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**The advent of double entry based costing practices in the British engineering industry:
Ransomes of Ipswich, 1856-1863**

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Abstract

The history of accounting in all countries is punctuated by significant gaps in our knowledge. For Britain, where topics such as cost accounting have been the subject of a substantive research effort, there is still much we do not know. It has been suggested that engineers played an important role in the development of costing during the nineteenth century (Wells 1977, 50), but that such activity occurred outside the double entry bookkeeping system. The lack of relevant contemporary literature and surviving business records has made it difficult to examine the validity of such claims. This paper reviews the surviving evidence from the agricultural implement manufacturer, Ransomes of Ipswich, in an attempt to provide a better understanding of the emergence of costing within the engineering sector during the 1850s and 1860s.

Keywords: Costing theory, costing practice, double entry bookkeeping, engineering industry.

Purpose, data and methodology

This paper reviews the surviving archives of the agricultural implement manufacturer, Ransomes of Ipswich, in an attempt to provide a better understanding of the emergence of costing within the engineering sector during the 1850s and 1860s. In so doing, this paper throws additional light on the following issues of interest to accounting historians: (i) the process by which accounting change emerges within a single business and (ii) whether or not accounting practice was ahead of accounting theory in nineteenth century Britain.

The methodology applied in this paper is that of an individual firm case study based on the available archives and relevant secondary literature. The business records of the agricultural machinery manufacturer Ransomes are held at the Museum of English Rural Life, part of the University of Reading (deposits TR RAN to TR 18RAN). While the focus of our study is on the period between 1856 and 1863, we consulted archival documents covering a longer time-span, including partnership agreements (draft and final) from the 1860s, minutes of partners' meetings held in 1864 (TR RAN CO 1), maps of the Orwell Works which show the existence of a 'Counting House' c.1850 (TR RAN AD 4) and photocopies of various financial accounting volumes and statements covering the period from 1804 through to the 1880s (TR RAN AC 7). Most significant, however, is a Cost Analysis Book for 1885 (TR RAN AC 5/1) and a folder (TR RAN AC 5/6) containing typewritten copies of three papers relating to the development of the cost accounting system in the mid-nineteenth century, namely:

- two memoranda authored by Robert Charles Ransome, dated 19 January 1856 (TR RAN AC 5/6/iii) and 20 March 1863 (TR RAN AC 5/6/ii);
- a document (TR RAN AC 5/6/i), probably written in late 1877 or early 1878, listing the contents of the Cost Analysis Book ('Book A', see below) and the timings at which summaries of the various outputs of the accounting system were to be drawn up and reported to management.

These typewritten copies of handwritten originals which do not appear to have survived were probably made c.1923-1924 when James B. Reeve compiled a volume of over 100 pages of typewritten notes relating to various aspects of the history of the company. In these notes, Reeve refers to the three papers as 'interesting' and, importantly, goes on to remark that 'These instructions started the system which has been in operation more or less ever since' (TR RAN AD 3/11, f.102).¹

The documents therefore provide us with a sketch of the accounting and costing systems in use and the relationship between them. By linking them with evidence from the first surviving Cost Analysis Book ('Book A') for 1885 (TR RAN AC 5/1), it is possible to obtain a reasonably good understanding of the main elements of the costing system, and how it related to the financial accounts which Robert Charles Ransome describes as the 'Commercial Books' (TR RAN AC 5/6, memo dated 20 March 1863). The main contents of the first surviving Cost Analysis Book are listed in Table 1.

[Insert Table 1 about here]

The accounts listed in Table 1 are similar to those described in the 1856 and 1863 memos and/or noted in the late 1870s list, save for changes reflecting variations over time in the departmental structure of the business and the products manufactured. Later surviving Analysis Books for the years 1936-1939 (TR RAN AC 5/2-5) indicate that, in essence, the same system was still in operation on the eve of the Second World War.

It is not our intention in this paper to comment at any length on the efficacy or otherwise of the accounting and costing system introduced at Ransomes during the 1850s and 1860s, or of the changes subsequently made, not least because of the lack of relevant documentary records. Rather, our focus is to explore the attempt by a mid-nineteenth century businessman to devise a system of costing which would generate information that, in his assessment, could help run the business more effectively.

The remainder of this paper is structured as follows. To provide context for this study, the development of costing theory and practice up to c.1850 is first reviewed. In the section which follows that, we outline the key events in the firm's history relevant to our study, including changes to the organisational structure of the business and the role of key players. This overview provides a backcloth for our examination of the development of Ransome's accounting system, in particular the development of the costing system in the 1850s and 1860s. These and subsequent developments at Ransomes are evaluated in the final section of this paper in the light of the contemporary accounting literature specific to the engineering sector. There we also bring together our conclusions: in particular, the illumination provided by the Ransomes' evidence on mid-nineteenth century costing developments in the British engineering sector.

Costing theory and practice, to c.1850

Theory

Accounting texts published in Britain up to and during the industrial revolution period (c.1780 – c.1850) focused, in the main, on bookkeeping techniques, be they single entry or double entry, and the periodic preparation of financial statements based on the content of those records (Edwards 2011; Edwards 2016). The general focus of mid-nineteenth century accounting texts, therefore, was financial accounting rather than cost accounting (e.g. Inglis 1850), although there is evidence that, by the 1840s, a concern emerged with the question of how to accommodate the information requirements of the manufacturer, for purposes of performance assessment and

decision making, within the double entry bookkeeping (DEB) system, e.g. Henderson (1841), Krepp (1858). Even these texts, however, failed to address the accounting requirements of an engineering concern, which is a little surprising given the importance of that sector in making Britain the 'workshop of the world' (Chambers 1961).

It was the growth of the coal, iron and textile industries which propelled Britain to a position of industrial supremacy (Deane and Cole, 1962), but it was the engineering industry which provided the crucial link with the emergence of Britain as the world's leading supplier of manufactured goods. The growth of coal output made possible the expansion of iron manufacture, and hence of engineering products, while the rise of the textile industry provided an important source of demand for such products (Allen, 2009). Together with the development of the railways, which supplied another important link between coal, iron and engineering, 'machines spread across the whole of British manufacturing' during the mid-nineteenth century (Allen 2009, 274). The growth of manufacturing activity brought into sharp relief a range of accounting issues, although most of these were not new (see Boyns and Edwards 2013). Amongst them were a number of key issues related to costing, such as the identification of overheads and their apportionment between cost centres, and whether or not to include charges for depreciation on plant and equipment and interest on the capital invested in the business. Where production involved a series of linked processes, the method of transfer pricing had also to be decided.

