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Accounting for Fair Competition between Private and Public Sector Armaments Manufacturers in Victorian Britain

Failures in rifle supply during the Crimean War (1853–56) caused the British Government to seek a more reliable method for procuring weapons for military use. Fact-finding missions to US rifle manufacturers led to the introduction of the 'American system of manufacturing' at a purpose-built factory in north London. The extension of gun-making facilities at the Royal Small Arms Factory, Enfield Lock, was accompanied by major accounting innovations driven by society's desire for 'cheap and efficient' government and, within a *laissez-faire* environment, the need to ensure fair competition between private and public suppliers of military goods. Accounting practices based on 'strictly commercial principles' were then disseminated to other government military manufacturing establishments located at the Woolwich Arsenal. The historical knowledge revealed in this paper adds a new dimension to existing accounting historiography, which focuses principally on the business sector as the driving force for accounting change in Britain.

Key words: Accounting change; Cheap and efficient government; Fair competition; Financial reporting; Management accounting; Military accounting.

> I think the greatest importance should be attached to pricing everything you manufacture so that you may know whether you are doing it cheaper than you could get it done for by the trade.
>
> Sidney Herbert, Secretary of State for War, interviewed by the Select Committee on Military Organization
>
> (BPP 1860 (441), q. 7309)

There are good reasons why the army, navy, and ordnance were referred to as the 'great Departments' of state in 19th-century Britain (BPP 1841, Session 1 (359), p. 5[1]). In the year prior to the outbreak of the Crimean War (1853), interest payments

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[1] Parliamentary papers cited in this paper have been sourced from Chadwyck Healey's collection of 'House of Commons Parliamentary Papers' which are accessed at parlipapers.chadwyck.co.uk

amounted to one-half (£28.1 million) of total government expenditure (£55.3 million), with the army, ordnance, and navy spend accounting for 56.3% (£15.3 million) of what remained. Three years later military expenditure had trebled to £46.7 million, comprising over one-half of *total* government disbursements amounting to £93.1 million (Mitchell, 1962, p. 397).

The prolonged period of peace that began with Wellington's victory over Napoleon at Waterloo in 1815 left the military in poor shape when hostilities resumed 39 years later,[2] this time with Russia as the enemy. The lack of progress in military affairs during that period can be attributed to factors which include demands for military economy when fear of foreign incursion subsided, the reluctance to strengthen an army whose subservience to Parliamentary democracy remained uncertain, and public resentment at the use of troops to cope with civil disorder as epitomized by the Peterloo Massacre in 1819 (Sweetman, 1984, pp. 15–17). Further, whenever attempts to reform the military were mooted, the 'Iron Duke' of Wellington was unwavering in his 'obstinate resistance to progress' (Sweetman, 1984, p. 15).

The 'abysmal performance of the [British] army in the Crimea' (Funnell, 1990, p. 319), however, which was partly attributable to failures in weapon supply (Hogg, 1963, p. 788; Lewis, 1996, p. 51), caused the government to seek alternative provision by expanding its military manufacturing establishments. As we shall see, such action had significant accounting implications driven by the following political priorities: (i) the endeavour to satisfy current demands for 'cheap and efficient' government (Perkin, 1969, p. 320; see also p. 379); and (ii) the desire to ensure 'fair competition' (BPP 1854 (236), p. 103) between government military manufacturing establishments (GMMEs) and armament suppliers in the private sector.

RESEARCH QUESTION, SOURCES AND STRUCTURE

Hoskin and Macve (e.g., 1988) have made an important contribution to our knowledge of accounting history through their studies of the role of the Springfield Armory in the development of accounting as the basis for managerialism in the US. In Britain, by way of contrast, the government sector features little in an historiography which focuses almost exclusively on accounting change within the private sector. The purpose of this study, therefore, is to discover whether knowledge of the financial affairs of GMMEs can enhance our understanding of the development of accounting practices in 19th-century Britain.[3] Such institutions comprised the Royal Small Arms Factory[4] (RSAF) at Enfield Lock, the Gunpowder Factory at Waltham Abbey, and the following three constituents of the Woolwich Arsenal: the Royal

[2] The Crimean War commenced in October 1853 but Britain did not join until March 1854.

[3] 1887 has been chosen as the end date for this study, partly to keep the length of the paper within manageable proportions. By 1887, however, accounting changes studied in this paper had been successfully introduced.

[4] The term 'small arms' signifies weapons a soldier could carry into battle. The appellation 'Royal' was added in 1855.

Laboratory which concentrated on the manufacture of ammunition; the Royal Carriage Department where gun carriages and transport wagons were constructed; and the Royal Gun Factory where cannons were the principal output. This study also addresses Funnell's (2009, p. 561) concern with the lack of attention to military accounting despite the fact that 'war and the methods of prosecuting war have dominated the history of humankind, and [that] the financial needs of armies and navies until well into the twentieth century dwarfed all other government spending'. To the extent that accounting historians have studied the British military, their principal concern has been to explore the determination of Parliament to achieve effective financial control over army finances and, therefore, the size and power of the armed forces (e.g., Funnell, 1990, 1997; Funnell and Chwastiak, 2010). Studies of British military accounting practices ~~have been~~ almost entirely confined to the affairs of the British army in the early decades of the 20th century (Wright, 1956; Marriner, 1980; Black, 2001; Funnell, 2006).[5]

The accounting records of Britain's GMMEs are virtually non-existent, with no ledgers having survived from the period studied here. The resources available to tackle the research question specified in the preceding paragraph are, nevertheless, extensive. The principal primary resource is the 19th-century content of the 'House of Commons Parliamentary Papers' that stretch from the Glorious Revolution of 1688 through to the present day. The website where these papers can be accessed and electronically searched claims that

> The [19th-century] House of Commons Parliamentary Papers are vital to the historical record of Britain, its former Colonies and the wider world. They are among the richest and most detailed primary sources . . . unlocking 100 years of policy making, investigation, correspondence and reporting for researchers of all kinds (Guide to Parliamentary Papers, 2015).

Relevant House of Commons papers were identified by searching for selected terms in the paper title such as 'ordnance', 'military', and 'manufacturing establishments'. The database, which encompasses the content of *Hansard*,[6] was also interrogated for relevant keywords such as 'depreciation' and 'cost of capital'. Data identified in this manner provide insights rarely available from the study of 19th-century corporate archives. In particular, the exchanges that took place before government committees determined to discover how accounting was done within GMMEs, and why it was done in a particular way, illuminate the ways of thinking among those responsible for instigating and implementing accounting change.

The remainder of this paper is structured as follows. The main characters implicated in the process of accounting change within GMMEs are first introduced followed by a review of the political and economic context within which this study is located. The

[5] See also the special issue of the *Accounting History Review* on 'Accounting and the First World War' edited by Funnell and Walker (2014).

[6] *Hansard* has been published since 1803 to provide an edited verbatim report of proceedings of both the House of Commons and the House of Lords.

paper moves on to examine the reform of accounting practices employed by the RSAF and other GMMEs in the endeavour to minimise manufacturing costs and justify in-house provision as opposed to the acquisition of weaponry from armament suppliers in the private sector. Concluding remarks are then presented.

DRAMATIS PERSONAE

The soldiers and civilians that feature in this paper are listed in Table 1, together with the principal roles filled at the time of their participation in accounting change within GMMEs. Most of those appointed to the post of Superintendent at a GMME were previously soldiers; the remaining *dramatis personae* were civilians. Captain Edward Mounier Boxer, Colonel William Manley Hall Dixon, William Brown, John Anderson, Henry W. S. Whiffin, James C. Hurst and James Henry Burton feature most prominently in the episodes examined in this paper.

