The Diffusion of Scientific Management: Reconsidering the Reform of Industry Related Training in the USA and NSW during the Early 20th Century

by

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INTRODUCTION

Scientific management has traditionally been closely associated with time and motion studies, payment incentive schemes and industrial efficiency. The following discussion reconsiders this portrayal by arguing that the combined effect of F.W. Taylor's philosophy, principles and methods made his system sufficiently flexible to infuse non-industrial spheres. Accordingly, scientific management's impact is evaluated by reference to the educational reforms introduced in both the U.S.A. and Australia during the first two decades of the twentieth century.

In order to explain why it appealed to progressive reformers in both countries, the paper begins by identifying the ideological imperatives underpinning scientific management and those of its features that were directed toward training. The diffusion of these features is initially examined in terms of Taylor's influence on American educational reformers and their practices. On this basis attention is given to the way that scientific management permeated Australian educational reforms.

Delineating the contours of scientific management's cultural diffusion from the U.S.A. to Australia, is no simple task; rather it is fraught with conceptual and methodological difficulties. As Hobsbawm argues: 'Defining the difference between... developed and non-developed parts of the world is a complex and frustrating exercise, since such


2 It was this flexibility, argues Merkle, that helped it to 'gain universality.' Judith A. Merkle, Management and Ideology: The Legacy of the International Scientific Management Movement (University of California Press, Berkeley, 1980) pp.48-49.
classifications are by their nature static and simple,' and the reality was neither.\(^3\) Often, too, comparative studies assume a linear social evolution 'in which such terms as "civilized," "modern," "developed" - and presumably "Americanized" - are interchangeable.'\(^4\)

In order to avoid such assumptions\(^5\), I use the American experience as an analytical device to make sense of analogous developments in Australia, such as for example the compatibility between Taylor's principles and certain ideological currents present in Australia during the early decades of the twentieth century. At the same time, however, this approach highlights differences between the two countries; it focusses attention on those uniquely Australian factors which partially assisted and partially inhibited the spread of scientific management in N.S.W., such as the interventionist role of the state and the structural barriers to industrial expansion inherent in Australia's political economy.

Another more specific methodological problem inherent in studying this innovation's diffusion relates to definitions of its nature. Much of the scholarship dealing with scientific management avoids the issue of diffusion by restricting the field of study to the system's technical features and their affect on the labour processes of specific enterprises. In such cases evaluations of its influence have turned on how many firms and/or industries adopted the mechanisms of scientific management as these were laid down by Taylor.\(^6\)

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\(^6\) Wright, 'Taylorism Reconsidered...,' generally; Nelson, *Managers and Workers...*, pp.70-71. Nelson suggests that the impact of scientific management was limited to only 29 enterprises. These, he argues were 'Taylor firms' because they were
This quantitative methodology has given rise to the conclusion that only small and medium size firms adopted the mechanisms of scientific management.\(^7\)

Edwards thus argues that although scientific management was greatly debated among professional management theorists, during the early decades of the twentieth century, it was not generalised in American industry because the major corporations ‘failed to give it a try’; it was ‘one of those failed (or only partially successful) experiments from which much was learned.’\(^8\) Other scholars have similarly depicted it ‘as an idea whose time had not yet arrived.’\(^9\) Avoiding the role of different structures and the agency of progressive reformers in the diffusion process, such conclusions have reinforced a narrow association between scientific management and the industrial arena.

These types of measures of its success and significance can be traced to the writings of the scientific managers themselves, as well as some of their allies. It was a popular undertaking after 1910 to investigate how many firms had adopted Taylor's ‘efficiency methods’\(^10\); it provided a good way of validating the system, advertising it to the wider American business community, and countering the claims of rival methods and the criticisms of opponents. But the use of such quantitative methods by subsequent systematized by Taylor's immediate followers and because they adopted the major features of the system which he identifies as: 1. preliminary technical and organizational improvements, including high-speed steel; 2. a planning department; 3. functional foremanship; 4. time study; and 5. an incentive wage system.


scholars is problematic. The organisations which developed partial applications of the system without referring to Taylor or acknowledging him as the source cannot easily be measured.\textsuperscript{11} As Drury commented in 1915:

\begin{quote}
not even the largest sounding of the estimates... would cover all the industry upon which scientific management has had some effect... We have noted... the large number of persons who have entered upon the work professionally or taken an active part in introducing changes into their own plants. Perhaps they do not completely understand scientific management, but they have read Taylor's books, or Emerson's, or caught their spirit, - and one or another of their principles is adopted.\textsuperscript{12}
\end{quote}

In addition, this quantitative approach avoids considering the effect of scientific management on non-industrial fields. Accordingly, this paper does not give exclusive attention to the 'nuts and bolts' of this new technology. As Layton points out, scientific management represented complex combinations of process innovations which were too difficult to transmit as a totality. Certainly direct borrowing occurred, but this was more in the nature of what Kroeber refers to as 'stimulus' or 'idea diffusion,' according to which a form of knowledge acts as a stimulus on others 'to do something similar, but in their own distinctive way.'\textsuperscript{13}

From this perspective, scientific management did not simply 'trickle down' to Australia from the U.S.A.\textsuperscript{14} It was transferred as a mass of ideas and orientations to work and training. In this form it had a marked impact on the social dimensions of industrial activity, even though it did not necessarily influence the labour processes of the majority

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\textsuperscript{11} Merkle, \textit{Management and Ideology...}, p.50.
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of industrial firms at this time. In short, this paper demonstrates how 'invention, development, and diffusion go on simultaneously,' both within and between nations.\textsuperscript{15}

It is worthwhile remembering that scientific management's evolution was closely related to far-reaching developments which occurred in the U.S.A. during the late nineteenth century, such as the scientific-technical revolution, the formation of trusts, the rise of 'systematic management,'\textsuperscript{16} the growth of bureaucratic structures and the unification of training and research in the modern university.\textsuperscript{17} Additionally, the 'philosophical principles' underpinning scientific management had significant ideological implications.\textsuperscript{18}

Stark argues that it represented the articulation of an engineer's ideology. And Merkle concludes that it was 'an ideology about management and for managers' which has had profound effects upon 'the ideology of the modern state and its industrial and business enterprises.'\textsuperscript{19} But Taylor's ideas on training and his involvement in educational reform associations also indicate that this ideology had immense cultural ramifications.\textsuperscript{20}

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\textsuperscript{16} Taylor's contemporaries stressed, however, that 'there is a vast difference between systematized management and Scientific Management.' Henry P. Kendall, 'Unsystematized, Systematized, and Scientific Management,' and Professor Charles W. Mixter, Discussion of Edwin F. Gay, 'Academic Efficiency,' in Dartmouth College Conferences, First Tuck School Conference - Addresses and Discussions at the Conference on Scientific management Held October 12, 13, 14, Nineteen Hundred and Eleven (Hive Publishing Company, Easton, republished 1972) pp.112-141, p.304.


In what ways were these manifested? First, the integration of scientific management with the educational reforms implemented in the U.S.A. during the first two decades of the twentieth century encouraged the professionalisation of many occupations. Second, the increased occupational division of labour fostered by the system gave professionals an influential role in shaping the training given to workers. I contend that in both regards Taylor's underlying aim was to initiate a new industrial culture in which professional engineers would be more central and powerful; and relatedly, to inaugurate a preliminary separation of planning and execution of work in the educational arena.

In fact, the connection that developed between scientific management and professionalisation in the U.S.A. affected the degree to which Taylor's ideas spread to various other industrialised and/or industrialising nations. McGuffie argues that Britain's highly segmented class structure limited the influence of scientific management because British universities 'remained bastions of privilege and monitors of class rank.' Likewise, Merkle concludes that the absence of 'technocrats of uncertain social origins' in Britain meant that 'there was no group whose greatest interest lay in the propagation of scientific management as a profession.' By contrast, in France, Henri Le Chatelier promoted a French variant of the system because he 'believed that Taylorism's methodology was perfectly designed to... restore the professional engineering elite to its

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The spread of scientific management in different national contexts thus depended on two interrelated preconditions: first, a fluid class structure that enabled the ascent of professionals; and second, an integrated educational system which fed into the social relations of production and facilitated the professionals' social mobility.