While the vast bulk of accounting texts published during the industrial revolution period in Britain failed to address such issues, they were not entirely ignored. In the late eighteenth century, Thompson (1777), Wood (c.1777) and Hamilton (1777-1779) dealt with some aspects of costing, most particularly the issue of how to track the movement of goods between different stages of productive activity. Thus, like Dodson (1750) before him, Thompson (1777) discussed the transfer of goods, at cost, by merchants to households under the domestic system. Others proposed the measurement of transfers at market prices to enable the profit contribution of the different stages of production to be determined. One early proponent of this view was Hamilton (1777-1779) who did so in the context of a linen manufactory, so that 'the gain or loss by dressing flax' and 'the gain or loss by spinning' could be revealed, while also enabling 'a comparison of the profit obtained by selling the linen, white or brown' (quoted in Mephram 1988, 60). Young (1797) recommended the application of a similar procedure to agricultural activities (Juchau 2002, 377) while, in the second decade of the nineteenth century, both Comins (1814) and Cronhelm (1818) addressed the issue of internal transfers; the latter in the context of a woollen cloth manufacturer, but only in terms of physical quantities (see Edwards 1937, 254). Writing in the 1850s, Sawyer (1852) discussed the appropriate method for determining the cost of transfers of hides in the process of tanning.

The prescribed inclusion of depreciation as an expense became more commonplace by the mid-nineteenth century. The civil engineer Charles Vignoles (1850), in the context of a manufacturing enterprise designed to produce coke from turf, included a charge for depreciation on plant used, while the accountant Joseph Sawyer (1852) did likewise for a tannery. Vignoles (1850, 24) indicates that the 'Cost of the Coking Establishment', namely the operating costs, should include 'repairs and depreciation' with 'Repairs and Renewals (or Depreciation)' on £3,000 of machinery and engines charged at 20% and on the remaining capital equipment (£2,000) at 10%, giving an overall rate of 16% 'on first outlay of £5,000'. Sawyer (1852, 200) recommends that 'a certain sum be annually deducted for depreciation' from 'Horses and Wagons, Utensils, Bark Mill, Fixtures, and anything of the like character'. Vignoles' work (1850, 27-28) is also notable because he advocated the need to recognise the opportunity cost of capital invested in the business, recommending that 'a provision [at 5%] must be made (beyond the 16% for repairs and depreciation already provided for) to cover interest or sinking fund; and this becomes fairly chargeable on the cost of making the Turf-coke before considering profits'.

Practice

Pollard (1965, 248) famously claimed that ‘the practice of using accounts as direct aids to management was not one of the achievements of the British industrial revolution; in a sense it does not even belong to the later nineteenth century, but to the twentieth’. For Pollard, there was really no need for cost accounts, since many firms were monopolies and could make ‘easy margins’ and, hence, large profits. A recent survey of the development of accounting for managerial purposes (Boyns and Edwards 2013) proves that such a view is no longer tenable and, indeed, that the generation of cost information to aid managerial decision-making pre-dates, significantly, the industrial revolution. Nevertheless, our knowledge of developments during, and immediately after the industrial revolution period remains limited. There is, however, clear evidence of the use of cost calculation within DEB systems within certain sectors of the British economy in the first half of the nineteenth century, including iron, coal and steel (Boyns and Edwards 1997), copper ore mining (Jones 1985), cotton manufacture (Stone 1973) and shipbuilding (McLean 1995). Although the bookkeeper, Henderson (1841, 105), considered that the use of DEB amongst manufacturers was not as ‘general as it might be’, in the following decades things began to change. Moreover, such systems were designed to generate managerially useful cost information alongside financial information.

During the mid-1850s, Captain Mark Huish, general manager of the London & North Western Railway (LNWR) from 1846 to 1858, devised methods of cost calculation in which cost per ton-mile and per passenger-mile statistics made their first ‘appearance as regular management aids’ (Gourvish 1972, 240). While most accounting innovation of this character is probably attributable to businessmen and accountants working within the firm, company auditors also played a part. The LNWR’s accountancy department was assisted in ‘the compilation of operating statistics which were used, in turn, to assess performance and the allocation of resources’ by Edwin Waterhouse (Jones 1995, 53), who, in 1864, undertook ‘a heavy piece of work in planning a system of cost accounts’ for the Leeds machinery manufacturer, John Fowler (Jones 1988, 79).² At the newly formed joint-stock iron and steel maker, Bolckow Vaughan, the company’s auditors Chadwick, Adamson & Co. ‘were called upon in the years immediately following the company’s formation in 1865 to advise on the implementation of an accounting system capable of generating cost information’ (Boyns and Edwards 2013, 150).

Our knowledge of the development of cost calculation around the middle of the nineteenth century, and especially within the engineering sector is, therefore, very limited. In large part this may reflect the fact that many private sector engineering companies were small-scale and left little or no record of their business activities. There is, however, evidence of an emerging focus on cost calculation, in the 1850s, at the rather larger government-run engineering establishments whose function was to supply weapons for military use.³ The trigger for accounting innovation was the introduction of the ‘American system of manufacturing’ (Chandler 1977, 75) at the newly-constructed Royal Small Arms Factory at Enfield Lock, north London, in the second half of the 1850s. Careful consideration was given there, and at the Woolwich Arsenal, to the development of accounting practices capable of establishing the ‘real true cost’⁴ of production based on DEB⁵ (BPP 1860 (441), q. 6084). John Anderson, a civil engineer who undertook a series of managerial roles at government military manufacturing establishments described, in evidence presented to a parliamentary select committee, the accounting practices put in place at the Arsenal’s Royal Gun Factory. His narrative reveals, first, the care taken to identify, on a daily basis, direct costs (materials and labour) involved in the ‘execution’ of ‘every order’ and, second, the close attention paid to the appropriate treatment of indirect costs: ‘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. 5168-5172, q. 5182).⁶ The concern to identify, accurately, total cost does not, however, appear to have been principally driven by a concern to manage and control costs. Indeed, for direct labour management, the careful recording and observation of piece rates served that purpose. The focus on true cost was more directly driven by the determination to help reach correct make or buy decisions and, consistent with a free market philosophy, to reassure the private trade that it was fairly treated.

