowds and Empires: Afro-Asian Riots and European Expansion, 1857-1882," *Comparative Studies in Society & History* 31, no. 1 (1989): 106-33. An after-action report by Lt. Cmdr Caspar Goodrich, USN, noted that "while guns of nearly every description in their possession were used during the bombardment," including some heavy smooth-bored pieces, "the Egyptians placed the most reliance upon the Armstrong rifles." Ranging in size from 7- to 10-inch bores, they also had some 40-pdr breech-loaders. The stocks of available ammunition

Figure 30: "Naval Brigade Clearing the Streets of Alexandria with the Gatling Gun." [22]

The bombardment and occupation of Alexandria marked the beginning of several decades of British involvement in Egypt, and support for the operation came from several factions in the British Parliament. Radicals believed Colonel Ahmed Arabi Bey, commander of the nationalist forces, wanted to establish a military dictatorship in Egypt; Liberals felt the unrest posed a financial and security threat to British interests. Under pressure from both, the Gladstone government dispatched an expedition under the command of Lt. Gen. Garnet Wolseley to deal with the Egyptian nationalists once and for all. The 24,000-man force began landing at Alexandria in early August, and by 13 September the British were in position to

were "enormous" and included modern Armstrong metal time-and-percussion fuzes and hundreds of heavy anti-ship mines. See Caspar F. Goodrich, *Report of the British Naval and Military Operations in Egypt, 1882* (Washington: Govt. Print. Off., 1885), 15-23.

[22] *London Illustrated News*, 29 July 1882; cover illustration.

strike. After a several-hour night march – a difficult exercise even in peace time – Wolseley's forces smashed the Arabi nationalists at their main encampment at Ter-el-Kebir. The victory capped what Wolseley himself later considered "the best-managed expedition in British military history."[23]

Unfortunately for the British, such a swift and victorious campaign would not be repeated two years later. The effective takeover of the Egyptian government meant that Britain inherited an ongoing revolution in Egyptian-controlled Sudan, led by Mohammed Ahmed, a religious leader and self-proclaimed "Mahdi," or prophet. In November of 1883, Mahdist forces ambushed and annihilated an Egyptian army of nearly eleven thousand led by William Hicks, a retired British army officer in the employ of the Egyptian government.[24] Concerned by the growing scope of the revolt, Evelyn Baring, the British consul-general and effective ruler of Egypt, approved the dispatch of Charles Gordon to supervise evacuation of the remaining Egyptian troops and civilians from Khartoum. Gordon unwisely elected to hold the city, which Mahdist forces surrounded in May of 1884. A popular figure back home in Britain, the press soon clamored for a military expedition to rescue Gordon. Pressured by the papers, members of his own cabinet, and even the Queen, Gladstone finally relented and ordered Wolseley and the army back to Cairo in July. The expedition fought its way up the Nile and across open desert, only to arrive before Khartoum two days too late to save Gordon and the city.[25]

A war scare with Russia followed closely on the heels of the very public death of

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[23] Ensor, 79; Williams, 242; Ian F. W. Beckett, "Wolseley, Garnet Joseph, first Viscount Wolseley (1833–1913)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/36995.

[24] "The Defeat of Hicks Pasha." *Times*, 23 November 1883, 5. *The Times Digital Archive*. Web. 1 July 2014.

[25] Ensor, 81-82; J. G. Darwin, "Baring, Evelyn, first earl of Cromer (1841–1917)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/30583; Jonathan Parry, "Cavendish, Spencer Compton, marquess of Hartington and eighth duke of Devonshire (1833–1908)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/32331; Richard Davenport-Hines, "Gordon, Charles George (1833–1885)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/11029.

Gordon which represented a huge reversal for the Liberals. Victory in 1882, according to the Pall Mall Gazette, had "clearly established that the GLADSTONE Administration is not cowardly or weak, and that when the interests of the country are assailed it has the courage to defend them."[26] The death of Gordon and fall of Khartoum, however, showed what Conservative leader Robert Cascoyne-Cecil (Lord Salisbury), had long argued at "countless meetings, in parliamentary speeches, and in letters – that the Liberals could not be trusted with the stewardship of the Empire."[27] The defeat also forced Gladstone to recall Wolseley and abandon the Sudan for the time being, which gravely weakened his government. Gladstone resigned in early June 1885; there followed a rapid flip-flopping of cabinets between the two political parties, until general elections held in 1886 put the Conservatives – and Salisbury – firmly in power for the next six years.[28]

The Ordnance Committee in Operation

As Britain's troops were engaged along the Nile in the early 1880s, the Director of Artillery and the Ordnance Committee remained engaged in modernizing the nation's weaponry. The flow of investigations remained somewhat similar to that of the previous decade; all proposals received by the War Office and passed to the Director of Artillery still had to be screened by the Experimental Branch before going before the Ordnance Committee. This two-step process solved one of the principal complaints of the older OSC: that too much of their time had been spent examining impractical, unworkable, and occasionally absurd suggestions.[29] As with the decade before, the Experimental Branch checked for prior inventions, sounded the relevant heads of the Manufacturing departments,

[26] "The Victory – and After." Pall Mall Gazette, 13 Sep 1882, 1.
[27] Andrew Roberts, *Salisbury: Victorian Titan* (London: Weidenfeld & Nicolson, 1999), 309.
[28] Ensor, 86-99.
[29] See examples in Chapter 4.

and determined if there might be any merit in the idea. For the rare proposals that came before the Ordnance Committee (OC), such as H. J. Barrett's "steel wheels for field artillery and service wagons," the OC communicated with the inventor, worked up an experimental program, and reported the results.[30] Occasionally, however, the Director validated his rejection by asking the OC for its official opinion, such as with a plan for a "breech-closing apparatus for a quick-firing gun" patented and submitted to the War Office by Mr. W. E. Corrigall in 1882. As the invention could apply to both ordnance and small arms, the Experimental Branch passed it for comment to the Superintendents of the Royal Gun Factory and the Royal Small Arms Factory. Neither recommended Corrigall's design for trial. Before the creation of the OC, the Director simply passed the project to the Surveyor-General for approval of his dismissal. Instead, Maj. Gen. F. A. Campbell, then the Director of Artillery, forwarded the proposal for formal report to the Ordnance Committee, which "concur[red] with [the] Superintendents" that Corrigall's plan "is much too weak for the purpose for which it is designed."[31] On its face, the report seems like a rubber-stamping of the Superintendents' previous judgment; having the proposal judged by a larger committee, however, gave Gen. Campbell a more defensible position if the inventor questioned the rejection later.

Corrigall's plan was one among dozens of unsolicited inventions received by the War Office every year. Although the rejection rate remained high, hopeful inventors brought forward their inventions, suggestions, or claims for reward to the War Office at an average of 180 per year through 1889, a rate slightly higher than the years in between the OSC and the Ordnance Committee. The peak occurred in 1885, the last year of the 1st Mahdist War, the opening of the 3rd Burma War, and the Russian incursion into Afghanistan. Submissions

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[30] Subj. 3337.46, TNA, SUPP 6/79: AP-OC 1883, 162, 371, 557, and SUPP 6/80: AP-OC 1884, 158, 527, 724.
[31] Subj. 3288.13, TNA, WO 33/39: AP-DDA 1882, 277.

remained high for the next four years, in part because of ongoing campaigns. J. Spyker, in proposing shields for field guns and machine guns, argued that such an invention was "a necessity, as shown by the results of the Boer war" of 1881.[32] A Mr. Copeman left a model at the War Office of a transport cart with a rather complex wheel design, to get better traction in the sands of Egypt.[33] J. C. Mertz also wrote in to suggest using a special powder discovered by "a friend of his" that caused blindness. By firing shells filled with the powder at Dervish troops, Mertz claimed, "the popular belief in the pretended divine power of the Mahdi might be successfully shaken."[34]

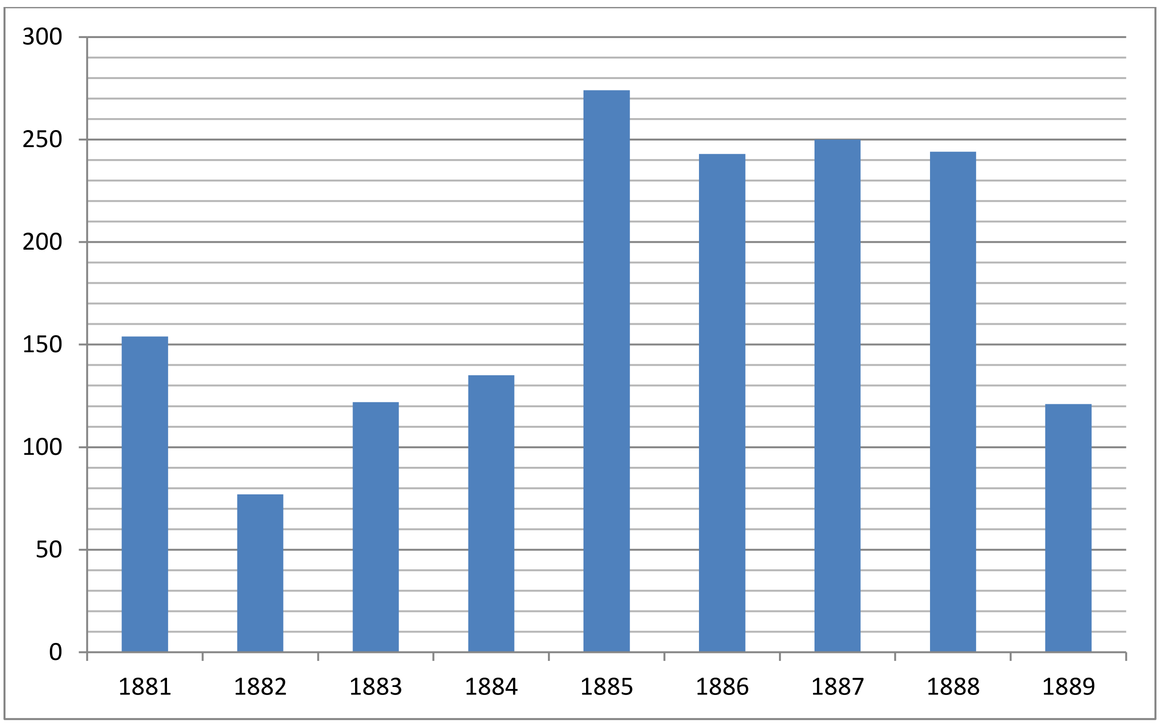

Figure 31: Submissions of Inventions, Etc. to War Office, 1881-1889[35]

Other factors also induced inventors to come forward with ideas. Specific military interests, such as the May 1888 advertisement by the War Office seeking examples of range

[32] Subj. 3163.18, TNA, WO 33/44: AP-DDA 1885, 243.
[33] Subj. 3277.12, TNA, WO 33/44: AP-DDA 1885, 135.
[34] Subj. 2322.8, TNA, WO 33/44: AP-DDA 1884, 185.
[35] Data taken from a survey of the *Abstracts of Proceedings* for both the DA and OC offices, for new subjects from submitted for consideration between 1881 and 1889. Subjects counted did not originate directly from the War Office, manufacturing departments, or officials connected with either.

finders for infantry use, generated thirty-seven submissions that year alone.[36] Inventors also sought to take advantage of changing technology. Dynamite, more powerful in its explosive effects than black powder, had obvious military applications, and despite being proven early after its 1867 patent to be too sensitive for use in explosive shells, Britons still approached the War Office promoting its use in such a role.[37] Mr. A. Houston, for example, forwarded the results of an 1885 home-made experiment in which he "fired…an Enfield rifle with regulation powder charge and 2 oz. dynamite as projectile…at a ¾-inch wooden board, distant 60 yards." Exploding on impact, the projectile made a nine-inch hole in the target and shook houses "within a radius of 1,000 yards." The DA's office dismissed his "findings" as having "no bearing upon the possible firing of dynamite from guns, which, it has been amply demonstrated, is simply impossible with any chance of safety to the gun."[38] One can only imagine how popular Mr. Houston was as a neighbor.

The war in the Sudan also seemed like an excellent opportunity to try out new weaponry, such as Hiram Maxim's recently invented recoil-operated machine gun. A Capt. A. L. Patton wrote Maj. Gen. Henry Alderson, Director of Artillery in 1885, with the offer that Patton "should go to the Soudan, taking with him a limited number of Maxim guns and his own trained men to work them." This provoked a bit of a crisis; Col. Henry T. Arbuthnot, the Superintendent of the Royal Small-Arms Factory, felt that putting civilians behind guns to be "against all the recognized rules of civilized warfare." He also wondered how Patton

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[36] Subj. 3205, TNA, SUPP 6/84: AP-OC 1888, 703-709; "Range Finders for Infantry," *Morning Post*, 21 May 1888, 4.

[37] Patented by the Swedish inventor Alfred Nobel, "dynamite" consisted of the mixture of a highly shock-sensitive explosive, nitroglycerin, with certain types of absorbent clays to produce a safer and industrially useful blasting compound. Although resistant to burning and light shocks, an experiment by the "Committee on Guncotton" in 1872 showed that the compound could be detonated by the impact of a rifle bullet – hardly a useful trait for an explosive liable to be found in large amounts on a battlefield. See Subj. 2322.2, TNA, WO 33/44: AP-DDA 1885, 114.

[38] Subj. 2322.2, TNA, WO 33/44: AP-DDA 1885, 114.

could procure "a number of guns on special carriages ready to start within 30 days" while "Her Majesty's Government has been for some months anxiously awaiting a gun…for trial, which they had been led to believe would have been submitted long ago." Arbuthnot tersely suggested "that it is time that some definite understanding was arrived at with the Maxim Gun Company;" if they could furnish Patton with completed weapons, they had better get one before the Ordnance Committee. The company's manager replied that they had only agreed to lend Patton their early model of machine guns "conditional on his offer being accepted," and that they had been unwilling to "submit for trial a gun inferior to their latest pattern." They promised to have their improved gun available "to try at Enfield during the ensuing week."[39]

Despite all of the outside proposals, the vast majority of the work of the Ordnance Committee involved materials designed and manufactured at either the Royal Arsenal or the growing number of private arms-related industries. A solicitation for a new 6-pdr "quick-firing" gun, for example, showed that by 1882 Ordnance was willing to do business with whoever could supply the best weapon.[40] "Messrs. Armstrong, Whitworth, Vavasseur, Hotchkiss, Gardner, and Nordenfelt, were called upon for designs," and Gen. Campbell even extended the deadline to allow the American firm of Pratt & Whitney to submit their own proposal.[41] Sir William Armstrong's firm, which merged with Charles Mitchell's ship-building company in 1882 to become Armstrong, Mitchell and Co., remained chief among the British arms companies and worked closely with the Committee in perfecting new

[39] Subj. 3272.20, TNA, WO 33/44: AP-DDA 1885, 265.

[40] "Quick-firing" guns of this era used "fixed" ammunition in which the projectile and charge formed one piece, after the style of small-arms ammunition. They still lacked any mechanism for controlling recoil.

[41] Subj. 3352.2, TNA, WO 33/39: AP-OC 1882, 284-286.

breech-loading ordnance.[42] The degree of cooperation between the two is reflected in an 1884 suggestion by the company that "considerable advantage would be obtained by an interchange of [ballistic data]…obtained from the experiments carried on from time to time by the Committee and by themselves." In return for extracts of such data from any experiments "made by the direction of the [OC], or…considered of sufficient importance to be reported to them," Armstrong would send "full accounts of any trials they make of a similar nature… [including] any results obtained by foreign Governments which may come within their cognisance, either directly or indirectly." In one of his last acts as Director of Artillery, Gen. Campbell forwarded the suggestion to the Committee with the recommendation that such a data-sharing program "would be most advantageous to the Service," to which the OC readily agreed.[43]

As with the earlier OSC, subject-specific sub-committees often assisted the Ordnance Committee in its work, as in the case of the design of a new light 12-pounder breech-loading gun intended for both field and horse artillery. Although the design of the gun itself had been settled by 1884, the question of the carriage remained open. The OC thought the carriage designed by Armstrong's Elswick Ordnance "approximated more nearly…the Service type of field carriage," but also felt that one designed by the Royal Carriage Department "offered great promise for future development." In April of that year, then, the question was handed off to a special committee chaired by Col. A. H. W. Williams of the Royal Horse Artillery for comparative trials. Ultimately, the special committee selected the Elswick pattern with a modified brake; although judged too heavy for horse artillery, the gun entered service with

[42] Bastable, *Arms and the State*, 175.
[43] Subj. Y, TNA, WO 33/44: AP-OC 1884, 195.

Royal Artillery field batteries in 1886.[44]

Although experiments with guns, ammunition and explosives always carried some degree of risk, facilities at both Woolwich and Shoeburyness had advanced to the point that serious injuries rarely occurred, even to errant livestock. The illusion of safety came to a catastrophic end, however, with the accidental detonation of an artillery shell on 26 February 1885. During the course of testing a new "delayed action" fuze designed by Col. Francis Lyon, then the Superintendent of the Royal Laboratory, the fuze exploded after being screwed into the base of the shell. According to witnesses, the experiment "was not considered a particularly dangerous one, [and] no special precautions were taken." Gunner Allen, who had just put the fuze in place and still stood over the shell "was literally blown to pieces" according to the *Times*. Five others died of their injuries soon after, including Lyon, Col. W. A. Fox-Strangways, Commandant of the School of Gunnery, and Capt. J. M. Goold-Adams, Lyon's assistant superintendent and a member of the Experimental Branch. Several other individuals were injured, including one officer posted three hundred yards away "rendered insensible" by a fragment of the shell.[45]

In addition to the unfortunate deaths caused, the accident also points out the degree of amateurish "tinkering" still involved in the development of deadly devices. An "apparatus for testing fuzes by jolting or shaking," developed by Lt. Col. Freeth of the Royal Artillery, had

[44] Subj. 3261, TNA, SUPP 6/88: AP-OC 1891, 1231-1232.

[45] "The Explosion at Shoeburyness." *The Times* (28 February 1885): 13; "Disastrous Explosion at Shoeburyness." *London Standard*, 27 February 1885, 5. Although the papers stated the fuze in question to be one of Lyon's design, he is not shown in the *Abstracts* as ever having brought forward a fuze, although as head of the Royal Laboratory it is most likely any fuze he designed was not directly credited to him. Capt. Goold-Adams, on the other hand, had submitted a proposal in 1881 for a base fuze. After three years effort neither he nor the Laboratory could produce a working fuze; an 1884 comparison found both "very liable to premature action, and when this did not take place the time of burning was very irregular." The Ordnance Committee "recommend[ed] that no further action be at present taken with respect to base time fuzes." Lyon and Goold-Adams clearly disregarded the Committee's decision. See Subj. 3290.5, TNA, WO 33/44: AP-OC 1884, 152-153.

been approved by the OSC in 1867, and almost certainly had been improved upon in the intervening years.[46] Knowledge of what procedures Col. Lyon used to test his fuze beforehand, if any, went with him to the grave; regardless, Brig. Gen. William Reilly, then the Director of Artillery, issued a comprehensive set of regulations regarding "the Conduct of Experiments with Ordnance Material" on 04 July 1885. In addition to laying down basic safety rules regarding the testing of ordnance and fuzes, the new regulations expanded the requirements for any experiments with explosives. A detailed program had to be prepared beforehand by either the Ordnance Committee "or other officials for whom the experiments are to be made," and given to the relevant official placed in charge of the experiment. That officer would make all necessary safety arrangements "such as shelters, mechanical appliances for firing from a distance, signalling and guard" beforehand. If any part of the program could not be safely carried out, that officer had authority to suspend the experiment and "refer the matter to the Director of Artillery." Such regulations were a significant step in the professionalization of British weapons development.[47]

"Not a Sound Gun in the Service:" Public Debate over the Nation's Ordnance

The War Office immediately handed over to the new Ordnance Committee a number of important questions, including the consideration of what material new British ordnance should be constructed of. Given the failure of the *Thunderer* gun, a better understanding of the workings of cannon when fired, and the development of new slower-burning gun powders, the future pointed to steel rather than wrought iron. After a year's worth of consideration, the OC concurred, based in part on the experience of both France and Germany "who profess themselves thoroughly satisfied with cast steel." When asked his

[46] Subj. 1671.c, TNA, SUPP 6/9: Abstracts 1867, 635. The *Abstracts* do not list any other fuze testing devices having been brought before the OSC or the Director of Artillery.
[47] Subj. Y, TNA, WO 33/44: AP-OC 1885, 445-446.

opinion, Col. Eardley R. Maitland, then Superintendent of the Royal Gun Factory, agreed: "the time has now arrived when steel should be more largely used" for both the center tube and breech-piece, and the use of the material in outer coils "cautiously extended." This decision was reinforced by the report of a special committee composed of Armstrong, Maitland, "and any other persons that the Committee may feel disposed to examine" on the entire question of gun construction. Within a month, the special sub-committee reported that "the superiority of steel over wrought-iron is so marked that… [the latter] should be abandoned," and all new ordnance "made wholly of steel."[48] Such a decision the soon led to an important and very public discussion of just *who* should manufacture these new weapons, a question of prime importance for the nation's steel producers in the South Yorkshire city of Sheffield.

Long known for its manufacture of steel cutlery, Sheffield by the 1880s boasted the factories of the nation's leading steel producers, including Henry Bessemer, John Brown, J. F. Firth & Sons, Cammell & Co., and Vickers, Sons & Co. Many had long done business with the War Department, supplying specialty steel products, artillery shells, and armor plate; Brown and Vickers had both tried to interest the Royal Artillery in the use of steel for ordnance.[49] Bessemer himself had in 1859 convinced Col. Eardley Wilmot, then Superintendent of the Royal Gun Factory, to try his patent manufacturing process to produce steel for heavy guns. Shortly afterward, however, the keys to the Factory were handed over to William Armstrong, who had both a mandate to produce his breech-loading cannon and a

[48] Subj. 3288, RAL, AP-OC 1881, 280-281, and RAL AP-OC 1882, 423.
[49] See Subj. 2458.2, "Manufacture of steel for ordnance and tools," TNA, Abstracts 1864-66, and Subj. 1788, "Cast steel ordnance," TNA, Abstracts 1859-63.

preference for tried-and-true wrought-iron.[50] The Royal Arsenal's early flirtation with steel production therefore ended quickly, and the long shadow of Armstrong coupled with Parliament's preference for cheap ordnance meant wrought iron remained the chief component of gun construction until the accident aboard the *Thunderer*.

The 1882 decision to abandon wrought iron in favor of cast steel should have been welcomed by private industry, but any celebration was dampened by the equally long shadow of the Royal Arsenal itself. Intent on remaining the primary source of ordnance, the Arsenal broke ground for its own steel plant at Woolwich in 1884, at a cost of £1,850.[51] Concerned about such a threat to the trade, Stuart Rendel, Liberal MP for Montgomeryshire and the London manager for Armstrong, began a campaign to keep Woolwich out of the steel business.[52] In a letter to Henry Brand, then Surveyor-General of Ordnance, Rendel argued that Woolwich would prejudicially inspect and pass its own steel over that obtained from the trade, as it seemed to do with ordnance. He also argued that the Arsenal could not successfully undertake such a complex operation as steel making "with nothing more than an Artillery Officer to guide them."[53]

The question of steel for ordnance was part of a larger question over the privatization of ordnance manufacture in general, pushed for by both sides of the political spectrum. In the House of Commons on 02 December 1884, Conservative MP and former First Lord of the Admiralty William H. Smith pointed out that a "very interesting Report" from a U.S. commission on ordnance construction in Europe showed that the French had firmly embraced

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[50] "Henry Bessemer," *Grace's Guide*, 10 Jan 2015, http://www.gracesguide.co.uk/Henry_Bessemer; Bastable, 173.

[51] HCPP, "Army Estimates of Effective and Non-Effective Services, for 1884-85, (with Index)," 1884 (75), 63. This is the only direct reference to a "steel foundry" in any of the Estimates through 1887-88.

[52] John Grigg, "Rendel, Stuart, Baron Rendel (1834–1913)," *ODNB*, 2004 http://www.oxforddnb.com/view/article/37889.

[53] Bastable, *Arms and the State*, 182.

the idea of private manufacture. Prior to 1870, "it was the custom in France to confide all matters relating to cannon to the Artillery-Corps of the Army and Navy; aid from private sources was neither sought nor offered." After the war, however, the new French government thought it "desirable to encourage private industries, so that a spirit of emulation might be excited by competition, and a channel afforded through which new ideas and inventions might reach the national works." French companies were turning out dozens of heavy guns, and had taken orders from the French navy for hundreds more; England, by comparison, was laboring to produce just a handful of heavy naval guns. "The fact is that France, owing to her prudence, foresight, and energy, is some years ahead of us in the construction and manufacture of guns," Smith charged. Regarding steel itself, Smith asked "whether the Government will take the steps which are necessary to secure…a supply of steel and material necessary for the production of steel guns?" Rather than rely on Woolwich, Smith suggested that "if the Government held out to the trade the prospect of a profitable business, they would certainly get the article they need."[54]

Brand agreed that the country needed to rely more on private industry; the major stumbling block to such participation, he pointed out, had not been with the nation's production capabilities, but with the Arsenal itself.[55] After the 1882 decision to use steel exclusively for building guns, Brand explained, acceptance tests of contract-supplied steel performed at Woolwich resulted in "a great many rejections" and an assumption that "the

[54] "Motion for a Paper." HC Deb 02 December 1884 vol 294 cc468-471.

[55] This was not the first time that difference of opinion regarding metal testing had arisen between the Royal Arsenal and private industry. Kenneth Pryke detailed the struggles that the Acadian Charcoal Iron Company experienced in attempting to demonstrate the acceptability of its Nova Scotia ore for ordnance. Ultimately, mechanical and chemical analysis of the finished pig iron yielded differing results; the former suggested the iron would work, the latter reported too many flaws in its composition. This led to the Arsenal's rejection of the ore as unsuitable. Pryke's article illustrates the very complex nature of metal testing and the differences of opinion that even noted experts in metallurgy had. See Kenneth Pryke, "The Woolwich Arsenal and Acadian Mines." *Scientia Canadensis* 34, no. 1 (2011): 25-50.

‘trade’ in Sheffield could not supply the Department with steel ingots of the size and quality required.” Such an assumption, based on what might have been a deliberate ploy to shut out the trade, allowed the Royal Gun Factory the justification it needed to pursue its own steel plant.[56] Alarmed at the rejection rate of trade-supplied steel, however, Director of Artillery Sir Frederick Campbell took a different view. He visited with producers throughout the UK and France to determine “what reasonable modification in the test would admit of the English trade producing steel that would be passed by the War Office Inspectors.” Based on Campbell’s findings, Brand reported that “the Ordnance Committee…recommended a revised specification, and some further modifications were subsequently suggested by the manufacturers, which had within the last few days been adopted.” This circular cooperative effort between the OC and private manufactures paid off, as Brand stated that “the position now was that the steel trade was both willing and able to meet the requirements of the War Office with regard to steel forgings.”[57]

Spencer Compton Cavendish (Lord Hartington), Gladstone’s Secretary of State for War, and Thomas Baring (Lord Northbrook), the First Lord of the Admiralty, also agreed that the War Office needed to rely on private industry for its steel needs. In the same debate, Brand noted that Cavendish thought the manufacture of heavy steel ingots at Woolwich “would be mischievous, and ought not to be adopted except under the stress of the most imperative necessity.”[58] That same day, Northbrook claimed before the House of Lords that although £100,000 had been approved “for increasing the plant for the manufacture of the new guns at Woolwich…it was not intended…to set up the manufacture of steel there.”

[56] This position is argued by Bastable, who accused Woolwich of having “used the quality control and inspection process to reject Elswick steel as defective” but offered no definitive proof. See Bastable, 183.
[57] “Motion for a Paper,” HC Deb 02 December 1884 vol 294 cc491-492.
[58] “Motion For a Paper,” HC Deb 02 December 1884 vol 294 cc491-492.