At the very time when Taylor's theories 'of job design and labour management' were being diffused in industrial America, so too were they being positively received by certain Australian professionals and manufacturers. Contrary to the conclusions drawn by both Rowse and Cochrane, this paper maintains that Australian intellectuals did make a 'concerted' effort to generalise plans 'for the scientific reconstruction of the civil and industrial administration' during the second decade of this century. This, despite the absence in Australia of large scale manufacturing.

Certainly, the structural limitations of Australia's political economy influenced the way that local engineers and manufacturers reacted to scientific management. Additionally, the system's Antipodean diffusion was mediated by British precedents. But it was not entirely constrained by these factors. Australians were particularly receptive to American approaches to a range of economic, political and social activities during this period precisely because of the U.S.A.'s rising pre-eminence in the global economy. Consequently, as in the U.S.A., professional members of the new middle class played

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26 My understanding of this social formation and the value of the term - 'the new middle class' - is informed by the following: Larson, The Rise of Professionalism..., pp.137-
a pivotal role in spreading the gospel of scientific management in Australia and applying it through the reform of industry-related training in ways that ensured them a prominent position.

II

During the first twenty-odd years of its evolution, Taylor's system of management was identified by a number of titles including the 'Piece-Rate System,' 'Task Management' and 'the Taylor System,' although it was the latter which was most widely used before 1910. Nevertheless, Taylor argued that the system 'should be properly called by some generic term which could be and ought to be acceptable to the whole country' on the grounds that it had universal possibilities.27 The principles of scientific management could, he wrote, 'be applied with equal force to all social activities'; to the management of homes, philanthropic institutions, schools, universities and government departments.28

After 1910 such universal claims were promoted by others. During the proceedings of the Eastern Rate Case in that year, when the north-eastern railroad companies appealed to the United States Interstate Commerce Commission for an increase in freight charges, Louis D. Brandeis, the lawyer representing the eastern shipping

139, pp.142-145; Weibe, The Search for Order..., pp.44-75, pp.111-113; Stabile, Prophets of Order..., pp.17-28; Reiger, The Disenchantment..., p.3, pp.11-29; Desley Deacon, Managing Gender: The State, the New Middle Class and Women Workers 1830-1930 (Oxford University Press, Melbourne, 1989) pp.1-17.


concerns, sought 'expert guidance' from members of Taylor's immediate circle of followers. Together, these men devised the title 'scientific management' as the most appropriate 'descriptive handle to use in the case'; it supported Brandeis's argument that no increases would be needed if the railroads overcame their inefficiency. The evidence presented by expert witnesses, such as Taylor and Harrington Emerson, caused a sensation that, according to Merkle, transformed Taylorism 'from an obscure obsession of certain middle-class engineers to an amazing and highly publicized nostrum for the evils of society.' The notion of science, so clearly embedded in this new title, not only invested the system 'with an aura of impartiality,' but also allowed progressive industrial managers, politicians and social scientists to promote the system in the very universal terms espoused by Taylor. On this basis he and his apostles engaged in a publicity campaign that succeeded in sparking wider interest among engineers, managers and even educators, many of whom become ardent publicists of his brand of business management. The evidence presented during the Eastern Rate Case captured the imagination of significant members of the American middle class. Additionally, the evangelical fervour with which scientific managers promoted their 'harmony of interests' gospel and its practical 'scientific' manifestations, through their consultancies and


popular literature, simply reinforced the efficiency craze which swept the U.S.A. during this period.°\(^3\)

The growing concern for efficiency was integrally related to the restructuring of capital which occurred in America between 1890 and 1920. The expansion in the scale of enterprise as well as the revolution in transport and communications technologies disrupted existing industrial and social relations. The employment of increasing numbers of workers in the rapidly growing corporate enterprises eliminated the personal contact between employers/sub-contractors and workers that had previously characterized the function of authority in the workplace.\(^4\) The social problems that accompanied these changes forced middle class reformers to consider a wide range of solutions.

Against this background, scientific management became renowned because it offered to adapt industrial practices to the larger scale of manufacturing; its methods increased the degree of co-ordination and control over the production process in ways that established new forms of contact between management and labour. Only Taylor's synthesis simultaneously focussed on technical and social problems. Hence, many of Taylor's contemporaries became especially interested in using his ideas to bridge the growing gulf between capital and labour - a detachment between employers and their workers which was evident in both America and Australia.\(^5\)

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\(^3\) Hoxie, ibid. p.8; Callahan, Education and the Cult..., p.42; Merkle, Management and Ideology..., p.11; Stabile, Prophets of Order..., p.61; Zerzan, 'Taylorism and Unionism...,' p.141.


Taylor's system was directed toward ameliorating such social conflict. As Taylor put it:

Scientific Management... has for its very foundation the firm conviction that the true interests of the two [employers and employees] are one and the same...and that it is possible to give the workman what he most wants - high wages - and the employer what he wants - a low labor cost - for his manufactures.36

Yet technically scientific management was not entirely new. It codified and restated a range of planning, co-ordination and control practices which had been evolving since the inception of the industrial revolution.37 Taylor, in fact, acknowledged that the originality of his approach was essentially based on 'a certain combination of elements which have not existed in the past.'38 Some therefore conclude that Taylor's work only 'made a new synthesis out of old practises.' If this is the case, then the real novelty of Taylor's approach can be identified in his insistence on combining scientific methodology with 'the unifying force of a clear-cut philosophy.'39 Taylor's point that 'one best way' could be discovered for the performance of any task, given sufficient investigation, was not only a central pivot of his system, it also became an important slogan which was disseminated far beyond America's shores.40


37 British industrialists and commentators were the most vociferous in pointing out that many features of scientific management had been predated by British developments. They, together with other writers, have therefore claimed that the work conducted in England by Charles Babbage during the 1820s and 1830s provided the foundation for Taylor's ideas. See, Edward Cadbury, 'Some Principles of Industrial Organisation, The Case For and Against Scientific Management,' Sociological Review vol.7, no.2, April 1914, pp.99-117; C.G. Renold, 'Comment on Cadbury's Paper,' Sociological Review vol.7, no.2, April 1914, p.122; L. Urwick, The Making of Scientific Management Vol.2 (Sir Isaac Pitman & Sons, London, 1957) p.7.

38 Taylor, The Principles..., pp.139-140.

39 Urwick, The Making..., pp.8-9, p.217; Merkle, Management and Ideology..., p.99; Taylor himself recognised that scientific management did not involve 'the discovery of new or startling facts.' But this posed no real problem for his contemporaries. As James M. Dodge, one of Taylor's followers, commented, 'we were impressed that Mr. Taylor in formulating his system had taken good points of management from various sources and had skilfully combined them in a harmonized whole.' Taylor, The Principles..., pp.139-40; James M. Dodge, 'A History of the Introduction of a System of Shop Management,' Trans., A.S.M.E. vol.27, 1905-1906, p.723.

scientific management in 1911, scientific managers usually approached workers by saying:

We do not know the best; we are sure that within two or three years a better method will be developed than we know of; but what we know is the result of a long series of experiments... these standards that lie before you are the results of these studies... the moment any man sees an improved standard... come to us with it; your suggestion will not only be welcome but we will join you in making a carefully tried experiment... If that experiment shows that your method is better... everyone of us will adopt that method until somebody gets a better one.\footnote{Frederick W. Taylor, 'The Principles of Scientific Management,' in Dartmouth College Conferences, Address and Discussions at the Conference on Scientific Management..., p.54.}

E.E. Hunt, the Assistant to the Secretary of Commerce and a member of the American Committee on the Elimination of Waste in Industry remarked some time later: 'scientific management is a dynamic thing; its principles are the principles of growth and change.'\footnote{Edward Eyre Hunt, Scientific Management Since Taylor (originally published in 1924; republished by Hive Publishing Co., Easton, 1972) p.xii.} Taylor's contemporaries evidently understood that his advocated 'one best way' of doing things was a mutable standard that required constant refinement through experimentation. His insistence on the documentation of experiments and their results was similarly novel. As Hollis Godfrey remarked in 1924, he had seen 'nothing more significant than the constant advance in selective written records on industrial matters.' Before Taylor emphasised the need to record industrial processes, he added, written records had not been used as guides for the future.\footnote{Godfrey was a member of the National Council of Defence during World War One and subsequently he became the President of the Engineering-Economic Foundation located in Boston. Cooke, 'The Influence of Scientific Management...,' p.35.}

The philosophy of scientific management and its methods were essentially linked by the assumption that traditional ways of doing things, as well as ways of thinking about the world, had to be discarded. Decades later Urwick stressed that basically scientific management meant 'thinking scientifically instead of traditionally or customarily about
the processes involved in the control of social groups who co-operate in production and
distribution.\textsuperscript{44}

How did Taylor's philosophy reflect this modern way of thinking? It defined four
principles which advocated that management should assume new duties. They were:

1. the gathering together of the traditional, 'rule-of-thumb' knowledge, previously
possessed entirely by craft workers, and developing a 'true science' by 'classifying,
tabulating and reducing this knowledge to rules, laws and formulae.'