The need to recognise the opportunity cost of capital if accounts are to report the full economic cost of production is a matter that has received little attention in the literature on accounting practice. Jones (1985, 168-171) cites evidence from the 1820s of the deduction of an interest charge prior to determining partnership profits, concluding that interest on capital was considered by some accountants to be an 'eligible' ingredient in the cost of a process or economic activity 'and had been so considered for fifty years or more' (Jones 1985, 170). However, it is not always clear in historical examples whether the inclusion within cost calculations of interest on capital invested in the business relates to the depreciation of assets or the opportunity cost of the capital.

In the light of contemporaneous developments discussed above, this paper adds to our knowledge of accounting's past by studying the surviving archival records of Ransomes of Ipswich for the period between 1856 and 1863. The particular focus of investigation is the development, by that engineering company, of a DEB system capable of generating cost information for performance assessment and decision making purposes.

Ransomes: a brief history

Growth, 1789-c.1869

Ransomes of Ipswich was founded in 1789 by Robert Ransome, Sr. (Table 2), subsequently passing through several generations of the family during the nineteenth century.⁷ An ironfounder based in Norwich, Robert Ransome, Sr. moved to Ipswich to expand his business and, in 1809, entered into a seven-year partnership with his elder son, James. The principal products of these early businesses were agricultural implements, especially ploughshares, for which Robert had taken out a series of patents. In 1785, for example, he patented the 'chilling' process which enabled ploughshares to sharpen themselves as they tilled the soil, and in 1808 one for interchangeable plough parts (Grace and Phillips 1975, 1).⁸ In common with most early nineteenth century ironfounders, Robert Ransome, Sr. also undertook a wide range of general work. In 1812 William Cubitt, the famous civil engineer (Hobhouse 2004), became the firm's engineer and 'under his direction the scope of the business was expanded to take in bridge-building and mill-wrighting' (Grace and Phillips 1975, 2).

[Insert Table 2 about here]

Diversification proved important during the agricultural depression following the Napoleonic wars and, although Cubitt left the business in 1826, by which time it employed about 60 men and boys (Weaver and Weaver 1989, 25), he maintained contact with the firm. This led to Ransomes becoming involved in the early railway industry, particularly from 1836 when Charles May joined the firm to take on responsibility for 'work arising from the railway building boom which was then gathering momentum' (Grace and Phillips 1975, 3). The agricultural side of the business was not neglected and indeed received a boost when James' son, James Allen Ransome, became a partner in 1830. Due to his 'specialised technical appreciation of the problems of agricultural engineering' (Grace and Phillips 1975, 2), the range of agricultural products produced by

Ransomes was extended to include harrows, cultivators, barn machinery and threshing machines, while in 1832 they 'began manufacturing the original Budding design [of lawn mower] under licence' (Grace and Phillips 1975, 3).

By the end of the 1830s the growth of the business outstripped available capacity at the Old Foundry. William Worby, the works manager, was instructed to find a site on which to construct a second works. A contract for the new dock scheme was signed on 12 June 1838, and the Orwell Works came into operation in 1841 ('Royal' 1939, 45-47). James Ransome took over superintendence of the new works while another partner, Charles May, remained in charge of the Old Foundry.⁹ The railway boom of the 1840s led to an expansion of railway equipment production, including rail chairs and fastenings, and resulted in the Old Foundry becoming too small and inconveniently situated. Thus, in '1849 the firm transferred the whole of their [sic.] activities to the dock site' ('Royal' 1939, 47). By the middle of the nineteenth century the firm's workforce had grown to well over 1,000 employees (Grace and Phillips 1975, 4) and in May 1852 the Orwell works comprised 'a complete Iron Foundry, Engine Shops, Boiler makers Shops, Dressing Stores, Carpenters and Wheel wrights Shops, Wagon-Building Shops, Manager's Houses, and a most extensive range of Offices', all of which had been recently erected (TR RAN AD 4/3).

By the time of the Great Exhibition in 1851, where Cubitt played 'a very active part' in supervising construction of the Crystal Palace (Hobhouse 2004), 'Ransomes had [achieved] a national reputation and was a leading member of the select group of East Anglia businesses which was to dominate the agricultural engineering industry for the rest of the century' (Grace and Phillips 1975, 5). Having commenced experimenting with the production of steam engines in the early 1840s, Ransomes ultimately became one of the leading manufacturers nationally of both threshing machines and steam engines, including traction engines. Ransomes first displayed a portable steam engine at the Liverpool 'Royal Show' in 1841 and followed this, in 1842, by producing their first agricultural traction engine (Weaver & Weaver 1989, 41). But while other engineering companies made steam powered machinery the cornerstone of their activities, at Ransomes it featured as one component of a diversified product range. Plough manufacture still comprised an important part of the agricultural side of the business through Ransomes technical, if not commercial, supremacy in this field (Phillips 1985, 844).

Determining the relative importance of different aspects of the business is, however, no simple task. While some figures feature in the archives from time to time, vague and inconsistent descriptions are employed. The 'Trade account' for the year 1845 (TR RAN AC 7/3) provides sales figures only for the broad categories 'Foundry' and 'Railway', and the first detailed indication of the relative importance of different parts of the business is provided in a document entitled 'Returns Nett 1851' (TR RAN AC 7/9 – see Table 3).

[Insert Table 3 about here]

An increasing demand for steam powered machinery for use in the agricultural sector (Grace and Phillips 1975, 4) and the continuing development of railways saw further growth of the business in the 1850s and 1860s, met initially by the use of spare capacity at the Orwell Works and, later, by the expansion of facilities at that site. Business correspondence indicates that the annual average turnover for the 7 years to 31 December 1862 amounted to £186,285, 50 per cent higher than in 1851, of which contract work had risen dramatically from £15,446 to £78,549 while the remainder amounted to £107,736 compared with the £106,351 (Railway £46,013 + Engineering £25,164 + Agricultural £35,174) recorded in Table 3 (TR RAN CO 1/3, f.20). On the agricultural side alone, in 1866, Ransomes sold 3,000 ploughs, 100 steam engines and 60 threshing machines (Phillips 1985, 845), while on the railway side, key components manufactured included chilled iron crossings, switches and railway fastenings (Weaver and Weaver 1989, 37):

The fastenings were moulded chairs which hugged the sleepers and were held by compressed wooden trenails. James Ransome invented the chairs which adjusted accurately to the tilt and gauge of the railway line and Charles May was responsible for the trenails. Patents were taken out in 1841. By 1866, 12,000 miles of railway track had been constructed on this principle in England, India, Australia and parts of the continent. The company was also involved in bridge and station construction.

