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KNOWING MORE AS KNOWING LESS? ALTERNATIVE HISTORIES OF COST AND MANAGEMENT ACCOUNTING IN THE U.S. AND THE U.K.

Abstract: In attempting to understand the genesis and scope of modern cost and management accounting systems, accounting historians adopting what has been labeled a "Foucauldian" approach have been rewriting the history of key 18th and 19th century developments in the U.K. and U.S. through new evidence, new interpretation, and a refocusing of attention on familiar events. This is a "disciplinary" history which sees modern cost and management accounting as articulating a new kind of "expert disciplinary knowledge," as well as exercising a "disciplinary power," in the construction of a new human accountability. However, this "disciplinary" view has been challenged by more "economic rationalist" historians, e.g., Boyns and Edwards [1996] for the British Industrial Revolution and Tyson [1998] for the U.S., as being too narrowly concerned with labor control.

This paper takes up the gauntlet. It addresses the theoretical issues and seeks to clarify the import of the "disciplinary view" and its contribution to understanding how 19th century accounting practices shaped emerging managerial discourses, initially in the U.S. It argues that, until businesses adopted this new disciplinarity, there remained an absence of practices focused on calculating human performance, and accounting was not fully deployed to construct that system of "administrative coordination" [Chandler, 1977] which distinguishes modern management action and control.

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INTRODUCTION

We are always rewriting the past, whether through new evidence, new interpretation, or a new focus on old overlooked events. Revisionism constitutes something newly read into some particular aspect of the past—a discovery of new evidence, a discerning of new patterns, a dislodging of old and cherished verities. But what is the knowledge gain? In the flux of such rewriting, and in the contest of ideas it necessarily entails, the quality of the new evidence and the plausibility of the supposed patterns discerned cannot but be questioned. Knowing more may disintegrate into knowing less; the loss of the cherished appraised as too high a price to pay.

We surmise that this is very much the situation currently with the history of cost and management accounting developments in the U.K. and U.S. during the late 18th and early 19th centuries. Authors such as ourselves, so-called "Foucauldians,"[1] are caught up in just such a proliferation of rewriting. In our own view, we are caught in the process of refining and redefining Chandler's [1977] "visible hand" thesis at all three abovementioned levels—evidence, interpretation, and refocus.

First, we have added to the evidence that Chandler adduced for the genesis of modern management by revisiting the sites he identified where forms of administrative coordination were first developed. Chandler specified the Springfield Armory as the place where single-unit management was developed in the context of developing interchangeable-part manufacture, largely under the superintendency of Roswell Lee. We agree on the location, but find that administrative coordination was developed not as a response to the technical breakthrough but as a separate "disciplinary"[2] intervention. Further, credit is ac-

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[1]This identification is an oversimplification as in certain key respects we depart from Foucault's own history or go beyond his own analysis of disciplinary practices, discourses, and institutions.

[2] "Disciplinarity" as we use it refers to new modes both of knowing and of exercising power, where the same set of practices—writing, examining, and grading—are involved in constituting both. Once these practices were translated into business, they enabled a constant tracking of performance, setting of targets, evaluation against norms, etc.—all of which became most powerful when internalized. Thus, a new kind of work control environment developed within hierarchically networked organization structures. So disciplinary power is grounded in the application of expert disciplinary knowledges. Our "disciplinary" approach therefore does not see modern business as a response to specifically economic demands, let alone explicable in terms of a calculus of economic costs and benefits. See further Hoskin and Macve [1986, 1993].

corded not to Lee but to Daniel Tyler, whose systematic work study in 1832, "watch in hand," both identified the time that *ought* to be taken for each task in musket production and reengineered that production process as one of consecutive steps to be followed with minimal bottlenecks. The implementation of the Tyler-based approach from 1841 produced a new, managed manufacturing system [Hoskin and Macve, 1988, 1994a].

As we then pointed out, the practices deployed by Tyler in managing the production system—turning all performance into writing, subjecting it to close examination, and grading the outcomes—initiated a world where targets and results were endemically produced from the past into the future. These became internalized by being integrated into coordinated systems of activities, with individuals often provided piece-rate incentives and governed by strict factory time keeping. This analysis we then applied to Chandler's [1965, 1977] story of how multiunit management was developed on U.S. railroads [Hoskin and Macve, 1994b]. Here again we saw administrative coordination as developed through the application of these practices to the problems of planning, coordinating, and controlling plant and personnel across extended space and time. We, like Chandler, saw the first key player as George Whistler on the Western Railroad, identified by Chandler [1977, pp. 97-98] as the first (in 1841) to adopt a "modern, carefully defined, internal organizational structure," making it "the first American business enterprise to operate through a formal administrative structure manned by full-time salaried managers." The second key railroad was the Pennsylvania (PRR), where the separation of financial and operating functions was achieved, leading in 1857 to the establishment of what Chandler [1977, pp. 105-106] called the first "decentralized line-and-staff divisional form of organization." Also, the continuous generation and examination of detailed information flows on both physical and human assets enabled a low-cost, high-efficiency regime to be established. "Of all the organizational innovators . . . the Pennsylvania Railroad made the most significant contributions to accounting" [Chandler, 1977, p. 109].

In all this, we were following Chandler's evidential trail, but as we undertook our own searching of the archives we found new primary sources of evidence.[3] We were able to track down

[3]The researches of O'Connell [1985] and Ward [1971] were also of valuable assistance. See Hoskin et al. [1998].

the details of Tyler's original work, to study first-hand his autobiography, and to trace the inscription of the implementation of his reforms in the Springfield Armory's payroll records held in the U.S. National Archives. We could show that Whistler implemented the new organization structure on the Western in 1839, not 1841, from day one of the railroad's operation. We could also challenge Chandler's view [1977, p. 101] that the "general principles" of administration were established and that "the flow of internal information" was first perfected on the New York and Erie Railroad around 1854-1855, as what appeared to be substantially identical innovations had already been introduced on the PRR. On the PRR itself, we disputed Chandler's identification of J. Edgar Thomson as the key player and argued for the role of Herman Haupt as the originator of the significant changes in 1851. As we have further argued [Hoskin et al., 1998], Haupt's contribution also included the first known example of an information-rich approach to strategic thinking, visible in proposals and initiatives from 1853-1854.

Thus, we began to rewrite Chandler's general explanation. In particular, where he saw single and multi-unit management as two distinct developments, we could see them as two aspects of a more general breakthrough. First, we could point out how both sets of developments in administrative coordination were achieved by people with a common past since Tyler, Whistler, and Haupt were all graduates of the U.S. Military Academy at West Point.[4] Second, we could suggest that this common past was decisive, not so much because of its military context but primarily because of the radically new pedagogic environment experienced by these West Point cadets. The "disciplinary" practices involved in both kinds of administrative coordination—constant writing, examining, and grading—were introduced into West Point by Superintendent Sylvanus Thayer, appointed to run the Academy in 1817, when both Whistler and Tyler were cadets in the same cohort.

These young men encountered a radically new learning en-

[4]Chandler recognized that there were West Pointers in the story and acknowledged the value of their engineering training. However, he overlooked how they had "learned to learn" under Thayer's new, disciplinary system [Hoskin and Macve, 1988], particularly when he focused on the New York and Erie Railroad and on J. Edgar Thomson rather than Herman Haupt on the PRR. As he viewed their input as marginal and secondary, he reserved the invention of "management" to career businessmen.

vironment which was newly disciplinary in a double way. First, they were subjected to the new discipline of constantly being made to write, and to be examined and graded on the results of their writing, and thereby were made subject to a panoptic system of surveillance and judgment. Constant record keeping on each and all, continuously defining their status as measured by their performance, was internalized in their competition for the highest rank. Second, they were constrained to acquire a new and superior expert disciplinary knowledge, based on studying the works of the French instigators of modern mathematics and science. These West Pointers were the vanguard of the first U.S. generation to become mathematically and scientifically literate. They were well-disciplined, disciplinary experts. Thus, we see the invention of administrative coordination as simultaneously an outcome of remaking humans as highly literate and numerate disciplinary experts, "calculating persons" perhaps, who could then apply their disciplinary knowledge to the coordination of objects, processes, and humans. This is a powerful new knowledge system because it is a knowledge-based way of exercising power. That is the power-knowledge interrelation.

Accounting is a significant factor in this transformation to administrative coordination because it was already there at hand, functioning in existing economic practices in various ways. Double-entry and charge-discharge accounting systems already put values on objects in problematic yet familiar ways. With the translation of writing, examining, and grading practices into the economic sphere, an historically new extension of accounting practice and knowledge occurred. The performance marks of West Point became the performance dollars of accounting. Accounting began to become newly disciplinary in the same double sense, as it was extended from being an accounting for objects or the best use of objects to a concomitant accounting for human performance, including a new kind of decision making concerned with the best joint use of human and physical assets within a defined organizational structure of accountability. Once forms of what we have called "human accounting" began to become integral to the accounting field, accounting as knowledge discovered its modern status as a discipline in its own right [Hoskin and Macve, 1993].

Thus, a new power accrued to accounting, but only because aspects of accounting remained the same. From Roman times and earlier still [Macve, 1985], as later in double-entry and charge-discharge formats [Hoskin and Macve, 1986], accounting had been a practice that turns events into writing, renders

them open to examination, and puts values on events and objects. In this respect it continues to remain the same, but at the same time it gains a new significance because it expands so effortlessly to take on the "human accounting" dimension. We then identify, as one precipitate of this expansion, a new discourse of accountability. As we have pointed out [Hoskin and Macve, 1988], accountability is a neologism of this general period. We find a reference at Springfield in 1819 to the "system of accountability" to refer to the proper stewardship of objects. But the expansion of accounting to incorporate human accounting leads to the term taking on its modern connotation of a general and human accountability. It becomes a term whose scope goes beyond being held responsible to identification through accounting norms as being responsible. Moreover, as new expertise in the technology of value calculation is created, one can also be called to account for what is yet to come, which is now nameable through prediction or prescription.[5]

In this respect we believe we have captured precisely what Chandler set out so forcefully in the introduction to *The Visible Hand* [1977]; namely, that modern management was a rupture in economic history. It displaced the power of market mechanisms by inventing a new kind of institution, the managed entity or modern business enterprise. By capturing cost and efficiency benefits internally and enabling a planning and coordinating of activity across time and space, often by "fiat" [Coase, 1937], the managed entity preempted, displaced, and fundamentally remade market relations. Managerialism engendered oligopoly because it was so feasible, via administrative coordination, to construct large organizations where managers manage other managers. Such organizations proved able to generate such economic rents that they could dominate and remake their sectors, even as they dominated and remade their work forces. Administrative coordination was, in this sense, a new kind of power, which has ultimately remade the parameters of the economic and organizational worlds.

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[5]None of this says that accounting was not significant before, nor that individuals were not judged before through their accounts. But these were traditionally prominent people already identified as significant individuals before the accounts were prepared. Such stewardship accounting dates from ancient practice, through medieval estate accounting, to modern times. What is different about the new human performance measurement is that it created "calculable persons" within mass populations [Hoskin and Macve, 1986; Miller and O'Leary, 1987].

In our view, Chandler's radical insight has become distorted as his work has been claimed by others as an historical basis for approaches such as transaction cost economics [Williamson, 1985]. We aim to reassert Chandler's radical insight, captured in the "visible hand" metaphor, by emphasizing how the invention of administrative coordination was not, as such, an economic invention.[6] It was, as a combination of writing, examining, and grading, a means to inventing a new kind of economic world.[7]

Our theoretical concern then is to give back to the theory of the visible hand both its metaphorical and substantive force. But, of course, such a rewriting occasions questions and disputes over the evidence, the adequacy of the theorizing, and the refocusing of debate. Thus, the issues of the early 19th century period, and of the relative significance of U.S. and U.K. developments, have been posed in acute new ways. Much valuable new evidence has accrued as a result, something we welcome. Further, the precise delimitation of terms such as "management" has come in for searching question [cf. Hoskin and Macve, 1990]. The roles of accounting in business and in non-business contexts have been seen as multiple. New levels of analysis have therefore proliferated as part of that general rewriting to which we have contributed.

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[6]Chandler [1977] himself did not believe that the new levels of administrative coordination introduced into the Springfield Armory and the early U.S. railroads could be explained by economic rationalism as they were introduced primarily by salaried managers rather than entrepreneurial owners, and their sophistication went beyond what was needed for adequate coordination of business activity and for economic survival.

[7]In this world, there are arguably three key precipitates, each of them a direct product of the new combination of disciplinary practices. First, there is a new form of the "subject" or self, as the calculable/calculating person. Second, there is a new form of "organizing," as a process of reticulation or networking. Here constant writing, examining, and grading make possible the hierarchical and accountable connection of subjects and groups of subjects into entities that therefore seem made up of interconnected parts. Third, yet concomitantly, comes the regime of information as a precipitate of our "grammatocentrism." In our organizations as much as ourselves, the secondary rewriting of events, acts, and objects becomes increasingly primary. From the topmost manager to the lowest managee, working life is directed and shaped via the circulation of multiple narrative and calculative texts. Decision is translated into a choosing from among the set of written, examined, and graded alternatives at hand. We therefore find profoundly problematic any theory that takes as its objects of analysis the subject as rational, the organization as structure, and information as objective.