2. scientific selection of workers;

3. scientific education and development of workers;

4. the promotion of intimate friendly cooperation between the management and
labour.\textsuperscript{45}

Taken together with the methods of scientific management, these principles introduced
a number of fundamental changes to the organisation of production. Time and motion
studies and the standardisation of methods and tools resulted in a greater division of
labour than had previously existed.\textsuperscript{46} And the creation of a planning department, where
experts co-ordinated information gleaned from the studies before passing it on to the
workers in the form of written instructions, allowed the separation of planning and
execution. In turn, the numbers, importance and power of supervisory, engineering and
clerical staff were strengthened. The planning department operated like Bentham's
Panopticon; it was a laboratory which 'could be used as a machine to carry out
experiments, to alter behaviour, to train or correct individuals.\textsuperscript{47}


\textsuperscript{46} Taylor, \textit{ibid.}, \textit{The Principles...}, pp.77- 80, p.117; Taylor, 'Shop Management...', pp.58-60. Drury suggested that scientific management introduced 'a greater differentiation than ever before between the various employees' so that there was no longer 'two large groups of persons, one at the top and the other at the bottom.' Drury, \textit{Scientific Management...}, p.221.

From this angle, Taylor's combination of scientific and bureaucratic methods with an ideology which promoted social harmony and consensus between capital and labour made scientific management much more than the sum of all its component parts. Its methods were simultaneously directed toward increasing production and consumption and implementing social change.\textsuperscript{48}

III

Taylor's dream of an ordered, individualized, sanitised, hierarchically differentiated and essentially rational industrial world focussed the trajectory of his system not only on the culture of work but also that of training. Those members of the new middle class who accepted and promoted scientific management did so precisely because of their empathy for Taylor's vision; it fitted neatly with their own general aims.\textsuperscript{49} Middle class reformers therefore fixed their attention on two related spheres. The first centred on the most pivotal 'site' for the internalisation of power relations - the workplace.\textsuperscript{50} Here, scientific management was used to institutionalise new forms of communication between managers and workers. In this respect, it advocated the introduction of a formal system of information exchange based on written instructions.

Written instructions enhanced the disciplinary power of the additional numbers of technical experts required by the system, as well as their capacity for surveillance. At the same time, these instructions provided an additional method of domination through their ability to constitute: 'the individual as a describable, analysable object... under the gaze


\textsuperscript{49} Merkle, \textit{Management and Ideology...}, p.51, p.81.

of a permanent corpus of knowledge.' Taylor's arrangements sought to transform the individual worker from 'a subject in communication' to an 'object of information.'

The second field targeted for 'reform' by scientific managers and their progressive supporters centred on industry-related training, at both technical and professional levels. Taylor's advocacy of new training methods was based on an attempt to communicate and generalise the ideals and practices of scientific management. The reorganisation of education effectively provided scope for increased surveillance and discipline similar to that exercised in the workshop. Taylor appears to have implicitly recognised that the 'disciplinary' nature of educational institutions differentiated individuals from each other in a hierarchical manner, homogenised them, and provided the means for punishing or excluding those who were unwilling or unable to conform.

Raymond Williams points out that what is conceived of as 'education' is 'in fact a particular selection, a particular set of emphases and omissions.' Williams and Harvey J. Graff both argue that the industrial training reforms introduced in most industrialising countries, during the late nineteenth and early twentieth centuries, were not simply designed to extend literacy and the range of technical skill. More significantly, they sought to inculcate a 'pattern of culture' and of power relations through the spread of particular values, morals and discipline concerning group loyalty, authority, justice, and lifestyle. Dore therefore concludes that the promotion of literacy 'constitutes a training in being trained'; it effectively increases the likelihood of a positive response to further training.


52 Foucault, ibid., pp.183-184.


Essentially designed for precisely such ends, Taylor's advocated training methods revolved around the combination of record-keeping, written instructions, payment incentives and 'functional foremanship'. Literary artefacts and bureaucratic techniques were pivotal features of scientific management. They included accounting and wage records, time cards, lists of mnemonic symbols for the identification of tools and manufactured articles, drawings, timetables, reports, charts and order of work slips. Drury commented that adequate records of past achievements enabled 'closer touch' with workers because records provided information on each individual's performance, punctuality, attendance, integrity, rapidity, skill, accuracy and, as Taylor put it, each worker's 'attitude towards his employers and fellow-workmen'.

Under scientific management the use of written instruction and return cards was intended to provide the chief means for instructing both foremen and workers in all the particulars of their work. Included in such cards were all accounting details, descriptions of work procedures and specific tools to be used, the exact time allowance for each element of the work and the particular pay rate for the job. In addition, their form differed depending on the nature of the instructions to be conveyed. Taylor wrote that in some cases the card 'should consist of a pencil memorandum on a small piece of paper... while in others it will be in the form of several pages of typewritten paper.'

Taylor argued that written instructions provided an important tool for altering the relationship between workers and their supervisors. The latter became 'teachers'


56 Taylor, The Principles..., p.68. These were precisely the details that were included in the Card System adopted by the N.S.W. Railways and Tramways Department in July 1917; a version of Taylor's system that sparked the NSW General Strike in August of that year. Refer to Taksa, 'All A Matter of Timing...,' Chapter Nine.

responsible for helping workers perform their duties according to the details outlined on the cards. But because workers resisted this source of managerial control, Taylor also devised a number of supplementary techniques to ensure compliance in the pursuit of industrial harmony. First, he promoted the adoption of rigid standards because he believed this would force workers to obey directions. Second, he linked the payment of additional wages to the exact performance of written instructions. For example, at the Bethlehem Steel Works, Taylor adopted Gantt's bonus pay scheme which offered a daily bonus of 50 cents to every worker who accomplished the task set out on instruction cards.

Taylor also advocated the division of supervisory functions among numerous specialist foremen, an innovation he entitled "functional foremanship." The training implications of this aspect of his system were recognised by his contemporaries. Nicholas Thiel Ficker pointed out in an Australian manufacturer's journal that when 'Frederick W. Taylor inaugurated a new epoch "of functional effort",' he demonstrated the 'dearth of properly trained' people and 'a corresponding necessity for some systematic scheme of industrial education along scientific lines to fit men (my emphasis) for positions of industrial


59 Taylor, The Principles..., p.123. Taylor wrote: 'Human nature is such, however, that many of the workmen, if left to themselves, would pay but little attention to their written instructions.' Copley, ibid., p.272.


61 'Functional foremanship' fragmented the traditional foreman's job into eight parts in order to enable more direct supervision of workers and to systematize the evaluation of work. Functional foremanship was thus divided as follows: 1. gang bosses 2. speed bosses 3. inspectors 4. repair bosses 5. order of work and route clerks 6. instruction card clerks 7. time and cost clerks 8. shop disciplinarian. Taylor, 'Shop Management...,' pp.100-106.
leadership. In effect, functional foremanship represented a direct attack on traditional modes of co-operative training among workers.