By 1869 the expansion of the previous twenty years meant it was time to consider the future of the business, not least because it had outgrown the Orwell Works despite the fact that the call for increased supplies of agricultural machinery had already necessitated further extensions of that site 'from the 6 acres occupied in 1849 ... to 10 acres in 1871' ('Royal' 1939, 55). It was decided to split the activities between two separate concerns: Ransomes, Sims & Head would focus on agricultural work at the Orwell Works, while Ransomes & Rapier, to be based at the new Waterside Works in Ipswich, would take over the railway work ('Royal' 1939, 55). 'In 1871 a further change to the activities of the former business was carried out, when the manufacture of food-preparation machinery was transferred to Hunts of Earls Colne' (Grace and Phillips 1975, 5-6).

From sole trader to limited liability – the role of key individuals

From 1809 until 1884 Ransomes was organised as a succession of partnerships. Partnership agreements were normally for a period of between five and ten years duration (TR RAN CO1/1-17), but were often subsequently amended as circumstances dictated. Such amendments and new agreements were used to bring new members of the family into the business and/or to allow more senior members to retire or remain engaged in a reduced capacity, e.g. on a consultancy basis. Occasionally non-family members were admitted to the partnership either from within the Quaker fraternity and/or former apprentices such as Charles May, William Dillwyn Sims (May's nephew – 'Royal' 1939, 52) and John Head. Control of the business always remained in the hands of the Ransome family and, by the middle decades of the nineteenth century, a mix of second and third generation members were directing operations.

A key figure in the story is Robert Charles Ransome (hereafter RCR), second grandson of the founder of the business, and son of Robert Ransome, Jr. (Table 2). In 1846, at the age of 16, RCR became apprenticed to the firm and, from the outset, showed a particular interest and ability in the more commercial side of the business, especially overseas trade. He became a partner in 1857 and, following further changes, profits were shared as follows by the early 1860s (TR RAN AC 7/9, f.51): Robert Ransome, Jr. 4/11; James Allen Ransome 4/11; RCR 2/11.¹⁰ On 1 January 1864 a new agreement admitted John Head to the partnership, with future provision made for the subsequent entry of James Edward Ransome (RCR's brother and second son of Robert, Jr.) and Robert James Ransome (son of James Allen Ransome and great grandson of the business's founder – Table 2). When Robert, Jr. died during 1864, James Allen Ransome took over as senior partner ('Royal' 1939, 55).

On 1 January 1869, the business, as already noted, was split into two for operating and management purposes: James Allen Ransome, Robert James Ransome and Robert Rapier together formed Ransomes & Rapier to take over the railway side of the business with James Allen in charge. His health failing, James Allen reduced his participation in the active management of the new agricultural partnership, Ransomes, Sims & Head, where RCR became the senior figure. When the agricultural business was incorporated as Ransomes, Sims & Jeffries Ltd in 1884 (Brown 2004), RCR was appointed its first chairman and died two years later.¹¹

The accounting system in operation at Ransomes, and how it developed over the years, is examined in the next section. In accordance with the purpose of this paper, the principal focus is

on Ransomes' costing system, but the general character of the financial accounts is first reviewed, with particular attention paid to the adoption of DEB.

The accounting system

The financial accounts

The earliest surviving accounting record, a General Account book dating from 1804, indicates a rudimentary accounting system in operation: a single statement of receipts and payments was prepared for 1804 (TR RAN AC 6/1/1) followed by quarterly cash statements during 1805 (TR RAN AC 6/1/2-5). A 'Stock' (i.e. capital) account dated 14 March 1809 (TR RAN AC 6/1/3/1ff) presents the assets and liabilities of the firm in debit and credit format, and this practice is repeated each year through to 1832, though the accounting date is changed to 31 December. The motivation behind the preparation of a capital account appears to have been the creation of the first partnership in 1809. The 'General Account' book for the period 1804-1832 also contains, from time to time, a series of 'profit' calculations, seemingly once again coinciding with changes in the partnership arrangements. Thus, on 5 March 1818, Robert and James Ransome put their signatures to a document (TR RAN AC 6/1/4) containing a calculation of the profit made in 1816-1817 preparatory to the change from Ransome & Son to Ransome & Sons, with the addition of Robert's second son, Robert Jr., to the partnership. A similar 'profit' statement was prepared on admittance to the partnership of James' son, James Allen, in 1830 (TR RAN AC 6/1/11).

By the 1840s there are clearer signs that the accounting records are kept on the basis of DEB. An annual 'Balance Sheet' (year ending 31 December) together with an account called 'Divisions', which provided an indication of how the 'gains' of the business were shared between the partners,¹² are presented in debit and credit format on a single sheet, with 'Divisions' appearing at the top, and the Balance Sheet below. For 1845, and then continuously from 1851 through to 1880, the annual accounts consist of three documents which, given their form and content, is a clear indication of the operation of a system of DEB:

- a 'Trade account'¹³ which reports sales revenue and operating expenditure, with the credit balance ('gain') transferred the profit and loss account.
- a 'P&L [profit and loss] account' where various additions and deductions (which in most years largely balance out) are made, with the overall balance divided between the partners according to the prevailing profit sharing ratio.
- a 'Balances' sheet which lists the debit (assets) and credit (liabilities) balances from the partnership's private ledger (TR RAN AC 7/9).

Also worth noting is the fact that the 'Manufacturing & Trade Exp[ense]s.' reported in the 'Trade account' contain, in addition to wages, salaries, rents, rates and taxes, etc., a figure for 'Interest'. We will return to the meaning and significance of this item when examining the cost accounting system in the next section.

A fascinating feature of the partnership agreements drawn up in the 1860s is the instructions they contain concerning the valuation of stock (i.e. inventory) at the year end: 'the whole stock and effects thereof shall be fairly and equitably valued at such a price as either of the Partners would be willing to buy of[f] or sell to the other or others of them' (clause 20, draft partnership articles dated 1 October 1863 – TR RAN CO 1/3, f.39). In a letter dated 29 September 1863 it is

stated that 'Our practice in valuing our Disposable Stock has been to ascertain as nearly as possible what it has cost us and adopt that as its value' (TR RAN CO 1/3, f.19). Further clarification is forthcoming in the minutes of the first meeting of the members of the new partnership, held on 7 January 1864 (TR RAN CO 1/3, f.132):

We then considered our Stock Valuation – and decided to value the articles usually classed under the head Materials & Stores at their present market value - ; also to value the articles described as manufactured goods at the costs as calculated before the rise in the value of Materials -; also the Pig iron prices to be taken at the rates quoted in the Glasgow Price current of the first market in the year.