Boxer hailed from a military background and served in the Royal Navy and as an Instructor in Practical Artillery before becoming Superintendent at the Royal Laboratory in 1854. He was also a notable inventor of military equipment. Colonel William Manley Hall Dixon, born into a renowned military family, was admitted to the Royal Military Academy, Woolwich, for training as a commissioned officer at 16 years of age. He joined the Royal Regiment of Artillery in 1835 (National Archives, WO 76/365/539; *Times*, 1888) and, in 1855, was appointed Superintendent of the RSAF with responsibility for transforming its manufacturing methods. Dixon remained in the post for 17 years and, on retirement, moved into the business sector where he served, successively, as Managing Director of the National Arms and Ammunition Company and Manager of the Birmingham Small Arms Small Heath Factory (Pam, 1998, p. 97). Little is known of William Brown's background, but he appears to have spent most, if not all, of his career in the civil service (*Times*, 1884). Described in 1860 as 'a very old member of the War Office' (BPP 1860 (441), q. 613), he was appointed Assistant Accountant General in 1857 and promoted to the post of Accountant General in 1860.

The principal actor in the history of technological/accounting innovation at the GMMEs was John Anderson – a civil engineer who possessed a sound commercial background. Born in 1814, the posthumous son of a merchant, John left school at 14 and served his apprenticeship as a mechanic at the cotton works of Gordon, Barron & Co in Woodside, Aberdeen. He then worked for 'the foremost Manchester establishments of his day, that of Sharp Roberts and Company, and William Fairbairn and Company' (Rosenberg, 1969, p. 80). Anderson then joined the 'Napier engineering firm of London, which at the time performed a great deal of work for the Board of Ordnance',[7] leaving in 1841 to take up a post as foreman at the Woolwich Arsenal's Royal Gun Factory (Rosenberg, 1969, p. 80). He immediately set to work: the Royal Gun Factory 'had scarcely changed since the end of the Napoleonic wars and Anderson rapidly mechanized the manufacture of ordnance, much of the machinery being of his own invention' (Ritchie, 2004; see also Pam, 1998, p. 48).

[7] The Board was responsible for the storage and supply of all warlike *matériel* (Hamer, 1970, p. 3).

TABLE 1

DRAMATIS PERSONAE

Character	Occupation	Principal role
John Anderson	Managerial roles at military establishments	Chief Engineer in the Royal Arsenal 1854–59; Assistant Superintendent, Royal Gun Factory from 1859; Superintendent of Machinery from 1866
William George Anderson	Civil servant, Treasury	Principal Clerk of the Finance Division of the Treasury
Sir William Armstrong	Industrialist	Superintendent, Royal Gun Factory, 1859–63
Colonel W. H. Askwith	Soldier	Superintendent, Royal Gunpowder Mills
Captain Edward Mounier Boxer	Soldier	Superintendent, Royal Laboratory
William Brown	Civil servant, War Office	Accountant General at the War Office, 1860–71
James Henry Burton	Managerial role at RSAF	Chief Engineer at RSAF
Colonel William Manley Hall Dixon	Soldier	Superintendent, RSAF
Captain Henry William Gordon	Soldier	Superintendent, Ordnance Stores Department
Sir James Graham	Politician	Chairman of Select Committee on Military Organization
Sir Benjamin Hawes	Politician	Permanent Under Secretary of State for the War Department
James C. Hurst	Civil servant, War Office	Clerk to War Office, 1855–62, Accountant to War Office, 1862, Accountant and Auditor to War Office from c. 1863
Colonel Alexander Thomas Tulloh	Soldier	Superintendent, Royal Carriage Department
George Webster	Civil servant, War Office	Clerk, and later Accountant, in the Accountant-General's Department of the War Office
Henry W. S. Whiffin	Civil servant, War Office	Assistant Accountant General at the War Office, 1860–70, Accountant General of the Army, 1870–71

Anderson was sent to Enfield Lock in 1853 to assess whether the Small Arms Factory was capable of manufacturing bayonets by machinery (Lewis, 1996, p. 13), and it was his report that encouraged the Board of Ordnance to give serious consideration to the whole issue of small arms provision (Lewis, 1996, p. 13). In 1856 he was appointed Chief Inspector of Machinery charged with responsibility for overseeing the transformation of manufacturing facilities at the RSAF. In 1859 he was made William Armstrong's resident Assistant Superintendent at the Royal Gun

Factory with responsibility for its 'entire local management' (BPP 1860 (441), q. 5727). From 1866 to his retirement in 1872, Anderson served as Superintendent of Machinery.

Whiffin's father was a wheelwright who, in 1851, described himself as a 'retired government contractor'.[8] Working as a wheelwright, he quite possibly built or repaired wooden wheels for the military. In 1841, when ~~he was~~ 16 years of age, his son Henry was recruited by the Ordnance Office as a clerk. One might imagine that Henry's father, given the military connection, encouraged his son to apply for a government position. It was Henry's appointment as Assistant Accountant General at the War Office in 1860 that saw him become active in bringing about accounting change within GMMEs. Hurst worked in business before joining the civil service as a temporary clerk in 1855 (*War Office List*, 1894, p. 236) and it was therefore natural that he should support recruitment to the civil service of applicants with a business background (Hurst, 1856, p. iv). Hurst served as Accountant to War Office from 1862 and Accountant and Auditor to War Office from about 1863.

James Henry Burton, formerly Master Armourer at Harpers Ferry, Virginia, moved to the RSAF on a five-year contract as Chief Engineer in 1855 (Pam, 1998, p. 58). His was one of a number of US appointments designed to help ensure the successful implementation of the 'American system of manufacturing' (Chandler, 1977, p. 75), that is, the manufacture of goods in large quantities through employing standardized designs and assembly-line techniques. Although working under Dixon, Burton had responsibility for 'the entire direction of the manufacturing operations of the establishment' (Tate, 2006, pp. 84–5). He returned to the US in 1860 to work for the Virginia State Armory (Tate, 2006, p. 142).

The next section positions 'accounting as a local, time-specific practice in the life and times of the period of study' (Gomes *et al.*, 2011, p. 391). In so doing, it explains why it was considered important to adopt 'commercial' accounting procedures for the purpose of computing the full cost of manufacturing military weapons.

POLITICAL AND ECONOMIC CONTEXT

By the middle of the 19th century Britain's capitalist middle class had begun to challenge the landed class for control of the nation's affairs, as famously reflected in the passage of the Great Reform Act of 1832. More broadly, as Perkin (1969, p. 272) observed: 'neither contemporaries nor historians have doubted that the capitalist middle class were the "real" rulers of mid-Victorian England, in the sense that the laws which were passed and executed by landed Parliaments and Governments were increasingly those demanded by the business men'. The pursuit of the 'entrepreneurial ideal' entailed the creation of a 'society based on capital and competition' and, its corollary, an emphasis on 'cheap and efficient government' (Perkin, 1969, p. 320). These ideas connected national interest with self-interest. The capitalist middle class

[8] Ancestry.com, Class: HO107; Piece: 488; Book: 7; Civil Parish: St Paul; County: Kent; Enumeration District: 4; Folio: 33; Page: 18; Line: 17; GSU roll: 306880; Class: HO107; Piece: 1606; Folio: 136; Page: 12; GSU roll: 193505.

was determined to restrict as far as possible the role for the state and leave business to undertake those activities which it believed could best be performed within the discipline of competitive market forces. This paper reveals that, when the government decided to become more involved in the supply of armaments, accounting was called upon to help ensure least-cost supply through fair competition between private sector weapon-making establishments and those run by the government.

The Concept of Fair Competition

The perennial question of whether armaments should be purchased from the 'private trade' (*Hansard*, 10 May 1858, vol. 150, col. 380) or manufactured by GMMEs interfaced with the newly derived political philosophy of *laissez-faire*. The first half of the 19th century saw British economic policy previously based firmly on a mercantilist philosophy superseded by a commercial strategy designed to promote unfettered freedom of trade. Economists such as David Ricardo convincingly argued that free trade would benefit an economy that was in a strong position to employ capital and population to its comparative advantage. These ideas slowly gained legislative support with landmark events including the repeal of the Corn Laws in 1846 and the Navigation Acts in 1849.

