

**Doing it for themselves:
The Steel Company of Wales and the study of American Industrial Productivity, 1945-1955**

In September 1947, Quincy Bent, vice president of the Bethlehem Steel Corporation, Pennsylvania, received a letter from Guest, Keen and Baldwins Iron and Steel Company, one of four collaborating firms involved in building a new steel works at Port Talbot, on the south Wales coast. It sought permission for their melting shop superintendent, Bill Evans, to visit Bethlehem's Sparrows Point works that Autumn. Its author, Fred Cartwright, described Sparrows Point as, "the finest melting shop in the world, and a target to aim at in performance and efficiency... I do hope", he continued, that "when we finish building the works at Port Talbot we will at least having something in Great Britain which is worthwhile an American visiting us to see ... do not believe that Britain is done for yet."¹

The idea of superior American industrial productivity was becoming something of a national obsession in Britain by the 1940s. Comparative data on industrial performance in Britain, Germany and America, published in 1943, revealed that in iron and steel products, output levels were four times greater in the US than in Britain.² In the context of Britain's post-1945 economy, this was especially significant. After the war, Britain's acute balance of payments deficit, coupled with the decline in exports of its coal and textiles, intensified the importance of the steel-consuming industries of motor vehicle production and engineering as drivers of economic recovery.³ Growing perceptions of a significant productivity gap fuelled knowledge exchange initiatives designed to enlighten British industry. The ensuing work of the Anglo-American Council on Productivity [AAP], which sent sixty-six teams representing different British industries to the United States in the late 1940s and early 1950s, helped spread awareness of some of the key features of American industrial practice, including mass production, systematic management, rationalization and competition.⁴ As the body formally charged with gathering and disseminating information about American productivity, the activities of the AAP have been well documented by British historians.⁵ By comparison, studies of company-led productivity investigations by British industrial firms in the immediate post-war period have been sparse.⁶ While the AAP's reports were heralded by contemporaries as bringing, "a stimulus to improvement in individual firms",⁷ the firms themselves, by implication, appear more as passive recipients of knowledge than active

participants in the process of investigating American industrial practice. Few steel company studies exist for the post-war period to suggest that there was much active study of American industrial performance beyond the remit of the AACP's iron and steel industry productivity team.⁸ If anything, studies of Britain's steel industry history in the post-war period have served to reinforce the picture of passivity, depicting an industry enjoying full employment and buoyant market demand, but characterised by complacency and riven with managerial conservatism.⁹

This study presents a different view by examining the process of international knowledge gathering in one steel firm where regular transatlantic information-gathering visits were being undertaken by managers responsible for modernization and expansion planning. There was nothing unique in this: in steel firms across Europe there were examples of managers and directors who were proactive in undertaking their own investigations of American industrial productivity.¹⁰ The significant thing about this case study of the Steel Company of Wales (SCOW), is not so much that the company was engaged in US productivity studies of its own, but that it was doing so in a way that was different from the approach adopted by the AACP. In method, extent and focus, SCOW's experience of US knowledge gathering was more personal, more in-depth and more bespoke. Moreover, its investigations of American industry to some extent preceded, and informed, the work of the AACP iron and steel productivity team. Far from waiting for productivity information to percolate down from official reports, the Steel Company of Wales became, in its own right, a disseminator of knowledge about the American steel industry, suggesting the need for a reassessment of the idea of key productivity messages in the industry radiating from centre to periphery.

SCOW has been identified as one of the "most dynamic companies" in the post-war British steel industry, staffed by "a new generation of professional managers",¹¹ yet its efforts to learn about American steel industry practice in the 1950s have not been widely explored. There are a number of reasons for this. Histories of Britain's steel industry in the post-1945 years have been dominated by the industry's relationship with the state and the impact of nationalization, de-nationalization and re-nationalization in the 1950s and 1960s.¹² The role of the central institutions and control boards established to plan the industry after the war, though important, provide few insights into the US connections

developed by firms and managers at the forefront of the steel modernization process in the post-war years.¹³ Historians' attempts to explore SCOW's activities have also been hampered by a lack of access to its business records with the result that voices like that of Fred Cartwright at Port Talbot have been barely audible. Using a previously un-researched body of archival records documenting SCOW's post-war business history,¹⁴ this study reveals an intense and ongoing commitment by the company to the study of US steel industry culture. A steady stream of information on US production methods filtered through to SCOW's management almost continuously in the first decade after the war, providing the company with insights that were more detailed and tailored to their own needs than those gleaned by the AACP study teams. Yet despite this, SCOW's responses to its own findings on US productivity were cautious and selective. Not surprisingly, for a firm created to build a new steel works, the question of how to modernize plant and processes dominated its early enquiries. This emphasis began to shift by the mid-1950s to a more critical review of labour productivity, but it was not until the 1960s that voices in the company advocating greater scrutiny of management practices and work study were fully heeded and an extensive manpower review commissioned. This change of pace and focus at SCOW in the 1960s was part of a wider intensification of productivity debates in Britain in that decade.¹⁵ It goes some way to explaining the dearth of attention to company initiatives in the 1950s but it should not overshadow the prolonged efforts to gather knowledge from the US in the first post-war decade. Then, an output-oriented focus on installing new plant and equipment was favoured, not only by the technocrats at SCOW, responsible for building and equipping Britain's first new steelworks of the post-war era, but also for the financially-minded chairman and directors, for whom ideas of culture change to labour and management practices seemed unnecessarily radical and risky.

Attempts by British steel firms to learn lessons from the industry in America did not begin after 1945. In the inter-war period a number of firms were investigating the acquisition of American wide strip mill technology.¹⁶ The hot rolling of wide strip steel was a revolutionary process pioneered in the US in the 1920s in response to growing demand in the motor industry for high quality sheet steel. By 1940 there were 28 wide strip mills operating in America.¹⁷ The firm of John Summers and Sons of Shotton, then the largest of Britain's sheet steel producers, had sent representatives to the United States in the late

1920s to investigate strip mill technology, before eventually placing an order with the Mesta Machine Company of Pennsylvania in 1937.¹⁸ At Richard Thomas and Co., meanwhile, investigations into the new American strip mill process had been ongoing since the late 1920s, before an order was placed with ARMCO for a wide strip mill to be installed at Ebbw Vale in 1938.¹⁹ Plans to install an American wide strip mill at Port Talbot also pre-dated the war. Led by its chairman, Sir Charles Wright, and later its managing director, J. S. Hollings, Guest Keen and Baldwins had enlisted the help of American engineers with the designs as early as March 1938.²⁰ The outbreak of war disrupted momentum but, even before its end, the announcement of Board of Trade proposals for the merger of four Welsh steel firms to facilitate the construction of a new works at Port Talbot, re-instigated the process and, two years later, the Steel Company of Wales was born.²¹ In America the steel industry had been re-shaped by a series of amalgamations in the early twentieth century, with the United States Steel Corporation and the Bethlehem Steel Corporation emerging as the two biggest players,²² but in Britain the SCOW experience was not typical. Although there had been some steel company mergers in the inter-war years, in recognition of the fact that adoption of new, mass production techniques, especially in sheet steel, was not economically viable by a multiplicity of small firms, the scale of re-organisation in south Wales was unusual. Elsewhere, dominant family interests hindered restructuring and uncertainty about the size of the market for new sheet products gave some firms the excuse they needed to avoid major reorganisation.²³