In particular, historians representing the "neoclassical revisionist"[8] or "economic rationalist" school of thought have established more clearly that elaborate accounting reports were prepared in U.S. private enterprises from the early 19th century, such as at the Waltham-Lowell mills [Tyson, 1998] and later at Waltham Watch [Fleischman and Tyson, 1996]. They were equally found in major industrial enterprises in Britain [Edwards et al., 1995; Boyns and Edwards, 1996, 1997a, 1997b; Fleischman and Parker, 1997]. Such accounting reports served management decision making in these sites, they argue, and entities became coordinated into increasingly large-scale industrial enterprises, in developments that they see as rational economic responses to the demands placed on management by technological innovation and economic growth.

Economic rationalist historians, based on archival evidence from the U.K., attempt to demonstrate the utilization of an array of accounting practices that still form part of the accountant's portfolio of techniques today. Accounting was a vital ingredient in contractual arrangements between owners, whether among the partners in a firm or in organizing and monitoring the operation of owners' cartels. It informed managers' concerns with expenditure control, with evaluating technical efficiency improvements through increased mechanization, and with major operational expansion/contraction decisions. Recent evidence from significant British Industrial Revolution (BIR) industries, such as Boulton & Watt's Soho Foundry, the Dowlais mining/ironworks complex, and the Northeast collieries [Fleischman et al., 1995; Boyns and Edwards, 1996, 1997a; Fleischman and Macve, 2000], has reinforced the evidence from the work of earlier historians [Stone, 1973; Jones, 1985] as to the variety of accounting's contractual and managerial roles. It also has contributed to refuting Pollard's oft-quoted conclusion [1965, p. 248] that "the practice of using accounts as direct aids to management was not one of the achievements of the British industrial revolution."[9] Consequently, these researchers would argue that the prime focus of research into the management accounting history of this period should be on investigating this variety of ways in which modern

[8]For the content of "neoclassical revisionist" history, see Loft [1995].

[9]Some guarded recognition of the significance of this new evidence is given in Wilson's [1995, pp. 29-31] synthesis of British business history.

accounting practices developed, to meet the demands of a range of organizational objectives under varying conditions.[10]

It has not been our purpose to deny the sophistication of the accounting practices developed in the BIR; indeed, they offer some of the earliest exemplars of the range of accounting practices also found in early industrial enterprises in the U.S. and elsewhere. But, given the disciplinary framework of analysis we have adopted, we would argue that the extension of such modern accounting techniques does not in itself explain the fullness of modern accounting's power. Instead, one must address the question posed by Miller and Napier [1993, p. 632] of "the extent to which 'successful' accounting methods transform the entities and practices of which they provide a calculative knowledge." The issue, we suggest, is to identify how far there is an integration of the accounting into the disciplinary nexus of practices.

As specific subquestions, one may ask, how far does organizing as reticulation in the sense of constructing networks of individuals and spaces for decision making, action, and creation of corporate identities become endemic? How far does the population of organizational selves become calculable and calculating? How far is there a privileging of information as objective? These, we suggest, are the key features of the new economic world of the modern business enterprise. Only in this context does accounting, we suggest, develop its distinctive modern power and status as a valuing technology, via its objectification, classification, and surveillance of human performance.[11] This is why we have seen the crucial historical question, the crux, for historians of management accounting as the identification of sites where and when human accounting was initiated. Demonstration of accounting's presence and useful-

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[10]For example, Fleischman and Parker [1991] rated historical management accounting practices along four dimensions: cost control, overhead accounting, decision making, and standard costing.

[11]Thus, do we enter the world of which Miller can say, "Far from being neutral devices for mirroring the social world, the calculative technologies of accountancy are complex machines for representing and intervening in social and economic life. Along with allied expertises, the creation of calculating selves and calculable spaces enables a normalization of individual lives that is cast in financial terms. The visibility conferred on the calculating self who occupies a specific locale within a loosely assembled network of calculable spaces is intrinsically linked to norms of financial performance. Ways of organizing and ways of calculating have developed hand in hand" [Miller, 1992, pp. 78-79].

ness in other ways, traditional or new, while important, is no longer enough.

In spite of a growing fashion for accepting pluralities of theoretical approaches and of methodologies in accounting history research [Carnegie and Napier, 1996; cf. Oldroyd, 1999], we find that a number of recent papers have directly attacked our own theoretical arguments and interpretations of evidence and charged that we have misread and misunderstood the historical significance of a variety of 19th century accounting developments. We therefore now turn to face our critics and review the evidence so far obtained from the archives of a number of significant early BIR and U.S. organizations. We continue to maintain that, despite a variety of conditions, no evidence of the application of our type of human accounting has yet been found in the U.K. at the time when such a development is observable in certain seminal organizations in the U.S. Nor is that development explicable within the U.S. in non- or antidisciplinary terms. On the contrary, even where the evidence at first appears to lead elsewhere, we argue that it actually proves to reinforce the disciplinary explanation of modern management's genesis.

Of course, a proviso must be offered. We recognize that archival evidence alone can never enable us to resolve the debate between the neoclassical revisionist and Foucauldian perceptions of the processes by which modern accounting and modern management evolved.[12] Our thesis remains as subject to falsification by evidence yet to come as any other. An accumulation of such evidence therefore remains essential in order to enable us to piece together more of the jigsaw of our theoretical understanding of how such developments occurred.

The structure of the rest of the paper is as follows. The next section sets out our concerns over the adequacy of conventional economic rationalist analysis as a sufficient explanation of the development of accounting's modern power. We also indicate briefly how our approach may be seen as relating to the recent

[12]The cases of Boulton & Watt, Dowlais, the Northeast coal mines, and other BIR firms examined to date constitute only negative archival evidence in the matter of a possible U.K. breakthrough to managerialism. We see U.S. cases such as the Lowell-Waltham mills in a similar light [Hoskin and Macve, 1996], to be distinguished from sites such as the Springfield Armory and certain early railroads in the matter of where and when the breakthrough was made.

work on U.K. and U.S. developments. We then focus in following sections on historical works that have directly or indirectly attacked our evidence and/or framework. We note here that we are frequently criticized for being too narrow, in particular for focusing purely on labor productivity or standard costing. We hope it is clear from the theoretical discussion above that this is not our general concern. At the same time, we recognize that there have been papers [e.g., Hoskin and Macve, 1994a, 1996] where we have focused on demonstrating specific aspects of our case, such as the details of management's development at the Springfield Armory, which may have led this part of our analysis to be taken as an adequate proxy for the whole. Subsequently, we provide brief responses to the critique put forward in some of the major recent papers and books by Boyns and Edwards, and by Tyson in sole-authored and joint papers, concerning our interpretation of historical developments. We then consider how our theoretical approach might be reconciled with the views expressed in surveys of recent work in accounting history, such as those of Miller et al. [1991], Stewart [1992], Miller and Napier [1993], Loft [1995], Carnegie and Napier [1996], Fleischman et al. [1996], Funnell [1996, 1998], and Oldroyd [1999]. We offer a brief summary of our conclusions on the debate so far. The concluding section sets out our view of the priorities for further research into the paths by which the networks that transmitted the "new" 19th century accounting were extended, apparently first in the U.S., subsequently in the U.K. and Europe, and now increasingly globally. Accounting's history must be rewritten so that we and other researchers, while discarding some currently cherished knowledge along the way, will indeed arrive at "knowing more."

ECONOMIC RATIONALISM: AN INSUFFICIENT EXPLANATION OF ACCOUNTING'S ROLE IN THE HISTORICAL DEVELOPMENT OF BIG BUSINESS

The economic rationalist view of accounting's history over the last quarter of this millennium offers an appealingly simple, functionalist account of technical response to the changing economic demands of the industrial revolution and the rise of big business. By Occam's razor, we should avoid elaboration of more complex explanations if a simple one will do. Why is the economic rationalist explanation unsatisfactory? There are three interconnected levels at which it must be challenged—the theoretical, the evidential, and the historiographical.

The Theoretical Level: The new accounting practices of the 18th and 19th centuries are argued by our critics to have provided necessary tools for management decision making and coordination of increasing complexity in new industrial revolution and managerial revolution firms. Others who have evaluated the practices of routine cost accounting from the perspective of economic theory, in particular its handling of the rapidly escalating burden of fixed costs that characterized the economics of the increasingly capital-intensive operations of these firms, have long condemned these routine practices as inadequate, if not downright inappropriate, for supplying the information needed by owners/managers for optimal allocation of resources. Particular culprits are the calculation of depreciation cost, the abandonment of the calculation of implicit interest cost, and, more generally, the arbitrary allocation of fixed overhead cost, driven by an emphasis on calculating average actual unit costs of products. Past total unit costs are themselves of little relevance to, and indeed may distort, rational decision making [Coase, 1938; Wells, 1978; Johnson and Kaplan, 1987; cf. Boyns and Edwards, 1997a].

Such theoretical critiques of accounting practice are themselves largely founded in theoretical neoclassical economics and a model of decision making that is atomistic and choice-theoretic, concerned with "constrained optimisation" [Jones, 1997]. However, more recent institutional versions of this rational economics, as applied to the new, large 19th century firms, do focus more on the relative transaction costs (more generally, information costs) of economic coordination through firms rather than markets [Casson, 1997]. They also address the particular strategic capabilities that provide individual firms with competitive advantage, whether they be innovators or established firms [Best, 1990; Kay, 1993]. These capabilities are argued to include a firm's particular structural architecture, the appropriate balance between formal, internal rules and organizational routines, on the one hand, and the flexibility needed to innovate and adapt to change on the other.

This line of economic analysis opens up a role for accounting routines in facilitating the construction and monitoring of activity both internal and external to business organizations. For more mainstream economists, the focus here is on how accounting assists with the construction and monitoring of the nexus of contracts, both formal and implicit, that is their heuristic model for the analysis of the economic structure of busi-

ness organizations [Coase, 1937; Jensen and Meckling, 1976; Williamson, 1985].[13]

This literature of transaction cost economics focuses primarily on analyzing the optimal equilibrium organizational structure, given *inter alia* the potential benefits and costs of alternative information systems. It has little if anything to say either about the processes by which firms emerge, grow, and survive/decay, or about the observed variety of organizational forms at different times and in different countries [Perrow, 1986; cf. Best, 1990; Casson, 1997; Jones, 1997; Gwilliam et al., 2000]. Nevertheless, it has enabled the forging of a strong link between economic theory and business history, as its theorization of the inevitability of large industrial firms [Williamson, 1985] fits with Chandler's [1990] history of the 19th and 20th century growth of the U.S. managerial firm, ultimately represented by the multidivisional, multinational "M-form" business.[14]

A significant criticism, however, of all current accounting history, both traditional and new, would be its relative lack of reciprocal success to date in penetrating the core of modern organizational theorization. While some historians, in addition to Chandler, have begun to recognize accounting's significance as the ideal of modern administrative efficacy in connecting the world to what Latour [1987] has called "centres of calculation" [Porter, 1995, pp. 50-51], there has been little identification in mainstream management texts of the importance of accounting practices in contributing to alternative approaches to the design of organizational strategy and structure. As argued recently by Boyns and Edwards [1997b], the conventional wisdom in U.K. business history persists in concluding that there was little in the development of cost and management accounting techniques in U.K. businesses that has been shown to be significant to the development of those businesses before the end of the

[13]This analysis is also consistent with recent theoretical research on accounting's role in facilitating incentive-compatible contracts for managers within an agency theory structure, focusing on the conflicting objectives of organizational participants [e.g., Feltham and Xie, 1994; Gietzmann, 1995; Wagenhofer, 2000]. It is also consistent with the traditional historical importance of audited accounting reports in monitoring stewardship, partnership, and other agency contracts, as well as linking to accounting's more modern external roles in relation to capital markets and regulatory compliance.

[14]We discuss critiques of Chandler's thesis in the historiographical section below.

19th century, despite increasing recognition in recent years of the work of economic rationalist accounting historians (e.g., Boyns and Edwards themselves and Fleischman and Parker).

The challenge therefore remains to develop the theory of how business accounting became powerful, in such a way as to persuade skeptical, mainstream business and economic historians that an understanding of accounting is vital, if not central, to their own agendas. An heroic challenge [Hoskin and Macve, 1993; cf. Napier, 1996a, 1996b]!