Taylor's ideas on written instructions and training were taken up and widely disseminated by followers, such as H.L. Gantt, F.B. Gilbreth, M.L. Cooke, C.B. Thompson and F.A. Parkhurst, amongst others. It was through them that Taylor's 'gospel' was spread internationally. Cooke, in fact, broadened the scope of scientific management by applying its principles and adapting its methods to suit universities in a study he conducted on academic efficiency, under the auspices of the Carnegie Foundation. Gantt, on the other hand, did the most to extend Taylor's ideas on vocational education.

62 A.M. 10/2/1917, p.23.


64 Drury, Scientific Management..., p.153.


66 Cooke, Academic and Industrial Efficiency.... This Report to the Carnegie Foundation for the Advancement of Teaching (Bulletin no.5, 1910) was received by the Royal Society of N.S.W. See Proc., Royal Society of New South Wales (R.S. of N.S.W.) vol.44, 1910, p.xxiii.
Traditional training undertaken 'in the atmosphere of the union' promoted and perpetuated hostility to employers instead of co-operation, thought Gantt. Accordingly, he wrote: 'To avert this hostility we must begin by giving workmen a different training;' 'the policy of the future,' he stressed, 'will be to teach and lead, to the advantage of all concerned.'\textsuperscript{67} From his perspective, the instruction card method was 'a system of education with prizes for those who learn.'\textsuperscript{68} In his own task and bonus system, much like Taylor's 'differential' and Gilbreth's '3-rate' pay schemes, rewards were given to those workers who co-operated with the management in exactly following instructions. And although Gantt thought that the methods associated with scientific management were 'simply the means to an end,' he argued that they could 'never be utilized properly until the rank and file have been trained to operate them.'\textsuperscript{69} 'To my mind,' he wrote, 'the training of workmen... is one of the most important functions of the management,' and although slow and expensive 'it is the only method which holds out any hope of producing even a partial solution of our present industrial problems.' He concluded:

If these methods were introduced extensively, it is without question that the habit of the shop would influence that of the community, and there would be a general increase in efficiency.\textsuperscript{70}

Gantt's view echoed that of Taylor's.

IV

The demand for management to take on the training of workers appeared in all of Taylor's major publications. It illustrated an astute judgement of his contemporaries' anxieties about the influx of unskilled immigrants and the alleged obsolescence of the traditional apprenticeship system. The tendency for both developments to reinforce the

\begin{itemize}
  \item[\textsuperscript{67}] Gantt, \textit{Work, Wages and Profit...}, pp.111-112.
  \item[\textsuperscript{68}] Gantt, \textit{ibid.}, p.256.
  \item[\textsuperscript{70}] \textit{ibid.}, p.148, pp.220-21.
\end{itemize}
prevailing social and industrial dislocation greatly perturbed America's social reformers.\textsuperscript{71}

Taylor and his colleagues responded by proclaiming that scientific management constituted a 'practical system of vocational guidance and training,' an idea which impressed Professor Hoxie, who commented that if scientific management could 'show the way through practical vocational adaption... to the elimination or alleviation of evils, such as 'discontent, degeneracy, crime, inefficiency and poverty,' then it deserved 'the support of all classes whatever be its limitations and shortcomings.' So, even though his own investigation revealed the sweeping claims of scientific managers to be unsubstantiated, Hoxie praised the attention given to instruction and training in scientific management shops because it was generally greater than in similar 'modern establishments.'\textsuperscript{72}

The social and political problems that characterised the U.S.A.'s progressive era created a general receptivity to the idea of reforming a wide range of activities according to the principles of scientific management. These principles appealed to middle class professionals because, according to Nelson, they ratified 'an aristocracy based on technical knowledge, formal education, and organizational skills rather than inherited wealth, social and family ties, or business acumen.'\textsuperscript{73} Taylor's social background and training located him squarely in the milieu of America's professional middle class and led to his involvement in a plethora of formal and informal occupational and reform-oriented associations. He participated in the political mobilisation represented by progressivism, using a variety of media outlets to establish a nexus between his ideas and practices and those espoused by progressive reformers.\textsuperscript{74} Of particular importance, in this regard,

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  \item \textsuperscript{72} Hoxie, Scientific Management and Labor..., p.13, pp.34-37.
  \item \textsuperscript{73} Nelson, Frederick W. Taylor..., p.ix.
  \item \textsuperscript{74} Taylor, The Principles..., pp.5-7; Louis D. Brandeis, 'Forward' in Gilbreth, The Primer ..., pp.vii-viii; Merkle, Management and Ideology..., pp.243-244; Samuel Haber,
was the mutual esteem that was publically expressed by Taylor and Theodore Roosevelt for each other's interests in national efficiency. To legitimate his system's focus on the reduction of human effort, Taylor invoked President Roosevelt's appeal for conservation and the elimination of waste in the introduction to his *Principles of Scientific Management*. Roosevelt, on the other hand, remarked that: 'Scientific management is the application of the conservation principle to production.'\(^\text{75}\) Yet Taylor's links with progressivism built on his purposeful involvement with other professionals concerned about the reform of engineering and industrial education. In 1906, during his term as President of the American Society of Mechanical Engineers (A.S.M.E.), Taylor's links with the field of education and academics grew substantially when he became vocal on the subject of educational reform. During his dedication of a new million dollar engineering building at the University of Pennsylvania, an event which saw him receive an honorary doctorate, Taylor attacked existing educational methods and presented proposals for the reform of industrial and professional education.\(^\text{76}\)

Subsequently printed as a pamphlet, this address attracted extensive attention in academic circles. In November 1907, Professor Ira N. Hollis from Harvard University's Division of Engineering wrote to Taylor:

> Your ideas on the subject of education seem to me well worth spreading, and I am looking for missionaries to the cause here at Harvard. Would you be willing to serve on the Visiting Committee for Engineering, at this university?

Taylor accepted this invitation and the following year he reiterated his views to the Harvard Engineering Society, as well as in a letter he wrote to Dr Alexander C. Humphries, President of the Stevens Institute, where some of the professors had

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The oration was entitled: *A Comparison of University and Industrial Methods and Discipline; Being a Protest against the Excesses of the Elective System and Loose University Discipline, and a Plea for Bringing Students Early into Close Contact with Men Working for Their Living.*
become his active followers. Support of this nature was forthcoming because scientific management idolised 'experts' and gave them a tool for monopolising scientific knowledge. The system's influential supporters, such as the President of the Carnegie Foundation for the Advancement of Teaching, Henry S. Pritchett ensured that Taylor's ideas were diffused beyond the factory; they were embodied in the 'business training' offered to American engineers by both technical schools and universities.

Taylor's interest in reforming industrial education built on the middle class engineers' involvement in adapting engineering education to meet the needs of their new role as inventors and professional regulators of modern technology. To this end, engineering educators had formed the Society for the Promotion of Engineering Education (S.P.E.E.) in 1894, an organisation in which Taylor became an active participant. In co-operating with the nation's trade associations, various engineering societies and the National Association of Corporate Schools (N.A.C.S.), the 'corporate reformers' within S.P.E.E. worked to bring college and apprentice training into line with industrial requirements.

Papers presented before the A.S.M.E. during 1907 and 1908 thus focussed increasing attention on 'Industrial Education,' and the discussions which followed provided a forum in which Taylor and his supporters could exchange views with representatives of some of America's leading corporations. Scientific management's emphasis on training through 'instruction cards' in order to specifically outline the task to be done, how it was to be done and the time allowed to do it, dovetailed nicely with the corporations' growing interest in supplementing the 'instruction' of 'green' apprentices with formal classes held during working hours.

Even after the expiry of his term as A.S.M.E. President, Taylor continued to extend his personal links with educational reform associations. When the National Society for the

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78 Copley, ibid., pp.267-9.
Promotion of Industrial Education (N.S.P.I.E.) was formed in 1906-1907, he joined its first board of managers, together with other founding members, such as Charles A. Coffin (President of General Electric), C.R. Dooley (Westinghouse) and Dugold Jackson (Massachusetts Institute of Technology). Additionally, Theodore Roosevelt's public approval of this new body reinforced Taylor's links with progressivism.  