Cavendish, Northbrook stated, "had thought it better to go to the trade, and to encourage the great manufacturers of steel."[59]

Edward H. Carbutt, a Liberal MP for Monmouth and former mayor for Leeds, took up the call for privatization.[60] In a letter to the *Pall Mall Gazette* dated 05 January 1885, Carbutt charged that "at the present moment we have not one single large steel breechloading gun in position." Deliberately taking Brand's comments of 02 December out of context, Carbutt claimed that Brand put the blame for the lack of guns on the Sheffield steel trade's inability to meet the War Department's needs. "If the trade could not…whose fault would it be but the Government's, who will not encourage their own manufacturers?" Carbutt asked. The answer, however, lay with the Arsenal's own "mismanagement…due to their not being conducted on commercial principles." Instead of a military head, Carbutt felt that a single person, "a man of great engineering knowledge and experience," should be appointed to head the Royal Arsenal on a permanent basis, rather than the five-year rotation then in practice. Such a post would "be worthy of the best talents in the kingdom." In addition, the Admiralty itself should be allowed "to order their guns either from private manufacturers or at Woolwich." Such measures would "obtain such competition as would give use the best gun with the least expenditure."[61]

On Friday, 13 March 1885, Carbutt joined William Anderson and several other speakers at the Royal United Services Institute (RUSI) to present a lecture "on the capabilities of private firms to manufacture heavy ordnance for Her Majesty's service." Head of the engineering firm Easton and Anderson, Anderson had considerable technical skill in

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[59] "Motion For a Paper," HL Deb 02 December 1884 vol 294 cc428-430; see also Bastable, 182.
[60] "Edward Hamer Carbutt," *Grace's Guide*, 06 Dec 2014, http://www.gracesguide.co.uk/Edward_Hamer_Carbutt.
[61] E. H. Carbutt, "Correspondence: The Ordnance of England and France," *Pall Mall Gazette*, 06 Jan 1885, 11.

his adaptation of a new hydraulic gun mount to double-gun turrets for Russia and Britain.[62] Anderson opened the lecture by outlining the changes in artillery that had occurred over the three decades since the Crimean War, and emphasized that current weaponry required a great deal of specialized skill and machinery. Only Whitworth and Armstrong's firms had such capability, but "they could only be brought to work…for the national service in a time of emergency at an immense cost – at a time, too, when the works would be too late to make good disaster." The design of big guns "had been left practically in the hands of a Government department administered with great, indeed, with ruinous parsimony." After Anderson "resumed his seat amid great cheering," Carbutt then led off the post-lecture discussion. He stated that "the working classes were convinced that the country should be fully prepared to meet an enemy, and instanced the fact that the public were pressing the Government to increase the Navy." He also "spoke against the Government manufacturing all the war material," and that "the present system of gun manufacture in this country was wrong." Using Krupp as an example, he noted that the German firm "was manufacturing the largest guns for Russia, and was enlarging his plant, while at home a pattern of gun had not yet been decided on."[63]

Carbutt followed up the RUSI discussion almost immediately with further debate in the House of Commons. On 16 March, he stated that "he was certain that the 2,000,000 voters who had been enfranchised" by the Third Reform Act of the year before "would not protest against any reasonable expenditure of money for the preservation of the honour of the Empire." Yet the country remained in possession of faulty ordnance, such as a new 12-inch breech-loader designed to fire a 400lb charge of powder, but for safety reasons was limited to

[62] E. I. Carlyle, "Anderson, Sir William (1835–1898)," rev. Ian St John, *ODNB*, 2004, http://www.oxforddnb.com.ezproxy.lib.uh.edu/view/article/507.
[63] "British Heavy Ordnance." *Times*, 14 Mar. 1885, 12.

one over a hundred pounds lighter. Carbutt brought up again the use of steel in ordnance, and noted that "it did seem strange that we should be the leading nation in the manufacture of steel, and in the application of the inventions of Bessemer and Siemens, and yet that we should be 15 or 20 years behind other nations in adopting steel guns." Again, the question had support from both political parties, in particular from Sir John Hay, who had served in the Admiralty under Disraeli. Hay stated that Carbutt "had done a great service in bringing forward the question of guns." He also charged that "The guns of this country…were in a most deplorable condition; and if war was to break out they would find themselves almost disarmed, and with the necessity of spending millions of money on a system not yet determined upon."[64]

Brand then rose to reassure both Carbutt and Hay that the Gladstone government was aware of the ordnance issues and were taking active steps to resolve them. Regarding steel, he stated that "the manufacturers at Sheffield and Newcastle were satisfied with the assurances which the Government had given," and "within a few weeks" several other companies besides Whitworth and Armstrong's "would be able to supply the Government with heavy forgings." In addition, a special committee "consisting of members of the Ordnance Committee and of gentlemen of very great experience outside the Department" had lately been appointed by Cavendish to examine the current designs of heavy British ordnance. "Speaking generally," Brand claimed "with the exception of some slight alterations for strengthening guns, the Committee approved of the present system of gun construction."[65]

[64] "Observations," HC Deb 16 March 1885 vol 295 cc1285-92.
[65] "Observations," HC Deb 16 March 1885 vol 295 cc1298-99. Brand's dismissal of the changes as "slight alterations" is open to interpretation. The committee examined all sizes of heavy naval guns from 4- through 16.25-inch, and made recommendation for changes to some – but not all – the designs; see

The *Times* followed up on the debate regarding steel for ordnance with an article reviewing "Sheffield Trade for 1885" early in January of 1886. The paper noted that Cammel, Brown, Firth, and Vickers had all "increase[d] their capacity for producing immense castings, chiefly for military material." In particular, Vickers had installed at their River Don Works "the largest forging press that has ever been made. It is capable of treating ingots for guns…[of] any size required," with a crane able to lift 150 tons. The upgrades had come as a direct result of the public discussion over Sheffield's ability to supply the needs of the War Department. Vickers itself contended that although "they had made forgings 40 per cent heavier than the heaviest which had so far been required by Woolwich Arsenal…[they had] decided still further on increasing their powers of production."[66]

Despite such changes, the *Times* noted that "the progress of steel making by the Government at Woolwich is regarded [in Sheffield] very jealously." Regardless of Northbrook's reassurance in the House of Lords, the Arsenal had pressed forward with construction of its own steel plant. The £100,000 earmarked in 1884 had not gone towards improvement of existing works, but instead been used to build a forge large enough to cast ingots for guns up to 6-inch in barrel diameter. The ruse proved both simple and effective, and by 1886 the Arsenal had "repaired" its forge to over double its original capacity, from 6- to 15-tons.[67] Clearly, Woolwich authorities intended to maintain the Arsenal's position as gun maker for the Crown, in spite of the wishes of some politicians, and perhaps with the complicity of the War Office. It would be at least two more years before any additional private ordnance makers joined Armstrong in challenging the near-monopoly held by the

"Recommendations of the Ordnance Committee, (with Special Associated Members), as to the Construction of Ordnance." London: HCPP, 1885 (C.4508).

[66] "Sheffield Trade for 1885." *Times*, 5 Jan. 1886, 13.

[67] Bastable, *Arms and the State*, 182-183.

Royal Gun Factory.[68]

Several weeks after the *Times* article, accidents occurred on board two of England's newest ironclads that again shook the nation's confidence in its heavy guns. In May, one of the 12-inch 43-ton Woolwich guns mentioned by Carbutt in his RUSI speech burst several inches from the muzzle aboard *HMS Collingwood*, when fired with just over a half-charge of 220lb of powder.[69] This was followed shortly by reports from *HMS Ajax* of the failure of both forward 12-inch 38-ton guns during target practice. After firing just one round each, "there was such a discharge of refuse powder and gas from the axial vent that the men had to be ordered out of the turret." On examination, both guns were found to have cracks in their internal barrel tubes.[70]

Such accidents unleashed a hail of criticism against what Robert H. Armit, editor of the *Admiralty and Horse Guards Gazette,* soon dubbed the "Great Gun Ring" at the Royal Gun Factory.[71] Through a series of letters to the *Times*, Armit claimed such accidents led to the "deplorable result that England has at this moment no artillery armament wherewith to defend her interests and her honour at home or abroad."[72] He further accused "certain members of the [Ordnance Committee] and of the Ordnance Department" of being

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[68] "Army and Navy (Guns). Return Showing the Number, Description, Name of Designer, Place of Manufacture, and Approximate Cost of the Various Rifled Iron and Steel Guns Supplied by the War Department to the Naval and Land Service During Each of the Years 1859-60 to 1885-86, Inclusive; Showing Whether Each Gun Is Land and Naval, or Only Land or Naval." HCPP, 1887 (109).

[69] "Bursting of a Gun on an Ironclad," *Manchester Times*, 08 May 1886, 5.

[70] "The storm of criticism…," *Dundee Evening Telegraph*, 29 July 1886, 2.

[71] Armit was a former lieutenant in the Royal Navy and captain (later major) in the 22nd Central London Rangers, Volunteer Battalion; see HCPP, "Report of the Royal Commission Appointed to Inquire into the System under Which Patterns of Warlike Stores Are Adopted and the Stores Obtained and Passed for Her Majesty's Service." 1887 (C.5062), xliii and 139. Founded in 1884, an 1891 advertisement for the *Admiralty and Horse Guards Gazette* claimed that it "is the recognized organ of the Naval and Military Services of Great Britain," see *Willing's British & Irish Press Guide and Advertiser's Directory and Handbook* (London: James Willing, Jun., 1891), 275. The *Gazette* appears to have continued publication until at least the outset of World War II, based on an informal survey of articles available through *The British Newspaper Archive* website. Its ultimate contribution to the military debates of the late nineteenth century, however, must remain a subject for further research.

[72] Robert H. Armit, "British Ordnance." *Times* 19 July 1886, 13.

shareholders in Armstrong's Elswick Ordnance "which, in conjunction with Woolwich, has designed" the faulty guns.[73] The charge had some degree of truth; Frederick Abel, for example, held £1,500 of shares in Elswick, and both Armstrong and Andrew Noble had sat on a special committee that investigated several instances of burst guns, including two designed by their firm.[74] The guns aboard the *Collingwood*, and a similar one which later burst on board *HMS Colossus*, were designed and manufactured solely by Woolwich, however, despite active lobbying for its own designs by Armstrong's company.[75] Still, Armit's cry that Britain had "not a sound gun in the service" was serious enough on its own, and pressure began to build for a Parliamentary investigation into the matter.[76]

"Guilty of Inefficiency and Ignorance:" The Stephen Commission, 1886-1887

The protestations of Carbutt and Armit against the Woolwich system combined with reports from abroad to raise serious questions regarding not just naval guns, but British military equipment and administration in general.[77] The fleet at Alexandria fired over three thousand shells at the Egyptian forts, but many did not detonate due to faulty fuzes. After the battle, a clean-up crew found an 8-inch shell fired by *HMS Penelope* "lying harmless in a magazine containing over four hundred tons of powder."[78] Wolseley's forces in Egypt and the Sudan returned home with reports of jammed machine guns, bent bayonets, and rifles

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[73] "Not a Sound Gun in the Service," *Huddersfield Chronicle*, 17 July 1886, 7.

[74] HCPP, 1887 (C.5062), lviii, and 141-142; "Ordnance Committee Reports 400-457, 1885," TNA, SUPP 6/99, "Ordnance Committee – Report 429, with Appendices and Plates – Construction of Ordnance; 30th April 1885." Most of the guns reviewed by the Committee were of RGF design.

[75] Beeler, 79-81.

[76] *Huddersfield Chronicle*, op. cit.

[77] Harold John Hanham, *The Nineteenth-Century Constitution 1815-1914: Documents and Commentary* (London: Cambridge U.P., 1969), 357.

[78] Goodrich, 37, 67. Sir Percy Scott, then a lieutenant in the Royal Navy, noted that "great care was necessary" in the removal of dud shells, "as the fuses were in the shells and an extra fall might send them off. An attempt to take out the fuse of a shell had been made with fatal results; it exploded and killed every one concerned." See Sir Percy Scott, *Fifty Years in the Royal Navy* (New York: George H. Doran Co., 1919), 61.

rendered useless by stuck Boxer cartridges.[79] The army faced considerable internal problems as well. Several factors, such as a high turnover rate caused by new short-service options and a lack of an effective recruiting program, combined to limit the pool of trained soldiers for overseas campaigning. The 1882 expedition had to draw heavily from the new reserve force, created by Cardwell for use in event of an invasion of England, not international expeditions.[80] Considerable friction also existed between Wolseley, the adjutant-general of the army, and the Duke of Cambridge, its commander-in-chief and cousin to the Queen. Wolseley, who saw much in the army that needed reform, clashed repeatedly and often publicly, via dinner speeches and in the press, with the "pipeclay prejudices" against change held by Cambridge.[81]

In July of 1886, Robert Gascoyne-Cecil (Lord Salisbury) returned as prime minister after the short-lived third government headed by Gladstone went down in defeat during the general election. His first Secretary of State for War, W. H. Smith, took serious the charges regarding the failure of British armaments, and in September of 1886 appointed Sir James Stephen to head a special "Ordnance Inquiry Commission." Charged with examining "the system under which the patterns of warlike stores are adopted," the commission's royal warrant also directed it to investigate complaints and to determine "the persons, if any, responsible for any defects which you may find." Originally limited to recent issues, the commission expanded its scope to include charges of "systematic fraud and corruption" that dated to 1858, on the grounds that "the administration of the Ordnance Department has ever

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[79] "The Anglo-Russian Scare..." *Western Daily press*, 07 May 1885, 5; "The British Bayonet: Challenge to the Ordnance Department," *Sheffield Independent*, 12 Jan 1886, 8.

[80] Williams, 250.

[81] Farwell, *Queen Victoria's Little Wars*, 255. The term refers to the material that British soldiers and marines used to whiten their leather belts and other accoutrements. For more on the Cambridge-Wolseley rivalry, see Giles St. Aubyn, *The Royal George, 1819-1904: the Life of H.R.H. Prince George, Duke of Cambridge* (New York: Knopf, 1964), specifically Chapter 7, and Halik Kochanski, *Sir Garnet Wolseley: Victorian Hero*(Bloomsbury Academic, 1999).

since been conducted more or less under the influence of that fraud."[82]

After a number of interviews with aggrieved inventors and others, including Armit, the Stephen Commission ultimately found that "the charges of corruption…are false and unfounded, and that nearly all…are either wholly untrue or distorted versions of innocent facts." "The charge of inefficiency," however, "both generally and in a variety of particular instances" could certainly be proved, and started at the top with the Secretary of State's office. The powers ceded to it over the preceding years were "so great that no single person can be expected to exercise them efficiently." As a political office, tenure could be fleeting, as witnessed by three different appointees in the politically turbulent year of 1886. In addition, every Secretary had a "presumable deficiency in [the] special knowledge" regarding the construction of weapons, as did the Surveyor-General of Ordnance, an office which by 1883 had devolved into a political appointment as well. This meant that both men were "practically in the hands of their subordinates," such as the Director of Artillery and Stores, "and this destroys all real responsibility and all effective superintendence."[83]

The Commission also had much to say about the dysfunctional small arms development system in Britain, through its review of the failed Enfield-Martini rifle program. Competition between Britain and Russia in their "Great Game" for dominance in Central Asia led to comparisons of the weapons fielded by both nations, particularly their infantry rifles. Much to the chagrin of British military leaders, the nearly off-the-shelf Berdan rifle adopted by the Russians proved more accurate than the committee-designed Martini-Henry at ranges under a thousand yards. "A certain number of soldiers thought that our rifle ought to be superior in every way to any foreign rifle," the Commission recounted, and in January of

[82] HCPP, 1887 (C.5062), iii-vi; see also Spiers, *The Late Victorian Army*, 40-42.
[83] HCPP, 1887 (C.5062), cv.

1881 then-Secretary of War Hugh Childers appointed a "large committee" to design the nation's replacement for the Martini-Henry. Childers hobbled the committee, however, by ordering the retention of the Martini action, in part because the Duke of Cambridge "decided that we had had great experience with [it], it had gone through campaigns satisfactorily all over the world, and there was nothing distinctly against it."[84] Gen. Phillip Smith also supposed the decision was done "to secure the introduction of an arm which could not be turned into a magazine rifle" because "in those days the authorities" – meaning, again, the Duke, without identifying him by name – "were very much averse to anything like magazine rifles."[85] Repeating the Fletcher committees' mistake of building a composite arm, the 1881 Rifle Committee married the Martini action to a smaller-diameter barrel with a pattern of rifling insisted on by Col. Arbuthnot under the dubious claim that it was "the way the French do the rifling, and that it has its advantages."[86] Two years into the existence of the Rifle Committee, the War Office formed a sub-committee, chaired by Gen. Smith, to examine magazine rifles; in 1884, the two committees were merged under Smith's oversight, and sat until March of 1886. By September, a thousand rifles were finally in the hands of troops for more extensive trials.[87] That same month, the War Office formed a third committee, again directed by Smith, tasked with reporting on the trials but also to consider further the issue of magazine rifles.[88]

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[84] HCPP, 1887 (C.5062), Question 9197, p. 382.

[85] HCPP, 1887 (C.5062), xxii-xxiii, and Question 6103, p.231. A "magazine rifle" held several rounds of ammunition, usually in column below the breech mechanism. The design of the Martini-Henry action prevented its use in such a rifle. The Rifle Committee's final report gives Childers's reason as being that he did not want to "reopen the question as to the pattern of breech action" which had occupied so much of the original Fletcher Committee's time (B. A. Temple and Ian D. Skennerton, *A Treatise on the British Military Martini: The .40 & .303 Martinis, 1880-1920* (Burbank, Queensland, Australia: B.A. Temple, 1989), 260).

[86] HCPP, 1887 (C.5062), xxii-xxiii, and Question 9204, p.382.

[87] Temple and Skennerton 1989, 349-369.

[88] HCPP, 1887 (C.5062), xxii-xxiii.

Figure 35: The action of the Lee box magazine rifle.[89]

The turnover of committees meant that the design of the Enfield-Martini lurched along spasmodically and consumed an inordinate amount of time, instead of progressing in a smooth and more rapid pace. In addition, rather than "a pair of harmonious bodies constructing the thing," the Stephen Commission found that the first Rifle Committee spent three years designing an imperfect weapon, after which Smith's committee spent three more years trying "to diminish the evils which the first body had introduced." "The history of these…committees," the Commission felt, "does little credit to the principle of constructive committees."[90] In the meantime, advances in weapons and ammunition design pointed towards a much different future for military small arms. While England dithered about with the Enfield-Martini, Remington Arms of the United States began marketing a box-magazine rifle designed by James P. Lee across the globe; China purchased 15,000 weapons in 1884, two years before the first batch of Enfield-Martini weapons were ready for troop trials.[91] The next year the U.S. offered to supply England with 10,000 Remington and Lee rifles along

[89] Eugene Myszkowski, *The Remington-Lee Rifle* (Latham, NY: Excalibur Publications, 1994), cover image.
[90] HCPP, 1887 (C.5062), xxii-xxiii.
[91] Roy M. Marcot, *The History of Remington Firearms: The History of One of the World's Most Famous Gun Makers* (Guilford, CT: Lyons Press, 2005), 59-60.

with five million rounds of ammunition; Cambridge myopically rejected the offer, as he "[did] not consider that we need adopt the magazine rifle till other nations do."[92]

The U.S. was not the only country rapidly surpassing the spasmodic British efforts to develop its next generation of infantry rifles. In Europe, Ferdinand Mannlicher of Austria perfected his clip-fed magazine rifle, adopted by the Austro-Hungarian Empire in 1886 and a principle eventually used by every rifle system into World War II. Switzerland's Maj. Eduard Rubin developed lighter and much smaller-bored ammunition in the first half of the 1880s which would greatly increase the striking power of infantry weapons while allowing the soldier to carry much more ammunition.[93] Such advances made the single-shot Enfield-Martini a technological dead end, something that Edward Stanhope, who took over the War Office in January of 1887, may have appreciated. In July he ordered the abandonment of the project and the conversion of any existing weapons to chamber the Martini-Henry cartridge as a stop-gap measure pending the introduction of a magazine rifle.[94] Two years later – a crash development effort given its previous history – England adopted its first small-bore magazine rifle, the .303" Lee-Metford.[95]

In addition to the Enfield-Martini fiasco, the Commission also investigated the failure of the Pattern 1882 general-purpose cavalry sword, designed to replace several different forms of swords then in service. Tests of the new blade put emphasis on "the conveniences or

[92] Subj. 3367, TNA, WO 33/44: AP-DDA 1885, 323.
[93] Hoyem Vol. 2, 178, 182-185.
[94] Temple and Skennerton 1989, 369.
[95] The new rifle combined the Lee bolt-action box magazine with William Metford's rifling design. Originally adopted as the "Magazine Rifle Mk. I," this was changed to "Magazine Rifle, Lee-Metford" on 08 April 1891 to recognize the contribution of those two inventors. Metford had a long history of assisting British military firearms efforts, including the design of bullet used in the Pattern 1853 Enfield, and a pattern of explosive bullet adopted by the OSC in 1861 (Subj. 1687, TNA, SUPP 6/3; *Abstracts 1861*, 691). Like so many other inventors, Metford had to fight for recompense over the government's use of his rifling design, finally being awarded £6,500 in September of 1891 – a month before his death. See Ian D. Skennerton, *The Lee-Enfield: A Century of Lee-Metford & Lee-Enfield Rifles & Carbines* (Labrador, Queensland: Ian D. Skennerton, 2007), 15-16, 61-66.

inconveniences of the sword as an article to be worn," the Commission found, but "no one seems to have thought of testing their efficiency as weapons." When used as such, "they were found to be disgracefully deficient and quite unfit for their purpose." An emergency contract for 30,000 swords had to be placed, and went to the German firm of Weyersberg in Solingen, Westphalia – a major embarrassment for an industrially-capable country such as England, since "the manufacture of swords is a perfectly simple matter, and has been well understood for many centuries." "There can hardly be a graver reflection on a system of military administration," the Commission wrote, "than that it makes no provision for ascertaining distinctly, and under the responsibility of properly qualified officers, the efficiency and adaptation to its purposes of all the arms issued to soldiers."[96]

One of the chief flaws of the entire system, the Commission felt, "originated in the inadequacy of the means provided for considering the numerous questions" related to small arms and other military stores. The Ordnance Committee, "the only permanent consultative body attached to the Ordnance Department," was by design "confined to questions connected with artillery." As the failures of the Enfield-Martini and Pattern 1882 cavalry sword showed, the development of small arms involved "considerations of as delicate and technical a nature as any which are involved in the construction of artillery." Without a central supervising body, such considerations were left in the hands of special committees "open to great objections, and…surrounded by difficulties." The committees had "no continuity, they involve no official responsibility, they are often unpaid, and sit only when it suits their convenience." In addition, "they are liable to be dissolved, reconstituted, or superseded at a moment's notice," all of which plagued the development of the Enfield-Martini.[97] A

[96] HCPP, 1887 (C.5062), xxiv-xxv.
[97] HCPP, 1887 (C.5062), xx.

committee "with real knowledge and authority" to deal with all manners of warlike stores, the Commission felt, "would hardly have sanctioned" the imperfect cavalry sword, nor "have taken six years to arrive at a conclusion about a rifle."[98]

Rather than expand the Ordnance Committee's purview to meet that of the defunct Ordnance Select Committee, however, the Stephen Commission suggested a much broader restructuring of the whole system of ordnance administration. Critical to this would be the establishment of some form of army or ordnance council to settle basic questions such as the needed size and abilities of regular, reserve, and volunteer forces the nation required. "The provision of stores…can hardly be determined unless there is an understanding as to the number of armed bodies for which provision is to be made," the Commission felt. Answering such questions meant "it would be possible to lay down in a clear intelligible way the amount and the nature of the stores which ought to be forthcoming at any moment, [as well as] the means by which and the proportions in which those stores should be increased in case of emergency."[99] Such a council would also report the current state of stores, decide upon the technological direction of future weapons programs, and most importantly make their findings public. Although the latter carried the danger of providing information to potential enemies, "foreign countries already know all that they care to know about our warlike stores," as much as the British knew about everyone else's. Such a danger would be outweighed, they felt, by the guidance such publication would give to "intelligent parliamentary discussion…and public opinion, and give a strong security to the public in general that their money was being intelligently applied to the purposes for which it was

[98] HCPP, 1887 (C.5062), xx, xxv.
[99] HCPP, 1887 (C.5062), xxxvii.

intended."[100]

The Commission also recommended the resurrection of the post of Master-General of Ordnance. Unlike the post abolished three decades earlier, the revised office would be limited to management of the military stores and manufacturing departments; command of the Royal Artillery would remain with the Commander-in-Chief. In addition, the holder of the new post "should be a soldier of the highest eminence" rather than a political appointment that the Surveyor-General of Ordnance office had devolved into. The new Master-General would submit annually "a statement of what he regards as necessary for his department," but the Secretary of State for War would retain responsibility for submitting army budgets to Parliament. In addition, the Commission felt that the Master-General should be assisted by a council responsible for advice on technical questions and evaluation of inventions, periodic inspection of stores, and investigations of any form of complaints.[101] As noted in the previous chapter, the Ordnance Council assembled as necessary to investigate complaints by inventors; clearly, however, the Commission felt that a permanent body with an expanded scope was required.

The press, in responding to the release of the report, was quick to notice that the Stephen Commission had "placed a very liberal interpretation upon the precise letter of their instructions," and expanded its scope to examine the whole of British army administration.[102] "It is clear," the *Lancashire Evening Post* wrote, that the Commission "are of opinion that our whole War Office system is bad." The head of the Secretary of State for War held "either a co-ordinate or a supreme control" over several different functions, "any one of which is sufficient to occupy the whole time of a first-class administrator with special training and

[100] HCPP, 1887 (C.5062), xxxviii.
[101] HCPP, 1887 (C.5062), civ-cv.
[102] "War Office Scandals." *Derby Daily Telegraph*, 18 May 1887, 4.

abilities. This, as is notorious, the [Secretary] does not usually possess." In particular, the *Post* emphasized that the Surveyor-General of Ordnance's post had turned into a civilian patronage position. "Out of seven gentlemen who have held the office in the course of sixteen years," the paper wrote, "three were never soldiers at all, others were mere subalterns and regimental officers." The paper went on to say that the office had originally been intended for "an officer of the same character" as those that previously held the Master-General of Ordnance, most notably the Duke of Wellington. "The concerns of the Empire," the paper acerbically concluded, "have been too engrossing for our statesmen to take note of trifles of this kind. The Commission have acquitted the Ordnance Department of corruption, and practically found it guilty of inefficiency and ignorance."[103]

"The Work…has Altogether Outgrown the System:" Stanhope's Reorganization of 1887

The Stephen Commission was not the only body investigating ordnance matters. Just before the Gladstone government fell in July of 1886, then Secretary of State for War Henry Campbell-Bannerman formed a committee chaired by the Earl of Morley (Albert Edmund Parker) to "inquire into the organization and administration of the Manufacturing Departments of the Army." 1886 also saw the launch of a commission chaired by Sir Matthew Ridley, directed "to inquire into the Establishments of the different Offices of State at Home and Abroad." Ridley's committee spent its first year examining "the two great spending departments, the War Office and Admiralty.... both of which have recently been the subject of much public criticism and discussion."[104] Finally, in May of 1887 Lord Randolph Churchill and his "Select Committee on Army and Navy Estimates" began taking evidence

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[103] "The War Office System." *Lancashire Evening Post*, 24 May 1887, 2.

[104] HCPP, "First Report of the Royal Commission Appointed to Inquire into the Civil Establishments of the Different Offices of State at Home and Abroad," 1887 (C.5226), xxv.

on how both branches made their annual pleas for funds from Parliament.[105] This brought the count of ongoing committees studying the British military to four, a surprising number considering Salisbury's lack of interest in military affairs.[106] It did, however, make good press for the Conservatives to be seen thoroughly examining the supposedly deteriorated state of nation's defenses left by the Liberals. Unfortunately, none of the committees took a whole-subject approach to their studies of the country's still-muddled military administration system.

As the reports from the various committees were issued, the press made their details available to the public. The first release of evidence from Churchill's committee came out just a few days ahead of Morley's report; taken together, their findings caused the *Lancashire Evening Post* to write that "the War Office has been in a very bad way of late." Both committees "tell the same tale of bad administration, want of control, and something like deliberate juggling in accounts," the paper continued. "The worst revelations…belong to Lord Randolph's branch of inquiry….The most serious of them all is the proof that Parliamentary control over the Estimates is a mere figment." Ultimately, the paper charged, responsibility for this financial muddle lay with the Secretary of State's office. "It is [this] official, sitting crowned, sceptered, and throned, whom the two Commissions present to our

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105 Churchill had been appointed Salisbury's Chancellor of the Exchequer in 1886. "Determined to be a retrencher and a reformer in the mould of Gladstone," he had proposed a budget late that year which reduced the income tax and select duties, based on increases in other taxes and £1,800,000 in "direct economy" – i.e., a decrease in defense spending. When met with considerable resistance by W. H. Smith, then the Secretary of State for War, Churchill tendered his resignation – a tactic that had worked for him before, and one common in Victorian-era politics. Salisbury declined to reign in Smith, which Churchill mistakenly took as acceptance of his resignation – and thereby ruined his career as a ranking Conservative party member. Churchill later defended his actions in a speech before his constituents on 02 April 1887, which presumably led to his being selected for the Committee. See Roland Quinault, "Churchill, Lord Randolph Henry Spencer (1849–1895)," *ODNB*, Sept 2010, http://dx.doi.org/10.1093/ref:odnb/5404; Ensor, 174-175; "Lord Randolph Churchill at Paddington – Speech on National Expenditure and Irish Legislation," *Morning Post*, 04 Apr 1887, 3; "Army and Navy Estimates —Speech of Lord Randolph Churchill at the Metropolitan Music Hall, Paddington," HC Deb 05 April 1887 vol 313 cc495-6; "Motion for a Select Committee," HC Deb 12 May 1887 vol 314 c1713.

106 Rodgers wrote that the prime minister "was fundamentally uninterested in military matters;" see p. 496.

eyes, and whom honest men of both parties must try and topple from his seat."[107]

Such an extreme measure did not get much support, but soon Stanhope had read enough committee reports to understand the muddled state of military and civilian control. In the House of Commons debate over army estimates on 08 September, he unveiled his plan to dissolve the muddle, prefaced with an explanation of what he saw to be a principal weakness put in place by Cardwell's reform efforts. Stanhope stated that all the subordinate departments under the control of the Surveyor-General of Ordnance (SGO) "labour at present under grave disadvantages," including instability of the post itself and the five-year tenures of his principal assistants. In addition, although the officer held "absolute financial responsibility" for his departments, the Surveyor-General had "no permanent financial adviser with whose assistance he could alone exercise adequate supervision." Such failings, combined with the tremendous pace of change in military technology meant that Stanhope felt that "the work [of the SGO's office] has altogether outgrown the system established a few years ago."

Stanhope proposed three major principles for his reorganization of the War Office. First, he would give to the Military Department "administration of all the executive duties of the Army… [and] to fix upon each military head of a [subordinate] Department full responsibility for that branch of the Service which he controls." Second, Stanhope intended to "separate altogether inspection of manufactured articles from [their] actual manufacture" through the formation of inspection departments at Woolwich and Enfield.[108] Finally, control of the Financial Department would be extended "to all the branches of the War Office." Such changes meant the elimination of the "false" position of the Surveyor-General, but also

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[107] "The War Office Inquiry," *Lancashire Evening Post*, 01 Aug 1887, 2.
[108] The distances between Woolwich and Enfield made separate departments a logical choice; see Hogg 1963, 859.

entailed a considerable alteration in the office of the Director of Artillery, the work for which "is absolutely beyond the power of any one man…to cope with." In addition, the Director frequently found himself "divorced from the observation of [Stanhope's] military advisers and it might actually happen that even large changes might take place in the armaments of the country almost without their knowledge." Control of the manufacturing departments therefore passed from the Director to a new Director-General of Ordnance Factories, under the direction of the Finance Department of the War Office. The Director of Artillery himself would answer to the Commander-in-Chief, and would hold onto the duties of "approval of designs…and be responsible for the inspection of all armaments and munitions of war, and in the case of those required for naval purposes…will be assisted by a representative of the Admiralty."[109] This extended the influence that Cambridge already held over the nation's small arms to ordnance *matériel* as well, although unlike the former there is little evidence that the Duke interfered in artillery development.