Britain's transformation from Napoleon's 'nation of shopkeepers' into 'the workshop of the world' (Lee, 1993) therefore saw the creation of an economic environment within which transactions between private parties were free from government restrictions, tariffs, and subsidies (Daunton, 2000). In conditions of economic liberalism, there was a natural assumption that manufacturing activities would be left to the private trade or, at the very least, that there should be a level playing field capable of ensuring fair competition[9] between suppliers in what are today labelled the public and private sectors. The issue of fair competition was the subject of discussion both before the 1854 Select Committee on Small Arms and in Parliament. The Select Committee was required 'to consider the Cheapest, most Expeditious, and most Efficient Mode of Providing Small Arms for Her Majesty's Service' (BPP 1854 (236), p. 1). In line with conventional practice, the Committee interviewed witnesses who hailed from different backgrounds and, therefore, possessed divergent viewpoints.

Joseph Whitworth,[10] an industrialist who supplied rifles to the military, presented evidence based on a fact-finding study of US manufacturing establishments that he had undertaken for the British government in 1853. Whitworth pointed out that 'at Springfield . . . there is an ingenious system of machinery for the manufacture of gun-stocks', and he recommended the establishment, in Britain, of a similar 'establishment as perfect as could be made, to produce a limited number [of

[9] Communication from Birmingham gunbarrel manufacturers read out by Captain Sir Thomas Hastings (BPP 1854 (236), p. 103).

[10] Whitworth was a leading mechanical engineer, inventor, and armaments manufacturer of the Victorian era (Seccombe, 2004; see also Rosenberg, 1969, p. 20). His company merged with that of his rival William George Armstrong to create Sir W. G. Armstrong, Whitworth & Co Ltd in 1897.

rifled-muskets], and set an example to other gun-makers' (BPP 1854 (236), p. v). Some witnesses were uncomfortable with any level of government provision, however, and they explained why. Westley Richards, a Birmingham gunmaker, declared the infallibility of market forces: 'I do not think that the Government could ever manufacture arms at the same advantage as private individuals could – they must do it at much greater cost' (BPP 1854 (236), q. 7824). He continued: 'I do not think that any irresponsible person, or any Government officer who is not responsible for the cost, and who does not in some measure himself benefit by the cost, could ever be so sensitive of profit and loss as a private individual' (BPP 1854 (236), q. 7826). These sentiments penetrated the deliberations of the House of Commons where the liberal MP Lord Dudley Stuart articulated views of this genre as follows: 'the Government, could not supply arms either at so cheap a rate or of so good a quality, by any Royal manufactory, as they could be by the Unfettered industry of the country' (*Hansard*, 1 March 1854, vol. 131, cols 170-1).[11]

The case for the government taking a greater degree of control over weapon manufacture naturally came from military personnel, with John Anderson at the forefront presenting the argument for building an establishment capable of producing 500 rifled muskets a day. To aid the Select Committee's deliberations, Anderson submitted a 'probable estimate of the cost' (£150,000) of building and equipping a new factory at Enfield Lock (BPP 1854 (236), p. 84). Captain Sir Thomas Hastings of the Board of Ordnance drew attention to the impossibility of obtaining a sufficient supply of muskets under the present system, which relied primarily on contractors, and was keen to replicate the US government's ability to rely on the Springfield Armory and Harpers Ferry to produce between them 60,000 muskets a year (BPP 1854 (236), pp. iii–iv; see also p. x). A further advantage anticipated for the government-controlled factory was that it would provide 'a check upon the price of contractors' (BPP 1854 (236), p. x).

The 1854 Select Committee formulated a compromise solution. The concern that private manufacturers might be discouraged from continuing to operate gun-making facilities if the government built too large a factory caused it to recommend 'that a manufactory of Small Arms under the Board of Ordnance should be tried to a limited extent', although it was acknowledged that, if the arrangement proved successful, the factory might then be extended (BPP 1854 (236), p. x).[12]

It was the expansion of the RSAF that first caused attention to be directed to the decision-useful role of accounting within GMMEs, and the next section examines the introduction of 'commercial' accounting procedures at that location. Such procedures had as their purpose to establish the full cost of producing firearms and, thereby, to enable Parliament to assess whether it was getting value for money and to better

[11] The *laissez-faire* lobby in Parliament remained active in its opposition to GMMEs. See, for example, the discussion of 'Government Manufacturing Departments' led by the businessman and radical politician, Richard Cobden (*Hansard*, 22 July 1864, vol. 176, cols 1907–77).

[12] However, 'under the pressures of war these reservations [concerning size] were cast aside' and '[p]lans for the creation of a large-scale plant proceeded' (Rosenberg, 1969, p. 51; see also p. 54).

inform make or buy decisions, with the latter priority today more commonly encapsulated in the term 'competitive neutrality' (Office of Fair Trading, 2010).

ACCOUNTING INNOVATION AT THE RSAF

When interviewed by the 1854 Select Committee, Richard Prosser, a civil engineer from Birmingham, recommended that, following the planned expansion, the RSAF should 'keep books by double entry, and have a public accountant' (BPP 1854 (236), q. 2840). The Select Committee (BPP 1854 (236), p. xi, emphasis added) agreed and explained the intended role for the new accounting system:

> In order that Parliament may have the means of ascertaining (in an economical point of view), the success of the Government factory for the construction of muskets, your Committee recommend that *a debtor and creditor account should be kept* of this separate establishment, *so that the whole profit or loss may be fairly shown*.

This recommendation was not forgotten by those in Parliament who supported the private provision of weapons. Four years later the MP for North Warwickshire, Charles Newdegate, addressed the House of Commons in support of the interests of Birmingham gun manufacturers when stressing the importance of 'a just Comparison between their productions and those of the Enfield establishment' (*Hansard*, 10 May 1858, vol. 150, col. 375). He complained that far more had been spent in developing the RSAF than anticipated by the 1854 Select Committee,[13] and he reminded the House of the Committee's recommendation, yet unfulfilled, that 'an accurate debtor and creditor account, so far as the profit and loss of the establishment was concerned, should be fairly made out and published' (*Hansard*, 10 May 1858, vol. 150, col. 375). Newdegate also protested that armaments supplied by private manufacturers were the subject of inspection by the same officer 'who was at the head of the Enfield establishment'. He continued: 'It was the intention of the House, when the new Enfield factory was established, that by competition in production it should be a check upon the prices and production of the trade; but it must be obvious that if they wanted a fair trial they should not set one competitor to judge another' (*Hansard*, 10 May 1858, vol. 150, col. 377).

Major-General Jonathan Peel, Secretary of State for War, attempted to meet Newdegate's concerns by alleging that there was plenty of work for both the RSAF and the private trade, and by insisting that 'competition between them was of the greatest possible service'. He acknowledged the fact that the present estimated cost of the Enfield rifle of £2 6s. 10½d. 'was not a fair calculation, for the interest of [sic] the money expended in plant had not been taken into account', but he insisted that, even if interest of 10 per cent was charged on the capital expended in constructing the new factory, the cost of Enfield rifles remained ~~20 per cent~~ lower (£2 11s. 6¾d.) than those supplied by the trade at £2 18s. 3½d. (*Hansard*, 10 May 1858, vol. 150, col. 379).

[13] In contrast to the estimated expenditure of £150,000, £240,593 was 'lavished' on building the new establishment between January 1854 and March 1857 (Pam, 1998, p. 57). The investment had risen to £352,580 by 1858 (*Hansard*, 10 May 1858, vol. 150, col. 379).