V

The belief that scientific management was applicable to non-industrial activities spread because of its emphasis on the provision of specialised training not covered by traditional apprenticeship schemes. It offered a way of bridging the gap between the university or technical college and the factory floor. Both obliquely and overtly scientific management infused industrial training. First, some of the charter members of N.A.C.S. had earlier been reorganised by Taylor's earnest followers, Gantt and Barth. Second, the Dean of the College of Engineering at Cincinnati University, Herman Schneider, was instrumental in consciously spreading Taylor's principles of scientific selection and scientific education. His Cincinnati Plan inaugurated a co-operative course in 1906 through which students alternated between the classroom and the factory. The Plan spread to 75 companies which had adopted the course by 1919. It was also replicated by the University of Pittsburg. Similar arrangements were then also made by other universities and institutes, notably the Municipal University of Akron, Case in Cleveland, Drexel in Philadelphia, Union in Schenectady, Marquette in Milwaukee, Harvard in Cambridge, and New York University in New York City. As McGuffie points out, the new industrial training which accompanied the 'displacement of the old contracting petite...

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82 At different times Gantt was hired by the American Locomotive Company, the Westinghouse Electric Company and the Remington Typewriter Company, while Barth reorganised the Yale and Towne manufacturing Company, whose President Henry R. Towne was a significant advocate of scientific management. Drury, *Scientific Management...*, pp.124-125, p.129, p.150.

bourgeoisie by a new petite bourgeoisie' effectively translated 'the ideology of professional management... into practice.'

Scientific management's educational influence soon extended beyond industrial training. At the height of its popularity, the administration of public education was being attacked by muckraking journalists and corporate leaders for mismanagement and inefficiency. At the same time, an increasing demand for industrial training and an accompanying campaign to extend vocational education to public schools, exacerbated the pressure on American educators and school administrators to become more concerned about efficiency.

The demand for educational reform climaxed in 1910, at the very time when American education was being strained by the arrival of large numbers of new immigrants, as well as by the effect of new child labour and compulsory school attendance laws. The growing potency of business values, coupled with a cost-conscious reform-minded public, helped spread Taylor's 'gospel'. Courses on his principles were soon launched at various educational institutions. In 1910 scientific management began to be taught formally at both the Harvard Business School and at the Amos Tuck School at Dartmouth. Soon, too, these principles were applied to virtually all aspects of secondary schooling.

As school administrators enthusiastically embraced scientific management numerous articles, books and reports on economy, efficiency and standardisation in education were published. In addition, the main topic of discussion during the 1913 convention of the Department of Superintendence was 'Improving School Systems by Scientific Management.' Educational methods were rapidly influenced by these developments. In 1911 the Efficiency Committee of the National Education Association (N.E.A.)

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84 McGuffie, *Working in Metal...*, p.79, p.86.
87 Two notable examples of the literature produced were 'Scientific Management and High School Efficiency' by Harrington Emerson, published in 1912 and *Scientific Management in Education* by J.M. Rice, published in 1914.
recommended that teachers use 'printed outlines, seating plans, recitation cards, attendance sheets and other "labor saving devices".' Increasingly, pupils were represented as the raw material of the education business and the school was likened to a factory. Educational administrators thus identified those aspects of education which could be measured for efficiency. They began to refer to standards and instructions, records, selection, training and rating of both pupil and teacher efficiency, 'pupil cost,' 'investment per pupil' and 'school plant.' In this way Taylor's record keeping and accounting techniques pervaded the field of education so that notions of investment, waste and the standard unit costs of the 'student hour' formed the criteria for measuring the relative value of different subjects, like maths, English or Latin.

These methods were then spread through the Gary Plan which was adopted in the schools of Gary, Indiana. In 1912, in an article on 'The Elimination of Waste in Education,' John Franklin Bobbitt argued that the Plan's value was based on its adoption of scientific management principles. Although the Gary Plan was not adopted extensively prior to 1914, after that year it spread quickly so that by 1925 it had been implemented in 632 schools in 126 cities.

VI

Scientific management spread at a much slower rate in Australia than in the U.S.A. primarily because of the former's subordinate position in the international division of labour. At the turn of the century manufacturing only made up 12 percent. of Australia's gross domestic product. Despite this structural difference between the two nations,

88 This was evident by the way the Plan (i) promoted the continuous use of education plant through the scheduling of continuous classroom use; (ii) reduced the number of workers to a minimum through the advent of specialised teachers; (iii) eliminated waste due to ill-health by providing additional outdoor recreational activity; and (iv) developed 'the raw material into that finished product for which it is best adapted' as this entailed altering each student's programme to fit his/her abilities.


however, scientific management did affect Australian ideas and practices after about 1912.

Socio-economic developments in N.S.W. after 1870 were comparable to, albeit quantitatively different from, those that occurred in the U.S.A. in roughly the same period. During the final decades of the nineteenth century, as a result of economic restructuring, labour and capital became increasingly polarised, a new middle class began to emerge, manufacturing became more significant and the state assumed a more interventionist role in Australia.91 In dealing with the resulting social and industrial problems, Antipodean professionals began to consider the applicability of American models to a wide range of activities and enterprises. It was on this basis that scientific management pervaded Australian ideas and practices.92 The problem of industrial training that had been vexing the minds of American industrialists and educators also worried intellectuals and manufacturers in Australia. From the late 1880s entrepreneurial mechanical engineers in N.S.W. had begun to allege that the apprenticeship system was extinct. As Shields points out, this demise was, in fact, slow in arriving.93 But the similarity of such anxieties with their American counterparts, as much as their concern for the relationship between labour supply, vocational training and national efficiency,


92 Irvine, National Efficiency.... generally; Correspondence between George Beeby and Frederick W. Taylor, 1912 and Correspondence between Charles G. Heydon and Birge Harrison and Frederick W. Taylor, 1914 in Frederick W. Taylor Collection, Samuel C. Williams Library, Stevens Institute of Technology, New Jersey; Correspondence, H.B. Higgins to Felix Frankfurter, 1914 and 1915 in Higgins Collection MS.2525, Australian National Library. And see further: Taksa, 'All a Matter of Timing...,' Chapters Six and Seven.

made middle class Australians receptive to American reforms in this particular arena.\textsuperscript{94} Indeed, some publicised the link between scientific management and American educational models.\textsuperscript{95}

The findings of J.W. Turner and G.H. Knibbs, who travelled to the U.S.A. in 1902 to inquire into instruction methods for the Royal Commission on Primary, Secondary, Technical and other Branches of Education, laid the basis for a positive reception to American reforms. Turner commented in the Report, produced in 1905, that American models were far superior to British ones. He thought that the former were more appropriate for Australia since both countries belonged to the New World.\textsuperscript{96} Peter Board, the N.S.W. Under-Secretary and Director of Education from 1904, reiterated Turner's sentiments in 1909 when reporting on his observations of the way secondary education was organised in the U.S.A.\textsuperscript{97}

As early as 1903, following a trip to Europe, Board produced a report that promoted the reform of teacher training, inspection and examination and the adoption of scientific methods in primary education which included amongst other features, the use of time-


tables, uniform classifications and standards of proficiency.\textsuperscript{98} Board then began to implement such artefacts at all levels of the education system, beginning in 1906 with the introduction of the first centralised school syllabus which included detailed timetables. This development, asserts Snow, altered the temporal dimensions of schooling and supplemented the move to professionalise teachers. Insofar as the new syllabus promoted scientific principles and practices related to industry, it also equated education with 'work.'\textsuperscript{99}

Board's 1909 Presidential Address before the Education Section of the Australasian Association for the Advancement of Science (A.A.A.S.) explained the aims underpinning these reforms. The meaning of education had to be extended in Australia as it had in the U.S.A., Board argued here, if Australia was to prepare the ground for a science of education. Accordingly, he suggested that observation, experiment, analysis and synthesis had to be substituted for 'imitative methods' because 'freshness and originality in industry and business' could only develop if an ever-increasing proportion of the population 'had its eyes opened to the methods of science.'\textsuperscript{100}

This rhetoric of science and efficiency was soon adopted by other Australian intellectuals when praising American educational reforms and their value for Australian circumstances.\textsuperscript{101} The spread of American literature, coupled with the increasing number of Australians, such as Turner, Knibbs and Board among many others, to visit America also helped to spread American notions of efficiency to Australia where they soon informed expectations about, and programmes for, future development. In turn,

\textsuperscript{98} Peter Board, \textit{Report on Primary Education} (N.S.W. Department of Public Instruction, Government Printer, Sydney, 1903) pp.4-5, pp.11-12 and generally. Here Board commented favourably on the Moseley Commission's findings regarding American educational practices.