Under a transaction or information cost approach, it may be argued that cost and management accounting routines conferred comparative advantage on those businesses that adopted them as compared with those that did not, even though they were suboptimal.[15] Thus, the arguments of Coase [1938] and Wells [1978] might be theoretically correct but not relevant. However, economic rationalists could only argue that suboptimality would have been consciously preferred to optimality *ex ante*, if decision makers would also have been able to evaluate *ex ante* the likely costs and benefits of differing degrees of sophistication in potential accounting calculations. This seems implausible.[16]

A more plausible version of this theory, as in Boyns and Edwards [1996, 1997a], is that the accounting routines found in the archive emerged as an intensification, modification, or byproduct of existing routines used for other purposes. If subsequently found to confer some economic advantage, even if not ideally suited for the purpose, what began as supplementary to economic management increasingly became central.[17] Then *ex post,* the costs of moving from existing suboptimal procedures to more sophisticated procedures may have appeared as prohibitive and imposed a path dependency that constrained the final outcome.

However, it would be theoretically much more compelling to identify first what led to the original adoption of those pre-

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[15]This argument is advanced by Tyson [1998] although it is not developed there.

[16]A similar objection may be made to the idea that firms are able to evaluate *ex ante* the relative transaction costs of firm versus market organization as posited by Coase and Williamson [Jones, 1997].

[17]By extension such routines could be suboptimally useful for a number of purposes, albeit ideally suited to none. Such an explanation resuscitates Derrida's [1976] idea that there is a "logic of the supplement," as discussed in Hoskin and Macve [1993].

cursor routines, and to investigate whether their adoption related to some other organizational, social, or economic changes, and only then to consider what particular changes in internal conditions provided the opportunity for their successful modification. This has been a focus of our own agenda.[18] Given that wider explanatory frame, economic rationalists might then wish to demonstrate, by analogy with evolutionary biology, how modified or intensified suboptimal practices did actually contribute a new economic advantage, and why, where they then remained in place, they were not in turn replaced by further superior alternatives.

But to say, as they tend to, that the routines found in the archive must have represented the optimal trade off of costs and benefits (given the decision-making and other uses that economic rationalists wish to attribute to such routines) is empirically empty and essentially tautological. What is still generally missing is an historical explanation for why particular routines and their subsequent modifications were the ones that were actually chosen and why consideration/experimentation was not given to possible alternatives that may have been even more cost-beneficial [Casson, 1997].[19]

The economic rationalists identify the adoption of cost and management accounting routines with the provision of information for improved decision making. But how are these to be linked? By way of illustration, take, for example, an accounting information signal, such as "cost" or "profit," that is correlated, albeit imperfectly, with the "true" economic performance of the item of interest. The calculation of the measure signaled may originally be a byproduct of some other accounting routine; e.g., the maintenance of double-entry records for the purpose of basic accountability over resources [Yamey, 1949]. Such a signal may be superior to no information, or to less well-correlated signals. But if the signal is still very "noisy," it is only likely to be advantageous for decision making on average; e.g., where there is a routine repetition of decision outcomes, as in continuous statistical quality control of an operational process.

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[18]For example, Hoskin and Macve [1996] argued that the use of precise, but arbitrary, unit costings at the Waltham-Lowell mills emerged from the steps needed to perform calculative routines, and from the need to check their accuracy, in an age of calculation by hand. Tyson's [1998] critique of this paper is discussed further below.

[19]Oldroyd [1999] pointed out the force of "inertia." However, we also need an explanation for the historical changes that do occur.

Accounting certainly can and does provide such statistics. Such a noisy signal will, however, generally be of little value for the major, more strategic decisions on pricing, output, and scale of investment and on fixing performance rewards. The latter has been the major focus of economic rationalist historians in arguing for the importance of 19th century management accounting developments [Boyns and Edwards, 1997b; Tyson, 1998]. Yet, accounting routines for the reporting of costs and profits are generally regarded as *extremely* noisy [Edey, 1970].

This noise further implies that, given the existence of increasingly standardized accounting routines, the comparative advantage, *ceteris paribus*, will lie with those firms that understand how to use them to best advantage,[20] or how best to combine them with other sources of information. This in turn means that the focus of archival enquiry needs to be as much on the material that provides insight into the contexts within which these accounting systems were employed and interpreted, as it does on the evidence of the accounting records themselves. This kind of approach is consistent with those organizational theories that see the secret of successful architecture in the balance of routine/nonroutine and formal/informal systems [Kay, 1993; Casson, 1997]. We discuss these issues further in the next sections on the evidential and historiographical levels.

The Evidential Level: The argument here can be stated briefly. It is not generally possible to deduce from the existence of the routine, formal accounting records themselves the purpose or purposes to which the information was put.[21] As will be discussed further below, even economic rationalists generally have to admit that, while they (like us) can produce evidence of an impressive array of increasingly complex, routine cost accounting records, both in the U.K. and the U.S., they are generally only able to suggest how the information could potentially have

[20]The history of cost accounting is replete with examples of situations where divisions, processes, or products appeared unprofitable under the basis of overhead allocation adopted, so that the management wisely changed the basis [Wells, 1978, p. 84].

[21]This contention lies at the heart of much of Yamey's work in demolishing the claims of those who have seen the emergence of double-entry bookkeeping in the 13th century as an essential tool of a new "rational capitalism" [Yamey, 1949]. Similar skepticism needs to be applied to the accelerating emergence of elaborate cost accounting records in the 19th century.

been utilized [Tyson, 1992, 1998; Boyns and Edwards, 1997b]. The major exceptions, of course, are 1) those records that explicitly compute future outcomes, which can only have been prepared in the context of decision making or negotiation, and 2) those records that were clearly prepared as the basis for contractual negotiations or *ex post* settling up.

Apart from these clear exceptions, the existence of the formal records of past performance, normally identified with double-entry accounting ledgers and supporting analyses, do not in themselves help us to deduce the internal management purposes for keeping them. How they were used is also problematic, other than very broadly as a potential statistical data base from which data might be extracted and/or extrapolated for estimates of future outcomes and *ex post* checks on actual outcomes as, for example, at Dowlais [Boyns and Edwards, 1997a]. But accounting is much more than useful statistics. If it were not, it is hard to understand how it developed so dramatically beyond being just one more of the tools in the manager's toolkit, providing the basis for the emergence of a much more highly rewarded, stand-alone profession [Matthews et al., 1998].

In summary, one must remember the old historian's maxim. When one is reduced to arguing "it is likely that . . . " or "there can be no doubt that . . . ," one generally means "there is no evidence that . . . "

The Historiographical Level: While Chandler's history has been contested as an explanation for the growth of firms outside the U.S. [Hannah, 1983, 1991; Jones, 1994], it represents what is now the conventional template for describing and explaining the relative growth of big business on both sides of the Atlantic [Payne, 1988; Schmitz, 1993]. It has also been used by Boyns and Edwards [1996] as a framework for exploring the role of accounting systems in the development of complex business enterprises, such as Dowlais in the 19th century in the U.K.[22]

Even within this historico-theoretical account of the construction of large business organizations, the role and significance of routine cost and management accounting practices remain problematical. Both the economic rationalist and disciplinary frameworks of accounting history, in so far as they

[22]However, in Boyns and Edwards [1997a] they argued against a Chandlerian explanation of developments at Dowlais in the 1850s.

build on Chandler's pioneering work, emphasize the value of the new routines of accounting among the range of practices which characterize the emergence of the new managerial firms. Here managers control other managers and ultimately, in an increasingly global environment, top managers are themselves controlled not by individual, entrepreneurial owners, but by the corresponding managerial hierarchies of financial institutions, competitors, suppliers, auditors, and/or regulators. All of these are subject to ever-increasing internal and public accountability. Their decisions and actions are scrutinized not only for their financial efficiency but also for their disinterested objectivity. These demands bring unremitting political, social, and economic pressure to emphasize the transparency of the process by which decisions are taken and actions monitored. The focus is on verifiable outputs or performance indicators rather than on the underlying value of the outcomes of those decisions and actions [Brunsson, 1989]. The processes of accounting systems and the quantifiable output measures that they report are among the practices that are most accommodating to this insatiable need for more and more seemingly objective verification [Porter, 1995; Power, 1997].

In this context it is somewhat paradoxical to find ourselves often being criticized for the narrowness of our view of management accounting [Boyns and Edwards, 1996; Tyson, 1998]. For our distinctive emphasis has been on the constitutive role of accounting practices and discourses in the widespread 19th century development of the new kind of human performance measurement which created "calculable persons" within mass populations [Hoskin and Macve, 1986; Miller and O'Leary, 1987].[23] If anything, we might have expected to be criticized more for a tendency to see everything modern as yet another accounting, thereby failing to identify important differences between the development of particular business accountings and other modes of accountability and calculative routine.

What we do have here is a major historical question: what is the connection, if any, between those business accounting developments that both we and economic rationalist accounting historians have charted from the late 18th century and

[23]Practices that we have labeled "grammatocentric" [Hoskin and Macve, 1994b].

these wider developments in accountability and, in particular, in calculative technologies?[24]

If there is none, accounting's history may still be important purely from a business perspective although, as already observed, the limited theorization to date of its importance within the economic rationalist framework, both at the general level and, more significantly, in respect of specific accounting techniques, has so far prevented its entry into the mainstream of business history and organizational theory. But a potentially greater illumination still lies in identifying wider linkages to changes in economic organization and society, to the phenomena of increasingly global markets, and to rapid advances in information technology, and new reflexivities between social structures and individual actions and freedoms, now deemed among the key characteristics of modernity [Giddens, 1991, 1999]. The quest may fail. But if it is to succeed, it suggests that a priority for the accounting history research agenda is a focus on the relationship between accounting developments and the wider historical developments in creating "calculable persons in calculable spaces" [Miller, 1992]. This focus has been central to our own research agenda [Hoskin and Macve, 1994b], as well as to our work with collaborators from a more economic rationalist tradition.

This has led us, when it comes to specific research questions, to argue that the historical crux is to identify the discontinuity between early attempts at costings for accountability, decision making, and control purposes, and what may be seen as the modern approach based in a human accounting. Hence we argue, in terms of tracing a new "normalization of human action," for the need to trace where, when, and why labor standards were first articulated and systematically implemented, when the focus shifted from machines to men. Such standards introduce new practices and a discourse which extends beyond the engineering standards that assess materials and machine efficiency to the establishment of norms of human performance for modern managerial control [Fleischman et al., 1995].[25] It is

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[24]In this respect, Miller and Napier [1993] asked pertinent historical questions, even though we would argue that the conclusions they drew as to the relevant archive were largely misplaced.

[25]Reference to labor standards does not imply the full panoply of labor standard costs and variance analysis that developed as part of the Taylorist efficiency movement of the late 19th/early 20th century [Fleischman et al., 1995, pp. 166-167]. Tyson [1998] here missed the point at issue (see below).

only a first, but it is nonetheless a crucial, step towards inventing the modern, increasingly internalized, human accountability, not just of labor but of all organizational participants, including all ranks of management, in a "hierarchy of mutual surveillance" that extends throughout and outwith the organization [Ezzamel et al., 1990].

It was in addressing this specific research question that Fleischman et al. [1995] found that, although Boulton & Watt was an engineering firm in the vanguard of BIR accounting practice in the sophistication of its records, the transition from highly sophisticated engineering standards for the material components of constructed steam engines to comparable standards of economic performance and labor efficiency was not achieved, despite an initial, impressive attempt around 1800. The famous piece-rate regime for which the firm has become renowned was found to be an isolated episode that did not presage the birth of modern managerialism. The historical discontinuity, the crux which introduced systems of control discipline of the kind that, through internalization of performance norms, nowadays "quietly order us about" [Foucault, quoted in Megill, 1979, p. 493] was still to occur.

Both Fleischman et al. [1995] and Boyns and Edwards [1996] called for confirming evidence to support the findings about Boulton & Watt in a wider application. And, as an example, Boyns and Edwards's own work [1996, 1997a] on the Dowlais ironworks demonstrated that accounting control over labor was not one of the features of the increasingly sophisticated use of the accounting system there in the mid-19th century.[26] Clearly more work needs to be done, and indeed the focus of various economic rationalist historians on unearthing the range of early accounting developments is itself grist to our mill. For the more evidence that is forthcoming of the sophisti-

[26]More recently, Fleischman and Macve [2000] have reexamined the archive of the coal mines of the Northeast of England during the late 18th and early 19th centuries. Their examination of the records shows, once again, that detailed accounts were kept of output and of the efficiency of inputs of materials and use of equipment (horses and engines). In this regard, their findings reinforce the growing evidence of the sophistication of BIR cost accounting, roughly dated 1750-1850, back to its origins in the 18th century. But, strikingly absent is any correspondingly detailed examination of human performance to provide a scientific determination of what should be a "fair-day's pay for a fair-day's work" as a basis for setting the piece rates for the miners, a practice that we have identified in particular U.S. contexts in the first half of the 19th century [Hoskin and Macve, 1994a].

cation of accounting developments in many other respects, both in the U.K. throughout most of the 19th century and in the U.S. before the Springfield Armory episode and the organization of the railroads [Hoskin and Macve, 1988, 1994], the more striking to us is the absence of what we call "human accountability."[27]

As we shall set out in our conclusions, this focus on the specific research question of how this kind of human accountability was introduced does not constitute our whole research agenda. However, we do regard it as a key piece of the jigsaw if we are to understand how the new power of accounting has changed both business strategy and its structure.