SCOW's remit, however, was to build the £60 million Abbey steelworks at Port Talbot. This project was part of the five year modernization plan drawn up in 1945, at the government's behest, by the British Iron and Steel Federation, which emphasised the urgent need for "new plant at the finishing end of the industry which would increase exports".²⁴ Located on a 1,700 acre coastal site adjacent to the existing Margam steelworks of Guest, Keen and Baldwins, the Abbey Works was a vast industrial complex with a new strip mill, melting shop, and cold mill at its core. Alongside this, the re-building of the blast furnaces and melting shop at Margam and the extension of a wharf and transporter bridges at the local docks made for an ambitious and costly modernization scheme which had a transformative effect on the town of Port Talbot.²⁵ The project was heralded by contemporaries as "Good news in a grim world", and was seen by some as emblematic of

Britain's post-war reconstruction.²⁶ With a sizeable purse of Marshall Aid to draw on for the purchase of American plant and equipment, there were good reasons to see this as a decisive break with the past. One American observer predicted that it would be, "the great and efficient foundation for a much needed modernization and expansion of the steel industry of Great Britain."²⁷

SCOW had a talented cohort of early- and mid-career managers who provided the kind of outward-looking, strategic perspective sometimes thought to have been lacking in the post-war British steel industry.²⁸ In keeping with a growing trend in post-war British firms, some of the top positions in the new company were occupied by men with backgrounds in accountancy and finance.²⁹ Ernest Lever, its first chairman, was an actuary who began his career with Prudential Assurance Company. By the time of his appointment at the Steel Company of Wales he had a proven track record as a steel industry modernizer, having already overseen the financial and organisational restructuring of Richard Thomas and Company.³⁰ Julian Pode, its managing director, had begun his career in steel in 1926 at Dowlais Works, Merthyr, as an accountant, after a period in the Navy.³¹ Technically skilled men were also prominent among SCOW's first wave of directors. Fred Cartwright, assistant managing director and general manager of SCOW's steel division, eschewed university in favour of an engineering training with the Great Western Railway. Like Pode, his career in the steel industry had begun at Dowlais works during the inter-war depression, but he also spent several months at steel companies in the Ruhr in 1930 before returning to Wales to take up a position with Guest, Keen and Baldwins who were then building a new steelworks at East Moors in Cardiff.³² Sid Graeff, appointed director of rolling mills for SCOW in 1947, was an American engineer who had previously advised Richard Thomas and Company on the installation of their hot strip mill in Ebbw Vale in 1938.³³ Below the level of directors there was also a crop of technically astute middle managers, including Gavin Smellie, works manager, recruited by Guest, Keen and Baldwin's from the Beardmores steelworks in Lanarkshire in the mid-1930s,³⁴ and Bill Evans, SCOW's melting shop superintendent and later assistant general manager, who was an acknowledged authority on open hearth furnaces and "a very highly qualified metallurgist".³⁵ Another rising star was Campbell Adamson, who began his career in the South Wales steel industry as a management trainee with Richard Thomas and Baldwins before leading labour relations work for SCOW and then

overseeing construction of the new Spencer Works at Llanwern, Newport, in 1958 for Richard Thomas and Baldwins.³⁶

These men were among a dozen or so staff involved in a series of visits to the US organised by SCOW, beginning in 1945 and continuing into the late 1950s.³⁷ The first two of these visits, by Fred Cartwright and Sid Graeff in 1945 and by Bill Evans in 1947, were undertaken as the Abbey Works was being planned and constructed, and brought back intelligence on the latest plant and design which fed directly into the building project. The eight week visit to America by Fred Cartwright and Sid Graeff in February 1945 “to investigate the manufacture of wide strip”³⁸ was, on the face of it, a continuation of the kinds of investigations British steel firms had been undertaking since the 1920s. On their return they wrote a report recommending an 80” fully continuous wide strip mill for the Abbey, to be supplied by the United Engineering and Foundry Company.³⁹ In practice, however, the study of strip mill technology occupied much less attention in the early post-war period than other aspects of the American industry. After all, British steel firms had been learning about US developments in the hot rolling of strip steel since the late 1920s and there had been little technical innovation in the US industry during the war.⁴⁰ More important in raising US wartime production levels had been the huge steel construction program underway since the early 1940s and it was this, especially the evolution in steelworks design, that was the real revelation to the first wave of Welsh-based steelmakers who visited the US from 1945.

The projected wartime increase in demand for steel in the US led to a growth in production capacity of some 15.4 million tons between 1938 and 1945.⁴¹ This was met by a program of expansion to existing works along with the construction of two brand new steel works: one at Fontana in California and the other at Geneva, Utah. Both featured long, low-rise, flat-roofed mill buildings, spaciouly arranged on newly developed sites, an aesthetic which had begun to develop in the US in the inter-war period as a response to the demands of the new, fast-moving, high volume production methods adopted by large manufacturers like the American sheet steel producers.⁴² Fred Cartwright and Sid Graeff gained only a partial insight into these developments in 1945 since their visit, albeit to more than a dozen steelworks and machine makers, was confined mainly to the American steelmaking heartlands of Pennsylvania and Ohio, and did not include the two newest steelworks in Utah

and California.⁴³ Nevertheless it was sufficient to provide them with a vision of how the design of modern steelworks was evolving and a new blueprint for the construction of the Abbey Works.

Following the visit, Cartwright shared his insights into the American steel industry in a lecture to the South Wales Institute of Engineers. In it he drew attention to the fundamental US shift in design, away from pitched roof mills to flat-profile “monitor” roof buildings. He enthused about the practical advantages of the new buildings: “Lighting is excellent. The windows are all vertical and extremely easy to clean and keep clean. Due to the insulation there is no condensation on the underside of the steel-decking. It is easy and safe to get at. The ventilation is even across the width. It lends itself to rigid joint construction.”⁴⁴ The long, flat-roofed mills also facilitated the installation of specialist equipment such as overhead craneways, designed to aid the speedy movement of materials through the workspace. This emphasis on rapid throughput was a key part of the approach to factory design favoured by American industrial engineers since the early twentieth century.⁴⁵ These new trends in steel mill design led to radical alteration of the original plans for the new Abbey strip mill and melting shop buildings which had been drawn up before the war. In the Winter of 1945 a new firm of consultant structural engineers, W.S. Atkins and Partners, with no prior experience of steelworks construction, was appointed by the Guest, Keen and Baldwins team and charged with delivering this new-look steelworks on the Abbey site. In William Atkins they had found a like-minded modernizer who disliked the traditional pre-1939 British factory buildings, with their typical pitched roofs and “sides covered with black corrugated bituminous coated sheeting.”⁴⁶ When provided with photographs of the recently constructed steel mills in the US with their innovative roof designs, Atkins saw the possibility of building something different at Port Talbot.