Clearly the partners took that view that it was appropriate to value various categories of inventory in quite different ways: some at market selling price; some at market buying price; and others at historical cost. Unfortunately the archives are silent on the motivation for these diverse approaches to asset valuation and the present authors have been unsuccessful in supplying a rational explanation for choices made.

The costing system

According to Phillips (1985, 845) 'a detailed and efficient system of departmental cost accounting' was introduced by RCR in 1856. As indicated at the start of this paper, our knowledge of Ransome's costing system in the mid-nineteenth century relies heavily on two memoranda dated 1856 and 1863 respectively and a further document from 1877/1878. The memoranda dated 19 January 1856 and 20 March 1863 are written by RCR and addressed to Henry Mohun who is described as 'the then head of the Wages & Cost Department' (TR RAN AD 3/11, f.101).¹⁴ These sources are buttressed by evidence from other documents and accounting books, especially relating to later periods, and to some comments made by James B. Reeve in a set of historical notes compiled in 1923-1924. The folder containing the three documents from the period 1856-1878 declares that they relate to the 'DESIGN OF MANUFACTURING DEPARTMENT SYSTEM AS ORIGINATED BY THE LATE MR. R.C. RANSOME, 1856'. It continues:

These papers show the origin of the system of Analysing Wages, Purchases, Sales and Stock, in Sections [of the business], and having cost accounts to correspond. At the end of each year, each Section was balanced and the gross profits thus shewn were totalled, and then agreed with the gross profits arrived at in the Private [i.e. financial] Books.

The 1856 memorandum (TR RAN AC 5/6/iii) comprises a four page 'letter' together with an eight page 'appendix'; one for each of the eight 'sections' of the business which RCR wishes to be used as the basis for recording entries in the stock ledger. The appendix lists 160 categories of 'product' manufactured by the company and the section of business activity to which each is assigned.¹⁵ The 1863 memorandum (TR RAN AC 5/6/ii) comprises a 14 page 'letter' detailing briefly the nature of the accounting systems and, at greater length, how RCR has attempted to reconcile the 'Cost Books' with the financial books.¹⁶ The 1877/1878 document (TR RAN AC 5/6/i) comprises five pages; four of which indicate the regularity with which various accounts are to be made available to management (including 'Book A' which is subsequently renamed the 'Cost Analysis Book') and a one page note which comments on the 'M[anufacturing].O[ffice]. Account', current problems, the timing of drawing up accounts and how their delivery might be improved.

The 1856 memo shows that RCR was determined to discover the cost of each individual order and section of activity so as to have available better information for managerial purposes (1856 memo, f.1). The eight separately identifiable 'sections' (TR RAN AC 5/6/iii, f.1) comprised: (i) a

product group (e.g. ploughs (section 1), steam powered machinery (section 3), chaff and turnip cutters (section 4)); (ii) a class of work (e.g. 'sundry agricultural work' (section 7); and (iii) 'railway and other work which is not agricultural' (section 8). Within each section of the Stock Ledger there is a separate account for each of the 160 products or items of work undertaken. Thus, section 1, for example, lists 27 types of plough, section 3 includes 12 different kinds of portable and steam threshing and dressing machines, while section 6 encompasses the 12 types of steam engine manufactured. Section 8 covers items such as chairs (for rails), cranes, turntables, pumps, mercury gauges, circular saw tables, bolts and nuts, etc.

The 1856 memo represents the early stages in the process of developing an accounting system designed to yield managerially-useful cost information, while the 1863 memo reveals that the system, far from finished, is still evolving. The latter memo provides further elaboration of the motivation of RCR in developing the new costing system, which was to provide a means of determining the profit or loss made by each article produced. The following extract reveals that RCR clearly recognised the fact that the 'Commercial [i.e. financial] Books' were deficient in this respect (TR RAN AC 5/6/ii, f.1):

All the accounts which are kept in the Commercial Books are sufficient by the help of the Annual Stocktaking to show the gross amount of Profit or Loss made by the business, but they are not sufficient, as kept at the Orwell Works, to show without the help of abstracts, or a subsidiary set of accounts, in what department or on what articles the Profit or Loss is made.

The company's 'Cost Books' were therefore devised to tackle this deficiency, with RCR pointing out that 'Book A' (Cost Analysis Book) provided a mechanism for determining 'how far they have fulfilled their functions so far as Wages, Materials, Stores and Manufactured Goods are concerned, but not so far as the general Trade Expenses of the business go' (TR RAN AC 5/6/ii, f.1). Book A was to be the means of determining whether direct costs had been recovered accurately in the 'Cost Books' (TR RAN AC 5/6/ii, f.1). If the reconciliation between the Cost and Commercial Books carried out by RCR revealed an over- or under-recovery of costs, the difference was transferred to the general trade expenses account. In describing how he conducted the reconciliation for the financial year ending 31 December 1861, RCR reveals the following key aspects of the costing system:

- All materials and wage costs are charged to orders in the 'Cost Books' but, due either to errors or the use of pre-determined rates which are greater than the actual, costs might be over- or under-stated. For 1861 there was small over-recovery of labour costs which was transferred to the General Trade Expense Account (TR RAN AC 5/6/ii, ff. 2-3).
- Wage costs, as charged to each section, are divided as between 'Customers and Stock' and 'F[ixtures] & U[tensils]', the latter term widely used in the mid-nineteenth century to signify plant and equipment (see Sawyer 1852, 200).
- In addition to wage and material costs, the General Foundry and Brass Foundry accounts are also charged with 'Foremanship' (TR RAN AC 5/6/ii, f. 5).
- Coal and coke are transferred to sections at cost, so that these accounts should 'balance very nearly' (TR RAN AC 5/6/ii, f.12).
- In respect of painting and bronzing activities, it is noted that 'the account rendered by Stearn is not passed until every item has been posted in the Cost Books', meaning that the Painting & Bronzing account 'ought to balance exactly' (TR RAN AC 5/6/ii, f.12).¹⁷
- General Trade Expenses to be recovered at the rate of 20 per cent¹⁸ (TR RAN AC 5/6/ii, f.13).