We now turn to the specifics of our critics' attacks. In order to avoid much repetition and the temptation to wander into interminable byways of alternative refutations of possible alternative interpretations given by one author of another, we set out here a highly simplified schema of our own view of the crucial discontinuities and linkages in the development of modern management accounting. Certain points are already supported by our own research and that of others to date; other components are still tentative and need further research, including further reexamination of archives which others have previously interpreted differently. We shall then be able to distinguish those of our critics' arguments which we consider reflect a misunderstanding of our own position and those where we have substantive disagreements to resolve. We therefore present the following propositions which will be subsequently referenced by the corresponding letter:

A) Accounting has always embraced cost and management accounting in the sense of analysis of activity and the use of accounting information for choosing, planning, and controlling activity.[28] These purposes remained embryonic until choice between significant economic alternatives became available

[27]While we have been criticized [Boyns and Edwards, 1996; Tyson, 1998] for the "narrowness" of our approach, and apparently been ignored by Miller et al. [1991] and Carnegie and Napier [1996], we would hope that accounting historians who do not share our own theoretical lens would nevertheless find value in the archival data that we and our collaborators have unearthed on the range of accounting practices in the U.S. and U.K. enterprises that we have ourselves examined. That is as much, perhaps, as an historian can legitimately ask of professional colleagues, however strong his or her own theoretical priors [de Ste. Croix, 1981].

[28]We accept, of course, that such concepts are part of a modern mentality which cannot be literally translated to earlier times [Miller and Napier, 1993].

[Macve, 1985]. They clearly gained a new intensity in the industrial revolution as technological innovation accelerated, as well as acquiring a much more significant role in enabling the coordination of large enterprises. The extent of those changes is an important area of accounting history research. At the same time, the financial aspect of accounting's role also intensified with the increasing separation of ownership and management and the increasing replacement of individual capitalist entrepreneurs by passive, dispersed shareholders [Yamey, 1977].

B) These 18th-19th century developments occurred in both the U.S. and the U.K.,[29] but at different times and to different extents, reflecting, *inter alia,* the longer persistence of family-owned and managed firms in the U.K. and a greater emphasis on informal and social methods of control in the U.K. versus formal, rational, and objective methods in the U.S.[30] The differing developments in management accounting are paralleled by differing developments in financial accounting. The professional influence of auditors came earlier in the U.K. [Armstrong, 1985; Matthews et al., 1998] while formalized standardization and regulation of accounting and auditing practice under the aegis of the SEC came much earlier in the U.S. [Macve, 1997].

C) A leading characteristic of modernity, certainly by the end of the 19th century, is the creation of "calculable persons in calculable spaces" [Miller, 1992], a new objectification of human performance and normalization of individuals within large statistical populations, linked also to new modes of state intervention in economic and business affairs. Given that rapid population growth and mass employment are features of the 18th-19th century economy on both sides of the Atlantic, it is relevant to enquire how far the significant discontinuity from which this characteristic of modernity has emerged may be argued to have had its genesis nearer to the beginning rather than to the end of the 19th century [Hacking, 1990; Defert, 1991; Ewald, 1991], and how far it is associated with changes in the management of business itself.

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[29]There is not space in this paper to consider developments in other 18th-19th century industrializing countries, although we mention the case of France briefly below.

[30]These characteristics, in turn, reflect the very different social history of the two countries, especially given the largely indigenous population of the U.K. versus the highly immigrant population of the U.S.

D) "Ways of organizing and ways of calculating have developed hand in hand" [Miller, 1992, pp. 78-79]. In the U.S., significant changes in the organization of business structure and accounting, linked to changes in business strategy, have been identified by Chandler at the Springfield Armory in the 1830s and on the railroads beginning in the 1840s. Our own reexamination of these archives has identified the most significant of these developments, both at Springfield and on the railroads, with engineers who were graduates of West Point, where their education under the new system introduced by Superintendent Thayer from 1817 was based on writing, examining, and grading all aspects of a student's performance, within a highly divisionalized and decentralized administrative structure. We argue that this disciplinary experience was a major factor influencing the approach taken by these graduates to the business reorganizations in which they played a leading role. They inculcated a new "grammatocentric" power-knowledge regime of management practices and discourses, which, following Foucault's [1977] analysis of modern knowledge and power in society generally, may be seen as comprising a system of objectification of human performance within a hierarchy of mutual surveillance. Both Springfield and the railroads were also important centers for the diffusion of new technologies, including these new technologies of management, so that the changes there had a much wider influence. This new managerial dimension of human accountability, we argue, combined with the existing technological and other economic factors that had already made Britain the wealthiest industrial country in the world, now enabled the new managers of U.S. business rapidly to overtake the U.K. in economic power during the 19th century, albeit starting from a negligible base.

E) In the business context, the distinguishing features of this new human accountability included, on the accounting dimension, the development of standards of work performance as a basis for fixing piece rates and wages, thereby providing at the shopfloor level both discipline and economic incentive to the work force to internalize business goals so as to begin to become governable persons [Miller and O'Leary, 1987]. At higher levels of management, a comparable, increasing emphasis on performance measurement reflected alignment with top management's emphasis on return on investment, linking the accountability and incentives of top management through financial accounting to owners' returns. On the organizational

dimension, a new emphasis on formal structures, which in the U.S. culminated in the divisional or "M-form" organization of profit centers, was reflected in linkages between accounting and organization, and between strategy and structure.

F) While the U.K. in many ways retained its distinctive management culture, it has always been fascinated by U.S. developments and been eager to import at least aspects of American innovation. Today, the American model of calculative, managerial enterprise dominates. This is not to argue for the "Ambrit" fallacy criticized by Littler [1982, p. 50] and others [Boyns and Edwards, 1996, p. 47]. As already argued, U.K. and U.S. accounting and management practice developed in different ways in the 19th and early 20th centuries. However, there was gradually increasing interchange, through the emergence of U.S. cost accounting literature and scientific management at the end of the 19th century [Fleischman, 2000]; through various British governmental and other official attempts to investigate what was held out as being American best practice; and, in the 20th century, through U.K. chartered accountants "learning American cost-accounting principles and procedures," whether as individuals working for American-owned firms [Matthews et al., 1998, p. 210] or by officially visiting the U.S. to learn about management accounting itself [Anglo-American Council on Productivity, 1950, cited by Boyns and Edwards, 1996, p. 46].

G) The combination of these factors suggests the need for a wide-ranging, theoretical and historical research agenda which covers developments in both management and financial accounting and links them to wider structural changes in business, business education, and beyond [Gwilliam et al., 1992]. However, it may be that only some of the above propositions can survive detailed examination of the historical evidence. Almost the whole chain of linkages would be shattered if certain key links were destroyed. From the perspective of accounting, the key links are clearly D and E. So here is where we have focused the majority of our research to date. Given the critiques that have been made of it already, as analyzed in the next two sections, we need to be careful to spell out exactly what we are saying at these points. We shall refer to them further in addressing the specific criticisms that have been made.

BOYNS AND EDWARDS

From a wide range of detailed conceptual and archival

work by Boyns and Edwards and their collaborators on BIR and French firms' accounting, we focus here on two recent papers and one book which have directly or indirectly challenged our own interpretation of the development of modern cost and management accounting. Below we briefly summarize the authors' main arguments, with our own comments thereon presented within double bold brackets.

Boyns and Edwards [1996]:

- U.K. and U.S. accounting in the mid-19th century must be seen as having developed in significantly different ways. **[[**We agree, as this is an essential element of our own thesis. See B and F above.**]]**

- Chandler's history of the growth of multi-unit business enterprises (MBEs) in the U.S. focuses on the new function of administrative coordination and allocation, the visible hand replacing the invisible hand of Adam Smith's competitive market economy. It is primarily concerned with higher levels of management coordination (departmental headquarters, central office, general office), not with control over the shopfloor, the focus of later scientific management and Taylorism where our own work on Springfield is located. **[[**We agree; see D and E above. But, as we have argued in D above, Springfield represents a crucial first stage. While Boyns and Edwards themselves accept the conclusions of our work on the link between West Point and Springfield,[31] Tyson [1990] has argued against there being any significant West Point influence on the developments at Springfield. Consequently, we have had to develop our arguments on the nature of the changes in shopfloor discipline there in considerable detail [Hoskin and Macve, 1994a]. Moreover, it is clearly important to our defending the significance of the West Point link to Springfield that we do not find similar developments elsewhere in the U.S. before then and that we do not find similar developments in the U.K. until much later. The necessary juxtaposition of the conditions of possibility for such a transformation in human accountability may have occurred elsewhere independently, but the only evidence and theoretical explanation that we have at present is uniquely American, so that the transmission to the U.K. (see F above) and elsewhere occurred much later. Testing this thesis has been a large part of

[31]They do not accept the significance of our link between West Point and certain railroads.

the motivation for the papers on the Waltham-Lowell mills in the U.S. [Hoskin and Macve, 1996] and on Boulton & Watt and the Northeast coal mines in the U.K. (Fleischman et al., 1995; Fleischman and Macve, 2000). Nevertheless, we agree that the more important arena is that of higher levels of management in MBEs, and we are currently focusing our work on the U.S. railroads, developing the arguments previously put forward in Hoskin and Macve [1988, 1994b] as to the significance of the West Point link to the railroads and thence to the mid and late 19th century U.S. industrial-military complex.**]]** In this context, Boyns and Edwards [1996, p. 41] noted, following Chandler, that "information originally collected to enable efficient co-ordination of flows between departments was recognized as having a potential to assess the performance of managers" but warned that "its usefulness and efficiency in this respect is an issue which has received little detailed examination by historians." **[[**This debate is at the heart of our own enquiry into the history of the present (C above), a present which is characterized by the proliferation of performance indicators [Power, 1997].**]]**

- Boyns and Edwards [1996, p. 43] correspondingly argued that our definition of managerialism focuses exclusively on "control of the workforce," contrasting Aucoin's wider definition:

> Managerialism, in contrast to the traditional bureaucratic ideal of 'administration', . . . emerged in the private sector, . . . [because of] an increased concern with 'results', 'performance' and 'outcomes'. Hence higher priority is given to the 'management' of people, resources and programmes compared to the 'administration' of activities, procedures and regulations.

[[We disagree with Boyns and Edwards' interpretation of our position for the reasons already given and because Aucoin's definition essentially matches our own.[32] The important difference of insight lies in our focus on how this managerialism is exercised "grammatocentrically" through "writing, examining and grading," as a "positive system of power which deploys the feedback of expert knowledge to identify weakness and engineer improvement" [Boyns and Edwards, 1996, p. 42]. We have

[32]"Management refers to the effective co-ordination of both 'men and matériel' (to use the military term)" [Hoskin and Macve, 1994a, p. 18].

set this argument out more fully in Hoskin and Macve, 1990.**]]** Boyns and Edwards [1996, p. 44] therefore asserted that our "narrow focus" on "human accountability" [e.g., in Hoskin and Macve, 1994a; Fleischman et al., 1995], in particular on establishing "the precise sequence of development that led to the widespread adoption of standards for measuring human performance that are the basis of modern managerial control," puts us at risk of "missing, or ignoring, significant developments and, possibly, discontinuities in accounting over the last two centuries." **[[**For the reasons already given, we reject this characterization of our overall framework and research agenda. We have explained above why we have given priority in much of our work to date to the issue of standards of work performance. However, our actual archival research, in order to emphasize what we see as distinctive, has necessarily had to look also at the related developments in other aspects of management and management accounting in the enterprises we have surveyed. Where we differ in substance from Boyns and Edwards and other economic rationalist accounting historians is in how we interpret the relative significance of those different kinds of changes in practice. The theoretical, evidential, and historiographical reasons that form our own interpretation, as in D and E above, have been previously discussed.**]]**

• Boyns and Edwards then proceeded to the heart of their paper and examined the Dowlais ironworks in the mid-19th century "to assess whether or not they used their system for achieving human accountability or for other purposes," essentially as we ourselves might have done. The conclusions they drew from the evidence, that the accounting system was not used for labor control in the 1850s, are, however, very different. They considered that we would regard this "lack of concern with labour discipline and performativity to represent entrepreneurial failure," while they would regard it as a rational decision by Dowlais management given the likely costs and benefits of attempting to add this kind of accounting control to their existing structure for work-force contracting and discipline, under the prevailing conditions in the labor market. This same argument was essentially used by Tyson [1990] with regard to the Springfield Armory work force in the 1830s [Hoskin and Macve, 1994a]. **[[**To this our response would be, there was no entrepreneurial failure; rather, the conditions of possibility which enabled the introduction of the new human discipline in the U.S., particularly the West Point influence, were not yet

manifest in the U.K. as they had not yet been in the U.S. at Springfield under Lee's superintendency:

> To come to treat human performance like that of a machine, functioning as if it is observable, measurable and controllable in terms of efficiency, is to create a new discourse and a new way of seeing, describing and controlling the world [Fleischman et al., 1995, p. 174, cited by Boyns and Edwards, 1996, p. 44].