The adoption of the American mill designs brought not only practical and aesthetic benefits but also provided an opportunity to reflect the modernity of the new steelworks in its external appearance. Characteristic of the new modernism which British architects were beginning to embrace in the post-war years were clean surfaces, the importance of light and the use of modern materials like plate glass and reinforced concrete.⁴⁷ Sir Percy Thomas, the Cardiff-based president of the Royal Institute of British Architects, was consulted by SCOW on the Abbey designs, having had extensive experience of factory architecture thanks to his

work on the inter-war trading estate projects in Wales, and his regional work for the Ministry of Supply and the Ministry of Production during the war.⁴⁸ At the Abbey, he advised on the use of long vertical window panels to complement the glazed sections in the “monitor” roof, positioned to maximise natural lighting in the internal working spaces, and selected an external paint colour for the corrugated steel panels cladding the buildings to reflect the sand dunes surrounding the Abbey site.⁴⁹ The result was an edifice strikingly different in appearance from other British steelworks. “A row of gigantic sand coloured buildings of modern design with massive curved windows dividing the building into segments”, was how one newspaper correspondent described the new strip mill. Another praised it as “a monument in glass, steel and concrete” with its “gracefully impressive walls”, a stark contrast to the adjacent old Port Talbot works which, “Like a tired old man ... looks shabby alongside its gleaming son.”⁵⁰

As well as encouraging new trends in the external design features of steelworks, the adoption of wide strip mills for sheet steel production had knock-on effects for other aspects of steel-making, not least the open-hearth process, which had to deliver increased quantities of steel to feed the new high-volume strip process. As the first post-war British plant to be built from scratch around a new strip mill, the Abbey Works’ new melting shop had to be equipped to produce sufficient steel to keep the mills operating to the fullest possible capacity. It presented a significant design challenge for SCOW’s management and again they looked to the United States for guidance. The great construction drive in the US steel industry during the war saw open-hearth capacity increase from 72.9 million tons in 1939 to 84.2 million tons in 1945.⁵¹ The open-hearth furnace was the dominant method of steel making in the US until the last third of the twentieth century and the process had undergone a succession of refinements to ensure that steel supply met the increasing demands of the strip mills.⁵² The result, as Cartwright observed after his 1945 US visit, was “a formidable difference between the best American practice and the best British.”⁵³ The Steel Company of Wales’ team turned to one of the most experienced hands in the American industry, George Danforth, of the Open-Hearth Combustion Company, based in Chicago, to design the furnaces for its new melting shop planned for the Abbey works. Danforth was credited with major improvements in the open-hearth process and his company had been a key supplier to the US steel industry,⁵⁴ but, aged 68 in 1947, he was

nearing the end of his career and could not be persuaded to make a site visit during the crucial Abbey melting shop construction phase.⁵⁵ Danforth's unavailability to give advice on site heightened the need for SCOW to mobilise home-grown expertise in the process of installing its new US equipment. It was a pattern of adapting and modifying imported American methods experienced in other British firms in the post-war era.⁵⁶ SCOW responded by sending one of its own open-hearth specialists on a fact-finding mission to America, and by undertaking a programme of on-site operational research to inform the design process.⁵⁷

The visit of Bill Evans, SCOW's melting shop superintendent, to examine the design and operation of the more modern American open hearth plants, was hastily arranged in the Autumn of 1947. It took in sixteen different plants and 22 melting shops, and covered a total of 19,401 miles.⁵⁸ In Cartwright's estimation, it amounted to an opportunity which "few steel men in Great Britain have ever had".⁵⁹ Armed with a detailed questionnaire covering all aspects of open-hearth operation and design, which he drew up before the visit, Evans became the key agent in channelling detailed information back to SCOW. He sent frequent letters to convey the most urgent construction information in answer to queries from Cartwright about such matters as brickwork design and flooring materials.⁶⁰ He was also authorised to take with him to the US copies of plans for the layout of the Abbey Works melting shop which he shared and discussed with a number of American operators. At Homestead works in Pittsburgh, Evans reported that the plant superintendent and his assistants were "enthusiastic" about the plans and "were struck by the resemblance of our plant to theirs", but they also commended novel features in the plan such as "our idea of building in blocks of four furnaces with spaces between each block."⁶¹ Such exchanges suggest that, far from engaging in a one-way knowledge-gathering process, SCOW saw its US productivity visits, to at least some degree, as opportunities for reciprocal information exchange with their US counterparts. What they learned of US open-hearth steel production was further supplemented by the results of internal research activity. Back at Port Talbot, Cartwright and his staff organised trials and experiments designed to help them avoid congestion and delays in open-hearth production. A miniature working model of the entire Abbey melting shop was built so that the most efficient ways of conveying materials around the space could be worked out and different methods of charging tested.⁶² This elaborate

task, involved the modelling of every crane and piece of rolling stock so that the most efficient angles of movement could be calculated.⁶³ It was, in effect, a pioneering piece of operational research aimed at ensuring rapid throughput of materials. It demonstrated the extent to which SCOW's productivity focus was trained on the efficiency of its plant and systems in this period, and it presaged the establishment of an OR department at SCOW in the early 1950s, the early work of which was similarly focused on throughput efficiencies.⁶⁴

The knowledge of American steel-making that SCOW had amassed by the late 1940s placed the company in an authoritative position in relation to the AACP's iron and steel industry productivity team which was then being assembled. Instead of participating in the AACP team visit to the US alongside representatives from many of Britain's other major steel firms,⁶⁵ the company contributed to its activities in an advisory role, as a disseminator of knowledge of US steel production to the British industry team. Sir Charles Goodeve, director of the British Iron and Steel Research Association,⁶⁶ and the man tasked with leading the iron and steel team visit to the US in May 1951, contacted SCOW for advice on which US plants to visit. In return, Fred Cartwright passed on the most up-to-date information he possessed on the US steel industry, including a copy of the extensive visit report written by Bill Evans.⁶⁷ Running to over 200 pages, it was possibly the most detailed written survey of the US steel industry in the immediate post-war period by any British observer. The AACP team also visited the Abbey Works shortly before its departure for the US, for "a pre-view of Britain's newest and largest steelworks".⁶⁸ In terms of its own remit, however, the AACP Iron and Steel team adopted a focus very different to that of SCOW. Instead of investigating sheet steel, it focused its attention on the heavy rolled product sector.⁶⁹ British firms involved in heavy plate production, in particular, were perceived to have been slow to modernize in the post-war years,⁷⁰ suggesting that Goodeve's team was directing its efforts where it felt the need was greatest. They also spent much less time examining steelworks design and layout than had Cartwright and his colleagues. By the time of their visit in 1951 the economic case for building new steelworks was being questioned and attention had turned more to achieving maximum productivity in the use of resources.⁷¹ The result was that its activities overlapped little with what SCOW had been doing, and did not lessen the incentive for the Welsh firm to continue pursuing its own programme of American steel industry scrutiny.