RCR was clearly aware that both the manner in which the 'Cost Books' were kept, and his attempt to conduct a reconciliation, were far from ideal in 1863, pointing out the following specific problem areas:

- While all steel should be charged to the General Forgings account, RCR acknowledges that the account 'will not be strictly accurate because all the steel does not go from the stores to the Smiths Shop – some of it goes to other shops direct – but I don't know practically how to get it nearer' (TR RAN AC 5/6/ii, f.7).
- Focusing on the General Foundry Account, General Timber Account, Brass Foundry Account, General Forgings Account, and certain others, RCR comments: 'This mode of settling these accounts I only look upon as a very clumsy one, and if you can see a better way for the past and present years, please adopt it. For 1864 I think we can scheme a better plan' (TR RAN AC 5/6/ii, f.11).
- The recovery of General Trade Expenses at the rate of 20 per cent appears to have been a first estimate; RCR admitting that he did not expect that arrangement to work out very accurately for 1861. He went on to note however, that 'errors may by degrees be removed until a very valuable degree of accuracy is arrived at and the error so reduced as not to affect the whole bulk of transactions when distributed pro rata over them' (TR RAN AC 5/6/ii, f.13).
- RCR recognised that, because transfers between departments were generally made at cost, rather than market price, the 'Cost Books' and the reconciliation process would not 'show whether the Treenail Mill pays well or ill, whether Steam Thrashing Machinery pays, or whether the Foundry pays. For these and such like questions we must go a step further and that must be left until I come home' (TR RAN AC 5/6/ii, f.13).

One item in the accounts that requires further consideration is that of 'Interest' which, as noted above, first featured in the 'Trade account' for 1845 and then in those from 1851 onwards. This item is of potential significance for accounting historians given the lack of evidence within current accounting historiography of its treatment as a cost of business operations. In his 1863 memo (TR RAN AC 5/6, f.9), when discussing the 1857 Timber Stock account, RCR refers to the need to charge 'Interest on Plant 5% on £636.9.1' prior to determining the profit or loss for the period. This rate corresponds with that specified in partnership agreements, from 1809 onwards, to remunerate partners for the capital invested in the business (TR RAN CO1/1).¹⁹ This pattern of recognising the opportunity cost of capital prior to the calculation of profit continued until the business was converted into a limited company in 1884. Its purpose is confirmed in a letter from members of the Ransome family to the incoming partner, James Head, dated 29 September 1863: 'In making up our accounts we always charge 5% Interest on Partners' as well as on all share Capital as a Trade expense before declaring Profits and Losses' (TR RAN CO 1/3, f.21).

The manner in which interest was included within the 'Cost Books' immediately following the implementation of the developments set out in the 1856 and 1863 memoranda is unknown since no copies of the relevant books have survived. As noted above, the first surviving copy of a Cost Analysis Book is for 1885 and, assuming the company's historian James B. Reeve is correct in his assertion that the cost system, once introduced, changed little, the treatment of interest in this book should provide reliable evidence of how it was previously accounted for. The Cost Analysis Book for 1885 (TR RAN AC 5/1) confirms that, for the purpose of preparing the various 'departmental' accounts, interest is charged at five per cent on the plant used in each department.

Overview

The surviving memoranda from 1856 and 1863 indicate a businessman, RCR, in conjunction with the head of the Wages & Cost Department, Henry Mohun, attempting to develop a costing system capable of providing RCR with useful information for the purpose of managing the business. At a time when the contemporary accounting literature dealing with such matters was thin on the ground, RCR exhibits a sound understanding of bookkeeping methods and the issues involved in attempting to determine the profit or loss made on each item produced.

Writing in the early 1920s, Reeve confirms that the specifics of RCR's system were continuously adjusted to take account of the changing nature of the business (TR RAN AD 3/11, ff.102-103):

A very complete method of arriving at expenditure of plant and fixtures has grown up, for instance, as also new methods for fixing percentages of this expenditure on wages for use in drawing up costs. Also a more elaborate system of detailing trade expenses or indoor expenditure has been devised, so that a more accurate percentage on wages can be arrived at for use in making costs.

Clearly, Reeve also believed that the system introduced by RCR proved fit for purpose: 'the methods designed nearly seventy years ago are practically those which are in use to-day' (TR RAN AD 3/11, f.103) and, indeed, they were still in use by the company at the outbreak of the Second World War (TR RAN AC 5/4-5).

The longevity of the system could alternatively be explained, of course, on the grounds that it became so deeply rooted in the culture of the organization that, for good or ill, its use was never questioned.²⁰ Due to a lack of evidence capable of addressing this issue further, the remainder of this paper focuses on the extent to which the system developed at Ransomes matched up to those described in the contemporary and late nineteenth century costing literature.

Ransomes and the costing literature of the period

The following key features of the Ransome system have been identified:

- separate but reconcilable 'Commercial' (financial) and Cost ('Manufacturing') accounting systems based on double entry bookkeeping;
- a focus on prime cost²¹ with overheads recovered initially at 20 per cent, probably based on wages;
- interest on the capital invested in the business included as a cost before determining 'surplus', 'gain' or 'profit'.

As noted in the Introduction, cost accounting remained a neglected feature of the accounting and engineering literatures up to the middle of the nineteenth century. It was not until after RCR had put the cost accounting system in place at Ransomes that bespoke accounting texts for engineering firms begin to appear (Walker 1875; Battersby 1878). A further relevant literature awaited the onset of the so-called 'costing renaissance', in the late 1880s, which saw the publication of a relative plethora of accounting/management texts which dealt, at least to some degree, with costing for engineering firms (Garcke and Fells 1887; Liversedge 1889; Norton 1889; Slater Lewis 1896; Burton 1896; Burton 1899), and also a pertinent journal literature (e.g. Plumpton 1892; Goode 1900; Cowan 1901). Given that the Ransome system was developed in

the 1850s and early 1860s and, thereafter, became firmly established, it is apparent that its gestation and early development could not have been influenced by an existing literature. Nevertheless, the system does show some similarities to those advocated in later books and articles, suggesting that practice may have been a little ahead of theory in this industrial sector in the 1850s and 1860s.