The Under Secretary of State for War, Sir John Ramsden, made further attempts to signal the government's concern to adopt an even-handed approach. He remarked that the lower manufacturing costs achieved by the government were attributable to mechanization and that the government was keen for the private trade to move over to machinery-intensive production methods so as to 'keep the Enfield establishment up to the mark by competition' (*Hansard*, 10 May 1858, vol. 150, col. 380). James Henry Burton's biographer, Thomas Tate (2006), confirms that it was not government policy to exclude the private trade. Indeed, quite the contrary: 'The War Department desired to allow private gun makers copy of the machinery in the RSAF. Men from the Birmingham gun trade and from the London Armory Company were frequent visitors' (Tate 2006, p. 131). Pam (1998, p. 108) supports this assessment when concluding that RSAF was 'never entirely commercial, free access was allowed to their competitors[,] and models, drawings and gauges supplied. Thus private arms manufacturers were kept in touch with the latest improvements, and were enabled to copy machinery designed at Enfield'.

An opportunity to assess the extent to which the RSAF had adopted commercial accounting practices arose when its Superintendent from March 1855 to November 1871, Colonel Dixon, was called to give evidence before the Select Committee on Military Organization appointed in 1859 'to inquire whether any Changes are required to secure the utmost *Efficiency and Economy* in the Administration of Military Affairs' (BPP 1860 (441), p. iii, emphasis added). Questioned whether 'the account [was] made out on strictly commercial principles', Dixon replied: 'it was my principle from the very first to obtain the assistance of a competent accountant, who should, from his knowledge of business in a merchant's office, be competent to undertake this business of the department'. The services of an accountant working for Brassey & Peto, civil engineers, was secured and, Dixon continued: 'I do not hesitate to say that they [the books] would bear, I think, fair comparison, or would stand well alongside the best commercial books of any firm in the kingdom' (BPP 1860 (441), q. 5513).

James Henry Burton, who was recruited from the US to help ensure the success of the manufacturing facility constructed at the RSAF, also played a role in developing its accounting practices. Burton's personal diaries reveal that on 23 February 1858 he had 'Remained at [the] office until 7 p.m. with Col. Dixon making up [a] balance sheet for the R.S.A. Factory up to 31st March/58'. The following day, Burton reported that he and Dixon had 'discussed the question of keeping the accounts of the factory so as to show the cost of the Arms made' and, for that purpose, decided that 'an annual depreciation of 2 per cent on the original cost of Plant should be charged against the arms made each year, thus giving the Plant a life of 50 years' (Burton Papers, 1858).[14] It was also decided that the accounts should report the financial effect of the decision to make rather than buy weapons from the private trade: 'profit to be the difference between the cost price of the Arms and the price at which they would have to be purchased from the Trade' (Burton Papers, 1858).

[14] Dixon advised the 1860 Select Committee that it was eventually decided to charge depreciation at five per cent on buildings, machinery and tools (BPP 1860 (441), qq. 5519–20).

Newdegate's demand for accounting information to be made publicly available bore fruit when General Peel supplied to Parliament a 'Return showing the total cost and total production of the Enfield Establishment, from the period of reconstruction in 1854' to 1858 (BPP 1859 Session 1 (120)). The profit and loss account and balance sheet prepared for the RSAF for the year to 31 March 1860 were the subject of discussion before the 1860 Select Committee and are reproduced as Figure 1 (BPP 1860 (441), p. 403). Dixon confirmed that the content of those annual accounts reflected the fact that comparisons were 'constantly being instituted' between the cost of rifles manufactured and 'the contract price' charged by the private trade (BPP 1860 (441), q. 5505). During 1859–60, therefore, the 85,605 rifles manufactured at the RSAF were valued at 63s. 8d. each to yield a gross revenue of £272,509 5s 0d. compared with the cost of production of £178,588 10s 7d. (Figure 1). The outcome was, in Dixon's words, 'a saving to the Government of 93,920*l*. 14*s*. 5*d* as contrasted with the present price of the same rifle made in the trade' in Birmingham and London (BPP 1860 (441), q. 5538; see also q. 5539).

PRESSURE FOR FURTHER CHANGE

The Chairman of the Select Committee on Military Organization (1860), Sir James Graham, emphasized the importance of accounting and financial control when observing that 'We are dealing now with immense sums, and with prices that are alarming in amount' (BPP 1860 (441), q. 7302). At that time, the system of accounting in central government remained principally cash-based and a money-oriented approach also dominated practice within most GMMEs. Leading treasury officials, George Arbuthnot and William George Anderson, when interviewed by the Select Committee, bemoaned the absence of useful data for decision-making purposes: 'you never know whether they [GMMEs] manufacture profitably or not, unless you keep correct accounts in order to show what the articles cost when they are manufactured. I suspect that we are a good deal in the dark upon these subjects' (BPP 1860 (441), q. 4605). Their conclusions were consistent with the view expressed by the Permanent Under Secretary of State for the War Department, Sir Benjamin Hawes. When asked whether it was possible to produce an 'account showing a comparison between the expenses of manufactures at Woolwich and the value of articles manufactured there', Hawes replied that he had 'never seen any comparison' with which he had been 'perfectly satisfied'. Further, 'I have long desired that the accounts at Woolwich should be kept upon a system which would enable us to come at an accurate solution as to the cost of the manufacture' (BPP 1860 (441), q. 5155). Based on this and other testimony, the Select Committee decided that it was 'in justice bound to state, that . . . the precautions taken as to the money payments and accounts are by no means satisfactory' (BPP 1860 (441), p. xvii).

As noted above, the RSAF had already made a start in introducing commercial accounting practices and, even at the Woolwich Arsenal, things were beginning to happen. John Anderson described the accounting practices already put in place at

FIGURE 1

••.

ROYAL SMALL ARMS FACTORY, ENFIELD LOCK.

Dr. — **BALANCE SHEET for the Year ending 31 March 1860.** — **Cr.**

1859: March		£.	s.	d.	1859: March		£.	s.	d.
To buildings and land		76,936	3	–	By Paymaster General		336,819	14	2
Gas works		4,880	17	–	Paymaster Storekeeper, Woolwich		1,910	14	5¼
Machinery		112,037	13	2½	Royal powder-mills, Waltham		168	10	5
Tools		13,915	7	7½	Joseph Saxon		3	15	1
Rifle Account: Components of arms in course of manufacture	£. 28,037 19 4½				Stationery Office		478	1	4
Rifle Account: Finished arms awaiting transmission to store	8,279 17 –				D. Rose		4	5	8
Rifle Account: Stores of raw material in factory	150 – –				Cottages		880	9	3
		36,467	16	4½	Income tax		617	12	10
Stores (Raw material in storehouses)		22,707	11	11	Joseph Taylor		11	–	–
Cash in hand		5,054	5	4	Fairbairn & Sons		98	9	11
Storekeeper (Birmingham)		3,476	3	3½	Rent of lands		18	4	–
London Armoury Company		205	11	–	,, fishery		20	–	–
Storekeeper, Tower		540,808	5	6½	A. Handyside		1	15	9
John Marshall		61	1	–	Storekeeper, Tilbury		–	11	–½
Stevens & Son		59	8	4	Her Majesty's Board of Works		118	10	10
Secretary of State		303	7	2¼	Stocks account		21,769	18	11½
Inspector of small arms, Liege		120	12	10	Sundry open accounts		2	15	1
Birmingham Museum		50	17	4	Stock (1 April 1859)		314,151	1	10
Model branch		2,904	14	1½	Saving effected, 1858–59 and 1859–60		54,191	6	10½
Storekeeper, Weedon		10	4	8	Net profit or saving for past 12 months		93,920	14	5
Small arms Vote		3,729	4	1					
Clerical and scholastic expenses		327	2	2					
Repairing factory, Pimlico		1,066	18	7					
Sundry open accounts		14	7	3½					
	£.	825,187	11	10¾		£.	825,187	11	10¾

ROYAL SMALL ARMS FACTORY, ENFIELD LOCK.