As Goodeve's sixteen-member delegation completed its five week US trip, Fred Cartwright was in the advanced stages of planning a further US visit of his own, later the same year, aimed at investigating developments in furnace design and new uses for sheet steel.⁷² The activities of formal industry productivity teams, however, did have implications for ongoing company initiatives like those of SCOW. Cartwright's 1951 visit plans had to compete for space in a calendar crowded with official visit programs such as those of the Economic Cooperation Administration (ECA) technical assistance division, which began promoting productivity studies by western European countries in the United States.⁷³ He acknowledged in his correspondence with United States Steel that, "you Americans must be fed up with the sight of Englishmen wishing to see your plants"⁷⁴ and some of his closest contacts were slower than usual to respond to his letters. Charles Muchnic of the United Engineering and Foundry Company, wrote that, "We have had so many visitors from Europe who came here under the auspices of the ECA and the National Association of Manufacturers that I was kept very busy."⁷⁵ Greater demand led, in some quarters, to greater formalisation of access procedures and, despite Cartwright's familiarity with most of the leading US companies and the readiness with which they had assisted with his requests for information in the past, he was warned in September 1951 to be sure of making "application for entrée to some of the steel plants you propose to visit, as frankly many of these plants are very sticky about permitting visitors."⁷⁶

In the increasingly crowded world of 1950s industrial knowledge exchange activity, however, SCOW enjoyed some advantages over the members of the industry-wide teams visiting the US. Unlike the large, group tours undertaken by these parties, the visits by Cartwright, Evans and their colleagues, undertaken individually or in pairs, provided scope for a more personal level of interaction, including valuable one-to-one discussion time with operators, superintendents and company bosses. At Gary Works, Indiana, for example, Cartwright's 1951 tour of the sheet and tin plant was followed by a private meeting with the company vice president, H. W. Johnson, and the use of the company president's chauffeur to transport him around the different sites.⁷⁷ In Utah, he was driven around by Walter Mathesius, the president of Geneva Steel and a director of the United States Steel Corporation.⁷⁸ In addition, his itinerary of plant visits was supplemented by a hectic social program of cocktail parties, country club lunches, theatre visits and dinners which cemented

friendships with some key American steel counterparts that went well beyond the professional.⁷⁹ Crucial to this aspect of the visit was the fact that, unlike the sixteen-strong, all male productivity team led by Goodeve, Cartwright travelled to the US in 1951 accompanied only by his wife, Sally. On informing his US contacts of this he found himself in receipt of dinner invitations and offers of hospitality, even before he had left Britain. C. B. Randall, president of Inland Steel Company wrote that, “if it can possibly be arranged, my wife and I shall insist on having you for dinner”, and K. C. Gardener of United Engineering and Foundry Company suggested that Sally Cartwright spend time with his wife while he visited the works.⁸⁰ In post-war Britain, the degree to which managers’ wives entered the company worlds of their husbands extended little beyond attendance at the annual dinner dance, but in America a much greater level of visibility of corporate wives was expected.⁸¹ Such social networking roles, described by scholars as “enabling” activities, were familiar territory to the American executive wife of the period, and undertaken in the belief that they helped the husband to reach his full potential in business.⁸² It was a relatively simple equation summed up by a respondent to one sociological study undertaken in the 1970s: “If a man wants you to go out to dinner and you haven’t got your wife, he has to leave his wife out. If your wife is there, his wife can come too. Often wives get to know each other and it’s good for them *and* good for business.”⁸³

The access gained by Welsh-based steel men into the business and social worlds of the American industry, enabled them to scrutinise at first hand the modern plant design and technologies employed by American steelmakers. Their knowledge-gathering efforts brought tangible rewards in terms of SCOW’s annual output which rose from 463,000 ingot tons in 1950 to 1,559,000 ingot tons in 1954. These kinds of gains prompted some self-congratulatory rhetoric in the British steel industry in the mid-1950s. In 1956, for example, the AACP’s successor organisation, the British Productivity Council, produced a report which claimed that the productivity gains in iron and steel since the war were unmatched in any other manufacturing sector.⁸⁴ But these figures were achieved in the context of a favourable sellers’ market and full employment and to some extent masked deeper problems which were exposed when the economic climate began to change. At SCOW’s Abbey Works, manning levels had increased over the same period from 4,863 to 11,051,⁸⁵ making it comparable in terms of workforce size with some of the biggest steelworks in the United

States. The trouble was that in terms of output per man, the gulf remained as wide as ever. In September 1954, output figures were received from the Inland Steel Company in Chicago which suggested that, for all of the reorganisation and capital investment, the Steel Company of Wales was not achieving anything like the same productivity levels as its American counterparts. Some 160 ingot tons per man year was produced at the Abbey Works compared to 260 at Inland, despite the fact that the Abbey Works was “much the more modern of the two”.⁸⁶ This revelation prompted a new phase of investigation by SCOW into American industrial performance. On this occasion the knowledge-gathering responsibilities were entrusted to two managers. Gavin Smellie, who already had twenty years’ experience as a works manager in the Port Talbot steel industry, and his younger colleague Campbell Adamson, appointed personnel superintendent by SCOW in 1952,⁸⁷ travelled to the US in February 1955 for a three-month fact-finding visit, six weeks of which were spent at Inland. Their approach was characterised by a much more critical appraisal of performance than either SCOW’s own previous investigations, or those of the official productivity teams in the early to mid 1950s. Rather than focusing on technological or design issues, as their predecessors had done, they identified quality of management as the most significant factor affecting production per man. They produced a hard-hitting report into the failure of the British steel industry in this regard, in which they lamented that, “it is distressing with the number of Productivity Teams that have reported since the war, to find how comparatively little has been done to act on their recommendations ... we have attempted to find excuses for any radical changes ... and appear to have lulled ourselves into a false sense of security about our efficiency.”⁸⁸ In particular, they highlighted two failings in British management as contributory factors to the enduring productivity gap: one was the lack of job evaluation as a means of exerting control over the labour force; the second was the growth of joint consultation between shop floor and management via works councils, which resulted in the erosion of the role of foremen in British steelworks.

In the US, “scientific management” had evolved since the late nineteenth century, as an approach to the control of labour through the establishment of fixed time and output measures for specific jobs.⁸⁹ In the American steel industry, an intensive programme of job evaluation was undertaken from 1944 to 1947 by a Co-operative Wages Board, which agreed work rates and wage levels across key roles in the industry. The iron and steel

productivity team's report, produced for the AACP in 1952, noted the impact of job evaluation in the American steel industry but did not make any specific recommendations about its implementation in Britain.⁹⁰ Likewise, Fred Cartwright, on his visit to the US in the Autumn of 1951, had informal discussions with the president of the Geneva Steel Company, Walter Mathesius, about job evaluation but did not attempt to introduce any similar schemes into the Abbey Works.⁹¹ Some of the more hard-edged management practices in the United States appeared unpalatable, both to Cartwright and to Bill Evans. At the Bethlehem Corporation's Sparrows Point works in Maryland, for example, Evans noted that the staff were "worked harder than at any other plant I visited, and all appeared tired and ready to go at 5pm."⁹² Its reputation for efficiency was based on the fact that the plant prided itself in its ability to extract maximum return out of its men and machinery.⁹³ It was not a working culture that the Steel Company of Wales wanted to emulate and Cartwright concluded that, "I am not sure whether from the human point of view, the type of organisation they have there is a good one, as they are driving their staff to the limit of human endurance."⁹⁴