Boyns and Edwards (similar to Tyson [1990] *mutatis mutandis*) saw sufficient explanation for the lack of an accounting focus on human performance in the economic conditions at Dowlais at the time. But to convince their skeptics, they would need to identify what change in costs and/or benefits would have been sufficient to make the change worthwhile. There is certainly no doubt that Dowlais, like other 19th century concerns, would have benefited from an improvement in labor discipline to minimize the cost disadvantages of downtime of expensive capital facilities [Boyns and Edwards, 1996, pp. 51-53], especially under Clark's strategy of increasing output to reduce unit costs (see our discussion of Boyns and Edwards [1997a] below). As Boyns and Edwards argued, the nature of 19th century labor contracts, in particular the ways in which internal contracting could substitute for accounting for and control over individual workers' labor costs, is an area where detailed knowledge is still largely lacking. Nevertheless, if one always assumes that accounting changes are an optimal response to changing costs and benefits, it is trivially true to conclude that any particular accounting configuration must have represented a rational trade off of the costs and benefits as currently perceived [Boyns and Edwards, 1996, p. 55]. We accept the tautology, but we believe it has potential empirical content because we have an historical theory of what it was that was missing from the perceptions of the Dowlais managers. They were trapped in the premodern discourse that could not yet see human performance in the same scientific terms as machine performance (see propositions D and E above).**]]** From Boyns and Edwards' own perspective, of course, what is more significant about Dowlais is the different way in which the accounting system came to be used following the change in top management in 1855. As this is also the substance of their 1997a paper, we will discuss it under that heading.

Boyns and Edwards [1997a]: This paper was not structured primarily as a critique of our own position, although the introduc-

tory and concluding sections repeated the observations that the work of "Foucauldian writers" such as ourselves "has given particular weight to the specific developments at the Springfield Armory in the 1830s;" that "there often appears to be an implicit assumption" that "developments in Britain were . . . identical, either in form or timing, to those in America;" and that "Foucauldians" have attributed the development of management accounting "to the need for managers of corporations to control and discipline labour by rendering their actions visible and calculable. . . . 'managing by the numbers' " (pp. 19-21). **[[**As already stated, we reject these interpretations of our position. See A, B, E, and F above.**]]**

A more important target was Chandler. "It is directly implied in his work that the direction of causation runs from strategy, through structure to accounting," although it is noted that Johnson and Kaplan suggested the reverse causation and "that developments in management accounting, rather than having been a consequence of the emergence of large-scale businesses, 'may have facilitated the growth of large scale firms' " (p. 20). Boyns and Edwards' own conclusion was that, "the link is more complex, possibly reflecting . . . a symbiotic rather than causal relationship" (p. 41). **[[**We would agree. The relationship between strategy and structure in the new 19th century managerial U.S. railroad corporations reflects the impact of the West Point graduates on both [Hoskin et al., 1998].**]]**

Boyns and Edwards were concerned to settle the definition of management accounting, where they adopted the ICAEW's 1954 definition, "any form of accounting which enables business to be conducted more efficiently" (p. 22). **[[**For the reasons given at A above, we have no quarrel with this as a working definition, as we do not believe our theoretical and historical differences of substance relate to the definition of management accounting, but to what have actually been its most significant developments in the 19th and 20th centuries. However, we would repeat our view that management accounting is more than just business statistics.**]]**

The substance of Boyns and Edwards' paper plots the changes at Dowlais, one of the largest industrial enterprises of the mid-19th century and a forerunner of today's GKN plc, where, following the death of Sir Josiah John Guest, direct management responsibility passed in 1855 to G.T. Clark. Clark was accountable solely to the trustees of the Guest family estate, the family now becoming absentee owners. Clark revived Dowlais' fortunes dramatically by a strategy of which the major

elements were (1) ensuring full use of capacity to reduce unit costs; (2) successfully gambling on technological advance by being the first manufacturer to adopt the new Bessemer converter to move into more profitable steel production; (3) intensifying the coal-mining activity to secure adequate supplies for his enlarged furnaces, thereby also diversifying into a new product for sale; and (4) abandoning the policy of the London House of maintaining high prices for the sale of final output.

Boyns and Edwards saw the changes in management structure as less extensive than had been previously argued by other economic and business historians, but they did see Clark paying much more attention to the implications of the cost accounting figures in relation to adopting and monitoring his high output strategy and to identifying the cost savings and other benefits from diversifying. His new general manager, William Menelaus, was routinely requiring "from each department weekly reports on a few centrally-determined strategic statistics, such as output, costs and hours, and giving similar summaries to Clark" (p. 29). The new accountant, William Jenkins, was able, as he put it, gradually to "alter the system in the large accounts of this place" so that "the transactions of the Company in the Books here are I think becoming more clear and simple." He began in 1860 providing Clark with annual reports, supported by many pages of detailed analysis (p. 32). The underlying cost accounting routines, however, may not have changed very much. The cost sheets, of which the surviving examples are all from before 1855, showed "the following three fundamental features . . . : the company used, as far as possible, transfer prices that exactly recovered costs incurred; the accounting method used was total (absorption) costing; and, consequently, profit recognition was delayed until products were sold to the customer." By 1851, the cost sheets reflected: "figures in terms of cost and quantity for inputs and outputs on a total and per ton basis" and "inputs per ton of output expressed in terms of cost and quantity."[33] It is also known that "the information was extracted from the books of accounts kept at Dowlais and that these were kept on the double entry basis" (pp. 33-34).

Boyns and Edwards summarized the use of this information: "Whilst some evidence exists, therefore, of the use of cost information by the Dowlais management prior to the Clark era

[33]Similar information can be found in the "view-books" of Northeast coal mines in the BIR [Fleischman and Macve, 2000].

of control, it is not very strong and does not suggest any major role for the accounting/costing system in management decision-making. This situation was to change, however, when Clark assumed control" (p. 36).

Clark's response to the crisis he inherited was to undertake extensive capital expenditure to refurbish the plant in order to increase output and thereby reduce the cost of manufacture. Improvement in profitability soon followed. For 1855-1856, the accounting records had shown that the cost per ton of finished iron had risen to nearly £7. 18s. 1.6d, while the selling prices had declined below that cost by an average of more than 18 shillings per ton (p. 36). But in 1857, Menelaus prepared a series of ad hoc reports for Clark based on figures supplied by Jenkins and others demonstrating (1) the difference in yield (i.e., improvement in output per ton of coal used and the consequential cost saving of £28,000 per annum) achieved, in part, through weekly monitoring of each furnace's output as changes in manufacturing methods were tried and through comparison of yield figures with those of local competitors; (2) the improvement in efficiency of use of other inputs from trying different input combinations, measured per ton of iron produced, and the consequential cost saving of £7,800. 14s. 8d per annum; and (3) comparisons to show the falling total cost per ton of output, although the computation of total cost was complicated by some of the £23,643 cost of capital improvements having been charged as current costs. There are also calculations of the implications of now needing both to build the country's most powerful mill to exploit the potential for increased production capacity and also to increase coal production.

By 1859, there are calculations by Menelaus of the benefit of paying the asking price of £50,000 for another ironworks in order to obtain cost savings on coal by exploiting its mining lease and by substituting small for large coal, to secure coal supplies, and also to obtain the benefits of diversifying into the sale of coal. Boyns and Edwards summarized, "The specialist reports made heavy use of costing information as a basis for assessing the effect of previous decisions and as a prominent input in formulating new plans. We also imagine that routine data was used on a day to day basis by middle management to identify inefficiency and waste, though insufficient material has survived to prove conclusively that this was the case. We know, however, that cost and yield analysis featured prominently in the annual reports prepared by Jenkins for Clark. . . . " (pp. 40-41).

Their conclusions to the paper were that the use of accounting information at Dowlais developed in an evolutionary fashion from existing systems in order to meet changing management needs, so that the relationship between strategy, structure, and accounting change is more complex than Chandler had proposed. Clark introduced a clear, new strategy, supported by costing and other production data. Although there were some top management changes, Dowlais was already, and remained, a multi-unit business with distinct departments. While the use of accounting information intensified, there was no marked change in the system itself.

Pointing out that there is no evidence of the use of the costing system "directly to monitor and control the performance of individual workers, be they unskilled labourers . . . or the managers of different departments" (p. 42), Boyns and Edwards again argued that this suggests "fundamental differences between the British and American approaches to management accounting" and called for "comparative research" which "could yield some important findings for contemporary debates" (p. 43). **[[**As already noted, exploration of such differences underlies some of our own work [e.g., Fleischman et al., 1995; Fleischman and Macve, 2000].

As to the central issues, Boyns and Edwards clearly handled the evidential issues very carefully. Whether one adopts the perspective of our work, that of their other studies [e.g., Boyns and Edwards, 1997b], or that of others [e.g., Fleischman and Parker, 1992, 1997], their major conclusions about the changes at Dowlais fit well with the general picture of U.K. management accounting developments around this time. They also fit with our main thesis as to the different pace of developments in the U.S. and U.K. (see B and F above). In generalizing from Dowlais to modern issues, one would, however, need to take into account some significant factors about Dowlais as Boyns and Edwards describe it. It was still a private company, and Clark himself observed that he would not have been able to persuade a meeting of stockholders in a limited company to endorse his strategy. While the operations were divided between departments with middle managers, Clark's own dominance was total and "despotic" (p. 41), quite contrary to that now prescribed by codes of corporate governance. Although a manager himself, he appeared to share the entrepreneur/owner's outlook as expressed by his neighboring ironmaster, William Crawshay II, who wrote to his son in 1860 [as quoted by Pollard, 1965, p. 22]:

> I know what the Master's Eye is—nothing can go long without it and I dread the consequences of your longer continued inability to personally look after the large concern at Cyfarthfa.[34]

As to the historical insights from identifying Clark's use of the costing information in support of his strategy to rescue Dowlais and secure its long-term survival, the main plank of the strategy did not really require any more sophisticated analysis than that greater volume of output reduces unit costs. Precisely what those costs were was less important, as illustrated by the accounting treatment of new work and consequently of depreciation. There was also plenty of mileage in the direct cost savings from the more efficient use of cheaper coal and other raw material inputs. Complex profitability calculations of price and volume do not seem to have been undertaken. Clark's faith in cutting prices was not shared by the London House agent responsible for sales (p. 28):

> we have never yet arrived at an understanding of the comparative loss of 'reduced make' and 'full make at losing prices'. The result of the latter are those which are more prominent here to our eyes—the former to yours—and I can well understand the difficulty of comparison is great.[35]

Clark's own remuneration was incentive-compatible with his chosen strategy [Gietzmann, 1995]. In 1858, he proposed, in addition to his salary, a commission based on sales above 60,000 tons of iron per year (p. 27).

Finally, the observation that use of cost accounting information is intensified during crises, or when owners/managers suddenly discover a need to get control and find out what is going on, is paralleled in earlier examples such as Wedgwood's pottery [McKendrick, 1970] and Boulton and Watt's Soho Foundry [Fleischman et al., 1995]. It is not always clear how intensively the information continued to be used after the crisis

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[34]Dufaud reported in 1823 that at Cyfarthfa, "all costs are known," but this was the result, not of "extensive costing systems but via subcontracting rates established between the mine owners and entrepreneurs in the mines who hired their own labour on the basis of independently determined wage contracts" [Bhimani, 1998b, fn. 4]. Further discussion of such internal contracting appears below.

[35]At this period on the U.S. railroads, such comparative calculations were commonplace and a particular feature of Haupt's strategic thinking on the PRR [Hoskin and Macve, 1994b].

had passed, and how far one can generalize to the likely routine use of such information by other industrial concerns.[36]

At the routine level, as Boyns and Edwards [1996, p. 48] put it, Dowlais' multi-unit structure meant that it "had a need for administrative co-ordination and to keep the production in the various departments 'in balance.' " As we see it, much of this need would presumably have been met by physical rather than monetary accounting measures.[37] Clearly routine accounting records have many actual and potential uses (our proposition A above), and it is interesting to have these various uses at different times and in differing circumstances illustrated. However, we would still argue that the development that gave them their most powerful, continuous, modern role, going way beyond that of statistics or simply organizational routine, was the development of what we have called human accountability within a defined organizational structure. The negative evidence from Dowlais set out by Boyns and Edwards in respect of human accountability and labor control confirms our own work on other U.K. enterprises, and on U.S. enterprises before the Springfield Armory episode.**]]**

Boyns, Edwards, and Nikitin [1997a]: This valuable study [see also Boyns et al., 1997b] charted developments in France and Britain, and illustrated (p. 18) the now generally well-accepted thesis that French 19th century accounting texts were ahead of French practice. By contrast, U.K. accounting practice was often well ahead of accounting texts, which only began to appear towards the end of the century [Boyns and Edwards, 1997b]. Clearly, from our own perspective, research on accounting developments in France is of particular interest, given the development of the pedagogic regime at West Point from French models.[38] There is not space here to discuss all the issues that the authors raised in examining the possible reasons for this

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[36]As Loft [1995, p. 22] recounted from an interviewee who had been a cost accountant between the two World Wars: "If the business was making a profit they weren't concerned with all my records…in my time, I gathered a lot of statistics which have never been used."