Dr. — **PROFIT AND LOSS.** — **Cr.**

1860: March		£.	s.	d.	1860: March		£.	s.	d.
To tools, depreciation, &c.		2,387	6	1½	By rifle account (gross saving)		115,011	2	6
Land and buildings, depreciation, &c.		5,343	9	10					
Machinery, depreciation, &c.		9,922	–	1½					
Police expenses		608	2	6					
Medical expenses		506	–	–					
Charges account		967	–	4					
Gas works		1,216	–	2					
Stores account, No. 1		140	9	–					
Balance, being net saving or profit		93,920	14	5					
	£.	115,011	2	6		£.	115,011	2	6

	£.	s.	d.
Note.—85,605 Arms sent into store, 1859–60, at 63 *s.* 8 *d.* each	272,509	5	–
Deduct saving or profit during 1859–60	93,920	14	5
COST PRICE	£. 178,588	10	7
85,605 Arms, at 2 *l.* 1 *s.* 8½ *d.*, nearly equals	£. 178,588	10	7

Source: BPP 1860 (441), p. 403.

the Royal Gun Factory to identify the 'real true cost'[15] of production. The narrative he offers reveals, first, the care taken to identify, on a daily basis, direct cost (materials and labour) involved in the 'execution' of 'every order' and, second, the close attention paid to the appropriate treatment of indirect costs: 'indirect labour, and even stores that are not direct stores . . . are all added up together, and at the end of the quarter or year the whole [establishment charges] are divided over the several orders executed in the proportion of the productive wages paid; that giving a better indication of the value of the article' (BPP 1860 (441), q. 6084; see also qq. 5168–72, q. 5182).[16]

The accounting practices of GMMEs had developed separately from one another, however, reflecting an organizational philosophy which Hogg (1963, p. 804) summed up as follows: 'the tendency was for each manufacturing department to retain its complete independence. Any suggestion of merging them under a common head would in 1860 have been received with horror as a revolutionary proposal unworthy of consideration'. A critique of the system of accounting in operation at the Woolwich Arsenal was provided by George Webster, a clerk in the Accountant-General's Department at the War Office. He was sent to the Arsenal by Sir Benjamin Hawes 'for the purpose of ascertaining the system on which the books in the manufacturing departments are kept' (BPP 1860 (441), p. 654). Webster's conclusion was that the 'head of each department is endeavouring to ascertain the actual cost of all articles manufactured by him, but each in a different way' (BPP 1860 (441), p. 655). All departments maintained a pivotal record designed to construct the cost of items manufactured, but it took diverse forms and produced different outputs (BPP 1860 (441), pp. 654–55).

ACCOUNTING INNOVATION AT THE WOOLWICH ARSENAL

Evidence presented to the Select Committee on Ordnance (1862) by William Brown, Accountant General at the War Office, confirmed that changes in the record-keeping systems had been made at the Woolwich Arsenal following the report of the 1860 Select Committee (BPP 1862 (448), q. 54). Consequently, in Brown's estimation, the Heads of Department at Woolwich could provide 'very accurate information' about the cost of different articles manufactured including 'a proportion of the general expenses of the department' (BPP 1862 (448), q. 50). Brown admitted that departmental accounts were still not kept 'on precisely the same system' (BPP 1862 (448), q. 63), but his Assistant Accountant General, Henry W. S. Whiffin, who had carried out a detailed study of accounting practices throughout the Woolwich Arsenal (BPP 1862 (448), pp. 179–82), confirmed that, for the purpose of 'affording

[15] 'True cost' became the term widely used to describe a costing objective in Britain only with the rise of scientific costing in the early years of the twentieth century (Boyns and Edwards, 2013, chapter 7).

[16] See Boxer on accounting practices employed at the Royal Laboratory, though these appear to be confined to the identification of direct cost at that time (BPP 1860 (441), q. 5132, qq. 5152–4).

reliable information as to the actual cost of the several articles manufactured', he had 'no hesitation in stating that they reflect, as nearly as possible, the result desired' (BPP 1862 (448), p. 180).

The development of military accounting systems focused principally on three inter-related issues: the preparation of a 'commercial balance sheet' (BPP 1862 (448). q. 1448); the treatment of overheads; and the adoption of double entry bookkeeping.

Commercial Balance Sheet

The nature of the modern-day balance sheet was fully recognized by authors of books published in Britain during the 17th and 18th centuries, though the label then used was 'balance' or 'ballance', sometimes linked with the word 'accompt' or 'account'. Within central government, however, the term 'balance sheet' was used well into the 19th century to describe a variety of bilateral statements including those simply listing receipts on the left and payments on the right. During the first half of the 19th century commentators on central government accounting practices *began* to refer to a 'mercantile balance sheet' or a 'commercial balance sheet' to signify a focus on assets and liabilities.

By 1862, in Whiffin's estimation (BPP 1862 (448), p. 180, emphasis added), it had become 'absolutely necessary that balance-sheets on (so far as practicable) *strict mercantile principles* should be rendered' by GMMEs, and he presented to the Select Committee revised forms of 'profit and loss account' and 'balance-sheet' which he believed complied with that philosophy (BPP 1862 (448), p. 180). Whiffin pointed out that if these pro forma financial statements received the Select Committee's approval, the following issues needed to be addressed (BPP 1862 (448), p. 180):

- the capital to be charged to each establishment for the value of fixed assets;
- the rate of depreciation to be charged, with Whiffin suggesting 5% on buildings and 10% on machinery;
- the rate of interest to be charged on capital invested. Whiffin favoured 3.5%, with its application to stores and work in progress, as well as to fixed assets, serving as 'a salutary arrangement, as heads of departments will then merely purchase such stores only as are absolutely necessary for their current requirements'.

Overheads

As noted above, John Anderson reported that, by 1860, accounting practices capable of identifying the 'real true cost' of items produced had been put in place at the Royal Gun Factory (BPP 1860 (441), q. 6084). Discussion of the treatment, at GMMEs, of 'General [Expenses] or Indirect Expenses'[17] (BPP 1862 (448), p. 188), was revived when Anderson was called to give evidence before the Select Committee on Ordnance on 15 July 1862. Its Chairman, Sir William Monsell, reminded Anderson that he had told the 1860 Select Committee that the Royal Gun Factory

[17] These terms did not cover all overheads; interest and depreciation are discussed in the next subsection.

already operated 'a very perfect system' of accounts (BPP 1862 (448), q. 1445). Given that subsequent changes to that accounting system were revealed in evidence presented to the Committee, Monsell teasingly inquired whether you are 'more perfect now in your system of accounts than you were then?' (BPP 1862 (448), q. 1446). Anderson ignored this gibe when commenting that 'Every month we are improving' (BPP 1862 (448), q. 1446), and he explained that this was happening because 'Parliament insisted on getting what is called a commercial balance-sheet' (BPP 1862 (448), q. 1448). In that context, he admits, the accounting system continued to remain unsettled even in 1862 because of a lack of consensus concerning the treatment of general expenses (BPP 1862 (448), q. 1450).