Approved by an Order-in-Council on 21 February 1888, Stanhope's reorganization cleanly divided the entire War Office between its civilian and military functions, and finally eliminated the amorphous Ordnance Department as a separate, high-level department. As noted by historian Edward Spiers, this "established the control of the Commander-in-Chief over supply and operations, so imparting a degree of co-ordination to the military system hitherto lacking."[110] Although he still answered to the Secretary, the 69-year-old Duke of Cambridge now held ultimate responsibility for both active and volunteer forces. It also made a man whom Wolseley once scoffed knew "as much of modern warfare…as my top-boot

[109] "Supply-Army Estimates, *HC Deb 08 September 1887 vol 320 cc1708-68.*

[110] Spiers, *The Late Victorian Army*, 44; see also "Orders in Council Relative to the War Department with a Statement of the Duties Assigned to Certain Officers under Such Orders," 1888 (C.5304). The orders also renamed the "Director of Artillery and Stores" position to that of simply the "Director of Artillery."

does" the principal military adviser to the Secretary of State for War.[111] For assistance, the Duke could turn to his principal military assistants – the Adjutant General, Quartermaster-General, Director of Artillery, and Inspector-General for Fortifications – for advice; the Secretary, on the other hand, could not consult with these officers except on an informal basis. Instead of a smoothly-operating military department, however, Stanhope's changes "simply produced an excessive centralization." Without a proper staff department, the Commander-in-Chief's office became a bottleneck for communications and a serious constriction on the responsibility of subordinate officers.[112]

Stanhope's reorganization of the War Office is important as much for what it did *not* do, as well as what it accomplished. It ignored the Stephen Commission's recommendation for a directing council on army requirements, as well as the resurrection of the post of Master-General of Ordnance. As a result, the Commission's concerns regarding the limited scope of the Ordnance Committee were also overlooked, and British military technology remained the product of a disparate committee system. Rather than appoint an "Inspector-General of Warlike Stores" to head a unified inspection department, the reorganization split inspection duties between separate offices. One, headed by the Assistant Director of Artillery, handled the ordnance factories and inspection work at Woolwich; Enfield in turn had its own under the new post of "Chief Inspector of Small Arms." The split made sense, given the distance between the two facilities, but effectively created separate entities under the nominal responsibility of the Director of Artillery. Finally, placing the manufacturing departments under the control of the Finance Department opened the possibility of interference by an officer "who of course had no intimate knowledge of the technical

[111] Williams, 253.
[112] Spiers, *The Late Victorian Army*, 45.

requirements of the Service," something that the Duke of Cambridge foresaw great problems with. In a later minute to Stanhope, the Duke worried that the army would have no voice in the operation the Ordnance Factories, and accurately predicted the eventual failure of this portion of Stanhope's plan.[113]

In addition, the reorganization exacerbated tensions over spending, as principal military officials such as the Duke and Wolseley held politicians responsible for the inadequate state of the army. The latter had well-known views regarding what he saw as British military weaknesses; Wolseley had argued since 1885 that the French could land an army unopposed on the English coast, a position backed up by an April 1888 memorandum written by his Assistant Adjutant-General, Col. John Adargh. In such an invasion, Ardagh claimed, heavy French naval guns could lay down such a barrage of shrapnel that "the operation of disembarkation can hardly be interfered with."[114] Until the release of the memo, Wolseley had only made his fears known in private conversations, but at a London dinner held on 23 April he publicly and acerbically blamed British politicians for the reason "all the nations of Europe…with the one exception of England [are] armed to the teeth". "What do we see when any new administration comes into office," he asked? "It is the same with all parties. The first thing is the endeavor made by the Minister...to obtain some clap-trap reputation by cutting down the expenses of the army and navy." If he does so, that minister then "plumes himself on the victory…and as he chuckles over this success he says, 'Say what a good boy am I!'"[115]

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[113] Hogg, 859-860.

[114] Roberts, 495.

[115] Spiers, *The Late Victorian Army,* 46; Roberts, 495; "Plain Words by Lord Wolseley." *Gloucester Citizen,* 25 April 1888, 3. Roberts noted the date as 27 April, but the *Citizen* reported the speech as being given the Monday before publication, making it the 23rd. Ardagh's memo was dated the 17th, just a few days before the dinner speech. See TNA, CAB 37/21/6, "Defence of England: Mobilization of the Regular and Auxiliary Forces for Home Defence."

The London *Daily Telegraph* followed Wolseley's widely-publicized speech with an alarmist article entitled "in large letters, England in Danger Our Army without Arms, Worst Guns in the World" on 11 May and which Viscount Charles Hardinge brought before the House of Lords that evening. Hardinge quoted the article as saying that, from "the highest military authority…the subjoined facts are indisputable….Owing to the deplorable neglect of Parliament…we are wholly unprepared for war, if not, indeed, at the mercy of any European enemy."[116] Hardinge then mentioned some of the "indisputable" facts pointed out by the *Telegraph*, including "the worst [artillery] served out to any army of the present day," and a new magazine rifle yet to be distributed to a single regiment. "The guns served out to the Volunteers are obsolete," the article charged; "the armaments of the forts are obsolete; the piles of shot and shell at Woolwich are for the most part obsolete." Directing his questions to the Duke of Cambridge, Hardinge asked if there was any foundation for the allegations raised by the *Telegraph*. The Duke dodged, first humorously claiming that until seeing that article he had believed himself to be the "the highest Military Authority." The Duke then tacitly agreed, stating that "the circumstances are such that these questions are well worthy of the fullest and most anxious consideration" by Government. Salisbury, on the other hand, pointed out that despite what the *Telegraph* claimed both his and previous governments passed increases in both men and money available to the army. For the most part, this was true, although as Table 4 shows both the manpower and money available for the army in 1887-88 had been reduced, in part because the costs related to Navy guns had finally been transferred to that service's estimates.[117] Salisbury also rebuked Wolseley and other

[116] Where the *Telegraph* got its information remains unknown; the "highest military authority" may have been Wolseley himself.

[117] The question of transfer of the money voted for naval ordnance stores from Army to Navy estimates had been raised several times over the years, and almost put into effect in 1868. In an 1884 memo to Henry

"distinguished authorities upon military affairs [for] making statements against the Government under which they serve…in a place there they cannot be answered," such as at the London dinner party speech. If Wolseley, a member of the House of Lords, "thinks his duty forces him to make such statements as these, let him come down here and make them."[118]

Table 4 - Military Manpower and Finance Estimates, 1880 – 1880.[119]

		Army			Navy		
Est. Year	Administration	Men	£ Estimate	*HCPP Source*	Men	£ Estimate	*HCPP Source*
1880-81	Gladstone	131,859	15,987,300	*1881 (46)*	n/a	10,566,935	*1881 (61)*
1881-82	Gladstone	134,060	16,589,500	*1882 (69)*	n/a	10,945,919	*1882 (82)*
1882-83	Gladstone	132,905	15,458,100	*1883 (23)*	n/a	10,483,901	*1883 (66)*
1883-84	Gladstone	137,632	15,975,300	*1884 (75)*	n/a	10,899,500	*1884 (76)*
1884-85	Gladstone	140,314	17,905,600	*1885 (49)*	n/a	11,185,770	*1885 (44)*
1885-86	Gladstone	142,194	17,750,700	*1886 (62)*	61,500	12,694,900	*1886 (66)*
1886-87	Salisbury	151,867	18,233,200	*1887 (70)*	51,400	13,270,100	*1887 (73)*
1887-88	Salisbury	149,391	16,852,319	*1888 (62)*	62,500	13,988,381	*1888 (71), (62)*

Such a public censure led many to expect Wolseley's resignation.[120] Instead, the general appeared before the House of Lords on the 14th to both explain himself, and – to the relief of Salisbury – apologize. Wolseley denied "most emphatically that I have ever said one word that could be in any way construed into an attack in any form upon the Administration presided over" by Salisbury. Reading from a letter sent to Stanhope after the dinner speech,

Brand, Col. H. J. Alderson wrote that "the great changes which have taken place…amounting almost to a revolution in our armaments, have tended to accentuate the importance of making the Admiralty entirely responsible (as indeed they are at this moment partially so) for the provision of all warlike material required for the Navy." The process which involved not only matters of accounting but also munitions custody and inspection, took to more years to work out. See TNA, WO 33/47, "Naval Armaments. Report of Inter-Departmental Committee appointed to consider the question of transfer to the Admirality of Naval Armaments," November 1886.

118 "The National Defences. Question. Observations." *HL Deb 11 May 1888 vol 326 cc1-7.*

119 Data compiled from "Estimates of Effective and Non-Effective Army Services" with the document number in parentheses. The chart presents the figures voted on by Parliament, not necessarily the amounts actually spent, which could be more or less depending on votes of credit, supplementary votes, etc.

120 "Will Lord Wolseley Resign?" *Pall Mall Gazette*, 12 May 1888, 8; "The Scare About the Army – Threatened Resignation of Lord Wolseley," *Hartlepool Mail*, 12 May 1888, 3

Wolseley insisted that he had "attributed our [military] shortcomings to the vicious system of Party Government, and not to any particular individual on one side of the House or the other. My reference to Ministers was to Ministers in the abstract." In a conciliatory gesture, Wolseley wound up his speech by "hop[ing] the Secretary of State for War and every Member of the Government will understand that I deeply regret that the words I made use of in that speech…could by any possibility be considered as reflecting in any way upon any Member of Her Majesty's Administration." Salisbury accepted Wolseley's disavowal of any direct attack on himself or his cabinet, and "hope[d] he will not take this incident too seriously, for I should regard his leaving the Public Service as the greatest blow that could fall upon our military administration."[121] The *Pall Mall Gazette*, however, reported that Wolseley had "stuck to his guns like a gallant general" and reiterated his belief in the deficiencies of England's defenses.[122] With a weakened Navy and an army dispersed "all over the world…our military forces are not organized or equipped as they should be to guarantee even the safety of" London itself.

Alive to the issues raised by Wolseley and other officers and concerned himself about the defense of the Empire, Salisbury already had plans to form yet another commission, this one to study the whole of military administration for both the army and navy.[123] On 07 June 1888, royal warrant directed the commission, chaired by Lord Hartington, "to inquire into the Civil and Professional Administration of the Naval and Military Departments, and the

[121] "The National Defences. Personal Explanation." *HL Deb 14 May 1888 vol 326 cc91-110.*
[122] "Lord Salisbury's Admission." *Pall Mall Gazette*, 15 May 1888, 1.
[123] Spiers (*The Late Victorian Army*, 46) wrote that on the day following Wolseley's appearance before the House of Lords, "government sought to defuse the debate" by announcing the commission. Well before then, however, the subject of forming the commission came up in the House of Commons in early March ("Protection of the Empire – Adjourned Debate," *HC Deb 08 March 1888 vol 323 cc593-678). On 04 May, W. H. Smith, First Lord of the Treasury and a former Secretary of State for War announced that Lord Hartington "*has consented to preside over the Royal Commission" ("Imperial Defences – The Royal Commission," *HC Deb 04 May 1888 vol 325 cc1370*).

relation of those Departments to each other and the Treasury."[124] Such a mandate limited the focus of the Commission to a very high-level examination of the entirety of British military administration, and precluded it from further investigating any hardware or organizational issues raised by the Stephen Commission, or the concerns voiced by Wolseley and alluded to by Cambridge.[125] Regardless, the new commission would have a significant long-term impact on the future of British military administration.

Even with the Hartington Commission under way, Stanhope felt confident enough assure the voters of North Islington that his government had made "substantial progress" in the strengthening of British land defenses in a 01 November 1888 speech. The reorganization at the War Office, the unification of the ordnance factories under a single head, and the establishment of the separate Inspection Departments figured prominently in his list of improvements. Passage of the Imperial Defence Act, he claimed, provided £3,000,000 for the defense of ports and coaling stations at home and abroad. The designs for new artillery had been finalized, with "fresh facilities…being afforded for testing both guns and ammunition wither greater convenience and rapidity." The business given to private industry had also increased, not only with established firms; Stanhope made the point that "for the first time, a large contract for guns had been placed with" Vickers and Sons of Sheffield, Britain's newest entry into the "gun trade."[126] Trials of the .303 Lee-Metford magazine rifle had been completed, and "reports from various climates and under all conditions proved that it was a weapon admirably adapted to its purpose." With full-scale manufacture scheduled,

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[124] HCPP, "Preliminary and Further Reports (with Appendices) of the Royal Commissioners Appointed to Enquire into the Civil and Professional Administration of the Naval and Military Departments and the Relation of Those Departments to Each Other and to the Treasury," 1890 (C.5979), iii.

[125] Spiers, *The Late Victorian Army*, 46.

[126] Vickers had long been famous for cast steel, especially church bells, and in 1888 began manufacturing armor plate for the Admiralty; the step towards producing finished guns was a large one but logical for a company seeking a greater share in the armaments market. See "Vickers, Sons and Co.," Grade's Guide, 03 Jul 2014, http://www.gracesguide.co.uk/Vickers,_Sons_and_Co.

"Government hoped…to begin the issue to the army of a rifle which they confidently believed to be superior to that now manufactured by any foreign Government." In addition, "the manufacture of the 12-pounder artillery recently described by Lord Wolseley as the best field gun in Europe" had also been pushed forward, as well as "another most formidable weapon…the machine gun." Such pronouncements were met with outbursts of cheering throughout Stanhope's speech. The proceedings were closed with "votes of confidence in her Majesty's Government and in Mr. [G. C. T.] Bartley," the MP that arranged the event.[127]

Tweaking the Machinery of Ordnance Development

Although Stanhope's reform program did not directly affect the constitution of the Ordnance Committee, several changes were made in its operations and scope during this decade, beginning with records-keeping. Since the reconstitution of the Committee in 1881, two separate sets of minutes had been kept by the Director of Artillery's office, one related to proposals considered by the Director and one specific to the Committee's business. On 17 February, Maj. Gen. Henry J. Alderson, then the Director of Artillery, noted that the dual-minute system "causes difficulty of reference without any corresponding advantage." Effective with the beginning of the next quarter of the year, Alderson consolidated the minutes of his office with those of the Ordnance Committee.[128] From 1889 forward, only one set of the *Abstracts of Proceedings* were published per year, instead of two as in 1881 through 1888.

The greatest change came with the elimination of the Surveyor-General's office and the assignment of the Director of Artillery underneath the Commander-in-Chief's office, which required the issuance of new "General Instructions for the Guidance of the Ordnance

[127] "Mr. Stanhope on the Army," *Times* (02 November 1888): 11.
[128] Subj. Y, TNA, SUPP 6/84: AP-OC 1888, 271-272.

Committee." Forwarded for review on 12 December 1888, the new instructions directed the Committee to answer to the Commander-in-Chief rather than directly to the Secretary of State for War as in 1881.[129] There were, however, important changes in the instruction details. Gunpowder and explosives were removed from the Committee's purview, having been handed over to a new "Committee on Explosives" earlier in the year.[130] The Ordnance Committee, on the other hand, now had "direct responsibility for the designs for all guns for H.M. Service," including those obtained from the trade, "except in special cases in which their recommendations have been overruled." In addition, the instructions gave the Committee limited leeway in undertaking experiments; any estimated to cost more than £25 required the express authority of the Director of Artillery.[131]

1889 saw additional changes, especially after a 10 January 1889 complaint by the Admiralty Office against the "very serious delays which take place in the settlement of questions connected with naval ordnance equipments." Such delays, for example, had left the "fuze question in an unsatisfactory state" and components of the new 6-inch breech-loading gun still undecided after two years. "The Admiralty would refer many more questions to the Committee," they went on, "but the delays and consequent inconvenience to the Service are so serious, that they have been compelled…to make other arrangements." What "other arrangements" are unknown, but in 1889 the Director of Naval Ordnance's office began keeping its own records of questions considered, an important step in the separation of army and naval ordnance matters.[132] As regards the Ordnance Committee, the Admiralty

[129] Wolseley issued the orders on 27 November, but the Duke informed the Committee that the new instructions would "take effect from date of receipt." Subj. Y, TNA, SUPP 6/84, AP-OC 1888, 1250, and "General Instructions for the Guidance of the Ordnance Committee" in Skentelbery, 284-289.
[130] Hogg, 1436.
[131] Skentelbery, 284-285.
[132] TNA, ADM 256/21 – 43, were the "Monthly Records of Principal Questions dealt with by Director of Naval Ordnance," were issued biannually from 1889 to 1907; ADM 256/44 covers the period 1908 to September

recommended that "greater facilities should be given…for carrying out their experiments," and that the stricture against direct communication by the Committee with department heads be lifted. Gen. Alderson, however, met the latter suggestion only half way by giving the Committee permission to contact the *chief inspectors*, and not the heads of the manufacturing departments, and on the understanding that "information imparted…be considered as emanating from [those officers] personally, and on their individual responsibility only." In February, the Committee itself complained of a "want of executive power to carry out experiments," and in the "great delay" in getting authority for "detail experiments" connected with larger investigations. The Committee suggested a money cap for such detail work, and a "free hand to carry out experiments without further reference, provided the sum allowed be not exceeded." After a meeting at the War Office "in order that a distinct understanding may be arrived at," Alderson approved the change.[133]

While the Admiralty wrangled with Alderson over the performance of the Ordnance Committee, a significant change occurred in the control of the great manufacturing departments. Salisbury's first pick for the new post of Director-General of Ordnance Factories (DGOF) had been Maj. Gen. Eardley R. Maitland, the Superintendent of the Royal Gun Factory since May of 1880. Maitland, however, held the post only until mid-1889 when he retired from the Royal Artillery. Salisbury agreed with Wolseley that the post should go to the most suitable candidate, and appointed William Anderson – the same engineer that had protested the Woolwich system before the United Services Institute four years before – as the new Director-General effective 11 August. The *York Herald* noted that "there will be a good

1911. The Archive online catalog shows an entry for Vol. 1 of the series (ADM 256/20), but lists it as "missing at transfer (see "Search results for ADM 256/20," *The National Archives*, accessed 14 Aug 2014, http://discovery.nationalarchives.gov.uk/SearchUI/s/res?_q=adm+256%2F20&_sd=&_ed).

[133] Supj. Y, TNA, SUPP 6/85: AP-OC 1889, 372-373.

deal of discontent among Army men" over handing control of factories producing military goods to a civilian, and indeed there already had been.[134] The Duke of Cambridge had "complained bitterly" to Stanhope over the assignment of control of the ordnance factories to the Financial Department in September of the previous year, as he felt that the army would have no say in the operation of the manufacturing departments.[135] With Anderson's appointment it seemed that loss of input would be complete. Both the *Times* and the military-oriented *Broad Arrow* supported the Duke, and published opinions against having a civilian "straight from a manufacturing firm" in charge of Ordnance factories and unused to the needs of the military.[136] Still, Anderson held the post until his death in December of 1898, and put in place many of the centralization and accounting changes recommended by the Morley and Churchill Committees.[137]

"Only Because the Country Itself has Spoken"

On 31 December 1889, the *Western Daily Press* took stock of the situation of the British army at the end of the year. "Mr. Stanhope has employed his time, or most of it, very usefully" in putting his reforms into place, the *Press* reported, "and he can at least console himself that the army is to-day generally more efficient than it was twelve months ago." The paper, however, stopped short of giving Stanhope full credit. "It is only because the country

[134] "London Letter," *York Herald*, 18 July 1889, 4.
[135] Hogg, 860.
[136] C. Orde Browne, "Our Ordnance Factories." *The Naval Annual* (1896): 167-74; 167.
[137] Anderson pushed hard to centralize the administration of the Royal Arsenal. Among his changes included the establishment of a central headquarters at Woolwich for both communications and accounting, and the creation of a Central Stores Branch to take the place of the individual efforts of the manufacturing departments. In 1890, as a result of the investigation of the Churchill Committee, "the whole method of factory accounting was overhauled and centralized" under Anderson's supervision, a process that continued into 1891. See Hogg Vol. 2, 871-879, 1108. An 1895 article in *Cassier's Magazine* noted that, in addition to "arranging many of the departments, [and] in improving the systems of accounts and cost-keeping," Anderson had supervised "the introduction of many new manufactures" for cordite, the production of wire guns, cast- and forged-steel projectiles, and quick-firing ammunition cases. See "Dr. William Anderson: Director-General of the British Royal Ordnance Factories," Carriers Magazine: Engineering Illustrated, Vol. VIII (May-Oct 1895), 457-458.

itself has spoken…that so much has been recently done," it claimed. "If our armaments are of a more serviceable character than they were when guns were bursting and bayonets were bending, it is because popular pressure has been brought to bear on the Secretary of State."[138] Although unfair to Stanhope, the paper was in some ways correct; the British public, kept informed by agitators such as Carbutt and Armit and with the aid of the press, put considerable pressure on Government to improve its military hardware. Such improvements were indeed considerable. In the space of nine years, the infantry went from a large-bore single-shot rifle to the small-bore, ten-shot Lee-Metford, equal if not better than weapons carried by Continental armies. Both the Royal Artillery and Royal Navy were fully committed to modernized breech-loading cannon, although rifled muzzle-loaders would remain in service for another decade. The monopoly that the Royal Gun Factory held on both ordnance design and manufacture had finally cracked, with orders being let to Elswick Ordnance, Joseph Whitworth and Co., and newcomers such as Hotchkiss of Paris and Maxim Nordenfelt Co.[139] Finally, new chemical-based propellants and explosives promised to increase the range, hitting power, and accuracy of both artillery and small arms, without the clouds of smoke that black powder produced. While all required more work to perfect, 1889 found Britain much better off in terms of military technology than a decade before.

The same could not be said of the underlying machinery that supported the military. Stanhope's reorganization, while it clarified the muddled distinction between civilian and military authority, stopped short of the complete rebuild that the nation's military

[138] "The Military Year." *Western Daily Press*, 31 December 1889, 7.

[139] Whitworth received its first contract for 6-inch breech-loading guns in 1887, although its founder did not live to see the results of so long a labor. See HCPP, 1887 (109), and "Joseph Whitworth," *Grace's Guide*, 1 Dec 2014, http://www.gracesguide.co.uk/Joseph_Whitworth. See also "Hotchkiss," *Grace's Guide*, 8 Aug 2014, http://www.gracesguide.co.uk/Hotchkiss, and "Maxim Nordenfelt Guns and Ammunition Co.," Grace's Guide, 21 Dec 2012, http://www.gracesguide.co.uk/Maxim_Nordenfelt_Guns_and_Ammunition_Co.

administration system needed. Some of the tensions produced by the Cardwell reforms remained, most notably the heavy weight that the Financial Department exerted through its excrutiating examinations of of army spending. In addition, the dissolution of the Surveyor-General's post removed a layer of professional advice on ordnance matters available to the Secretary's office. Stanhope, like so many of his predecessors, came into office generally ignorant of military matters; the Duke of Cambridge's "massive authority build on long tenure and royal connections" therefore gave him considerable influence at the War Office. This most likely affected Stanhope's decision to centralize military matters under the Commander-in-Chief's office, but such a change overwhelmed the aging Duke with expanded responsibilities.[140] Stanhope also ignored the Stephen Commission's call for a more systematic approach to determining the army's needs, and their suggestion for better oversight of weapons development efforts through a resurrected Master-General of Ordnance post.

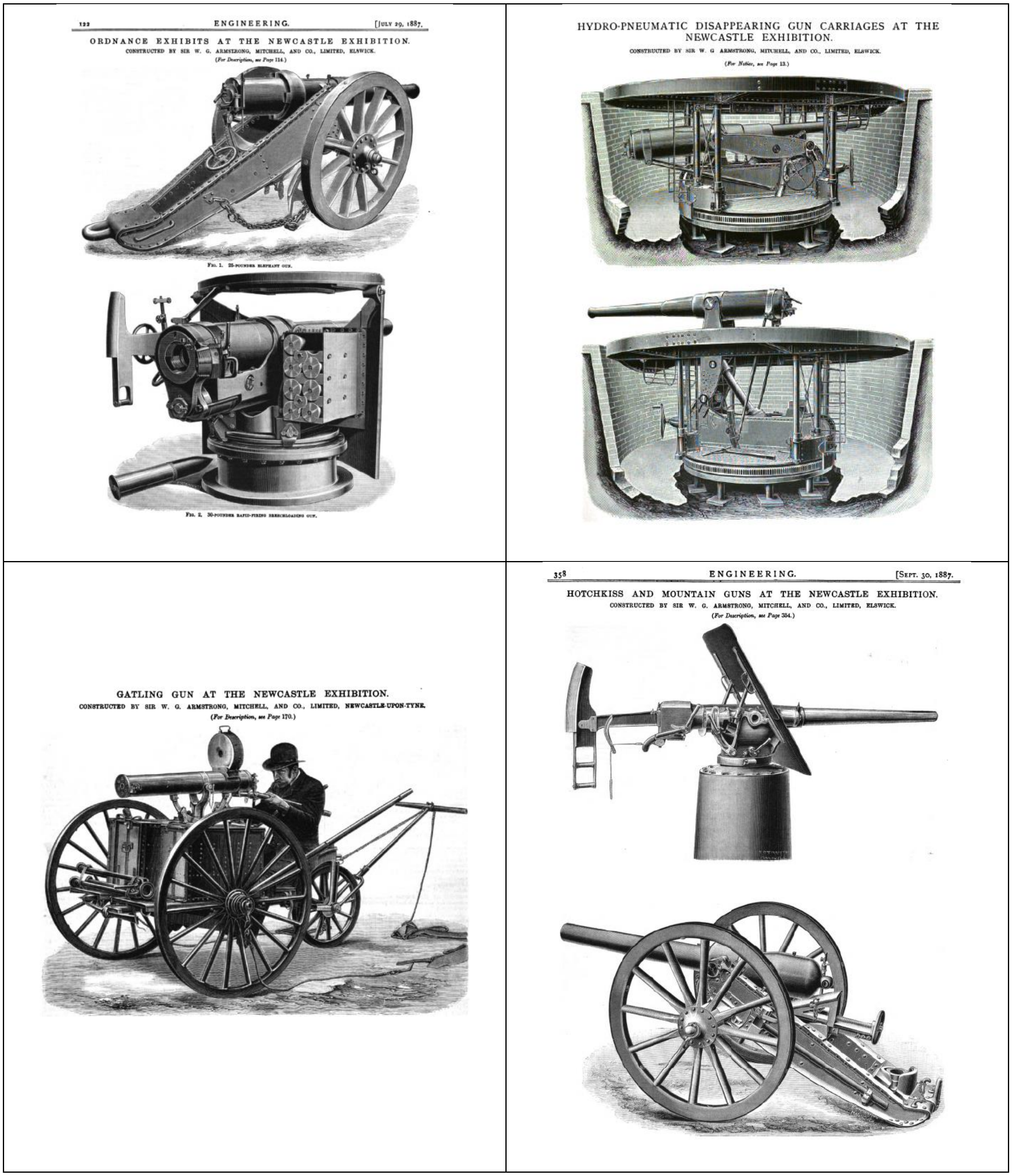
Stanhope's piece-meal selection of committee recommendations illustrates a governmental habit that bedeviled British military reform efforts. Since the Crimean War, dozens of Royal Commissions and Select Committees regarding military administration had been called into existence, including at least a half-dozen during Stanhope's tenure. Yet despite thousands of man-hours of testimony and hundreds of pages of reports, recommendations from such committees were often brushed aside. This issue was not unique to the War Office; any reform committee, no matter how strongly constructed, could find its work ignored if the department under study proved uninterested in change.[141] Unlike other

[140] Ian F. W. Beckett, "Edward Stanhope at the War Office, 1887-92." *Journal of Strategic Studies* 5, no. 2 (1982): 280, 286.

[141] John Ehrman, *Cabinet Government and War, 1890-1940,* (Cambridge, UK: University Press, 1958), 7. Ehrman noted that prior to 1880, "no fewer than seventeen Royal Commissions, eighteen Select

departments of government, however, the War Office and Admiralty's decisions could mean the difference between life and death for men on the bleeding edge of the Empire. With the Hartington Commission still in action at the turn of the decade, what remained to be seen is whether Stanhope would listen to advice from yet another report on British military administration.

Committee, nineteen Committees of officers inside the War Office, and thirty-five Committees of Military Officers had considered matters of policy affecting the army." For a partial list compared to the governments in power, see Appendix 5.



Figures 33-6: A selection of Armstrong products displayed at the 1887 Newcastle Exhibition. *UL*: 25-pdr field gun and 30-pdr naval-mount quick-firing guns. *UR*: a hydro-pneumatic "disappearing" gun platform for shore batteries. *LL*: a small-caliber Gatling gun. *LR*: A naval-mounted Hotchkiss and 7-pdr mountain gun for Indian service.[142]

[142] W. H. Maw and J. Dredge, Ed. *Engineering, An Illustrated Weekly Journal*, Vol. XVIV, July – Dec 1887; UL: 122; UR: 17; LL: 165; LR: 358.

Chapter 7: The Muddle Resurgent: The Second Boer War and the End of the Ordnance Committee

The British army coasted into the last decade of Queen Victoria's reign confident of its ability to defend the Empire, having lost only two small expeditions since Waterloo: a disastrous foray into Afghanistan in 1838, and a short 1881 campaign in South Africa. 1890 represented a rare year of peace for Britain, with only a small army in the field against holdouts in Burma.[143]

Military technology continued to advance after the stall of the 1870s; the army fielded its first small-bore magazine rifle, the .303 Lee-Metford, and the transition to breech-loading artillery in both the land and naval forces was well under way. Black powder was finally on its way out; "lyddite," a high explosive made of cast picric acid, had been approved for use in artillery shells, and smokeless "cordite" promised to give both small-arms and artillery a longer reach without the huge clouds of smoke that obscured the battlefield. The reconstructed Ordnance Committee seemed to be accomplishing what it had been appointed to do: shepherd the nation's artillery into the modern era.

When Victoria died in January of 1901, however, her Empire found itself again embroiled in a faraway war in which British forces suffered serious setbacks; worse, on the whole, than what it suffered during that terrible winter of 1854. That could at least be blamed on Mother Nature and the freak gale that sank so much of the army's winter supplies. Now, however, the setbacks were directly due to the military actions of the Empire's opponents, a bunch of "dirty, innocent-looking old farmers" that cost the British some 2,700 casualties in the "Black Week" of December of 1899.[144] It could also be blamed on failures in the nation's

[143] "The Chin-Lushai Expedition (1889-1890)," *Zomi Re-Unification Organisation*, 2014, http://www.zogam.org/chin-lushai-expedition-1889-1890.