[37]See also Payne [1988, p. 32] re Cyfarthfa in 1825, citing Jones [1985, p. 136].

[38]For a history of Gribeauval's experiment with interchangeable-part manufacture of French artillery, see Alder [1997]. The potential links to Europe go deeper given the Prussian development of professional examinations for military officers from 1808, reflecting the existing university-based training of civil officials [Hoskin et al., 1998].

differential development. We simply note that, in their introductory chapter, the authors complained that "Foucauldian accounting historians believe that their methodological approach is broader than that followed by other accounting historians, and are particularly critical of what they call 'traditional' accounting history." The authors went on to state that, while they themselves adopt an essentially economic rationalist approach, they are nevertheless "willing to acknowledge the potential influence of other factors, including the socio-political and historical contexts of a period" (p. 6). In their concluding chapter, they repeated their criticism of our focus on "shopfloor labour" and the Springfield Armory as an "incomplete" analysis of management accounting's development (pp. 180-181). **[[**We have rebutted this criticism above. Here we do no more than note Bhimani's [1998a, p. 397] surprise, in his review of this book, at the authors' summary dismissal of the Foucauldian approach.**]]** Boyns et al. do, however, confirm that they had found no positive evidence in Britain or France of accounting before 1880 being used principally to control labor (p. 181).[39]

TYSON

We have previously responded [Hoskin and Macve, 1994a] to Tyson's [1990] critique of our work on the Springfield Armory, where he received support from Boyns and Edwards [1996, p. 43], so we do not repeat our arguments here. We have also challenged Tyson's [1992] conclusions concerning the use of cost information at the Waltham-Lowell mills [Hoskin and Macve, 1996], but Tyson [1998] has now restated his own case, and it is to this paper that we now briefly reply.

Tyson [1998]: At the Lawrence Manufacturing Co. in the 1840s, the costings included six-month schedules, integrated with the double-entry ledgers, analyzing profits and costs by each of five mills for nine individual varieties of cloth. The main thesis of our 1996 paper was the contention that the sophistication of these Waltham-Lowell companies' cost analyses, and the extent of their use for management purposes, had been overstated by previous researchers. The accounts had been taken as evidence that a modern managerial approach was already being adopted in manufacturing contexts for the purpose of developing a re-

[39]Further research is needed on Decazeville [cf. Hoskin and Macve, 1988, p. 64].

gime of cost control and performativity within the factory. We suggested that they have a different explanation, as calculations made for classic mercantile purposes to track flows of money spent and received in manufacturing. Their arithmetical precision reflected the conditions under which the calculations had to be carried out and verified rather than their economic significance. It is important for accounting historians to allow modern intent in such accounting only after the most stringent scrutiny of the evidence.

Tyson [1998] responded in three main ways:

- Our narrow interpretation of managerialism and management accounting is focused on the development of labor standard costs and variances, ignoring other important managerial functions and corresponding uses of accounting information. **[[**We have dealt with this argument, which we consider to be a basic misunderstanding of our position, above in relation to Boyns and Edwards' criticisms (see also our propositions A and E above). Anyway, it is irrelevant to the thesis in our 1996 paper that there is no *evidence* of the supposed other uses of the information by the mill owners/managers.**]]**

- We "wrongly imply that decision making based on suboptimal information cannot be perceived as rational," although this line of argument is only "suggested but largely undeveloped in the current [i.e., Tyson's] paper" (p. 212). **[[**Although it is not developed further, we have discussed this issue from a theoretical perspective above. One of the major motivations for our own work has been to try to understand how such "inherently problematical" information [Ezzamel et al., 1990] has come to play such a powerful role in modern corporate life.**]]**

- Tyson's primary argument was that evidence from outside the accounting records themselves does in fact demonstrate that Waltham-Lowell owners/managers were using their accounts in "a variety of decision-making, management control and problem-solving scenarios" (pp. 211-212). **[[**The production of such evidence would indeed refute our 1996 arguments where we adduced evidence [from Lubar, 1984] that the mill agent at Lawrence, for example, did not regard the costings as of any great significance beyond demonstrating a full and honest accounting for monies received and spent:

> expenses are not easily distributed with entire accuracy, nor is it of much importance whether it is so or not, so long as it can be fully documented that the

> funds have been faithfully applied and correctly accounted for.

Tyson [1998] did not comment on this first-hand observation. Neither did he adduce any substantial evidence of the use of the costing figures for management decision making and control.[40] Tyson cited a number of secondary opinions, but when he turned to the primary sources, rightly looking for evidence "beyond the ledger," the best he could come up with was (1) an ad hoc report at Merrimack Manufacturing Co. which, if anything, suggested that the apparent cost should be ignored in making the most economically favorable decision (p. 217 and fn. 15), and (2) a surmise that "it is not unreasonable to assume that Nathan Appleton read the cost reports he received regularly . . . " (p. 217). See our comments on evidence above.

To be fair, Tyson admitted (p. 218) in relation to the detailed information about mill and product costs that, "it is unclear whether or how it was used in deciding which mill should manufacture particular grades of cloth" (spare capacity may have been the decisive factor) and "unfortunately, the available evidence does not permit a more precise conclusion about the actual use of cost information" although "it can also be argued that summary reports[41] contain information that, when extracted, *could* be used for production control" (our emphasis added). While Tyson unsurprisingly was able to find correspondence and minutes in the archive which exhibited awareness of considerations of quantity and cost on the part of mill owners/managers in making decisions, he adduced no primary evidence of the costs reported in the formal accounting system being directly utilized for any such management purpose, however widely defined. He merely repeated the assertions and conclu-

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[40]While Tyson quoted (p. 215), from Lubar's Ph.D. thesis [1983, p. 150], Lubar's own opinion as: "Cost accounting enabled managers and owners to communicate the results of the mill operations. It allowed them to evaluate technologies, to assess the productivity of employees, and, more generally, to establish and maintain control over the operations of the mill," Tyson was left speculating over the paradox that Lubar appeared to be describing a so-called "Hoskin and Macve" type managerialism when there is actually no evidence of accounting for labor discipline at the Lawrence mills (p. 215). When it comes to secondary opinions rather than primary sources, we would place more weight on a refereed article such as Lubar [1984] than on a dissertation.

[41]We do not understand why Tyson [1998, pp. 218-219) appeared to argue that we ignored the six-monthly "Analysis of the Profits," when this was the major focus of both Porter's [1980] and our 1996 paper. However, Tyson again only conjectured potential uses of the information therein.

sions of other historians who probably failed to understand the reasons for which such cost analyses evolved out of traditional mercantile records.**]]**

VERSIONS OF THE NEW ACCOUNTING HISTORY

Boyns and Edwards [1997b, p. 7] have commented: "In her otherwise admirable survey of the different methodological approaches—traditional, neo-classicist, Johnson and Kaplan, labour process and Foucauldian—Loft (1995) does not attempt to present a new, consensual view of the development of accounting." We ought therefore ourselves to review in detail the growing number of recent overviews of accounting history research in an attempt both to indicate where we believe our approach complements those of other accounting historians, and where substantive differences remain. A fuller version of that project must await another paper as, at this meta-level of critique, the various overviews do not directly criticize our own approach, although clearly such criticism is often a logical implication of the views expressed [e.g., Oldroyd, 1999]. We therefore restrict ourselves here to an abbreviated, nonspecific "review of reviews" of accounting history research. We identify three common themes in these reviews:

- While there is often polemic between "traditional" and "new" history, and between differing degrees of "critical" history (but also collaboration; e.g., Fleischman et al., 1995), the new conventional wisdom is that plurality of conceptual perspectives, research questions, and methodologies is now to be regarded as a sign, not of intellectual weakness, but rather of both the maturity of accounting history and of its consonance with the state of social science research and wider historical research. Hence Boyns and Edwards should not be surprised [cf. 1997b, p. 7] that "Loft (1995) does not attempt to present a new consensual view of the development of accounting." An exception is labor process and Marxist critical history which has a singular, clear, and exclusive, albeit monochromatic, view of the main driver of capitalistic development and of accounting's role as its accomplice.

- The "new" history frequently focuses on individual, apparently unconnected incidents in which changes in accounting, or new accountings, emerge in order to explore the discursive and institutional factors that underlay the "event," to reveal the "ensemble" of techniques and practices that constitute new forms

of social and economic calculation, and to demonstrate the historical contingency of what is called, or operates as, accounting at different times and in different places, including the present.

- While new historians respect the archive, rightly arguing its extension beyond traditional ledgers and accounting texts, their particular interest in theoretical interpretation has so far meant that much of the new history has primarily comprised reinterpretation of existing histories and other secondary sources rather than revisiting the primary archive to examine whether it will bear the weight of the new interpretations.

In relation to these three themes, we ourselves nevertheless adopt historico-theoretical positions which in several respects are closer to those of "traditional" historians [e.g., Fleischman et al., 1996; Oldroyd, 1999]:

- First, we approach our own study of accounting history from a unifying perspective of seeking to understand the relationships between accounting change and a theorization of economic and social change from antiquity to the present day. We focus in particular on forms and modes of writing and calculation, and on how, through their interplay with certain other practices (particularly pedagogic ones), they engender new modes of discourse and new institutional forms, thus constituting particular kinds of power-knowledge interrelation. We build on the work of Michel Foucault, but, given his own ignorance of accounting and his other historical misunderstandings, have developed our own theoretical view [Hoskin and Macve, 1993; Hoskin, 1993, 1994]. Clearly such a view stands in contradiction to other "unitary" views of accounting history, be they "capitalistic"/economic rationalist or "labor process"/Marxist.[42]
- Second, we believe that in any significant interpretive history of an accounting event, there should be an implicit, if not explicit, attempt to understand its relationship to events at other times and in other places, a hypothesis at least of how it might fit into a broader conception of the history of accounting.[43] Without such a conceptual grounding, there is no way of identifying what might or might not be a significant event in

[42]We have countered the criticisms made of us by the former school above. We shall deal with the latter in a further paper, although we comment on the inadequacy of its interpretation of changes in labor practices at the Waltham Watch Company in our concluding coda below.

[43]Although we ourselves have such a substantive conception, we consider that this second requirement holds even if the researcher's theory is that there can be no such broader conception [e.g., Oldroyd, 1999].

the sense, for example, that it illustrates the coming together of significant linkages between discourses, practices, and institutions. Implicit in our own approach to understanding what have been the significant discontinuities in the history of accounting is a parallel conception of what have been the continuities.

- Third, there must be a primacy of respect for the evidence.[44] While the evidence may often be inconclusive, and while it may be that many interpretations are plausible, nevertheless historical rigor demands that new interpretations demonstrate that they are at least not incompatible with the surviving, primary evidence. Also, proponants of new interpretation should have made the effort, in the spirit of Popper and scientific "falsification," to uncover and investigate sources of evidence that might have the potential to discredit them.

Our larger project is therefore to write, or at least to contribute, to a "new" history of accounting.[45] We have begun by seeking to identify the major discontinuities in that history that claim priority on our attention. As we have argued above, our work on the 19th century is not only or even primarily a "genealogy" of the Springfield Armory event [cf. Miller and Napier, 1993]. At the same time, if we have interpreted that event wrongly in the sense that there is no discontinuity discoverable there, the rest of the endeavor would probably be built on sand. However, if we have interpreted it correctly, and there is a genealogical link from West Point both to Springfield Armory production and to multi-unit management on the railroads, then our continuing genealogical task is to trace out how the increasingly complex networks of change agents extended from those sites into different spheres.

CONCLUSION

What then are the priorities now for accounting history research? We would argue that tracing the networks of influence by which the new 19th century accounting transformed individuals and organizations, first in the U.S., then in the U.K. and Europe, and now globally, still requires much work to build a coherent picture out of the pieces of the jigsaw. We have

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[44]As we have previously affirmed in Hoskin and Macve [1994a, pp. 22-23].

[45]The late 18th century and 19th century period will be the subject matter of Hoskin and Macve [2000]. Here we shall challenge Levenstein's [1998] recent revision and extension of the Chandlerian thesis.

reviewed here a number of the negative findings from BIR history and early 19th century U.S. history. We need more positive findings from U.S. history in the later 19th century and early 20th century. So we conclude with a coda, an example of how the extension of the network of the newly significant discursive practices might be traced. It is only a tentative example, as we have not ourselves revisited the relevant archive, but it is suggestive.

We do so, while re-echoing the calls in Fleischman et al. [1995] and Boyns and Edwards [1996] for continuing investigation on both sides of the Atlantic, as well as in Europe and beyond [cf. Boyns et al., 1997a, 1997b; Bhimani, 1998b], to trace the conditions of possibility for the emergence of the key defining characteristics of modern accounting's power. Accounting's history must be further rewritten. While we must discard some currently cherished knowledge along the way so that there is a sense of loss and of "knowing less," we hope that thereby we and other researchers will indeed arrive at "knowing more."