The method used to recover overheads, other than interest and depreciation (see next subsection), at the Royal Gun Factory was devised and introduced by Hurst whose objective was to ascertain 'the precise cost of manufacturing guns' (BPP 1862 (448), p. 180; see also p. 183). The memorandum he prepared contained a list of 'the whole of the charges of a general nature that could not be allotted to any particular gun or service, but which should properly be spread *pro ratâ* over all the work performed during the year . . . to arrive at a just result' (BPP 1862 (448), p. 183). The decision was made to recover these overheads as a proportion of direct labour only (i.e., the method introduced at the RSAF in the 1850s), producing a loading of 39% for 1861–62. The return of 'the annual accounts of the several manufacturing establishments under the War Department' (including Waltham Abbey and the RSAF) made to the House of Commons for the accounting year 1861–62, on 17 April 1863, reveals that it was the general practice, among GMMEs, to value articles and orders on the total cost basis, though the Royal Carriage Department and the Royal Laboratory instead recovered general expenses on the basis of 'Labour and Material combined' (BPP 1863 (176), p. 3). By 1887 the direct labour basis was in use at all three departments (BPP 1887 (C. 5116), p. 22, qq. 3426–7), with Charles D. Piper, Principal Clerk, Royal Carriage Department, explaining that the change had been made because the level of general expenses 'is not much affected by the class [i.e., value] of material that they [outputs] use in any way' (BPP 1887 (C. 5116), q. 5501).

Interest and Depreciation

Brown advised the 1862 Select Committee that charges were made in the accounts of each of the Arsenal's GMMEs for interest on 'capital expended in erecting buildings and the purchase of machinery' (BPP 1862 (448), q. 68). Boxer (BPP 1862 (448), q. 1128) explained that the rationale for the inclusion of an interest charge of 3.5%[18] was to enable the accounts to be rendered upon 'commercial principles', that is, to enable a fair comparison to be made with the private trade which would need to charge prices adequate to cover its cost of capital. Boxer (BPP 1862 (448), q. 704) pointed out that interest needed also to be charged on 'floating capital . . . because the Government would be obliged to advance money to commence manufacturing'

[18] This was considered to be the 'maximum rate' at which the government could borrow money to buy plant (BPP 1862 (448), p. 180 see also qq. 704–05).

whereas, 'when the supply is from contractors, the payment is made for articles only when they have been delivered into store'. Interest was first reflected in the returns made to Parliament detailing the financial affairs of GMMEs for the accounting year 1863–4.

The appropriate treatment of interest on floating capital continued to be the subject of attention. In evidence presented to the Committee appointed to inquire into the Organization and Administration of the Manufacturing Departments of the Army, in 1886, the Accountant and Auditor to War Office, James C. Hurst (BPP 1887 (C. 5116), q. 3567), revealed that he 'took counsel with a great many men in the trade' and reached the conclusion that if 'I can spend upon wages and materials 100,000*l*. a year in carrying on a business, I consider that I could do it with a [working] capital of 20,000*l*.'. Therefore interest was henceforth charged on 'one fifth the Annual Expenditure' (BPP 1887 (C. 5116), q. 3567).

Turning to depreciation, Brown reported (BPP 1862 (448), q. 144) that, in 1862, it was charged at 10% on machinery and 5% on buildings. Hurst expressed the opinion, quite correctly, that by charging depreciation on a systematic basis the ordnance establishments were in advance of contemporary business practice: 'it is a mere matter of expedience what they [limited companies] write off for depreciation, that in a good year they will write off, we will say, 10 per cent. or 7½ per cent., and in a bad year they will write off nothing' (BPP 1887 (C. 5116), q. 3464).[19]

The treatments adopted for the purpose of recognizing fixed assets and depreciation at the Woolwich establishments, following the Report of the 1862 Select Committee, are reflected in the first of a series of 25 returns of 'the annual accounts of the several manufacturing establishments' made to the House of Commons. Focusing on the Royal Carriage Department for illustrative purposes,[20] its accounts for the year to 31 March 1862 contained a 'Memorandum' (BPP 1863 (176), pp. 17–18) showing valuations placed on buildings and on plant in 1805, plus additions less depreciation (at 5% and 10% respectively) to construct the figures which appeared as the opening balances at 1 April 1861 in a second statement called the 'Capital Account' (BPP 1863 (176), p. 17).

This 'Capital Account' reported the depreciation charges for 1861–62 and the closing fixed asset balances at 31 March 1862. A third financial statement – called a 'Balance Sheet'[21] (BPP 1863 (176), p. 3, reproduced as Figure 2 in this paper) – set out costs incurred (including opening stock and work in progress) as debits and, as credits, stock and work in progress at the end of the year and cost-based calculations of work completed for the army and other departments. None of fixed assets, depreciation, or interest feature in this balance sheet though the '*Memorandum*' note states that, if the depreciation charge for the year (as computed for the purpose of the Capital Account) was included, 'the cost of Production would be enhanced by

[19] Lack of systematic treatment of depreciation by limited companies continued well into the 20th century (Leake, 1923, Introduction; Edwards, 1981, pp. 21–25).

[20] The treatment was similar at the Royal Gun Department and the Royal Laboratory.

[21] Re-titled 'Balance Sheet No. 1 in 1866' for reasons explained in the next paragraph.

FIGURE 2

••.

— No. 1. —

ROYAL CARRIAGE DEPARTMENT, WOOLWICH ARSENAL.

(A.)—BALANCE SHEET of the ROYAL CARRIAGE DEPARTMENT, ROYAL ARSENAL, WOOLWICH, 1861–2.

Dr. *Cr.*

	£. s. d.	£. s. d.		£. s. d.	£. s. d.
To Balance:			By Balance:		
For Stores in Stock on the 1st April 1861	284,242 12 9		For Stores in Stock on the 31st March 1862	339,534 1 1	
For semi-manufactured Articles in Stock on the 1st April 1861	40,221 17 1	324,464 9 10	For semi-manufactured Articles in Stock on the 31st March 1862	51,592 11 1	391,126 12 2
To Army Supplies, 1861–2—For Cash advanced through the Paymaster General and expended on the following Services during the year ended the 31st March 1862:			By Production Account:		
Salaries	5,099 19 5		For Work performed for other Departments during 1861–2	692 2 7	
Wages	136,186 19 –		For General Service Repairs performed during 1861–2	7,227 13 3	
Stores, Materials, &c.	178,762 15 6		For Work performed in the Drawing Office during 1861–2	347 7 –	
Manufactured Articles	56,254 17 3		For Articles made new and converted during 1861–2, as per detail B.	283,548 17 4	291,818 – 2
Miscellaneous Services	636 15 3		By Sundry Departments:		
Gas, and Repairs to Fittings, &c.	1,180 5 1		For Stores, &c. issued during 1861–2	3,316 15 5	
Water	180 – –		For Manufactured Articles procured by Contract and issued during 1861–2	46,388 17 1	
Police	1,367 1 2		For Difference in value of obsolete Ironwork issued from Store as old Iron for remanufacture during 1861–2	3,801 – 9	53,506 13 3
Military Horses, Carts, Drivers, &c.	341 9 4				
Divine Service	107 10 –				
Medical Department	176 – –				
Library	13 15 –				
Schools	26 6 3				
Military Pay of Officers	773 1 3				
Repairs to Buildings	1,322 12 11				
Repairs to Machinery	48 – –				
Superannuations	639 8 6	383,116 15 11			
To Miscellaneous Services, 1861–2—For Expenditure not defrayed out of Army Supplies, viz.:					
Stationery	338 19 5				
Rates	400 – –	738 19 5			
To Sundry Departments, 1861–2—For Stores, &c. received from various Sources		28,131 – 5			
	£.	736,451 5 7		£.	736,451 5 7

Memorandum.—The above results are exclusive of any charge for depreciation on Plant, &c. If a charge be raised for this Item, viz., at 5 and 10 per cent. on Buildings and Machinery respectively, it would amount to 8,202 *l.* 2 *s.* 10 *d.*, and the cost of Productions would be enhanced by 2·930 per cent. (*see* separate Statement of Capital Account). The Indirect Expenditure is distributed as far as possible over the work in course of execution, the Balance of Indirect Expenditure at the end of the year is then distributed, *pro rata*, over the work performed, the general result being that this Expenditure is proportioned according to the amount expended upon Labour and Material combined.

William Brown, Accountant General.

War Office, 31 March 1863.

(signed) *H. Clerk*, Superintendent.