[144] "The Boer War. 'Dirty, Innocent-Looking Old Farmers.'" *Western Times*, 25 August 1900, 4.

weapons: artillery outranged by that of the enemy, high-explosive shells that failed to detonate properly, rifles that did not shoot straight. The question for Britons, then, was did the Ordnance Committee fail its task, or were there other, more systemic flaws in the country's military? The whole system of British military administration, tinkered and tampered with since the Crimean War but never completely overhauled, put all of its faults on public display in the opening months of the war. Despite so many years of study, including the ongoing Hartington Commission, the "disastrous muddle" that mired Raglan's forces in 1854 threatened to claim more victims nearly fifty years later.

As it did after the shock of 1854, both the public and the British government recovered from the initial disasters to make good the deficiencies in its army and bring the conflict to a successful conclusion. Until the advent of home rule a few years later, South Africa would be colored red on the world map of the British Empire, but at the cost of thousands of lives and millions of pounds sterling. True to form, calls for post-war retrenchment by some members of Parliament began soon after the conclusion of hostilities. Other politicians, however, began to take a much longer view of imperial defense than before, especially the situation at the War Office. Not without considerable pain and missteps, the "disastrous muddle" would finally be cleared away, beginning with the final elimination of the anachronistic post of Commander-in-Chief. Ultimately both the Master-General of Ordnance office and the Ordnance Board – shades of the institutions that fell in 1855 but with narrower focus and responsibilities – would also be recreated. The Boer War, therefore, proved to be a critical trial run that helped prepare the Empire for the cataclysm of 1914.

The Ordnance Committee at the End of the Century

The Ordnance Committee in the last decade of the century continued to function much as it had on its reconstitution in 1881, but on a larger scale.[145] If the physical sizes of the *Abstracts* are any indication, the Director of Artillery and the Committee were quite busy; the publication for 1890 is split into two volumes, totaling nearly 1,450 pages, excluding the index. The volumes for 1895 and 1896 are also split, at 1,064 and 753 pages respectively. Proposals for products and inventions continued to flow into the War Office, albeit at a slightly lower yearly average of 175 than in the decade before. Although eccentric ideas still appear in the *Abstracts*, such as T. Le Poidevin's suggestion of a "catapult for throwing shells," the proposals brought forward in this decade consist mostly of suggestions for improvements of existing hardware, rather than the "visionary and speculative projects" that had plagued the OSC.[146]

Increasingly mixed in with solitary individuals were a growing number of companies seeking a market for their wares. Some tried to tempt the War Office with free trials; the Porter and Thomas Paint Company, for example, stated they would "supply free of charge any quantity" of paint for iron and steel structures, and J. B. Wheen & Sons offered to submit a cask of axle grease.[147] Such tactics rarely worked; usually the company would be turned away with the reply that there were "no orders to give" for their products. Occasionally, however, samples did get noticed; an electrical "accumulator," or rechargeable battery, from the Epstein Electric Accumulator Company impressed the Inspector-General of Fortifications enough in 1893 for him to recommend "that the firm should be placed on the list of

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[145] For a list of changes in the primary officers and their duties, see Appendix 2.
[146] Subj. 2621, TNA, SUPP 6/6: AP-OSC 1864, 733
[147] Subj. 3337.461, TNA, SUPP 6/90: AP-OC 1893, 809; Subj. 3337.468, TNA, SUPP 6/90: AP-OC 1893, 810.

manufacturers, in case accumulators should be required."[148] The Weldless Chain Company also sent in samples of their patented chain, which William Anderson (as Director-General of Ordnance Factories) reported favorably on. As a result, Lt. Gen. Hay "inform[ed] the Company that orders will be given should chains of this description be required."[149]

Both Epstein and Weldless Chain are examples of the numerous companies formed to work specific patents, and the risks such ventures carried to their investors. Occasionally there were winners, such as the Morris Tube & Ammunition Co., which by the 1890s did brisk business with the War Office selling all manner of practice equipment for field and naval ordnance.[150] Most firms folded often as fast as they came together; Weldless, for example, received a "compulsory winding-up order" in 1896 for non-payment of debts.[151] Despite such risks, the entrepreneurial spirit of British businessmen is quite evident in the *Abstracts*: the Eclipse Patent Safety Horseshoe Syndicate, Elmore's Patent Copper Depositing Company, Mackie Patent Stopper Syndicate, and the Shellbend Folding Boat Company lined up with dozens of others in their attempts to secure a slice of the War Office budget.[152]

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[148] Subj. 3337.462, TNA, SUPP 6/90: AP-OC 1893, 809.

[149] Subj. 3337.479, TNA, SUPP 6/90: AP-OC 1893, 1056.

[150] Richard Morris held several patents related to using "sub-caliber" rifle barrels and ammunition, which allowed for accurate target practice with less expensive ammunition. His adaptors for naval ordnance, for example, used a special 1-inch cartridge whose trajectory matched that of service ammunition out to a thousand yards. He was a prolific inventor, and by 1892 had received seventeen patents, eight of them in 1890 alone. For a list of his inventions used by the British government, see *The Railway News and Joint-Stock Journal*, Vol. XLVII: January-June, 1887 (London: The Railway News, 1887), 810; see also *Patents for Inventions: Abridgments of Specifications. Class 119, Small-Arms. Period A.D. 1855-1930*, Vols. 1877-1888 and 1889-1900 (British Patent Office, 1905, repr. Armory Publications, Oceanside CA 1993).

[151] "Chancery of Lancashire," *Manchester Courier and Lancashire General Advertiser*, 28 July 1896, 3. The company made another go of things later, as the "Shields Daily Gazette reported in May of 1900 that new works had been established in Newcastle-on-Tyne, "and the Company hope to produced their first steel weldless chain within the next two months". See "Maritime Notes," *Shields Daily Gazette*, 26 May 1900, 4.

[152] For Eclipse, see Subj. 3337.467, TNA, SUPP 6/90: AP-OC 1893, 809; for Elmore, see 3284.125, TNA, SUPP 6/90: AP-OC 1893, 494; for Mackie, see Subj. 3337.380, TNA, SUPP 6/89: AP-OC 1892, 648; for Shellbend, see Subj. 3215.40, TNA, SUPP 6/143, "Proceedings of the Ordnance Committee," Q1-2 1898, Min. 45318.

Until the mid-1880s, the realm of the inventor remained exclusively male, with the very occasional request by a widow or surviving daughter for financial consideration in light of their husband's or father's prior inventions or service.[153] In 1886, however, Mrs. Ellen Graddon put her patent for "improvements in the apparatus for working Ordnance" before the War Office for consideration.[154] Although Gen. Alderson declined Mrs. Graddon's invention, she remains the first of a very small number of women in the late nineteenth century to step before the War Office with their ideas. Mrs. A. Wardroper, who proposed a new form of water bottle for infantry use in 1891, had perhaps the best success; Alderson ordered twenty of her zinc water bottles for trial, but tests at Aldershot found them "more liable to damage, and…[unable to] keep the water so cool as the Service bottle."[155] Miss Fanny Godfrey tried in 1893 with her "improvements relating to buttons," and in 1895 Mrs. J. Clarke suggested "[putting] steel in bullets, in order to allow surgeons in probing wounds to find out, by means of a magnet, where the bullet is."[156] Again, neither proposal received more than a "thanks for playing" notice. Those women had represented themselves; in 1896, however, a Mrs. Ronalds became the first woman to act as agent for an inventor, when she brought drawings and specifications for Mr. A. W. Tooley's "combined nosebag and water bucket" before the War Office. For her troubles, she received a very polite note "for bringing the invention to notice, [but] the S. of S. is not prepared to take any further steps in regard

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[153] An example of such a case: in 1865, the widow of a Lt. A. H. Bell appealed for some form of reward for his work on a "Hydroscope, or instrument for determining the distance of an object at sea from an elevated battery." The OSC thought her appeal to be "a very proper case for a gratuity of £50," in view of the expenses Lt. Bell might have incurred "in maturing his instrument, and the credit justly due to him for its introduction." See Subj. 2295, TNA, SUPP 6/7: AP-OSC 1865, 147.

[154] Subj. 3283.6, TNA, WO 33/47: AP-DDA 1886, 303. Sonya Pinnock of the British Library, in an email to the author on 06 Sep 2014, confirmed that Pat. No. 3025, dated 03 March 1886, had been granted to Ms. Graddon for "Working Ordnance," but no further details were available as the patent either became void or abandoned.

[155] Subj. 3337.272, TNA, SUPP 6/88: AP-OC 1891, 314.

[156] Subj. 3337.430, TNA, SUPP 6/90: AP-OC 1893, 239; Subj. 3301.356, TNA, SUPP 6/91: AP-OC Q1-2 1895, 254.

thereto."[157] Although these women only play a very small role in the story of British ordnance development, such participation – in an era not known for women's independence – emphasizes how alive the British inventive spirit was at the turn of the century.

"This System Cannot and does not Work Well:" The Hartington Commission, 1890

Unlike the stability exhibited by the Ordnance Committee, British military administration in the 1890s experienced considerable turmoil once the Hartington Commission released its report on "Internal Administration of the War Office" on 11 February 1890. In its opening paragraph, the Commission recognized that while War Office administration "has undergone far more changes than that of the Admiralty," the process of building the office had been slow, and the responsibility of the Secretary of State for War remained "less real than that of the First Lord of the Admiralty."[158] In particular, Stanhope's reorganization put "an excessive centralisation of responsibility in the person of the Commander-in-Chief," the only military officer who answered directly to the Secretary. Such centralization weakened the positions of other department heads within the office; the Commission also felt that "the system cannot adequately provide for the consultative…duties of the War Department….a point to which we attach much importance." This resulted in "wholesale recourse…to committees appointed to deal with certain classes of questions," similar to what occurred after the dissolution of the OSC but writ large across the whole War Office. "This system cannot and does not work well," the Commission pointedly stated. "It is impossible that sound and well matured decisions can be arrived at." As Gen. Adye had found with the interim technical committees in the 1870s, the Commission noted that "it is

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[157] Subj. 3337.630, TNA, SUPP 6/93:AP-OC 1896 Q1-2, 377

[158] HCPP, "Preliminary and Further Reports (with Appendices) of the Royal Commissioners Appointed to Enquire into the Civil and Professional Administration of the Naval and Military Departments and the Relation of Those Departments to Each Other and to the Treasury," 1890 (C.5979), xix.

inevitable that the work of these numerous committees sometimes overlaps, and that there is a want of touch between them."[159]

Table 5: List of Committees in Operation, 1888.[160]

Committee Name	***Subject***	***Head***	***Appointed / Status***
Defence	Defence matters generally	Duke of Cambridge, *President*	Standing
Mobilization	Equipment of expeditions	Adjutant-General [Wolseley], *President*	Standing
Ordnance	Ordnance and warlike stores	Lt. Gen. Sr M. A. S. Biddulph, RA, *President*	Standing
Ordnance Council	Rewards to inventors	Parliamentary Under-Secretary of State, *President*	Standing
Proportions	Proportions in which stores are to be issued for armaments	Asst. Director of Artillery and Stores, *President*	Standing
Royal Engineers	Royal Engineers' instructions, etc.	Col. R. N. Dawson-Scott, RE, *President*	Standing
Sanitary	Barracks, hospitals, etc.	Maj. Gen. Sir R. H. Buller, *President*	Standing
Colonial Defence		Gen. Sir L. Nicholson, *President*	Standing
Small Arms	General questions of	Maj. Gen. P. Smith, *Chairman*	11 Sep 1886; has made interim reports
Distribution of troops in the United Kingdom	With a view to greater concentration	Lord Harris, *Chairman*	3 Dec 1886; has not met yet.
Stores supplied to India	Prices charged for	Mr. R. H. Knox, *Chairman*	15 April 1887; last met 25 April 1887.
Gibraltar	Limitation of civil population, and putting a stop to smuggling	None specified	16 Jan 1886; last met 14 June (1888?)
Colonial Military Contributions	To settle amount of	Sir A. L. Haliburton, *President*	17 Feb 1888; last met 21 June (1888)
Watkin artillery range finder	Effect on training of gunners, and numbers required	Lt. Gen. Brackenbury	09 Mar 1888; has not met yet.

159 HCPP, 1890 (C.5979), xxii.
160 HCPP, 1890 (C.5979), 102-103. The table is reproduced verbatim with the exception of the last entry regarding range finders.

The recommended solution to this and other problems involved nothing less than a total rebuilding of the British system of army administration. It the Commission's view, three aspects of the War Office especially needed strengthening: the Secretary's ultimate responsibility to Parliament, the important distinction between consultative vs. administrative and executive advice, and direct responsibility of officers "charged with certain well-defined duties" to the Secretary. To these ends, the Commission made several recommendations, beginning with the formation of a "Naval and Military Council" to jointly consider budget estimates and policy that involved national defense.[161] It also recommended a permanent "War Office Council" whose principal function "would be to secure the harmonious working of the several branches of the War Office in all cases in which they are collectively concerned."[162] Finally, it recommended the creation of a Chief of Staff's office, in line with "the military systems of all the great Powers of Europe." The new department would handle military operations planning, intelligence gathering, and advise the Secretary "upon all matters of organisation and the preparation of the army for war." In addition, the Commission felt that passing all responsibility through the Commander-in-Chief, "even for such a matter as the defective design of a heavy gun," to be a level of centralization not found in any other Great Power army. They argued that the heads of subordinate departments – including the recently created Director-General of Ordnance Factories – should be made directly answerable to the Secretary of State.[163]

Such changes would effectively eliminate the need for a Commander-in-Chief's post, which the Commission recognized as problematic given the long tenure of bythe Duke of Cambridge in that post. With due deference, the Commission noted that George's long

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[161] HCPP, 1890 (C.5979), viii.
[162] HCPP, 1890 (C.5979), xxvii.
[163] HCPP, 1890 (C.5979), xxii-xxiii; see also Spiers, *The Late Victorian Army*, 46-47.

service had aided the functioning of the current system of military administration to function, despite its flaws. The Duke had, "with the greatest loyalty," worked with successive Secretaries and brought "a personal popularity with the Army in general which cannot fail to be of public advantage" (although that advantage was not spelled out). "It is clear," the Commission warned, "that no possible successor could enjoy a position and influence which years of service to the State are alone capable of establishing." Therefore, the Commission recommended the elimination of the Duke's post should be delayed until "the occurrence of a vacancy in the office of Commander-in-Chief, or at any favourable opportunity."[164] Such an opportunity, however, proved to be a few years in the future.

The Hartington Commission had significant long-term impact on British military administration, but royal and political pressure kept Stanhope from implementing most of its recommendations. Both Cambridge and Wolseley opposed the creation of a Chief of Staff, except as an appendage of the Commander-in-Chief's office, which the Duke was firmly determined to retire from – eventually. Although she had no direct influence over the choice of the Duke's successor, Queen Victoria hoped that Prince Albert, her third son and the Duke of Connaught, would be tapped for the post. Stanhope did form the War Office Council in May of 1890, but like the Ordnance Council before it, the new body became something other than what the Commission recommended. Rather than a higher-level board with responsibility for its own decisions, the Council became just another tool to assist the Secretary, if and when he saw fit to consult it.[165] As one paper predicted, "no very great

[164] HCPP, 1890 (C.5979), xxii.
[165] Spiers, *The Late Victorian Army*, 47-48. As Stanhope later noted in a speech before the House of Commons, the War Council consisted of "Civil and Military officers…The fullest freedom of discussion is allowed every member of the Council, who is absolutely entitled to bring forward with notice anything he thinks necessary." As president of the Council, the Secretary "call[s] on every member to express his opinion; and having heard the views of the various members, I am in a position to form an opinion, for which I am responsible to this House." Therefore, ultimate responsibility of the Council rested with the Secretary's

changes result from the Report of the Hartington Commission," at least in the immediate years after its release.[166]

An important structural change, meanwhile, occurred in the relations between the army, navy, and their supply of warlike stores with the 9 May 1891 establishment of a formal Naval Ordnance Department.[167] Such a division had been made possible by the transfer to the annual votes on Naval estimates of all amounts requested for guns, ammunition, and other stores previously carried in the Army votes, which went into effect in 1887.[168] Although it took several months to effect the transfer, by October of 1891 the new department stood ready to handle the "provision, care, custody, and distribution of all ordnance stores required for use in the Navy." The Admiralty headquartered the new Department at Woolwich, which the *London Standard* reported as the "most suitable position…as it is there in close touch with the Ordnance Factories, the Royal Navy being [their] best customer."[169] Although this finally freed control of the physical supply of ordnance products from the army, design remained with the Ordnance Committee, under ultimate authority of the Director of Ordnance. Given the presence of naval officers on the Committee, and despite the Admiralty's complaints regarding its performance, the arrangement worked well enough to remain in force through the end of the century.

1891 also saw an attempt to split field artillery design off from the Ordnance

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office, although Stanhope said he "look[ed] to every member of the Council for individual responsibility for the opinion he gives." ("Army Estimates, 1891–92." HC Deb 23 February 1891 Vol. 350 cc1382-463). The Council meetings decreased over time, from a high of eleven in 1891 to not at all in the first half of 1895; see Spiers, 48.

[166] "The Services." *Cheltenham Looker-On*, 12 July 1890, 9.

[167] *The Orders in Council for the Regulation of the Naval Service*. Vol. VI: 7th February 1888 to 26th November 1892 (London: HMSO, 1893), 127-129.

[168] Such a split had been under consideration for decades; evidence presented to an 1886 "Inter-Departmental Committee" appointed to study the division included memoranda dating to 1833. See TNA, WO 33/47, "Naval Armaments: Papers and Correspondence relating to the Question of Responsibility for provision of Money, Custody of Stores, &c.," 11.

[169] "The New Naval Ordnance Department." *London Standard*, 10 October 1891, 3.

Committee, despite the condemnation by the Hartington Commission of the War Office predilection for forming committees. During development of a new 12-pounder field gun, in 1883 the Ordnance Committee had recommended a powder charge that resulted in a high initial muzzle velocity of 1700 feet per second. The combination of gun and carriage also came in over 3600 pounds, the generally recommended weight for horse-drawn artillery but acceptable for field artillery. When questioned, the OC replied that higher velocity produced a flatter trajectory and better terminal effects for shrapnel shells, "now fully recognized as, *par excellence*, the projectile for light Field Artillery." The Committee "consider[ed] that the gain more than counterbalance the practical difficulty of attaining it," but in the intervening years other artillerymen had doubts.[170] Maj. Gen. C. E. Nairne, the Inspector-General of Artillery in India, reported on 25 October 1891 that "a feeling of mistrust in the power of the 12-pr B.L. Gun is springing up, based on an unsound re-action in favour of low velocity fire." Such feelings were echoed in complaints reported by Gen. Sir Redvers Buller, who had succeeded Wolseley as Adjutant-General in 1890.[171] "The high initial velocity…was by no means absolutely essential to effective shrapnel fire," Buller claimed, and "lower velocity guns in other armies give as good results." In addition, "every Battery Officer he had spoken to condemned" the carriage of the new gun, "and declared the recoil to be excessive, while every Horse Artillery Officer declared that the gun and carriage is so heavy as to be positively unserviceable."[172] Directed by the Duke of Cambridge to investigate the matter, Buller apparently received a suggestion by one Lt. Gen. Goodenough that a separate

[170] The OC entry noted that, despite numerous design changes the weight could not be reduced significantly. A special committee appointed to review light artillery in 1889 decided that "the present equipment must be retained" until after the completion of experiments with new cordite-firing guns. In the interim, "to reduce the weight behind the [horse artillery] team, the limber gunners must be mounted on horses." See Subj. 3261, TNA, SUPP 6/88: AP-OC 1891, 1232.

[171] Ian F. W. Beckett, "Buller, Sir Redvers Henry (1839–1908)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/32165.

[172] Subj. 3261, TNA, SUPP 6/88: AP-OC 1891, 1230.

"Artillery Committee" be appointed to consider questions related to field and horse artillery.[173] Buller passed the suggestion to Director of Artillery Lt. Gen. Robert Hay in December of 1891, along with instructions to "consider the whole subject as to how Inventions and New Equipments are now dealt with."[174]

In response, Gen. Hay emphasized "the difficulties…experienced by the Director of Artillery, in not having a properly constituted Committee to whom to refer, previous to determining on any new invention of war." Regarding the 12-pounder, Hay felt that "precisely the same course as now recommended was adopted," in that design of the carriage had been referred to a special committee prior to adoption. "Experience gained by actual trial" led to subsequent modifications to the carriage, and Hay could "not see how any definite conclusions could be arrived at otherwise." Not only did Hay "consider it unfortunate that opinions on such an important point as ballistics should be suddenly changed," he felt that "an independent Artillery Committee would…clash with the duties of the [OC], and would raise the question of [its] continuance." In the spirit of careful contemplation, however, Hay laid out a scenario where the OC still played an intermediary role in developing new equipment based on specifications from technical committees for field, siege or other types of artillery. "Whatever system may be adopted," Hay warned, "it must be remembered that careful experiments can alone ensure that any equipment recommended will meet the requirements of the service, and that experiments necessarily take time."[175] Hay won his point, and the Ordnance Committee survived. Buller, in his reply to the Duke, stated he didn't want to "substitute any Artillery Committee for any function of

[173] The suggestion may have come from Gen. W. W. H. Goodenough, a former Assistant Director of Artillery; see *General Indexes to the Abstracts of Proceedings, 1869 – 1883* (Royal Armouries Library, Leeds, UK).
[174] TNA, WO 32/7156, "Question of appointment on Artillery Committee in addition to Ordnance Committee. Introduction of 12 PR B.L. gun. Subjects referred to Director of Artillery."
[175] TNA, WO 32/7156, Minute of Gen. Hay, 16 December 1891.

the Ordnance Committee," although he felt that technical committees would help design "advance…with more decided steps than we do at present."[176]

The Retirement of "Poor George"

Stanhope reigned as Secretary of State for War for five and a half years, longer than any of his predecessors since the office came into being in 1854. His term of office, however, ended with the fall of Salisbury's government following the general elections of 1892. On 18 August, Sir Henry Campbell-Bannerman, or "C-B" as he often went by, once again took up the office, having held it for a brief five months in 1886.[177] Bannerman retained his post after Archibald Primrose (Lord Rosebery) took over from Gladstone in March of 1894.[178] Bannerman had been a member of the Hartington Commission, although he dissented in their final recommendation regarding a Chief of Staff office and had little use for the War Council once in office. He did, however, wish to solidify civilian control over the military, and agreed with the Commission's recommendation to abolish the post of Commander-in-Chief. To that end, "C-B" developed a two-prong plan of attack. In 1894, his staff began work on a revised version of the Commission's proposals, centered on the creation of an Army Board. This new entity would be composed of the five principal military officers (the Adjutant-General, generally in charge of Army personnel policies, the Quartermaster-General, Director of Artillery, and Inspector-General of Ordnance) and presided over by the C-in-C. The Board would take over numerous duties from the latter and "discuss such questions as may be…referred to it by the Secretary of State."[179] Given equal access to the Secretary, this

[176] TNA, WO 32/7156, Minute of Gen. Buller, 22 December 1891.
[177] A. J. A. Morris, "Bannerman, Sir Henry Campbell- (1836–1908)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/32275.
[178] H. C. G. Matthew, "Gladstone, William Ewart (1809–1898)," *ODNB*, May 2011, http://dx.doi.org/10.1093/ref:odnb/10787.
[179] "Army Estimates, 1895-6: War Office Re-Organisation." *HC Deb 31 August 1895 Vol. 36 cc1379-414*.

essentially made the other four officers contemporaries, rather than subordinates, to the Duke and greatly diminished the power of his office.[180]

The second part of the plan involved engineering the "favourable opportunity" suggested by the Hartington Commission: the resignation of the Duke of Cambridge. Considerable pressure came from both Campbell and the press; in a 4 May 1895 letter to his cousin the Queen, Cambridge complained "that there are serious attacks being made in some of the newspapers on the Authorities of the War Office and on myself in particular."[181] By then, however, even the Queen had been convinced that "poor George" had to go. On the 19th, she wrote that "on the advice of my Ministers...I have arrived at the decision, that for your own sake as well as in the public interest, it is inexpedient that you should much longer retain" the office, and that "you should be relieved at the close of your Autumn duties."[182]

Bannerman announced the Duke's impending retirement to the House of Commons on 21 June 1895. He opened with a very glowing description of the personal qualities of the officer, and disputed that "he [was] an impediment in the way of all reform." Instead, Bannerman said that "of late years he has never shown himself unwilling to adopt such changes…likely to be of advantage to the Army." Campbell even held up the Duke's retirement as illustration "that he now makes way in order that certain changes may be introduced" into army administration. Bannerman then outlined the changes he proposed: the retention of the office of Commander-in-Chief, but in a reduced capacity; the elevation of "the other heads of the Military Departments, who will each be directly responsible" to the Secretary and who will "constitute a deliberative council" as recommended by the

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[180] Spiers, *The Late Victorian Army*, 48-49.
[181] Willoughby Verner and Erasmus Darwin Parker, *The Military Life of H.R.H. George, Duke of Cambridge*. Vol. II: 1871-1904 (London: J. Murray, 1905), 395.
[182] Elizabeth Longford, *Queen Victoria: Born to Succeed* (New York: Harper & Row, 1964), 533; Verner and Parker, 395-396. See also Spiers, *The Late Victorian Army*, 49.

Commission. "I firmly believe," Campbell continued, that with a "less centralized and more elastic" system in place, "great advantage to the Army will ensue."[183]

Unfortunately for Bannerman, however, his triumph proved *very* short-lived. When the debate returned to the army vote under consideration, Conservative MP William St. John Broderick bushwhacked the Secretary with a charge that reserve stocks of small arms ammunition had fallen to dangerous levels during the Liberal administration.[184] Four years earlier, he claimed, the country had gone through "two processes that were always dangerous in Army matters: " a change not only the size of cartridge used in its infantry rifle (from the .45" Martini-Henry to the .303" Lee-Metford) but also in the propellant, switching from black powder to cordite. The newness of cordite meant British manufacturers lacked experience with the material, and supplies of the propellant were very unsure. Private industry – the only real source of immediate expansion in time of war – had struggled to bring enough capacity on-line to meet just the needs of peacetime ammunition requirements, never mind a reserve stockpile in case of war. "This was a serious state of things," Broderick claimed. "To have practically no reserve of small arm (sic) ammunition was the height of impolicy." As he could not move to increase the vote for warlike stores, Broderick moved to reduce the salary of the Secretary by £100, a "snap vote" tactic used to open debate on a subject. Campbell proved unable to defend his policies; the motion passed, 132 to 125, and Rosebery's government resigned the next day.[185]

In the general election that followed, both the Conservatives and their Liberal

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[183] "Orders of the Day: Army Estimates, 1895-6." *HC Deb 21 June 1895 Vol. 34 cc1673-713.*

[184] Broderick served as Financial Secretary to the War Office from 1886 to 1892 in the previous Salisbury government, and would return as Undersecretary of State for War with Salisbury's return in 1895. See J. B. Atkins, "Brodrick, (William) St John Fremantle, first earl of Midleton (1856–1942)," rev. H. C. G. Matthew, *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/32085.

[185] "Orders of the Day: Army Estimates, 1895-6." *See also Spiers, The Late Victorian Army, 49, and Wheeler, 247.*

Unionist allies made significant gains.[186] This brought Lord Salisbury back as head of a Conservative-led coalition government, his third term as Prime Minister and the last man to serve Queen Victoria in that office. Salisbury tapped Henry Fitzmaurice (Lord Lansdowne) to lead the War Office, and Lansdowne spent the next two months planning how to take advantage of the Duke's removal as Commander-in-Chief.[187] Essentially, Lansdowne copied Bannerman's idea for a new Army Board, but renamed the Director of Artillery post to that of Inspector-General of Ordnance (IGO). Established by an Order-in-Council dated 21 November 1895, the duties of IGO included inspection and supply of equipment and military stores, and "dealing with questions of armament, of patterns, of inventions and designs, and with the direction of the Ordnance Committee." He would also provide whatever technical advice the Secretary of State may require regarding ordnance.[188]

The Army Board, along with the War Office Council, gave the Secretary of State for War better consultative support, but "hardly transformed the War Office." The Council met very infrequently, and the Secretary ultimately made the final decision on any subjects referred to it. The Army Board met more often, but other than the preparation of the annual estimates could only consider such subjects as the Secretary forwarded to it. In addition, the generals disliked having to "face one another & argue out their ideas instead of attempting to push them through independently," presumably within their own spheres of influence. They also disliked that a civilian not only witnessed the sausage-making involved in preparing the

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[186] Ensor, 221.

[187] Lansdowne, a converted Liberal, had previously served as Under-Secretary of War in 1872 in Gladstone's first government. From 1888 to 1894 he served as viceroy in India, and worked well with Sir Frederick Roberts, Commander-in-Chief of the Indian Army. See Andrew Adonis, "Fitzmaurice, Henry Charles Keith Petty-, fifth marquess of Lansdowne (1845–1927)," *ODNB*, May 2009, http://www.oxforddnb.com/view/article/35500.

[188] HCPP, "War Office. Orders in Council Defining the Duties of the Principal Officers Charged with the Administration of the Army: (1.) Order in Council, Dated 21st November 1895. (2.) Order in Council, Dated 7th March 1899, Revoking the Order in Council, Dated 21st November 1895," 1899 (113). 4. See also "The Army Reorganisation," *The Star*, 29 August 1895.

annual estimates, but forced them to keep financial considerations in mind. Lord Wolseley, who replaced the Duke as Commander-in-Chief, also resented the gelding of the post and that the other military department heads were essentially his equals, to the point of requiring any correspondence to the Secretary to go through his office.[189] This would at least keep Wolseley informed of what was going on within the army, even if he lacked direct control.