Such responses were not unusual in post-war Britain where some contemporaries viewed American scientific management methods as "de-humanizing", and for much of the early post-war period the growth of trade unionism and full employment underpinned more conciliatory labour relations with many employers favouring welfare-based approaches to management, with an emphasis on human relations.⁹⁵ At SCOW these developments manifested themselves in a keen level of attention to environmental factors, such as the appearance and cleanliness of buildings and the quality of amenities in the workplace. Artworks were hung in the amenity blocks, the regime of cleaning and inspection of canteen facilities, locker rooms and lavatories was stepped up and efforts made to enlarge showering and drying room facilities to keep pace with the expanding workforce. Such matters occupied the bulk of the business of the Abbey's Works Council, chaired by Cartwright and consisting of representatives of the various trade unions with members on site.⁹⁶ In part this was a carry-over from the inter-war period when the provision of worker welfare and amenities were seen as key components of labour relations and productivity,⁹⁷ but it did not seem at odds with what SCOW's managers had observed in some of the newer American steelworks, where attempts had been made to create a pleasant working

environment. Bill Evans, for example, was impressed by the attractive landscaping of the Fontana works in California where he concluded that, “the horticultural adornment of the plant ... must be in part responsible for the very excellent labour relations which exist here and for the general care of ‘housekeeping’ which is evident.”⁹⁸ While studies of other employment sectors have cast doubt on the extent to which workers really cared about such issues,⁹⁹ they were viewed by Cartwright, as vital to avoiding “labour trouble”,¹⁰⁰ and came to dominate the work of the growing numbers of personnel staff which SCOW, in common with many other UK firms, added to the ranks of its employees in the 1950s.¹⁰¹

Following their US visit, Smellie and Adamson pressed for a more professional approach to management, less steeped in the labour relations practices of the inter-war years. To them, a more assertive approach to workforce control appeared urgent if the tendency to over-man and thereby limit productivity at SCOW by the mid-1950s was to be halted. They compared the number of bricklayers employed at Inland and SCOW to illustrate the extent of the problem, revealing that the Inland Company was operating twice the number of open hearth furnaces with fewer than half the number of bricklayers used for the same job in SCOW, and still achieving greater output.¹⁰² It was a situation that had been allowed to develop, they argued, because British managers lacked reliable information about what percentage of each working day was occupied by each job, and where additional manpower was needed. “In the British steel industry”, Smellie and Adamson observed, “no one has this information and can therefore exercise no real control when extra men are asked for.”¹⁰³ What they had identified was the need for a wholesale job evaluation exercise as a prelude to the reorganisation of manning throughout the plant. It was a radical vision and, ultimately, one which proved to be almost a decade ahead of its time. The seller’s market in Britain in this period meant that there was a much stronger emphasis on maximising output than reducing manning levels. Any attempt at the latter would have risked undermining labour relations and upsetting the multiple trade unions. In this context, Smellie and Adamson’s report made such uncomfortable reading for SCOW’s top hierarchy that its chairman, Sir Ernest Lever, recommended it be destroyed,¹⁰⁴ and the size of the labour force continued to increase unchecked at the Abbey Works during its various phases of expansion in the 1950s.

The adverse reaction displayed at the top level of the company to Smellie and Adamson's findings, demonstrated the gulf which existed in some British firms in of the period, between the top level of decision-makers and the plant-level managers who, in practice, often lacked the support and influence to implement radical change.¹⁰⁵ Faced with this situation, Cartwright's approach was pragmatic. He found other elements of Smellie and Adamson's report, particularly their recommendations relating to the role of foremen, which were more like a continuation of initiatives already underway at SCOW to improve communication with the burgeoning workforce at the Abbey. The problem of how to convey management decisions effectively and cultivate a sense of loyalty and common purpose among a workforce of over 11,000 was a challenging one for managers more accustomed to the employment levels of Britain's pre-war steelworks.¹⁰⁶ In their early visits to the US, Bill Evans and Fred Cartwright expressed a general admiration for the way in which American companies seemed to be able to foster a strong sense of shared endeavour. At Kaiser Company's Fontana Works Bill Evans observed, "an unmistakable air of determination to get the most out of the plant, both by the staff and the men."¹⁰⁷ Smellie and Adamson attempted to delve deeper into what lay behind this culture and concluded that the "key man" in achieving good communications between management and shopfloor was the foreman. At Inland Company's Indiana Harbour works, as well as at Fontana, Geneva, and the other sites they visited in 1955, they found that "the foreman is held responsible for all dealings with the men, all orders or information passed to them from any source, all first decisions on their grievances, and all disciplinary action taken, and is complete master of his department." It was this, they argued, that was "probably the most vital single fact about successful management in America", whereas in Britain, "the foreman position has weakened in the period of full employment that we have enjoyed."¹⁰⁸

It had taken a decade or more of disputes, re-structuring and collective organization for US industrial foremen to reach this influential position.¹⁰⁹ At SCOW the rejuvenation of the foreman's role had already been identified as a means of streamlining communications between management and shop floor, but it proved difficult to achieve via the mechanisms of joint consultation, overseen by senior members of the burgeoning personnel department at the Abbey Works. A Foreman's Council had been established in 1954 but attendance at its meetings was poor.¹¹⁰ Efforts to revitalise interest in it and, in particular, to spread

knowledge of the role of American foremen, gathered pace after the return of Smellie and Adamson from the US. To this end, an American speaker was engaged to address members of SCOW's Foreman's Council on "The place of foremen in US industry".¹¹¹ An initiative was also introduced to make foremen more distinctive and recognisable figures on the shopfloor, by issuing them with dust coats.¹¹² Tellingly, even these these small measures, which Fred Cartwright considered to be uncontroversial, had to be negotiated carefully with the foremen via the works' personnel superintendent to whom he wrote that, "in a very large plant, I would have thought the identification of foremen was very important, but I quite realise that it is of no use pushing it through if foremen are against it. It is one of those things which has to come naturally or not at all."¹¹³ The following year attempts were made to increase the responsibilities of foremen in their departments, particularly in relation to safety and accident prevention. This time the plant's welfare manager urged tact and patience: "This is, I realize, only a small step towards the appropriate imitation of American practices here", he explained to Cartwright, "but I am sure that you and Mr Smellie would agree that we should not attempt to imitate them all at once."¹¹⁴

Such exchanges provide some insights into why American productivity messages proved so difficult to implement at company level. They go some way to explaining why, in the 1950s, SCOW's initiatives were tentative compared to the far-reaching manpower review of the following decade, and certainly did not deliver any improvements in levels of output per man in the short term.¹¹⁵ The cautious approach adopted in these years fell far short of the urgent call for action which Smellie and Adamson had tried to convey in their report, but typified the non-confrontational attitude to labour relations which SCOW pursued throughout the 1950s as they attempted to carry their burgeoning workforce with them through the boom years of high demand and rapid expansion. At one level, this conservative approach by SCOW at the end of a decade in which they had invested so much time and effort in attempting to learn the secrets of the US steel industry's success, seemed to point to the kind of managerial failure and lack of strategic thinking identified in studies of post-war British industrial management, but the full picture of SCOW's productivity investigations tell a different story.