Source: BPP 1863 (176), p. 3.

2.930 per cent' (Figure 2). The statement reproduced as Figure 2 had as its principal focus, therefore, the calculation of the cost of production and was not a balance sheet in the present-day sense, or even in a contemporary sense as understood within the private sector.

Four years later, an additional financial statement—Balance Sheet No. 2 (Figure 3)—was included in the annual return made to Parliament. This additional financial statement was published because the Secretary of State had 'decided upon showing the effect of debiting the Government Manufacturing Establishments with Depreciation of Buildings, Machinery, &c., and Interest on Invested and Working Capital' (BPP 1867 (66), p. 2). The trigger for accounting innovation, in 1865–66, was objections raised by representatives of the Chambers of Commerce that 'the results recorded in an official publication known as the "Priced Vocabulary of Stores used in Her Majesty's Service,"[22] made up without including Depreciation and interest as part of the Cost', caused unfair comparisons to be made with prices charged for armaments by private business (BPP 1888 (120), p. 122). For accounting periods beginning 1865–66, interest and deprecation were recovered as a proportion of total cost of production *excluding* those two items.

The build-up of costs for inclusion in Balance Sheet No. 1 and Balance Sheet No. 2 is illustrated drawing on the contents of the annual return for army manufacturing establishments for the year to 31 March 1866. Taking the Royal Gun Factory for illustrative purposes, the direct cost of armaments produced during the year consisted of labour £90,225 18s. 0d. and materials £169,843 4s. 8d. (Table 2). General expenses amounted to £42,420 11s. 7d. (approximately 46% of direct labour), and this created the total cost figure of £302,489 14s. 3d., reported in Balance Sheet No. 1. The addition of interest and depreciation amounting to £52,518 3s. 6d. (approximately 11.7% of materials + labour + general expenses) produced the revised total cost figure of £355,007 17s. 9d., reported in Balance Sheet No. 2 (Table 2). Nine different types of weapons were manufactured during the year at the Royal Gun Factory, including 233 rifled, muzzle-loading (RML) 7 inch, 6½ ton guns, an image of which is reproduced as Figure 4. The total cost of these guns reported in Balance Sheet No. 2 amounted to £173,760 14s. 8d., with the build up of this figure also shown in Table 2. Work on the RML 7 inch, 6½ ton gun (as with all other large weapons produced by workers at the Royal Gun Factory) might extend over some weeks, with the manufacture of component parts the subject of numerous individual job orders. For illustrative purposes, the costs associated with Order No. 44, which involved 'Sighting and finishing' the gun, is reproduced in Table 2

Government committees also paid attention to the question of whether the accounting systems of GMMEs should be based on double entry bookkeeping.

Double Entry Bookkeeping

William George Anderson was seconded to the War Office to introduce double entry bookkeeping in 1841, adopting the system already in force at the Admiralty and in

[22] This was a triennial publication containing the accounting information that appeared in returns made by GMMEs to Parliament.

FIGURE 3

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No. 1.—ROYAL CARRIAGE DEPARTMENT, WOOLWICH ARSENAL—*continued.*

(B.)—BALANCE SHEET, No. 2, of the ROYAL CARRIAGE DEPARTMENT, ROYAL ARSENAL, WOOLWICH, 1865–6.

Dr. *Cr.*

To Balance:	£. s. d.	£. s. d.	By Balance:	£. s. d.	£. s. d.
For Stores in Stock on 1st April 1865	380,166 16 11		For Stores in Stock on the 31st of March 1866	346,639 9 –	
„ Semi-manufactured Articles in Stock on 1st April 1865	37,078 1 –	417,244 17 11	For Work in hand on 31st March 1866	60,092 8 5	406,731 17 5
To Army Supplies, 1865–6:			By Capital Account:		
For Cash advanced through the Paymaster General and expended on the following Services during the Year, viz.:			For New Buildings added during 1865–6	5,635 1 6	
Salaries	5,771 16 3		For New Machinery added during 1865–6	6,998 14 10	12,633 16 4
Wages	90,689 1 –		By Production Account (during the Year 1865–6):		
Wages of Men invalided on Medical Certificate	1,704 11 2		For General Service Repairs performed	22,258 6 –	
Stores, Materials, &c.	55,319 4 8		For Work performed in Drawing Office	531 8 –	
Miscellaneous Services	439 7 –		For New Patterns added	636 10 –	
Gas, and Repairs to Fittings, &c.	1,205 19 3		For Articles made new (per Statement C.)	93,020 5 –	
Water	180 – –		For Articles converted (per Statement D.)	63,469 2 –	
Police	1,224 19 –		For Additions to Plant in Department (per Statement E.)	2,427 8 –	182,342 19 –
Military Horses, Carts, Drivers, &c.	558 17 4		By Sundry Departments:		
Divine Service	101 5 –		For Serviceable Stores issued during 1865–6	5,576 14 –	
Medical Department	403 3 3		For Obsolete Stores issued during 1865–6	20,132 16 –	25,709 10 –
Chemical Department	100 – –				
Works Department	498 – –				
Library	13 4 9				
Schools	24 13 5				
Military Pay of Officers	874 9 7				
Repairs to Buildings	2,366 19 9				
Repairs to Machinery	5 16 4				
New Buildings	5,635 1 6				
New Machinery	6,998 14 10				
Superannuations and Gratuities	1,731 16 1	175,877 – 2			
To Miscellaneous Services, 1865–6:					
To Expenditure not defrayed out of Army Supplies, viz.:					
Stationery	471 4 7				
Rates	400 – –				
Rental Value of Official Residences	200 – –	1,071 4 7			
To Sundry Departments, 1865–6:					
For Stores, &c. received from various Sources	5,786 2 3				
For Work performed by other Departments	11 1 8	5,797 3 11			
To One Year's Interest, at 3½ per Cent., on Invested Capital, viz.:					
Lands £. 5,602 3 9					
Buildings 75,304 4 11					
Machinery 36,652 9 2					
Stores and semi-manufactured Articles in Stock on 31st March 1865 417,244 17 11					
£. 534,803 15 9	18,718 2 8				
To One Year's Interest, at 3½ per Cent., on Working Capital, viz. One-fifth of Annual Expenditure	1,279 4 4				
To One Year's Depreciation, 5 per Cent., on Buildings, and 10 per Cent. on Machinery, as per Capital Account (F.)	7,430 9 2	27,427 16 2			
	£.	627,418 2 9			627,418 2 9

H. W. S. Whiffin,
Chief Auditor of Army Accounts.

H. Clerk, Col. R. A.,
Superintendent.

Source: BPP 1867 (66), p. 4.

TABLE 2

SELECTED PRODUCTION COSTS. ROYAL GUN FACTORY. YEAR TO 31 MARCH 1866

	Production account			RML 7 Inch 6½ Ton Gun			Order No. 44		
	£	s.	d.	£	s.	d.	£	s.	d.
Labour	90,225	18	0	36,473	18	8½	528	19	10½
Materials	169,843	4	8	93,048	10	7¼	85	19	4¾
General expenses	42,420	11	7	16,873	4	1¼	243	9	7½
Balance Sheet No. 1	302,489	14	3	146,395	13	5	858	8	10¾
Interest and depreciation	52,518	3	6	27,365	1	3	91	17	4
Balance Sheet No. 2	355,007	17	9	173,760	14	8	950	6	2¾

Sources: Production account: BPP 1867 (66), pp. 41–42, p. 81; RML RML 64-pounder 64 cwt, BPP 1867 (66), p. 43; Order No. 106, BPP 1867 (66), p. 49.[24]

FIGURE 4

RML 7 INCH 6½ TON GUN DISPLAYED AT FORT SILOSO, SINGAPORE

Colour online, B&W in print

Source: Spencer (2009).