One final change that directly affected the Ordnance Department took place before the end of a turbulent decade for British military administration. Stanhope's changes had put control of the Arsenal under the Director-General of Ordnance Factories (DGOF), who answered to the War Office's Financial Secretary. The change had rankled the military in 1888, and remained a point of contention ever since.[190] The issue came to the fore with the death of William Anderson, the civilian DGOF, in December. Lansdowne selected Lt. Gen. Sir Henry Brackenbury to fill the position, who despite a difficult personality came with a host of credentials. Brackenbury had spent the previous two and a half years as president of the Ordnance Committee, served as the last Director of Artillery prior to that office's abolition, and had served on the Hartington Commission as well.[191] Brackenbury's consent to fill the DGOF position, however, came with a price: the removal of the post from under the Financial Secretary and its return to direct control by the military.[192] As he later testified, he felt that control of the factories by the military to be absolutely essential; if the DGOF "had to go with his hat in his hand to the Financial Secretary and ask that this, that, and the other

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[189] Spiers, *The Late Victorian Army*, 50-52.

[190] For an example, see "Supply – Army Estimates." *HC Deb 25 March 1898 Vol 55 cc929-1035.*

[191] Ian F. W. Beckett, "Brackenbury, Sir Henry (1837–1914)," *ODNB*, Jan 2008, http://dx.doi.org/10.1093/ref:odnb/32021.

[192] Maj. Gen. Sir Charles E. Callwell and Maj. Gen. Sir John E. W. Headlam. *The History of the Royal Artillery from the Indian Mutiny to the Great War*, Vol. 1: 1860-1899 (Woolwich: Royal Artillery Institution, 1931; repr. Naval & Military Press, 2009), 211.

thing might be done," the needs of the service in wartime might never be met.[193] At his behest Lansdowne reorganized the military departments one more time, replacing the Inspector-General of Ordnance post with a resurrected "Director-General of Ordnance." The duties were similar to those of the Inspector-General, but the "Orders in Council" issued on 07 March 1899 explicitly granted "direction of the Ordnance Committee and the Manufacturing Departments of the Army" to the new post. In addition, the Orders made the new Director-General answerable to the Secretary of State rather than Treasury. The DGOF itself transformed into a new "Chief Superintendent of Ordnance Factories," which while remaining open to civilians now answered to the Director-General's office.[194] "The result," according to Royal Artillery historians Sir Charles Callwell and Sir John Headlam, "was a marked improvement in the working of the machinery" of the ordnance factories.[195] As regards the day-to-day operations of the factories – accounting, internal communications, inspection and so forth – this became true during Brackenbury's reign. As regards the products themselves, the upcoming war in South Africa showed there was much left to be desired.

The press, in particular the *Times*, welcomed the change. "The latest Order in Council…introduces an organic change of great importance," it announced on the 14th, which undid "the gross mistake of 1888." Placement of the factories under the Financial Secretary "could not succeed….Friction, confusion, and a great increase of unproductive expenditure naturally resulted, while political considerations tended to more and more assert themselves in the management of the national factories." Brackenbury, the paper claimed, "has a wide

[193] HCPP, "Royal Commission on the War in South Africa. Minutes of Evidence Taken before the Royal Commission on the War in South Africa. (Volume I.)." 1904 (Cd. 1790). 72.
[194] HCPP, 1899 (113), 6.
[195] Callwell and Headlam, 211.

experience of administration, and there is no one better able to bring order out of chaos in the great Ordnance Department." Putting him in charge meant that "a great anomaly and growing evils are abolished."[196] The *Pall Mall Gazette* agreed. Stanhope's placement of the ordnance factories under the Finance Department "was notorious, and on the face of it, inefficient, absurd, and…probably quite unconstitutional." Such facts, however, "did not in the least interfere with the resolution of the War Office to create the system, and 'to run it' until the whole affairs of the Government factories had been got into an inextricable muddle."[197] Even periodicals such as the *Cheltenham Looker-On* took notice. The weekly decried Stanhope's change as "simply a sample of the manner in which we, a great business people, manage our public departments, particularly the War Office….the result has been extravagance, friction, and confusion."[198]

The turbulence in War Office administration in the last decade of the nineteenth century matched the unsettled and increasingly solitary position of Britain on the international stage, a result of Salisbury's policy of "splendid isolation." [199] A war scare with the United States erupted over a boundary dispute between British Guiana and Venezuela in 1895; that same year, tensions with Germany frayed over the Kaiser's support for Boer nationalists in South Africa, made worse by a botched raid on Johannesburg by pro-British forces.[200] The Russians and the French, formal allies since 1894, had by 1897 built up their Eastern fleets to match the Royal Navy's power in the area, and Japan's rise as a regional

[196] "The Changes At The War Office." *Times*, 14 Mar. 1899, 13
[197] "Service Notes," Pall Mall Gazette, 28 Mar 1899, 1.
[198] "From Clubland," *Cheltenham Looker-On*, 18 Mar 1899, 14.
[199] J. A. S. Grenville, *Lord Salisbury and Foreign Policy: The Close of the Nineteenth Century* (London: University of London, Athlone Press, 1964), 11.
[200] Ensor, 229-231. See also Oliver Ransford, *The Battle of Majuba Hill: The First Boer War* (London: John Murray, 1970).

force could not be ignored.[201] Both Britain and France were marching across Africa, and required conferences between the two nations to avoid going to war over territorial disputes.[202] Britain found its list of potential allies growing thin, while its list of possible opponents seemed only to expand – making the question of imperial defense, and therefore the quality of its weaponry, all the more important.[203] It also made the failure to thoroughly address the "disastrous muddle" all the more damning.

From Omdurman to the "Black Week" of 1899

Although the *Abstracts* illustrate the tremendous effort involved in modernizing British weaponry, the success of such efforts could only be measured on the battlefield. In 1898, the overwhelming victory at Omdurman seemed a conclusive demonstration of that modernization effort. On 02 September, an 8,000-man British expeditionary force under Gen. (later Lord) Herbert Kitchener, bolstered by 17,000 Sudanese and Egyptian troops, stood against 60,000 Dervishes under the banner of *Khalifa* Abdullah, successor to *Mahdi* Mohammed Ahmed.[204] Kitchener's army could only be attacked across an open plain with little cover; at dawn, the Dervish infantry began a series of uncoordinated charges in an attempt to rush the plain. "From early morning to noon," historians D. H. Cole and E. C. Priestly wrote, "the Anglo-Egyptian army maneuvered as if on parade, wheeling to meet the successive attacks from different directions." "To all intents and purposes," they continued, it was "a battle of a much earlier period, save that the weapons used were infinitely more

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[201] Glen St John Barclay, *The Empire Is Marching: A Study of the Military Effort of the British Empire 1800-1945* (London: Weidenfeld & Nicolson, 1976), 23.

[202] Ensor, 243-245.

[203] Grenville, 19; see also Paul M. Kennedy, *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000* (New York, NY: Random House, 1987), 226-232; G. R. Searle, *A New England? Peace and War, 1886-1918* (Oxford; Oxford University Press, 2004), 239-269.

[204] Maj. D. H. Cole and Maj. Edgar C. Priestley. *An Outline of British Military History, 1660-1936* (London: Sifton, Praed & Co., 1936), 236. Ahmed, who died shortly after his victory at Khartoum in 1885, had beforehand named Abdullah, one of his principle lieutenants, to be "khalifa" (successor).

effective." With repeating rifles, Maxim machine guns, and shrapnel shells, the British made a literal hash of their Sudanese attackers. By the end, 10,800 Dervish lay dead, with another 16,000 wounded and 4,000 prisoner, against forty-eight dead and less than four hundred wounded on the Anglo-Egyptian side. It was, in the words of war correspondent G. W. Steevens, "not a battle, but an execution."[205]

Omdurman represented a tremendous victory for the British method of colonial warfare, and many Britons expected a repeat performance the following year when the nation found itself again at war in South Africa. This time, however, their opponents were not poorly trained tribesmen armed with spears and muskets. After the botched raid against Johannesburg in 1895, President Paul Kruger of the South African Republic invested in modern weaponry for his army and the Boer farmers that made up the country's militia. The French firm of Creusot sold the South Africans four 155mm heavy and six 75mm quick-firing field guns, and Krupp supplied four 120mm howitzers and eight 75mm field pieces. Ironically, Vickers of Sheffield sold them twenty quick-firing 1-pdr guns, rejected for service in the British army in 1894.[206] In addition, Kruger purchased 37,000 magazine rifles from Mauser, the well-regarded German rifle company.[207] Not only did the 7mm ammunition used in the Mauser have a higher velocity and longer range than the British .303, but the rifles themselves could be reloaded faster. The British soldier had to recharge his magazine one

[205] Cole and Priestly, 239-240; Farwell, *Queen Victoria's Little Wars*, 335-337.

[206] The gun had been brought before the OC in 1892, and recommended for further tests in 1893; Lt. Gen. Hay ruled on 10 Jan 1894 that he "does not consider that this gun is required for Land Service" (Minute 35,327, TNA, SUPP 6/135, "Proceedings of the Ordnance Committee, Q1-2, 1894; Subj. 3272.20, TNA, SUPP 6/89: AP-OC 1892, pp. 850, 1157, and SUPP 6/90: AP-OC 1893, pp. 454, 702, 976). Vickers had purchased the Maxim-Nordenfelt Guns and Ammunition Co. in 1897; see "Vickers, Sons and Maxim," *Grace's Guide*, 29 Aug 2014. http://www.gracesguide.co.uk/Vickers,_Sons_and_Maxim, and Clive Trebilcock, "Legends of the British Armament Industry 1890-1914: A Revision." *Journal of Contemporary History* 5, no. 4 (1970 Oct 01): 3; see also *The Vickers Brothers: Armaments and Enterprise, 1854-1914* (London: Europa, 1977) by the same author.

[207] Thomas Pakenham, *The Boer War* (New York: Random House, 1979), 35.

cartridge at a time; the Mauser, on the other hand, used a five-round "stripper clip" that allowed the shooter to refill his magazine with one action. This small difference in military technology – ignored by British small arms committees for over fifteen years – proved to be a game-changer in upcoming battles in South Africa.[208]

Figure 37: a 7mm Mauser with its five-round clip. To load, the soldier positioned the full clip in the bolt holder, then pushed all five cartridges in at once with the thumb.[209]

Much as they had forty-five years earlier, a "huge, cheerful, patriotic crowd" saw off the advance guard of the expeditionary force bound for South Africa on 14 October 1899. At 47,000 men strong, it would be the biggest army dispatched abroad since end of the Napoleonic Wars, and nearly twice the size of the force that sailed with Lord Raglan in 1854.[210] On the surface, the two expeditionary forces were materially different; Raglan's red-coated, long-service army were equipped with smoke-belching single-shot weapons, while Sir Redver Buller's khaki-clad reservists carried ten-round repeating rifles. But there were unsettling similarities between 1854 and 1899. In both wars, the army found itself in the midst of a change in infantry weapons; Raglan's between smooth-bore and rifled musket, and

[208] Austria introduced a rifle using a five-round clip, the design of noted arms inventor Ferdinand Ritter von Mannlicher, in 1886; see Hoyem Vol. 2, 178.
[209] Paul Scarlata, "The Spanish Modelo 1893 Mauser Rifle," *Shooting Times*, 23 Sep 2010, http://www.shootingtimes.com/long-guns/longgun_reviews_st_spanmodelo1892mr_200812/.
[210] Pakenham, 111-114.

Buller's between two different versions of the .303-inch Lee magazine rifle. In addition, the army still borrowed heavy guns from the navy, as they had for nearly every war since the Crimea; in South Africa, the field artillery had nothing to counter the range of the "Long Toms," as the French 155's were nicknamed.[211] Critically, infantry tactics also remained unchanged; soldiers were still drilled rigorously in line-of-battle tactics, schooled to stand shoulder-to-shoulder, deliver unaimed fire in volleys, and close with the bayonet. Such training worked in the numerous colonial wars of the nineteenth century, where small numbers of highly-disciplined soldiers regularly won against amateurs armed with inferior weapons.

The Boer, unfortunately for many a British infantryman, would not prove to be the same type of foe. Hardy farmers with generations of experience fighting the Zulu and other hostile tribes, they knew the best tactics for the South African landscape. In addition, most were excellent horsemen and marksmen, especially with their new Mauser rifles. Organized along regional lines, the mounted Boer *commandos*, or militia units, could move fast and hit hard. Rather than risk decisive battles, Boer leaders preferred to ride off before their units became hopelessly entangled. When they did chose to defend, Kruger's artillery units proved adept at moving their heavy guns where needed, and the commando leaders encouraged their men to dig in rather than stay out in the open. Trench warfare, mounted infantry, mobile artillery, and rapid-fire rifles were not what the British army had trained to fight.

[211] Major D.D. Hall, "The Naval Guns in Natal 1899-1902." *Military History Journal*, Vol 4 No. 3, June 1978; The South African Military History Society, http://samilitaryhistory.org/vol043dh.html.

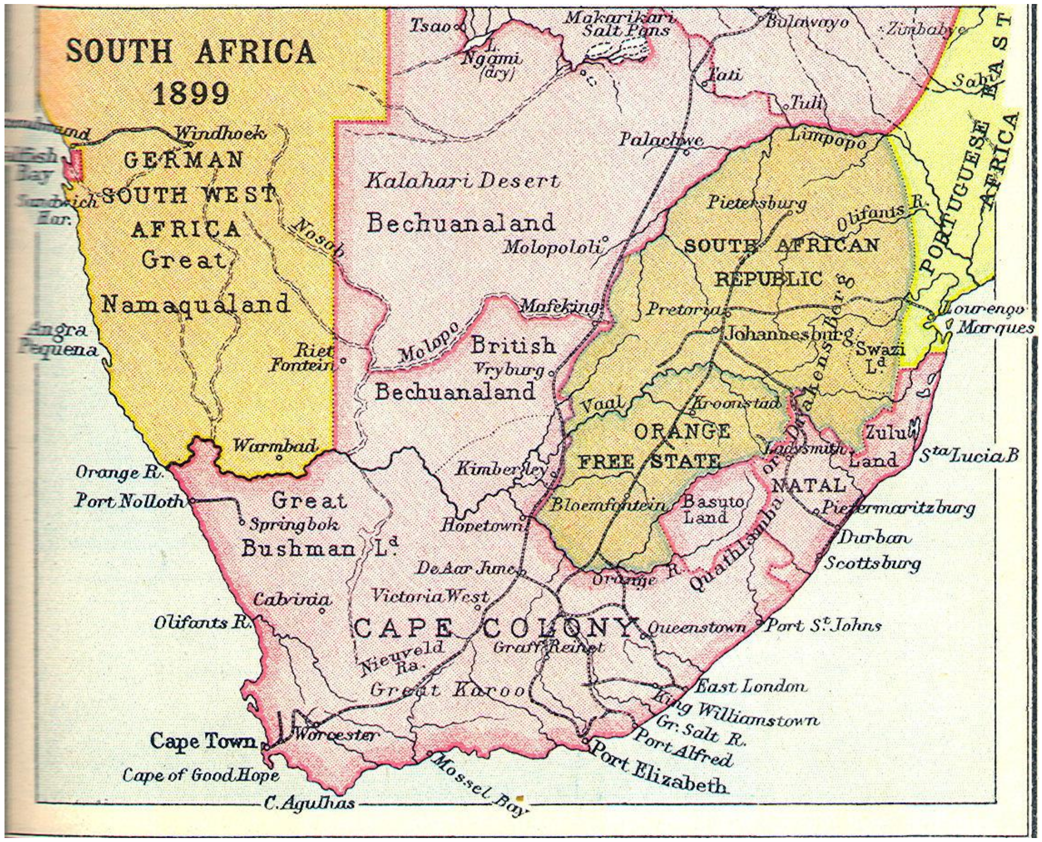

Figure 38: South Africa, 1899. On 11 October 1899, Boer forces invaded both the Natal and Cape Colony.[212]

Nor were British – its soldiers, politicians, nor the public – prepared for the debacles that followed Buller's landing in Cape Town on 31 October. The Boer invasions into Natal and Cape Colony bottled up the British units already on the ground; after several sharp actions, the Boers had laid siege to the town of Ladysmith, and severed communications to and from the towns of Mafeking and Kimberly.[213] The sieges forced Buller to split his army into three wings, all of whom suffered defeat during the "Black Week" of 10-17 December. "In less than a week," historian Byron Farwell wrote, the "famed military might" of England had "gone down to defeat before the rifles of a collection of rustics from a pair of tenth-rate

[212] "South Africa." http://people.virginia.edu/~mes2ee/southafrica.html, accessed 11 Sep 2014.
[213] Raymond Sibbald, *The Boer War: The War Correspondents* (Johannesburg: J. Ball, 1993), 40.

republics" at a cost of over 2,700 dead, wounded, or captured.[214] Among the losses were two batteries of 15-pdr field guns, which Col. C. J. Long stupidly led parade-ground fashion into the teeth of Boer Mausers at Colenso – a major embarrassment in an age when losing artillery still brought considerable shame on a commander.[215] "Since the days of the Indian Mutiny," the *Times* wrote, "the nation has not been confronted with so painful and anxious a situation."[216]

Figure 39: British cavalry carbines. Top is the Snider; middle, a Martini-Enfield (a single-shot Martini action married to a .303 Enfield barrel) and bottom is the Lee-Enfield. Both lower weapons saw service in the Second Boer War.[217]

The state of the nation's military, however, was much more serious than the public knew. The same day as the disaster at Colenso, Lt. Gen. Brackenbury, the Director-General of Ordnance, brought a "very strong representation in writing" before Lord Wolseley: the nation's stock of "warlike stores" had been seriously depleted with the outfitting of Buller's army. "It had simply never occurred to anyone [at the War Office] that a war might mean

[214] Byron Farwell, *The Great Anglo-Boer War* (New York: Harper & Row, 1976), 142.
[215] Sibbald, 74; Pakenham, 234-250.
[216] "We deeply regret to announce that SIR REDVERS…" *Times,* 16 Dec. 1899, 11.
[217] E. G. B. Reynolds, *The Lee-Enfield Rifle* (London: Herbert Jenkins, 1960), 31.

more than a one-day event," historian Thomas Pakenham later wrote.[218] Brackenbury painted a dire situation indeed: very few field artillery guns remained in country, for example, and no reserve ammunition stocks existed. Even after borrowing from the Navy and from the Indian Government, Brackenbury could not meet Buller's demand for 5-inch howitzer shells, a situation that foreshadowed the "shell shortage" of World War One. Stocks of saddlery, cavalry sabers, tents and transport vehicles were also dangerously low, as was the nation's reserve of small arms ammunition, forty percent of which could not be used in combat because of defective bullets.[219] Brackenbury asked that steps be taken and money provided "to enable the country to be put into a condition of safety, so that this could never occur again." Wolseley in turn passed the report to Lansdowne, along with Brackenbury's threat of resignation if the situation did not get corrected.[220]

The unfortunate parallels with the Crimean War continued past Black Week. Additional British forces landed in the Cape Colony in January of 1900, and as they pushed inland logistics became increasingly problematic. Supplies could only be sent up from the coast by a single railway line, and once offloaded, could only be carried by cart at a great cost in animals. Inadequate maps and a lack of entrenching equipment contributed to the "acre of massacre" at Spion Kop on 23 January, which cost the British a further 1,500

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[218] Pakenham, 261.

[219] HCPP, 1904 (Cd. 1790), 73-75. Brackenbury estimated that, of a reserve stock of 172 million rounds, 66 million cartridges "or thereabouts" were of the Mark IV type which used hollow-nosed expanding bullets, adopted after experience in the Chitral campaign of 1895 showed that the original round-nosed bullet then used in the Mark II cartridge didn't always stop a determined opponent. The Mark IV, unfortunately, had a tendency to shoot its lead core out of the surrounding nickel jacket under conditions "of great heat and a dirty rifle," and leave a dangerous obstruction in the bore. This meant that Ordnance had to scramble to find enough trustworthy cartridges, and at one point "we had actually got reduced in this country to two or three boxes of Mark II. ammunition."

[220] Pakenham, 261. Brackenbury's minute to Lansdowne is reproduced as Appendix E in HCPP, 1904 (Cd. 1789), 278-280.

casualties and again kept them from forcing the Tugela.[221] Undeterred, Buller tried again at Vaal Krantz, a ridge of small hills a few miles east of Spion Kop, on 05 February; poor knowledge of local terrain worked against him, as artillery could not be hauled up to the crest of the ridge to engage the Boers. After three days, thirty dead and three hundred more wounded, Buller called off the attempt.[222] Clearly, the tactics and training of the British army were not producing the results Buller needed, despite the incredible bravery and sacrifice of many of his officers and men.

The final tragic reminder of 1854 surfaced in February as well: disease, in the form of typhoid fever. Bloemfontein, occupied in March, became the epicenter, and as in the Crimea the army hospital system broke down. William Burdett-Coutts, a Liberal Unionist MP and special correspondent for the *Times*, wrote scathingly about the conditions of the sick and wounded in army hospitals, criticizing the rule- and form-obsessed medical officers and especially the lack of female nurses. To him, the example of Florence Nightingale had been completely ignored. “Where are the women? Where are the nurses? A wretched hundred or two or three are here; while thousands – trained, skilled, willing, eager – are sitting at home wringing their hands!” he wrote. “All this for an antiquated tradition, an unnatural, blind, stupid prejudice of some fusty ‘department,’ which the War Office ought to have knocked on the head at the outset of the war, with the medical profession and public opinion at its back.”[223] Burdett-Coutts’s rant could easily have covered the condition of the army – from its hospitals, to its supply, to its armament – throughout the entire theatre of war.

The Reaction to the “Black Week”

Unlike Aberdeen’s government half a century before, Salisbury’s government did not

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[221] Pakenham, 298-307.
[222] Pakenham, 361; Julian Symons, *Buller's Campaign* (London: Cresset Press, 1963), 257.
[223] William Burdett-Coutts, “Our Wars and our Wounded,” *Times,* 29 June 1900, 14.

fall as a result of "Black Week;" he would remain prime minister for the duration of the war. But clearly, something had to change, and that began with the British commander-in-chief in South Africa. After the battle of Colenso, Buller feared that he could not reach Ladysmith in time to prevent its fall, and suggested to Lansdowne that the town might need to be "let go."[224] Although only a temporary bout of pessimism – within a few days, Buller began planning for an attack on Spion Kop – it was enough to get him sacked as overall commander. On 18 December, Lansdowne tapped Field Marshall Sir Frederick Roberts to replace Buller in that role. Roberts, or "Bobs" as he was known to his men, had seen considerable service in India, and had lobbied for command of the operation with his friend Lansdowne for some time.[225] Buller remained in charge of British forces in the Natal, however, and continued to seek a way to break through Botha's forces on the Tugela.

Lansdowne also convened a new Small Arms Committee in January of 1900 to deal with a major problem discovered on the battlefield: the .303 Lee-Enfield, the nation's newest infantry rifle, had proven to be incorrectly sighted. Reports from the field showed that the weapon consistently shot low and to the right of its aim point; tests showed as much as twenty inches to the right at 200 yards depending on the rifle's place of manufacture.[226] Given the long combat ranges experienced in South Africa, this constituted a dreadful handicap. In addition, the older Lee-Metford rifles still carried by many units were rapidly wearing out. The root causes of the accuracy issues proved not only to be flawed sights on the rifle, but also flawed accuracy acceptance standards. British inspectors only tested ten percent of newly-made rifles for *consistent* shot grouping at 500 yards, but not *accurate*

[224] Pakenham, 249.
[225] Pakenham, 253-256.
[226] Skennerton, 93; HCPP, "Report of His Majesty's Commissioners Appointed to Inquire into the Military Preparations and Other Matters Connected with the War in South Africa." 1904 (Cd. 1789). 94.

shooting. All the strikes had to occur within a certain distance of each other, but not necessarily around a specific point on the target. The standards could, and were, changed quickly, especially after a survey showed that several Continental powers tested *all* their rifles for accurate shooting. The problem with the sights, on the other hand, required several months to sort out, and would not be approved until October.[227]

Lansdowne also brought Brackenbury's minute on the deplorable state of British military supplies and equipment before his Cabinet. It immediately did what Victorian governments seemed to do best: appoint a committee, in this case two, to study the issue, which they did with alacrity. One, headed by Sir Robert Grant (late Inspector General of Fortifications), reported back on 26 February 1900; the other, headed by Sir Francis Mowatt (Permanent Secretary to the Treasury) delivered its findings on 31 March.[228] Both recommended a greatly increased expenditure to rebuild and maintain a "true war reserve" at predetermined levels, "not only of guns and ammunition, but of every conceivable category of war requirements."[229] Although they asked for £11.5 million, in April Parliament approved £10.5 million to be spent over the course of the next three years. The sum also contained monies needed for "alterations in the Ordnance factories and modernisation of existing machinery," as well as storage facilities for war reserves.[230] Parliament's vote for the funds came with an important caveat: yearly certification by the Army Council "that the

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[227] Skennerton, 93; Reynolds, 55-63.

[228] HCPP, "Royal Commission on the War in South Africa. Minutes of Evidence Taken before the Royal Commission on the War in South Africa. (Volume II)," 1904 (Cd. 1791), 518. Mowatt's committee studied the general state of reserve equipment, while Grant's "expert committee" considered the question of "movable armaments," presumably field and horse artillery (see HCPP, "Army. Summary of the Recommendations of the Interdepartmental Committee, 1900, on the Reserves of Guns, Stores, &C., Required for the Army; Showing Also to What Extent These Recommendations Have Been Carried Out." 1904 (Cd. 1908)). Lansdowne's testimony regarding their appointment does not explain the need for two committees, nor their different scopes. In addition, the first volume mentions only Mowatt's committee in its index of "Commissions and Committees referred to in Evidence; see HCPP, 1904 (Cd. 1789), 289.

[229] Headlam, John Emerson Wharton. *The History of the Royal Artillery from the Indian Mutiny to the Great War*. Vol. II: 1899-1914 (Woolwich: Royal Artillery Institution, 1937), 13.

[230] HCPP, 1904 (Cd. 1790), 75.

reserve was intact."[231] Here was final recognition that the defense of the realm required longer-term planning than could be done through the annual estimates and the management-by-crisis approach that had plagued every military action since before 1854.

The Mowatt committee also echoed the previous Morley commission's recommendation that private industry be invited to supply the military further than it had. This would allow the trade to meet the sudden expansion in military needs in time of war, which it clearly could not do in 1899. Brackenbury's minute of 15 December, for example, noted that he needed to dispatch to Gen. Buller "about 3 millions weekly" of rifle ammunition, but that "the Ordnance factories and the trade together can only produce about 2½ millions weekly." To get private firms familiar with the production of war *matérial*, Mowatt's committee recommended they be given "a definite proportion of all orders, including the more delicate articles, such as fuzes, not hitherto entrusted to the trade."[232] The ordnance factories "should have as their primary function the creation of a standard of workmanship, and the demonstration of the true cost of production."[233] Such a recommendation could not be put into practice immediately, but would guide relations between the Ordnance department and private industry well beyond the end of the war.

"Black Week" also made Wolseley, Buller and others realize that they would need many more men to subdue South Africa, and in particular a mobile fighting force to match the abilities of the mounted Boer commandos. Even before war had been declared, several volunteer units had offered their services, but were declined for active duty; some militia

[231] Headlam, 13.
[232] Headlam, 12-13.
[233] HCPP, 1904 (Cd. 1789), 279.

units had been called up in November, but only to release regulars for the front.[234] The day after Colenso, however, Buller cabled home with the suggestion that the War Office "raise eight thousand irregulars… equipped as mounted infantry, [and] able to shoot as well as possible and ride decently." George Wyndham, an under-secretary at the War Office, saw this as an opportunity to turn the long-established volunteer cavalry, or "yeomanry," into something more than "a theatrical reminder of the Cavalry which fought in the Crimea and the Peninsular" wars.[235] Lansdowne agreed, and on 20 December, the papers announced that Government had "decided to raise for service in South Africa a Mounted Infantry force, to be named 'The Imperial Yeomanry.'"[236] The response was overwhelming; Lord Chesham, appointed a battalion commander in the new force, "was besieged" at his office "by officers eager to join him. When they were not in his room, they waited outside the door… [or] parleyed with the official at the bottom of the stairs."[237] It was not just officers clamoring to serve, however; the *Dundee Courier* noted "enthusiasm throughout the country" as "the militia, yeomanry, and volunteers are readily offering themselves for active service in South Africa and garrison duty at home."[238] Ultimately, over 100,000 men volunteered to fight in the war, and such enthusiasm drew considerable attention to the state of the volunteer movement and its future role in the defense of the realm.[239]

Change occurred on the ground in South Africa as well as at home. Failed attacks at Spion Kop and Vaal Kratz finally demonstrated to Buller that "the old three-act, one-day

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[234] I. F. W. Beckett, *The Amateur Military Tradition: 1558-1945,* (Manchester: Manchester University Press, 1991), 200.

[235] Packenham, 263. The yeomanry had been formed in 1794 in case of invasion by France, but local units also available to county magistrates to deal with public disturbances; a Manchester unit was involved in the "Peterloo" incident in 1819, which left eleven dead and 400 injured. See Beckett, 74-75, 135.

[236] "Imperial Yeomanry - New Force for the Front." *Dundee Courier*, 20 December 1899, 5.

[237] "The Imperial Yeomanry - Eight Thousand Men Wanted." *London Daily News*, 21 December 1899, 3.

[238] "Our Citizen Soldiers - Volunteering for the Front." *Dundee Courier*, 20 December 1899, 5.

[239] Miller, Stephen M. *Volunteers on the Veld: Britain's Citizen-Soldiers and the South African War, 1899-1902* (Norman: University of Oklahoma Press, 2007), 9

battle of the past had been killed stone-dead by the combination of the trench and the magazine rifle." Rather than a single frontal assault on a key piece of terrain, Buller now planned for an extended campaign in both miles and days to clear the Boers hill by hill, in what historian Thomas Pakenham termed "the painful prototype of modern warfare." Buller's infantry had learned the hard way about cover, concealment, and innovation under fire; now came time to unite such knowledge with a new way to use artillery. Long's destruction at the hands of Boer riflemen at Colenso also clearly demonstrated that old-style direct fire tactics were a thing of the past. Between Brackenbury's efforts and loans from the Navy, Buller had now had fifty guns arrayed against the Tugela, and he decided to use this overwhelming advantage to provide a screen for his infantry. The guns would fire over the heads of the attacking troops, and walk their barrage forward as the men advanced, to keep the heads of the enemy down in their trenches.[240] This new "creeping barrage" form of indirect fire would become a staple of offensive artillery tactics in modern warfare. On 14 February Buller launched his final assault, and his new tactics worked. Over the next two weeks, his army kept up the pressure, driving the Boers back across the Tugela and off the hills that overlooked Ladysmith. Finally, on 27 February, the enemy pulled out altogether; the next day, the first British relief column reached the city. After 118 days, the siege had finally been broken.[241]

At home, Brackenbury did his best to feed, clothe, and arm the rapidly growing army in South Africa. Unable to secure everything he needed from the trade, he had to turn to overseas suppliers for items such as saddles, horse shoes, and even mule shoes, since

[240] Pakenham, 363.
[241] Pakenham, 365-384.