The works of Walker and Battersby have certain similarities with one another, but also a number of important differences. Both texts promoted prime cost calculations which went beyond wages and materials to include some indirect expenses, with general overheads recovered as a percentage of selected direct costs. Both systems employed subsidiary books of account as did Ransomes; in Walker's case six and ten for Battersby. While Walker did not explicitly state the nature of the relationship of these books to the Commercial Books, Battersby (1878, 43) clearly recommended the use of two, interlocking systems of double entry-based records. Battersby's system corresponds with the 'Italian [DEB] system' advocated by the chartered accountant, Thomas Plumpton (1890), and used c.1870 at a large, unnamed, engineering firm in the North which employed c.1,000 workers. There, 'the costing and departmental accounts ... [were] interwoven with the general transactions of the firm' (Plumpton 1890, 17-18) although, in a subsequent paper, Plumpton suggested that, for larger establishments, such a scheme was 'almost unworkable owing to the magnitude of the work' (1892, 269) and a more effective approach might be to (Plumpton 1892, 269):

open up separate Cost Ledgers to take up the threads where the Commercial Books terminate, making the Cost Accounts form a system of double entry within themselves, free and apart from the Commercial Accounts, but the total result of profit agreeing with the same figure in the Balance Sheet.

Whether cost and financial accounts should be fully-integrated, inter-locked, and/or reconcilable, was a debate which continued within the British costing literature until well into the twentieth century (see Boyns and Edwards 2013; 178; 251-254).²² Most writers during the late nineteenth century 'costing renaissance', though not all, favoured reconcilable accounts, and the need for a reconciliation to be made, as effected at Ransomes, to ensure the accuracy of the cost accounts (see, for example, Dicksee 1903/1976, 220; Strachan 1903, 75).

Another issue which has perennially exercised accountants is whether an allowance should be made in the cost accounts for the opportunity cost of capital. Here Walker, the 'practical foundryman' (Lawrence and Humphreys 1947, 26), and Battersby, a public accountant, took differing standpoints. Walker considered a return on the capital invested in the business to be an expense and therefore part of the cost of manufacture, while Battersby recognised interest in the sense of the desired rate of return (i.e. profit) on invested capital when computing selling price. As a public accountant, Battersby clearly could not countenance the concept of opportunity cost entering into the DEB accounting/costing equation; a view that many chartered accountants who came after him shared.²³ The available evidence suggests that RCR put in place the kind of system advocated by Walker, and was therefore exceptional in including cost of capital as part of business costs. This is not to suggest that Ransomes was entirely at the forefront of costing innovation given the absence of any reference whatsoever to charging depreciation on fixed assets until the early 1920s.²⁴

Given that the key elements of the Ransome system were, at the very latest, firmly established by the mid-1870s, neither Walker (1875) nor Battersby (1878), nor any of the later works of the 'costing renaissance' could possibly have had any influence on the thinking of RCR. This raises the question of from where RCR got his ideas for the system. There is no evidence that he had any specific training in bookkeeping during his education at the Friends' schools in Hitchin and York, though it is known that commercial subjects featured in the curricula of nonconformist

academies. It is also possible that he studied bookkeeping as part of his master apprenticeship with the firm (Phillips 1985, 844). Whatever the source of his knowledge, RCR clearly understood the techniques of costing and DEB, and was intent on developing an accounting system which, in his view, would enable him to better understand his business and discover from which activities profits were generated.

A further intriguing question is: Why did RCR begin to interest himself in such questions from 1856 onwards? At the time of the 1856 memo, RCR was still completing his apprenticeship, although shortly afterwards to become a partner in the business. While references to RCR's commercial rather than technical bent may refer to an interest in bookkeeping, they seem more likely to signal actions taken to develop and manage the firm's export trade. While an interest in costs may have resulted from a desire to generate better data for the purpose of price setting, an increasing involvement with such issues during the mid-1850s could have been triggered by the following factors: (1) the somewhat fluctuating fortunes of the business; and (2) the growing range of products produced by the firm (e.g. the development of steam engines, threshing machines²⁵, etc.). Ransomes' 'Profits' grew rapidly during the railway boom of the mid-1840s, but losses were incurred in the years 1849-1851. Profitability was then restored through to the early 1860s, and a desire to know whether it was the railway, the agricultural or the general side of the business which was generating the profits, and how much, is a plausible explanation for RCR's desire to identify production costs.

Without further evidence, it is impossible to be certain why RCR began development of the costing system c.1856, but it is clear that he did so in the absence of instruction from a relevant literature. The appearance of the works of Walker (1875) and Battersby (1878), and also those published during the so-called 'costing renaissance', thus represent the literature catching up with practice, at least as far as Ransomes is concerned. Moreover, we cannot rule out the possibility that other businessmen developed, or attempted to develop, costing systems of their own. This indicates a need for historians to study mid-nineteenth century business archives to achieve a better understanding of the extent to which costing was practised in mid-nineteenth century Britain and to establish more clearly the role of the engineering industry in its development.

Notes

1. Reeve also refers to an exchange of memos in February 1861 between Robert Charles Ransome and John Wood, whereupon the former asked for a 'brief account of the various books, tickets, etc., in use in the Manufacturing Office, and for a statement which would "simply explain to a junior clerk or to a stranger, the various operations by which we arrive at our results"' (TR RAN AD 3/11, f.102). It is indicated that in his reply, Wood provided 'A rough and condensed account of the various books, forms, etc., used in the Manufacturing Office, and appertaining thereunto, showing the several operations by which Ransomes & Sims arrive at the prime costs of manufactured goods, etc., prepared pursuant to instructions of 2mo. 16. 1861 [i.e. 16 February 1861]' (quoted in TR RAN AD 3/11, f.102). Unfortunately neither the original nor any copy of this memo seem to have survived.
2. Fowler established his business producing steam traction engines for agricultural use having initially co-operated with Ransomes during the early and mid-1850s.
3. Material in this paragraph draws on the research findings presented in Edwards (2015).
4. '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).
5. DEB, introduced as the basis for record keeping at the Royal Small Arms Factory in the 1850s was extended to the establishments located at the Woolwich Arsenal in 1864.
6. The question of whether indirect costs should include charges for depreciation and interest on capital invested featured prominently in debates about cost calculation at these government establishments.