[24] The interest and depreciation charge of £52,518 3s. 6d. is made up of the charge for the year of £37,285 14s. 6d. (BPP 1867 (66), p. 42) plus the amount of interest and depreciation included in semi-manufactured weapons on 1 April 1865, derived as the difference between the figures for work-in-progress at the beginning and end of the year (BPP 1867 (66), pp. 42–43).

the Paymaster-General's office where, at the time, he worked as an accountant (BPP 1860 (441), q. 4372; see also p. 679). But although 'the mercantile system of book-keeping by double entry' (BPP 1831 (313), p.17) was introduced at Pall Mall in 1841, this had not happened at any of the three GMMEs comprising the Woolwich Arsenal when the Select Committee on Military Organization met in 1860 (BPP 1860 (441), q. 2187, q. 2193, q. 4600, q. 5513). Two years later William Brown confirmed that double entry bookkeeping had still not been introduced because, in his estimation, the additional cost could not be justified (BPP 1862 (448), q. 129).

It was not until a further two years later, in 1864, that double entry bookkeeping was instituted at the Woolwich Arsenal. Hurst informed a government committee which met in 1887 that, prior to this change being made, he had visited a large number of private sector companies in an endeavour to discover best practice, and that 'they quite ridiculed the idea of anyone objecting to double entry' (BPP 1887 (C. 5116), q. 3383). Following that fact-finding exercise, the Secretary of State for War decreed that double entry be adopted. Hurst was given responsibility for implementing the new system, and he did so despite the fact that GMME Superintendents claimed it to be 'totally inapplicable'. '[T]herefore, as you may imagine' said Hurst, 'I had not much assistance in doing it' (BPP 1887 (C. 5116), q. 3383). The 'great advantage' of the new system was that managers of GMMEs were provided with a 'current record, or at least monthly record', of work performed. Hurst also claimed that the accuracy of the records was improved and, in his estimation, the system put in place in 1864 was 'as good as any system that can be applied or that is applied to any of the large establishments in the kingdom' (BPP 1887 (C. 5116), q. 3383).

CONCLUDING REMARKS

This paper has studied the reform of accounting practices at Britain's GMMEs within a pervading political philosophy that emphasized the importance of 'cheap and efficient' government, competition between the public and private sectors and respect for ways of doing things within the ~~business~~ sector (Daunton, 2000; Edwards *et al*., 2002). The story starts with failures in the supply of weapons during the Crimean War 1854–56. More specifically, 'the difficulty of procuring muskets' (BPP 1854 (236), p. iii) led to fact-finding missions to the US and, as a consequence, the British government's decision to adopt 'the American system of manufacturing' at the RSAF. It has been revealed that careful consideration was also given to the development of accounting practices capable of establishing the 'real true cost' of production (BPP 1860 (441), q. 6084); an endeavour that was not simply an academic exercise but one required to help reach make or buy decisions and, consistent with a free market philosophy, to reassure the private trade that it was fairly treated.

It is clear that the quest to improve accounting practices caused GMMEs to adopt procedures that had already taken root within the private sector, as signalled by the importation of accruals accounting, double entry bookkeeping, and the move towards a 'commercial' form of balance sheet. We also know that Colonel Dixon recruited 'a competent accountant' with business experience to introduce an accounting system at the newly constructed RSAF in the mid-1850s. However, this

study also shows that issues involved in the better measurement of profit and assets were *more effectively* addressed by GMMEs than by many private sector companies. First, the inclusion of depreciation on a systematic basis when computing periodic profit was in advance of much contemporary business practice. Second, there is little evidence of private sector companies including charges for imputed interest when computing total cost of production (Boyns and Edwards, 2013, pp. 158–59, p. 186, p. 193),[23] whereas this became standard practice within GMMEs. Third, although surviving records show that some private sector companies used overhead recovery rates both before and during the Industrial Revolution, the methods of apportionment usually remained 'unclear' (Boyns and Edwards, 2013, p. 154). It was an issue that received much attention with the development of a costing literature in the late 19th century (Boyns and Edwards, 2013, pp. 172–77), but often continued to be neglected by many companies right up until World War I (Boyns and Edwards, 2013, pp. 183–87).

More generally, it has been noted that Dixon believed that the RSAF's books would bear 'fair comparison [with], or would stand well alongside the best commercial books of any firm in the kingdom' (BPP 1860 (441), q. 5513). John Anderson, who hailed from a commercial background, confirmed that the system devised at the Royal Gun Factory was 'not taken from any commercial establishment' (1860 (441), q. 6089; see also q. 6087 and q. 6090). Indeed, he reports that 'many [manufacturers] have visited our establishment for the purpose of seeing our system of accounts' and copying it (1860 (441), qq. 6089–90; see also q. 6137).

Archival research, particularly over the last quarter of a century, has added to our knowledge of costing practices employed by companies in the 19th and early 20th centuries (Boyns and Edwards, 2013). The prior view that costing, to the extent that it existed, was confined to the isolated efforts of engineers and clerks loitering in the dark recesses of industrial concerns has been the subject of major revision. As a corollary, so has the idea that accountants engaged by the Ministry of Munitions to ensure contracts were properly priced during World War I had a dramatic (and positive) effect on companies' costing procedures ~~(Marriner, 1980; Loft, 1986)~~. It is nevertheless still suspected that companies such as Ransomes of Ipswich, which introduced a costing system in 1856 (Boyns and Edwards, 2013, p. 150), were at the forefront of costing innovation in the private sector and that most managers continued to run their businesses without very much by way of costing data, if anything at all. It was the general lack of costing innovation that caused writers and accounting practitioners such as John Mann (1891) to describe cost records as 'a neglected branch of accounting'. Therefore, we might imagine that the GMME managers, in implementing, in a systematic manner, procedures which enabled the calculation of direct cost, the identification of general (or indirect) expenses, the inclusion of

[23] Nor is there visible evidence of contemporary experts advocating the inclusion of a charge for imputed interest. The specimen, and very detailed, costs sheets for a mining company recommended by the Scottish chartered accountant, Frederick Hayne Carter (1874, pp. 66–76), for example, make no provision for a charge.

charges for both depreciation and cost of capital, and the use of overhead recovery rates, were at the forefront of costing innovation in the mid-19th century, and ~~probably~~ much later.

Citing John Anderson and Samuel Bentham as examples, Rosenberg (1969, p. 80) complains of 'a deplorable tendency to ignore or neglect entrepreneurial talents, even of a most unusual sort, when these talents find their expression in the public sector'. This study suggests that public sector officers as initiators of accounting change have been similarly overlooked. In the space available, no attempt has been made to undertake a detailed comparison of the state of the art in the two sectors of the economy, but there is enough evidence to suggest that it is important for accounting historians not to disregard the government sector if their concern is to achieve a meaningful understanding of accounting's past.

POSTSCRIPT

The above study identifies GMMEs as a fruitful site for further investigation. One potentially rewarding research topic might involve an in-depth study of personnel such as Whiffin and Hurst in order to better understand how they obtained the skills required to become successful agents of accounting change in the government sector. A second topic could focus on a fuller exploration of the 'dynamics' of account change (i.e., the change process) that relocated accounting practices within GMMEs 'where accounting [previously] was not' (Hopwood, 1987, p. 214). A third investigation might inquire into labour control practices within GMMEs given that Hoskin and Macve (1988, 1994) locate the genesis of managerialism, in the US, at the Springfield Armory based on scientifically conducted time-and-motion studies. The findings presented in the present paper also signal the need to explain major historical discontinuities within British government accounting. Why was it the case, for example, that documented accounting change within GMMEs appears not to have survived through to World War I, given the apparent need for similar practices to be newly created at the Ministry of Munitions (Marriner, 1980)? Then, moving through to more recent times, an explanation is required for the need to reinvent, once more, accruals accounting and management control practices as part of the phenomenon known as New Public Management.

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