The evidence from the Steel Company of Wales's US visits in the late 1940s and early '50s reveals a picture of a firm fully engaged with the issue of productivity, and addressing it

primarily through the modernization of its facilities and processes. A number of its early managers were highly practical, technically skilled men who excelled at finding solutions to the operational and design questions that they encountered as they worked to develop and refine a sheet steel making operation capable of satisfying the buoyant market for sheet and tinsplate in the 1950s. For a company which had been created to build and equip a brand new steelworks, this pre-occupation with plant and premises was understandable. From 1945 the Welsh-based specialists building the new steelworks at Port Talbot, went ahead and developed their own links with American firms as part of a thorough and personal immersion into the business and social cultures of leading US steel companies. Their self-reliant and sustained commitment to the study of US productivity was designed to answer queries and solve production problems specific to their own operation, and evolved quite independently of the parallel productivity missions of the period. The detailed fact-finding visits by members of SCOW's management throughout its first decade of operation made the company one of the best informed UK steel firms on the features of American steel production. One consequence of this was not only that its expertise was used by the AACF's iron and steel productivity team, but also that it became the focus of modernization studies by other European steel firms. Throughout the 1950s the Abbey Works hosted visits by steel company managers from Germany, France, Italy, Sweden and the Netherlands, as a wave of Marshall Aid-funded economic development programs rejuvenated steel production across Europe.¹¹⁶ For many of them, the Abbey works was, for a brief period, the nearest place where they could view up-to-date American equipment and discuss associated operational issues with staff in the new melting shop and strip mill.

Thanks to their detailed scrutiny of the US steel industry from the mid-1940s onwards, SCOW managers were far from oblivious to the greater levels of control of pay and manning which were in place in the American industry. Even at the height of the post-war boom, there was a growing awareness of the need to review manning structures in order to improve competitiveness. The fact that these ideas were not acted upon at the time was less a sign of complacency and more a consequence of some of the limiting effects of the post-war British economic climate. No matter how well informed or modernizing in outlook the industrial managers of the mid-1950s, their ability to implement the productivity lessons learned from examining US business practices was constrained by factors much closer to

home. Prevailing market conditions, legacies of welfare-based approaches to management from the inter-war period and the growth of a culture of joint consultation, combined to provide a check on the extent to which plant managers could push through their ideas and the appetite of company bosses to support them. This combination of circumstances did not last for long. Growing “panic” about Britain’s decline in the early 1960s did much to create a climate more favourable for addressing problems of labour productivity.¹¹⁷ At the same time, increased international competition created a more challenging trading environment, conducive to a more systematic review of job roles and manpower productivity.¹¹⁸ In the case of SCOW, the twin developments of falling demand for steel and craftworkers’ claims for improved holidays and pay restructuring in the early 1960s, which the company calculated would cost it £85,000 per annum to meet, precipitated its wide ranging manpower productivity review, conducted by a firm of American management consultants brought in by SCOW in May 1964.¹¹⁹

The Steel Company of Wales, formed as a kind of flagship for the rejuvenation of the industry, was not a “typical” British steel firm of the post-war years. Without additional studies based on the activities of other British steel companies in the same era, it is difficult to know how far its efforts at international knowledge gathering and its familiarity with US practices, were mirrored in other British firms. Yet its experience of struggling to implement productivity lessons learned in one economic environment to another, very different, one was shared by sheet steel makers elsewhere in 1950s Europe where the process was equally selective and “piecemeal”.¹²⁰ In terms of broader patterns of knowledge acquisition and dissemination at work in the sector after the war, there also insights to be gained from a single company study. In an industry which was highly subject to centralised planning from the interwar period onwards,¹²¹ the SCOW case provides a useful reminder of the autonomy and proactivity of the individual firm when it came to learning productivity lessons from across the Atlantic. It also raises questions about the extent to which notions of managerial complacency during the post-war boom, can be applied uniformly across the steel sector. Evidence of SCOW’s activity ultimately provides an important counter-point to the more familiar story of the AACP as a disseminator of American practice in British industrial circles revealing a more nuanced picture in which particular business objectives and individual perspectives contributed to the process of steel modernization in Britain.

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¹ RBA CART 1/49/2/1, W. F. Cartwright to Q. Bent, 9 September 1947.

² Rostas, "Industrial Production", 48.

³ Keeling and Wright, *The Development of the Modern British Steel Industry*, 90.

⁴ Identification of the distinctive features of American industrial production can be found in, Zeitlin, "Introduction," in *Americanization and its Limits*, ed. Zeitlin and Herrigel, 18; Schröter, "Economic Culture and its transfer", 222-23.

⁵ For details see Tiratsoo and Gourvish, "'Making it like in Detroit'", 206-16; Carew, "The Anglo-American Council on Productivity", 49-69; Vickers, "Understanding the Anglo-American Council on Productivity", 207-22. Some authors have acknowledged that the findings of AACP study teams were not the only means by which British industries accessed information about American productivity. See for example Tiratsoo and Tomlinson, "Exporting the 'Gospel of Productivity'", 51.

⁶ Company-led initiatives by American firms, however, have attracted some attention. See for example Tolliday, "Transplanting the American Model", in *Americanization and its Limits*, eds. Zeitlin and Herrigel, 76-119; Miskell, "Americanization and its Limits: United Artists in the British Market", in *Anglo-American Media Interactions*, eds. Wiener and Hampton, 215-33.

⁷ "Anglo-US work on Productivity", *The Times*, 21 October 1950.

⁸ Ranieri, "The Productivity Issue in the UK Steel Industry, 1945-1970", in *Americanisation in 20th Century Europe*, ed. Kipping and Tiratsoo, 357-73. Company-focused histories include

Payne, *Colvilles and the Scottish Steel Industry*; Andrews and Brunner, *Capital Development in Steel*.

⁹ See for example Abromeit, *British Steel*, 110-18; Vaizey, *The History of the British Steel Industry*, 105; Kelly, "Productivity Bargaining in the British Steel Industry", 12

¹⁰ European examples include, Ranieri, "Learning from America", in *The Americanisation of European Business*, eds. Kipping and Bjarnar, 208-28; Kipping, "A Slow and Difficult Process", in *Americanization and its Limits*, eds. Zeitlin and Herrigel, 209-35; Ricciardi, "The Circulation of Practices", 231-48; Kleinschmidt, "An Americanised Company in Germany", in *The Americanisation of European Business*, eds. Kipping and Bjarnar, 171-89; Ranieri, "Remodelling the Italian Steel Industry", in *Americanization and its Limits*, eds. Zeitlin and Herrigel, pp.236-68; Mioche, "The Mistakes of Productivity Missions to the United States", in *Catching Up With America*, ed. Barjot, 265-76; Godelier, "American Influence on a Large Steel Firm", in *Catching Up With America*, ed. Barjot, 277-84.

¹¹ Ranieri, "Steel and the State in Italy and the UK", in *European Yearbook of Business History*, eds. Feldenkirchen and Gourvish, 139.