"nobody in this country at first seemed to be able to make [them]."[242] Brackenbury also had grave concerns about the state of British field ordnance. Not only were the numbers in the reserve dwindling, but the Royal Artillery was being outfought; the Boer field guns firing explosive shell outranged the shrapnel fired by British 15-pounders by 2,000 yards.[243] The Creusot guns were also true quick-firing guns whose hydro-pneumatic recoil mechanisms allowed them to be rapidly reloaded without repositioning. The British gun, on the other hand, relied on a large spade suspended from the carriage axle to reduce recoil, which kept the gun in position, but caused it to jump in place instead of roll backwards. The spade saved the time and effort required to get the gun back into position, which improved the reloading time, but the crew still had to re-aim after each shot.[244]

Rather than design a new gun from scratch, which Brackenbury knew could take years, he took the unprecedented step of purchasing eighteen batteries – 108 guns with limbers, support wagons, and 54,000 rounds of ammunition – from the German firm of *Rheinische Metallwaaren und Machinenfabrik* in Dusseldorf.[245] Known as the "Ehrhardt" gun, after its designer, Heinrich Ehrhardt, the contract for the weapons had to be made in great secrecy. German public opinion sided very much with the Boers, especially after the Royal Navy boarded three German passenger ships inbound to South African ports in December of 1899 to search for war supplies.[246] There was also international law to consider, so to avoid any breach-of-neutrality issues, the April 1900 contract arranged the deal as if

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[242] HCPP, 1904 (Cd. 1790), 73-74.
[243] John P. Wisser, *The Second Boer War, 1899-1900* (Kansas City, Mo.: Hudson-Kimberly Pub. Co., 1901), 254.
[244] Headlam, 14-15; Michael Davitt, *The Boer Fight for Freedom* (New York; London: Funk & Wagnalls, 1902), 67-68. The British 15-pdr fired a shell three inches in diameter, making it and the Creusot approximately the same size.
[245] Headlam, 16.
[246] Pakenham, 264.

between two private firms: Ehrhardt's, and a shell English "Chartered Company."[247] By December, when the news finally leaked out, the guns were on hand at Woolwich, and a further contract for twelve more batteries had been signed.[248] While Brackenbury retained the new quick-firing guns to augment the reserve stockpile rather than complicate logistics in South Africa, they gave the Royal Artillery a weapon "markedly in advance of that of any Great Power except France." The Ehrhardt guns also gave British ordnance officials important experience with a weapon most artillerymen agreed represented the future, but which until the war "financial considerations… stood in the way of."[249]

The Ordnance Committee in the Boer War

When Brackenbury took up the post of Director-General of Ordnance in March of 1899, he also assumed overall direction of the Ordnance Committee, whose operations had essentially remained unchanged since its creation in 1881. The war, however, caused several changes that would ultimately spell the end of the Committee. On 30 April 1900, Brackenbury notified the OC that "the Quarterly Abstracts of the Committee's Proceedings need not be any longer rendered." Instead, indexes for their actual minutes, which had been published since 1881, were to be prepared on a quarterly basis.[250] Since compilation and printing ran two years behind, 1897 represents the last published volume of the *Abstracts of Proceedings.* The delay may be part of the reason for Brackenbury's decision; given the speed of change in military technology, he may have felt that two-year-old compilations did not warrant the staff work involved. He may have also felt that an index to the *Proceedings* would be an effective substitute, while eliminating the work required for compilation. At the

[247] "German guns for Britain." *Evening Telegraph*, 07 December 1900, 4.
[248] "Chartered Company and German Guns," *Sheffield Evening Telegraph*, 10 December 1900, 3.
[249] Headlam, 16; "Quick-Firing Guns for Field Artillery," *London Standard*, 14 July 1898, 6.
[250] Minute 49,364, TNA, SUPP 6/147, "Proceedings of the Ordnance Committee, 1900: January to June."

same time, however, it appears he also ceased recording proposals not specifically considered by the Committee. The *Proceedings* for 1898 and 1899 show 158 and 107 new items, respectively, and on par with 1896-1897; the 1900 *Proceedings*, however, list only forty-five new entries, and the numbers decrease from there.

The end of the *Abstracts* meant the end of forty years of the often colorful *record* of public participation in military technology, but not the end of *actual* participation. Given the high level of press coverage of the war in South Africa and the public's past history of sending suggestions to the War Office, there is no reason to suppose the habit ended simply because such proposals were no longer listed. Brackenbury himself ordered the Ordnance Committee to begin daily meetings, Sundays excepted, for the duration of the war on 12 February 1900, possibly to handle an expected influx of suggestions passed from the War Office.[251] Past record is no guarantee of present interest, however, and by 1900 the British public had other outlets for its martial spirit, including the volunteers and Imperial Yeomanry formed for service on the African veld. Weaponry had also changed to the point that the average gun enthusiast, civil engineer, or even professional soldier could not thoroughly understand the technology without considerable specialized knowledge. Regardless of the reason, the wave of suggestions that besieged the War Office during the Crimean War seems not to have repeated itself, and Brackenbury rescinded the daily-meeting order on 14 June 1900.[252]

The Ordnance Committee still had plenty to do, however, especially as reports of British weapons performance came back from the field. One of the biggest disappointments proved to be Britain's choice of explosive filler for artillery shells. "Lyddite," named for the

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[251] Minute 48,744, TNA, SUPP 6/147.
[252] Minute. 49,498, TNA, SUPP 6/147,

town where experiments with the new explosive were performed, had been adopted in 1888; one newspaper report claimed the explosive could "blow humanity into atoms with more expedition than any of its predecessors."[253] Very insensitive to shock, lyddite performed well in the large armor-piercing shells required by the Navy, but in smaller explosive shells was less successful. One in four fired in South Africa failed to fully detonate; instead, the shells would pop in a cloud of greenish-yellow smoke, which the Boers at first thought poisonous but which soon proved not to be. The most common side effect in such cases was violent coughing, although one young defender at Spion Kop "pitifully complained that the lyddite had turned his hair and skin as yellow as a canary."[254] Captured shells tested in Pretoria led the Boer command to conclude "that the projectiles were about as harmless as those of the early part of the 18th century."[255]

In May of 1900 Lansdowne, "in concert with the First Lord of the Admiralty," appointed a "Special Committee on Propellants and High Explosives" to investigate both the problems with lyddite and concerns regarding cordite.[256] Chaired by John W. Strutt (Lord Rayleigh), a noted professor of natural philosophy at the Royal Institution of Great Britain, the two other named members included Sir Andrew Noble, former Royal Artillery officer and now director of Armstrong, Mitchell & Co., and Richard B. Haldane, the future Secretary of State for War.[257] They were joined later by Sir William Crookes and Sir William

[253] "Lyddite." *Sheffield Evening Telegraph*, 07 November 1888, 2. A form of picric acid, the explosive was licensed by Capt. Vavasseur on behalf of Armstrong's company from its French inventor Mons. E. Turpin, who had tried to interest the War Office in his development as early as 1881. See Subj. 2322.1, TNA, WO 33/38, AP-DDA 1881, 232; TNA, WO 33/41, AP-DDA 1883, 89, and TNA, SUPP 6/30, AP-DDA 1887, 10. See also "Military News," *York Herald*, 24 October 1888, 5.
[254] "Some Lessons from the War." *Sheffield Independent*, 03 May 1900, 5.
[255] "Boers and Lyddite." *Dundee Evening Post*, 13 February 1900, 2.
[256] Minute 49,307, TNA, SUPP 6/147.
[257] Kostas Gavroglu, "Strutt, John William, third Baron Rayleigh (1842–1919)," *ODNB*, May 2007, http://dx.doi.org/10.1093/ref:odnb/36359. Haldane, although a politician, was fluent in German, a useful

Roberts-Austen, both noted chemists, and Capt. T. G. Tulloch of the Royal Artillery, the only military member and secretary of the committee.[258] This latest iteration of the Explosives Committee had three charges: to determine the best form of smokeless powder for both artillery and small arms, to report any modifications necessary to either class of weapon to develop "the full powers of any propellant which may be proposed," and to try out other high explosives "with as much safety as lyddite, with greater certainty of detonation, and with greater explosive effect."[259] The *Daily News*, which derisively claimed "the destruction of flies" as lyddite's principal use in South Africa, welcomed the new committee, as did the *Times.*[260] The latter prophetically wrote that "even if [it] is barren of results, it will be highly satisfactory to those who either make or use our service explosives to know that we have not been on the wrong track."[261] Ultimately, both cordite and lyddite remained in service with the British military into World War One; the new committee, however, represented the first time that a panel of civilian experts had control over a major weapons program in Britain. The relationship between civilian scientists and the military remained problematic, however, into the opening months of World War One. Not until 1915 – when it was clear that the war in Europe would not end anytime soon – did the War Office form a civilian-led advisory body to guide military research efforts.[262]

The same month that Rayleigh's committee began to meet, British fortunes seemed to

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trait for anyone studying explosives. See H. C. G. Matthew, "Haldane, Richard Burdon, Viscount Haldane (1856–1928)," *ODNB*, Jan 2011, http://dx.doi.org/10.1093/ref:odnb/33643.

[258] W. H. Brock, *William Crookes (1832-1919) and the Commercialization of Science* (Aldershot, England: Ashgate, 2008), 448-449.

[259] Minute 49,307, TNA, SUPP 6/147.

[260] "Explosive Committee and Lyddite." *Cheltenham Chronicle*, 19 May 1900, 2.

[261] "A Correspondent," "British Service Explosives." *Times*, 17 October 1900, 12.

[262] See Michael Pattison, "Scientists, Inventors and the Military in Britain, 1915-19: The Munitions Inventions Department." *Social Studies of Science* 13, no. 4 (1983): 521-68; Roy M. MacLeod and E. Kay Andrews, "Scientific Advice in the War at Sea 1915-1917: The Board of Invention and Research." *Journal of Contemporary History* 6, no. 2 (1971): 3-40; Guy Hartcup, *The War of Invention: Scientific Developments, 1914-18* (London; Brassey's Defence Publishers, 1988).

improve in South Africa. Roberts's forces broke the siege of Mafeking on 17 May; at the end of the month he captured Johannesburg, and five days later Pretoria.[263] After a summer's hard fighting, the British had annexed both the Transvaal and the Orange Free State, and Roberts returned home to take over as Commander-in-Chief from an ailing Wolseley.[264] Annexation, however, did not mean total control; sizable Boer forces were still at large and fighting when and where they could. Still, Salisbury felt confident enough in both the direction of the war and the patriotic fervor it generated to call for general elections in late September. The result was a landslide victory for Salisbury and his Conservative/Liberal Unionist coalition, the first time since 1865 that a sitting government had been voted back into power.[265]

In November, Salisbury promoted Lansdowne to Foreign Secretary, and appointed William St. John Broderick to the War Office, a reward for engineering Salisbury's accession to premiership with the "cordite vote" of 1895.[266] Aware of the problems shown by British artillery in South Africa, Broderick constructed a series of special "gun committees" formed along the lines of Lt. Gen. Robert Hay's 1891 suggestion. These "technical" committees were charged with working out the desired details of a particular type of ordnance; the Ordnance Committee then handled details of construction and ammunition.[267] The first, the "Special Committee on Horse and Field Artillery Equipments," formed in January of 1901 under the chairmanship of Maj. Gen. Sir George Marshall, who had commanded the Royal Artillery units in South Africa. A "Field Howitzer Committee" took the question of that form

[263] Pakenham, 617.
[264] David G. Chandler and I. F. W. Beckett, *The Oxford Illustrated History of the British Army* (Oxford; Oxford University Press, 1994), 204.
[265] Roberts, 775-779.
[266] Roberts, 785.
[267] Headlam, 85-86.

of gun over from Marshall soon after its appointment; that same year saw the formation of committees on machine guns and 1-pdr "pom-pom" guns, as the 37mm Vickers-Maxim came to be known. The next year the War Office also formed a "Heavy Battery Committee" to design its "guns of position" for coastal and fortification defense.[268]

Figure 40: A Vickers-Maxim "pom-pom" gun, nicknamed for the sound it made when fired.[269]

Similar to the Fletcher small-arms committees of the 1860s, Marshall's "Equipments Committee" drew up a list of specifications, then invited private industry to submit their designs. Armstrong, Vickers, and the Royal Gun Factory (RGF) submitted several, and in 1902 specimen guns were examined and test-fired. In an echo of 1869 and the Martini-Henry

[268] Headlam 85; TNA, WO 32/9029, "Report of Special Committees on Automatic Q.F. Gun (Pom-pom) and Machine Guns," and TNA, WO 33/137, "Report of Special Committees on: (i) 1-pr. automatic QF gun (Pom Pom) (ii) Machine guns."

[269] "Heritage Images," *Auckland Council Libraries*, accessed 28 Sep 2014, http://www.aucklandcity.govt.nz/dbtw-wpd/HeritageImages/images/photos/AWNf/1900/AWNS_19000511_p012_i002_b.jpg.

rifle, the committee found no single weapon met all their requirements; rather than tweak the design themselves, however, they brought in representatives of the two firms to work with the RGF on a solution. The urgency of the program, coupled by the willingness of the three outfits to work together, meant that by 1903 four test batteries were ready, and in 1904 new quick-firing guns were approved for both horse and field artillery.[270] A vast improvement on the older equipment, the 18-pound field gun could fire twenty rounds a minute, as opposed to three for the older 15-pounder, and with new longer-burning fuzes could deliver its shrapnel three thousand yards further.[271] The speed and success of the program was unprecedented; both gun designs saw wide usage in World War One, and variants of the 18-pounder remained in use into World War II.

Broderick also wasted little time trying to mop up the muddle that still pervaded the War Office, but in this regard was much less successful. On 17 December 1900, he drafted Clinton E. Dawkins to chair yet another committee to study the organization of the department, but with special emphasis on the financial business conducted by the office.[272] In addition, he drew up a "radical and comprehensive scheme" to reorganize the army into six permanent corps, "complete and fully equipped, and in every way ready to take the field…practically at a moment's notice."[273] The plan, presented before Parliament in March 1901, ran into much resistance, and was still under debate when the Dawkins Committee delivered its report on 09 May 1901.[274] It listed nineteen "important recommendations involving large changes" in both the Office and the existing military districts of the country.

[270] Headlam, 72-76.
[271] "The Rearmament of the Artillery." *Times*, 15 December 1904, 7.
[272] HCPP, "Committee on War Office Organisation. Report of the Committee Appointed to Enquire into War Office Organisation." 1901 (Cd.580).
[273] "Army Reorganisation." *Whitstable Times and Herne Bay Herald*, 16 March 1901, 7.
[274] For debate on the plan, see "Supply (Army Estimates)," *HC Deb 08 March 1901 Vol 90 cc1052-92, and "Army Organisation," HC Deb 16 May 1901 vol 94 cc281-396.*

Among these included the simplification of regulations and the replacement of many of the civilian clerks with "carefully selected" soldiers or officers. The Committee also repeated the Hartington Commission's calls for greater decentralization and a permanent "War Office Board" to "control and supervise the business of the War Office as a whole."[275] Broderick renamed the older War Office Council as the new War Office Board in October, and gave it and the Army Board power to originate topics, not just consider what the Secretary passed to them.[276] Broderick's army corps plan, which foundered on a perceived need to increase the size – and hence the expense – of the army, overshadowed his attempts to put more of the Dawkins Committee recommendations into action.[277]

While Sir Marshall and his committee wrestled with the issue of field artillery, the war in South Africa ground on, with peace finally being signed on 31 May 1902. Technically, the British won; Kruger's South African Republic became part of the British Empire, and except for a force of about 25,000 men, the "Khakis" began their journey homeward. In truth, the war had cost the Empire much: twenty-two thousand dead, nearly a hundred thousand sick or wounded, at a cost of over £200 million. The latter included £3,000,000 to pay off the debts of the former South African Republic, and another two million in aid to Boer farmers to help them rebuild.[278] The greatest casualty, however, was imperial security; the army that marched in 1899 clearly was not prepared to defend the empire, much less fight successfully in a modern European war.

With the peace in place, Salisbury resigned on 11 July due to in part to failing health, but also because of the impending coronation of Edward VII, whom Salisbury did not get

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[275] HCPP, 1901 (Cd.580), 23-24.
[276] "New Army Board." *Aberdeen Journal*, 19 October 1901, 5; Wheeler, 259-261; 1904 (Cd. 1789), 142.
[277] Barnett, 356.
[278] Chandler and Beckett, 204-205; Pakenham, 607-608.

along with.[279] The premiership passed to Arthur James Balfour, First Lord of the Treasury and leader of the House of Commons.[280] Serious questions still existed regarding the war, however, and in September Balfour's government formed the "Royal Commission on the War in South Africa" to study its preparations for and conduct in the conflict. Chaired by Victor Alexander (Lord Elgin), the Commission heard evidence from 114 witnesses over fifty-five days of meetings, and issued their report on 09 July 1903.[281] Their report clearly documented that the "disastrous muddle" that mired the nation's military efforts in 1854 had yet to be conquered. Once the report went public, the press pounced; the *Times*, for example, printed a long letter from former Prime Minister Lord Rosebery that excoriated the government's policies. "We are not, outside our Fleet, in possession of the *minimum* of national security," Rosebery wrote. "With that report in their hands, foreign statesmen may commit the mistake of holding Great Britain cheap."[282]

The Esher Reports and Haldane Reforms

Fortunately for the country, no "foreign statesmen" made such a mistake, but the report clearly signaled that reforms were needed in the War Office. It also came shortly before a series of Cabinet resignations over tariff reform, and Balfour therefore decided to reshuffle his government in October of 1903. Broderick, tainted by the failure of his own scheme to reorganize the army, was bundled off to the India Office, and both Balfour and the King invited Reginald Baliol Brett (Lord Esher) to take Broderick's place. Esher had been a member of the Elgin Commission and therefore familiar with its findings, but he refused the office. Instead, he felt he could better effect change from the outside, and pitched the idea of

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[279] Roberts, 796-816; Robin Harris, *The Conservatives: A History* (London: Bantam, 2011), 227-229.
[280] Ruddock Mackay, H. C. G. Matthew, "Balfour, Arthur James, first earl of Balfour (1848–1930)," *ODNB*, Jan 2011, http://dx.doi.org/10.1093/ref:odnb/30553.
[281] HCPP, 1904 (Cd. 1789), 3.
[282] "Lord Rosebery on the War Commission Report." *Times*, 22 September 1903, 7.

yet *another* commission to draw up the needed reforms. As "chairman of such a body," Esher felt he "could take the War Office administration right through, from top to bottom, and…make it a first-class business machine."[283] Both Balfour and the King agreed, and appointed Esher head of a new "War Office Reconstitution Committee" in late 1903.[284]

The "Esher Committee," as it is most generally known, took as its model the Hartington Commission suggestions of 1890. If that previous commission "had not been ignored," the new Committee claimed, "the country would have been saved the loss of many thousands of lives, and of many millions of pounds, subsequently sacrificed in the South African War."[285] Esher and his fellow committee members, Admiral John A. Fisher and Sir George S. Clarke, belonged to the "blue water" school of imperial defense, which made the Royal Navy the primary shield of the Empire. The army certainly needed to be an effective tool prepared for war, rather than managed for peace as it had in years passed, and modernized along the lines of potential foreign adversaries. It also needed to be efficient, however, especially in its use of funds. "What would be the good of a British army as big as that of Germany," Fisher once asked, "if the navy were insufficient to keep command of the sea?" Among the goals of the Committee, therefore, were not only "the imperative need for harmonizing naval and military policy in the broadest sense," but also reduction of army estimates from the current £52 million by nearly half. Such a goal was in keeping with the classic British tradition of retrenchment after war, although the Committee did intend to increase in the share of defense spending given to the Navy.[286]

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[283] Peter Fraser, *Lord Esher: A Political Biography* (Barnesly, South Yorkshire: Pen & Sword Politics 2013), 92-93.

[284] Fraser, ibid. See also Michael L. Waller, "The Conservatism of the British Cavalry and Its Effect on the British Army of WW II" (Dissertation, Drew University, 2009), 76-77; Chandler and Beckett, 205.

[285] HCPP, "War Office (Reconstitution) Committee. Report of the War Office (Reconstitution) Committee. (Part III.)." 1904 (Cd. 2002). 1.

[286] Fraser.

The Esher Committee delivered its recommendations in three parts, between January and March of 1904, and Balfour acted quickly to put the changes into action. At the top stood a permanent, inter-departmental "Committee of Imperial Defence" which united both naval and army policy and directed both the War Office and Admiralty. In the War Office itself, Balfour finally eliminated the Commander-in-Chief's position; it gave way to a General Staff office, in line with that used by the German Army for overall planning and budget-calculation.[287] Balfour also abolished the post of Inspector-General of Fortifications, and re-united "the entire technical work of the Artillery and Engineers" under a recreated Master-General of Ordnance. Under him came a resurrected Director of Artillery, who in turn had full control of the ordnance factories as well as the Ordnance, Explosives, and Small Arms Committees. Such a move finally eliminated the vestigial control the Financial Secretary still had over the manufacturing departments, and made development of infantry weapons a direct responsibility of Ordnance once again.[288]

In the long run, the changes made by Balfour were necessary modernizations, and laid the groundwork for the future of both the army and the War Office. Between Broderick's failed restructure program and the "clean sweep" of the War Office, however, the British army in 1904 suffered extensively from demoralization and dishevelment. "New measures demand new men," the Committee had reasoned, "and we…attach special importance to the immediate appointment of Military Members…not likely to be embarrassed by the traditions of a system which is to be radically changed."[289] All of the heads of the military departments, from Lord Roberts to Brackenbury, suddenly found themselves on the retired list, as did

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[287] Chandler and Beckett, 205.
[288] HCPP, 1904 (Cd. 2002), 12-15.
[289] HCPP, "War Office (Reconstitution) Committee. Report of the War Office (Reconstitution) Committee, Part I." 1904 (Cd. 1932). 10.

many of their subordinates. The memory of Second Anglo-Boer War had also receded to the point that fiscal retrenchment threatened to undo all the hardware modernizations proposed by the Marshall Committee. In the annual debate on army estimates before the House of Commons, for example, Bannerman complained vociferously about the cost of not only the army forces that remained in South Africa, but the upgrades to artillery hardware. The new 18-pounder, he argued, "does not involve any charge this year, because all the guns of the new pattern are to be sent to India, and paid for by India. But what will it be in subsequent years? Will there not be a large expenditure on this account?" "The cost of the whole Army has been allowed so to increase that the burden has become absolutely insufferable," he continued. "I do not think I should find much disagreement if I said that at the present time the country is sick of war—sick of what I have called a policy of conquest and adventure. This scale of military expenditure cannot be maintained."[290] Such a pronouncement reflected not a pacifistic streak on the part of Bannerman, but more of a political wish to reduce taxation – and the long shadow of Gladstonian financial orthodoxy.

Bannerman misjudged the mood of the country, however. The British press, although distracted by the Russo-Japanese War, had noticed the delay in the gun program, and on 15 December 1904 the *Times* published "one of those special articles which cannot be ignored."[291] "Our Horse and Field Artillery," the paper wrote, were still equipped with guns whose design "dated back to somewhere near the period of the Russo-Turkish war" of 1877. "Unless it wishes to risk disasters like that which befell Colonel Long's guns at Colenso," the paper continued, the army needed mobile, quick-firing guns to support the infantry through tactics such as Buller's "creeping barrage." Although the Arsenal stood ready to construct the

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[290] "Army Estimates – 1904-5." *HC Deb 09 March 1904 vol 131 cc599-652.*
[291] Headlam, 77.

new 18-pounder, the rearmament program remained unfunded. Had action been taken immediately, the article remarked, "manufacture might have been begun in the spring of this year, and we should be well on our way towards proper artillery equipment."[292] The *Dover Express* echoed the *Times* complaint on the 16th, in a much shorter but more strident article. The Treasury's "extraordinary action," the paper charged, meant the guns of the army remained "absolutely outclassed by the weapons of every other European country." "The voice of England must immediately condemn this foolish and wicked policy," the *Express* cried, "for the Artillery is to the Army what the heart is to the body – its very life!"[293] Such accusations were taken seriously enough that the very next day, the War Office released notice of "orders…about to be issued…for the expenditure of two and a half millions sterling" to re-equip "the Royal Horse and Royal Field Artillery at home and abroad."[294]

Balfour also misjudged the mood of the country, and resigned on 05 December without dissolving Parliament. He expected the Conservatives to win the election that must necessarily follow, but guessed wrong; instead, the King invited Campbell-Bannerman to construct a minority government, and the Liberals along with their Labour allies made significant gains in the 1906 election.[295] Bannerman, in turn, appointed Richard Haldane as Secretary of State for War, a move that would prove well for the British army over the next several years. The two men both subscribed to the same "blue water" opinion regarding the defense of the Empire, and over the rest of his tenure as head of the War Office, Haldane succeeded where Broderick and his successor H. O. Arnold-Foster could not. Ably chronicled by historian Edward M. Spiers in his 1980 work, *Haldane, an Army Reformer*,

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[292] "The Rearmament of the Artillery." *Times*, 15 December 1904, 7.
[293] "Field Artillery - Extraordinary Action of the Treasury." *Dover Express*, 16 December 1904, 2.
[294] "The Artillery - Its Re-Armament." *Exeter and Plymouth Gazette*, 17 December 1904, 6.
[295] Morris, "Bannerman," *ODNB*.

Haldane's program of reforms effectively created the Expeditionary Force that Britain would send to France in 1914. Over the next six-and-a-half years, he reduced the size and cost of the standing army and rebuilt the nation's pool of reserves by reverting to the original terms of service established by Cardwell so many years before.[296] Haldane also extended the control of the Imperial General Staff to the entire army, and transitioned the yeomanry, volunteers, and militia into a Territorial Army capable of both home defense and reinforcement of any expeditionary force abroad.[297]

By permission of Punch.

OUR GUNLESS ARMY.

MR. BULL: "WHERE ARE THESE QUICK FIRING GUNS I WAS PROMISED *AGES* AGO? I CAN'T GET ON WITHOUT 'EM."

PRESIDENT OF THE COMMITTEE OF NATIONAL DEFENCE: "QUITE SO. QUITE SO. BUT OUR FIRST CONSIDERATION IS THE BUDGET."

[In spite of the undertaking given by MR. ARNOLD-FOSTER, as to the re-arming of the artillery with quick-firing guns of the new pattern, only about one-twentieth of this equipment has at present been supplied. See recent articles in the ***St. James's Gazette***.]

Figure 41: The British illustrated magazine *Punch* criticized the delay in rearming the Royal Artillery with this 16 November 1904 cartoon.[298]

[296] Edward M. Spiers, *Haldane, an Army Reformer* (Edinburgh: Edinburgh University Press, 1980), 62-4, 143; Chandler and Beckett, 207.

[297] Spiers 1980, 95, 116.

[298] "Our Gunless Army." *Punch, or the London Charivari*, Vol. CXXVII, July-December 1904, 353, reproduced in Headlam.

The End of the Ordnance Committee

Among the various changes that Haldane put into place included the elimination of the separate committees that oversaw British weapons technology. The Esher Committee had noted the War Office's habit of assembling committees "whenever any question arises requiring special consideration." It recommended paring down several of the permanent bodies and formation of new ones only in "exceptional" cases, and "never…as a means of evading responsibility."[299] Although such action reduced the number of committees, it did not break the War Office's penchant for forming them; 1905 saw the creation of a new "Mountain Gun Committee," which made the number of technical committees working with the Ordnance Committee inconvenient. The following year, therefore, the War Office and the Admiralty made their first joint attempt at reworking the entire system of ordnance design. The Explosives Committee became the "Ordnance Research Board," which had the president and vice-president of the Ordnance Committee in those same roles, and a naval and army officer, also from the OC.

The arrangement, however, merely increased the duties of men already heavily involved in ordnance work and soon proved unsatisfactory.

In October of 1907 the Director of Naval Ordnance (DNO), Rear Adm. J. R. Jellicoe, and the Master-General of Ordnance (MGO), Maj. Gen. C. F. Hadden, drew up a plan for a unified "Ordnance Board" to take the place of both the OC and the Research Board. The new body would consist of a naval and military officer, alternately, as President and Vice President. Military members would also include two naval officers and two army officers, the Director-General of Ordnance for India, and the superintendent of the recently formed

[299] HCPP, 1904 (Cd. 2002), 20. The report recommended the elimination of the Barracks Board, Rifle Ranges, Works, and Army Sanitary committees, and suggested a reduction in the size of the Royal Engineers Committee.

Research Department at Woolwich.[300] Unlike the OC, civilian members would include a chemist and engineer from the Research Department who "would devote their *whole* time to the work of the Ordnance Board," rather than on an as-needed basis.[301] The Ordnance Board also had direct communication with the Admiralty, something that all the previous ordnance committees had lacked. In addition, the new Board was specifically tasked with research, "with a view to increasing [British] knowledge on all ordnance matters;" matters of design, manufacture and supply would hence forth be handled by the DNO or MGO offices. To assist the Master-General with such questions, the five technical committees were swept together into a single "Royal Artillery Committee" composed of the army officer members of the new Board and regimental officers from the Royal Horse, Field, and Garrison Artillery branches.[302] The new Ordnance Board took over the duties of the Ordnance Committee on 01 January 1908, and the Committee's final volume of proceedings closed a sixty-year record of public involvement in British weapons development.