CODA: THE WALTHAM WATCH COMPANY AS A MOMENT IN MANAGERIALISM'S EMERGENCE

The Waltham Watch Company (WWC) has been celebrated by U.S. historians as a major site for both managerial and technological innovation [Clawson, 1980; Hoke, 1990]. Recently, Fleischman and Tyson [1996] have looked more closely at how accounting may have contributed to this process. Their particular interest was stirred by the fact that the WWC, founded in 1849, still employed inside contracting (IC) up to the mid-1870s. Given that it was both an innovative and successful enterprise, as the first mover and then global market leader in the mass production of watches into the 20th century, this is an intriguing finding. IC has frequently been seen as a premodern form of organization. From an economic rationalist point of view, it has been seen as less efficient for managing large, complex businesses than full-blown, bureaucratic, managerial control, supported by cost and management accounting systems [Chandler, 1977; Johnson and Kaplan, 1987], and as maintaining a "producer ethos" inadequate to meet the forces of competition and insufficiently responsive to consumer choice [Fleischman and Tyson, 1996, p. 64]. From a labor process perspective [Braverman, 1974], IC has also been seen as premodern, an interim step on the way to the full capitalist

subjugation of mass labor within managerial hierarchies. At WWC, however, IC appears in the context of a highly modern technological and economic success story. Fleischman and Tyson therefore saw this as a strong refutation of both the economic rationalist argument as to IC's inefficiency, and the labor process thesis [Hopper and Armstrong, 1991] that the elimination of IC was effected primarily as means to secure the control of labor, with accounting as its tool [Littler, 1982, p. 66], rather than to introduce a more economically rational means of managing production.[46]

We share much common ground here with Fleischman and Tyson's presentation of the operation of, and then change from, IC at WWC. We have argued above for our own view of the disciplinary nature of accounting control, and why we find the economic rationalist explanation to be insufficient. We also reject the labor process theory, not because more powerful control of labor was not an outcome of the elimination of IC (or later of management based or standard costing, target costing, ABC systems, etc.), but because the theory so preemptively narrows an understanding of accounting's significance.[47] From our disciplinary standpoint, accounting becomes a powerful knowledge precisely as it begins to deliver cost and productivity gains, as well as both work force and manager discipline, simultaneously. So Fleischman and Tyson concluded (p. 74) that at WWC "the co-operation reflected in the raising and lowering of wage rates, as well as partial operative ownership of the enterprise,[48] was more suggestive of a power nexus to attain the

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[46]In the light of Fleischman and Tyson's [1996] work, the relationship between IC and accounting-based modes of managerial control requires a more comprehensive consideration than we can give it here. Further discussion with regard to 18th/19th century U.K. mining practices is given in Fleischman and Macve [2000] and to the Soho works of Boulton & Watt, around 1800-1802, in Fleischman et al. [1995].

[47]Karl Marx demonstrated, from his own observations of factory conditions in early 19th century England, how capitalist owner/managers sought to extract more surplus value from labor through stratagems such as lengthening the working day ("absolute surplus value") or intensifying the rate of work ("relative surplus value") [Macve, 1999, p. 596]. This did not, as such, require any use of sophisticated accounting practices, although accounting systems could be deployed to facilitate such "sweating" once organizations became much larger and individual workers became less directly observable to "the Master's eye." But accounting could facilitate other modes of efficient managerial coordination and control equally as well.

[48]In 1871, over 40% of the work force were shareholders [Fleischman and Tyson, 1996, p. 69].

common good [the firm's wellbeing] than the labour process vision of single-purpose exploitation."

Fleischman and Tyson's analysis of WWC also suggests that the presence of IC as such was not such a significant feature in defining the absence or presence of managerial control. Correspondingly, its abolition did not signify a significant intensification of managerial control, and in particular of accounting, for whatever purpose. They cited (p. 73) Englander's [1987, p. 445] comments "about the uniqueness of company or industry factors," so that each case needs to be examined in context. To clarify that, however, we suggest that what is perhaps required is a closer differentiation between modes of inside contracting, noting that such quasi-market-based forms of control and coordination as ROI and contracting out, nowadays called outsourcing, are clearly compatible with the modern managerial regime, as well as being frequently justified in transaction cost terms.

The traditional IC model was for owners to strike a deal, usually a labor contract with an overseer or manager, who was then left to establish the work/reward ratio and the level of potential personal profit in negotiating further deals with prospective workers. However, Fleischman and Tyson's analysis of the IC model at the WWC (p. 68) challenged the view held by Clawson that the system was traditional in this way.[49] Instead, their interpretation of the limited evidence suggests that a very different set of work relationships may have been in play both while IC was in place and after its demise.

By the 1880s, when IC had been replaced and the internal contractors had become salaried foremen, an eyewitness account by Fitch in 1883 [Fleischman and Tyson, 1996, p. 68] describes a hierarchical control system where department foremen reported regularly to the superintendent:

> monthly cards are prepared by the superintendent for each foreman, stating the number and kind of watches to be made. Each foreman makes a daily report of work done and of the transfers of work between the several departments, and to facilitate this *each foreman*

[49]Clawson [1980, p. 116] claimed that at WWC "the contractor of 1870 was simply given a sum of money based on the contract price and the number of units delivered. The contractor had complete control over this money and paid his employees. The company had no records or formal way of knowing the number of the contractor's employees…or how much money the contractor kept for himself."

> *has a bookkeeper, who is responsible to the superintendent* (our emphasis).

In other words, by this time at the WWC, there was a highly disciplinary nexus. Centrally decided plans were relayed down to each foreman, from whom daily reports were relayed back. The production of each department and the coordination of production overall were both open to continuous examination and evaluation, with correction or improvement where necessary. In addition, a formal objectivity was conferred on the information generated through the separate definition of the bookkeeper's role as part of a staff (not a line) function. Thus, workers, foremen, and bookkeepers would seem to have been rendered calculable and calculating subjects of constant surveillance and judgment through being brought within the interplay of writing, examining, and grading.

But the historical question then is, when and how did this disciplinary nexus emerge? Did it actually predate the abolition of IC at WWC? Here Fleischman and Tyson tried to trace the emergence of the IC model back to the early days of the company, but found (p. 68) that there is little direct evidence one way or the other (no written inside contracts survive in the archive) so that it is not clear how, or indeed whether, IC contributed to the company's success from the 1860s. However, they cited indirect evidence from the reports of R.E. Robins, the company's treasurer.[50] As early as 1862, Robins' reports indicate that "WWC executives were knowledgeable about the total costs of IC" (although this knowledge refers to no more than knowledge of the costs being paid to the internal contractors, rather than how the piece rates for individual job workers were determined). Job workers' rates certainly do appear in the 1874-1875 wage book, the earliest to survive, and reconcile with the figures in the payroll book, indicating that there was an "integrated record-keeping system." Fleischman and Tyson [1996, pp. 69-72] argued that, although the extant wage books only date from the period in the 1870s during which the transition from IC to direct employment was gradually being introduced, the comparability of the "before" and "after" wage bills in the

[50]Robins is clearly an important figure since he had rescued the WWC, first founded in 1849, from a financial collapse suffered in the Panic of 1857, buying it at auction [Hoke, 1990, p. 188]. He then teamed up with the original founders, Aaron Dennison, the so-called "Father of American Watchmaking," and Edward Howard, to relaunch the company.

accounts suggests that "the firm knew the wages paid by the subcontractors to the underlings before their transition to day rates."

The evidence available therefore remains incomplete as to what, if any, was the impact of IC, and of its subsequent demise, on the success of WWC. Fleischman and Tyson suggested in their conclusion (p. 72) that, while the conventional "economic efficiency" arguments and the alternative "labour process" analysis both seem implausible for explaining what went on at the WWC, a "Foucauldian perspective may contribute to enrich the discussion."[51] We would agree, both in a general way and with regard to the specifics of the WWC story. We would suggest that their interpretation of the limited evidence for the nature of the detailed changes in accounting and control systems for labor there can be buttressed by looking beyond the IC process itself to locate it in what is known of the early company's wider technological and organizational development. In particular, we can trace the influences of Springfield Armory practices on both these dimensions of its development. We suggest that these influences are far more substantial than has been recognized, and that what they reveal is WWC remaking itself, in a general way, as a locus of disciplinarity.

Historians of technology have already celebrated the fact that Waltham was the first watch company to have taken up the interchangeable-part manufacture approach, as developed at the Springfield and Harper's Ferry Armories [Smith, 1985], and then to have adapted it to the very different, high-precision demands of watch making.[52] An initial debt to Springfield is clearly acknowledged in that WWC's cofounder, Dennison, first had the idea of mass-producing watches when "inspired by a

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[51]Fleischman and Tyson observed (p. 72) that "historians of the Foucauldian persuasion have not addressed specifically the issues of IC in early US industrialization." We agree that further examination is necessary, but we have examined the case of the Springfield Armory which, right from its beginning at the start of the 19th century, had its own managed work force, even though IC was normal for the industry and was used at Harper's Ferry Armory [Ezzamel et al., 1990, pp. 158, 160].

[52]As Hoke [1990, pp. 181-182] pointed out, this entailed adopting the system's key features as "a model-based system" which therefore required "gauges made to fit the model, interchangeable parts, manufacturing to fit the gauges," and then adapting this to the machine production of watch parts. This required both the design of unprecedented machines and machine tools, and a radical redesign of gauges which could pass good parts at the required microlevel of accuracy.

visit to the US Armory at Springfield" [Hoke, 1990, p. 181]. However, this visit alone did not make for a successful enterprise since the company, as noted, went under in 1857 before being rescued by Robins. It appears that, as with arms manufacture before it, the technological transformation problems proved unanticipatedly huge and vastly expensive in both time and money terms.[53]

It is at the subsequent stage of relaunch, however, that a move to disciplinarity, largely shaped by Springfield Armory technical and organizational practice, seems to have gathered momentum. The historical record indicates that the company moved impressively fast, from 1858 on, to solve its technical problems and to become economically successful. By the early 1860s, it had achieved step increases in productivity. Whereas in 1854, it took 21 man-days to produce one watch, by 1862 the time was down to three days [Hoke, 1990, p. 250]. The associated savings in cost per unit were dramatic, if unrepeatable. Subsequent to 1862, when another financial failure loomed with the onset of the Civil War, production levels and profits soared. The original company had produced less than 5,000 watches from 1849 to 1857, but now WWC produced 38,103 watches in 1864 and totaled over 18 million by 1910 [Hoke, 1990, p. 184].

No doubt a number of factors contributed to this turnaround. The increasing success of the move towards automated part-production was one. The contingent intervention of the Civil War was another, as the market for domestically produced watches took off with the virtual disappearance of foreign watches.[54] A third factor would seem to have been an insightful

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[53]We have noted before [Hoskin and Macve, 1994a, p. 24, fn. 10] Smith's [1985, p. 86] estimate that the arms-making uniformity project involved a total investment of over $2 million in 19th century prices, spread over 40 years before reaching success in the 1840s. The time and dollar investment was much less for this second-phase industry, but we note the comments of Dennison's partner, Edward Howard. Reflecting well after the financial collapse and rebirth of WWC, he observed [Hoke, 1990, p. 189]: "When I look back . . . I am astonished at the endurance and perseverance with which I stuck to the task. . . . Could I have seen beforehand the trials and tribulations, I never should have made the first movement. Millions would not tempt me to go over the same ground." These constitute two interesting asides on the viability of the theory that we criticized above that successful organizational transformations are the result of the rational, comparative calculation of transaction costs.

[54]The effects of the Civil War initially included huge financial hardship, hence a near collapse in 1862. The work force, Robins notes, agreed to forego

application of strategic thinking given this sudden market opportunity. On the one hand, production seems to have been targeted to maximize consumer choice and capture a wide swathe of the market. A full product line was on sale by 1864, led by the $13 Wm. Ellery grade which acquired brand value as "the so-called *Soldier's Watch*" [Hoke, 1990, p. 248].[55] By 1867, there were 24 grades of watch, basically assembled from the same standard parts and differentiated by the quality of relatively few of these, such as the jeweling, balance type, and regulator type [Hoke, 1990, p. 183]. On the other hand, Robins, and presumably the Board, evinced a strong sense of the importance of investing to maintain technological leadership, even to the detriment of short-term dividends. In 1862 the dividend was passed, and in 1867 it was cut back.[56]

Thus, by 1870, WWC had become a highly profitable and productive company, resurrected from the ashes of a dozen years before; a company, furthermore, which was well aware of the joint importance of long-term thinking and short-term effectiveness. A drive towards automation via research and investment was one priority, but this was matched by considerable market awareness and an effective approach to coordi-

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up to 50% of their wages that year, contributing greatly to keeping the concern going [1862 Report, cited by Fleischman and Tyson, 1996, p. 69]. At the same time, no 1862 dividend was declared [Hoke, 1990, p. 251]. Given that in 1871 over 40% of the work force were shareholders, it is possible, if not likely, that some in 1862 took a double hit. Subsequently, the War had beneficial effects, not only in terms of the market opportunity it created, but also through an inflation which helped to ease debt repayment. Striking dividend rewards ensued in 1864-1867.