¹² See for example Abromeit, *British Steel*; McEachern, *A Class Against Itself*; Ranieri, "Steel and the State", in *European Yearbook of Business History*, eds. Feldenkirchen and Gourvish, 125-54.

¹³ See for example Burn, *The Steel Industry 1939-1959*; Keeling and Wright, *The Development of the Modern British Steel Industry*; Heal, *The Steel Industry in Post-War Britain*. Mention of the use of American and German expertise by British firms including

Stewarts and Lloyds and the Steel Company of Wales is made in Pagnamenta and Overy, *All Our Working Lives*, 76-101.

¹⁴ These records were loaned by Tata Steel Records Centre, Shotton, to Swansea University's Richard Burton Archives in 2013 for a cataloguing and research project, and are abbreviated throughout as RBA CART.

¹⁵ Tomlinson, "The British 'Productivity Problem' in the 1960s"; Smith, *Productivity Bargaining*; Kelly, "Productivity Bargaining in the British Steel Industry".

¹⁶ Ranieri and Ayles, *Ribbon of Fire*.

¹⁷ Warren, *The American Steel Industry 1850-1970*, 218.

¹⁸ Ayles, "Construction of the Shotton Wide Strip Mill", 57-85.

¹⁹ Tolliday, *Business, Banking and Politics*, 124-55.

²⁰ Brinn, "BSC's Port Talbot Works", 8; Cartwright, "Preliminary Planning of Margam and Abbey Works", 1.

²¹ *The Times*, 29 January 1945. The three works to close were Briton Ferry, Landore and Bryngwyn. See Burn, *The Steel Industry, 1939-1959*, 246. The four firms participant in SCOW were Richard Thomas and Baldwins; Guest, Keen and Baldwins; Lysaghts and Llanelly Associated Tinsplate Companies. See Smith, *Productivity Bargaining*, 77-78.

²² For details see Seely, "The United States Steel Corporation", in *The Iron and Steel Industry in the Twentieth Century*, ed. Seely, 438-46; Warren, *Bethlehem Steel*, 151.

²³ Tolliday, "Steel and Rationalization Policies", in *The Decline of the British Economy*, eds. Elbaum and Lazonick, 82-108.

²⁴ PP 1945-46 [Cmd. 6811] Iron and Steel Industry. Reports by the British Iron and Steel Federation and the Joint Iron Council to the Minister of Supply, 7.

²⁵ For details of the site and its facilities, see Parry, “A History of the Steel industry in the Port Talbot Area”, 122; Brinn, “BSC’s Port Talbot Works”, 10-11. For a detailed analysis of the impact of the new steelworks on the local area, see Thomason, “An Analysis of the Effects of Industrial Changes”.

²⁶ LSE SCOW 270, Review of British and Foreign Press, March – December 1947.

²⁷ RBA, CART 1/49/2/1, C. M. Muchnic to W. F. Cartwright, 22 September 1947.

²⁸ Vaizey, *The History of the British Steel Industry*, 105.

²⁹ Matthews, “Accountants v. Engineers”, 82-104.

³⁰ *The Times*, “Sir Ernest Lever” (obituary) 5 September 1970.

³¹ Cartwright, “Pode, Sir (Edward) Julian (1902-1968) steel executive”, *Oxford Dictionary of National Biography*.

³² “He found his challenge in steel”, *The New Scientist*, 21 May 1959, 1134-5; ‘W. F.

Cartwright – Deputy Chairman – British Steel Corporation’, *Supplement on Industry, South Wales Magazine*, 1975.

³³ Brinn, “BSC’s Port Talbot Works”, 8.

³⁴ *Steel Company of Wales Ltd. Bulletin*, September 1950.

³⁵ RBA CART 1 49 /2/3, J. Pode to F. D. Foote, Alloys Development Company, Pittsburgh, 16 December 1953.

³⁶ Later he was appointed director general of the Confederation of British Industry (CBI). See Silberston, “Adamson, Sir (William Owen) Campbell (1922-2000), industrialist”, *Oxford Dictionary of National Biography*. The firm of Richard Thomas and Baldwins was formed from the merger of Richard Thomas and Company with Baldwins Iron and Steel Company in 1945. See Smith, *Productivity Bargaining*, 76.

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- ³⁷ The others included A. J. Kesterton, G. Redmore, R. N. Dale, J. Poole, K. Sharp, H. Tufnail, H. Ascough and A. J. Honeyman.
- ³⁸ Cartwright, *Modern American Steelworks Practice*, 217.
- ³⁹ RBA, CART 1/49/1/1, Cartwright-Graeff Report, September 1945.
- ⁴⁰ Seely, "Introduction", in *Iron and Steel in the Twentieth Century*, ed. Seely, xxxii.
- ⁴¹ Warren, *The American Steel Industry*, 240.
- ⁴² Lewis, "Re-designing the Workplace", 666-67.
- ⁴³ Details of the itinerary can be found in RBA, CART 1/49/1/1, Cartwright-Graeff Report, September 1945.
- ⁴⁴ Cartwright, *Modern American Steelworks Practice*, 222.
- ⁴⁵ Biggs, "The Engineered Factory", S174-S188.
- ⁴⁶ Atkins, *Partners. Fifty Years of WSA & P*, 23-4.
- ⁴⁷ Rosen, *The Transformation of British Life*, 124.
- ⁴⁸ Thomas, *Pupil to President (Memoirs of an Architect)*, 49; Davey and Thomas, "Chief Creator of Modern Wales", 54-70.
- ⁴⁹ Atkins, "The Work of the Consulting Engineers", 37.
- ⁵⁰ *Western Mail and South Wales Daily News*, 17 July 1951; *The Guardian*, 20 July 1950. Both of these articles can be found in West Glamorgan Archives Service, D/D LE 127, "Abbey Works and Local Industries", a scrapbook of press cuttings compiled by A. Leslie Evans.
- ⁵¹ Warren, *The American Steel Industry*, 240.
- ⁵² Casey, "Open-Hearth Furnace", in *Iron and Steel in the Twentieth Century*, ed. Seely, 342-43.
- ⁵³ Cartwright, *Modern American Steelworks Practice*, 240.

⁵⁴ Casey, "George Lewis Danforth Jr., 1879-?", in *Iron and Steel in the Twentieth Century*, ed. Seely, 107-8.

⁵⁵ RBA CART 1/49/2/1, G. L. Danforth to W. F. Cartwright, 18 July 1947.

⁵⁶ See for example Zeitlin, "Americanizing British Engineering?", in *Americanization and its Limits*, eds. Zeitlin and Herrigel, 123-52.

⁵⁷ Parallels can be drawn between this approach and the concept of "open innovation". For details see Chesbrough, *Open Innovation*, 43-51.

⁵⁸ Details of Evans' itinerary can be found in RBA CART 1/49/2/2, "Report of visit to the United States", 3.

⁵⁹ RBA, CART 1/49/2/1, W. F. Cartwright to G. L. Danforth, 29 January 1948. By way of comparison, the visit itineraries of the AACP study teams typically lasted from four to six weeks. See Carew, "The Anglo-American Council on Productivity", 55.