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7. Between 1789 and 1881, the business operated under the following titles: 1789 Robert Ransome; 1809 Ransome & Son; 1818 Ransome & Sons; 1825 J. & R. Ransome; 1830 J. R. & A. Ransome; 1846 Ransome & May; 1852 Ransome & Sims; 1869 Ransome, Sims & Head.
 8. The 1809 partnership agreement indicates ownership of two patents: one dated 24 September 1803 for 'chilling cast iron ploughshares' and one dated 30 May 1808 for 'improvements to ploughs' (TR RAN CO1/1).
 9. May left the firm to become a consulting engineer in London in 1851.
 10. The balance accrued to W.D. Sims.
 11. The partnership had taken on the title Ransomes, Sims & Jeffries in 1881.
 12. Two types of 'gain' (or 'loss') are shown: one 'on Trade' and the other 'on P. & L. acct.'.
 13. The Trade Account may pre-date 1845, but this is the first surviving copy of such an account.
 14. The first memo is addressed to Henry Mohum and the second to a Henry Mohun but the signs are that they were the same person.
 15. As is noted below, the emphasis of sections is on product groups rather than a physical location or department. In his notes, Reeve suggests that the 'instructions also laid it down that the same analysis into sections must be carried out in all other departments, that is to say, in the Stock Books, in the Goods Sent Away books, in orders to Works, etc.' (TR RAN AD 3/11, f.101).
 16. The memorandum commences as follows: 'All the accounts of every description, which are kept at the Orwell Works are kept in two sets of books, the Commercial and Manufacturing'.
 17. Samuel Geater Stearn, of Brandeston, Suffolk, was the designer of the registered Suffolk Pig & Hog Troughs manufactured by Ransomes (TR RAN AD 7/39, f.119).
 18. It is not recorded whether this percentage was on wages or materials or some combination of both, though later comments by Reeve (TR RAN AD 3/11, ff.102-103) reproduced below would suggest that it was on wages.
 19. At the time the 1809 partnership agreement was signed, all of the capital was considered to have been provided by Robert Ransome.
 20. The system presumably met with some approval from the accountancy profession since the chartered accountant, J.H.W. Pawlyn became company chairman in 1939. Having served his articles with Messrs. Champness, Corderoy & Company in London, Pawlyn then joined Price, Waterhouse & Co, in 1897, where he undertook the audit of Ransomes, Sims & Jeffries Ltd. He was appointed chief accountant at the Orwell Works in May 1901, temporarily becoming company secretary in early 1917, before joining the board of directors in July 1917 ('Royal' 1939, 72).
 21. The 1878 memo (TR RAN AC 5/6/i) specifically notes that the annual 'Prime Cost Analysis' will be available at the end of January of the following year.
 22. Such a situation was, of course, in marked contrast to that in France, where the cost and financial accounts had traditionally been conceived of as a single entity, enabling cost calculation to be carried out within the DEB system, until their separation as the result of the implementation of the first *Plan Comptable* in 1947 (Boyns, Edwards and Nikitin 1997, 91).
 23. For example, when the leading chartered accountants, Frederick Whinney and Edwin Waterhouse, were engaged by the government, in 1887, to advise on the costing system to be used by government military manufacturing establishments, Whinney described imputed rent as a 'fancy item', interest on capital as 'a very fancy item', and the inclusion of either simply a 'matter of taste and opinion' (BPP 1888 (212), q. 2075, q. 2088).
 23. Reeve's account of costing at the Orwell Works in the early 1920s indicates that, at that date, interest on plant was included in shop charges, while depreciation of plant and machinery was included in trade expenses, though it is unclear when this latter practice commenced (TR RAN AD 3/11, f.18).
 24. In the 1856 memo (TR RAN AC 5/6/iii, f.2) RCR notes that the company is still experimenting with steam threshing machines and that a special account should be opened to include 'all the experimental work done for steam thrashing machines until we had arrived at standard machines'.

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Table 1. Main elements of Cost Analysis Book ('Book A'), 1885

Folios	Contents
6-7	'Weekly wages analysis – annual total for the different shops'
8	'Statement of the different accounts to which wages are charged in the Cost Books'
9	'Payments during 1885 through the Foremen's Wages Book'
10-11	'Annual totals of the wages postings from the "Summaries" 1885'
12-13	'Annual totals of amounts debited to various accounts in the Cost Books containing Customers and Stock a/cs as Working Charges'.
14-15	'Engineering department. Fixtures & Utensils'
16-17	'Boiler Makers Dept. Fixtures & Utensils'
18-19	'Foundry Dept. Fixtures & Utensils'
20-21 to 36-37	Similar entries for other departments, namely 'Forge', 'Agricultural Implement Dept.', 'Park Turners, Fitters, etc.', 'Park Converting Mill', 'Park Saw Mill', 'Park Sundries', 'Stable Dept' and 'Office Dept'
38-39	'Steam Engine & Shafting. Fixtures & Utensils'
40-41	'Lawn Mower Works Dept. Fixtures & Utensils'
50-51	'Statement of Materials charged in the different Cost Books'
56-57 to 70-71	A separate account for each of the eight sections of the business
72-73	'Dr. General Foundry A/c.'
74-75	'Dr. Brass Foundry A/c.'
78-79	'Dr. Timber A/c.'
80-81	'Dr. General Forgings'
82-83	'Dr. Stores A/c.'
84-85	'Coal & Coke A/c.'
88-89	'Steam Hammer A/c.'
90-91	'Dr. Sundry Materials A/c.'
92-93	'Dr. General Trade Expenses A/c.'

Source: Extracted from TR RAN AC 5/1.

Table 2. Ransome male family (abridged)

Founder	Robert Ransome, Sr. (1753-1830)	
Sons	James Ransome (1782-1849)	Robert Ransome, Jr. (1795-1864)
Grandsons	James Allen Ransome (1806-1873)	Robert Charles Ransome (1830-1886) James Edward Ransome (1839-1905)
Great grandson	Robert James Ransome (1830-1891)	

Source: Based on Grace and Phillips, 1975, 19.

Table 3. Sales analysis for 1851

Product	£	£
<i>Railway etc.</i>		
Chairs	27,296	
Wedges	7,908	
Treenails	10,077	
Casks	732	
	<u>46,013</u>	46,013
<i>Engineering</i>		
Turntables	8,923	
Switches & Crossings	4,398	
Water Cranes	692	
Coal Shoots	246	
Bridge Work	2,630	
Screw Piles	271	
Tanks	220	
Steam Engines & Engine Work	5,617	
Iron Boat	453	
Travelly Cranes	386	
Parts of Cranes	228	
Repairs &c	600	
Various	500	
	<u>25,164</u>	25,164
		<u>71,177</u>
<i>Contract Work etc.</i>		
Trucks	4,615	
Bolts & c	2,114	
Various	5,982	
Castings	881	
Freight &c	870	
Various	984	
	<u>15,446</u>	15,446
		<u>86,623</u>
<i>Agricultural</i>		35,174
		<u>121,797</u>

Source: TR RAN AC 7/9.