Conclusion

Despite the cost in men and treasure, Royal Artillery historian John E. Headlam pointed out that the Second Boer War came at a point "just when our old guns were wearing out." If the Royal Artillery had re-equipped before the war, it would have done so with a gun "little better in principle than those in the service….It would not have been a true quick-firer, and it would have been a hard task to persuade any Government to re-arm again before

[300] The Director-General of Ordnance for India worked out of the India Office in London; see HCPP, "East India (Army System). Return to Two Addresses of the Honourable the House of Commons, Dated 8 May and 9 June 1884;--for, 'Copy of Correspondence between the Government of India and the Secretary of State in Council, Respecting the Proposed Changes in the Indian Army System.' 'Copies of Any Dissents, and of Despatches, against the Changes Proposed or Ordered in the Indian Army System (in Addition to the Return of the 8th Day of May 1884)'," 1884 (17), 171. The Research Department had been formed in April of 1907 by the combination of several ongoing research departments at Woolwich; see Hogg, 1440, and TNA, DEFA 15/3, "History of Research Department, Woolwich, 1900-1919."

[301] Skentelbery, 292.

[302] Skentelbery, 29, 290-295; Headlam, 86.

1914."[303] There is much truth to the statement, and not just for artillery. Combat experience in the South African veld led the Small Arms Committee of 1900 to redesign the Lee-Enfield, and their work produced a shortened, simplified, charger-fed weapon in just two years. France, on the other hand, remained primarily armed with an individually-reloaded magazine rifle into World War One.[304]

The war also caused British politicians to address the persistent problems in its military administration. The Esher Committee changes ended "the struggle for supremacy between the civil and military authorities," the root cause of the "disastrous muddle" that had plagued the British army through much of the Victorian era.[305] Haldane's subsequent reforms and the changes made to British weaponry by the various committees involved gave the nation a modernized volunteer army, properly armed for war in Europe. The Expeditionary Force sent to France in 1914 would be "in every respect…incomparably the best trained, best organized, and best equipped British Army which ever went forth to war" – yet woefully small in comparison to the huge conscript armies fielded by the Continental European powers.[306]

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[303] Headlam, 87.
[304] Garry James, "The 1886/93 Lebel," *American Rifleman*, October 2014, 67-70.
[305] Gordon, 81.
[306] Spiers, *The Army and Society*, 284.

Conclusion: A Successful or Failed Revolution?

The sixty years that separate 1854 and 1914 represented a period of incredible change for military forces all over the world. Within the section of time covered by the existence of the Ordnance Select Committee (1855-1868), every single weapon that had served European armies in good stead for over a hundred and fifty years had been replaced. Past that point, continued refinements in weaponry meant that the constraints on warfare that had existed for centuries – bad weather, slow communications, muscle-powered transportation, and short range of combat – would finally be overcome. Humanity, to paraphrase a recent Hollywood blockbuster, had prepared itself for a higher form of war.

The tremendous changes in military technology that the nineteenth century ushered in are validated by their longevity; like the flintlock musket, many weapons systems pioneered in that era persist on the modern battlefield. Despite experiments with other forms of propellant, electrical primers, and self-consuming ammunition, the brass-cased cartridge using smokeless powder and fired by percussion cap remain the norm for small arms across the world. Bolt-action rifles served admirably through both World Wars, until being supplanted by automatic weapons in the 1950s. Even then, the older form of rifle continued to serve as a front-line weapon in many armies until the late 20th century, and remains a popular choice for sporting purposes and special military use, such as in sniper rifles. Quick-loading, fixed-ammunition artillery also is still widely used, albeit with various refinements since its late nineteenth-century introduction. The recoil-operated machine gun, invented by Hiram Maxim in 1883, remains a critical piece of technology for all militaries. Although Maxim guns have long passed into the hands of collectors and museums, John Browning's follow-on design is still in service across the globe. Gatling's rotary-barrel machine gun is also still in use, although now electrically powered and capable of spitting bullets out at fearsome rates. Finally, the principle of the salvo rocket launcher that Hale tried unsuccessfully to interest British ordnance officials in on a number of occasions is still very much a part of modern arsenals today.

Figure 42: the Browning .50" M2 HB (Heavy Barrel), affectionately known as the "Ma Deuce" to American servicemen, is based on John Browning's 1921 adaptation of Maxim's recoil-operation principle.[1]

There are, of course, a number of mixed-use technologies that proved critical to military success before World War One, such as the railroad, telegraph, and new forms of medicine to name a few. 1914 would also see many more "civilian" technologies harnessed and refined for military use, such as the automobile, telephone, and that most amazing bit of hardware of the age, the airplane. If anything, the military revolution that began in the mid-nineteenth century would be accelerated by the Great War, again by World War II, and in truth shows no signs of abating. Although we seem to have plateaued in some regards – the

[1] Source: "The U.S. Ordnance M2HB .50 BMG Machine Gun," Small Arms Defense Journal, 18 Aug 2011, http://www.sadefensejournal.com/wp/?p=377. The article title is double-titled; "BMG" stands for "Browning Machine Gun."

current US battle rifle, the M4, is a variant of a weapon introduced nearly fifty years ago – advances in other areas are producing weapons that were the stuff of science fiction only a generation ago.[2]

Unlike all other major powers of the age, however, Britain emerged from the Victorian era with a major constraint still in place: the political will of the nation, which took two different forms. The willingness to finance military modernization remained an important constraint throughout the nineteenth century. Driven mostly by the Gladstonian belief in keeping military costs to a minimum so as to reduce the burden of taxation, British politicians consistently refused to authorize the spending necessary to effectively defend the expanding British empire. Through choice and occasionally sheer luck, the nation steered clear of any major engagements against capable opponents between 1856 and 1899; when it finally did go to war, the tenacity and ability of Kruger's farmer-soldiers caught the nation by surprise. In the post-Boer war era, however, the desire to reduce taxation gave way to the interest in building social welfare programs, beginning with a 1908 old-age pension plan.[3] To fund such programs while keeping the budget more-or-less in balance meant that reductions had to come from somewhere. Historically, these came from – and would continue to come from defense spending. The other half of the political will issue expressed itself in how the army found its manpower. British political parties consistently refused to tackle the thorny issue of conscription, which meant the country remained dependent on an all-volunteer army. Well-trained and adequately armed, expandable in times of war through reserves and an active volunteer component, British land forces remained almost microscopic compared to the mass-conscription armies of its Continental counterparts.

[2] For an example, see Brad Lendon, "Navy: New laser weapon works, ready for action," *CNN News*, 11 Dec 2014, http://www.cnn.com/2014/12/11/tech/innovation/navy-laser-weapon/.
[3] Searle, 367.

In many ways, therefore, the military revolution that the country experienced was incomplete; having constructed "a projectile to be fired by the Royal Navy," the nation found itself materially and mentally unprepared to launch that projectile more than once.[4] By the time the war on the Western Front switched from one of movement to one of position, the British Expeditionary Force – which had successfully fought the Germans to a standstill in its sector – found itself exhausted. Such unpreparedness reached all levels of the British military, on both land and sea, and included its system of weapons development. Although the "disastrous muddle" that plagued military administration throughout the Victorian era had finally been dissolved, change only occurred at the top levels of the War Office. As Chapter Seven shows, ordnance development continued to suffer from its own internal muddle, witnessed by the parade of commissions and the mind-numbing redefinitions of the chief ordnance positions.

The wartime problems with ordnance development that surfaced in 1914 are examined by at least three scholarly studies, which approach the issue from different directions. In 1971, Roy MacCleod and E. Kay Andrews took a closer look at the Board of Invention and Research, appointed to harness scientific efforts for the Royal Navy.[5] Michael Pattison took a similar approach but with army-related weaponry, in his 1983 examination of the Munitions Invention Department.[6] Finally, Guy Hartcup expanded such research with his 1988 book, *The War of Invention: Scientific Developments, 1914-18.*[7] The picture that

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[4] Jehiel Keeler Hoyt and Kate Louise Roberts, *Hoyt's New Cyclopedia of Practical Quotations* (New York; London: Funk & Wagnalls Co., 1940), 847; the quote is attributable to Sir Edward Grey, but no date is given.

[5] Roy M. MacLeod, and E. Kay Andrews, "Scientific Advice in the War at Sea 1915-1917: The Board of Invention and Research." *Journal of Contemporary History* 6, no. 2 (1971): 3-40.

[6] Michael Pattison, "Scientists, Inventors and the Military in Britain, 1915-19: The Munitions Inventions Department." *Social Studies of Science* 13, no. 4 (1983): 521-68.

[7] Guy Hartcup, *The War of Invention: Scientific Developments, 1914-18*. London: Brassey's Defence Publishers, 1988.

emerges from these three studies is indeed one of a military procurement and development system unready for the demands that would be made of it in 1915, once the war settled into stalemate and attrition.

As this project has also shown, the root causes of this remaining muddle were themselves deep, and recognized over the years by both politicians and the British press. An 1871 editorial in the *Quarterly Review*, for example, skewered politicians of the "blue water school" three decades before that term came into common usage. Champions of the Royal Navy as the nation's best means of preventing invasion, the author noted, "encouraged otherwise responsible statesmen to disregard the Army in peacetime, to reduce its establishments, to deprive it of weapons, to ill-treat its officers and neglect its men."[8] Brought about in part by the long shadow cast by Gladstonian financial principles, such retrenchment and redirection occurred yet again after the conclusion of the Boer War – and would take place again with the end of the Great War.

While the resolution of the "disastrous muddle" has been a major focus of this project, it has also sought to put into greater historical context the role of the public in weapons development in the era between the Crimean and Boer Wars. Interesting on their own for the great parade of colorful and occasionally eccentric characters, the records of the *Abstracts of Proceedings* represent a largely unexplored resource for anyone exploring the dynamics of military and social relationships in this era. When combined with other sources, in particular the active daily and weekly press in Britain, what emerges is a picture not of a passively interested public, but one concerned for the defenses of the empire and actively

[8] Sir Charles Petrie, "An Eccentric at the Horse Guards: 'The Royal George 1819-1904,' by Giles St. Aubyn," The Illustrated London News, 09 Nov 1963, 769. The original article that the quote comes from has not yet been located.

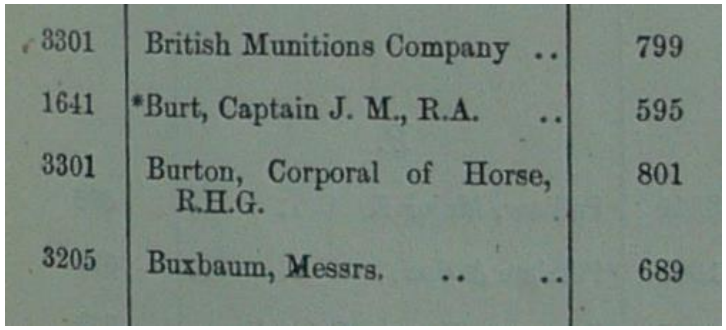
trying to improve them. The British public had, indeed, lost none of its inventive spirit in the late Victorian era.

Much work remains to be done in the socio-technical history of British weapons development. Several collections came to light too late to be included in this study, such as the records of the Director of Naval Ordnance and the Research Department at Woolwich. In addition, MacCleod and Andrews mention the "hundreds of devices and suggestions… from enthusiastic British inventors" submitted to the Admiralty since the beginning of World War One.[9] Given the history of such inventors over the course of the nineteenth century, this is both not surprising and reason to suspect the same occurred at the War Office. If details of such submissions survived the Battle of Britain, then cataloging them will increase the statistical base of this project and shine additional light on how inventive the British public really was in this era. Regardless, the *Abstracts* contain a rich source on information on the military revolution in England in the Victorian era, and a very useful starting point for considering the changes the revolution brought about.

[9] MacCleod and Andrews, 6-7.

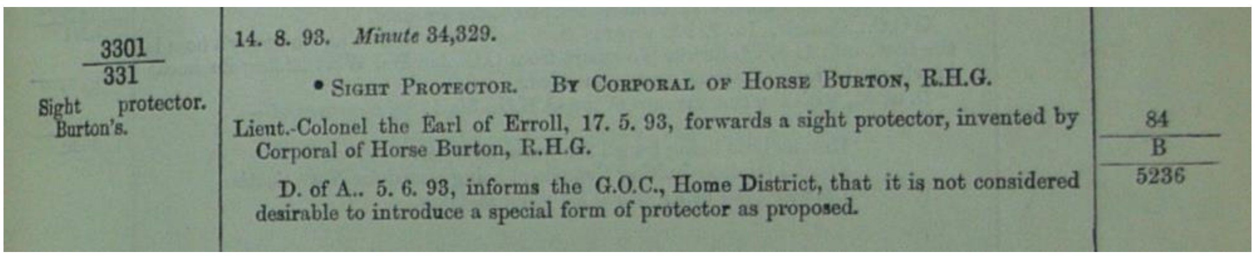
Appendix 1: Analyzing the **Abstracts of Proceedings**

The British in the Victorian Era were prodigious record-keepers – but not necessarily accurate ones. Transcription errors abound in the *Abstracts*, making the compilation of statistics somewhat problematic, especially in tracking submissions by specific inventors. All of the *Abstracts* have an index that lists not only the inventors, by name, but also a cross-reference of the subjects brought forward for discussion. The name indices, however, are not reliable; they generally only show the last name, and occasionally a first initial. Common names like "Smith" and "Brown," without a first name, can lead the researcher to associate a proposal with the wrong inventor, and even uncommon names can be problematic. "Fosberry, G. V.," "Fosbery, G. V.," "Fosbery," "Fosbery, V. C.," for example, are all references to Capt. G. V. Fosbery, V. C., of the Bengal Army, who submitted several proposals for consideration. In addition, not all first-time submitters are asterisked, as they should have been. The 1893 *Abstracts* name index compounds this problem with a lack of sub-project designators. The entry for "Burton, Corporal of Horse, R.H.G." (Fig. 43) credits that soldier with a proposal under subject number 3301 but does not mark him as new to the *Abstracts*. The actual entry (Fig. 2) shows that Cpl. Burton was a first-time submitter, and his actual subject number to be 3301.331. Such errors mean that the researcher can only use the indices as a general guide, and must – page by page – slog through inches of *Abstracts* to build an accurate picture of who brought what to the War Office.



3301	British Munitions Company ..	799
1641	*Burt, Captain J. M., R.A. ..	595
3301	Burton, Corporal of Horse, R.H.G.	801
3205	Buxbaum, Messrs.	689

Figure 43: The name index (1893 Q3, iii) showing the entry for Corporal Burton. Note that Capt. J. M. Burt's entry above clearly identifies that officer as a first time submitter.



3301/331 Sight protector. Burton's.

14. 8. 93. *Minute* 34,329.

• SIGHT PROTECTOR. BY CORPORAL OF HORSE BURTON, R.H.G.

Lieut.-Colonel the Earl of Erroll, 17. 5. 93, forwards a sight protector, invented by Corporal of Horse Burton, R.H.G.

D. of A.. 5. 6. 93, informs the G.O.C., Home District, that it is not considered desirable to introduce a special form of protector as proposed.

84/B/5236

Figure 44: The actual entry for Cpl. Burton's invention, clearly marked as new to the *Abstracts*.

In addition, it is clear from anecdotal evidence that not every invention forwarded to the War Office or Admiralty came to the attention of the relevant ordnance committee of the time. Sir Percy Scott, in his memoirs of his fifty years of naval gunnery, noted that in 1881 he developed an electrical indicator for communicating changes in range between an officer on deck and the gun crews below. Although he received a communication from the Admiralty that they "highly appreciate the intelligence and zeal he has shown" in the development of the instrument, it did not get forwarded to the Ordnance Committee for evaluation, possibly because they felt it applicable only for use aboard ship. Similarly, the Admiralty ignored his suggestion for a lightweight firefighter's suit, designed after Scott's own experience dealing with a fire aboard his ship *HMS Inconstant* in 1882. Despite the recommendation of his captain that "a few pounds expended in furtherance of [the invention] might in all probability be the means of saving one or perhaps more of H.M. ships from destruction," the Admiralty chose to retain a German-designed "smoke cap" that failed aboard the *Inconstant*.[1]

Despite these errors and omissions, careful study of the *Abstracts* from 1857 to 1907 detail 9,186 different subjects considered by the OSC and its successors, the vast majority being proposed changes to ordnance and related military supplies.[2] Of these, 4,713 – just over 50% - may be classed as "failed" – proposals dismissed without trial, rejected after experimentation, or claims for reward denied by the committee. The actual percentage is most likely far higher, as many projects in the period after the dissolution of the OSC were not expressly identified as rejected; comments simply end with no final status. Time constraints meant resolution of these "unfinished" projects must remain for a later date.

Table 6: Ordnance Select Committee Project Count by Year. "Failed" projects include any dismissed outright, rejected after trial, or rejected reward claims. Note that some projects would not "fail" until the following year.

Year	Active	New	Failed Project Count	Percent Failed
1857	228	228	100	43.86%
1858	220	137	87	39.55%
1859	401	318	193	48.13%
1860	544	383	211	38.79%
1861	441	241	156	35.37%
1862	425	207	154	36.24%
1863	363	151	100	27.55%
1864	447	231	197	44.07%
1865	490	234	174	35.51%
1866	373	146	128	34.32%
1867	421	209	198	47.03%
1868	287	80	101	35.19%

[1] Scott, Percy. *Fifty Years in the Royal Navy* (New York: George H. Doran Co., 1919), 55-59. Scott continued that on his return to England he found that his indicator "had been pirated and patented by someone else."
[2] "Project" refers to any proposal, claim for reward, or information forwarded for reference of the OSC. Not all "projects" represented actual inventions to be considered.

Table 6 shows a breakdown by year of the subjects, grouped by year, for the period of the OSC's operation. This breakdown, while useful, does not tell the entire story. Each individual subject assigned a number by the Committee may, in fact, contain several other suggestions by different persons grouped under the same subject number. For example, Subject 1671, regarding Armstrong breech-loading cannon and equipment, contains eighteen sub-topics: questions regarding the painting of the guns, improvements in construction and equipment, and so forth. A very subjective review of the *Abstracts* show over 10,000 sub-topics considered by the committees until 1907, when the publication of committee proceedings ended.

Appendix 2: British Chiefs of Ordnance, 1819 - 1907[1]

Master-Generals of Ordnance, 1819-1855

Years	*Officer*	*Government*	*Reason for Departure*
1819-1827	Duke of Wellington	Liverpool	Change of government
1827-1828	Henry William Paget (Lord Anglesey)	Canning	New appointment
1828-1830	William Carr Beresford (Lord Beresford)	Wellington	Change of government
1830-1834	Sir James Kempt	Grey	Retired
1834-1835	Sir George Murray	1st Peel	Change of government
1835-1841	Sir Richard Vivian	2nd & 3rd Melbourne	Change of government
1841-1846	Sir George Murray	2nd Peel	Change of government
Jul 1846 - Mar 1852	Lord Anglesey	1st Russell	Change of government
Mar – Sep 1852	Henry Hardinge (Lord Hardinge)	1st Derby	Promotion to Commander-in-Chief.
1852-1855	FitzRoy James Somerset (Lord Raglan)	Aberdeen	Effectively left on his departure for the Crimean front.

Director-General of Artillery (DGA): This post dates to 1793, but became the primary ordnance officer on the abolition of the Master-General of Ordnance. The duties of the DGA were defined as:

1. Charge of reserve and depots of artillery;
2. To advise on nature of artillery for any particular services;
3. To advise, in concert with the Inspector-General of Fortifications, as to armament of works;
4. To be ex officio President of the OSC;
5. To digest all returns of practice, experimental or otherwise;
6. To examine all demands for ammunition and stores made by districts;

[1] Tables are extensions of Hogg 1963, 1037-1039, with corrections from Kane and Askwith, *List of Officers of the Royal Regiment of Artillery from the Year 1716 to the Year 1899*. Full dates for all offices from the latter, p. 167.

7. To digest half-yearly reports on the general state of armaments;

8. To advise on novelties and improvements.[2]

Gen. Sir William Cator held the post over several governments from 19 Aug 1852 – Dec. 1858. On his resignation the post was abolished. Until 1861, the Secretary of State for War served as the head of the Ordnance Department.

Director (or Director-General) of Ordnance, 1861-1870

There is some confusion regarding the exact title. In the debate regarding the 1861 army estimates, T. G. Baring (later Lord Northbrook) mentioned that "provision had been taken for the appointment of a Director General of Ordnance, who would have the general superintendence of the manufacturing departments at Woolwich, and would advise the Secretary of State in relation to the artillery."[3] The title shown in the estimates for 1861 through 1868, is "Director of Ordnance;" testimony given before various committees show that "Director-General" was often used.[4] The estimates for 1869-70 show the exact title "Director-General of Ordnance" with an increase in salary from £1,000 to £1,200.[5] Formal orders-in-council or other documents have not been found that define the exact duties of either office. Holders of the office include:

16 Aug 1861 – 11 Dec 1863: Maj. Gen. Alexander Tulloh

11 Dec 1863 – 08 Dec 1868: Maj. Gen. Sir John St. George

09 Dec 1868 – 31 Mar 1870: Maj. Gen. Sir John Henry Lefroy

[2] Jocelyn, 82; HCPP, "Army Civil Departments. Copy of an Order of the Queen's Most Excellent Majesty in Council (Passed on the 6th Day of June 1855), Regulating the Establishments of the Civil Departments of the Army," 1854 (307), 2-3.

[3] *HC Deb 14 March 1861 Vol 161 cc2005-2006.*

[4] For an example, see HCPP, "Report of a Committee Appointed by the Secretary of State for War to Enquire into the Administration of the Transport and Supply Departments of the Army," Question 768, 1867 (3848), 46.

[5] HCPP, "Army Estimates of Effective and Non-Effective Services, for 1869-70," 1869 (39), 83-89.

Surveyor-General of Ordnance (SGO) and Director of Artillery and Stores (DAS), 1870-1888

The 1870 War Office Act created two primary posts: the SGO and DAS. The former had overall control of the Commissariat, Barracks, Military Stores, and Clothing Departments. He also had nominal control of the supply of artillery equipment; in reality, the DAS had effective control of the latter.

Orders in Council issued 04 June 1870 listed the duties of the SGO as:

1. "Providing, holding, and issuing to the Army and Reserve Forces food, forage, fuel and light, clothes and accoutrements, munitions of war, and other stores necessary for the efficient performance of their duties by such forces, of proper quality and pattern, and in proper quantities according to the regulations governing the provision, custody, and issue of such supplies;
2. Exercising a strict control over the expenditure of such supplies, and with seeing that they are properly accounted for by the several officers and others who may be charged with their custody, issue, and use;
3. The custody of all buildings in which troops are quartered, and with allotting quarters;
4. Providing transport for troops, and directing land and inland water transport;
5. Preparing the estimates for all the above services, and causing the expenditure for them to be duly and carefully examined;
6. Rendering such other advice and assistance as may be required of him by the Secretary of State for War."[6]

SGO	1870-1874	Maj. Gen. Sir Henry Knight-Storks	Died
SGO	1874- May 1880	Lord Eustace Cecil	Change of government

[6] HCPP, "Copies of Orders in Council Relating to the War Department," 1870 (C.164), 2.

SGO	1880-1883	Lt. Gen. Sir John Miller Adye	Left to become governor of Gibraltar.
SGO	1883-1885	Henry Robert Brand	Change of government
SGO	1885-1886	Guy Cuthbert Dawney	Change of government
SGO	1886	William Woodall	Change of government
SGO	1886-1887[7]	Sir Henry Stafford Northcote	Resigned; office abolished
DAS	1 Apr 1870 – 31 Jul 1875	Lt. Gen. Sir John Miller Adye	
DAS	1 Aug 1875-31 Jan 1883	Lt. Gen. Frederick A. Campbell	
DAS	1 Feb 1883 – 31 Dec 1884	Brig. Gen. William Moyses Reilly	Resigned
DAS	1 Jan 1885-31 Mar 1888	Maj. Gen. Henry James Alderson	Office abolished

Director of Artillery (DA) and Director-General of Ordnance Factories (DGOF), 1888-1895

Stanhope's reorganization of the War Office eliminated the SGO position, and split duties between the Director of Artillery and a Director-General of Ordnance Factories. The latter, placed under the Financial Secretary of the War Office, put control of the Factories into civilian hands, which caused a great deal of conflict with the military.[8]

Orders in Council issued 21 Feb 1888 charged the DA with the following duties:

1. Supplying the Army with warlike stores and equipment;
2. Inspection of all stores supplied by the Manufacturing Departments, or by contractors;
3. Dealing with questions of armament, of patterns, of inventions and designs, and control of the Ordnance Committee;
4. Administration of the Ordnance Store Department and the Ordnance Store Corps;
5. In concert with the Quarter-Master-General, will prepare the Annual Estimates for the above Services.

The same orders charged the DGOF with:

[7] Hogg states 1888, but Callwell and Headlam (205-206) state that the office existed until the end of 1887.
[8] Callwell and Headlam, 211.

1. The administration and working, so far as possible upon a commercial basis, of the Ordnance Factories at Woolwich, Enfield, Waltham, and Birmingham;
2. Submission of estimates of the expense necessary to carry out the orders he may receive for Army, Navy, India, and Colonial Services;
3. Preparation of the accounts of expenditure incurred in the Factories for audit in the Finance Division and submission to Parliament;
4. Submission of an annual report to the Secretary of State through the Financial Secretary.[9]

DA	1 Apr 1888- 30 Oct 1891	Maj. Gen. Henry James Alderson	Became President of Ordnance Committee
DA	31 Oct 1891- 27 Apr 1895	Lt. Gen. Robert John Hay	
DA	28 Apr 1895 – 31 Mar 1896	Lt. Gen. Sir Henry Brackenbury	Office abolished
DGOF	Jan 1888 – Apr 1889	Maj.-Gen. Eardley R. Maitland	
DGOF	11 Aug 1889- 11 Dec 1898	Sir William Anderson	Died; office abolished

Inspector-General of Ordnance (IGO) and DGOF, 1896-1898

Lansdowne's reform replaced the Director of Artillery, who answered to the Commander-in-Chief, with the Inspector-General of Ordnance, who answered to the Secretary of State for War and became "virtually a colleague of the Commander-in-Chief."[10]

Orders in Council issued 21 Nov 1895 charged the IGO with the following duties:

1. Supplying the Army with warlike stores and equipment
2. The inspection of all stores supplied by the Manufacturing Departments, or by contractors;

[9] HCPP, "Orders in Council Relative to the War Department with a Statement of the Duties Assigned to Certain Officers under Such Orders," 1888 (C.5304), 5-7.
[10] Callwell and Headlam, 207.

3. Dealing with questions of armament, of patterns, of inventions and designs, and with the direction of the Ordnance Committee;
4. Administration of the Ordnance Store Department and the Ordnance Store Corps;
5. Making such inspections as may be necessary to secure the efficiency of the duties under his control;
6. Submission of proposals for the Annual Estimates for the above Services;
7. To advise the Secretary of State on all questions connected with the duties of his department.[11]

Lt. Gen. Sir Edwin Markham held the office from 01 April 1896 until 1898, when he left on his appointment as head of the Royal Military College, Sandhurst.[12]

Director-General of Ordnance (DGO) and Chief Superintendents of Ordnance Factories (CSOF), 1899-1904

Friction over military v. civilian control of the Manufacturing Departments led Lansdowne to change the title for the chief of the ordnance position to that of "Director-General of Ordnance" and place the Ordnance Factories underneath him via the CSOF.[13]

Orders in Council issued 07 Mar 1899 charged the DGO with the following duties:

1. Supplying the Army with warlike stores, equipment, and clothing;
2. Direction of the Ordnance Committee and the Manufacturing Departments of the Army;
3. Dealing with questions of armaments, of patterns, of inventions and designs;
4. The inspection of all stores whether supplied by the Manufacturing Departments or by contractors;

[11] HCPP, "War Office. Orders in Council Defining the Duties of the Principal Officers Charged with the Administration of the Army:-- (1.) Order in Council, Dated 21st November 1895. (2.) Order in Council, Dated 7th March 1899, Revoking the Order in Council, Dated 21st November 1895," 1899 (113), 4.
[12] *London Standard*, 07 November 1898, 5.
[13] Callwell and Headlam, 211.

5. Administration of the Army Ordnance Department and Army Ordnance Corps;
6. Making such inspections as may be necessary to secure the efficiency of the Services under his control;
7. Submission of proposals for the Annual Estimates for the above Services;
8. To advise the Secretary of State on all questions connected with the duties of his Department.[14]

DGO	1899-1904	Lt. Gen. Sir Henry Brackenbury	
CSOF	1899 – 1903	Col. Sir Edmond Bainbridge	
CSOF	1903 – 1916	Sir Frederick Donaldson	This post remains in existence to 1955

Master-General of Ordnance (MGO), 1904 and forward

On the recommendation of the Esher Committee, Government reconstituted the post of MGO and made it the fourth military member of the new Army Council. Maj. Gen. Sir James Wolfe Murray served as the first new MGO from 1904 until 1907.

[14] HCPP, 1899 (113), 6.

Appendix 3: Scientific Committees, 1869-1883[1]

Question	Duration	Members on Establishment	Reports and Remarks
1) Field artillery equipment for India (Subj. 2779 and 2779.3)	Dec 1868 - Sep 1870	Maj. Gen. F. M. Eardley-Wilmot, RA (President) Maj. Gen. W. G. Simpson, RA Col. E. Wray, CB, RA Col. J. M. Adye, CB, RA Col. W. H. Middleton, CB, RA Col. H. H. Maxwell, RA Col. W. E. M. Reilly, CB, RA Capt. W. R. Lluellyn, RA (Secretary)	Provisional Report, 30 Jun 1869: Proceedings 1869, p. 358 Final Report, 24 Nov 1869: Proceedings 1870, p.142 Detailed Tables and Appendices sent in, 30 Jun 1870, p. 377
2) Palliser projectiles (2424)	Apr 1869 – May 1870	Col. E. Wray, CB, RA (President) Capt. W. Arthur, RA Maj. W. Palliser, CB, unattached J. Anderson, Superintendent of Machinery	Progress Report, 10 Feb 1870, p. 98
3) Explosive substances (1641)	May 1869	Col. C. W. Younghusband, RA (President) Lt. Col. F. Miller, VC, RA Capt. Morgan Singer, RN Capt. A. Noble, CE, late RA Capt. V. D. Majendie, RA, Asst Sup RL Capt. W. H. Noble, RA (Secretary) Capt. F. S. Stoney, RA, Asst Sup RGF F. A. Abel, Chemist, War Dept. Col. W. M. Dixon, RA, Sup RSAF (Asso. Memb.) Lt. Col. H. C. Fletcher, Scots Fusilier Guards (Asso.)	Preliminary Report, 05 Feb 1870, p.22 Further Report, 12 Jul 1870, p.435 Progress report, 01 Jan 1871, p.199 Indian powder, Jan 1872, p.11 Progress report, Apr 1872, p.324 Picric powder, 04 Feb 1873, p.8 Proof of guns, 03 Apr 1873, p.109 Proof of guns, 14 Nov 1873, p.286 Ishapore powder, 05 Aug 1873, p.206 Report, Mar 1876, on 38-ton gun, p.7
4) Segment v. shrapnel shells for field service	May 1869 - Sep 1869	Maj. Gen. C. Dickson, CB, VC, RA (President) Col. T. Elwyn, RA Col. R. C. Romer, RA	Report, 18 Sep1869, p. 394

[1] Source: *General Indexes to the Abstracts of Proceedings, 1869-1883* (Royal Armouries Library, Leeds, UK), unless otherwise noted.