⁶⁰ RBA, CART 1/49/2/1, W. F. Cartwright to R. W. Evans, 27 October 1947.

⁶¹ RBA CART 1/49/2/2, "Report of a visit to the United States", 226.

⁶² Cartwright, "Preliminary Planning of Margam and Abbey Works", 11-12.

⁶³ Cartwright, *The Design of Iron and Steel Works*, 112.

⁶⁴ Jones, "Early OR in the Steel Company of Wales", 563-67.

⁶⁵ Ian S. Scott-Maxwell, who later joined SCOW as chief engineer, was the British Iron and Steel Federation's representative on the AACP Iron and Steel Productivity Team. See *Report of a Productivity Team Representing the Iron and Steel Industry*, xi.

⁶⁶ Horrocks, "Goodeve, Sir Charles Frederick (1904-1980)", *Oxford Dictionary of National Biography*.

⁶⁷ RBA CART 1/49/2/1, W. F. Cartwright to C. Goodeve, 17 June 1949.

⁶⁸ *Report of a Productivity Team Representing the British Iron and Steel Industry*, 1.

⁶⁹ These products included heavy bars and sections, rails, plates and billets. See *Report of a Productivity Team representing the British Iron and Steel Industry*, 1.

⁷⁰ Burn, *The Steel Industry, 1939-1959*, 558.

⁷¹ Burn, *The Steel Industry, 1939-1959*, 264.

⁷² RBA CART/1/49/1/7, 1951 USA visit, Brief Report.

⁷³ Keeling and Wright, *The Development of the Modern British Steel Industry*, 125; Djelic, *Exporting the American Model*, 203.

⁷⁴ RBA, CART 1/49/1/5, W. F. Cartwright to J. L. Young, 18 September 1951.

⁷⁵ RBA, CART 1/49/1/5, C. M. Muchnic to W. F. Cartwright, 12 December 1951.

⁷⁶ RBA, CART 1/49/1/5, K. C. Gardener to W. F. Cartwright, 21 September 1951.

⁷⁷ RBA CART/1/49/1/6, "American Journey", 22 October 1951.

⁷⁸ Casey, 'Walter Emil Ludwig Mathesius (10 August 1886 – 20 June 1966)', in *Iron and Steel in the Twentieth Century*, ed. Seely, 290-91.

⁷⁹ For details, see RBA CART/1/49/1/6, "American Journey", Autumn 1951.

⁸⁰ RBA CART 1/49/1/5, C. B. Randall to W. F. Cartwright, 27 September 1951; K. C. Gardener to W. F. Cartwright, 21 September 1951.

⁸¹ Pahl, *Managers and their Wives*, 176-97.

⁸² Pavalko and Elder, "Women behind the Men", 559-60.

⁸³ Young and Willmott, quoted in Finch, *Married to the Job*, 91.

⁸⁴ *Productivity Review 27: Iron and Steel*, 3.

⁸⁵ Smith, *Productivity Bargaining*, 86.

⁸⁶ Smellie and Adamson, *A Study in Steel Productivity in Great Britain and USA*, 5.

⁸⁷ *Steel Company of Wales Ltd. Bulletin*, August 1952.

⁸⁸ *Ibid.*, 16.

⁸⁹ Chandler, *The Visible Hand*.

⁹⁰ *Report of a Productivity Team Representing the British Iron and Steel Industry*, 20.

⁹¹ RBA CART/1/49/1/6, "American Journey", 30 October 1951.

⁹² RBA CART 1/49/2/2, "Report of a visit to the United States", 220.

⁹³ Reutter, *Sparrows Point*, 389-90.

⁹⁴ RBA, CART 1/49/2/1, W. F. Cartwright to C. Goodeve, 17 June 1949.

⁹⁵ See Smith and Boyns, "Scientific Management and the Pursuit of Control in Britain", 187-216; Guillén, *Models of Management*, 214.

⁹⁶ RBA, CART 4/6, Works Council, 1955-59. The multiple trade union structure in the steel industry is described in Smith, "Productivity Bargaining", 31-38.

⁹⁷ Jones, "Employers' Welfare Schemes and Industrial Relations in Inter-War Britain", 61-75.

⁹⁸ RBA, CART 1/49/2/2, "Report of visit to the United States", 135-40.

⁹⁹ Hayes, "Did Manual Workers Want Industrial Welfare?", 637-58.

¹⁰⁰ RBA CART 1/54/1, W. F. Cartwright to K. D. M. Dauncey, 22 August 1955.

¹⁰¹ See for example, McGivering, Matthews and Scott, *Management in Britain*, 152;

Pagnamenta and Overy, *All Our Working Lives*, 91.

¹⁰² Smellie and Adamson, 10.

¹⁰³ *Ibid.*, 15.

¹⁰⁴ Pagnamenta and Overy, 92-93.

¹⁰⁵ Wilson and Thomson, *The Making of Modern Management*, 111.

¹⁰⁶ For example, the Shotton steelworks in North Wales, had a workforce numbering 5,054 in 1936. See Scott, Banks, Halsey and Lupton, *Technical Change and Industrial Relations*, 42.

¹⁰⁷ RBA CART 1/49/2/2, "Report of visit to the United States", 161-3.

¹⁰⁸ Smellie and Adamson, 12.

¹⁰⁹ See for example, Melling, "Fordism and the Foreman", in *Managing the Modern Workplace*, eds. Melling and Booth, 27-47; Wray, "Marginal Men of Industry: the Foremen", 298-301.

¹¹⁰ RBA CART 4/1, W. F. Cartwright to representative foremen, 10 Nov. 1954.

¹¹¹ The speaker was Don Slaiman, a former committee member of the United Auto Workers of America, who was then studying for a Ph.D. on trade union organisation at the Department of Industrial Relations in Cardiff University. RBA CART 4/1 G. Dennis to W. F. Cartwright, 19 May 1955.

¹¹² RBA CART 4/1, K. Dauncey to W. F. Cartwright, 19 November 1955.

¹¹³ RBA CART 4/1, W. F. Cartwright to K. Dauncey, 23 November 1955.

¹¹⁴ RBA CART 4/1, F. Hardie to W. F. Cartwright, 1 May 1956.

¹¹⁵ Smith, *Productivity Bargaining*, 86-87.

¹¹⁶ RBA CART 1/46/ 1-12, Visits to Abbey Works, January 1955 to January 1962.

¹¹⁷ Tomlinson, "The British 'Productivity Problem' in the 1960s", 196; Tomlinson, "The Labour Party and the Capitalist Firm, c.1950-1970", 696-97.

¹¹⁸ Kipping, Ranieri and Dankers, "The emergence of new competitor nations in the European steel industry", 69-96; Gospel, "The Management of Labour", in *A History of British Industrial Relations*, ed. Wrigley, 92.

¹¹⁹ Smith, *Productivity Bargaining*, 116-46.

¹²⁰ See for example, Godelier, “American Influence on a Large Steel Firm”, in *Catching Up With America*, ed. Barjot, 277-84.

¹²¹ Broadberry, “The Performance of Manufacturing”, in *The Cambridge Economic History of Modern Britain III*, eds. Floud and Johnson, 57.