\textsuperscript{100} P. Board, Presidential Address to Section J. (Education): 'Mental Science and Education,' \textit{Proc., A.A.A.S.} vol. 12, 1909, pp.703-705, p.711.

\textsuperscript{101} Clarence H. Northcott, \textit{Australian Social Development} (Columbia University, New York, 1918) p.293; Turner, \textit{Apprenticeship in Industries...}, p.21 and generally pp.8-14.
the growing perception of an affinity between the two countries led the Australian literary media to give extensive coverage to American reforms particularly where they related to industrial efficiency, scientific innovation and education.\textsuperscript{102} By 1918, C.H. Northcott recommended that Australian schools be reorganised and curricula be readjusted according to the model of the Gary Schools in the U.S.A.\textsuperscript{103} And two years later, G.V.M. Turner, member of the N.S.W. Board of Trade, paid particular attention to the Cincinnati Plan, in his Report on 'Work Schools and their Methods.'\textsuperscript{104}

The pattern by which scientific management spread in N.S.W. owed much to the form which it had assumed in the U.S.A. Its association with progressivism and educational reform made it particularly appealing to middle class engineers, such as S.H. Barraclough, as well as professional educators, such as Peter Board and James Nangle, all of who were concerned about the need to reform the training methods offered by the Sydney Technical College.

During the first decade of the twentieth century, in N.S.W. as in the U.S.A., progressive university-based engineers became prominent in education reform circles. Their growing links with other professionals, fostered by their common membership of the Royal Society of N.S.W., encouraged their participation in the New Education Movement and enabled them to influence the reform agenda. As a result, such engineers were able to differentiate themselves from the older generation of entrepreneurial engineers and to establish themselves as the rightful group to influence the practices of the engineering artisan.

To reinforce this distinction, university-trained engineers emphasised the connection between engineering and science. They argued that the 'great rule of thumb' that had 'reigned supreme and undisputed' during the nineteenth century, when engineers were trained under a pupillage system, had been overthrown. The view of these theoretical

\textsuperscript{102} White, \textit{Inventing Australia...}, pp.141-143; Churchward, \textit{Australia & America...}, pp.79-80, pp.84-90, p.101, pp.110-111, pp.115-116; Megaw, 'Some Aspects of the United States' Impact...', Chapters Six and Seven.

\textsuperscript{103} Northcott, \textit{Australian Social Development...}, p.293.

\textsuperscript{104} Turner, \textit{Apprenticeship in Industries...}, p.21 and generally pp.8-14.
engineers that scientific laws, principles and methods were necessary to elevate Australia's international position vis-a-vis Germany and the U.S.A. aligned them with other middle class reformers. Gradually, university-trained professionals agreed that the improvement of technical education was critical to national efficiency and industrial development.\textsuperscript{105} The progressive engineer and University of Sydney lecturer, S.H. Barraclough, who studied at Cornell University in the mid-1890s, was instrumental in spreading American ideas and practices. In his 1905 Address to the Royal Society's Engineering Section, Barraclough extolled a range of American educational reforms. In comparing Australia with the U.S.A., Barraclough argued that the fulfilment of Australia's cherished ideal of shorter hours, higher wages, restricted numbers of workers and limited output from them, made it even more imperative for Australia to amend its system of training.\textsuperscript{106}

He complained that despite their tacit agreement with other nations that apprenticeship was dead, Australians had substituted nothing in its place. Barraclough's proposals to overcome this state of affairs echoed those of American reformers both in form and content. Since industrial capacity no longer depended on tradition and manual skill but instead on scientific and rational knowledge and machinery, he argued that it was now essential to ensure oversight and direction which would produce the largest possible output. In his view, new scientific discoveries called for changes in methods and greater amounts of technical knowledge which could no longer be learned 'at the bench or in the shops.' And although Barraclough admitted that no scheme of education could be 'imported ready made... from even the best educated country in the world,' he nevertheless thought that American models should be emulated. Barraclough stressed:

\begin{quote}
\text{it is a sorry argument that because natural opportunities are less, a people therefore is to be excused from making an equal effort.... if, as is evident, the resources of the country are not quite so readily to hand as in the}
\end{quote}

\textsuperscript{105} C.O. Burge, Presidential Address, \textit{Proc., R.S. of N.S.W.} vol.38, 1904, p.7, pp.9-10. For a discussion of the part played by professional engineers in the reform of technical education in N.S.W. refer to Taksa, 'All a Matter of Timing....,' Chapters Five to Seven.

United States, it is surely all the stronger argument for a resolute and
determined exploitation of those resources.\textsuperscript{107}

Barraclough's position was informed by his own American experiences and
associations. While reading for his Masters Degree at Cornell University's Sibley College
of Engineering, between 1892 and 1894, Barraclough had been influenced by Robert
Henry Thurstan, who Barraclough described as his 'sincere friend' and the 'father of the
modern engineering school.'\textsuperscript{108} This connection provided an important channel through
which the American pattern of engineering professionalisation spread to Australia.

As the first engineer ever to be appointed Professor of Mechanical Engineering at the
Stevens Institute of Technology, Thurston taught the subject between 1870 and 1885 to
upwardly mobile engineers like F.W. Taylor who obtained his Masters of Engineering
from this institution. In 1880, Thurston became the first President of the A.S.M.E. and
five years later he became the first Director of Sibley College. Significantly for
Barraclough, during his time at Sibley Thurston presented an extremely influential paper
before the A.S.M.E. in which he set out a complete and integrated training system for
mechanical engineering. Many years later, one of Taylor's supporters argued that
Thurston's vision had expanded the Society's province to include the field of social
economy; it laid down a 'germ of thought' which 'always remained in the Society' and
which 'found its most widely known expression in Frederick W. Taylor's classic paper on
Shop Management.'\textsuperscript{109}

Thurston's ideas, as well as those of other American engineers, influenced Barraclough.
He joined S.P.E.E., which was formed during his final year at Sibley. This was the very
same organisation through which Taylor developed links with progressives and
corporate leaders. S.P.E.E., in fact, provided Taylor with an important arena in which to

\textsuperscript{107} Barraclough, \textit{ibid.}, p.xiii, pp.xxv-xxvi, pp.xx-xxi, pp.xxv-xxv.

\textsuperscript{108} Correspondence, S.H. Barraclough to Professor Robert Henry Thurston, Series 3,
Folder 3, Sir S.H.E. Barraclough, Personal Papers, Group P.10, University of Sydney
Archives.

\textsuperscript{109} Dexter S. Kimball, 'The Relation of Engineering to Industrial Management,' \textit{Trans.,
promote his model for the reform of industrial and professional engineering education.\textsuperscript{110} Barraclough's continuing membership of this organisation, long after his return to Australia, would have exposed him to these ideas.\textsuperscript{111}

Like F.W. Taylor, Barraclough's vision for a reformed system of technical training promoted a greater sub-division of labour which would reinforce the university-trained engineer's managerial role. In his view there were three 'clearly recognisable, although not sharply defined types' of labour in the community: the skilled and unskilled artisan; the foreman type; and the professional scientific type. And he proposed that a systematic scheme of instruction which co-ordinated primary and secondary education on the one hand, and the University on the other, with the industrial life of the community would specifically cater for the needs of all three types.\textsuperscript{112}

Barraclough's progressive ideas on the stream-lining of education in N.S.W. had much in common with those of other middle class reformers, such as Peter Board.\textsuperscript{113} Like the latter, Barraclough acclaimed the use of scientific methods in the university training given to engineers. In 1908, he promoted the adoption of continuous rolls of students, professional records of graduates and recording systems for technical stores by the P.N. Russell School of Engineering. To improve workshop training for students he proposed a systematically planned syllabus and the creation of distinct lines of authority for those who ran the engineering workshops and laboratories. He also recommended that 'a definite and detailed scheme be issued in writing defining the duties' of each of the Engineering School's attendants. Moreover, like Board, Barraclough sought the introduction of time management. He remarked:

\begin{quote}
I think it very much to be regretted that the system of keeping Time Sheets in the Workshop has fallen through as it was an excellent object
\end{quote}


\textsuperscript{111} Correspondence, S.H. Barraclough to Professor Robert Henry Thurston.