(1314.2)		Col. H. T. Strange, CB, RA Lt. Col. J. R. Sladen, RHA Capt. J. E. Mitchell, RHA Capt. W. Stirling, RA Capt. H. J. Alderson, RA (Secretary)	
5) Muzzle pivoting carriages (2463, 2463.5, 2482)	May 1869 - Oct 1870	Col. T. Elwyn, RA (President) Cap. Hon. F. Foley, RA Col. E. Wray, CB, RA Capt. J. E. Cornes, RE Lt J. S. Sladen, RA (Secrtary)	Report, 31 Mar 1870, p. 350
6) Endurance of 12-in RML gun (2335, 2335.2)	July 1869 – May 1870	Col. T. Elwyn, RA (President) Col. F. A. Campbell, RA, Sup RFG Col. T. M. Milward, CB, RA, Dept DGO	Report, 10 Feb 1870, p.232
7) Mountain equipment for India (1671.A5)	July 1869 – Jan 1873	Col. E. Wray, CB, RA (President) Col. H. Clerk, RA., Sup RCD Bvt-Maj. G. Twiss, RA. Bvt-Maj. T. E. Hughes, RA	Preliminary Report, 7 Aug 1869, p.408. Report, 27 Nov 1869, p.409 Report, 8 Jun 1870, p.294. Report, 19 Jan 1871, p.18
8) Boxer ammunition for Snider breech-loading rifles	Aug 1869 – Sep 1869	Col. W. R. Haliday, Insp-Gen Musketry (President) Col. W. M. Dixon, RA, Sup RSAF Col. W. M. Boxer, RA, Sup RL Col. E. Wray, RA	Reports, 27 Aug 1869 and 6 Sep 1869
9) Effect of vertical fire on iron-plated structures	Aug 1869 – Nov 1870	Bvt-Col. G. Shaw, RA (President) Capt. W. Arthur, RN Capt. J. E. Cornes, RE Capt. W. H. Noble, RA Capt. A. Harrison, RA (Secretary)	Restructured as #10 below.
10) Trial of— Ships decks protected with iron. Turrets for coast	Nov 1870 – Oct 1873	Col. T. Elwyn, RA (President) Capt. Hon. F. A. Foley, RN Capt. W. Arthur, RN Lt. Col. T. Inglis, RE	

fortifications.		Capt. A. Harrison, RA Capt. W. H. Noble, RA (Secretary) Lt. W. Innes RE	
11) Mitrailleurs	Sep 1869 – May 1872	Lt. Col. E. Wray, CB, RA (President) Col. G. Shaw, RA, Asst. Adj-Gen. RA Capt. Hon. F. A. Foley, RN Lt. Col. H. C. Fletcher, Scots Fusilier Guards. Capt. F. E. Beaumont, RE, MP Capt. W. H. Noble, R.A. Lt. Col. H. Heyman, RA (Secretary)	Report, 28th October 1870. p.416. Report on evidence, 28 Nov 1871, p.381
12) Martini-Henry rifles	Jan 1870 – May 1870	Lt. Col. H. C. Fletcher, Scots Fusilier Guards (President) Lt. Col. H. Heyman, RA Capt. R. W. Haig, RA. Capt. V. D. Majendie, R.A	Minute, 21st February 1870 Report, 26th March 1870, p. 505 Minute, 12th April 1870 Restructured into #13 below.
13) Martini-Henry rifles	May 1870 – May 1872	Lt. Col. H. C. Fletcher, Scots Fusilier Guards (President) Capt. R. W. Haig, RA Capt. V. D. Majendie, RA, Asst Sup RL Capt. A. T. L. Chapman, Inspector of Musketry, 34th Regiment. Capt. J. E. F. Aylmer, half-pay, late 8th Regiment. Lord Elcho, MP E. Ross, Esq. C. H. Gregory, CE Lt. B. de B. Tupper, RA	Report, 14th July 1870, p. 502 Final Report, 9th February 1871 Supplementary Report, 21st March 1871 Report on light bullets, 29 Jul 1871, p.351 Report on carbines, Feb 1872, p.135
14) Hale's war rockets	Jan 1870 – May 1870	Bvt-Col. T. W. Milward, CB, RA Lt. Col. G. Fraser, RA Capt. A. Harrison, RA. F. A. Abel, Esq., Chemist, War Department. Col. T. Elwyn	Preliminary Report, 18th January 1870,p. 6. Report, 24th February 1870, p. 7.

15) Trial of modified E time and C percussion fuzes.	Jan 1870 – Mar 1870	Col. T. Elwyn, RA (President) Col. H. F. Strange, CB, RA Lt. Col. H. Heyman, RA.	Report, 3rd March 1870, p. 42. Dissolved.
16) Concussion fuzes for RML guns.	Jan 1870 – May 1871	Col. E. Wray, CB, RA (President) Lt. Col. H. Heyman, RA Capt. H. J. Alderson, RA. Capt. V. D. Majendie, RA., Asst Sup RL	Preliminary Report, 14th July 1870, p. 525. Report, 6th March 1871.
17) Moncrieff carriages	Jan 1870 – Aug 1874	Col. T. Elwyn, RA (President) Bvt-Col. T. W. Milward, CB, RA Bvt-Col. T. L. Gallwey, RE Lt. Col. H. Wray, RE Bvt-Col. G. Shaw, RA Lt. Col. H. Heyman, RA (Secretary) Major Close, RA. Capt. H. J. Alderson, RA.	Reports, 05 and 12 Jan 1871 Report, 19 Apr 1871 Report, 13 Dec 1871 Report, 07 Feb 1872, p.43 Report, Jul 1872, p.261 Minute, 01 May 1873, p.161 Report, 18 Jun 1873, p.233
18) Iron field gun carriages	Jan 1870 – Oct 1870	Col. J. M. Adye, CB, RA (President) Col. W. A. Middleton, CB, RA. Bvt-Col. T. W. Milward, CB, RA. Bvt-Col. G. Shaw, RA. Bvt-Col. C. S. Henry, CB, RHA Bvt-Col. G. H. Vesey, RA. Capt. H. Thornhill, RA Capt. T. L. H. Lyon, RA Lt. Col. H. Heyman. RA (Secretary)	Report, 14th February 1870, p.106.
19) Range, &c., of Whitworth 9-inch RML gun	Feb 1870 – Jul 1870	Col. T. Elwyn, RA (President) Capt. W. Arthur, RA Lt. Col.. F. Miller, VC, RA	Report, 18th June 1870, p.462.
20) 15-inch shield No. 31	Feb 1870 – Mar 1870	Col. T. Elwyn, RA (President) Bvt-Col. T. L. Gallwey, RE Lt. Col. H. Heyman, RA Capt. A. Harrison, RA Capt. J. E. Cornes, RE	Report, 29 Mar 1870. The duties of this Committee were subsequently merged with #10 above

21) Heavy rifled howitzers and shell guns for field service.	May 1870 – Jan 1878	Maj. Gen. F. M. Eardley-Wilmot, RA (President) Col. E. Wray, CB, RA Bvt-Col. G. Shaw, RA Lt. Col.. W. E. M. Reilly, CB, RA Lt. Col. H. Heyman, RA (Secretary) Lt. Col. Hay, RA Capt. V. D. Majendie, RA, Asst Sup RL Capt. W. H. Noble, RA	Progress Report, 19 Nov 1870, p.623 Report, 04 Oct 1871, p.372 Report, Nov 1871, p.58 Report, Jan 1872, p.153 Report, Apr 1872, p.279 Report, Aug 1872, p.281 Report 17 Apr 1873, p.165 Minutes from time to time Reported dissolved, Oct 1874, but continues as committee on siege guns and howitzers. Report, Feb 1876, on experiments at Okehampton, p.98 Question of rifled field guns closed Feb. 1876, p.99
22) Transport of regimental reserves of infantry ammunition.	Jul 1870 – Nov 1870	Col. E. Wray, CB, RA (President) Bvt-Col. W. G. Cameron, CB, 4th King's Own Royal Regt. Bvt-Col. T. W. Milward, CB, RA, Sup RL Lt. Col.. W. E. M. Reilly, CB, RA Assistant Controller J. Bailey, CB	Preliminary Report, 8th July 1870,p. 394. Report, 18th July 1870, p. 394. Report, 18th September 1870.
23) RML and RBL guns	Jul 1870 – Dec 1870	Maj. Gen. Sir J. St. George, K.CB (President) Maj. Gen. F. M. Eardley-Wilmot, RA Maj. Gen. G. Gambier, CB, DA.G., RA Col. E. Wray, CB, RA Bvt-Col. C. S. Henry, CB, RHA Bvt-Col. T. W. Milward, CB, RA, Sup RL Bvt-Col. J. K Michell, CB, RHA Lt. Col.. W. E. M. Reilly, CB, RA Capt. W. M. S. Wolfe, RA, Brigade Major, SBN. Capt. H. Thornhill, RA Capt. H. J. Alderson, RA, Asst Sup of	"Report of the Special Committee on M.L. V. B.L. Field Guns." 1871 (C.283).

		Experiments, SBN Lt. Col. H. Heyman, RA (Secretary)	
24) Time and percussion fuzes of field artillery	Jul 1870 – Dec 1870	Maj. Gen. F. M. Eardley-Wilmot, RA (President) Maj. Gen. G. Gambier, CB, DAG, RA Capt. H. W. Gordon, CB, Controller, Woolwich Col. E. Wray, CB, RA Bvt-Col. T. W. Milward, CB, RA., Sup RL Capt. W. Arthur, RN Bvt-Col. J. E. Michell, CB, RHA Lt. Col.. H. Heyman, RA Capt. H. J. Alderson, RA, Asst. Sup. of Experiments, SBN. F. A. Abel, Esq., Chemist, War Dept. Capt. W. H. Noble, RA (Secretary)	Report, 17th October 1870, p.448
25) Range finders for ordnance and small arms	Sep 1870 – Dec 1872	Col. E. Wray, CB, RA (President) Capt. H. J. Alderson, RA Lt. C. E. B. Leacock, RA	
26) Traversing gear for heavy guns	Oct 1870 – Oct 1874	Col. E. Wray, CB, RA (President) Lt. Col. H. Heyman, RA Capt. H. J. Alderson, RA Lt. E. H. Steward, RE Lt. W. Innes, RE	Report, 02 Jan 1871, p.99 Report, 03 Jul 1871, p.195 Report, 15 Sep 1871, p.198 Report, Nov 1871, p.184 Report, Oct 1872, p.322 Report, Jan 1873, p.6
27) Bronze for field guns	Nov 1870 – Jun 1875	Maj. Gen. F. M. Eardley-Wilmot, RA (President) Col. F. A. Campbell, RA, Sup RGF Capt. V. D. Majendie, RA, Asst Sup RL F. A. Abel, Chemist, War Department	Report, 22 Nov 1870, p.532
28) Stores and fitments for magazines	Nov 1870	Lt. Col. R. J. Hay, RA (President) Capt. H. J. Alderson, RA Capt. E. H. Steward, RE Capt. E. O. Hollist, RA	Report, 17 Dec 1870 Report, 02 Feb 1871 Subsequent reports on arrangements at various stations
29) Iron targets, &c.	Nov 1870	Col. E. Wray, CB, RA (President)	Report, 17 Jul 1871, p.231

	– Oct 1873	Capt. Herbert, RN Capt. Sharp, RN Col. T. Inglis, RE Maj. H. J. Alderson, RA Cap. W. H. Noble (Secretary) Lt. W. Innes, RE	Report, Aug 1872, p.231 Report, Oct 1872, p.335
30) Proportions for ordnance	Dec 1870	Bvt-Col. G. Shaw, RA, Asst. Gen. RA Capt. Gordon, Controller Royal Arsenal Lt. Col. H. Heyman, RA (1870) Lt. Col. E. Reilly, CB, RA (1872)	
31) Packing 9-pdr RML batteries	Jan 1871	Col. E. Wray, CB, RA (President) Lt. Col. H. Heyman, RA Lt. Col. R. J. Hay, RA	
32) Traction engines for transport purposes	Mar 1871 – Oct 1871	Maj. Gen. Sir J. L. A. Simmons, KCB, RE (President) Col. Sir G. J. Wolseley, KCMG Lt. Col. H. Heyman, RA	
33) Wads for RML guns	Mar 1871	Lt. Col. H. Heyman, RA (President) Cmdr. E. Rice, RN Capt. J. C. Lowrey, RA, Royal Laboratory (1870) Capt. F. S. Stoney, RA, Royal Gun Factory (1870) Maj. F. Lyon, RN (1872) Maj. Maitland, RGF (1872) Capt. W. H. Noble, RA (Secretary)	Report, 4 Apr 1871, p.122 Report, Jul 1872, p.347
34) Pack-saddles	Mar 1871	Col. Herbert, AAG Col. McKenzie, AQMG Col. Wray, CB, RA Capt. Fenn	Report, 24 Mar 1871, p.168 Dissolved, 1877
35) Gun-cotton and lithofracteur	Sep 1871 – Nov 1874	Col. Younghusband, RA (President) Col. T. L. Gallwey, RE Col. T. W. Milward, CB, RA	Report, 14 Dec 1871 Report on lithofracteur, May 1872, p.224

		LtC Nugent, RE Capt. E. Field, RN Dr. Odling H. Bauerman G. P. Bidder, FRS Capt. W. H. Noble, RN (Secretary)	Report, Jul 1872, p.224 Report on lithofracteur, No. 2, Apr 1873, p.138 Report, Jun 1873, p.223 Reports on dynamite, Aug 1873, p.223, and Dec 1873, p.308
36) 12-in. RML guns	Jun 1872	Col. F. A. Campbell, RA (President) Col. G. Field, RA Col. T. Inglis, RE Lt. Col. Heyman, RA Maj. Steward, RE	Merged in that for heavy guns, etc.
37) Picklecombe experiments	Nov 1872 – Mar 1873	Col. T. Inglis, RE Lt. Col. Heyman, RA Maj. Alderson, RA Maj. Steward, RE Capt. Ellis, RA Lt. English, RE (Secretary)	Report, Jan 1873, p.155
38) Shells and fuzes for heavy RML guns	Apr 1871 – Oct 1874	Col. E. Wray, CB, RA Bvt-Col. T. W. Milward, CB, RA Lt. W. H. Hall, RN Maj. H, J. Alderson, RA	
39) Heavy guns, hydraulic loading, &c. 40) Also iron plates and armour-piercing projectiles	Jun 1872	Col. F. A. Campbell, RA (President) Col. G. Field, RA Col. T. Inglis, RE Lt. Col. Heyman, RA Lt. Col. Hay, RA Maj. Steward, RE Lt. T. English, RE	Report on trial of 38-ton gun (100 rounds), Jun 1876, pp.174-184 Second progress report, Jul 1876, p.282 Committee expanded for 80-ton gun trials, p.279
41) Range finders	Dec 1872	Col. E. Wray, CB, RA Lt. Col. Heyman, RA Lt. Col. Stotherd, RE Maj. Alderson, RA	

		Maj. Steward, RE Capt. F. Stoney, RA Capt. W. H. Noble, RA (Secretary) Capt. Warren, RE	
42) Ammunition for Martini-Henry rifles	Dec 1872 - 1874	Col. T. W. Milward, CB, RA Lt. Col. Heyman, RA Lt. Col. Fraser, RA	Report, Mar 1873, p.150 Report, Jun 1873, p.232
43) Engineer wagons	Apr 1873 – Apr 1876	Col. H. Wray, RE Lt. Col. Heyman, RA Maj. Oldfield, RA Capt. E. Micklem, RE	
44) Transport and storage of gunpowder and gun-cotton	Nov 1874	Col. C. W. Younghusband, RA (President) Controller H. Tatum, CB Bvt-Col. C. B. Nugent, CB, RE Bvt-Col. G. H. J. A. Fraser, RA, Sup RL Maj. H. J. Alderson (Secretary) F. A. Abel, Chemist, War Dept.	Report on experiments at Eastbourne, Nov 1876, p.362
45) Siege carriages	Feb 1878	Col. R. Curtis, RA Maj. W. Kemmis, RA Maj. T. Fraser, RE Capt. E. Bainbridge, RA (Secretary)	
46) Machine guns and magazine arms	Feb 1879	Vice-Adm. H. Boys, RN (President) Col. D. MacFarlan, RA Col. F. Close, RA Cmdr. R. N. Custance, RN Maj. W. H. King-Harman, RA, Asst Sup RSAF Capt. H. C. Adams, 52nd Reg’t Capt. J. F. Lewis, RE Capt. E. Bainbridge, RA (Secretary)	
47) Rockets	Sep 1878	Lt. Col. F. Lyon, RA, Sup RL (President) Cmdr. R. N. Custance, RN Maj. C. H. Fairfax Ellis	

48) Construction of Ordnance	May 1879	Maj. Gen. S. E. Gordon, CB, RA (President) Vice-Adm. H. Boys, RN Col. T. Inglis, RE Col. F. Close, RA Col. C. H. Owen, RA Col. D. MacFarlan, RA Capt. C. A. Bridge, RN Maj. C. H. Faifax Ellis, RA (Secretary)	"Report by the Special Committee on Ordnance. Subject: Experiments with a 12-Inch R.M.L. Gun Returned from H.M.S. Thunderer." 1880 (C.2722).
49) Friction Tubes	Apr 1880	Col. D. MacFarlan, RA (President) Col. T. E. Hughes, RA, Asst. Adj.-Gen. Mr. Barrington, Dep. Commissary-Gen. of Ordnance Lt. Col. F. Lyon, RN Cmdr. R. N. Custance, RN F. A. Abel, CB, Chemist, War Dept. Maj. C. H. Fairfax Ellis, RA (Secretary)	

Col. T. M. Harris, RA, Ordnance Consulting Officer for India, was appointed *ex officio* member of all War Office Scientific Committees, Apr 1879. Bvt.-Col. D. MacFarlan, Royal (late Bengal) Artillery succeeded him in Nov 1879.

Appendix 10: British Military Expenditure, 1837-1907[1]

Year	Government	Total Expenditure	Army & Ordnance	Navy	Defence as %
1837	Melbourne	54.0	7.9	4.2	22.4%
1838	Melbourne	51.0	8.0	4.8	25.1%
1839	Melbourne	51.7	8.2	4.4	24.4%
1840	Melbourne	53.4	8.5	5.3	25.8%
1841	Melbourne/Peel	53.2	8.5	5.4	26.1%
1842	Peel	54.3	8.2	6.2	26.5%
1843	Peel	55.1	8.2	6.2	26.1%
1844	Peel	55.4	7.9	6.2	25.5%
1845	Peel	54.8	8.1	5.4	24.6%
1846	Peel/Russell	53.7	8.9	6.3	28.3%
1847	Russell	55.4	9.1	7.3	29.6%
1848	Russell	59.1	10.5	7.5	30.5%
1849	Russell	59.0	9.7	7.3	28.8%
1850	Russell	55.5	8.9	6.2	27.2%
1851	Russell	54.7	9.0	5.7	26.9%
1852	Russell/Derby	54.0	8.7	5.0	25.4%
1853	Aberdeen	55.3	9.5	5.8	27.7%
1854	Aberdeen	69.8	11.6	7.8	27.8%
1855	Aberdeen/Palmerston	69.1	13.8	13.7	39.8%
1856	Palmerston	93.1	27.8	18.9	50.2%
1857	Palmerston	76.1	20.8	12.7	44.0%
1858	Palmerston/Derby	68.2	12.9	9.6	33.0%
1859	Derby/Palmerston	64.8	12.5	8.2	31.9%
1860	Palmerston	69.6	14.1	10.8	35.8%
1861	Palmerston	72.9	15.0	13.3	38.8%
1862	Palmerston	72.3	16.5	12.6	40.2%
1863	Palmerston	70.3	17.3	11.4	40.8%
1864	Palmerston	67.8	15.4	10.8	38.6%
1865	Palmerston/Russell	67.1	15.0	10.9	38.6%
1866	Russell/Derby	66.5	14.4	10.3	37.1%
1867	Derby	67.2	15.1	10.7	38.4%
1868	Derby/Disraeli/Gladstone	71.8	15.9	11.2	37.7%
1869	Gladstone	75.5	15.5	11.4	35.6%
1870	Gladstone	67.1	12.1	9.4	32.0%
1871	Gladstone	67.8	12.1	9.0	31.1%

[1] Source: Brian R. Mitchell, and Phyllis Deane, *Abstract of British Historical Statistics* (Cambridge, UK: University Press, 1962), 396-398.

Year	Government	Total Expenditure	Army & Ordnance	Navy	Defence as %
1872	Gladstone	69.9	14.7	9.5	34.6%
1873	Gladstone	68.8	13.8	9.3	33.6%
1874	Gladstone/Disraeli	74.6	13.5	10.1	31.6%
1875	Disraeli	73.0	14.0	10.5	33.6%
1876	Disraeli	74.7	14.2	10.8	33.5%
1877	Disraeli	75.7	14.5	11.0	33.7%
1878	Disraeli	79.6	14.3	10.8	31.5%
1879	Disraeli	82.8	16.9	11.8	34.7%
1880	Disraeli/Gladstone	81.5	15.0	10.2	30.9%
1881	Gladstone	80.6	14.7	10.5	31.3%
1882	Gladstone	83.3	15.7	10.6	31.6%
1883	Gladstone	87.1	15.1	10.3	29.2%
1884	Gladstone	85.4	16.1	10.7	31.4%
1885	Gladstone/Salisbury	88.5	18.6	11.4	33.9%
1886	Salisbury/Gladstone/Salisbury	92.2	17.0	12.7	32.2%
1887	Salisbury	90.0	18.4	13.3	35.2%
1888	Salisbury	86.7	18.2	12.3	35.2%
1889	Salisbury	86.5	16.0	13.0	33.5%
1890	Salisbury	90.6	17.4	15.3	36.1%
1891	Salisbury	93.4	17.8	15.6	35.8%
1892	Salisbury/Gladstone	96.0	17.6	15.6	34.6%
1893	Gladstone	95.8	17.5	15.7	34.7%
1894	Gladstone/Rosebury	98.5	17.9	15.5	33.9%
1895	Rosebury/Salisbury	100.9	17.9	17.5	35.1%
1896	Salisbury	105.1	18.5	19.7	36.3%
1897	Salisbury	109.7	18.3	22.2	36.9%
1898	Salisbury	112.3	19.3	20.9	35.8%
1899	Salisbury	117.7	20.0	24.1	37.5%
1900	Salisbury	143.7	43.6	26.0	48.4%
1901	Salisbury	193.3	91.5	29.5	62.6%
1902	Salisbury/Balfour	205.2	92.3	31.0	60.1%
1903	Balfour	194.2	69.4	31.2	51.8%
1904	Balfour	155.3	36.7	35.5	46.5%
1905	Balfour/Campbell-Bannerman	149.5	29.2	36.8	44.1%
1906	Campbell-Bannerman	147.0	28.9	33.3	42.3%
1907	Campbell-Bannerman	143.7	27.8	31.4	41.2%

Appendix 5: British Prime Ministers and Committees Related to Military Administration, 1837-1907

Note: below each entry is listed any commissions or committees whose work related to War Office reorganizations or army administration. For brevity, the shorthand HCPP reference number is used.

From	*To*	*Duration*	*Name*	*Party*	*Election*[1]
18 Apr 1835	30 Aug 1841	6 yrs, 4 mo.	William Lamb (Lord Melbourne)	Whig	Jan 1835; Jul 1837
Grey Commission (Army Administration), 14 Dec 1835 – 21 Feb 1837; HCPP, 1837 (78)					
30 Aug 1841	29 Jun 1846	4 yrs, 10 mo.	Sir Robert Peel	Conservative	Jun/Jul 1841
30 Jun 1846	21 Feb 1852	6 yrs, 8 mo.	Lord John Russell	Whig	Jul 1847
Somerset Committee (Military Estimates), 22 Feb – 28 Jul 1848; HCPP, 1847 (555)					
23 Feb 1852	17 Dec 1852	10 months	Edward Smith-Stanley (Lord Derby)	Conservative	Jul 1852
19 Dec 1852	30 Jan 1855	2 yrs, 1 mo.	George Hamilton-Gordon (Lord Aberdeen)	Peelite	
6 Feb 1855	19 Feb 1858	3 years	Henry John Temple (Lord Palmerston)	Whig/Liberal	Mar 1857
Roebuck Committee (Sebastopol), 29 Jan – 18 Jun 1855; HCPP, 1855 (86, 156, 218, 247, 318)					
20 Feb 1858	11 Jun 1859	1 yr, 3 mo.	Edward Smith-Stanley (Lord Derby)	Conservative	Apr/May 1859
Peel Committee (Indian Army), 7 Mar 1859; HCPP, 1859 (2515)[2]					
12 Jun 1859	13 Oct 1865	6 yrs, 4 mo.	Henry John Temple (Lord Palmerston)	Liberal	Jul 1865
Graham Committee (Military Organization), 10 Mar 1859 – 9 Jul 1860; HCPP, 1860 (441)					
29 Oct 1865	26 Jun 1866	7 months	Lord John Russell	Liberal	
28 Jun 1866	25 Feb 1868	1 yr, 7 mo.	Edward Smith-Stanley (Lord Derby)	Conservative	

[1] Richard Kimber, "UK General Elections since 1832," *Political Science Resources*, http://www.politicsresources.net/area/uk/edates.htm, accessed 17 Jan 2015.
[2] Unlike the others, this committee specifically investigated the organization of just the Indian Army.

Strathnairn Committee (Transport and Supply), 29 Jun – 06 Aug 1866, HCPP, 1867 (3848)					
27 Feb 1868	1 Dec 1868	9 months	Benjamin Disraeli (Lord Beaconsfield)	Conservative	Nov 1868
3 Dec 1868	17 Feb 1874	5 yrs, 2 mo.	William Ewart Gladstone	Liberal	Feb 1874
Northbrook Committee (Army Departments), 11 Mar 1869, HCPP, 1870 (C.54) *Abyssinian Expedition Committee, 11 Feb – 29 Jul 1870, HCPP, 1870 (401)*					
20 Feb 1874	21 Apr 1880	6 yrs, 2 mo.	Benjamin Disraeli (Lord Beaconsfield)	Conservative	Apr 1880
Airey Committee (Army Reorganization), 20 Jun 1879 – 08 Mar 1880; HCPP, 1881 (C.2791)					
23 Apr 1880	9 Jun 1885	5 yrs, 1 mo.	William Ewart Gladstone	Liberal	29 Apr 1880
Wardlaw Committee (Cavalry Organization), 03 Jan – 19 Jan 1882; HCPP, 1882 (C.3167) *Army Hospital Services Inquiry Committee, 23 Oct 1882 – 25 Apr 1883; HCPP, 1883 (C.3607)* *Derby Committee (Egyptian Campaign), 07 Mar – 18 Jul 1884; HCPP, 1884 (285)*					
23 Jun 1885	28 Jan 1886	7 months	Robert Gascoyne-Cecil (Lord Salisbury)	Conservative	Nov 1885
1 Feb 1886	20 Jul 1886	5 months	William Ewart Gladstone	Liberal	Jul 1886
25 Jul 1886	11 Aug 1892	6 years	Robert Gascoyne-Cecil (Lord Salisbury)	Conservative	Jul 1892
Morley Committee (Manufacturing Departments), 8 Jun 1886 – 14 Jul 1887; HCPP, 1887 (C.5116) *Ridley Commission (Civil Establishments), 20 Sep 1886; HCPP, 1887 (C.5226), 1888 (C.5545), 1889 (C.5748), 1890 (C.6172)* *Stephen Commission (Warlike Stores), 27 Sep 1886 – 30 Apr 1888; HCPP, 1887 (C.5062), 1888 (C.5413)* *Churchill Committee (Army & Navy Estimates), Jul-Aug 1887; HCPP, 1887 (216, 223, 232, 239, 259)* *Harris Committee (Royal Artillery), 01 Oct 1887 – 27 Apr 1888; HCPP, 1888 (C.5491)* *Hartington Commission (Military Administration), 07 Jun 1888 – 10 Jul 1889; HCPP, 1890 (C.5979)* *Wantage Committee (Army Service), 28 Apr 1891 – 27 Feb 1892; HCPP, 1892 (C.6582)*					
15 Aug 1892	2 Mar 1894	1 yr, 6 mo.	William Ewart Gladstone	Liberal	
5 Mar 1894	22 Jun 1895	1 yr, 3 mo.	Archibald Primrose (Lord Rosebery)	Liberal	Jul 1895

25 Jun 1895	11 Jul 1902	7 years	Robert Gascoyne-Cecil (Lord Salisbury)	Conservative	Sep/Oct 1900
Dawkins Committee, 07 Mar 1899 – 09 May 1901; HCPP, 1901 (Cd.580, Cd.581)					
11 Jul 1902	5 Dec 1905	3 yrs. 4 mo.	Arthur James Balfour	Conservative	
Elgin Commission, 11 Oct 1902 - 09 Jun 1903; HCPP, 1904 (Cd.1789, Cd.1790, Cd.1791, Cd.1792) *Esher Committee, 11 Jan – 09 Mar 1904; HCPP, 1904 (Cd. 1932, Cd.1968, Cd.2002)*					
5 Dec 1905	7 Apr 1908	2 yrs. 4 mo.	Sir Henry Campbell-Bannerman	Liberal	Jan/Feb 1906

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