[55]This strategy casts doubt on the allegation that IC systems reflect a producer rather than a customer-oriented or marketing ethos, reflected, for example, in Brown's comments cited by Fleischman and Tyson [1996, p. 64]. Somewhat surprisingly, a similar allegation was still being made about WWC in the 1880s, after the demise of IC there [see Moore's comments cited by Fleischman and Tyson, 1996, pp. 67-68].

[56]In the 1867 report, Robins notes that the Board has resolved to "vigorously press the manufacture" via increased mechanization, as "the only way open to us by which to recede the cost of manufacturing," even should the "result of such a course . . . be naturally to leave us temporarily without dividends" [Hoke, 1990, p. 316]. In this regard, it is interesting to contrast the belief of Clark at Dowlais in the 1850s that he would never have been able to persuade a stockholders' meeting of the necessity of a similar long-term strategy of belt-tightening, investment, and expansion to overcome imminent disaster.

nating a low-unit-cost, high-productivity, production regime.[57] WWC might therefore be seen, in the context of its time, as a pioneer of world-class manufacturing.

The value of a disciplinary analysis, certainly in comparison to a labor process one at least, seems clear. Controlling the labor process was only one factor. WWC's success came through the first-mover advantages it achieved and then maintained by the application of differing forms of disciplinary knowledge, including engineering knowledge, financial calculation, and market-sensitive planning. It was the interplay of this set of disciplinary practices that made this an organized entity.

At the same time, the fashioning of business opportunities out of Springfield disciplinary practices is striking. To give just one example, one procedure followed at Springfield was stamping a serial number on each musket, both to keep track of issues and to facilitate the provision of appropriate replacement parts. As early as 1858, WWC had turned this process into a marketing opportunity, advertising replacement parts by mail purely "by sending the serial number and describing the part" [Hoke, 1990, p. 246]. This implies that batch production to stock was large enough, or replacement-part production reliable enough, to produce any required part to order. In addition, as Hoke [1990, p. 246] observed, it implies that "the company had a sufficiently sophisticated record-keeping system to provide the needed data."

But it is in the wider integration of record keeping with target setting into a general systematization of work across the factory that the Springfield Armory precedents seem particularly influential. At this early stage, productivity gains and cost reductions were not achievable through automation alone, since, as Hoke [1990, p. 182] stressed, only part manufacture, not assembly, was automated, down through the 1880s at least. As yet:

> . . . Waltham's mechanics, like their counterparts in the typewriter industry, perfected the techniques to mass

[57]Both goals come across in the data set out in Hoke's [1990] tables. Machinery investment goes up year on year even in the crisis year of 1862. The reduction in man-days of labor per watch continues though at a lower rate, down to 2.2 in 1883 and 1.5 in 1905. The ratio of labor to output appears to have been tracked as an important key to profitability. Robins, in his 1867 report, observes that "the gain in number of watches made [has been] . . . forty percent, while the average number of hands has . . . increased . . . about 12+%" [Hoke, 1990, p. 248].

produce parts, but still relied heavily on hand assembly and adjusting.

Much of WWC's economic success therefore came from its success in implementing system across this great divide. That system was not simply given, but made. Based on Hoke's evidence, it appears to have been made by directly copying the Springfield disciplinary organizational regime, along with adopting its commitment to developing as much automation as possible, via research in the machine shop. As Hoke [1990, p. 181] put it: "The most important transfer of technology from the armories to the watch factories was the imposition of a rigid system of organization and the elevation of the machine shop to a position of supremacy."[58]

From among the skilled mechanics hired following the refinancing of 1858, Hoke [1990, pp. 189-190] singled out a few key individuals, in particular James Shepard, who was hired directly from the Armory, and Ambrose Webster, who "came via the Springfield Tool Company having served an apprenticeship at the Springfield Armory." According to Edward Marsh, who came as Webster's apprentice and later rose to be general manager and the company's historian, Webster was the most significant single individual in the reorganization of the work process, the man who realized "the imperative need of 'system' in creating and maintaining a successful manufacturing enterprise" [Hoke, 1990, p. 191]. Marsh credits Webster with the two crucial innovations: (1) securing agreement for treating the machining department not as a "burden" but as the potential source of competitive advantage via its research into automation; and (2) applying "system" via a standardizing principle. This he introduced first within the machine shop which then "led to the standardization of sizes of certain 'spindles' and

[58]The manufacturing situation was, in this respect, precisely analogous to that at Springfield where, up until the Civil War, parts were also increasingly manufactured by machine but still assembled manually. But then, the whole point of Tyler's study there had been to impose time and performance standards on each individual task, whether manufacturing or assembly, in order to speed up and smooth the overall production of the musket as a whole, including the transfer of work-in-progress from shop to shop. This was the heart of the Springfield system, where the outcome had been that even highly skilled manufacturing tasks undertaken by hand, such as barrelwelding, showed the disciplinary outcome of productivity rises combined with falls in unit costs from 1841 on [Hoskin and Macve, 1988, pp. 44-45].

'bushings' which were common to a variety of uses" [Marsh, cited in Hoke, 1990, p. 191].

This standardized approach to parts was combined with a normalization of activity within departments and its coordination across the whole manufacturing process. It is not clear if Hoke saw this as all due to Webster. On the one hand, he [1990, p. 191] credited Webster for having been "able to structure the work within the factory, and insist on a series of standard measurements to which the individual operatives were required to conform." On the other, when discussing factory organization in more detail, Hoke [1990, p. 242] simply said:

> At least as early as 1863, and probably by 1857, the Waltham Watch Company developed functionally differentiated departments staffed by a highly skilled and specialized workforce coordinated by the Superintendent.

In either event, Hoke was here describing an organizational setup precisely like that implemented at Springfield in 1841-1842 under Daniel Tyler's direction [Hoskin and Macve, 1994a]. Furthermore, as at Springfield, the primary evidence indicates an immediate and dramatic economic effect, with the fall in man-days production per watch from 21 to 3. In the absence as yet of clear archival proof one way or the other, our own application of Occam's razor would suggest that the most likely source of this whole set of innovations, technological and organizational, is the Springfield Armory, with the means of its adoption being the men who had worked there.

What we therefore perceive, in more general terms, is a translation of disciplinarity in both its aspects. As we see it, the expert disciplinary knowledge of the engineer was put to work to solve a new series of technological challenges which, if solved, were seen as having huge potential economic payoff. The coordination and control of work, period by period and project by project, was made subject to constant writing, examining, and grading. Whatever its precise form may have been, accounting was clearly integral to this process. At the strategic level, there was a value calculus within which possible future outcomes were weighed, while in the everyday practice of management there was planning and appraisal of cost and production levels. Thus, a new industrial mass-production sector was born, wherein the visible hand would henceforward rule and where, as Chandler has recognized, new entrants could only

compete by adopting and hoping to improve on the same visible-hand advantages.[59]

What, then, was the significance of the IC system in the WWC story, and how does a disciplinary analysis enrich our understanding of it? We suggest, tentatively, that the continuation of IC until the 1870s may well have been one of those contingent outcomes that frequently accompanies a major transformation. Given the prevalence of IC systems in early 19th century private-sector companies, we surmise that IC was already widely established in the watch-making industry.

Given the dependence on hand assembly, there would be no particular reason for its abandonment, and perhaps some cost in dissatisfaction among key worker/managers. Therefore, so long as work coordination could be rendered susceptible to system, it was unimportant whether the IC system itself was replaced or not. What mattered, in implementing system, was the panoply of disciplinary practices. What specifically made the organizational difference was the importation of the range of such practices from Springfield through the insider knowledge of men such as Webster, supported by the Board. The fact that an IC system had not been used at the Springfield Armory would therefore be of no real significance.

We may suppose that, as a tradeoff, an existing culture of IC was allowed to remain in place, except that, as in so many classic tradeoffs, the existing culture was thereby irrevocably remade, given its relentless circumscription by the new disciplinary regime. Here Fleischman and Tyson's [1996] arguments about the level of managerial knowledge about labor at WWC under IC fit with our own interpretation. IC was then, presum-

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[59]Unsurprisingly, the first would-be competitor firm, the Nashua Watch Company, was formed by a breakaway group of WWC mechanics in 1859 who "attempted to manufacture the first mass produced *precision* American timekeeper" [Hoke, 1990, pp. 189, 197]. Unlike WWC, Nashua did go bankrupt in 1862, and many of its key workers were then hired back, along with their expertise and design improvements. Indeed, a "Nashua Department" remained as a separate wing within WWC, "producing the company's high grade + plate movements" [Hoke, 1990, p. 255]. (We do not know whether or not this was also an IC unit.) In any event, competition, and the hiring away of key employees, continued apace. WWC's major competitor from the mid-1860s was the Elgin National Watch Company, founded in 1864, which hired seven WWC men, including Charles Moseley as the factory's superintendent. Thus, a Latour-style network [Latour, 1987] of expert men and knowledge developed new nodal points in a way that made the boundaries of particular organizational "structures" supernumerary.

ably, maintainable into the 1870s because it was not a serious detriment to the effective management of the company, either at the day-to-day or strategic levels. Equally, though, it appears from Fleischman and Tyson's analysis not to have commanded any great allegiance by then. It seems to have been discarded with minimal disruption, with the foremen becoming straightforward line managers within the hierarchical structure. Perhaps the erstwhile contractors had indeed become, as Fleischman and Tyson suggested, members of a managerial hierarchy in all but name, and so were relieved in the end to be freed from any residual demands of the IC system. Perhaps its demise was connected with the advancing automation of the production process and with the new managerial challenges posed as assembly also became increasingly automated.

In any event, what we would then see is a more general dissemination of the disciplinary practices first introduced into the economic world at Springfield, as on the railroads, to begin remaking the economy in general.[60] By 1900, production at

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[60]We recognize that not all have bought this scenario, even where the evidence appears strong. For instance, Hoke himself [1990, pp. 253-254] concluded his analysis by saying that, although "watch factory mechanics and entrepreneurs were initially enthralled with armory practice, and several mechanics employed at Waltham had previously worked at the Springfield Armory," in the end "these mechanics borrowed very little from the Armory directly." At the same time, Hoke's overall thesis is that the rise of the American System of manufactures was really the result of private-sector effort, carried through by the "Ingenious Yankees" of his book's title. Against that conclusion, we would point out that, on his own evidence, the two sectors where genuine modern, high-tech manufacturing was successfully achieved were watch and typewriter manufacturing. In both, one may discern the importance of the Springfield Armory connection, once one abandons a focus on industry-specific emendations of the Springfield template. We have summarized the evidence concerning WWC here. The typewriter case is perhaps less crucial, since it comes later, with the first successful handmade, mechanical typewriters dating to the early 1870s, and the first version of mass production at Remington's, to 1873 [Hoke, 1990, pp. 146-149]. But Remington, of course, had its own earlier Springfield connection. Having begun as an arms manufacturer, it was now looking to expand its generic skills to new potential products and markets, such as sewing machines. Its first move in each case was therefore, on the Springfield model, to produce a "pattern machine, by which the rest are to be manufactured." It is not clear how effective the work-discipline was at Remington. Perhaps because of this diversification, it failed and was relaunched in the 1880s. The application of system may nonetheless be discernible in the organization of typewriter production; by 1886, Remington carried out subassembly in three departments before final inspection [Hoke, 1990, p. 167]. But by this time, a more generalized move to work-discipline

WWC was driven by "pneumatically controlled, self-feeding, self-acting, self-gauging, automatic machine tools." Perhaps as early as 1890, women were sitting at banks of automatic machine tools on "roller chairs." These were set on "miniature railroad tracks in front of some benches which allowed an operative to slide her wheeled chair past a row of automatic machines, inserting wire into one end of each machine and collecting finished, interchangeable parts from the other end" [Hoke, 1990, p. 181]. At which point, the genealogy of managerialism moves on yet another generation, reproducing Dennison's own experience on his visit to the Springfield Armory. As Hoke [1990, p. 255] remarked, in concluding the WWC episode: "Henry Ford was reportedly inspired to manufacture automobiles by his trip through the WWC."[61]

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was disseminating across many industrial sectors as a necessary response to the visible-hand revolution. Indeed, Tyler's Springfield study was about to be invented anew as the time-and-motion study by F.W. Taylor [Miller and O'Leary, 1987; Fleischman, 2000].

[61]Such networks extended from other West Point sites also, not only via the route of other U.S. universities to the first business schools or through military institutions, but also, for example, from Haupt on the Pennsylvania, through the military-industrial linkages of the Civil War, to the steel industry through industrialists like Andrew Carnegie, and then beyond [see Hoskin et al., 1998].

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