\textsuperscript{112} Barraclough, Annual Address to Engineering Section..., pp.xxxii-xxxvi, p.xix, p.xxxvi.

\textsuperscript{113} Board, 'Mental Science and Education....,' pp.703-705, p.711.
lesson for the students in the Shop, and a good check on the work that was being done and the cost of it. I think that some system of 'costing' should be introduced.\textsuperscript{114}

These ideas complemented those of Board's. Students, Board argued in 1909, had to be taught to appreciate the lessons of scientific inquiry because the increasing subdivision of labour accompanying the development of industry required 'from the few the ability to direct, and from the many the power to do some small thing.' Board concluded that the evolution of industry would ensure that the school would 'become the adjunct of the workshop, and the workshop a class-room of the school.'\textsuperscript{115}

In the pursuit of distinctly progressive goals intellectuals, such as Board and Barraclough, introduced far-reaching changes to education. But it was specifically in the area of industry-related training that F.W. Taylor's principles and methods were diffused in N.S.W. by the fervent supporter of motion study, James Nangle, who was appointed Superintendent of Technical Education in 1913.\textsuperscript{116}

\textbf{VII}

The new technical education scheme developed by Board and Nangle was approved by the Minister of Public Instruction on 28th November 1913, and it came into operation in February 1914.\textsuperscript{117} By rationalising courses the scheme promoted closer relations between the Sydney Technical College and 'the various employers who subsequently engaged the services of the students trained' there, and it also integrated technical education with the other branches of the Department of Public Instruction. Trade

\begin{footnotes}
\item[114] Memorandum to Professor Warren on the General Organisation of the Engineering School from S.H. Barraclough, 24/9/1908, Barraclough Papers, Sydney University Archives.
\item[115] Peter Board, 'Mental Science and Education...,' p.703-705, pp.711-712. Also see, Board, \textit{Report Following Upon Observations...}, generally.
\end{footnotes}
Schools were established for those who were already employed in a trade and who had 'a certain degree of preparatory knowledge.' Those who were not so endowed were first required to obtain certificates from either a Commercial Superior Junior Technical School or an evening Continuation Junior Technical School. Henceforth the main object of the Technical College would be 'the training, first of competent tradesmen, and secondly, of a more limited number of students who would fill the positions of foremen.'

The integration of such functional divisions between training institutions in a centrally-controlled but hierarchically-differentiated education system reinforced occupational divisions between the new middle and working classes. Trade courses were linked to apprenticeships in ways that limited workers' theoretical knowledge, while at the same time restricting the more advanced courses that encompassed the 'technology of the various trades and technical professions' to those who were deemed to be 'capable of reaching positions such as that of foreman, works manager, or clerk of works.' Limited opportunities for working class mobility, for those who entered the field of engineering through traditional avenues, were also created through exemptions from first year university examinations for any 'special' students who performed well in the newly established 'sub-professional' diploma courses. (Figures I and II, Appendix A)

Industrial management methods were central to the scheme's administration and courses. Registration forms (effectively entrance tests) were introduced in the Trade Schools to select students on the basis of their literacy. Simultaneously, Sydney Technical College also adopted new record-keeping procedures for courses in order to chronicle students' results, as well as 'their experience during their daily occupations.' The record-keeping system introduced by the College involved the use of 'job-cards' which included each student's name, roll-book number, the total hours of attendance per week, the number of the job exercise and the time allotted for completion. Spaces were


also left on cards for students to enter dates and times when exercises were started and finished.

The Sydney Technical College job-cards were filled in after every exercise was completed. They not only enabled marks to be allocated for accuracy and general knowledge but, perhaps more importantly, for the time taken by each individual student to complete their own personal tasks. In situations where cards were inappropriate, such as for lectures or practical work in laboratories, progress was measured by a time test or 'Quiz' which required students to answer questions in an allotted time. Marks were then recorded in a roll-book in which information from the job-cards was also collated. Finally, all such information was recorded on a summary card for each student which was kept in the Record Office until the end of the year when examiners checked students' progress. Also, in order to bridge the gap between the classroom and the workshop, the information on these cards was forwarded to employers. In turn, employers were invited to fill in a form 'giving a brief account of the work and progress of each apprentice during each half year.' These job-cards inaugurated a new literary culture in technical education. (Figures III-VI, Appendix B)

These changes to technical education complemented a range of reforms then being implemented by the University of Sydney. Under the terms of the University Amendment Act of 1912 tertiary education was infused with a utilitarian ethos designed to cater to the concerns of the new professional middle class. Like the technical college, the University was pushed into closer association with the world of industry and commerce. These connections were then formalised when Nangle created course

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120 Nangle, Report of the Superintendent of Technical Education For 1914..., pp.104-108. In his Report for the year 1914, Nangle commented that employers had generally responded well to the invitation, although a certain portion were 'careless enough not to supply the information.' He therefore suggested that an officer be appointed 'to call on this type of employer and get the information.' See further: James Nangle, Report of the Superintendent of Technical Education For 1916, Report of the Minister of Public Instruction For The Year 1916, N.S.W.P.P. 1917-1918, Vol.2, p.96.

121 Nangle, Report of the Superintendent of Technical Education... 1914, pp.104-106.

122 Barcan, Two Centuries of Education..., p.192; Nangle, ibid., p.100. See also S. Murray-Smith, 'Technical Education: The Lines of Development,' in C. Sanders (ed)
advisory committees, involving trade union, industry and professional representatives together with Technical College staff, to advise him on appointments, content of instruction, equipment and examiners. These committees directly aided the formation of closer ties between intellectuals and engineers, particularly those who occupied management positions in government departments. The engineering trades committee, for instance, included S.H. Barraclough, as well as E.E. Lucy and James Scoular as representatives of the N.S.W. Railways and Tramways Department.

The closer links between the Departments of Public Instruction and Railways and Tramways resulting from these reforms also extended the locus of these innovations. In an effort to prevent `overlapping' and `wasted effort' and to ensure the conservation of public resources and uniform teaching practices throughout N.S.W., the Railway and Tramway Institute ran Trade Courses in tandem with those offered by the Department of Public Instruction's Trade Schools and a formal compact was also established between the Institute and the Sydney Technical College. Accordingly, the Institute also made arrangements to have promising Trade Course students, those who showed the capacity to become foremen and managers, submit to entrance examinations for the Diploma Courses offered at the College. Such foremen would be among those that railway workers would later equate with Taylor's 'functional foremen.'

The alliance between these public educational bodies enabled the standardisation of courses, exercises, workshop practices and administrative procedures. The Institute adopted the job cards, roll books, time quizzes, and exams used by the College to

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126 Curlewis, Royal Commission..., pp.36-37, p.40.
award marks and tabulate student assessment. It also installed `up-to-date methods' to record membership which involved a `complete card system.'

Literary artefacts of this sort complemented the job and time cards that were then being experimented with by the N.S.W. Railways and Tramways Department in its workshops. (Refer to Exhibits B. to F, Appendix C and compare with Figures III to VI, Appendix B). The new occupational culture that was being diffused throughout the technical education system was thus effectively reinforced in one of the largest state enterprises in Australia. In 1916 this culture was further generalised in the public sector when this Department, together with the Commonwealth Naval Department and the Sydney Municipal Council, began to send apprentices to the College to attend supplementary day-time trade classes. When the Railways and Tramways Department extended educational facilities to its employees throughout N.S.W. by opening Branch Institutes in other centres such as North Sydney, Bathurst, Dubbo, Goulburn, Junee, Orange, Parkes, Newcastle and Nyngan, such innovations were spread even further afield.

In this way, the state played an instrumental role in translating Barraclough's vision of a functional division of labour into practice. Both the Trade Schools and the Railway and Tramway Institute restricted access to Diploma courses offered by the Sydney Technical College. As the Institute's ideologues put it, the purpose of the Diploma Course was not `to train and educate men of professional standing,' but to provide a means of improvement for those who stood `midway between the tradesman and the man of professional rank.'

VIII


128 Curlewis, Royal Commission..., pp.71-73.


131 The few who excelled in Diploma courses would, it was thought, be able to take advantage of the change in regulations introduced by the University of Sydney Senate which exempted such students from the first year exam in engineering. Report of the Minister of Public Instruction For...1913..., p.19; R. & T. Budget 1/3/1917, pp.209-212.
Professional engineers and government administrators were not the only ones to support the streamlining of the education system with its implicit functional and social demarcations. From 1910 manufacturers showed an increasing concern for technical education as a means of overcoming the shortage of skilled labour. They therefore consciously extended their contact with educators and educational institutions, such as the Sydney Technical College.\footnote{132}

In 1910, they participated in a Printers Conference at the College that was convened by the Superintendent of Technical Education, J.W. Turner. Here, Turner referred to educational developments in the U.S.A. where the tendency to combine college tuition with workshop practice had come to be recognised as being 'the very best method of ensuring competency'; the very same method then being extolled by F.W. Taylor. Turner informed those present that: 'It is with the above [American] spirit of advancement in mind that this movement in the cause of high technology in New South Wales is formulated.' The Chamber of Manufactures' President reiterated these views in his Annual Address for 1910. 'We are,' the Hon. J.G. Farleigh M.L.C. stressed, 'aiming at greater industrial efficiency, and this opens up the question of higher technical training'. He then agreed with Turner that the tradition of limiting training to the workshop would not produce commercially useful artisans.\footnote{133}

Like Australian intellectuals, manufacturers increasingly referred to the educational models advanced by their American counterparts.\footnote{134} Such ideas provided a strong incentive for Australian manufacturers to strengthen their ties with local educational reformers. Manufacturers praised the Minister for Education, George Beeby, when he announced that educational facilities were to be improved and extended. In addition, they supported the N.S.W. Government's proposal to inaugurate a scheme of continuation schools which would make attendance compulsory for boys over fourteen.

\footnote{132}{See for example: Australian Manufactures' Journal (A.M.J.) 15/4/1910, p.28.}
\footnote{133}{A.M.J. 15/12/1910, p.367.}
\footnote{134}{A.M.J. 24/11/1910, pp.321-322.}
By taking this stance, manufacturers gave their blessing to Board's educational reforms.¹³⁵

Compared to the activities of their American counterparts during this period, the mobilisation of manufacturers in N.S.W. was restrained. They simply did not have the resources offered by trusts, nor were they engaged in a major political struggle reflected in anti-trust campaigns that were then occurring in the U.S.A.¹³⁶ But the close ties that had developed between manufacturers and progressive educators in the U.S.A. were paralleled in N.S.W. Manufacturers and reform-oriented intellectuals were increasingly brought together by their shared view that Australia's future industrial expansion depended on improved technical education. At the same time, influential members of the professional middle class considered manufacturers' support as crucial for the success of any technical education reforms. To a certain extent, manufacturers reciprocated such interest by promoting greater contact between them.¹³⁷

At the N.S.W. Chamber of Manufactures' Council Meeting in November 1913, James Nangle was formally congratulated on his appointment as Director for Technical Education. And after Nangle explained his new scheme at one of the Chamber's Quarterly Meetings, manufacturers publicly praised it.¹³⁸ Subsequently, the Australian Manufactures' Journal (A.M.J.) published a comprehensive account of the scheme which depicted it as part of a wider effort to guard against 'a serious waste of time both by teachers and students.' One of its chief reforms was to 'be the conservation of energy.' Since Australian employers had to pay the same minimum wage to 'indifferent' as to 'efficient' workers, Nangle pointed out that it was in everyone's interests to do everything they could to ensure that the minimum efficiency was of a high standard. 'It is quite comprehensible,' Nangle informed manufacturers:


that a technically well-educated tradesman, trained to do the maximum amount of work with the minimum amount of effort, employed in a healthy workshop and under the most skilful direction, can from the business point of view, be given shorter hours and paid more money.

The A.M.J. reported further that 'economy of motion' figured prominently among Nangle's goals because Australia's industrial conditions, especially the shortage of skilled workers, required 'the greatest amount of labour with the least possible expenditure of energy.' To this end, students had to be taught the best and shortest way of doing a job.\textsuperscript{139}

Nangle's promotion of motion study, scientific training and time management in the name of conservation indicates support for the basic tenets of scientific management and the cult of efficiency. Nangle was not alone. Manufacturers sympathised with him and, increasingly, they too helped to spread the gospel by reporting on various applications of scientific management. As World War One progressed both the Australian Manufactures' Journal and the Australian Manufacturer (launched in 1916) published extensively on this subject using the rhetoric popularised by American progressives. Scientific management was represented in terms of the elimination of waste and inefficiency and also of vocational training.\textsuperscript{140} In this regard, the writings of Gantt and Gilbreth were prominent.\textsuperscript{141}

**CONCLUSION**

The educational reforms implemented by Board and Nangle allowed Australian educators to use scientific management principles and methods to divide the planning of work and its execution; it was a process which selected, individualised and 'normalised'


workers in the classrooms of technical colleges, as a complement to the divisions that were gradually being implemented in industrial workshops.\textsuperscript{142}

The stopwatch has loomed large in the historiographical imagination. Scientific management has generally been reduced to this symbol with time and motion studies and bonus incentive schemes being represented as this system's core features. The effects of scientific management have also been portrayed in a similarly reductionist way. Most scholars have concluded that the adoption of these technical features resulted in the deskilling of workers.\textsuperscript{143} This paper has argued that such a reductionist view tells only part of the story. The educational reforms of the first two decades of the twentieth century were sufficiently infused with scientific management to ensure its continued, albeit more oblique, influence in Australia. This laid the foundation for an acceptance of American ideas and methods for producing cultural change for future generations of workers.

In the U.S.A. the cult of the expert was institutionalised by the systematic integration of America's public education system with the corporations' internal chain of command, and by the restriction of professional training.\textsuperscript{144} These developments were paralleled by the technical education reforms implemented in N.S.W. after 1913; reforms that were ensconced in the educational practices of the N.S.W. Railways and Tramways Department.\textsuperscript{145} Scientific management was adopted in this context to rationalise the public education system's efforts to produce a compliant labour force. Its value related to its capacity to promote a 'training in being trained' not just in the classroom but also in

\textsuperscript{142} Foucault, \textit{Discipline and Punish...}, pp.183-184.


\textsuperscript{144} Montgomery, \textit{Workers' Control...}, p.157.

\textsuperscript{145} Refer to Taksa, 'All A Matter of Timing...,' Chapters 8 and 9.
the workshop, while simultaneously defining which social groups should provide such training.

The structural differences between the U.S.A. and Australia were primarily responsible for the uneven spread of scientific management. In the interwar period, its integration into the public education system in N.S.W. diminished. Australia did not have a sufficiently developed industrial base on which industrial professionals could legitimate their expertism during the 1920s, as was the case in the U.S.A. While this period has been depicted as the latter nation's epoch of 'educational efficiency,' in Australia the 1920s witnessed a growing neglect of technical education as a result of the political and economic exigencies of conservative governments. Nevertheless, the comparative approach taken here has shown that because of broadly similar social developments in these two countries scientific management was diffused by reformed educational practices in both at roughly the same time. The early decades of the twentieth century thus reflect the first phase of gestation for the birth of a modern industrial society in Australia; a birth that did not eventuate until the Second World War. Yet this time lag should not devalue the earlier impact of scientific management. It played an important role in shaping the administrative arrangements and expectations underpinning later progress.